JAGUAR

4·2 *MARK 10 MODEL*

SERVICE MANUAL

BRITISH Jaguar LEYLAND

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Publication No. E.136/2

INDEX TO SECTIONS

SECTION A

GENERAL INFORMATION

4·2 MARK 10 MODEL

Note: All references in this Manual to "right-hand side" and "left-hand side" are made assuming the person to be looking from the rear of the car or unit.

INDEX

GENERAL INFORMATION

CAR IDENTIFICATION

It is imperative that the car and engine numbers together with any prefix or suffix letters are quoted in any correspondence concerning this vehicle. If the unit in question is the gearbox or overdrive the gearbox number and any prefix or suffix letters must also be quoted. This also applies when ordering spare parts.

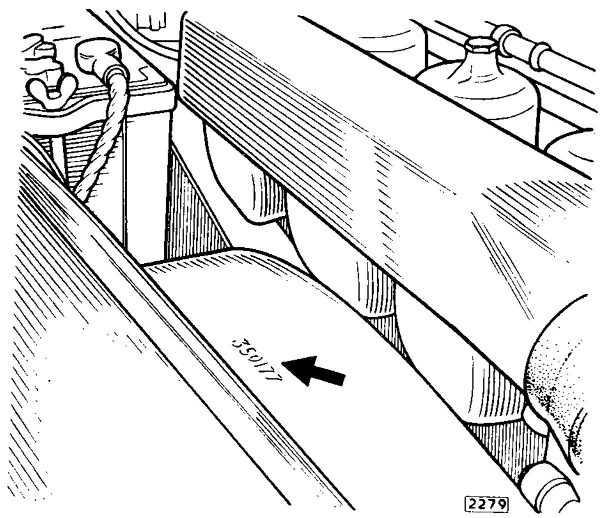


Fig. 1. Location of the car number.

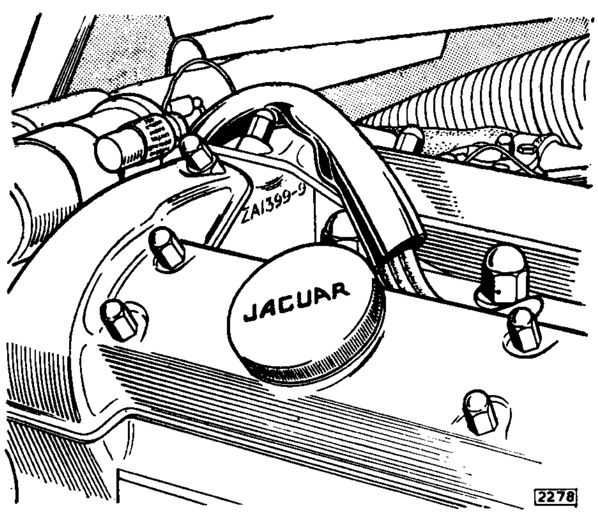


Fig. 2. Location of the engine number.

Car Number .. ..

Stamped on the top of the right-hand front wheel arch.

Suffix "DN" to the car number indicates that an overdrive is fitted.

Engine Number .. ..

Stamped on the right-hand side of the cylinder block above the oil filter and at the front of the cylinder head casting.

/7, /8 or /9 following the engine number denotes the compression ratio.

Gearbox Number .. ..

Stamped on a shoulder at the left-hand rear corner of the gearbox casing and on the top cover.

Letter "N" at the end of the prefix letters indicates that an overdrive is fitted.

Key Number .. ..

Two different types of key are provided to enable the car to be left with the luggage compartment and glovebox locked on the occasions when it is required to leave the ignition key with the car.

(i) The round headed key operates the ignition switch, fuel tank filler lids and the door locks.

(ii) The rectangular headed key operates the locks for the luggage compartment lid and the glovebox.

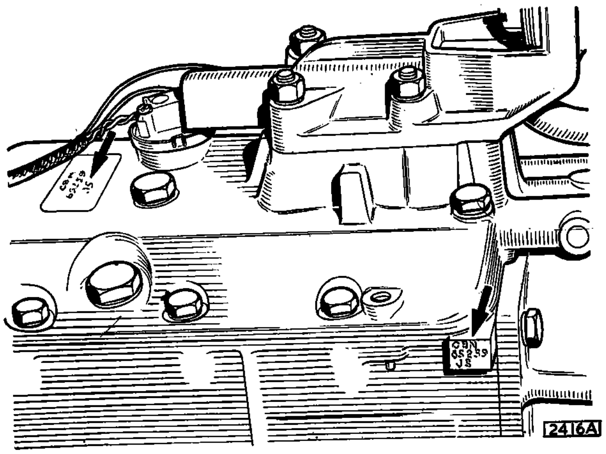


Fig. 3. Location of the gearbox number.

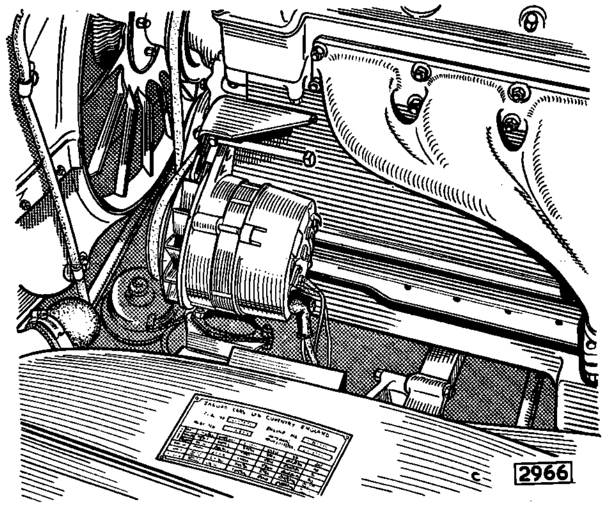


Fig. 4. The identification numbers are also stamped on a plate attached to the left-hand front wing valance.

GENERAL DATA

DIMENSIONS AND WEIGHTS

Wheelbase	10′ 0″ (3·05 m.)
Track—front and rear	4′ 10″ (1·47 m.)
Overall length	16′ 10″ (5·13 m.)
Overall width	6′ 4″ (1·93 m.)
Overall height	4′ 6½″ (1·38 m.)
Ground clearance	6½″ (165 mm.)
Turning circle	37′ 0″ (11·28 m.)
Weight (dry, approximate)	35 cwt. (1778 kg.)

CAPACITIES

	Imperial	U.S.	Litres
Engine refill (including filter)	12 pints	14½ pints	6·75
Gearbox (without overdrive)	2½ pints	3 pints	1·5
Gearbox (with overdrive)	4 pints	4¾ pints	2·25
Automatic transmission unit (from dry)	15 pints	18 pints	8·5
Rear axle	2¾ pints	3¼ pints	1·5
Cooling system (including heater)	24½ pints	29½ pints	14
Petrol tanks—left-hand	10 galls.	12 galls.	45·5
—right-hand	10 galls.	12 galls.	45·5

PERFORMANCE DATA

The following tables give the relationship between engine revolutions per minute and road speed in miles and kilometres per hour.

It is recommended that engine revolutions **in excess of 5,000 per minute** should not be exceeded for long periods. Therefore, if travelling at sustained high speed on motorways, the accelerator should be released occasionally to allow the car to overrun for a few seconds.

AXLE RATIO 3.54 : 1

ROAD SPEED		ENGINE REVOLUTIONS PER MINUTE			
Kilometres per hour	Miles per hour	First Gear 10·76	Second Gear 6·98	Third Gear 4·7	Top Gear 3·54
16	10	1408	913	615	463
32	20	2816	1826	1230	926
48	30	4223	2740	1845	1390
64	40	5632	3652	2460	1852
80	50		4565	3075	2315
96	60		5480	3690	2780
112	70			4305	3241
128	80			4920	3704
144	90			5535	4167
160	100				4630
176	110				5093

AXLE RATIO 3.77 : 1

(Ratio for cars fitted with an overdrive)

ROAD SPEED		ENGINE REVOLUTIONS PER MINUTE				
Kilometres per hour	Miles per hour	First Gear 11.46	Second Gear 7·44	Third Gear 5·00	Top Gear 3·77	Overdrive 2·933
16	10	1500	973	654	493	383
32	20	2998	1946	1308	986	766
48	30	4498	2920	1962	1480	1150
64	40		3892	2616	1972	1532
80	50		4865	3270	2465	1915
96	60			4578	2960	2300
112	70			5232	3451	2681
128	80				3944	3064
144	90				4440	3450
160	100				4930	3830
176	110					4213
192	120					4596

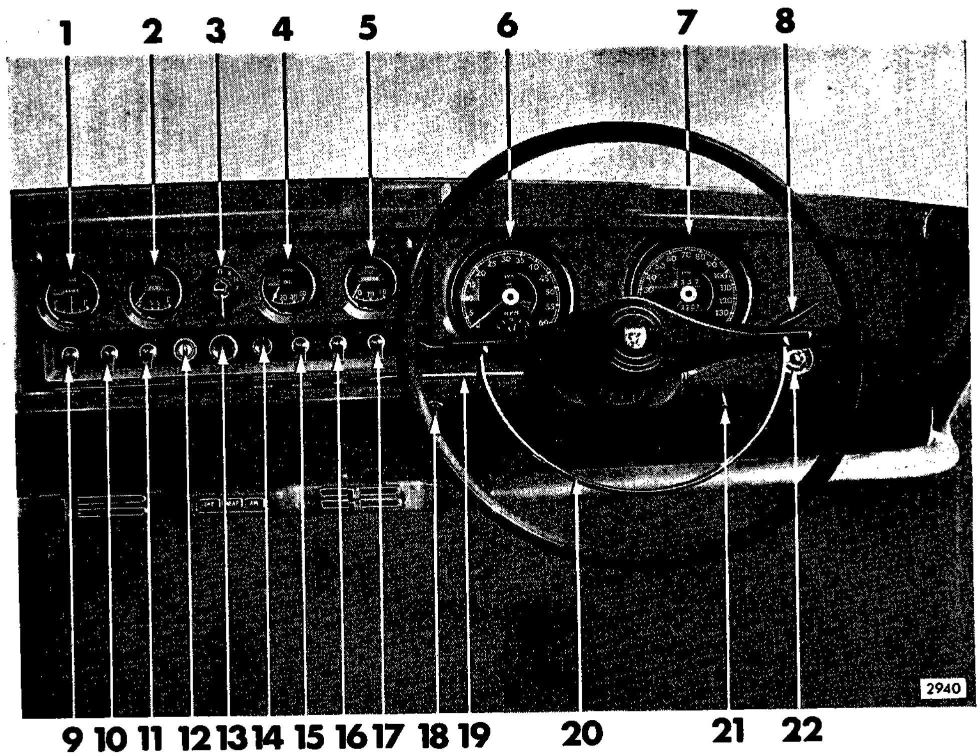
Note: The figures in these tables are theoretical and actual figures may vary slightly from those quoted due to such factors as tyre wear, pressures etc.

AXLE RATIO 3.31 : 1

(Optional extra U.K., standard equipment for Europe)

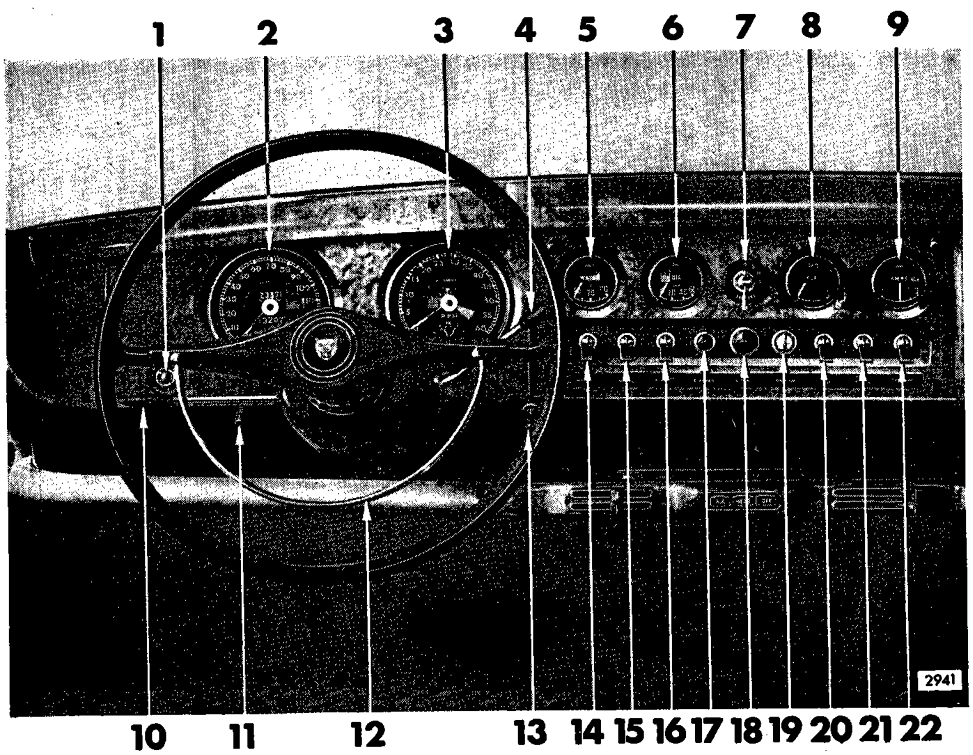
ROAD SPEED		ENGINE REVOLUTIONS PER MINUTE				
Kilometres per hour	Miles per hour	First Gear 10.06	Second Gear 6.53	Third Gear 4.396	Top Gear 3.31	Overdrive 2.575
16	10	1316	854	575	433	337
32	20	2632	1708	1150	866	674
48	30	3948	2563	1725	1300	1011
64	40	5264	3416	2300	1732	1348
80	50		4270	2875	2165	1685
96	60		5124	3450	2598	2022
112	70			4025	3031	2359
128	80			4600	3464	2696
144	90			5175	3897	3033
160	100				4330	3370
176	110				4763	3707
192	120				5196	4044

Note: The figures in these tables are theoretical and actual figures may vary slightly from those quoted due to such factors as tyre wear, pressures etc.



1. *Ammeter.*
2. *Fuel gauge.*
3. *Lighting switch.*
4. *Oil pressure gauge.*
5. *Water temperature gauge.*
6. *Revolution counter.*
7. *Speedometer.*
8. *Automatic transmission selector lever or overdrive switch lever.*
9. *Interior/map light switch.*
10. *Panel light switch.*
11. *Heater fan switch.*
12. *Ignition switch.*
13. *Cigar lighter.*
14. *Starter switch.*
15. *Fuel tank change-over switch.*
16. *Windscreen wiper switch.*
17. *Windscreen washer switch.*
18. *Clock adjuster.*
19. *Flashing direction indicator and headlight flashing switch.*
20. *Horn ring.*
21. *Speedometer trip control.*
22. *Brake fluid level/handbrake warning light.*

Fig. 5. **Instruments and controls—Right hand drive.**



1. *Brake fluid level/handbrake warning light.*
2. *Speedometer.*
3. *Revolution counter.*
4. *Automatic transmission selector lever or overdrive switch lever.*
5. *Water temperature gauge.*
6. *Oil pressure gauge.*
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8. *Fuel gauge.*
9. *Ammeter.*
10. *Flashing direction indicator and headlight flashing switch.*
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20. *Fuel tank change-over switch.*
21. *Windscreen wiper switch.*
22. *Windscreen washer switch.*

Fig. 6. **Instruments and controls—Left hand drive.**

INSTRUMENTS

Ammeter

Records the flow of current into or out of the battery. The flow of current is adjusted to the state of charge of the battery; thus when the battery is fully charged the alternator provides only a small output and therefore little charge is registered on the ammeter, whereas when the battery is low a continuous high charge is shown.

Oil Pressure Gauge

The electrically operated pressure gauge records the oil pressure being delivered by the oil pump to the engine; it does not record the quantity of oil in the sump. The minimum pressure at 3,000 r.p.m. when hot should not be less than 40 lb. per square inch.

Note: After starting up a period of approximately 20 seconds will elapse before the correct reading is obtained.

Water Temperature Gauge

The electrically operated water temperature gauge records the temperature of the coolant by means of a bulb screwed into the inlet manifold water jacket.

Fuel Level Gauge

Records the quantity of fuel in the supply tank in use. To obtain readings for the opposite tank operate the fuel changeover switch on the instrument panel. Readings will only be obtained when the ignition is switched "ON".

Note: Lift the switch lever for the left-hand tank, lower for the right-hand tank as shown on the indicator strip.

Electric Clock

The clock is built into the revolution counter instrument and is powered by the battery. The clock hands may be adjusted by pushing up the winder and rotating. Starting is accomplished in the same manner.

Revolution Counter

Records the speed of the engine in revolutions per minute.

Speedometer

Records the vehicle speed in miles per hour, total mileage and trip mileage (kilometres on certain export models). The trip figures can be set to zero by pushing the winder upwards and rotating clockwise.

Headlight Warning Light

A warning light marked "Headlamps" situated in the speedometer, lights up when the headlights are in the full beam position and is automatically extinguished when the lights are in the dipped beam position.

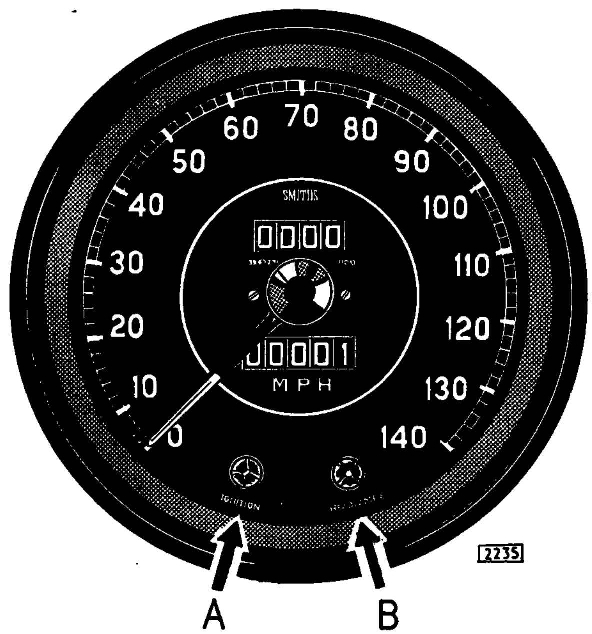


Fig. 7. Warning lights in speedometer.

Ignition Warning Light

A red warning light (marked "Ignition") situated in the speedometer, lights up when the ignition is switched "on" and the engine is not running. This light does not provide any indication of the state of charge nor does it indicate if the fan belt has broken. Always switch "off" when the engine is not running.

Flashing Direction Indicators-Warning Lights

The warning lights are in the form of green arrows, one at each side of the quadrant situated behind the steering wheel.

When the flashing indicators are in operation one of the arrows lights up on the side selected.

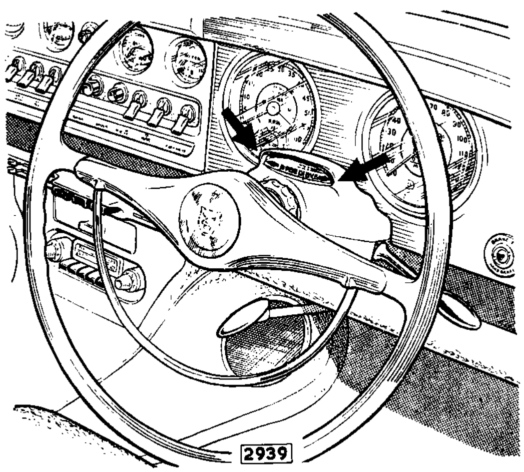


Fig. 8. Flashing direction indicator warning lights.

Side Lamp Warning Light (Italy only)

A blue warning light situated on the side facia between the speedometer and the revolution counter lights up when the side lamps are switched "on".

Brake Fluid Level and Handbrake Warning Light

A warning light (marked "Brake Fluid—Handbrake") situated on the facia behind the steering wheel, serves to indicate if the level in the brake fluid reservoir has become low, provided the ignition is "on." As the warning light is also illuminated when the handbrake is applied, the handbrake must be fully released before it is assumed that the fluid level is low. If with the ignition "on" and the handbrake fully released the warning light is illuminated the brake fluid must be "topped up" immediately.

As the warning light is illuminated when the handbrake is applied and the ignition is "on" a two-fold purpose is served. Firstly, to avoid the possibility of driving away with the handbrake applied. Secondly, as a check that the warning light bulb has not "blown"; if on first starting up the car with the handbrake fully applied, the warning light does not become illuminated the bulb should be changed immediately.

Fig. 9. Brake fluid level and handbrake warning light.

CONTROLS AND ACCESSORIES

Accelerator Pedal

Controls the speed of the engine.

Brake Pedal

Operates the vacuum-servo assisted disc brakes on all four wheels.

Clutch Pedal

On overdrive and standard transmission cars, connects and disconnects the engine and the transmission. Never drive with the foot resting on the pedal and do not keep the pedal depressed for long periods in traffic. Never coast the car with a gear engaged and clutch depressed.

Headlight Dipper

Situated on the toe boards to the left of the clutch pedal. The switch is of the change over type and if the headlights are in the full beam position a single pressure on the control will switch the lights to the dipped beam position and they will remain so until another single pressure switches them to the full beam position again.

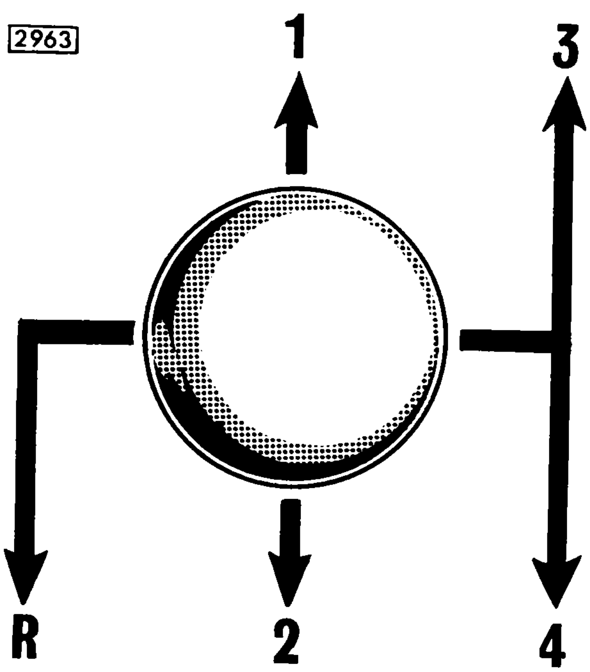


Fig. 10. Gear positions.

Gear Lever (Overdrive and Standard Transmission Models)

Centrally situated and with gear positions indicated on the control knob. To engage reverse gear first press the gear lever against the spring pressure before pulling the lever rearward. Always engage neutral and release the clutch when the car is at rest.

Overdrive Switch Lever

For full instructions on the operation of the overdrive, see page A.20.

Automatic Transmission Selector Lever

For full instructions on the operation of the automatic transmission, see page A.21.

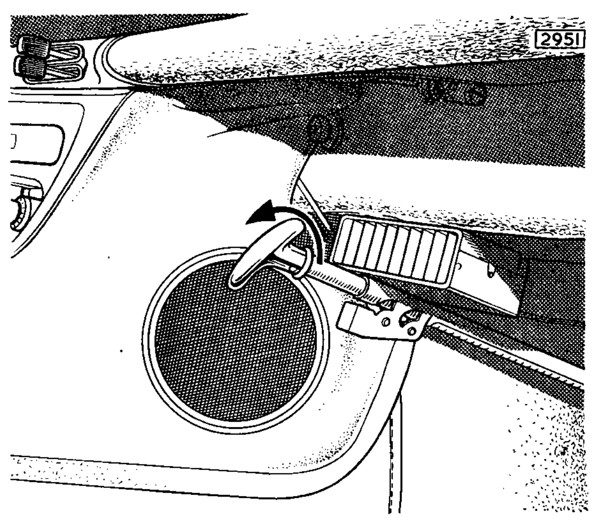


Fig. 11. Handbrake control—to release the handbrake turn the control in the direction shown.

Handbrake Control

Positioned under the dash behind the steering wheel. The handbrake operates mechanically on the rear discs only and is provided for parking, driving away on a hill, and when at a standstill in traffic. To apply the brake, pull the lever handle outwards and the trigger will automatically engage with the ratchet. To release the handbrake turn the lever handle anti-clockwise until the ratchet is disengaged and allow the control to return to the fully OFF position.

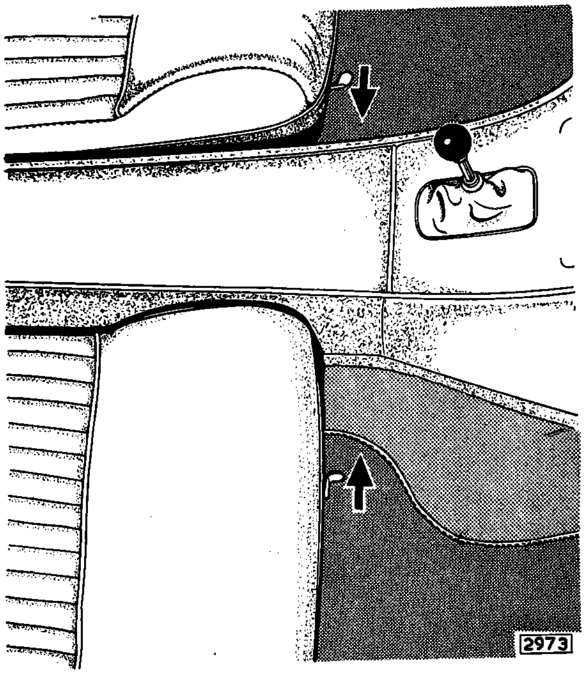


Fig. 12. Front seat adjustment.

Seat Adjustment

Both the front seats are adjustable for reach. Push the lever, situated beside the inside runner, towards the centre of the car and slide into the required position. Release the lock bar and slide until the mechanism engages with a click.

The seat back is adjustable from the vertical to the fully reclined position.

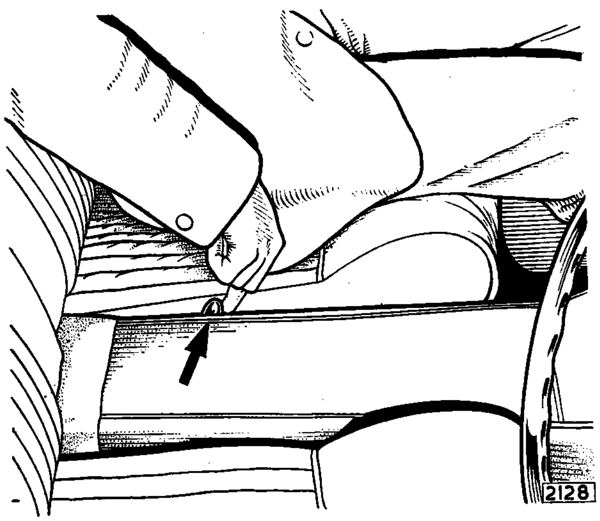


Fig. 13. Reclining seat back adjustment lever.

To adjust, lift the lever located between the seat and the propeller shaft tunnel cover and adjust the seat back to the desired position. Release the lever to lock the seat back in position.

Steering Wheel Adjustment

Rotate the knurled ring at the base of the steering wheel hub in an anti-clockwise direction so that the steering wheel may be slid into the desired position. Turn the knurled ring clockwise to lock the steering wheel.

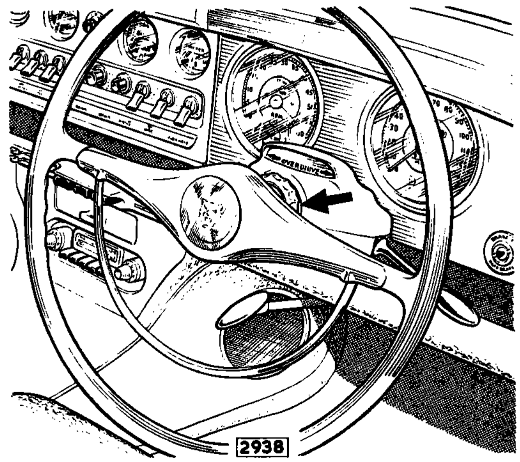


Fig. 14. Steering wheel adjustment.

Front Door Locks

The front doors may be opened from the outside by pressing the button incorporated in the door handle. The doors are opened from the inside by pulling the interior handles rearward.

Both front doors can be locked from the inside by pushing the interior handles forward and allowing them to return to their original position; this feature only applies if the doors are fully closed before operating the interior handles.

Both front doors can be locked from the outside by means of the ignition key; the locks are incorporated in the push buttons of the door handles.

To lock the right-hand door insert the key in the lock, rotate anti-clockwise as far as possible and allow the lock to return to its original position—the door is now locked. To unlock the right-hand door turn key clockwise as far as possible and allow the lock to return to its original position.

To lock the left-hand door rotate key clockwise; to unlock, rotate key anti-clockwise.

KEYLESS LOCKING is obtainable by first pushing the interior door handle fully forward and allowing it to return to its original position. If the door is now closed from the outside with the push button of the handle *fully depressed* the door will become locked.

Warning: If the doors are to be locked by this method the ignition key should be removed beforehand (or the spare key kept on the driver's person) as the only means of unlocking the front doors is with this key.

Rear Door Locks

The rear doors may be opened from the outside by pressing the button incorporated in the door handle. The doors are opened from the inside by pushing the interior door handle forward.

The rear doors are locked by pulling the interior door handles rearward.

Horn

Depress the semi-circular ring or the centre button of the steering wheel to operate the twin horns.

Ignition Switch

Inserting the key provided in the switch and turning clockwise will switch on the ignition.

Never leave the ignition on when the engine has stopped, a reminder of such circumstances is provided by the ignition warning light situated in the speedometer.

Interior/Map Light Switch

The map and interior lights are controlled by a three position switch marked "Interior/Map". Lift the switch lever to the second position to operate the map light situated above the instrument panel. For interior lights lift the switch lever to the third position. To provide ease of entry into the car at night the interior lights are automatically switched on when any one of the doors is opened and are extinguished when the door is closed.

Lighting Switch

From "Off" can be rotated clockwise into two positions, giving in the first location, side and tail, in the second location, head, side and tail.

Panel Light Switch

Lift the switch lever (marked "Panel") to enable the instrument to be read at night and to provide illumination of the switch markings. The switch has two positions "Dim" and "Bright" to suit the driver's requirements. The panel lights will only operate when the side lights are switched on.

Starter Switch

Press the button (marked "Starter") with the ignition switched on, to start the engine. Release the switch immediately the engine fires and never operate the starter when the engine is running.

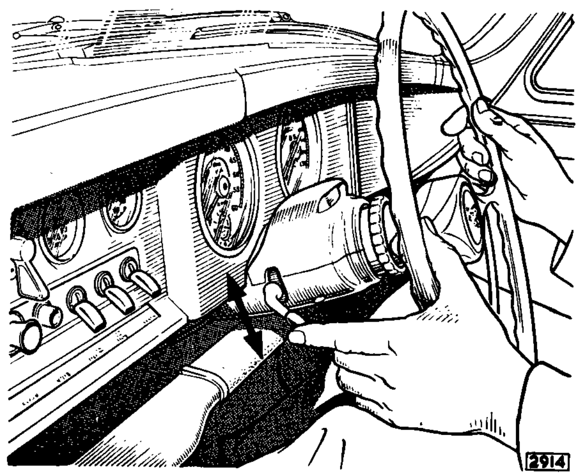


Fig. 15. Flashing direction indicator control.

Flashing Direction Indicators

The "flashers" are operated by a lever behind the steering wheel. To operate the flashing direction indicators on the right-hand side of the car, move the lever clockwise; to operate the left-hand side indicators move the lever anti-clockwise. While the flashing indicators are in operation one of the warning lights in the quadrant behind the steering wheel lights up on the side selected.

Headlight Flasher

To "flash" the headlights as a warning signal, lift and release the flashing indicator lever in quick succession. The headlights can be "flashed" when the lights are "off" or when they are in the dipped beam position; they will not "flash" in the main beam position.

On cars for the Italian market the headlights can be flashed when in the "off" position or when the lights are in the main beam position. Headlights so fitted cannot be "flashed" when dipped.

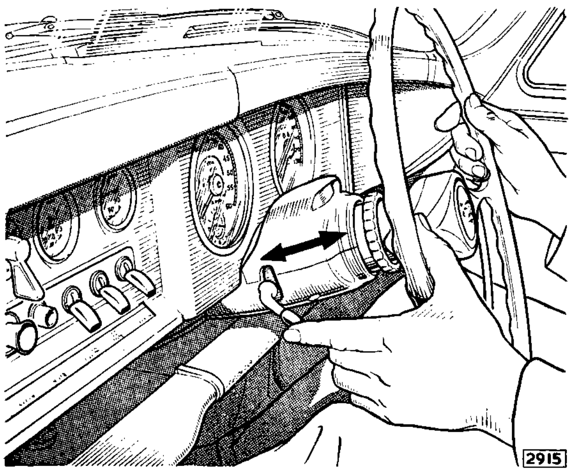


Fig. 16. Method of "flashing the headlights".

Glovebox Light

A light in the glovebox is automatically illuminated when the lid is opened and the sidelights are "on."

Braking Lights

Twin combined tail and brake lights are situated at the rear of the car. The latter automatically lights up when the footbrake is applied.

Reversing Lights

The twin reversing lights are automatically brought into operation when reverse gear is engaged and the ignition is switched on.

Luggage Compartment Illumination

The luggage compartment is automatically illuminated by a light when the lid is opened. The light operates only when the sidelights are switched on.

Cigar Lighter

To operate, press the holder into the socket (marked "Cigar" on the indicator strip) and remove the hand. On reaching the required temperature, the holder will return to the extended position. Do not hold the lighter in the "pressed in" position.

Windscreen Wipers

The wipers are controlled by a three position switch (marked "Wiper" on the indicator strip). Lift the switch to the second position (Slow) which is recommended for all normal adverse weather conditions and snow.

For conditions of very heavy rain and for fast driving in rain lift the switch to the third position (Fast). This position should not be used in heavy snow or with a drying windscreen, that is, when the load on the motor is in excess of normal; the motor incorporates a protective cut-out switch which under conditions of excessive load cuts off the current supply until normal conditions are restored.

When the switch is placed in the "Off" position the wipers will automatically return to a position along the lower edge of the screen.

Windscreen Washer

For full instructions on the use of Windscreen Washing Equipment see Section O.

Heating and Ventilating Equipment

For full instructions on the use of the Heating and Ventilating Equipment see Section O.

Scuttle Ventilator

The scuttle ventilator is operated only by the Heating and Ventilating controls see Section O.

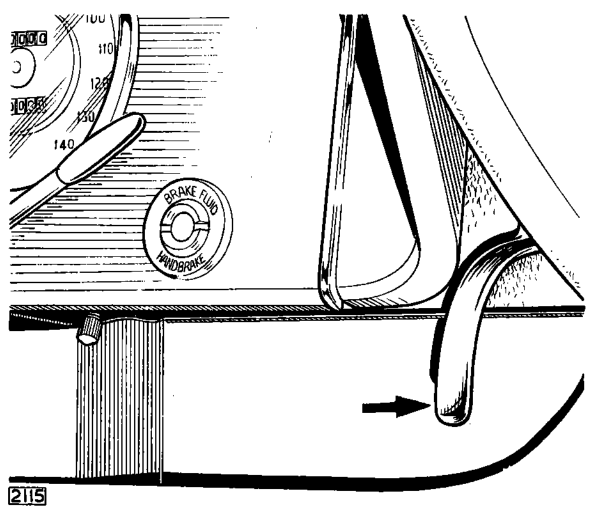


Fig. 17. Bonnet lock control.

Bonnet Lock Control

The bonnet lock is controlled from the driving compartment. To open the bonnet pull the lever situated behind the facia on the right-hand side. This will release the bonnet which will now be retained by the safety catch. Insert the fingers under the rear edge of the bonnet and lift up the safety catch.

The bonnet is automatically retained in the fully open position by the action of the hinge torsion bars.

The bonnet is self-locking when pushed down firmly into the closed position.

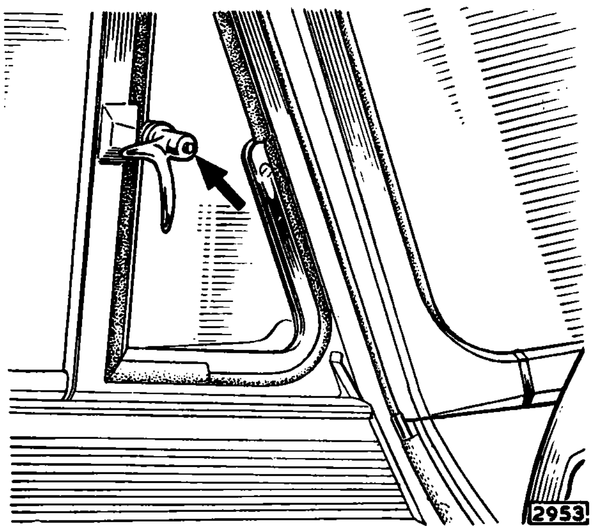


Fig. 18. Plunger to operate front N.D.V.

No Draught Ventilation

All doors are fitted with no draught ventilation windows incorporating quick locking plungers.

The ventilation windows may be pushed open as far as required by pressing the handle centre button and turning the handle. When operating a vent window ensure that the handle is turned until the button clicks. (This is an anti-theft device). It will be observed that initial openings of the front window gives extraction of air from the body. When the window is opened further, air is forced into the body due to the angle of the ventilator and forward motion of the car. It should be observed that using the N.D.V. windows as extractors (that is, partially open) has, to a minor degree, the effect of demisting the windscreen.

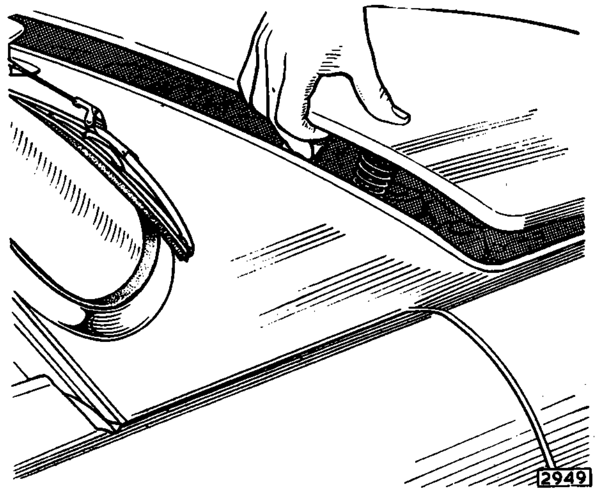


Fig. 19. Bonnet safety catch.

Spare Wheel and Jacking Equipment

The spare wheel is housed in the luggage compartment. To remove the spare wheel, rotate the serrated nut securing the wheel clamp in position. Lift the clamp clear of the tyre and remove the wheel.

The jack and wheel brace are retained in clips accessible when the spare wheel is removed.

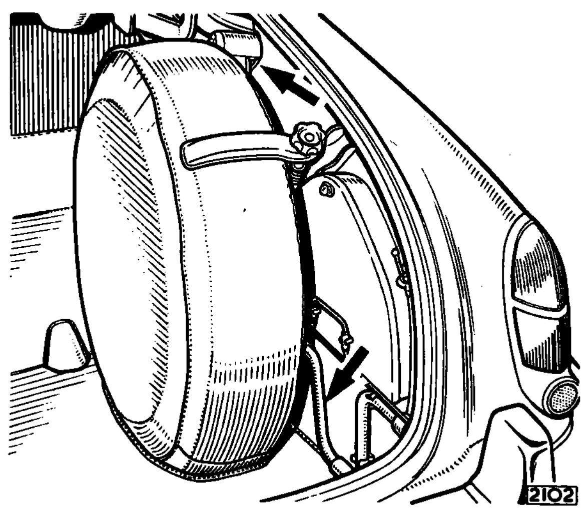


Fig. 20. The spare wheel is housed on the right-hand side of the luggage compartment and the wheel brace, jack and hand tools are secured behind the wheel.

Tools

The container for the hand tools, bleeder tube and sparking plug is housed in the luggage compartment behind the spare wheel.

Release the catch and withdraw the container from the retaining clips. Rotate the turnbutton to open the lid.

Two Pin Plug Socket

A two pin plug socket is situated under the bonnet forward of the battery. The socket may be used to "trickle charge" the battery, or to provide an inspection lamp point.

Fuel Tank Fillers

The two fuel tank fillers are situated in recesses in the rear wings. The filler lids are fitted with locks opened by the round-headed key provided.

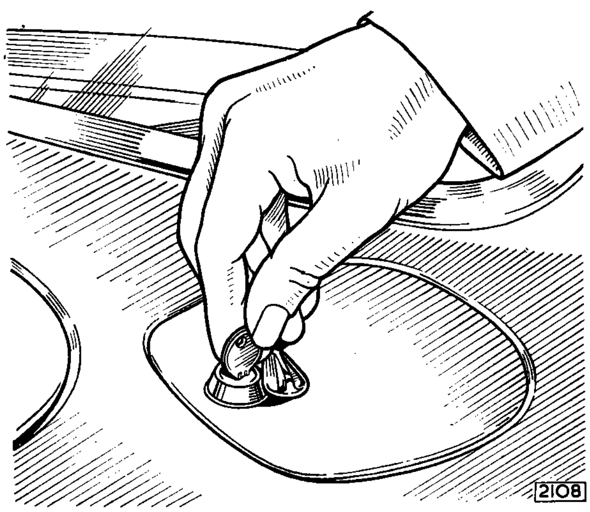


Fig. 21. Unlocking the fuel tank filler lid.

Luggage Compartment

To open the luggage compartment, insert the square-headed key in the lock situated between the twin reversing lamps and unlock by rotating anti-clockwise through half a turn. Release the catch lever located beneath the lock and raise the lid. The lid is retained in the fully open position by means of torsion bar springs.

Interior Driving Mirror

This is of the dipping type. Move the lever, situated under the mirror, to the left for night driving to avoid being dazzled by the lights of a following car.

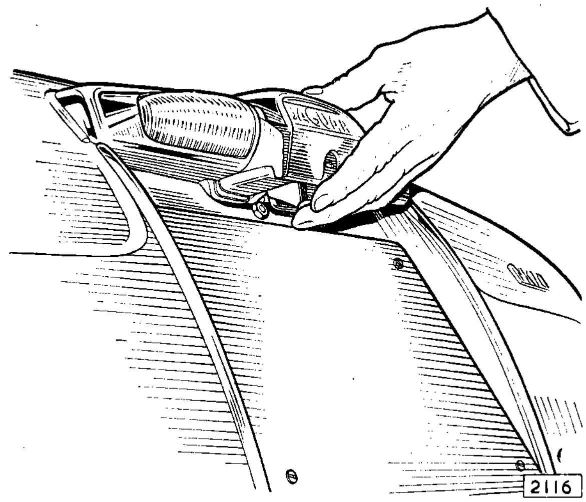


Fig. 22. Opening the luggage compartment.

Ash Trays

Three ash trays are provided, one being mounted centrally below the instrument panel and one mounted in the back panel of each front seat above the picnic tables.

To remove the front ash tray for cleaning purposes, lift the retaining spring blade and withdraw the tray.

To remove the rear ash trays press down the retaining spring.

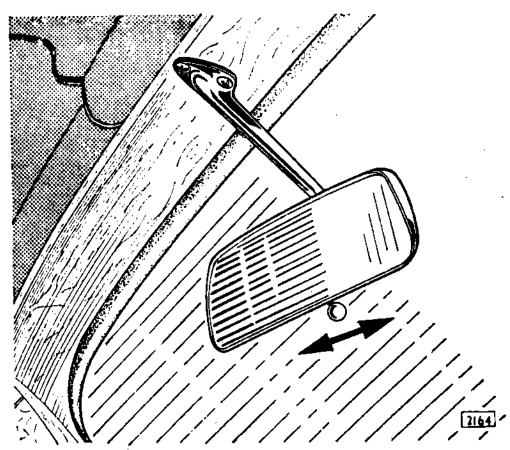


Fig. 23. Interior driving mirror dipping operation.

Wheel Changing

Whenever possible, the wheel changing should be carried out with the car standing on level ground and in all cases with the handbrake fully applied.

The spare wheel is housed in the luggage compartment; the wheel changing equipment being accessible when the spare wheel is removed.

Unlock the luggage compartment by turning the key in the lock, situated between the twin reverse lamps through half-a-turn. Lift the catch lever located beneath the lock and raise the lid as far as possible where it will be retained by the action of the hinge torsion bars.

Remove the spare wheel after rotating the serrated nut and lifting the clamp clear of the tyre.

Remove the jack and wheel brace from the retaining clips.

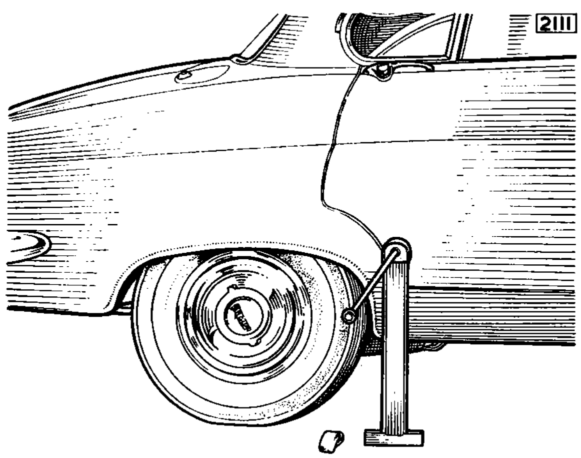


Fig. 24. The jack in position for raising the right-hand rear wheel.

Detach the wheel nave plate by levering off with the blade end of the wheel brace. Using the wheel brace loosen, but do not remove the wheel nuts; all wheel nuts have right-hand threads, that is, they are unscrewed anti-clockwise. Remove the rubber plug from the jacking socket adjacent to the wheel to be removed, insert the square portion of the jack well home into the socket and rotate the

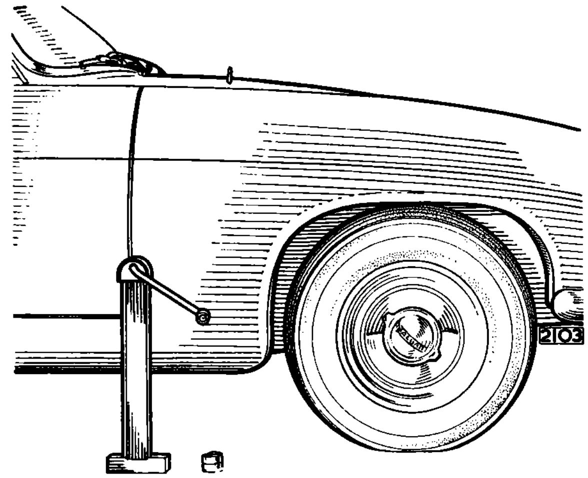


Fig. 25. The jack in position for raising the right-hand front wheel.

handle attached to the jack clockwise. Raise the car until the wheel is clear of the ground. Remove the wheel nuts and withdraw the road wheel.

Mount the spare wheel on the fixing studs and start all five nuts on the threads by rotating clockwise. Apply the wheel brace and run up all the nuts until they are tight.

Rotate the jack handle anti-clockwise and lower the jack until the full weight of the car is on the wheel. Finally tighten all wheel nuts.

Fit the nave plate over two of the three mounting posts and secure by a sharp tap from the hand at a point in line with the third mounting post.

Picnic Tables

Picnic tables are provided in the back of each front seat and are opened by pulling the handles upwards and outwards until the tables assume a horizontal position.

With the tables in the opened position two angled vanity mirrors will be exposed.

Seat Belts

Anchorage points for seat belts are incorporated in the construction of the car as shown in Fig. 26.

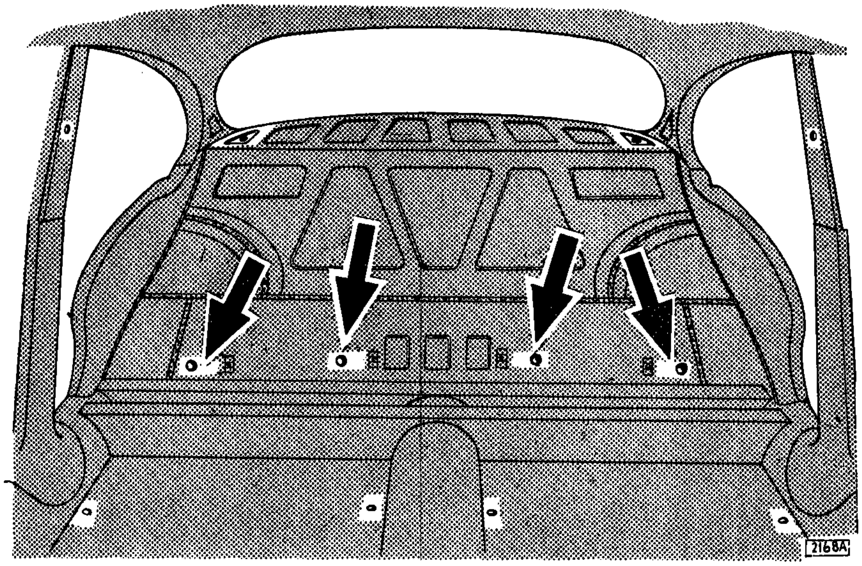


Fig. 26. Seat belt anchorage points.

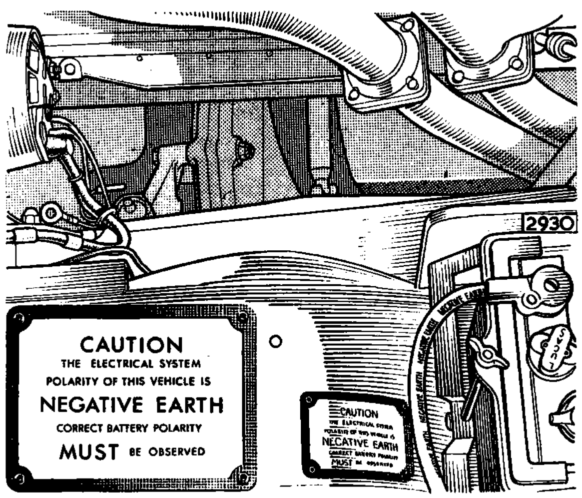


Fig. 27. Showing negative earth battery connection.

IMPORTANT

This model has a Negative Earth (ground) system and certain of the electrical components are different to those fitted to positive earth cars. When fitting auxiliary equipment or replacing any of the electrical components use only those specified for this particular model or ensure that they are suitable for use with negative earth.

Do NOT run the engine with the alternator electrical cables disconnected or loose otherwise the alternator may burn out.

STARTING AND DRIVING

Prior to starting

Before starting the engine the new owner should be familiar with the location and function of the instruments and controls.

Ensure that the water level in the radiator and the oil level in the sump are correct. Check for sufficient petrol in the tanks.

Place the gear lever in the neutral position and check that the handbrake is applied.

Starting from Cold

It is not necessary to use any manual choke control when starting from cold, since the auxiliary starting carburetter is entirely automatic and controls the mixture strength without assistance from the driver. The starting carburetter automatically cuts out when the temperature of the water in the cylinder head reaches 35°C.

When starting from cold do not depress the accelerator pedal until the engine has run for a few seconds.

Warming up

Do not operate the engine at a fast speed when first started but allow time for the engine to warm up and the oil to circulate. A thermostat is incorporated in the cooling system to assist rapid warming up. In very cold weather run the engine at 1,500 r.p.m. with the car stationary until a rise in temperature is indicated on the temperature gauge.

Driving

(a) Careful adherence to the "Running-in" Instructions given on this page will be amply repaid by obtaining the best performance and utmost satisfaction from the car.

(b) The habit should be formed of reading the oil pressure gauge, water temperature gauge and ammeter occasionally as a check on the correct functioning of the car. Should an abnormal reading be obtained an investigation should be made immediately.

(c) Always start from rest in first gear. To start in a higher gear will cause excessive clutch slip and premature wear. Never drive with a foot resting on the clutch pedal and do not keep the clutch depressed for long periods in traffic.

(d) The gearbox is provided with synchro-mesh on all forward gears.

When changing down a smoother gear change will be obtained if the accelerator is left depressed to provide the higher engine speed suitable for the lower gear. Always fully depress the clutch pedal when changing gear.

(e) Gear changing may be slightly stiff on a new car but this will disappear as the gearbox becomes "run-in".

(f) Always apply the footbrake progressively; fierce and sudden application is bad for the car and tyres. The handbrake is for use when parking the car, when driving away on a hill and when at a standstill in traffic.

"Running-in" Instructions

Only if the following important recommendations are observed will the high performance and continued good running, of which the Jaguar is capable, be obtained.

During the "running-in" period do not allow the engine to exceed the following speeds and particularly do not allow the engine to labour on hills; it is preferable to select a lower gear and use a higher speed rather than allow the engine to labour at low speed:—

First 1,000 miles (1,600 km.) .. 2,500 r.p.m.

From 1,000—2,000 miles (1,600—3,200 km.) .. .. 3,000 r.p.m.

Have the engine sump drained and refilled and the oil filter attended to as recommended at the free service, that is, after the first 1,000 miles (1,600 km.).

OVERDRIVE

The Laycock de Normanville overdrive unit (fitted as an optional extra) comprises a hydraulically-controlled epicyclic gear housed in a casing which is directly attached to an extension at the rear of the gearbox.

When brought into operation, the overdrive reduces the engine speed in relation to the road speed. This permits high road speeds with low engine revolutions resulting in fuel economy and reduced engine wear.

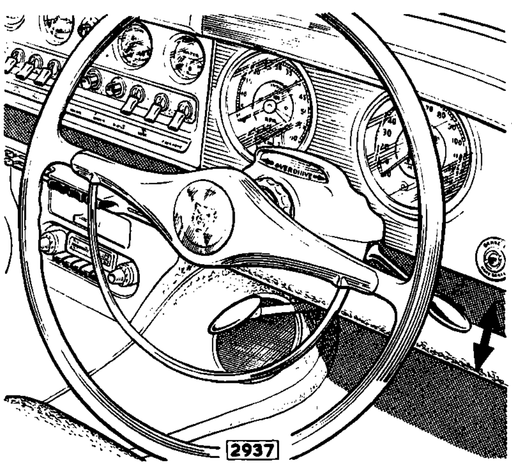


Fig. 28. Overdrive switch lever.

Operation

The overdrive will operate in top gear only and is brought into action by means of the lever behind the steering wheel on the right-hand side of the column. Operate the lever clockwise to engage the overdrive and anti-clockwise to bring the drive into top (4th) gear.

When the overdrive is in operation the word "Overdrive" in the quadrant behind the steering wheel becomes illuminated. When the sidelights are switched on, the light is automatically dimmed.

Use of the clutch pedal when changing into or out of overdrive is unnecessary but to ensure maximum smoothness of operation particularly when changing down from overdrive to top gear, the accelerator pedal should be slightly depressed.

Do NOT bring the overdrive into operation at high speed with a wide throttle opening; release the accelerator momentarily when engaging overdrive.

For driving in towns, heavy traffic, or hilly country when the maximum flexibility and low speed performance is required the overdrive manual switch should be placed in the "Out" position which will bring the drive into normal top gear ratio.

For normal driving in open country the overdrive should be brought into operation when the required cruising speed has been obtained.

AUTOMATIC TRANSMISSION

Operation

The automatic transmission incorporates an hydraulic torque converter in place of the flywheel and clutch. This converter is coupled to an hydraulically operated planetary gearbox which provides three forward speeds and reverse.

Operation of the automatic transmission is controlled by the driver through the selector lever mounted on the steering column behind the steering wheel. The quadrant markings, from left to right are P, R, N, D2, D1, L.

The selector lever can be moved freely between N—D2 and D1—L. To move the lever between D2 and D1 or to the P or R positions the lever must be lifted towards the steering wheel.

Warning: Neither P nor R should be engaged whilst the car is in motion.

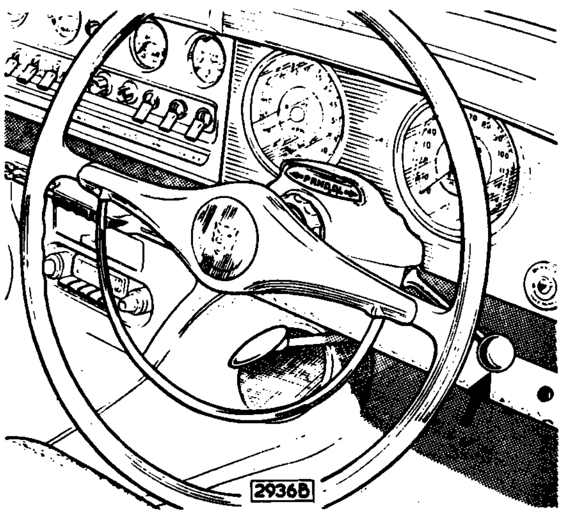


Fig. 29 Automatic transmission selector lever.

P (Park)

In the Park position the gearbox is mechanically locked by means of the parking pawl which engages with external teeth formed on the ring gear integral with the driven shaft.

Park should not be selected when the car is in motion.

Use of the Park position is recommended whenever the car is parked with or without the engine running.

Preparatory to re-starting on a steep gradient, apply the brakes before disengaging P to prevent the car from rolling; disengagement of the parking pawl will be audible.

R (Reverse)

The "R" position provides reverse ratio. Do not select Reverse when the car is moving forward.

N (Neutral)

All clutches are disengaged and there is no drive beyond the torque converter. The handbrake must be applied whenever Neutral is selected and the car is at rest.

D2 (Drive range, 2nd gear start)

In the Drive 2 position, the car starts from rest in second gear and operates automatically between second and third gears.

At, or below, a preset maximum vehicle speed, downshifts from 3rd to 2nd may be effected by depressing the accelerator fully. ("Kickdown" position).

First gear is not obtainable in this position but D2 is suitable for normal driving where maximum acceleration is not required.

In this position, the car will not roll back on hills as long as the engine is running.

D1 (Drive range, 1st gear start)

When in the D1 position, the car starts from rest in first gear and operates automatically through all three forward ratios. Upshifts and downshifts occur in accordance with car speed and throttle position.

At, or below, preset maximum road speeds downshifts may be effected from 3rd to 2nd, from 2nd to 1st, or, directly, from 3rd to 1st. This is accomplished by depressing the accelerator fully. ("Kickdown" position).

L (Lockup)

Lockup position provides overriding control for either first or second gear with engine braking in either ratio.

GENERAL INFORMATION

When starting from rest in the lockup position the transmission starts in 1st gear and remains in that gear regardless of road speed or throttle position. Maximum engine braking is available in this gear.

In either D1 or D2 with the transmission in 3rd gear, the selection of L will cause an immediate downshift to second gear. This will provide moderate engine braking when the throttle is closed.

If the road speed is reduced to approximately 16 m.p.h. (25 k.p.h.) the transmission will downshift automatically from second to first and provide maximum engine braking.

Once first gear is attained, no upshift will be possible until the selector lever is removed from the L position.

Starting

A starter inhibitor switch ensures that the starter will operate only when the selector is in either the P or N position.

Engine Braking

When engine braking is required whilst descending steep hills apply the footbrake to reduce speed to approximately 60 m.p.h. (96 k.p.h.) or below.

Move the selector lever to the L position to obtain an immediate downshift to second gear.

If the road speed is below 16 m.p.h. (25 k.p.h.) when L is selected the downshift will be directly from 3rd to 1st gear.

Rocking the Car

In order to extricate a car from mud, sand or show, employ a constant slight throttle opening and rock the car backwards and forwards by alternately selecting the R and D2 positions.

Stopping

To bring the car to rest, release the accelerator and apply the brakes.

If the car is temporarily stopped for traffic lights, etc., the selector lever may be left in whatever forward range it is in, but the foot or handbrake should be applied to stop any tendency for the car to "creep".

Parking

When the car is stationary select the P (Park) position.

Push Starting

It is possible to effect an engine start by pushing the car.

To do this, select N and switch the ignition ON.

Depress accelerator pedal approximately $\frac{1}{4}$ and when the car reaches approximately 20 m.p.h. (32 k.p.h.) select D2 or L. Do NOT tow the car to start the engine—it may overtake the towing vehicle.

Towing

The car may be towed with a dead engine in an emergency. Before towing ensure that the transmission fluid is at the correct level. Towing should be done with the transmission selector in the N position and speed should not exceed 30 m.p.h. (48 k.p.h.).

If the car is being towed because of transmission damage, the propeller shaft should be removed or towing should be done by lifting the rear wheels from the ground. Failure to do this may result in further extensive transmission damage.

> Do NOT select "P" or "R" whilst the car is in motion.

DATA

Maximum ratio of torque converter	2·00 : 1
Low gear reduction	2·40 : 1
Intermediate gear reduction	1.46 : 1
Direct drive—no converter	1·00 : 1
Reverse gear reduction	2·00 : 1

AUTOMATIC GEAR CHANGES

Selector Position	Throttle Position	Upshifts 1–2	2–3	Downshifts 3–2	3–1	2–1
				M.P.H.		
D1	Minimum	6–7	10–12	6–12	—	3–6
	Full	31–36	54–58	18–31	—	—
	Kickdown	42–46	66–73	59–67	16–20	16–20
D2	Minimum	—	10–12	6–12	—	—
	Full	—	54–58	18–31	—	—
	Kickdown	—	66–73	59–67	—	—
L.	Zero	—	—	60	—	9–17
				K.P.H.		
D1	Minimum	10–11	16–19	10–19	—	5–10
	Full	50–58	87–93	29–50	—	—
	Kickdown	68–74	106–117	95–108	26–32	26–32
D2	Minimum	—	16–19	10–19	—	—
	Full	—	87–93	29–50	—	—
	Kickdown	—	66–73	95–108	—	—
L.	Zero	—	—	97	—	14–27

AUTOMATIC TRANSMISSION MAINTENANCE

EVERY 3,000 MILES (5,000 KM.)

Checking Transmission Fluid Level

The transmission filler tube is located on the right hand side of the engine under the bonnet just forward of the bulkhead. Check the fluid level every 3,000 miles (5,000 km.).

Before checking the fluid level, the car should be on level ground and the transmission should be at the normal operating temperature.

Set the handbrake and select P position.

The engine should be at normal idle.

While the engine is running, remove the dipstick, wipe clean and replace in the filler tube in its correct position.

Withdraw immediately and check.

If necessary, add fluid to bring the level to the FULL mark on the dipstick. The difference between FULL and LOW marks on the stick represents approximately $1\frac{1}{2}$ pints (2 U.S., pints or 0·75 litres).

Be careful not to overfill.

If fluid is checked with the transmission cold, a false reading will be obtained and filling to the FULL mark will cause it to be overfilled.

If it is found necessary to add fluid frequently it will be an indication that there is a leakage in the transmission and it should be investigated immediately to prevent damage to the transmission.

Total fluid capacity (including cooler) 15 Imperial pints from dry (18 U.S. pints 8·5 litres).

Fluid Changing

The transmission fluid should be changed after the first 1,000 miles (1,600 km.) of operation. No periodic fluid changes are recommended except when other transmission service is necessary.

If the oil pan is removed for other service the fluid should be drained and replaced with fresh fluid.

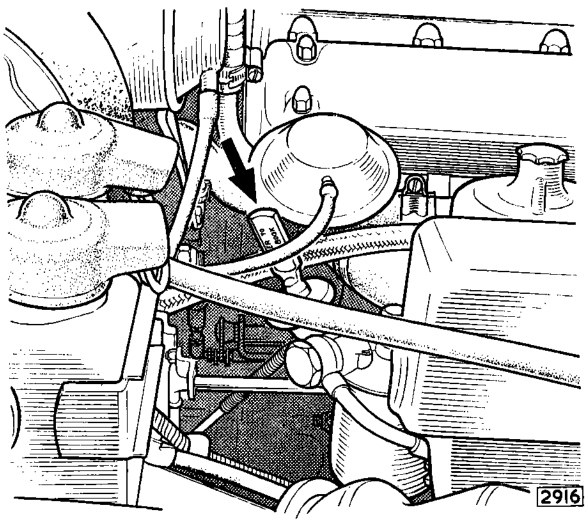


Fig. 30. Automatic transmission dipstick.

SUMMARY OF MAINTENANCE

DAILY

Check radiator water level.

Check engine oil level.

WEEKLY

Check tyre pressures (including spare wheel).

MONTHLY

Check battery electrolyte level and connections.

EVERY 3,000 MILES (5,000 KM.)

Check radiator water level.

Check tyre pressures (including spare wheel).

Check battery electrolyte level and connections.

Check fluid level in automatic transmission unit (if fitted).

Check fluid level in power-assisted steering reservoir.

Check fluid level in brake and clutch master cylinder reservoirs.

Check gearbox oil level.

Check rear axle oil level.

Drain engine sump and refill.

Clean oil filter element.

Top up carburetter hydraulic piston dampers.

Lubricate distributor and check contact points.

Clean, adjust and test sparking plugs.

Check carburetter slow running.

EVERY 6,000 MILES (10,000 KM.)

Carry out 3,000 mile (5,000 km.) service.

Lubricate all grease nipples (excluding wheel bearings).

Renew oil filter element.

Clean carburetter filters.

Clean fuel feed line filter.

Examine brake friction pads for wear.

Clear drain holes in bottoms of doors.

Adjust top timing chain (if necessary).

Check front wheel alignment.

Check driving belts for wear.

Carry out oil can lubrication of (a) seat runner and adjusting mechanism (b) handbrake lever ratchet (c) door locks (d) luggage compartment hinges and lock (e) bonnet hinges and catches (f) windscreen wiper arms (g) accelerator and carburetter linkage (h) fuel filler cover hinge.

EVERY 12,000 MILES (20,000 KM.)

Carry out 3,000 and 6,000 mile (5,000 and 10,000 km.) service.

Drain and refill gearbox.

Clean overdrive oil pump filter (if overdrive fitted).

Drain and refill rear axle.

Renew air cleaner element.

Renew sparking plugs.

Lubricate front and rear wheel bearing hubs.

Check front and rear wheel bearings for end-float (Additional charge for adjustment).

Check exhaust system for leaks.

Check and tighten all chassis and body nuts, bolts and screws.

EVERY 21,000 MILES (35,000 KM.)

Adjust front and rear bands (automatic transmission).

RECOMMENDED LUBRICANTS

Component	Mobil	Castrol	Shell	Esso	B.P.	Duckham	Regent Caltex/Texaco
Engine	Mobiloil Special*	Castrolite* or Castrol XL	Shell Super Oil	Esso Extra Motor Oil 5W/20* Esso Extra Motor Oil 10W/20* Esso Extra Motor Oil 20W/40*	Visco-Static	Q20-50 or Q5500*	Havoline 20W/40 or 10W/30*
Upper cylinder lubrication	Mobil Upperlube	Castrollo	Shell U.C.L. or Donax U	Esso U.C.L.	U.C.L.	Adcoid Liquid	Regent U.C.L.
Distributor oil can points . Oil can lubrication . .	Mobiloil A	Castrol XL	X-100 30	Esso Motor Oil 20W/30	Energol SAE 30	NOL 30	Havoline 30
Gearbox . . . . . Rear axle	Mobilube GX 90	Castrol Hypoy	Spirax 90 E.P.	Esso Gear Oil G.P. 90/140	Gear Oil SAE90E.P.	Hypoid 90	Multigear Lubricant EP 90
Front wheel bearings . . Rear wheel bearings . . Distributor cam . . . Steering tie-rods . . . Wheel swivels . . . Rear wishbone pivots . .	Mobil-grease MP	Castrolease LM	Retinax A	Esso Multi-purpose grease H	Energrease L.2.	LB.10	Marfak All purpose
Automatic transmission unit Power steering system	Mobilfluid 200	Castrol T.Q.	Shell Donax T6	Esso Automatic Transmission Fluid	Automatic Trans-mission Fluid Type A	Nolmatic	Texamatic Fluid

*These oils NOT to be used in engines requiring overhaul.

RECOMMENDED HYDRAULIC FLUID

Braking System and Clutch Operation

Dunlop Disc Brake Fluid is recommended. This conforms to SAE 70 R3 specification modified for additional safety to give a higher boiling point.

Where this is not available, only fluid guaranteed to conform to SAE 70 R3 specification which is fully miscible with Dunlop Disc Brake Fluid, may be used as an alternative.

SPECIAL SERVICE TOOLS

Distributors and dealers should obtain the Churchill special tools (i.e. tool numbers marked by an asterisk) illustrated in this manual direct from Messrs. V. L. Churchill & Co. Ltd., London Road, Daventry, Northants., P.O. Box No. 3.

Section	Description
ENGINE	Timing chain adjuster (J.2)*
	Valve spring compressor (J.6118)*
	Crankshaft rear seal sizing tool (J.17)*
	Valve guide bore reamer (J.18)*
OVERDRIVE	Hydraulic test equipment (L.301)*
	Freewheel assembly ring (L.178)*
	Operating piston remover (L.300)*
REAR AXLE	Multi-purpose hand press (SL.14)* used with:—
	Pinion bearing inner race remover (SL.14-1)*
	Differential side bearing cone remover (SL.14-3)*
	Multi-purpose handle (550)* used with:—
	Differential side bearing cone replacer (SL.550-1)*
	Pinion outer bearing cup replacer (SL.550-4)*
	Pinion inner bearing cup replacer (SL.550-5)*
	Pinion cone setting gauge (SL.3)*
	Pinion oil seal replacing collar (SL.4)*
	Hub inner and outer bearing cup replacer (J.20A)*
	Adaptor (J.20-1)*
	Hub endfloat master spacer and inner bearing cone replacer (J.15)*
	Hub endfloat dial gauge (J.13)*
	Hub remover (JD 1C)*
	Hub outer bearing cone remover (J.16B)*
STEERING	Steering box centralising gauge (J.27)*
	Power steering gauge adaptor (J.28)*
	Power steering assembly sleeve (J.30)*
	Valve seal expander (J.32)*
	Valve seal compressor (J.33)*
	Sector shaft spline seal protector (J.34)*
	Rotor spline seal protector (J.35)*
FRONT SUSPENSION	Front coil spring compressor (JD.6B)*
REAR SUSPENSION	Rear spring compressor (J.11A)* used with SL.14 above
	Rear wishbone pivot dummy shaft (J.14)*
BRAKES	Piston resetting tool
	Master cylinder clearance setting gauge (J.26)*
	Master cylinder return spring compressor (J.29)*
	Servo end plate remover (J.31)*

SERVICE DEPARTMENTS

Factory:

The Service Division,
Jaguar Cars Limited,
Coventry, England.
Telephone No. Coventry 27677 (P.B.X.)

London:

Messrs. Henlys Ltd.,
The Hyde,
Hendon,
London, N.W.9.
Telephone No. Colindale 6565

U.S.A.:

The Technical Service Department
Jaguar Cars Inc.
42/50, 21st Street, Long Island City 1.
New York, U.S.A.

Canada:

The Technical Service Department,
Jaguar Cars (Canada) Ltd.
8505 Delmeade Road, Montreal 9
Quebec, Canada.

CONVERSION TABLES

METRIC INTO ENGLISH MEASURE

1 millimetre is approximately 1/25", and is exactly ·03937".
1 centimetre is approximately ⅜", and is exactly ·3937".
1 metre is approximately 39⅜", and is exactly 39·37" or 1·0936 yards.
1 kilometre is approximately ⅝ mile, and is exactly ·6213 miles.
1 kilogramme is approximately 2¼ lbs., and is exactly 2·21 lbs.
1 litre is approximately 1¾ pints, and is exactly 1·76 pints.
To convert metres to yards, multiply by 70 and divide by 64.
To convert kilometres to miles, multiply by 5 and divide by 8 (approx.).
To convert litres to pints, multiply by 88 and divide by 50.
To convert grammes to ounces, multiply by 20 and divide by 567.
To find the cubical contents of a motor cylinder, square the diameter (or bore), multiply by 0·7854, and multiply the result by the stroke.
1 M.P.G.—0·3546 kilometres per litre or 2·84 litres per kilometre.

MILES INTO KILOMETRES

Kilo.	Miles	Kilo.	Miles	Kilo.	Miles	Kilo.	Miles	Kilo.	Miles
1	⅝	16	10	31	19¼	46	28⅝	60	37¼
2	1¼	17	10⅝	32	19⅞	47	29¼	70	43½
3	1⅞	18	11¼	33	20½	48	29⅞	80	49¾
4	2½	19	11¾	34	21⅛	49	30½	90	55⅞
5	3⅛	20	12⅜	35	21¾	50	31⅛	100	62⅛
6	3¾	21	13	36	22⅜	51	31¾	200	124¼
7	4⅜	22	13⅝	37	23	52	32¼	300	186⅜
8	5	23	14¼	38	23⅝	53	32⅞	400	248½
9	5⅝	24	14⅞	39	24¼	54	33½	500	310¾
10	6¼	25	15½	40	24⅞	55	34⅛	600	372⅞
11	6⅞	26	16⅛	41	25½	56	34¾	700	435
12	7½	27	16¾	42	26⅛	57	35⅜	800	497⅛
13	8⅛	28	17⅜	43	26¾	58	36	900	559¼
14	8¾	29	18	44	27⅜	59	36⅝	1000	621⅜
15	9⅜	30	18⅝	45	28				

PINTS AND GALLONS TO LITRES

Pints	Gallons	Litres Approx.	Litres Exact	Pints	Gallons	Litres Approx.	Litres Exact
1	⅛	½	·57	40	5	23	22·75
2	¼	1	1·14	48	6	27	27·30
3	⅜	1½	1·71	56	7	32	31·85
4	½	2¼	2·27	64	8	36½	36·40
8	1	4½	4·54	72	9	41	40·95
16	2	9	9·10	80	10	45½	45·50
24	3	13½	13·65	88	11	50	50·05
32	4	18	18·20	96	12	54½	54·60

RELATIVE VALUE OF MILLIMETRES AND INCHES

mm.	Inches	mm.	Inches	mm.	Inches	mm.	Inches
1	0·0394	26	1·0236	51	2·0079	76	2·9922
2	0·0787	27	1·0630	52	2·0473	77	3·0315
3	0·1181	28	1·1024	53	2·0866	78	3·0709
4	0·1575	29	1·1417	54	2·1260	79	3·1103
5	0·1968	30	1·1811	55	2·1654	80	3·1496
6	0·2362	31	1·2205	56	2·2047	81	3·1890
7	0·2756	32	1·2598	57	2·2441	82	3·2284
8	0·3150	33	1·2992	58	2·2835	83	3·2677
9	0·3543	34	1·3386	59	2·3228	84	3·3071
10	0·3937	35	1·3780	60	2·3622	85	3·3465
11	0·4331	36	1·4173	61	2·4016	86	3·3859
12	0·4724	37	1·4567	62	2·4410	87	3·4252
13	0·5118	38	1·4961	63	2·4803	88	3·4646
14	0·5512	39	1·5354	64	2·5197	89	3·5040
15	0·5906	40	1·5748	65	2·5591	90	3·5433
16	0·6299	41	1·6142	66	2·5984	91	3·5827
17	0·6693	42	1·6536	67	2·6378	92	3·6221
18	0·7087	43	1·6929	68	2·6772	93	3·6614
19	0·7480	44	1·7323	69	2·7166	94	3·7008
20	0·7874	45	1·7717	70	2·7559	95	3·7402
21	0·8268	46	1·8110	71	2·7953	96	3·7796
22	0·8661	47	1·8504	72	2·8347	97	3·8189
23	0·9055	48	1·8898	73	2·8740	98	3·8583
24	0·9449	49	1·9291	74	2·9134	99	3·8977
25	0·9843	50	1·9685	75	2·9528	100	3·9370

RELATIVE VALUE OF INCHES AND MILLIMETRES

Inches	0	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$
0	0·0	1·6	3·2	4·8	6·4	7·9	9·5	11·1
1	25·4	27·0	28·6	30·2	31·7	33·3	34·9	36·5
2	50·8	42·4	54·0	55·6	57·1	58·7	60·3	61·9
3	76·2	87·8	79·4	81·0	82·5	84·1	85·7	87·3
4	101·6	103·2	104·8	106·4	108·0	109·5	111·1	112·7
5	127·0	128·6	130·2	131·8	133·4	134·9	136·5	138·1
6	152·4	154·0	155·6	157·2	158·8	160·3	161·9	163·5
Inches	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{3}{4}$	$\frac{13}{16}$	$\frac{7}{8}$	$\frac{15}{16}$
0	12·7	14·3	15·9	17·5	19·1	20·6	22·2	23·8
1	38·1	39·7	41·3	42·9	44·4	46·0	47·6	49·2
2	63·5	65·1	66·7	68·3	69·8	71·4	73·0	74·6
3	88·9	90·5	92·1	93·7	95·2	96·8	98·4	100·0
4	114·3	115·9	117·5	119·1	120·7	122·2	123·8	125·4
5	139·7	141·3	142·9	144·5	146·1	147·6	149·2	150·8
6	165·1	166·7	168·3	166·9	171·5	173·0	174·6	176·2

SECTION B

ENGINE

4·2 MARK 10 MODEL

INDEX

INDEX *(continued)*

INDEX *(continued)*

ENGINE

The 4·2 Mark 10 has the twin overhead camshaft XK type engine, fitted with an "S" type cylinder head with straight ports and $\frac{3}{8}''$ lift camshafts.

Compression Ratio	Engine No. Prefix	Colour of Cylinder Head
7:1; 8:1 9:1	7D	Gold

Compression ratios of 7:1, 8:1, and 9:1 are specified for the 4·2 Mark 10 engine, the differences in compression ratio being obtained by varying the crown design of the piston.

The compression ratio of an engine is indicated by /7, /8 or /9 following the engine number.

DATA

Camshaft

Number of journals	Four per shaft
Journal diameter	1·00" — 0·0005" — 0·001" (25·5 mm. — 0·013 mm.) — 0·025 mm.)
Thrust taken	Front end
Number of bearings	Four per shaft (eight half bearings)
Type of bearing	White metal steel backed shell
Diameter clearance	0.0005" - 0·002" (0·013 - 0.05 mm.)
Permissible end float	0·004" - 0·006" (0·10 - 0·15 mm.)
Tightening torque—Bearing cap nuts	15 lb. ft. (175 lb. in.) (2·0 Kgm.)

Connecting Rod

Length centre to centre..	$7\frac{3}{4}''$ (19·68 cm.)
Big end—Bearing type	Lead bronze, steel backed

Bore for big end bearing	2·288″ – 2·2335″ (56·72 – 56·73 mm)
Big end—Width	$1\frac{3}{16}$″ – 0·006″ – 0·008″ (30·16 – 0.15 mm.) – 0·20 mm.)
Big end—Diameter clearance	0·0015″ – 0·0033″ (0·037 – 0·083 mm.)
Big end—Side clearances	0·0058″ – 0·0087″ (0·15 – 0·22 mm.)
Bore for small end bush	1·00″ ± 0·0005″ (25·5 ± 0·013 mm.)
Small end bush—Type	Phosphor bronze—steel backed
Small end—Width	1 5/64″ (27·4 mm.)
Small end bush—Bore diameter	0·875″ + 0.0002″ — 0·0000″ (22·22 + 0·005 mm.) — 0·000 mm.
Tightening torque—connecting rod bolts	37 lb. ft. (450 lb. in.) (5·1 Kgm.)
Crankshaft	
Number of main bearings	7
Main bearing—Type	Lead bronze, steel backed shell
Journal diameter	2·750″ – 2·7505″ (69·85 – 69·86 mm.)
Journal length—Front	$1\frac{9}{16}$″ (39·06 mm.)
Journal length—Centre	$1\frac{3}{8}$″ + 0·001″ — 0·0005″ (34·37 + 0.025 mm. — 0·0125 mm.)
Journal length—Rear	$1\frac{11}{16}$″ (42·86 mm.)
Journal length—Intermediate	$1\frac{7}{32}$″ ± 0·002″ (30·96 ± 0·05 mm.)

Thrust taken	Centre bearing thrust washers
Thrust washer—Thickness	0·092″ ± 0·001″ and 0·096″ ± 0·001″ (2·33 ± 0·025 mm. and 2·43 ± 0·025 mm.)
End clearance	0·004″ – 0.006″ (0·10 – 0·15 mm.)
Main bearing length	
Front, Centre, Rear	1$\frac{1}{2}$″ ± 0·005″ (38·1 ± 0·13 mm.)
Intermediate	1″ ± 0·005″ (25·5 ± 0·13 mm.)
Diameter clearance	0·0025″ – 0·0042″ (0·063 – 0·106 mm.)
Crankpin—diameter	2·086″ + 0·0006″ — 0·0000″ (52·98 + 0·015 mm.) — 0·000 mm.)
Length	1$\frac{3}{16}$″ + 0·0007″ — 0·0002″ (30·16 + 0·018 mm.) — 0·006 mm.)
Regrind undersize	0·010″, 0·020″, 0·030″ and 0·040″ (0·25, 0·51, 0·76 and 1·02 mm.)
Minimum diameter for regrind	— 0·040″ (1 mm.)
Tightening torque—main bearing bolts	83 lb. ft. (1,000 lb. in.) (11·5 Kgm.)

Cylinder Block

Material	"Brivadium" dry liners
Interference fit	0·001″ – 0·005″ (0·025 – 0·127 mm.)
Overall length of liner	6·959″ – 6·979″ (17·39 – 17·45 cm.)
Outside diameter of lead-in	3·758″ – 3·760″ (93·95 – 94 mm.)

ENGINE

Size of bore honed after assembly—in cylinder block—

Nominal	3·625″ (92·97 mm.)
Main line bore for main bearings	2·9165″ + 0·0005″ — 0·0000″ (74·08 + 0·0125 mm. — 0·0000 mm.)

Cylinder Head

Type	Straight Port (Gold Top)
Material	Aluminium alloy
Valve seat angle—Inlet	45°
—Exhaust	45°
Tightening torque—Cylinder head nuts	54 lb. ft. (650 lb. in.) (7·5 kgm.)
Firing order	1,5,3,6,2,4 No. 1 cylinder being at the rear of the engine

Gudgeon Pin

Type	Fully floating
Length	3·00″ (75 mm.)
Inside diameter	$\frac{5}{8}$″ (15·87 mm.)
Outside diameter	0·8750″ – 0·8752″ (22·22 – 22·23 mm.)

Lubricating system

Oil pressure (hot)	40 lb./sq. in. at 3,000 r.p.m.
Oil pump—Type	Eccentric rotor
—Clearance at end of lobes	0·006″ maximum (0·15 mm.)
—End clearance	0·0025″ maximum (0·06 mm.)
—Clearance between outer rotor and body	0·010″ maximum (0·25 mm.)

Piston and Piston Rings

Make	Brico
Type	Semi-split skirt
Piston:	
Skirt clearance (measured at the bottom of skirt at 90° to gudgeon pin axis)	0·0011″ – 0·0017″ (0·028″ – 0·043 mm.)
Gudgeon pin bore	0·8751″ – 0·8753″ (2·188 – 2·1883 mm.)

Compression height

7:1 compression ratio	1·846″ – 1·841″ (46·76 – 46·89 mm.)
8:1 compression ratio	2·069″ – 2·064″ (52·42 – 52·55 mm.)
9:1 compression ratio	2·247″ – 2·242″ (56·94 – 57·07 mm.)

Piston Rings Number

Compression	2
Oil control	1 (Maxiflex)
Piston rings—Width	
Compression	0·0770″ – 0·0780″ (1·97 – 2·00 mm.)
Oil control	Self expanding
Piston rings—Thickness	
Compression	0·151″ – 0·158″ (3·775 – 3·95 mm.)
Piston rings—Side clearance in groove	
Compression	0·001″ – 0·003″ (0·02 – 0·07 mm.)
Oil control	0·001″ – 0·003″ (0·02 – 0·07 mm.)
Piston rings—Gap when fitted to cylinder bore	
Compression	0·015″ – 0·020″ (·38 – 0·51 mm.)
Oil control	0·015″ – 0·033″ (0·38 – 0·82 mm.)

ENGINE

Sparking Plugs

Make	Champion
Type	N 11 Y
Gap (7:1, 8:1 and 9:1 compression ratios)	0·025″ (0·63 mm.)

Tappets and Tappet Guides

Tappet—Material	Cast iron (chilled)
—Outside diameter	1·3738″ – 1·3742″ (34·89 – 34·90 mm.)
—Diameter clearance	0·0008″ – 0·0019″ (0·02 – 0·048 mm.)
Tappet guide—Inside diameter (before reaming)	1·353″ – 1·357″ (34·37 – 34·48 mm.)
—Reaming size (when fitted to cylinder head)	1·375″ + 0·0007″ —0·0000″ (34·925 mm. + 0·018 mm. — 0·000 mm.)
—Interference (shrink) fit in head	0·003″ (0·07 mm.)

Timing Chains and Sprockets

Type	Duplex
Pitch	$\frac{3}{8}$″ (9·5 mm.)
Number of pitches—Top chain	100
—Bottom chain	82
Crankshaft sprocket—Teeth	21
Intermediate sprocket (outer)—Teeth	28
Intermediate sprocket (inner)—Teeth	20
Camshaft sprocket—Teeth	30
Idler sprocket	21

Valve Timing

Inlet valve opens	15° B.T.D.C.
Inlet valve closes	57° A.B.D.C.
Exhaust valve opens	57° B.B.D.C.
Exhaust valve closes	15° A.T.D.C.

(with valve clearances set at 0·101″ (0·25 mm.)

Valves and Valve Springs

Valves—Material, Inlet	Silicon chrome steel
Exhaust	21–4–NS
Valve head diameter—Inlet	$1\frac{3}{4}'' \pm 0{\cdot}002''$ (44·45 mm. ± 0·05 mm.)
—Exhaust	$1\frac{5}{8}'' \pm 0{\cdot}002''$ (41·27 mm. ± 0·05 mm.)
Valve stem diameter—Inlet and Exhaust	$\frac{5}{16}''$ — 0·0025″ — ·06″ — 0·0035″ (7·95 mm.— ·09 mm.)
Valve lift	$\frac{3}{8}''$ (9·4 mm.)
Valve clearance—Inlet	0·004″ (0·10 mm.)
—Exhaust	0·006″ (0·15 mm.)
Valve seat angle—Inlet	45°
—Exhaust	45°
Valve spring—Free length—Inner	$1\frac{21}{32}''$ (42 mm.)
—Outer	$1\frac{15}{16}''$ (49·2 mm.)
Valve spring—Fitted length—Inner	$1\frac{7}{32}''$ (30·96 mm.)
—Outer	$1\frac{5}{16}''$ (33·34 mm.)
Valve spring—Fitted load—Inner	30·33 lb. (13·76 kg.)
—Outer	48·375 lb. (21·94 kg.)
Valve spring—Solid length (max.)—Inner	0·810″ (20·57 mm.)
—Outer	0·880″ (22·35 mm.)

Number of free coils—Inner	6
—Outer	5
Diameter of wire—Inner	12 SWG (0·104″) (2·64 mm.)
—Outer	10 SWG (0·128″) (3·25 mm.)

Valve Guide and Valve Seat Insert

Valve guides—Material	Cast iron
Valve guide—Length—Inlet	$1\frac{13}{16}$″ (46·04 mm.)
—Exhaust	$1\frac{15}{16}$″ (49·21 mm.)
Valve guide—Inside diameter—Inlet	$\frac{5}{16}$″— 0·0005″ — 0·0015″ (7·94 mm.— 0·013 mm.) — 0·038 mm.)
—Exhaust	$\frac{5}{16}$″ ± 0·0005″ (7·94 mm. ± 0·01 mm.)
Interference fit in head	0·0005 – 0·0022″ (0·013 – 0·055 mm.)
Valve seat inserts—Material	Cast iron (centrifugally cast)
—Inside diameter—Inlet	$1\frac{1}{2}$″ + 0·003″ — 0·001″ (38·1 mm. + 0·076 mm.) — 0·025 mm.)
—Exhaust	1·379 – 1·383″ (35·03 – 35·13 mm.)
Interference (shrink) fit in head	0·003″ (0·076 mm.)

FUEL REQUIREMENTS FOR 9:1 and 8:1 COMPRESSION RATIO ENGINES

If the engine of your car is fitted with 9:1 compression ratio pistons (indicated by /9 after the engine number) use only Super grade fuel with a minimum octane rating of 98 (Research method). If a car is fitted with 8:1 compression ratio pistons (indicated by /8 after the engine number) use Premium grade fuel with a minimum rating of 94 (Research method).

If, of necessity, the car has to be operated on lower octane fuel do not use full throttle otherwise detonation may occur with resultant piston trouble.

ROUTINE MAINTENANCE

DAILY

Checking the Engine Oil Level

Check the oil level with the car standing on level ground otherwise a false reading will be obtained.

Remove the dipstick and wipe it dry. Replace and withdraw the dipstick; if the oil level is on the knurled patch, with the engine hot or cold, no additional oil is required. If the engine has been run immediately prior to making an oil level check, wait one minute after switching off before checking the oil level.

Note: Almost all modern engine oils contain special additives, and whilst it is permissible to mix the recommended brands it is undesirable. If it is desired to change from one brand to another this should be done when the sump is drained, and the Oil Company's recommendation in regard to flushing procedure should be followed.

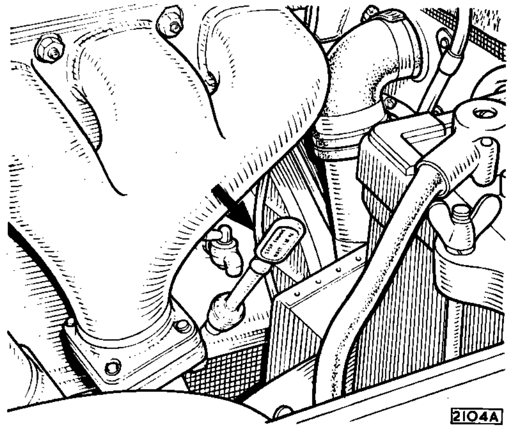


Fig. 1. The engine dipstick.

EVERY 3,000 MILES (5,000 KM.)

Changing the Engine Oil

Note: Under certain adverse operating conditions, conducive to oil dilution and sludge formation, more frequent oil changing than the normal 3,000 mile (5,000 km.) period is advised. Where the car is used mainly for low-speed city driving, stop-start driving particularly in cold weather or in dusty territory the oil should be changed at least every 1,000 miles (1,600 km.).

The draining of the sump should be carried out at the end of a run when the oil is hot and therefore will flow more freely. The drain plug is situated at the right-hand rear corner of the sump. When the engine oil is changed, the oil filter which is situated on the right-hand side of the engine, must also receive attention.

Unscrew the central bolt and remove the canister and element. Thoroughly wash these parts in petrol and allow to dry out. When replacing the canister ensure that a new circular rubber seal is fitted in the filter head. (Attention is drawn to the importance of renewing the filter element at 6,000 mile (10,000 km.) intervals.

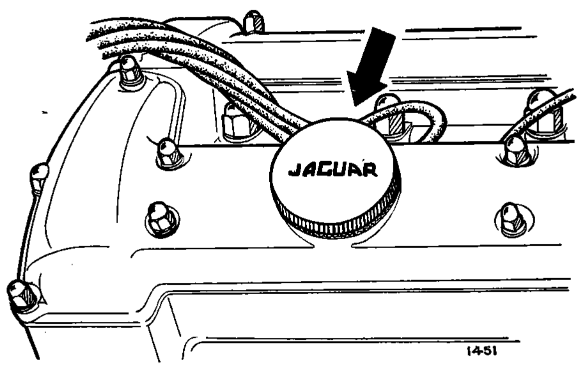


Fig. 2. The engine oil filler.

Note: Almost all modern engine oils contain special additives, and whilst it is permissible to mix the recommended brands it is undesirable. If it is desired to change from one brand to another this should be done when the sump is drained, and the Oil Company's recommendation in regard to flushing procedure should be followed.

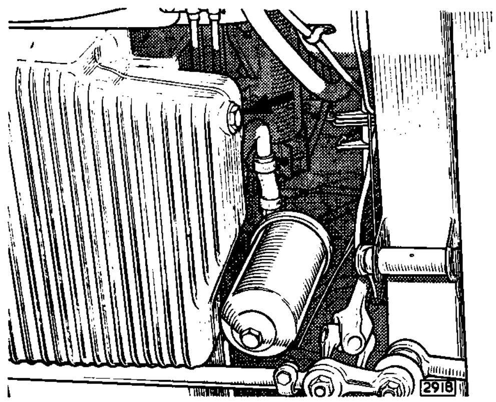


Fig. 3. The engine drain plug

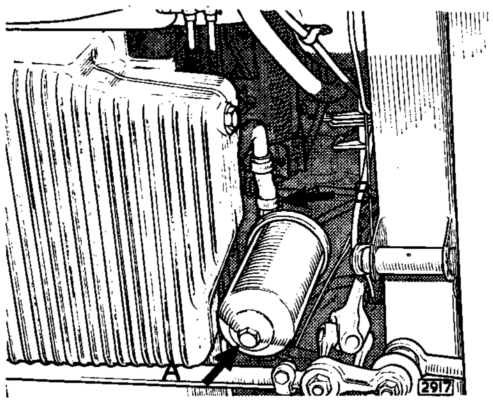


Fig. 4. The engine filter is removed by unscrewing. the bolt "A" and withdrawing the canister and element. The oil pressure relief valve is situated behind the outlet "B".

Distributor—Lubrication

Take care to prevent oil or grease from getting on or near the contact breaker points.

Remove the moulded cap at the top of the distributor by springing back the two clips. Lift off the rotor arm and apply a few drops of engine oil around the screw (A, Fig. 5) now exposed. It is not necessary to remove the screw as it has clearance to permit the passage of oil.

Apply one drop of oil to the post (B) on which the contact breaker pivots. Lightly smear the cam (C) with grease. Lubricate the centrifugal advance mechanism by injecting a few drops of engine oil through the aperture at the edge of the contact breaker base plate.

Distributor Contact Breaker Point Adjustment

Check the gap between the contact points with feeler gauges when the points are fully opened by one of the cams on the distributor shaft. A combined screwdriver and feeler gauge is provided in the tool kit.

The current gap is 0·014–0·016″ (0·36–0·41 mm).

If the gap is incorrect, slacken (very slightly) the contact plate securing screw and adjust the gap by turning a screwdriver in the slot in the contact plate, clockwise to decrease the gap and anti-clockwise to increase the gap. Tighten the securing screw and recheck to gap.

Examine the contact breaker points. If the contacts are burned or blackened, clean them with a fine carborundum stone or very fine emery cloth. Afterwards wipe away any trace of grease or metal dust with a petrol moistened cloth.

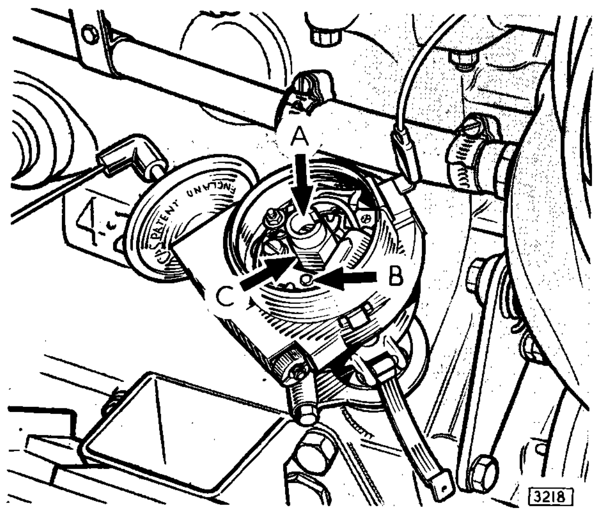


Fig. 5. Distributor lubrication points.

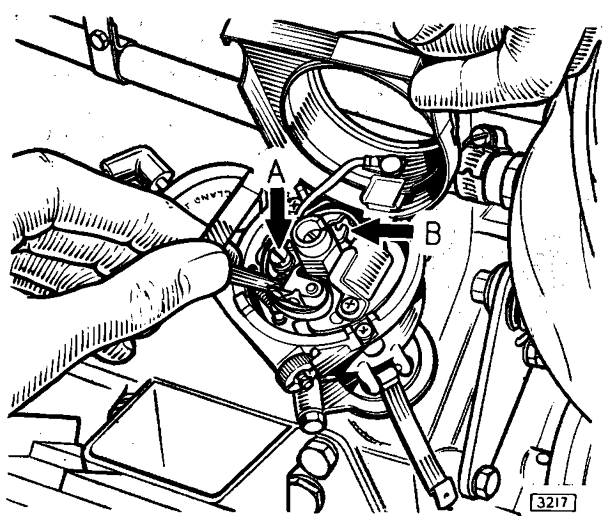


Fig. 6. Checking the gap—the screw "A" secures the fixed contact plate; the contact plate is adjusted by turning a screwdriver in slot "B".

Cleaning of the contacts is made easier if the contact breaker lever carrying the moving contact is removed. To do this, remove the nut, insulating piece and connections from the post to which the end of the contact breaker spring is anchored. The contact breaker lever can now be lifted off its pivot post.

Sparking Plugs

Every 3,000 miles (5,000 km.) or more often if operating conditions demand, withdraw, clean and reset the plugs.

The only efficient way to clean sparking plugs is to have them properly serviced on machines specially designed for this purpose. These machines operate with compressed air and utilise a dry abrasive material specially graded and selected to remove harmful deposits from the plug insulator without damaging the insulator surface. In addition the majority of the machines incorporate electrical testing apparatus enabling the plugs to be pressure tested to check their electrical efficiency and gas tightness.

The gap between the points should be 0.025" (0.64 mm). When adjusting the gap always move the side wire—never bend the centre wire.

The Champion Sparking Plug Co. supply a special combination gauge and setting tool, the use of which is recommended.

Every 12,000 (20,000 km.) a new set of plugs of the recommended type should be fitted. To save petrol and to ensure easy starting, the plugs should be cleaned and tested regularly.

EVERY 6,000 MILES (10,000 KM.)

Drive Belts—Check for Wear

The drive belts should be examined for wear periodically and the alternator belt should be checked for adjustment. Routine adjustment is not necessary in the case of the fan and steering box pressure pump as the drive belt is automatically adjusted by means of a spring loaded jockey pulley.

To remove the fan and steering pump belt, slacken the adjustment belt in the steering pump supporting strap and press the body of the pump in towards the engine.

Place the new belt in position over the fan, crankshaft and jockey pulleys. Press the jockey pulley against the spring and pass the belt over the pressure pump pulley.

Pull the pressure pump away from the engine as far as possible and tighten the securing bolt.

Alternator Belt Tension

Release the top mounting bolt (the nut "A" is welded to the support bracket and cannot be turned).

Release the button mounting nut "B" and swing the alternator upwards away from the engine until the correct belt tension is obtained. Re-tighten the mountings.

When correctly tensioned it should be possible to depress the belt $\frac{1}{2}''$ (17 mm.) between the two pulleys.

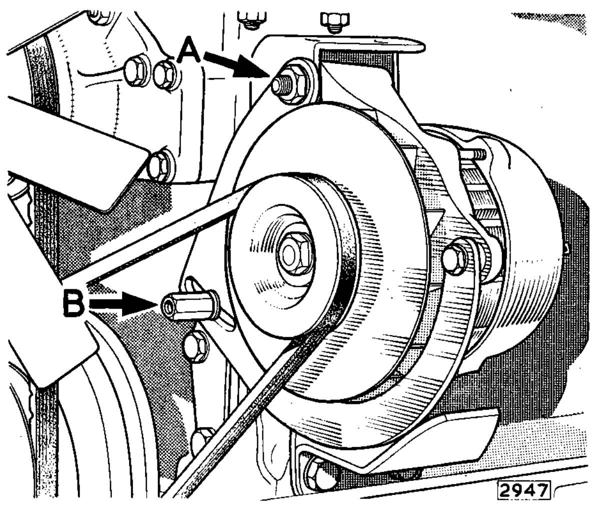


Fig. 7. Alternator belt adjustment.

Oil Filter Element

It is most important to renew the oil filter element every 6,000 miles (10,000 km.) as after this mileage it will have become choked with impurities.

To guard against the possibility of the filter being neglected to the extent where the element becomes completely choked, a balance valve is incorporated in the filter head which allows unfiltered oil to by-pass the element and reach bearings. This will be accompanied by a drop in normal oil pressure some 10 lb./sq. in. (0.703 kg./cm.^{2}) and if this occurs the filter element should be renewed as soon as possible.

To gain access to the element, unscrew the central bolt when the canister complete with the element can be removed. Thoroughly wash out the canister with petrol and allow to dry before inserting the new element.

When replacing the canister ensure that a new circular rubber seal is fitted in the filter head.

Top Timing Chain Tension

If the top timing chain is audible adjust the tension as follows:

This operation requires the use of a special tool to enable the adjuster plate to be rotated. To gain access to the adjuster plate remove the breather housing attached to the front face of the cylinder head.

Slacken the locknut securing the serrated adjuster plate. Tension the chain by pressing the locking plunger inwards and rotating the adjuster plate in an anti-clockwise direction.

When correctly tensioned there should be slight flexibility on both outer sides of the chain below the camshaft sprockets, that is ,the chain must not be dead tight. Release the locking plunger, and securely tighten locknut. Refit the breather housing.

EVERY 12,000 MILES (20,000 KM.)

Air Cleaner

The air cleaner is of the paper element type and is situated in the right-hand wing valance accessible from inside the engine compartment.

No maintenance is necessary but the element should be renewed every 12,000 miles (20,000 km.) or more frequently in dusty territories. A clogged air cleaner element will cause heavy fuel consumption.

To gain access to the element detach the flexible hose connecting the cleaner to the air intake pipe after removing rubber joint from the pipe and the hose clip from the air cleaner cover plate.

Turn the two quick-release screws securing the air cleaner cover plate anti-clockwise through 90° and withdraw plate with the attached element. Remove the thumb nut and retainer plate from the base of the unit and withdraw the element.

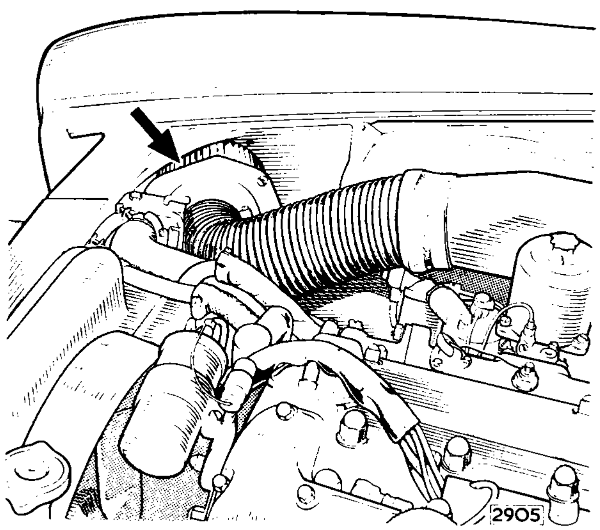


Fig. 8. Removing the air cleaner element.

Recommended Lubricants

Component	MOBIL	CASTROL	SHELL	ESSO	B.P.	DUCKHAM	REGENT Caltex/Texaco
Engine	Mobiloil Special*	Castrolite* or Castrol XL	Shell Super Oil	Esso Extra Motor Oil 5W/20* Esso Extra Motor Oil 10/W30* Esso Extra Motor Oil 20W/40* †	Visco-Static	Q20–50 or Q5500*	Havoline 20W/40 or 10W/30*
Upper cylinder lubrication	Mobil Upperlube	Castrollo	Shell U.C.L. or Donax U.	Esso U.C.L.	U.C.L.	Adcoid Liquid	Regent U.C.L.

* These oils must NOT be used in engines requiring overhaul.

If an SAE 30 or 40 oil has previously been used in the engine a slight increase in oil consumption may be noticed but this will be compensated by the advantages gained.

† According to availability in the country of operation.

Capacity

	Imperial	U.S.	Litres
Engine - refill (including filter)	12 pints	$14\frac{1}{4}$ pints	6·75

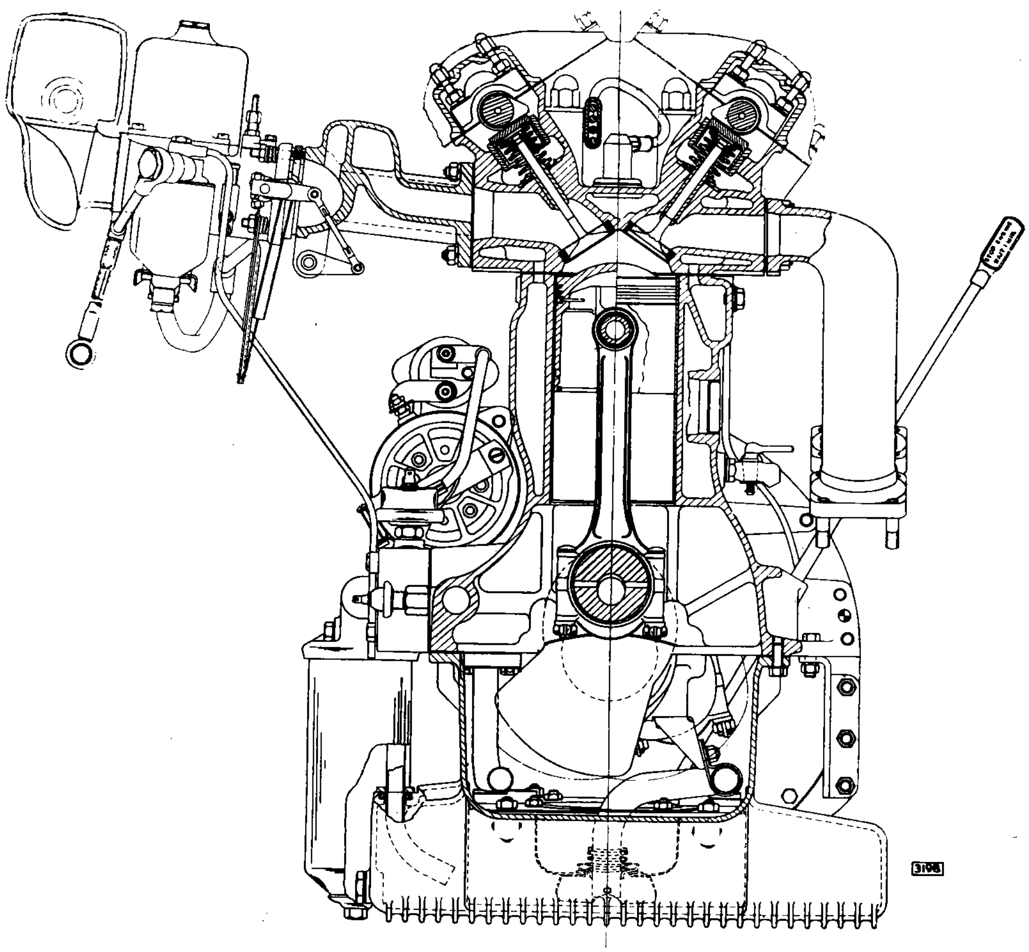


Fig. 9. Cross section of the 4.2 litre Mk. 10 engine.

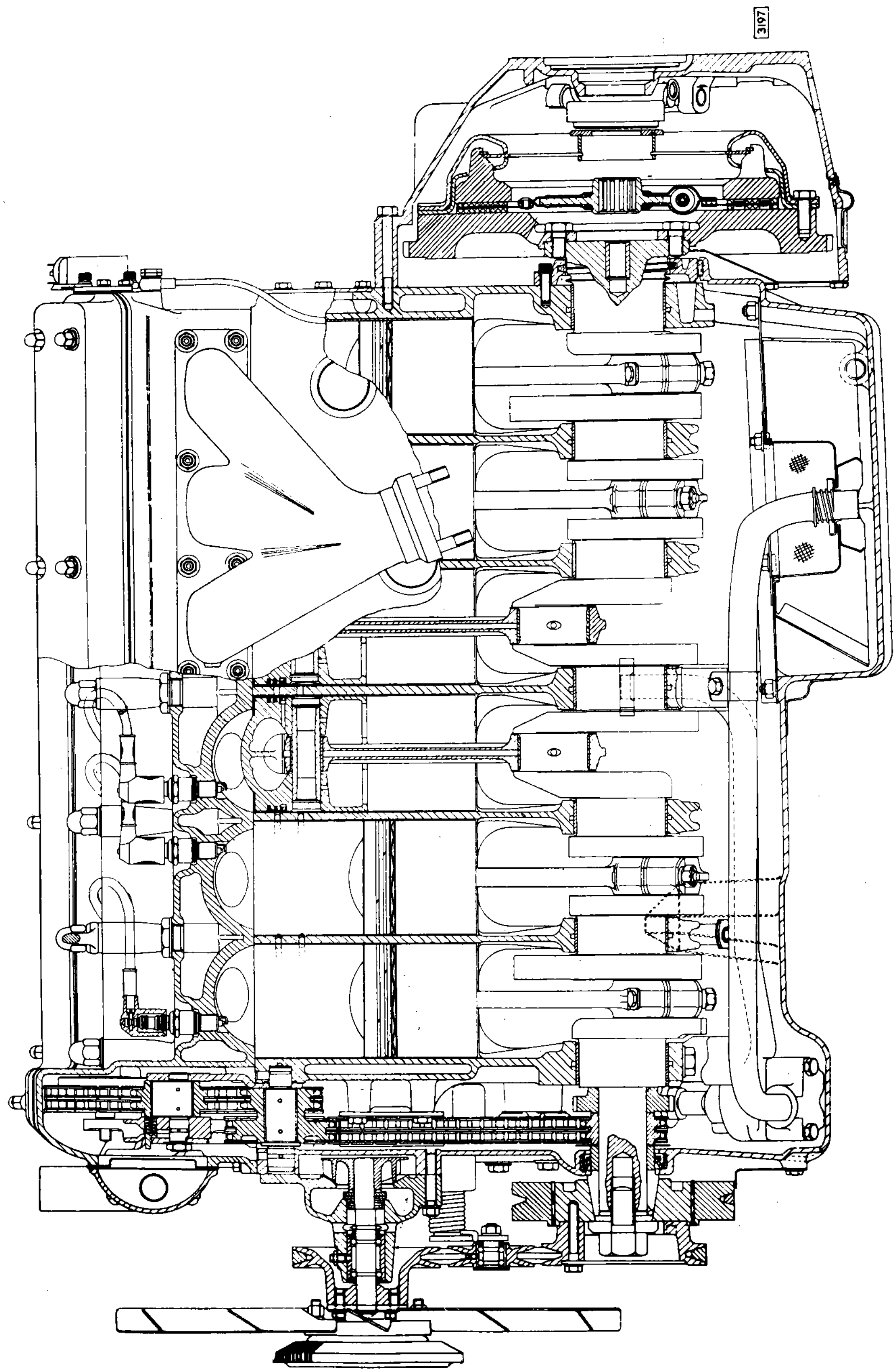


Fig. 10. Longitudinal section of the 4.2 litre Mk. 10 engine.

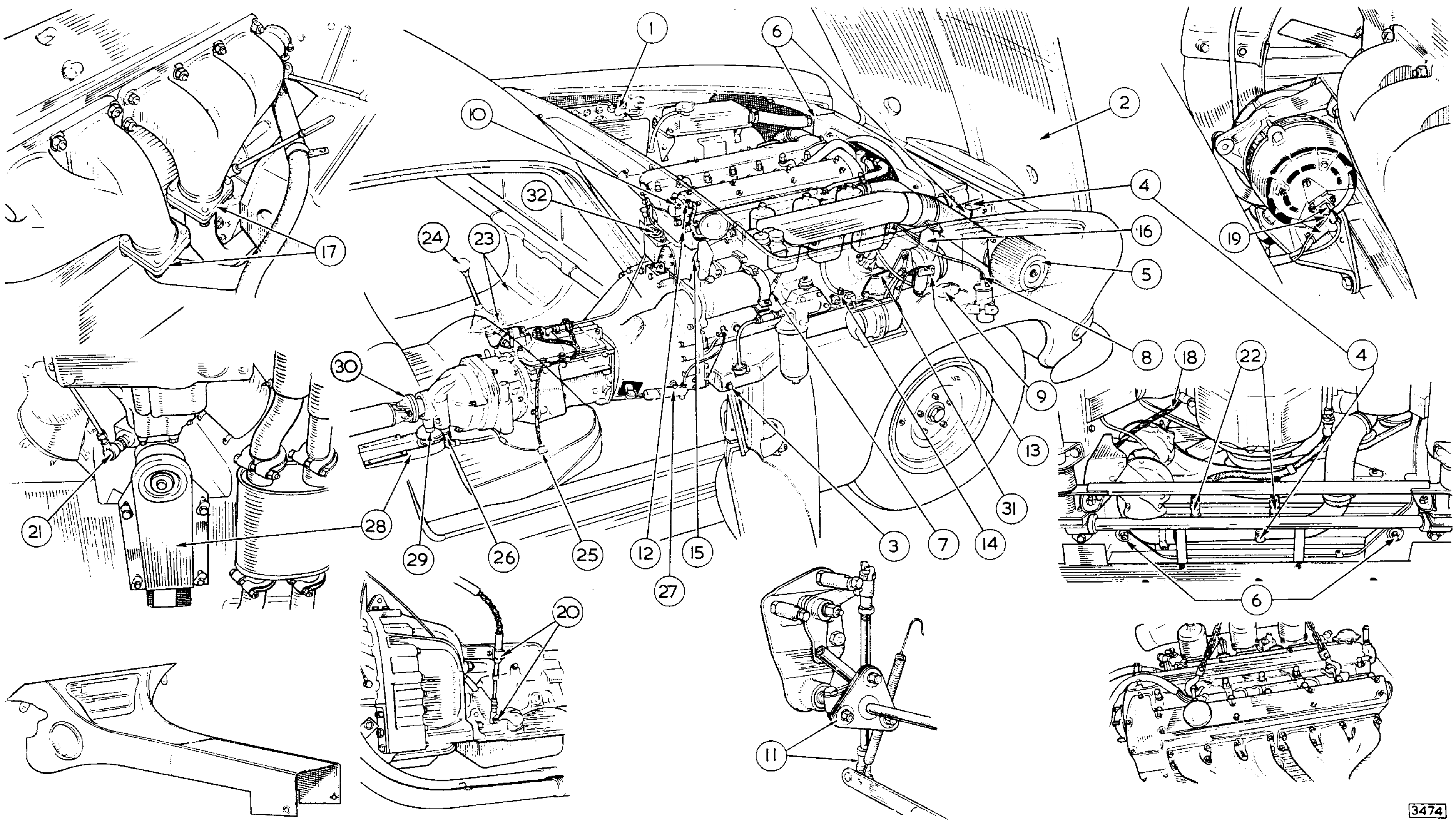


Fig. 11. Engine removal sequence.

ENGINE REMOVAL AND REFITTING

REMOVAL (Fig. 11)

Disconnect the battery (1).

Remove the bonnet (2) (for details see Section N).

Drain the engine sump (3).

Drain the cooling system (4).

Remove the air cleaner (5).

Remove the radiator (6).

Disconnect the starter cables (7).

Remove the H.T. Lead from the coil (8).

Disconnect the engine harness line plug and socket (9).

Remove the cables from the revolution counter generator (10).

Disconnect the main throttle shaft (11).

Remove the water hoses from the heater unit (12).

Disconnect the fuel feed pipe at the fuel filter bowl (13).

Remove the vacuum pipe from the check valve (14).

Remove the brake vacuum reservoir pipe (15).

Disconnect the power-assisted steering pump and secure to avoid damage (16).

Disconnect the exhaust pipes and remove the two sealing rings (17).

Disconnect the earth strap (18).

Disconnect the alternator cables (19).

On the automatic transmission models proceed as follows:

(a) Remove the nut securing the selector cable pivot pin to the selector lever (20) together with bracket and disconnect the cable.

(b) Disconnect the speedometer cable (21).

(c) Disconnect the oil cooler pipes from the bottom water pipe assembly (22).§ In the case of standard and overdrive models proceed as follows:

(a) Remove the console and gear lever grommet (23).

(b) Remove the gear lever knob (24).

(c) Disconnect the solenoid wires at the snap connectors (25).

(d) Disconnect the speedometer drive cable (26).

(e) Disconnect the clutch slave cylinder (27) from the clutch housing.

Jack up the rear engine mounting (28) and remove the four setscrews, spring washer and oval washers.

Lower the jack slowly to relieve the tension on the mounting spring.

Remove the mounting and spring ensuring that the four packing pieces between the mounting and body are not mislaid.

Unscrew the mounting pin and remove the upper spring seat (29).

Remove the four propeller shaft securing nuts and disconnect the universal joint (30).

Support the engine on lifting tackle by means of the engine lifting straps.

Remove the two front engine mounting bolts (31).

Remove the nut and washer from the stabiliser between the rear of the cylinder head and the bulkhead (32).

Lower the rear of the engine on the lifting tackle, support on the jack and withdraw forwards.

ENSURE THAT THE CAMSHAFT OIL FEED PIPE AND THE IGNITION TIMING POINTER ARE NOT DAMAGED.

REFITTING

Refitting is the reverse of the removal procedure

but it is important to adjust the engine stabiliser (see page B.71).

Note that the cables from the revolution counter generator may be replaced on either terminal.

ENGINE TO DISMANTLE

GENERAL

The following instructions apply when the engine components are removed in the following sequence with the engine unit out of the chassis. Dismantling of sub-assemblies and the removal of individual components when the engine is in the chassis frame are dealt with separately in this section.

All references made in this section to the top or bottom of the engine to be in the normal upright position. References to the left- or right-hand side assume the engine to be upright and looking from the rear.

REMOVAL OF FAN AND STEERING PUMP BELT

Slacken the link between the steering pump and water pump, press the jockey pulley in towards the engine and remove the belt.

REMOVAL OF ALTERNATOR DRIVE BELT

Slacken the top mounting bolt and remove the bottom mounting nut. Swing the alternator inwards and remove the belt.

Refitting

Refitting is the reverse of the removal procedure. DO NOT use a tool to lever the belts on or off as this may break the endless cords in the belt.

REMOVE STARTER

Remove the two set pins and spring washers securing the starter to the clutch housing and remove the starter motor.

REMOVE ALTERNATOR

Remove top mounting bolt (A, Fig. 7) and bottom mounting nut (B, Fig. 7). Remove alternator and mounting strap.

REMOVE GEARBOX

Unscrew the four setscrews and remove the cover plate from the front face of the clutch housing.

Remove the set bolts and nuts securing the clutch housing to the engine and withdraw the gearbox unit.

REMOVE DISTRIBUTOR

Slacken back the clips and remove the cover complete with high tension leads. Disconnect the white/black cable from the distributor. Slacken the clamp plate bolt and withdraw the distributor. Remove the setscrew and clamp plate. Note the cork seat in the recess at the top of the distributor drive hole.

REMOVE CYLINDER HEAD

Disconnect the distributor vacuum feed pipe trom the front carburetter. Remove the high fension leads from the sparking plugs and lead carrier from the cylinder head studs. Remove the bolt securing the high tension lead clip to the timing cover. Remove the sparking plugs. Disconnect the camshaft oil feed pipe from the rear of the cylinder head. Remove the eleven dome nuts from each camshaft cover and lift off the covers.

Remove the four dome nuts securing the breather housing and withdraw the housing and gauze baffle. Release the tension on the camshaft chain by slackening the nut on the eccentric idler sprocket shaft, depressing the spring-loaded stop peg and rotating serrated adjuster plate clockwise. Anti-clockwise rotation of the serrated adjuster viewed from the front of the engine tightens the chain.

Break the locking wire on the two setscrews securing the camshaft to their respective camshafts.

Remove the setscrews and withdraw the sprockets from the camshafts with the chain in position. Having once disconnected the camshaft sprockets do NOT rotate the engine or camshafts.

Slacken the fourteen cylinder head dome nuts and six nuts securing the front of the cylinder head a part of a turn at a time in the order shown until the nuts become free. Lift off the cylinder head complete with exhaust manifold and inlet manifold. Remove and scrap the cylinder head gasket.

REMOVE CLUTCH AND FLYWHEEL

Unscrew the six setscrews securing the flange of the clutch cover to the flywheel and remove the clutch assembly. Note the balance marks "B" stamped on the clutch cover and on the edge of the flywheel.

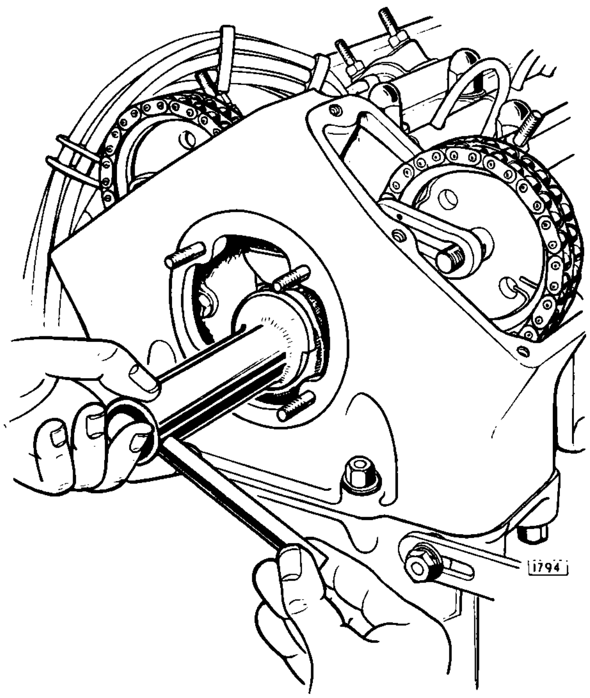


Fig. 12. Adjusting the top timing chain using Churchill Tool Number J.2.

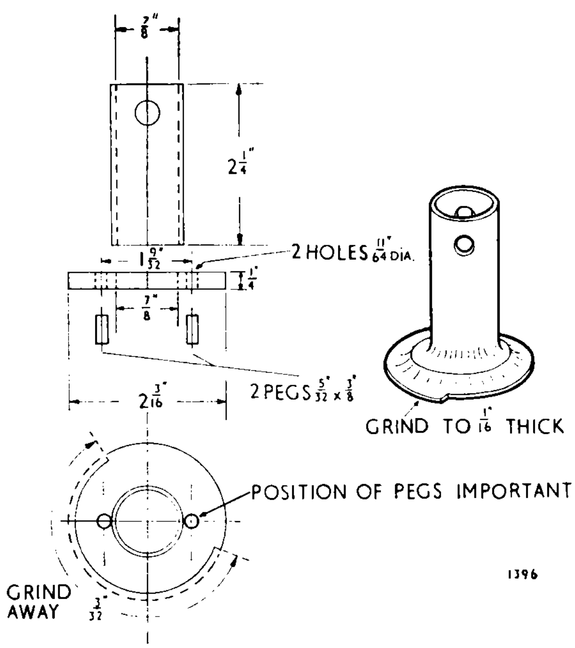


Fig. 13. The top timing chain adjusting tool (Churchill Tool No. J.2.)

Knock back the tabs of the locking plate securing the ten flywheel bolts. Unscrew the flywheel bolts and remove the locking plate. Remove the flywheel from the crankshaft flange by gently tapping with a rawhide mallet.

REMOVE CRANKSHAFT DAMPER

Knock back the tab washer, unscrew the large centre bolt (43, Fig. 30).

Remove the four set pins, shakeproof washers and the plain washer.

Remove the crankshaft pulley and insert two levers behind the damper and ease it off the split cone—a sharp tap on the end of the cone will assist removal.

REMOVE POWER STEERING PUMP

Remove the power steering and water pump belt.

Disconnect the low pressure and high pressure pipes from the rear of the steering pump. Plug pipes to avoid loss of oil.

Disconnect the adjusting link from the oil pump.

Remove the two nuts securing the oil pump to the mounting bracket.

REMOVE WATER PUMP

Unscrew the bolts and three nuts, and remove the water pump from the timing cover. Note the gasket between the pump and timing cover.

REMOVE OIL FILTER

Detach the short length of flexible pipe between the oil filter head and the oil sump.

Unscrew the five bolts with plain and copper washers securing the oil filter head to the cylinder block and remove the filter head.

REMOVE SUMP

Drain the sump by removing the hexagon plug and washer from the right-hand side of the sump.

Remove the 26 setscrews securing the sump to the crankcase and the four nuts securing the sump to the timing cover. The sump can now be removed.

REMOVE OIL PUMP AND PIPES

Tap back the tab washers and unscrew the two bolts securing the oil feed pipe from the oil pump to the bottom face of the crankcase. Withdraw the pipe from the pump.

Remove the nut and bolt securing the oil pump inlet pipe clip to the bracket on the main bearing cap.

Remove the nut and bolt secur ng the oil pump inlet pipe clip in the bracket on the oil pump.

Withdraw the pipe from the pump.

Tap back the tab washers and unscrew the three bolts securing the oil pump to the front main bearing cap. The oil pump can now be withdrawn.

Remove the coupling shaft from the squared end of the distributor and oil pump drive shaft.

REMOVE PISTONS AND CONNECTING RODS

As the pistons will not pass the crankshaft it will be necessary to withdraw the pistons and connecting rods from the top.

Remove the split pins from the connecting rod bolt nuts and unscrew the nuts. Remove the connecting rod cap, noting that the corresponding cylinder numbers on the connecting rod and cap are together.

Withdraw the piston and connecting rod from the top of the cylinder block.

Note: Split skirt pistons MUST be fitted with the split opposite to the thrust side, that is, with the split on the left-hand or exhaust side of the engine. To facilitate correct fitting the pistons crowns are marked "Front."

REMOVE TIMING COVER

Remove the two bolts securing the jockey pulley to the timing cover. Remove the remaining bolts securing the timing cover to the front face of the cylinder block. Remove the tim'ng cover, noting that the cover is located to the cylinder block by two dowels.

REMOVE TIMING GEAR ASSEMBLY

When removing the bottom timing chain tensioner from the engine, remove the hexagon head plug and tab washer from the end of the body. Insert an Allen key into the hole until it registers in the end of the restraint cylinder. Turn the Allen key clockwise until the restraint cylinder can be felt to be fully retracted within the body. The adjuster head will then be free of the chain.

Knock back the tab washers on the two set bolts securing the chain tensioner to the cylinder block.

Withdraw the bolts and remove the tensioner together with the conical gauze filter fitted in the tensioner oil feed hole in the cylinder block; this should be cleaned in petrol.

Unscrew the four set bolts securing the front mounting bracket to the cylinder block. Release the tabs of the tab washers and remove the two screw-driver slotted setscrews from the rear mounting bracket; these setscrews a so secure the intermediate timing chain damper bracket.

The timing gear can now be removed.

REMOVE DISTRIBUTOR DRIVE GEAR

Tap back the tab washer securing the distributor drive gear nut and remove the nut and washer. Tap the squared end of the distributor drive shaft through the gear, noting that the gear is keyed to the shaft.

Remove the gear and thrust washer and withdraw the drive shaft.

REMOVE CRANKSHAFT

Knock back the tab washers securing the 14 main bearing cap bolts. Unscrew the bolts and remove the main bearing caps, noting the corresponding numbers stamped on the caps and bottom face of crankcase and also the thrust washers fitted to the recesses in the centre main bearing caps.

Detach the bottom half of the crankshaft rear oil seal by unscrewing the two Allen screws. Note that the two halves are located by hollow dowels. The crankshaft may now be lifted out of the crankcase. When overhauling an engine it is advisable to replace the asbestos oil seal at the rear of the crankshaft (see Page B.36).

FIT PISTONS AND CONNECTING RODS

Turn the engine on its side. Remove the connecting rod caps and fit the pistons and connecting rods to their respective bores from the top of the cylinder block, using a suitable piston ring compressor, Tool No. 38U3. The cylinder number is stamped on the connecting rod and cap, No. 1 cylinder being at the rear.

Note: Semi-split skirt pistons MUST be fitted with the split opposite the thrust side, that is, with the split on the left-hand or exhaust side of the engine. To facilitate correct fitting, the piston crowns are marked "Front."

Fit the connecting rod caps to the connecting rods with the corresponding numbers together. Fit the castellated nuts and tighten to a torque of 37 lb. ft. (5.1 kgm.). Secure the nuts with split pins.

FIT CRANKSHAFT GEAR AND SPROCKET

Fit the Woodruff key to the inner slot and tap the distributor crankshaft gear into position with the widest part of the boss to the rear (see Fig. 29).

Fit the Woodruff key to the outer slot and tap the crankshaft timing gear sprocket into position. Fit the oil thrower and distance piece.

Turn the engine until Nos. 1 and 6 pistons are on T.D.C.

FIT DISTRIBUTOR AND OIL PUMP DRIVE GEAR

Ensure that the Woodruff key on the distributor drive shaft is in good condition and renew if necessary.

Place the drive shaft into position with the offset slot in the top of the shaft as shown in Fig. 14.

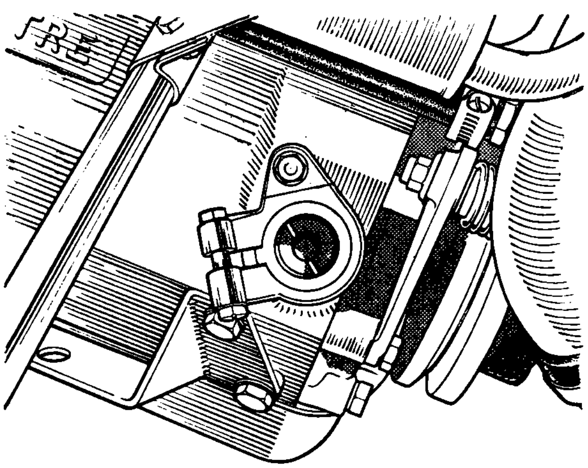


Fig. 14. Showing the position of the distributor drive shaft offset when Number 6 (front) piston is on Top Dead Centre.

Withdraw the shaft slightly maintaining the same slot position and place the thrust washer and drive gear on the end of the shaft. Press the shaft into the drive gear ensuring that the key engages the keyway correctly.

Fit the pegged tab washer with the peg in the keyway of the drive gear.

Fully tighten the nut and secure with the tab washer. Check the end float of the shaft which should be 0·004–0·006" (0·10–0·15 mm.).

If no clearance exists fit a new oil pump/distributor drive gear which will restore the clearance. In an emergency if a new drive gear is not available, the thrust washer may be reduced in thickness by rubbing down on a piece of emery cloth placed on a surface plate.

ENGINE TO ASSEMBLE

GENERAL

All references in this section to the top or bottom of the engine assume the engine to be upright, irrespective of the position of the unit when the reference is made. References to the left- or right-hand side assume the engine to be upright and looking from the rear.

FIT DISTRIBUTOR DRIVE SHAFT BUSH

If a new bush is to be fitted, press the bush into the bore of the lug at front of cylinder block.

Ream the bush in position to a diameter of:

$\frac{3}{4}''$ $+0{\cdot}00050''$ $-0{\cdot}00025''$ (19·05 mm. $+0{\cdot}012$ mm.) ($-0{\cdot}006$ mm.)

FIT CRANKSHAFT

Fit the main bearing shells to the top half of the main line bore in the cylinder block. Lay the crankshaft in the bearing shells. Fit the bottom half of the crankshaft rear oil seal to the top half which is bolted to the cylinder block behind the rear main bearing. The two halves are located by hollow dowels and secured with Allen screws. If the asbestos seal has been replaced, ensure that it has been well lubricated with colloidal graphite before fitting the crankshaft and lower half of the seal. The two halves of the oil seal housing are supplied only as an assembly together with the dowels and screws.

If the crankshaft rear asbestos seal has been replaced, ensure that the seal has been correctly sized and lubricated as detailed on Page 37 before fitting the crankshaft.

Fit the centre main bearing cap with a thrust washer, white metal side outward, to the recess in each side of cap. Tighten down the cap and check the crankshaft end float, which should be 0·004–0·006" (0·10–0·15 mm.). The thrust washers are supplied in two thicknesses, standard and 0·004" (0·10 mm.) oversize and should be selected to bring the end float within permissible limits. The oversize thrust washers are stamped +0·004" (0·10 mm.) on the steel face.

Fit the main bearing caps with the numbers stamped on the caps with the corresponding numbers stamped on the bottom face of the crankcase.

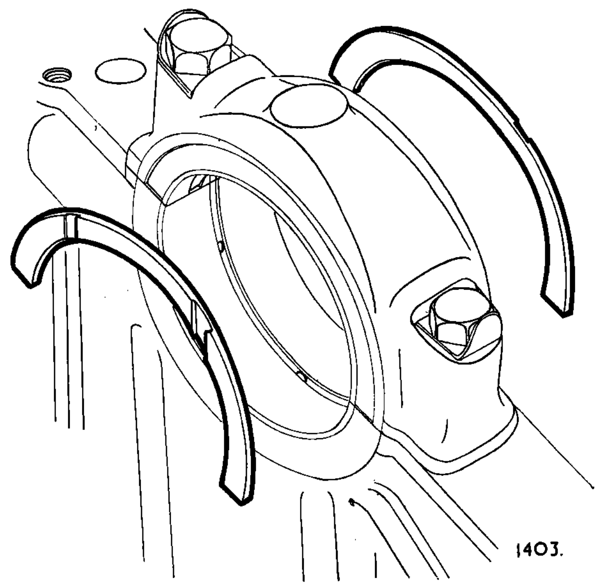


Fig. 15. The crankshaft thrust washers.

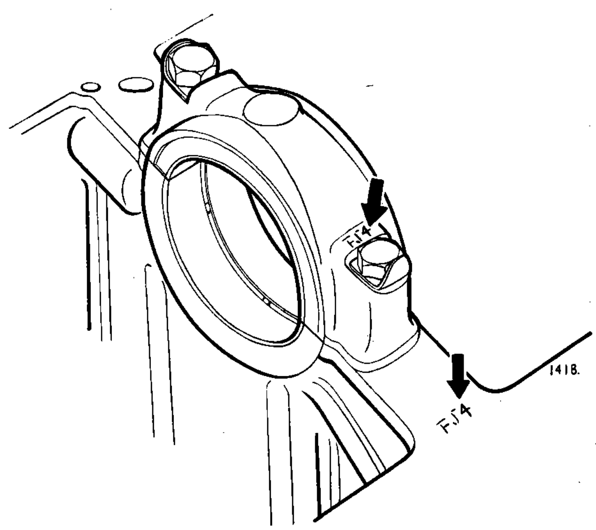


Fig. 16. Showing the corresponding numbers on the main bearing cap and the crankcase.

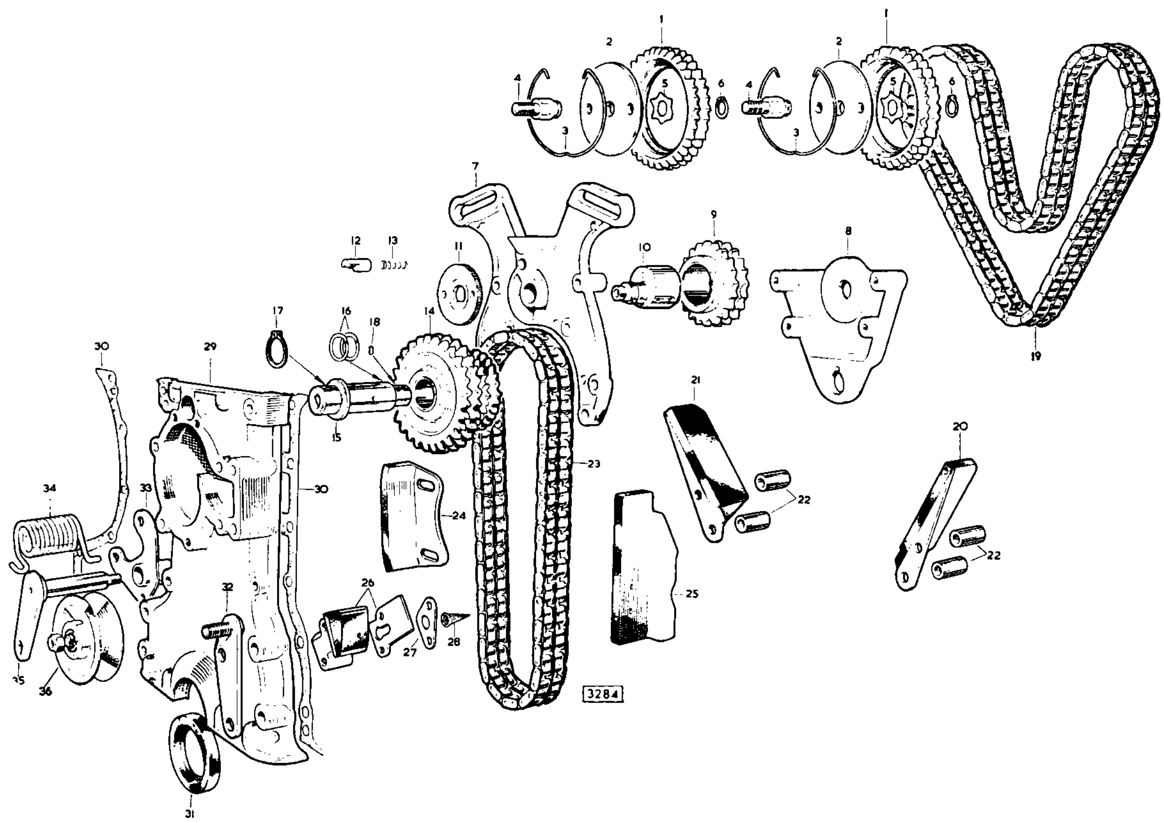


Fig. 17. Exploded view of the timing gear.

1. Camshaft sprockets
2. Adjusting plate
3. Circlip
4. Guide pin
5. Star washer
6. Circlip
7. Front bracket
8. Rear bracket
9. Idler sprocket (21 teeth)
10. Eccentric shaft
11. Micro adjustment plate
12. Plunger pin
13. Spring
14. Intermediate sprocket
15. Shaft
16. Shims
17. Circlip
18. Peg
19. Upper timing chain
20. Left-hand damper
21. Right-hand damper
22. Distance piece
23. Lower timing chain
24. Intermediate damper
25. Vibration damper
26. Hydraulic tensioner
27. Shim
28. Filter gauze
29. Front timing cover
30. Gasket
31. Oil seal
32. Adjusting bracket
33. Fan belt tensioner bracket
34. Torsion spring
35. Jockey pulley carrier
36. Jockey pulley

Fit the main bearing cap bolts and tab washers and tighten to a torque of 83 lb.ft. (11.5 kg.m.).

Test the crankshaft for free rotation.

The tab washers for the rear main bearing bolts are longer than the remainder and the plain ends should be tapped down around the bolt hole bosses.

FIT OIL PUMP AND PIPES

Fit the coupling shaft between the squared end of the distributor drive shaft and the driving gear of the oil pump. Secure the oil pump to the front main bearing cap by the three dowel bolts and tab washers. Check that there is appreciable end-float of the short coupling shaft. Fit the oil delivery pipe from the oil pump to the bottom face of the crankcase with a new "O" ring and gasket. Fit the suction pipe with a new "O" ring at the oil pump end.

TO ASSEMBLE TIMING GEAR (Fig. 17)

Fit the eccentric shaft (10) to the hole in the front mounting bracket (7). Insert the spring (13) and plunger pin (12) for the adjustment plate (11) to the hole in the front mounting bracket (7). Fit the serrated plate (11) and secure with shakeproof washer and nut. Fit idler sprocket (9) to the eccentric shaft (10).

Fit the intermediate sprocket (14) to the shaft (15) with the larger sprocket forward and press the shaft through the lower central hole in the rear mounting bracket (8). Secure with key (18) at the rear of the bracket.

Fit chain (19) to the small intermediate sprocket and chain (23) to the large intermediate sprocket.

Loop upper timing chain under the idler sprocket and offer up the front mounting bracket to the rear mounting bracket with the two chain dampers interposed between the brackets.

Pass the four securing bolts through the holes in the brackets, chain dampers and spacers noting that shakeproof washers are fitted under the bolt heads. Secure the two mounting brackets with four stud nuts and shakeproof washers.

FIT TIMING GEAR

Turn the engine upside down. Fit the lower timing chain damper (26) and bracket to the front face of the cylinder block with two set bolts and locking plate.

Turn the timing gear assembly upside down and offer it up to the cylinder block. Loop chain (23) over the crankshaft sprocket and secure the mounting brackets to the front face of the cylinder block with the four long securing bolts.

TIMING CHAIN TENSIONER

Place the timing chain tensioner, backing plate and filter in position so that the spigot on the tensioner aligns with the hole in the cylinder block. Fit shims as necessary, between the backing plate and cylinder block so that the timing chain runs centrally along the rubber slipper. Fit the tab washer and two securing bolts. Tighten the bolts and tap the tab washers against the bolt heads.

It is important that no attempt is made to release the locking mechanism until the adjuster has been finally mounted in the engine WITH THE TIMING CHAIN IN POSITION.

Remove the hexagon headed plug and tab washer from the end of the body. Insert the Allen key into the hole until it registers in the end of the restraint cylinder. Turn the key clockwise until the tensioner head moves forward under spring pressure against the chain. Do not attempt to turn the key anti-clockwise, nor force the tensioner head into the chain by external pressure.

Refit the plug and secure with the tab washer.

FIT TIMING COVER

Fit the circular oil seal to the recess in the bottom face of timing cover, ensuring that seal is well bedded in its groove.

Fit the timing cover gasket with good quality jointing compound and secure the timing cover to the front face of the timing cover with the securing bolts noting that the jockey pulley is attached to the right-hand side of the timing cover by two of the securing bolts.

FIT OIL SUMP

Fit a new sump gasket to the bottom face of the crankcase. Fit the cork seal to the recess in the rear main bearing cap.

Fit the sump to the crankcase and secure with the 26 setscrews, four nuts and washers.

Note: The short setscrew must be fitted to the right-hand front corner of the sump.

FIT FLYWHEEL AND CLUTCH

Turn the engine upright.

Check that the crankshaft flange and the holes for the flywheel bolts and dowels are free from burrs.

Turn the engine until Nos. 1 and 6 pistons are on T.D.C. and fit the flywheel to the crankshaft flange so that the "B" stamped on the edge of the flywheel is at approximately the B.D.C. position. (This will ensure that the balance mark "B" on the flywheel is in line with the balance mark on the crankshaft which is a group of letters stamped on the crank throw just forward of the rear main journal).

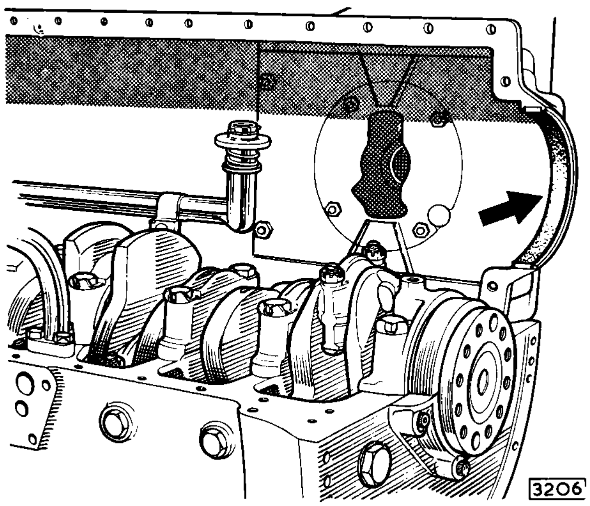


Fig. 18. Fitting the sump rear oil seal.

Tap the two mushroom-headed dowels into position, fit the locking plate and flywheel securing setscrews. Tighten the setscrews to a torque of 67 lb.ft. (9.2 kg.m.) and secure with the locking plate tabs. Assemble the clutch driven plate to the flywheel, ensuring that the larger part of the splined hub faces the gearbox. Centralise the driven plate by means of a dummy shaft which fits the splined bore of the driven plate and the spigot bush in the crankshaft. (A constant pinion shaft may be used for this purpose). Fit the clutch cover assembly so that the "B" stamped adjacent to one of the dowel holes coincides with the "B" stamped on the periphery of the flywheel. Secure the clutch assembly with the six setscrews and spring washers, tightening the screws a turn at a time by diagonal selection. Remove the dummy shaft.

FIT CYLINDER HEAD

Before refitting the cylinder head it is important to observe that if the camshafts are out of phase with piston position fouling may take place between the valves and pistons. It is, therefore, essential to adhere to the following procedure before fitting the cylinder head:

Check that the grooves in the front flanges of the camshafts are vertical to the camshaft housing face and accurately position by engaging the valve timing gauge. If it is found necessary to rotate one of the camshafts the other camshaft must either be removed or the bearing cap nuts slackened to their fullest extent to allow the valves to be released.

Turn No. 6 (front) piston to the top dead centre position with the widest portion of the distributor drive shaft offset positioned as shown in Fig. 14.

Do NOT rotate the engine or camshafts until the camshaft sprockets have been connected to the camshafts. Fit the two camshaft sprockets complete with adjuster plates and circlips to the top timing chain and enter the guide pins in the slots in the front mounting bracket.

Fit the cylinder head gasket, taking care that the side marked "Top" is uppermost. Fit the cylinder head complete with manifolds to the cylinder block. Note that the second cylinder head stud from the front on the left-hand side is a dowel stud.

Fit the sparking plug lead carrier to the 3rd and 6th stud on the right-hand side. Fit plain washers to these and the two front stud positions and "D" washers to the remaining studs. Tighten the 14 large cylinder head dome nuts a part of a turn at a time to a torque of 54 lb.ft. (7.5 kg.m.) in the order shown in Fig. 19. Also tighten the six nuts securing the front end of the cylinder head.

VALVE TIMING

Check that the No. 6 (front) piston is exactly in the T.D.C. position.

Through the breather aperture in the front of the cylinder head slacken the lock nut securing the serrated plate.

With the camshaft sprocket on the flanges of the camshafts, tension chain by pressing locking plunger inwards and rotating serrated plate by the two holes in an anti-clockwise direction.

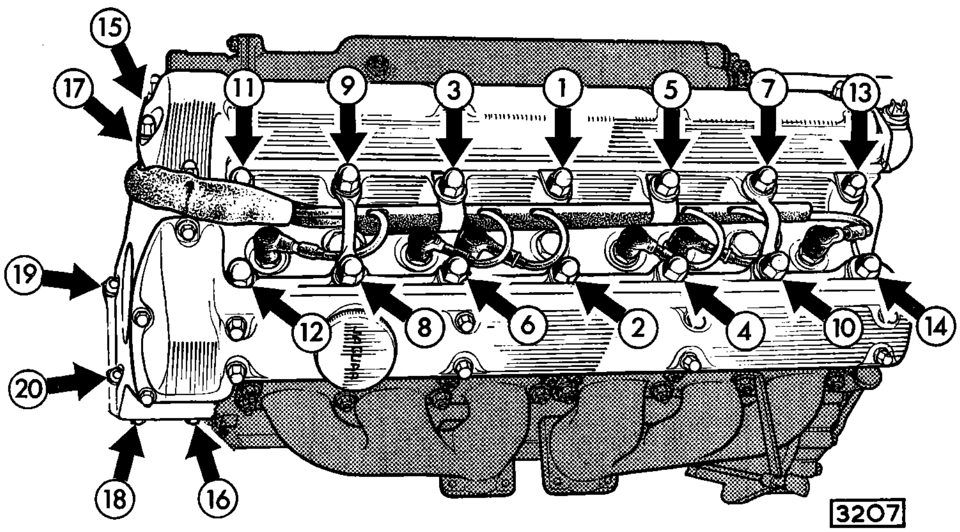


Fig. 19. Tightening sequence for the cylinder head nuts.

When correctly tensioned there should be slight flexibility on both outer sides of the chain below the camshaft sprockets, that is the chain must not be dead tight. Release the locking plunger and securely tighten the locknut. Tap the camshaft sprockets off the flanges of the camshafts.

Accurately position the camshaft with the valve timing gauge, and check that the T.D.C. marks are in exact alignment.

Withdraw the circlips retaining the adjusting plates to the camshaft sprockets and pull the adjusting plates forward until the serrations disengage. Replace the sprockets on to the flanges of camshafts and align the two holes in the adjuster plate with the two tapped holes in each camshaft flange. Engage the serrations of the adjuster plates with the serrations in the sprockets.

Note: It is most important that the holes are in exact alignment, otherwise when the set-screws are fitted the camshafts will be moved out of position. If difficulty is experienced in aligning the holes exactly, the adjuster plates should be turned through 180° which, due to the construction of the plate, will facilitate alignment.

Fit the circlips to the sprockets and one setscrew to the accessible hole in each adjuster plate. Turn the engine until the other two holes are accessible and fit the two remaining setscrews.

Finally, recheck the timing chain tension and timing in this order. Secure the four setscrews retaining the camshaft sprockets with new lock wire.

FIT CYLINDER HEAD OIL FEED PIPE AND OIL FILTER

Fit the cylinder head oil feed pipe from the tapped hole in the main oil gallery to the two tapped holes in the rear of the cylinder head. Secure the pipe with the three banjo bolts with a copper washer fitted to both sides of each banjo.

Fit the oil filter head to the cylinder block with the five bolts and copper washers. New gasket(s) must always be fitted between the filter and cylinder block.

Fit the short length of flexible hose between the oil filter head and the oil sump and tighten two hose clips.

FIT CRANKSHAFT DAMPER AND PULLEY

Fit a Woodruff key to the crankshaft and the split cone. Fit the split cone to the crankshaft with the widest end towards the timing cover. Fit the damper and pulley to the cone and secure with the flat washer (chamfered side outwards), and large bolt secured with tab washer.

FIT WATER PUMP

Fit the water pump to the timing cover with a new gasket and secure with six bolts, three nuts and spring washers. Note that the steering pump link is attached to the water pump by one of the securing bolts.

FIT STEERING PUMP

Fit the steering pump to the mounting bracket.

Attach the adjusting link to the steering pump.

Connect the low and high pressure pipes to the rear of the steering pump.

Fit the drive belt.

FIT ALTERNATOR

Fit the two bolts securing the alternator to the mounting bracket and adjuster link.

Replace the alternator drive belt by pushing the spring loaded jockey pulley inwards and lifting the belt over the alternator pulley.

Attach the cables to the three terminals on the slip ring end cover.

Note: A fourth terminal is located on the slip ring end cover. This terminal is not used and no cables must be connected to it when refitting the alternator.

FIT DISTRIBUTOR AND SPARKING PLUGS

Fit the cork seal to the recess at the top of the hole for the distributor. Secure the distributor clamping plate to the cylinder block with the set-screw. Slacken the clamping plate bolt.

Set the micrometer adjustment in the centre of the scale.

Enter the distributor into the cylinder block with the vacuum advance unit connection facing the cylinder block.

Rotate the rotor-arm until the driving dog engages with the distributor drive shaft.

Rotate the engine until the rotor-arm approaches the No. 6 (front) cylinder segment in the distributor cap (Fig. 14).

Slowly rotate the engine until the ignition timing scale on the crankshaft damper is the appropriate number of degrees before the pointer on the sump.

Slowly rotate the distributor body until the points are just breaking.

Tighten the distributor plate pinch bolt.

A maximum of six clicks on the vernier adjustment from this setting, to either advance or retard, is allowed.

Fit the vacuum advance pipe from the distributor to the union on the front carburetter.

Fit the distributor cover and secure with the two spring clips. Fit the sparking plugs with new washers and attach the high tension leads.

HIGH TENSION LEAD RENEWAL

If it is necessary to renew the high tension leads the following procedure should be followed:

Remove the plug terminals and withdraw the leads from the conduit.

Remove the distributor cap terminals and the five spacing washers.

Cut the new high tension leads to suitable length.

Fit the leads to the conduit. No. 1 lead emerges from the rear of the conduit and the other leads from holes along the conduit.

Fit the plug terminals.

Fit the two thick fibre washers, arranging the leads in the firing order (1, 5, 3, 6, 2, 4) in an anti-clockwise order, as the leads will enter the distributor cap.

Fit the three thin fibre spacers and place them equally along the leads.

Fit the distributor cap terminals.

FIT CAMSHAFT COVERS

Fit each camshaft cover to the cylinder head using a new gasket. Fit the eleven copper washers and dome nuts to the cover retaining studs but do not tighten fully.

Fit the revolution counter generator and flanged plug to the rear of right-hand and left-hand camshaft covers respectively with the rubber sealing rings seated in the recesses provided. Secure the generator and sealing plug with the setscrews and copper washers. Tighten fully the dome nuts securing the camshaft covers.

FIT STARTER

Fit the starter motor to the clutch housing and secure with the horseshoe bracket, two nuts and spring washers.

FIT GEARBOX

Fit the gearbox and clutch housing to the rear of the crankcase with the setscrews and shakeproof washers.

Fit the support brackets to each side, at the bottom face of the crankcase with two bolts, nuts and spring washers, and to the clutch housing with three bolts, nuts and shakeproof washers.

DECARBONISING AND GRINDING VALVES

REMOVE CYLINDER HEAD

Remove the cylinder head as described on page B.20.

REMOVE VALVES

With the cylinder head on the bench remove the inlet manifold, and the revolution counter generator.

Remove the four bearing caps from each camshaft and lift out the camshaft (note mating marks on each bearing cap).

Remove the twelve tappets, and the adjusting pads situated between tappets and valve stems. Lay out the tappets and pads in order, to ensure that they can be replaced in their original guides.

Obtain a block of wood the approximate size of the combustion chambers and place this under the valve heads in No. 1 cylinder combustion chamber. Press down the valve collars and extract the split cotters. Remove the collars, valve springs and spring seats. Repeat for the remaining five cylinders. Valves are numbered and must be replaced in their original locations, No. 1 cylinder being at the rear, that is the flywheel end.

DECARBONISE AND GRIND VALVES

Remove all traces of carbon deposits from the combustion chambers and the induction and exhaust ports. The cylinder head is of aluminium alloy and great care should be exercised not to damage this with scrapers or sharp pointed tools. Use worn emery cloth and paraffin only. Thoroughly clean the water passages in the cylinder head. Clean the carbon deposits from the piston crowns and ensure that the top face of the cylinder block is quite clean particularly round the cylinder head studs. Remove any pitting in the valve seats, using valve seat grinding equipment. Reface the valves if necessary using valve grinding equipment: grind valves to the seats, using a suction valve grinding tool.

Clean the sparking plugs and set gaps; if possible use approved plug cleaning and testing equipment. Clean and adjust the distributor contact breaker points.

VALVE CLEARANCE ADJUSTMENT

Thoroughly clean all traces of valve grinding compoind from the cylinder head and valve gear.

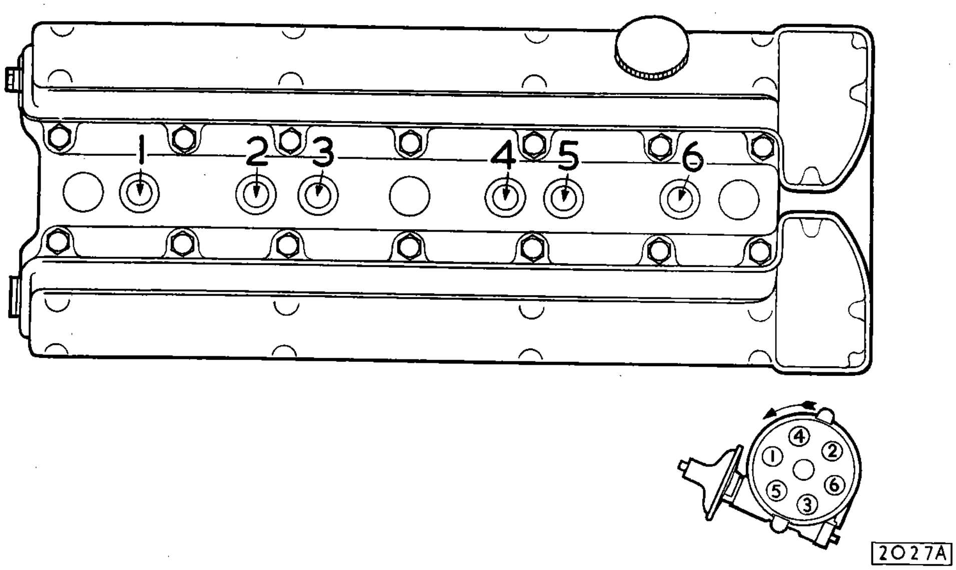


Fig. 20. View of engine from above showing the firing order and cylinder numbers.

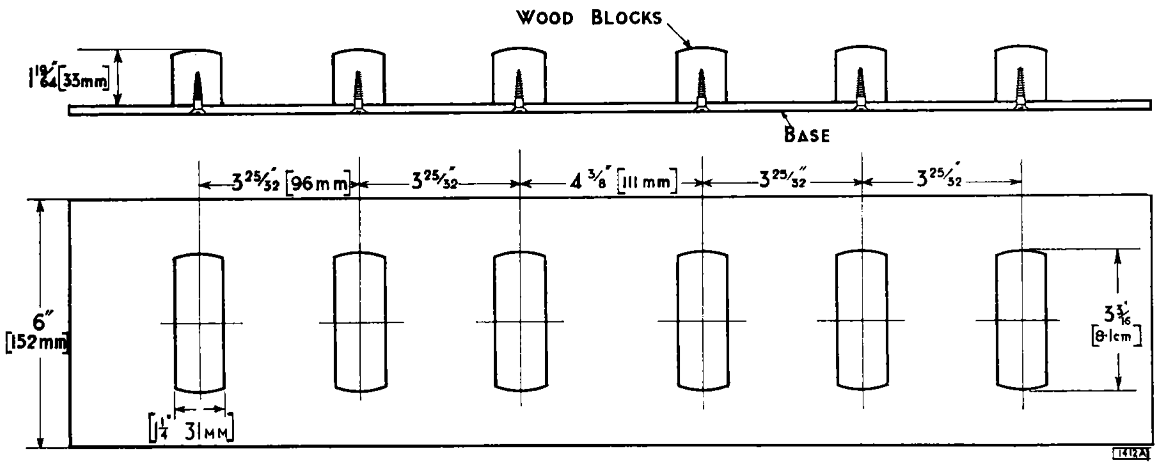


Fig. 21. Combustion chamber blocks for valve removal.

Assemble the valves to the cylinder head. **When checking the valve clearances the camshafts must be fitted one at a time. If one camshaft is rotated when the other camshaft is in position, fouling is likely to take place between the inlet and exhaust valves. Obtain and record all valve clearances by using a feeler gauge between the back of each cam and the appropriate valve tappet.**

Correct valve clearances are:

Normal Touring Use

Inlet	0·004″ (0·10 mm.)
Exhaust	0·006″ (0·15 mm.)

Adjusting pads are available rising in 0·001″ (0·03 mm.) sizes from 0·085–0·110″ (2·16–2·79 mm.) and are etched on the surface with the letter "A" to "Z," each letter indicating an increase in size of 0·001″ (0·03 mm.). Should any valve clearance require correction, remove the camshaft, tappet and adjusting pad. Observe the letter etched on the existing adjustment pad if visible. If the letter is not visible measure the pad with a micrometer, and should the recorded clearance for this valve have shown say 0·002″ (0·05 mm.) excessive clearance, select a new adjusting pad bearing a letter two lower than the original pad.

As an example, assume that No. 1 inlet valve clearance is tested and recorded as 0·007″ (0·18 mm). On removal of the adjusting pad, if this is etched with the letter "D" then substitution with a pad bearing the letter "G" will correct the clearance for No. 1 inlet valve.

When fitting the camshafts prior to fitting the cylinder head to the engine it is most important that the keyway in the front bearing flange of each camshaft is perpendicular (at 90°) to the adjacent camshaft cover face (using valve timing gauge) before tightening down the camshaft bearing cap nuts.

Tighten the camshaft bearing cap nuts to a torque of 15 lb.ft. (2·0 kg.m.).

REFIT CYLINDER HEAD

Before attempting to refit the cylinder head refer to the instructions given on page B27.

Remove all oil and grease from both mating surfaces by means of a cloth wetted with trichlorethylene, petrol or other volatile grease solvent, wiping dry with a clean cloth.

Apply Wellseal with a soft brush. One coat on each mating surface should suffice.

COMPRESSION PRESSURES

The compression pressures for all the six cylinders should be even and should approximate to the figures given below.

If one or more compressions are weak it will most probably be due to poor valve seatings when the cylinder head must be removed and the valves and valve seats refaced and reground.

COMPRESSION PRESSURES

7:1 compression ratio	150 lb./sq. in. (10·55 kg./sq. cm.)
8:1 compression ratio	170 lb./sq. in. (11·95 kg./sq. cm.)
9:1 compression ratio	175 lb./sq. in. (12·30 kg./sq. cm.)

Pressures must be taken with all the sparking plugs removed, carburetter throttles wide open and the engine at its normal operating temperature (70°C. approximately).

Note: When taking compression pressures ensure that the ignition switch is "off"; rotate the engine by operating the push button on the starter solenoid. On cars fitted with automatic transmission it will be necessary to remove the rubber cap and the brass cover from the solenoid switch before the manual button can be operated. It is *important* that the cover and cap are replaced when all pressures have been checked.

THE CONNECTING ROD AND BEARINGS

The connecting rods are steel stampings and are provided with precision shell big-end bearings and steel backed phosphor-bronze small end bushes. A longitudinal drilling through the connecting rod provides an oil feed from the big end to the small end bush.

REMOVAL

As the pistons will not pass the crankshaft it will be necessary to withdraw the pistons and connecting rods from the top.

Proceed as follows:

Remove Cylinder Head

Remove the cylinder head as described on page B.20.

Remove Sump

Remove the sump as described on page B.53.

Remove Piston and Connecting Rod

Remove the split pins from the connecting rod bolt nuts and unscrew the nuts. Remove the connecting rod cap, noting that the corresponding cylinder numbers on the connecting rod and cap are on the same side. Remove the connecting rod bolts and withdraw the piston and connecting rod from the top of the cylinder block.

OVERHAUL

If connecting rods have been in use for a very high mileage, or if bearing failure has been experienced, it is desirable to renew the rod(s) owing to the possibility of fatigue.

The connecting rods fitted to an engine should not vary one with another by more than 2 drams (3·5 grammes). The alignment should be checked on an approved connecting rod alignment jig. Correct any misalignment as necessary. The big end bearings are of the precision shell type and under no circumstances should they be hand scraped or the bearing caps filed.

The small ends are fitted with steel-backed phosphor-bronze bushes which are a press fit in the connecting rod. After fitting, the bush should be reamed or honed to a diameter of 0·875″ to 0·8752″ (22·225–22·23 mm.). Always use new connecting bolts and nuts at overhauls.

When a new connecting rod is fitted, although the small end bush is reamed to the correct dimensions, it may be necessary to hone the bush to achieve the correct gudgeon pin fit.

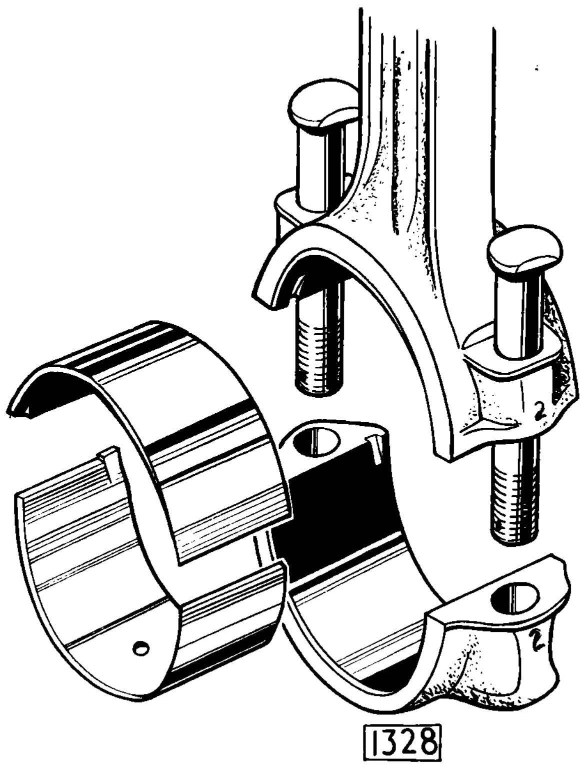


Fig. 22. The connecting rod and cap are stamped with the cylinder number.

REFITTING

Refitting is the reverse of the removal procedure. Pistons and connecting rods must be fitted to their respective cylinders (pistons and connecting rods are stamped with their number, No. 1 being at the rear) and the same way round in the bore.

The pistons must always be fitted with split on the left-hand or exhaust side of the engine. To facilitate correct fitting the piston crowns are marked "Front", see Fig. 45.

The cap must be fitted to the connecting rod so that the cylinder numbers stamped on each part are on the same side.
Tighten the connecting rod nuts to a torque of 37 lb.ft. (5·1 kg.m.).

BIG END BEARING REPLACEMENT

The big-end bearings can be replaced without removing the engine from the car but before fitting the new bearings the crankpin must be examined for damage or for the transfer of bearing metal. The oilway in the crankshaft must also be tested for blockage.

Remove the sump as described on page B.53.

Turn the engine until the big-end is approximately at the bottom dead centre position.

Remove the split pins from the connecting rod bolt nuts and unscrew the nuts. Remove the connecting rod cap, noting that the corresponding cylinder numbers on the connecting rod and cap are on the same side.

Lift the connecting rod off the crankpin and detach the bearing shell.

If all the big-end bearings are to be replaced they are most easily replaced in pairs, that is, in pairs of connecting rods having corresponding crank throws.

THE CAMSHAFTS

The camshafts are manufactured of cast iron and each shaft is supported in four white metal steel backed bearings. End float is taken on the flanges formed at each side of the front bearing. Oil is fed from the main oil gallery to the camshaft rear bearing housings through an external pipe. Oil then passes through the rear bearing into a longitudinal drilling in the camshaft; cross drillings which break into this oilway feed the three remaining bearings.

Warning: Before carrying out any work on the camshafts the following points must be observed to avoid possible fouling between (a) the inlet and exhaust valves and (b) the valves and pistons.

(a) Do NOT rotate the engine or the camshafts with the camshafts sprockets disconnected. If, with the cylinder head removed from the engine, it is required to rotate a camshaft, the other camshaft must either be removed or the bearing cap nuts slackened to their fullest extent to allow the valves to be released.

(b) When fitting the camshafts to the cylinder head ensure that keyway in the front bearing flange of each camshaft is prependicular (at 90°) to the adjacent camshaft cover face (use the valve timing gauge) before tightening down the camshaft bearing cap nuts.

If this operation is being carried out with the cylinder head fitted to the engine, rotate the engine until No. 6 (front) piston is on Top Dead Centre in the firing position, that is with the distributor rotor opposite No. 6 cylinder segment, before fitting the camshafts.

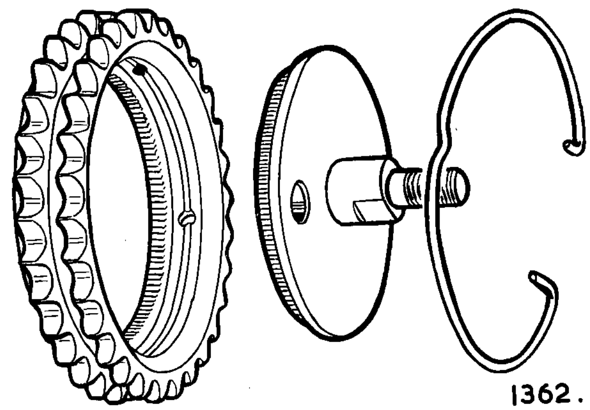


Fig. 23. Exploded view of the camshaft sprocket assembly

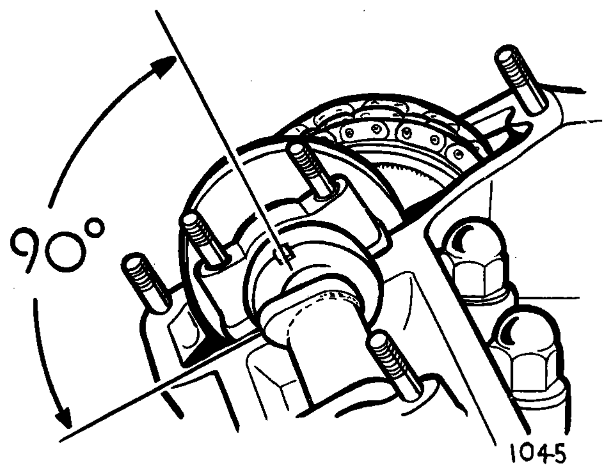


Fig. 24. When fitting a camshaft the keyway must be at 90" to the camshaft cover face.

REMOVAL

Remove the eleven dome nuts and copper washers securing each camshaft cover and lift off the cover.

Unscrew the three Allen setscrews attaching the revolution counter generator to the right-hand side of the cylinder head and the sealing plug from the left-hand side (note the copper washers under the left-hand side (note copper washers under the heads of the setscrews). Remove the circular rubber sealing rings.

Break the wire locking the camshaft adjuster plate setscrews.

Rotate the engine until No. 6 (front) piston is approximately on Top Dead Centre on compression stroke (firing position), that is, when the keyway in the front bearing flange of each camshaft is at 90° to the adjacent cover face (see Fig. 24).

Note the positions of the **inaccessible** adjuster plate setscrews and rotate the engine until they can be removed.

Turn back the engine to the T.D.C. position with No. 6 firing and remove the two remaining setscrews.

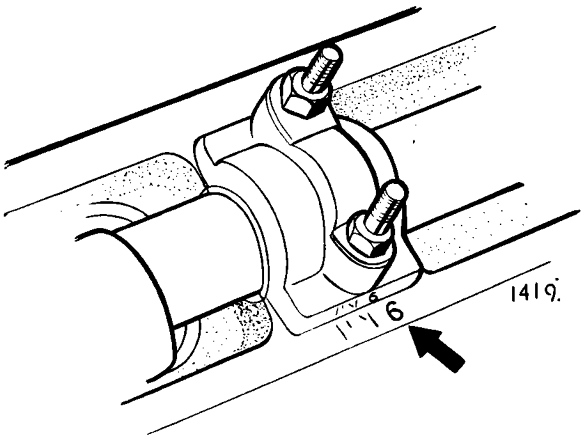


Fig. 25. Showing the corresponding numbers on the bearing cap.

Tap the sprockets off their respective camshaft flanges. Release the eight nuts securing the bearing caps a turn at a time. Remove the nuts, spring washers and "D" washers from the bearing studs.

Remove the bearing caps, noting that the caps and cylinder head are marked with corresponding numbers. Also note that the bearing caps are located to the lower bearing housings with hollow dowels.

If the same bearing shells are to be replaced they should be refitted to their original positions.

The camshaft can now be lifted out from the cylinder head.

REFITTING

Check that No. 6 (front) piston is exactly on T.D.C. on the compression stroke (firing position), that is, with the distributor rotor opposite No. 6 cylinder segment. (Fig. 14).

Replace the shell bearings—in their original positions if the same bearings are being refitted.

Replace each camshaft with the keyways in the front bearing flange at 90° to the adjacent cover face (using the valve timing gauge).

Refit the bearing caps to their respective positions together with the "D" washers, spring washers and nuts.

Tighten down the bearing caps evenly a turn at a time. Finally tighten the nuts to a torque of 15lb.ft. (2 kgm.).

Set the valve timing as described on page B.67.

OVERHAUL

It is unlikely, except after very high mileages, to find wear in the camshafts and camshaft bearings. The camshaft bearings are of the precision shell type and under no circumstances should these be hand scraped or bearing caps filed. Undersize bearings are not supplied.

THE CRANKSHAFT

The counterbalanced crankshaft is of manganese molybdenum steel and is supported in seven precision shell bearings. End thrust of the crankshaft is taken on two semi-circular white metal faced steel thrust washers fitted in recesses in the centre main bearing cap. A torsional vibration damper is fitted at the front end of the crankshaft.

Initially, the crankshaft is itself balanced both statically and dynamically and is then re-balanced as an assembly with the flywheel and clutch unit attached.

REMOVAL

Proceed as detailed under "Engine—To Dismantle" on page B.20.

OVERHAUL

Regrinding of the crankshaft journals is generally recommended when wear or ovality in excess of 0·003″ (0·08 mm.) is found. Factory reconditioned crankshafts are available on an exchange basis, subject to the existing crankshaft being fit for satisfactory reconditioning, with undersize main and big end bearings —0·010″ (0·25 mm.), —0·020″ (0·51 mm.), —0·030″ (0·76 mm.), and —0·040″ (1·02 mm).

Grinding beyond the limits of 0·040″ (1.02 mm.) is not recommended and under such circumstances a new crankshaft should be obtained.

New crankshaft thrust washers should be fitted, these being in two halves located in recesses in the centre main bearing cap. Fit the main bearing cap with a thrust washer, white metal side outwards, to the recess in each side of cap. Tighten down the cap and check the crankshaft end float, which should be 0·004″–0·006″ (0·10–0·15 mm). The thrust washers are supplied in two thicknesses, standard and 0·004″ (0·10 mm.) oversize and should

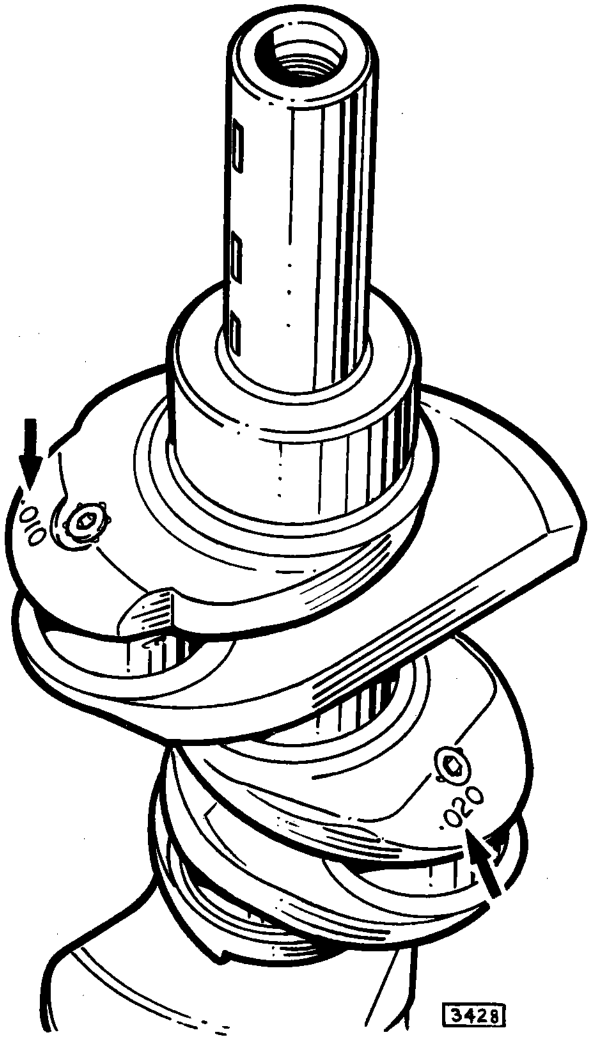


Fig. 26. Identification markings for under-size main and big end bearings.

be selected to bring the end float within the required limits. It is permissible to fit a standard size thrust washer to one side of the main bearing cap and an oversize washer to the other. Oversize thrust washers are stamped 0·004″ (0·10 mm.) on the steel face.

Ensure that the oil passages in the crankshaft are clear and perfectly clean before re-assembling. If the original crankshaft is to be refitted remove the Allen headed plugs in the webs (which are secured by staking) and thoroughly clean out any accumulated sludge with a high pressure jet followed by blowing out with compressed air.

After refitting the plugs, secure by staking with a blunt chisel.

REFITTING

Proceed as detailed under "Engine—To Assemble" on page B.24.

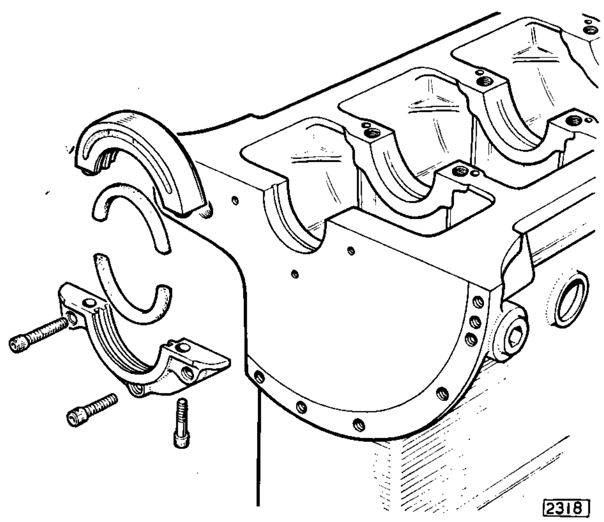


Fig. 27. Exploded view of the crankshaft rear oil seal.

CRANKSHAFT REAR OIL SEAL

DESCRIPTION

The crankshaft rear oil seal consists of a cast iron housing in two halves and an asbestos seal also in two halves, fitted to the housing. The two halves of the housing are located by hollow dowels and secured by Allen screws. The top half of the housing is secured to the cylinder block by three Allen screws and is located by two hollow dowels.

REMOVAL

Having removed the lower half of the oil seal and the crankshaft as described on page B.22 "Crankshaft Removal", remove the three Allen screws securing the upper half of the oil seal noting the hollow locating dowels at the two outer holes.

Prise out the asbestos seal from its groove and discard it.

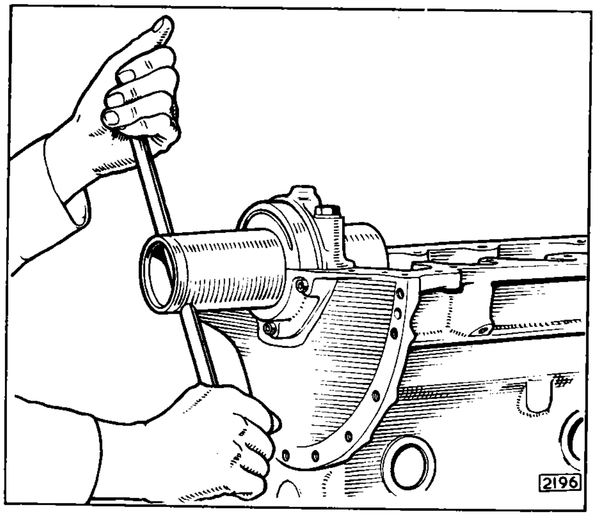


Fig. 28. Sizing the rear oil seal using the special tool (Churchill Tool No. J.17.).

REPLACING THE SEAL

Take the new asbestos seals and carefully tap them on the side face to narrow the section of the seal. Fit the seals to the housing and press into the groove using a hammer handle until the seal does not protrude from the ends of the housing. Do NOT cut the ends off the seal if they protrude from the housing but continue pressing the seal into the groove until both ends are flush. Using a knife or similar tool, press all loose ends of asbestos into the ends of the groove so that they will not be trapped between the two halves of the housing when assembled.

REFITTING

Assemble the two halves of the rear seal and secure with the two Allen screws. Fit the rear main bearing cap to the block without the bearings and tighten to a torque of 83 lb. ft. (11·5 kgm). Fit the seal and housing to the cylinder block and secure with the three Allen screws. Smear a small quantity of colloidal graphite around the inner surface of the asbestos seal and insert the sizing bar (Churchill Tool No. J.17). Enure thsat the pilot end of the sizing bar enters the bore of the rear main bearing then press the bar inwards and rotate at the same time until the bar is fully home. Remove the bar by pulling and twisting at the same time. Remove the three Allen screws securing the oil seal housing to the cylinder block and remove the Allen screws securing the two halves of the seal. Separate the two halves of the seal and remove the rear main bearing. The crankshaft may now be refitted as described on page B.24.

CRANKSHAFT DAMPER AND PULLEY

A torsional vibration damper is fitted at the front end of the crankshaft.

The damper consists of a malleable iron ring bonded to a thick rubber disc. An inner member also bonded to the disc is attached to a hub which is keyed to a split cone on the front extension of the crankshaft.

The crankshaft damper and pulley are balanced as an assembly, therefore, mark each part before dismantling so that they can be refitted in their original positions.

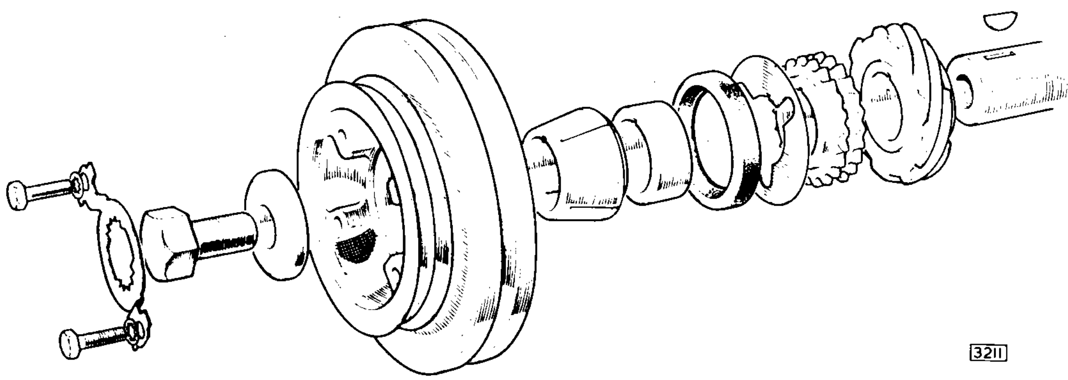


Fig. 29. The crankshaft damper.

REMOVAL

It will be necessary to remove the crankshaft damper from beneath the car.

Remove the fan belt by slackening the steering pump and moving it towards the engine and pressing the jockey pulley towards the engine.

Remove the locking washer securing the damper bolt by knocking back the tabs. Remove the other four setscrews securing the crankshaft pulley to the damper and remove the pulley.

Unscrew the large damper securing bolt and remove the flat washer.

Insert two levers behind the damper and ease it off the split cone—a sharp tap on the end of the cone will assist removal.

OVERHAUL

Examine the rubber portion of the damper for signs of deterioration and if necessary fit a new one. Also examine the crankshaft pulley for signs of wear and renew if necessary. The drive should be taken on the "V" faces of the pulley; renew the pulley if a new fan belt bottoms in the "V" groove.

REFITTING

Refitting is the reverse of the removal procedure.

Key to Fig. 30

1. Cylinder block assembly
2. Core plug
3. Blanking plate
4. Gasket
5. Front timing cover
6. Dowel
7. Setscrew
8. Copper washer
9. Dipstick adaptor tube
10. Plug
11. Headed plug
12. Copper washer
13. Dowel
14. Stud (plain)
15. Stud (plain)
16. Stud (dowel)
17. Cover assembly
18. Ring dowel
19. Cap screw (centre)
20. Cap screw (outer)
21. Banjo bolt
22. Copper washer
23. Sealing ring
24. Filter gauze
25. Water drain tap
26. Copper washer
27. Fibre washer
28. Crankshaft
29. Screwed plug
30. Bush
31. Thrust washer
32. Main bearings
33. Crankshaft damper
34. Cone
35. Distance piece
36. Oil thrower
37. Gear
38. Gear
39. Key
40. Pulley
41. Bolt
42. Shakeproof washer
43. Bolt
44. Washer
45. Tab washer
46. Connecting rod
47. Big end bearing
48. Flywheel
49. Dowel
50. Dowel
51. Set screw
52. Lock plate
53. Piston
54. Pressure ring (upper)
55. Pressure ring (lower)
56. Scraper ring (Maxiflex)
57. Gudgeon pin
58. Circlip
59. Oil sump
60. Gasket
61. Seal
62. Seal
63. Drain plug
64. Copper washer
65. Baffle assembly
66. Stud
67. Filter basket assembly
68. Pipe assembly
69. "O" ring
70. By-pass hose
71. Clip
72. Dipstick
73. Felt washer
74. Ignition timing pointer
75. Bracket assembly (R.H.)
76. Bracket assembly (L.H.)
77. Front engine mounting
78. Support bracket assembly
79. Stabilising link
80. Bush
81. Stepped washer
82. Stepped bush
83. Rubber mounting
84. Bearing bracket
85. Coil spring retainer
86. Pin
87. Channel support
88. Packing piece
89. Coil spring

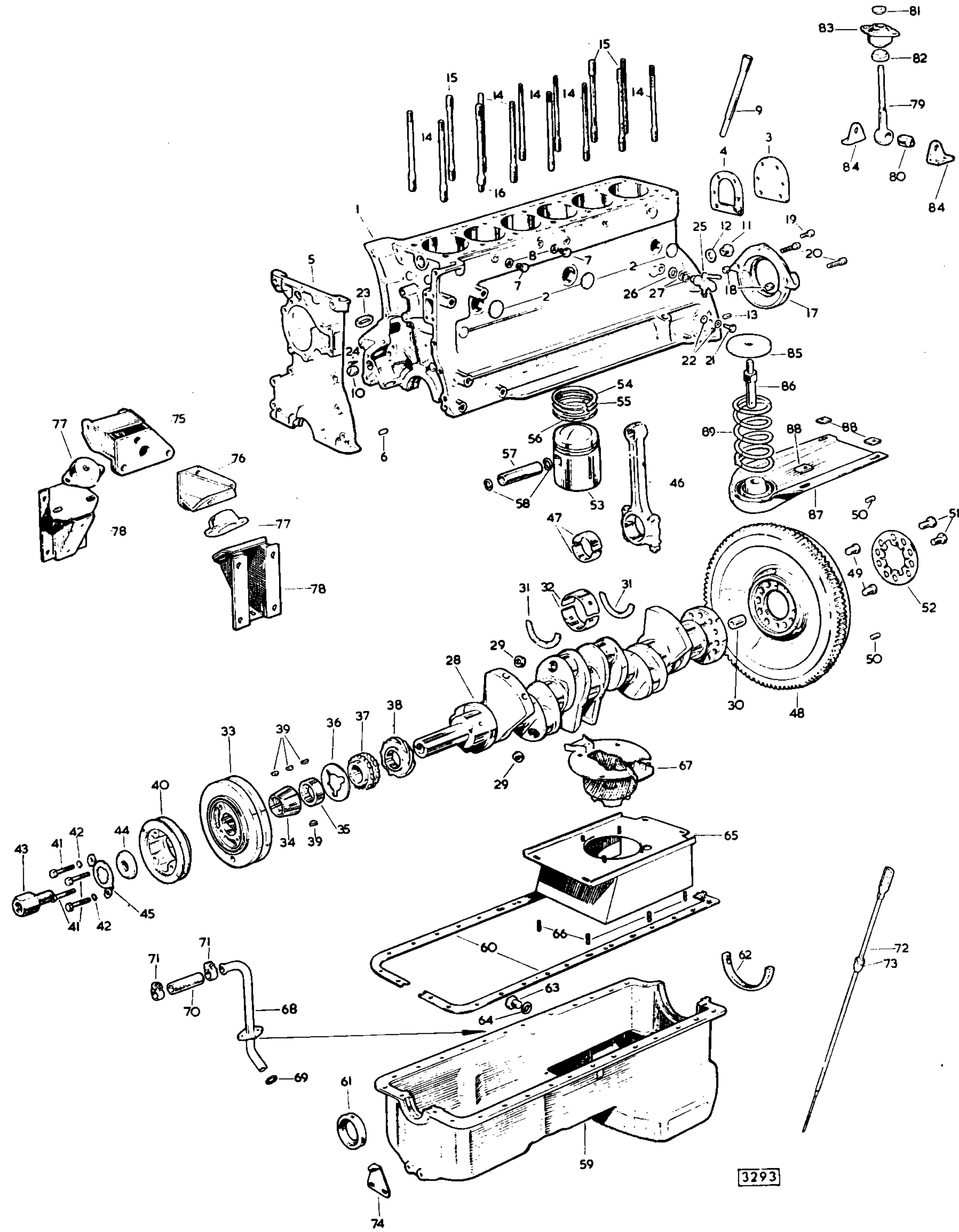


Fig. 30. The cylinder block.

THE CYLINDER BLOCK

The cylinder block is of chromium iron and is integral with the crankcase. The main bearing housings are line bored and the caps are not interchangeable, corresponding numbers being stamped on the caps and the bottom face of the crankcase for identification purposes. Pressed in dry liners are fitted.

OVERHAUL

Check the top face of the cylinder block for truth. Check that the main bearing caps have not been filed and that the bores for the main bearings are in alignment. If the caps have been filed or if there is misalignment of the bearings housing the caps must be re-machined and the bearing housings line bored.

After removal of the cylinder head studs prior to reboring, check the area around the stud holes for flatness. When the edges of the stud holes are found to be raised they must be skimmed flush with the surrounding joint face, to ensure a dead flat surface on which to mount the boring equipment.

Reboring is normally recommended when the bore wear exceeds 0·006″ (0·15 mm). Reboring beyond the limit of 0·030″ (0·76 mm.) is not recommended and when the bores will not clean out at 0·030″ (0·76 mm.), new liners and standard size pistons should be fitted.

The worn liners must be pressed out from below utilizing the illustrated stepped block.

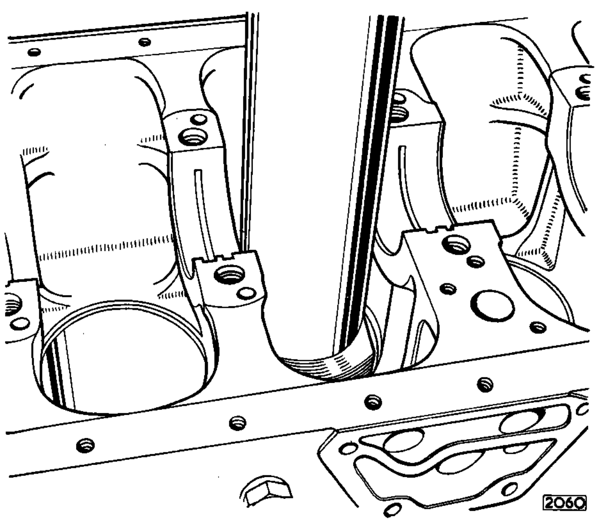


Fig. 31. Pressing out a cylinder liner using a stepped block.

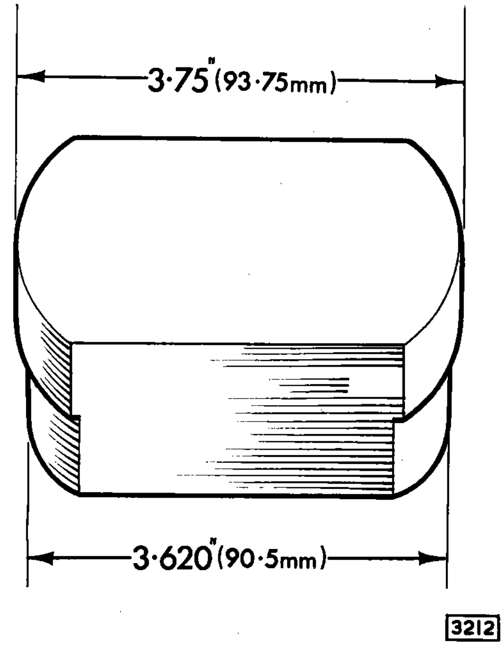


Fig. 32. Stepped block for cylinder liner removal.

Before fitting the new liner, lightly smear the cylinder walls with jointing compound to a point half way down the bore and also smear the top outer surface of the liner.

Press the new liners in from the top and lightly skim the tops of the liners flush with the top face of the cylinder block.

Bore out and hone the liners to suit the grade (or grades) of pistons to be fitted. (See piston grades on page B.54).

The following oversize pistons are available: +0·010″ (0·25 mm.), +0·020″ (0·51 mm.) and +0·030″ (0·76 mm.).

Following reboring the blanking plugs in the main oil gallery should be removed and the cylinder block oilways and the crankcase interior thoroughly cleaned. After cleaning, paint the crankcase interior with heat and oil resisting paint.

THE CYLINDER HEAD

The cylinder head is manufactured of aluminium alloy and has machine hemispherical combustion chambers. Cast iron valve seat inserts, tappet guides and valve guides are shrunk into the cylinder head castings.

Warning: Before carrying out any work on the cylinder head the following points should be observed to avoid possible fouling between (a) the inlet and exhaust valves, and (b) the valves pistons.

Do NOT rotate the engine or the camshafts with the camshaft sprockets disconnected.

If, with the cylinder head removed from the engine, it is required to rotate a camshaft, the other camshaft must either be removed or the bearing cap nuts slackened to their fullest extent to allow the valves to be released.

When fitting the camshafts to the cylinder head ensure that the keyway in the front bearing flange of each camshaft is perpendicular (at 90°) to the adjacent camshaft cover face before tightening down the camshaft bearing cap nuts. If this operation is being carried out with the cylinder head fitted to the engine, rotate the engine until No. 6 (front) piston is on Top Dead Centre in the firing position, that is with the distributor rotor opposite No. 6 cylinder segment, before fitting the camshafts.

Note: As the valves in the fully open position protrude below the cylinder head joint face, the cylinder head must not be placed joint face downwards directly on a flat surface; support the cylinder head on wooden blocks, one at each end.

REMOVAL (Fig. 34)

Drain the cooling system by turning the radiator drain tap remote control, opening the cylinder block drain tap and removing the radiator filler cap. Conserve the coolant if anti-freeze is in use.

Disconnect the battery. Remove the flexible pipe between the air cleaner and the air intake elbow. Disconnect the engine breather hose (59) below the air intake elbow and remove the air intake elbow. Disconnect the accelerator linkage at the rear of the engine. Disconnect the fuel feed pipe at the joint below the front carburetter. Remove the cables (green/black and green) from the auxiliary starting solenoid.

Disconnect the cables (which may be replaced at either position) from the revolution counter generator (39) at the rear of the cylinder head. Disconnect the top water hose and by-pass hose from the inlet manifold. Remove the cable (green/black) at the thermostat switch. (84).

Remove the high tension leads from the sparking plugs and the lead carrier from the cylinder head studs. Disconnect the cables (white/black and white) from the ignition coil and remove the coil. Remove the sparking plugs. Remove the cables from the retaining clips below the inlet manifold.

Disconnect the exhaust manifolds from the engine. Disconnect the two camshaft oil feed pipe unions from the rear of the cylinder head. Remove the heater pipe brackets from below the inlet manifold. Remove the carburetter overflow pipe clip from the oil filter head.

Slacken the clips on the heater hoses at the rear of the inlet manifold and on the heater unit. Disconnect the vacuum pipe from below the heater water valve. Unscrew the nut securing the water valve and automatic transmission dipstick tube (if fitted), to the mounting bracket. Remove the water valve and hoses.

Disconnect the cable (green/blue) from the water temperature transmitter in the inlet manifold water jacket. Slacken the clips and remove the two vacuum servo pipes from the connection at the rear of the inlet manifold.

Remove the 11 dome nuts from each camshaft cover and remove the covers.

Slacken the hose clips at the engine breather housing, remove the four dome nuts securing the housing to the front of the cylinder head and withdraw the housing noting the gauze baffle and gaskets (Fig. 33).

Release the tension on the top timing chain by slackening the nut on the eccentric idler sprocket shaft, depressing the spring loaded stop peg and rotating the serrated adjuster plate clockwise.

Break the locking wire on the two setscrews securing the camshaft sprocket to the respective camshafts.

Remove one setscrew only from each of the camshaft sprockets; rotate the engine until the two remaining setscrews are accessible and remove these two screws.

Do NOT rotate the engine or the camshafts after having disconnected the sprockets.

The two camshaft sprockets may now be slid up the support brackets.

Slacken the 14 cylinder head dome nuts a part of a turn at a time in the order shown (Fig. 19) until the nuts become free. Remove the six nuts securing the front of the cylinder head.

Lift off the cylinder head complete with inlet manifolds. Remove and scrap the cylinder head gasket.

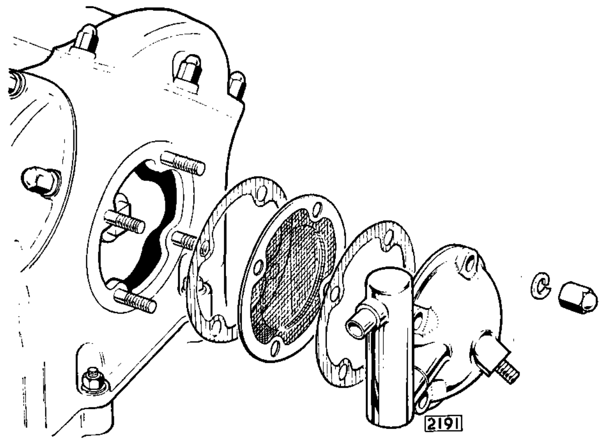


Fig. 33. The engine breather components.

OVERHAUL

As the cylinder head is of aluminium alloy, great care should be exercised when carrying out overhaul work, not to damage or score the machined surfaces. When removing carbon do not use scrapers or sharply pointed tools—use worn emery cloth and paraffin only.

Check the bottom face of the cylinder head for truth.

Remove all traces of carbon and deposits from the combustion chambers and the inlet and exhaust ports and regrind the valve and seats if necessary, as described under "Decarbonising and Grinding Valves" on page B.30.

If it is required to replace the valve guides, valve seat inserts or tappet guides, only the special replacement parts must be used. The replacement parts must be shrunk into the cylinder head in accordance with the instructions given under the appropriate headings in this section.

REFITTING

Fit Cylinder Head

Before refitting the cylinder head it is important to observe that if the camshafts are out of phase with piston position fouling may take place between the valves and pistons. It is, therefore, essential to adhere to the following procedure before fitting the cylinder head:—

Check that the keyways in the front flanges of the camshafts are vertical to the camshaft housing face and accurately position by engaging the valve timing gauge. If it is found necessary to rotate one of the camshafts the other camshaft must either be removed or the bearing cap nuts slackened to their fullest extent to allow the valves to be released.

Turn No. 6 (front) piston to the Top Dead Centre position with the distributor rotor arm opposite No. 6 cylinder segment. (Fig. 14).

Do NOT rotate the engine or camshafts until the camshaft sprockets have been connected to the camshafts.

Fit the cylinder head gasket, taking care that the side marked "Top" is uppermost. Fit the cylinder head complete with manifold to the cylinder block. Note that the second cylinder head stud from the front on the left-hand side is a dowel stud.

Fit the sparking plug lead carrier to the 3rd and 6th stud from the front on the right-side. Fit plain washers to these and the two front stud positions. Fit "D" washers to the remaining studs.

Tighten the 14 large cylinder head dome nuts a part of a turn at a time to a torque of 54 lb.ft. (7·5 kgm.) in order shown on Fig. 19. Also tighten the six nuts securing the front end of the cylinder head.

Valve Timing

Check that No. 6 (front) piston is exactly in the T.D.C. position.

Through the breather aperture in the front of the cylinder head slacken the locknut securing the serrated plate.

Tension the chain, with the camshaft sprockets on the camshaft flanges, by pressing the locking plunger inwards and rotating the serrated plate, using Churchill Tool No. J2, in an anti-clockwise direction. When the chain is tight, turn the serrated plate back two serrations.

When correctly tensioned there should be slight flexibility on both outer sides of the chain below the camshaft sprockets.

Release the locking plunger and securely tighten the locknut. Tap the camshaft sprockets off the flanges of the camshafts.

Position the camshafts accurately with the valve timing gauge and check that the T.D.C. marks are in exact alignment.

Withdraw the circlips retaining the adjusting plates to the camshaft sprockets and pull the adjusting plates forward until the serrations disengage. Replace the sprockets on to the flanges of camshafts and align the two holes in the adjuster plate with the two tapped holes in each camshaft flange. Engage the serrations of the adjuster plates with the serrations in the sprockets.

Note: It is most important that the holes are in exact alignment, otherwise when the set-screws are fitted the camshafts will be moved out of position. If difficulty is experienced in aligning the holes exactly, the adjuster plates should be turned through 180°, which, due to the construction of the plate, will facilitate alignment.

Fit the circlips to the sprockets and one setscrew to the accessible hole in each adjuster plate. Turn the engine until the other two holes are accessible and fit the two remaining setscrews.

Finally, recheck the timing chain tension and valve timing in this order. Secure the four setscrews retaining the camshaft sprockets with new locking wire.

Fit Cylinder Head Oil Feed Pipe

Fit the cylinder head oil feed pipe from the tapped hole in the main oil gallery to the two tapped holes in the rear of the cylinder head. Secure the pipe with the three banjo bolts with a new copper washer fitted to both sides of each banjo.

Fit Camshaft Covers

Fit each camshaft cover to the cylinder head using a new gasket. Fit the 11 copper washers and dome nuts to the cover retaining studs but do not tighten fully.

Fit the revolution counter generator and flanged plug to the rear of the left-hand and right-hand camshaft covers respectively with the rubber sealing rings seated in the recesses provided and secure with the setscrews and copper washers.. Tighten fully the dome nuts securing the camshaft covers.

Note on Refitting

When refitting the throttle linkage, note that the backing plate is offset and ensure that the backing plate assembly is aligned correctly before tightening up.

The remainder of the reassembly is the reverse of the removal procedure.

THE EXHAUST MANIFOLDS

REMOVAL

Remove the eight brass nuts and spring washers securing the exhaust pipe flanges to the exhaust manifolds.

Remove the 16 brass nuts and spring washers securing the exhaust manifolds to the cylinder head when the manifolds can be detached.

REFITTING

Refitting is the reverse of the removal procedure. Use new gaskets between the manifolds and the cylinder head and new sealing rings between the exhaust pipe and manifold flanges.

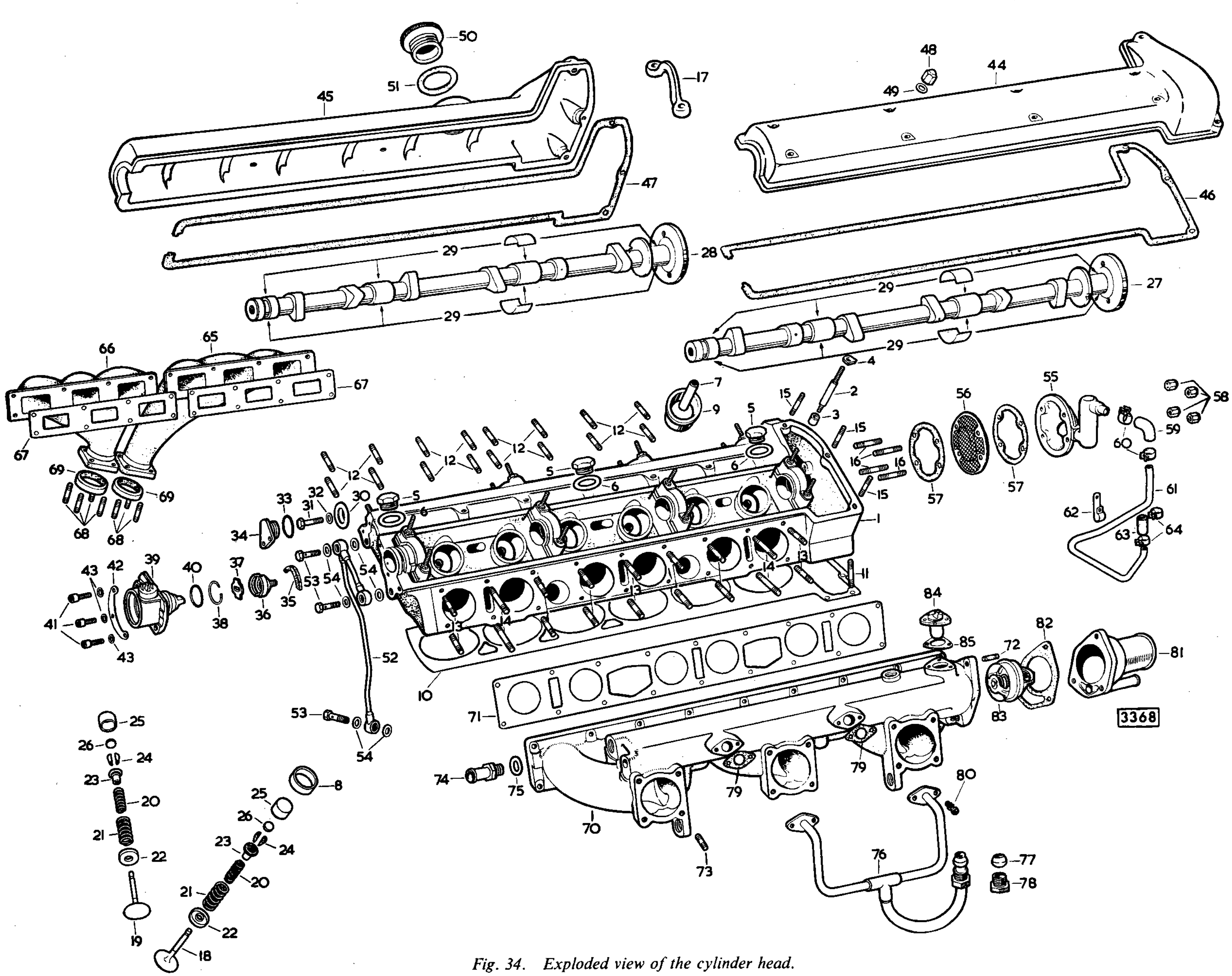


Fig. 34. Exploded view of the cylinder head.

Key to Fig. 34

1. Cylinder head assembly
2. Stud
3. Ring dowel
4. "D" washer
5. Core plug
6. Copper washer
7. Guide
8. Valve insert (exhaust)
9. Tappet
10. Gasket
11. Stud (short)
12. Stud
13. Stud (short)
14. Stud (long)
15. Stud
16. Stud
17. Engine lifting bracket
18. Inlet valve
19. Exhaust valve
20. Valve spring (inner)
21. Valve spring (outer)
22. Seat
23. Collar
24. Cotter
25. Tappet
26. Adjusting pad
27. Inlet camshaft
28. Exhaust camshaft
29. Bearing
30. Oil thrower
31. Set screw
32. Copper washer
33. "O" ring
34. Flanged sealing plug
35. Seal
36. Adaptor
37. Driving dog
38. Circlip
39. Revolution counter generator
40. "O" ring
41. Allen screw
42. Plate washer
43. Lock washer
44. Inlet camshaft cover
45. Exhaust camshaft cover
46. Gasket
47. Gasket
48. Dome nut
49. Copper washer
50. Oil filler cap
51. Fibre washer
52. Oil pipe
53. Banjo bolt
54. Copper washer
55. Front cover and breather housing
56. Gauze filter
57. Gasket
58. Dome nut
59. Elbow hose
60. Clip
61. Breather pipe
62. Clip
63. Hose—breather pipe to air intake
64. Clip
65. Exhaust manifold (front)
66. Exhaust manifold (rear)
67. Gasket
68. Stud
69. Sealing ring
70. Inlet manifold
71. Gasket
72. Stud
73. Stud
74. Heater water feed adaptor
75. Copper washer
76. Starting pipe
77. Olive
78. Nut
79. Gasket
80. Screw (Phillips Head)
81. Water outlet pipe
82. Gasket
83. Thermostat
84. Thermostat (operating automatic choke)
85. Gasket

THE FLYWHEEL

The flywheel is a steel forging and has integral starter gear teeth. The flywheel is located to the crankshaft by two mushroom-headed dowels and is secured by ten setscrews retained by a circular locking plate.

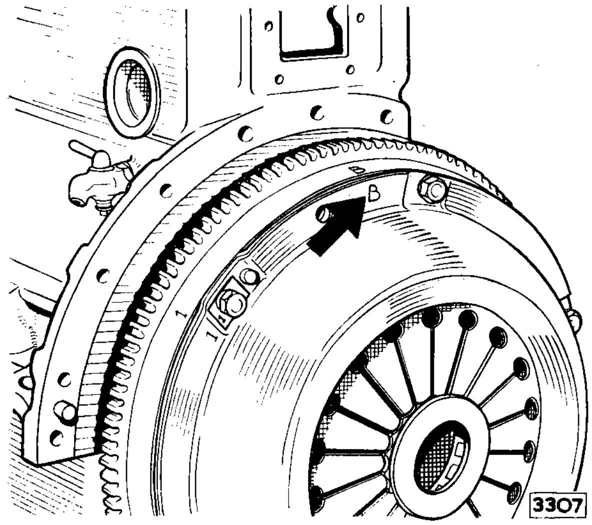


Fig. 35. Mating the balance marks "B" on the clutch and flywheel.

REMOVAL

Remove the engine as described on page B.19. Unscrew the four setscrews and remove the cover plate from the front face of the clutch housing.

Remove the bolts and nuts securing the clutch housing to the engine and withdraw the gearbox unit.

Unscrew the six setscrews securing the flange of clutch cover to the flywheel and remove clutch assembly. Note the balance marks "B" stamped on the clutch cover and on the periphery of the flywheel.

Knock back the tabs of locking plate securing the ten flywheel bolts. Unscrew the flywheel bolts and remove the locking plate. Remove flywheel from the crankshaft flange by gently tapping with a rawhide mallet.

OVERHAUL

If the starter gear is badly worn a new flywheel should be used, since the starter gear teeth are integral with the flywheel, and in this case it will be necessary to balance the flywheel and clutch as an assembly.

If a new flywheel is being fitted, check the flywheel and clutch balance as an assembly by mounting on a mandrel and setting up on parallel knife edges. Mark the relative position of clutch and flywheel. If necessary, remove the clutch and drill $\frac{3}{8}''$ (9.5 mm.) balance holes not more than $\frac{1}{2}''$ (12.7 mm.) deep at a distance of $\frac{3}{8}''$ (9·5 mm.) from the edge of the flywheel.

REFITTING

Turn the engine upright.

Check that the crankshaft flange and the holes for the flywheel bolts and dowels are free from burrs.

Turn the engine until Nos. 1 and 6 pistons are on T.D.C. and fit the flywheel to the crankshaft flange so that the "B" stamped on the edge of the flywheel is at approximately the B.D.C. position. (This will ensure that the balance mark "B" on the flywheel is in line with the balance mark on the crankshaft which is a group of letters stamped on the crank throw just forward of the rear main journal).

Tap the two mushroom-shaped dowels into position, fit the locking plate and flywheel securing setscrews. Tighten the setscrews to a torque of 67 lb.ft. (9·2 kgm.) and secure with the locking plate tabs. Assemble the clutch driven plate to the flywheel, noting that one side of the plate is marked "Flywheel Side". Centralise the driven plate by means of a dummy shaft which fits the splined bore of the driven plate and the spigot bush in the crankshaft. (A constant pinion shaft may be used for this purpose.) Fit clutch cover assembly so that "B" stamped adjacent to one of the dowel holes coincides with the "B" stamped on the periphery of the flywheel. Secure the clutch assembly with the six setscrews and spring washers, tightening the screws a turn at a time by diagonal selection. Remove the dummy shaft.

IGNITION TIMING

Set the distributor micrometer adjustment in the centre of the scale.

Rotate the engine until the rotor arm approaches the No. 6 (front) cylinder segment in the distributor cap (Fig. 14).

Slowly rotate the engine until the ignition timing scale on the crankshaft damper is the appropriate number of degrees before the pointer on the sump.

Ignition Settings

Connect a 12 volt test lamp with one lead to the distributor terminal (or CB terminal of the ignition coil) and the other to a good earth.

Slacken the distributor plate pinch bolt.

Switch on the ignition.

Slowly rotate the distributor body until the points are just breaking, that is, when the lamp lights up with the fibre heel leading the appropriate cam lobe in the normal direction of rotation.

Tighten the distributor plate pinch bolt.

A maximum of six clicks on the vernier adjustment from this setting, to either advance or retard, is allowed.

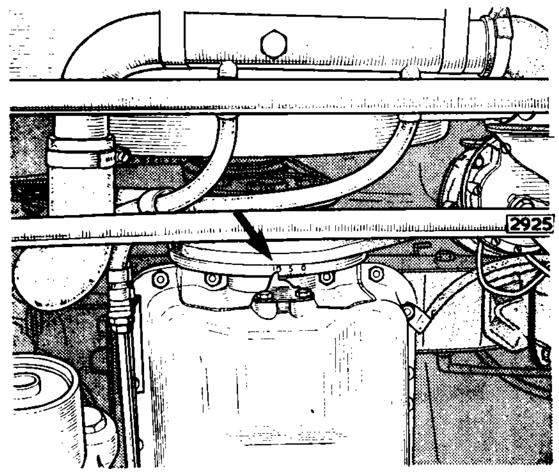


Fig. 36. Showing the timing scale marked on the crankshaft damper. The scale is marked in crankshaft degrees from 0° (Top Dead Centre) to 10° advance (before Top Dead Centre).

Static Ignition Timing

8:1 compression ratio	9° B.T.D.C.
9:1 compression ratio	10° B.T.D.C.

THE OIL FILTER

The oil filter is of the full flow type and has a renewable element. The oil from the oil pressure relief valve is returned to the engine sump by an external rubber hose. The oil pressure relief valve is retained by the outlet adaptor to which the hose to the sump is secured.

A balance valve fitted in the filter head opens at a pressure differential of 10–15lb./sq. in. (0·7–1·1 kg./cm^2) to provide a safeguard against the possibility of the filter element becoming so choked that oil is prevented from reaching the bearings.

REMOVAL

When removing the oil filter it is advisable to catch any escaping oil in a drip tray.

With the car on a ramp disconnect the cable at the oil pressure transmitter unit and slacken the clip at the oil return hose. Remove the five bolts with plain and copper washers securing the oil filter head to the cylinder block, note the clip retaining the carburetter float chamber overflow pipes.

Remove the oil filter assembly from beneath the car, collecting the gasket between the oil filter head and the cylinder block.

REFITTING

Refitting is the reverse of the removal procedure but a new gasket must be fitted between the oil filter head and the cylinder block.

ELEMENT REPLACEMENT

It is most important to renew the oil filter element at the recommended periods as after this mileage it will have become choked with impurities.

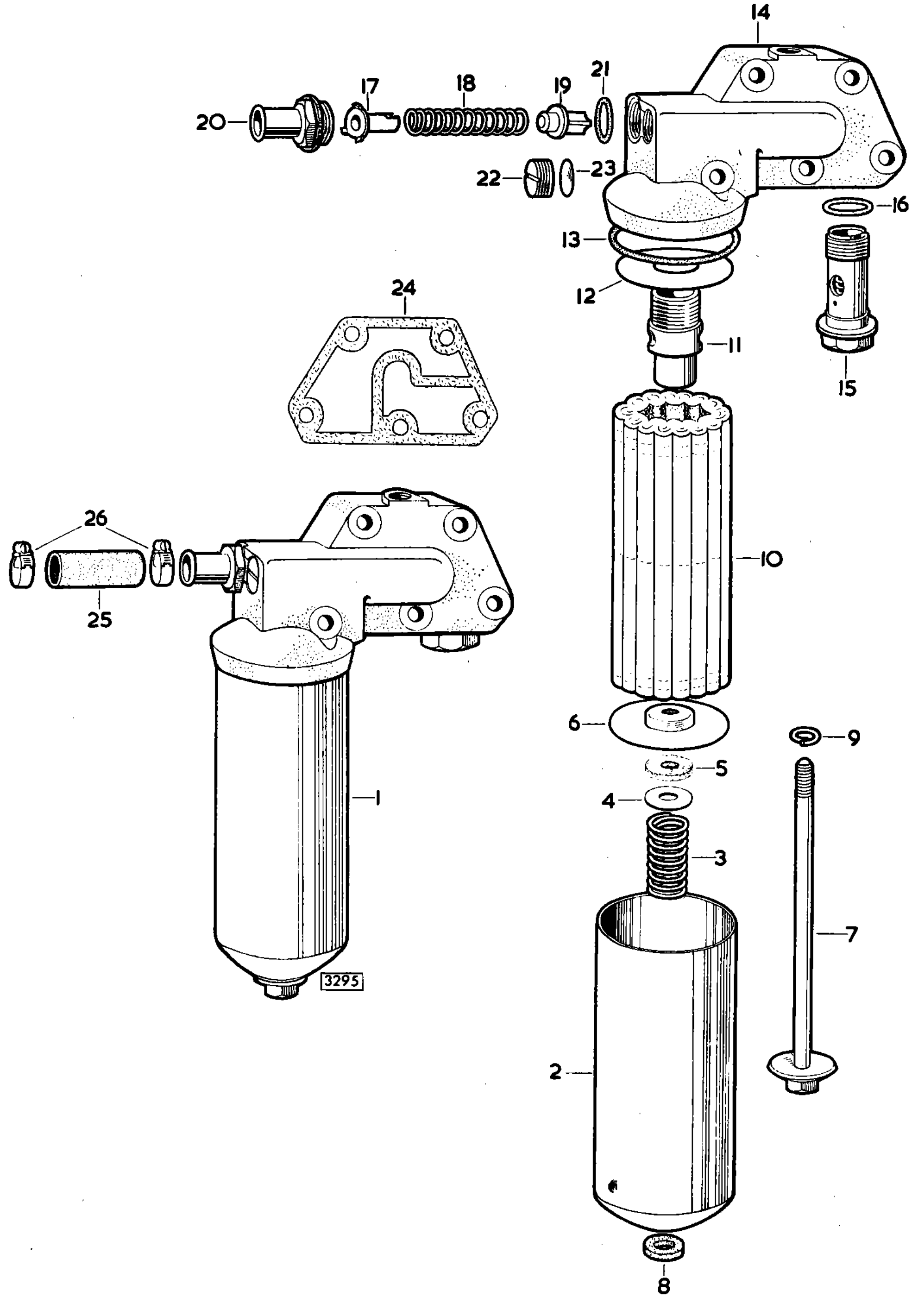


Fig. 37. Exploded view of the oil filter.

To guard against the possibility of the filter being neglected to the extent where the element becomes completely choked, a balance valve is incorporated in the filter head which allows **unfiltered oil** to by-pass the element and reach the bearings. This will be accompanied by a drop in the normal oil pressure of some 10 lb./sq. in. (0·703 kg./cm^2) and if this occurs **the filter element should be renewed as soon** as possible.

The oil filter is situated at the right-hand side of the engine and it is advisable when removing the filter canister, to catch any escaping oil. Unscrew the centre bolt and remove the canister and element from beneath the car retaining the rubber sealing ring. Empty out the oil, thoroughly wash out the canister with petrol and allow to dry before inserting a new element.

When refitting the canister, inspect the rubber sealing ring and renew it if necessary. Ensure that the ring is seating correctly in the groove beteenw the canister and the filter head before tightening the centre bolt.

Key to Fig. 37

1.	Oil filter assembly	14.	Filter head
2.	Canister	15.	Balance valve
3.	Spring	16.	Washer
4.	Plain washer	17.	Relief valve
5.	Felt washer	18.	Spring
6.	Pressure plate	19.	Spider and pin
7.	Bolt	20.	Adaptor
8.	Rubber washer	21.	Washer
9.	Spring clip	22.	Plug
10.	Element	23.	Fibre disc
11.	Anchor insert	24.	Gasket
12.	Clamping plate	25.	Hose
13.	Sealing ring	26.	Clip

THE INLET MANIFOLD

The inlet manifold is integrally cast with the water outlet pipe which houses the thermostat.

REMOVAL

Drain the cooling system by turning the radiator drain tap remote control, opening the cylinder block drain tap and removing the radiator filler cap. Conserve the coolant if anti-freeze is in use.

Disconnect the battery.

Slacken the clips and disconnect the hoses from the inlet and outlet pipes.

Remove the flexible air hose from between the air intake elbow and the air cleaner.

Disconnect the cable (green/blue) from the water temperature transmitter and the cable (green/black) from the thermostat switch.

Disconnect the two cables (green/black and green) from the auxiliary starting carburetter.

Disconnect the flexible fuel feed pipe at the joint below the front carburetter and remove the vacuum advance pipe from the front carburetter.

Disconnect the accelerator linkage at the rear of the engine.

Remove the two vacuum pipes at the rear of the manifold.

Withdraw the manifold, complete with the carburetters, and the manifold gasket.

Remove the carburetters from the manifold (as described in Section C).

REFITTING

Refitting is the reverse of the removal procedure but a new manifold gasket should be fitted.

THE OIL PUMP

The oil pump is of the eccentric rotor type and consists of five main parts: the body, the driving spindle with the inner rotor pinned to it, the outer rotor and the cover, which is secured to the main body by four bolts, finally being secured to the engine with additional dowel bolts. The inner rotor has one lobe less than the number of internal segments in the outer rotor. The spindle centre is eccentric to that of the bore in which the outer rotor is located, thus the inner rotor is able to rotate within the outer, and causes the outer rotor to revolve. The inlet connection is positioned in the pump cover, and the outlet connection in the body. These are both connected to the ports in the pump.

Consider the oil flow with the lobes of the inner rotor lying along the line of eccentricity. In this position oil is free to flow from the port into the space (dotted portion) between the rotors, and on the other side of the lobe (shaded portion) the oil is free to flow into the delivery port (see Fig. 38).

In the second position, the inner and outer rotors have rotated and caused the oil that was flowing from the inlet port into the space between them to be cut off from the port and transferred to the enclosed space between the ports. Similarly, the space which enclosed oil free to flow to the delivery port in the first position has decreased in size in the second position, and thus caused this oil to flow into the delivery port. The action of the pump is then a repetition of the above, oil flowing into the space between the rotors from the inlet port under atmospheric pressure and being discharged into the delivery port by reason of the space in which it is contained decreasing in size as it passes over the port.

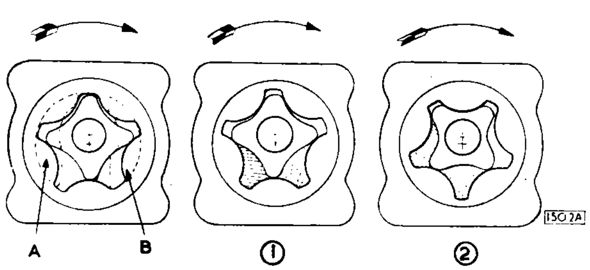


Fig. 38. The operation of the rotor type oil pump. "A" indicates the outlet port. "B" indicates the inlet port. 1. First position. 2. Second position.

REMOVAL

Remove the sump as directed on Page B.53.

Detach the suction and delivery pipe brackets and withdraw the pipes from the oil pump.

Tap back the tab washers and remove the three dowel bolts which secure the oil pump to the front main bearing cap.

Withdraw the oil pump and collect the coupling sleeve at the top of the drive shaft.

DISMANTLING

Unscrew the four bolts and detach the bottom cover from the oil pump.

Withdraw the inner and outer rotors from the oil pump body. The inner rotor is pinned to the drive shaft and must not be dismantled.

OVERHAUL

Check the clearance between lobes of the inner and outer rotors which should be 0·006″ (0·15 mm.) maximum (see Fig. 39).

Check the clearance between the outer rotor and the pump body (see Fig 40) which should not exceed 0·010″ (0·25 mm.).

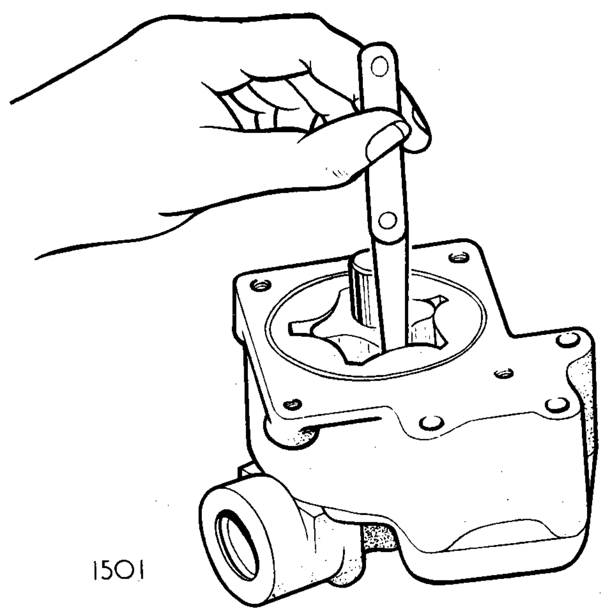


Fig. 39. Measuring the clearance between the inner and outer rotors.

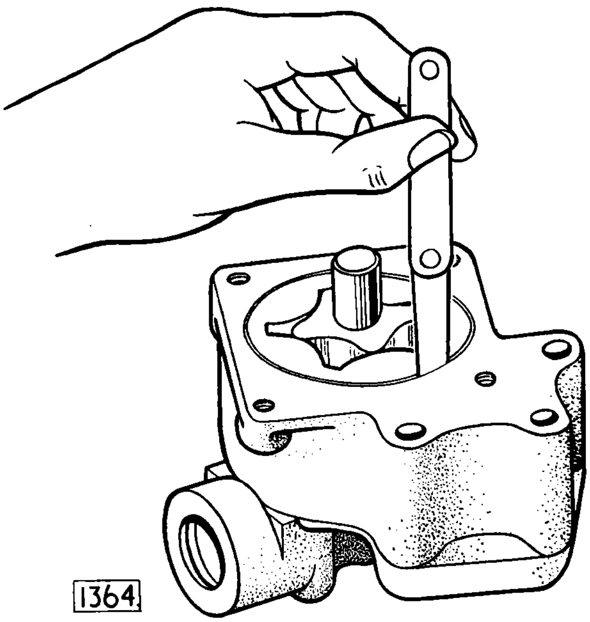


Fig. 40. Measuring the clearance between the outer rotor and the pump body.

Check the end-float of the rotors by placing a straight edge across the joint face of the body and measuring the clearance between the rotors and straight edge (see Fig. 41). This clearance should be 0·0025″ (0·06 mm.) and in an emergency can be restored by lapping the pump body and outer rotor on a surface plate to suit the inner rotor.

Examine the pump body and bottom cover for signs of scoring and the drive shaft bores for signs of wear; fit new parts as necessary.

Place the drive shaft in a vice fitted with soft jaws and check that the inner rotor is tight on the securing pin.

Note that the drive shaft, inner and outer rotors are supplied only as an assembly.

REASSEMBLING

Reassembly is the reverse of the dismantling procedure but it is important when fitting the outer rotor to the pump body to insert the chamfered end of the rotor foremost.

Always fit new "O" rings to the suction and delivery pipe bores.

REFITTING

Refitting is the reverse of the removal procedure.

Do not omit to fit the coupling sleeve to the squared end of the drive shaft before offering up the oil pump.

After fitting the oil pump, check that there is appreciable end-float of the coupling sleeve.

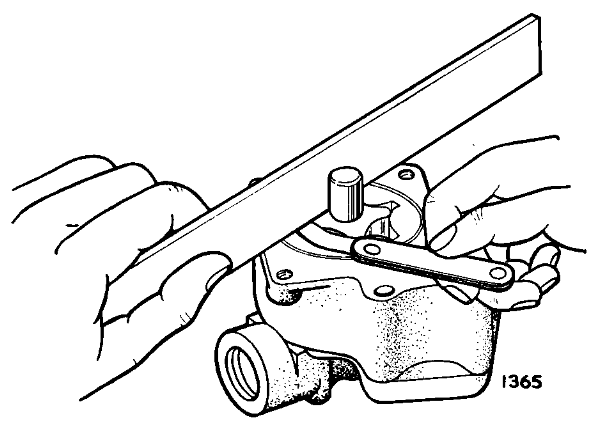


Fig. 41. Measuring the end float of the rotors.

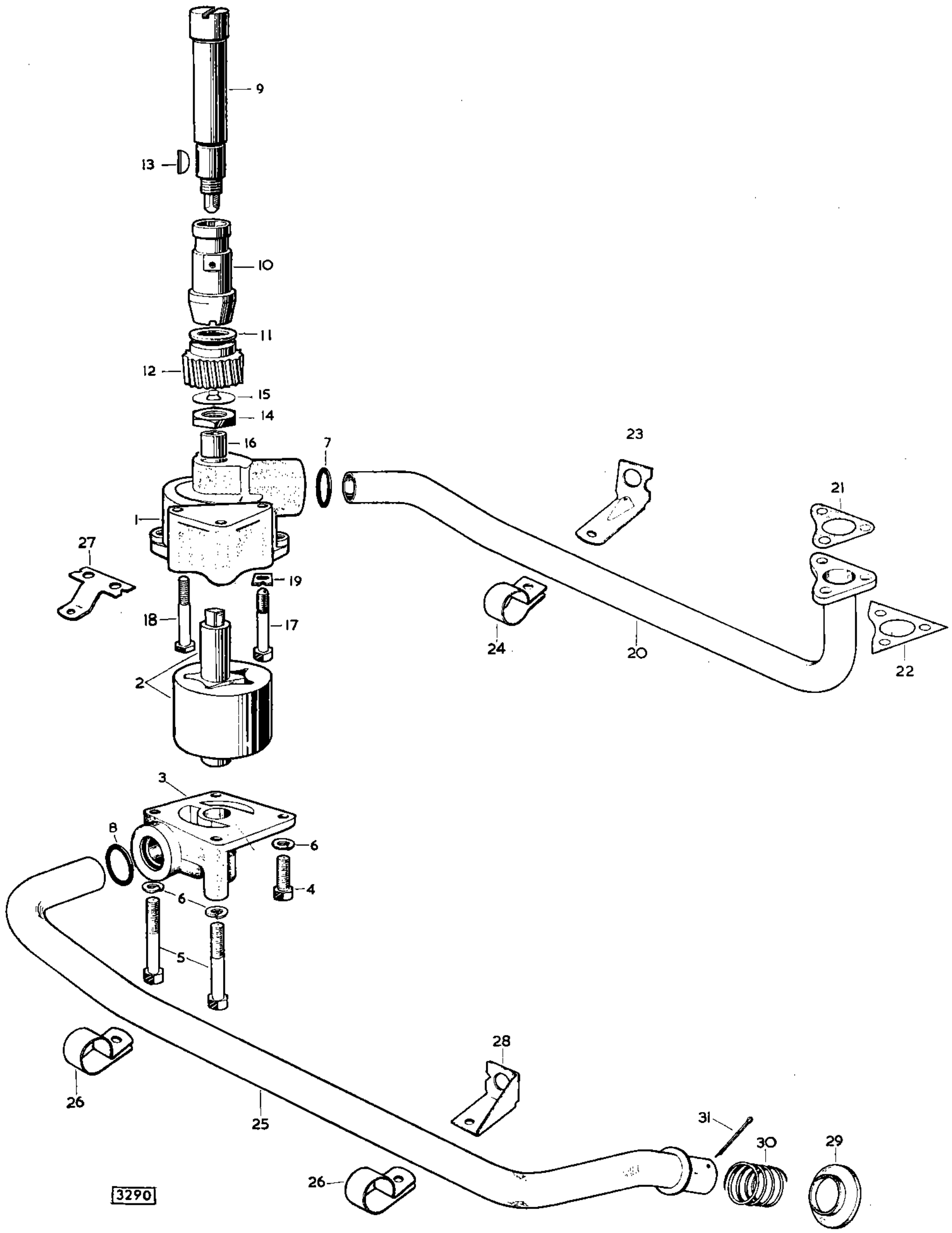


Fig. 42. The oil pump.

1. Pump body
2. Rotor assembly
3. Cover
4. Setscrew
5. Setscrew
6. Spring washer
7. "O" ring
8. "O" ring
9. Drive shaft
10. Bush
11. Washer
12. Helical gear
13. Key
14. Nut
15. Special washer
16. Shaft
17. Dowel bolt
18. Bolt
19. Tab washer
20. Oil delivery pipe
21. Gasket
22. Tab washer
23. Strut
24. Clip
25. Oil suction pipe
26. Clip
27. Strut
28. Strut
29. Plate
30. Spring
31. Split pin

OIL SUMP

All engines are fitted with aluminium sumps. An oil return pipe is fitted between the oil filter head and the well of the sump. A gauze bowl type oil filter is attached to a baffle plate in the sump well.

REMOVAL

Remove the drain plug and drain the oil from the sump.

Remove the front suspension unit as described in Section J "Front Suspension".

Slacken the clip and disconnect the oil return hose at the oil filter head.

Unscrew the 24 setscrews, two bolts and four nuts securing the sump. Remove the sump from the cylinder block noting that a short setscrew is fitted at the right-hand front corner of the sump as shown in Fig. 43.

Remove the four nuts securing the baffle plate in the sump well. Withdraw the baffle plate and remove the four nuts securing the filter basket. Remove the basket and wash out with petrol.

Remove the two nuts securing the oil return pipe flange to the sump, remove the pipe, examine the "O" ring and renew if necessary.

REFITTING

Scrape off all traces of old gaskets or sealing compound from the joint faces of the sump and crankcase.

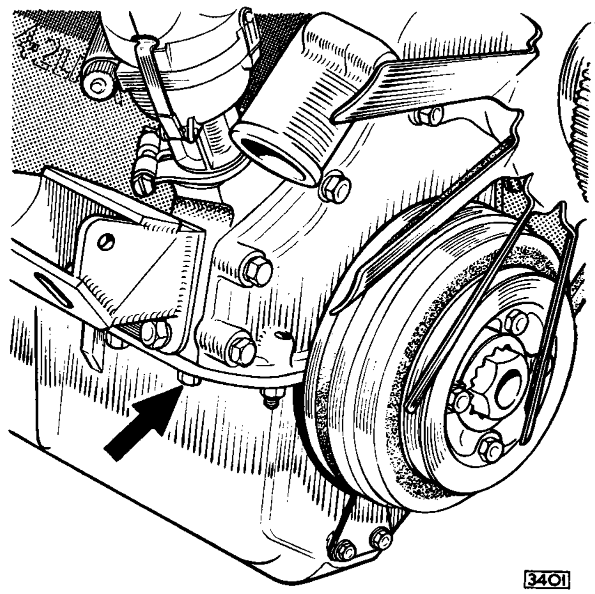


Fig. 43. Showing the location of the short setscrew.

Always fit new gaskets and rear oil seal when refitting the sump. If time permits, roll the rear oil seal into a coil and retain with string for a few hours. This will facilitate the fitting of the seal to its semi-circular recess.

Ensure that the short setscrew is fitted to the right-hand front corner of the sump.

PISTONS AND GUDGEON PINS

The pistons are made from low expansion aluminum alloy and are of the semi-split skirt type.

The pistons have three rings each, two compression and one oil control. The top compression ring only is chromium plated; both the top and second compression rings have a tapered periphery.

The fully floating gudgeon pin is retained in the piston by a circlip at each end.

REMOVAL

As the pistons will not pass the crankshaft it will be necessary to withdraw the pistons and connecting rods from the top. Proceed as follows:—

Remove Cylinder Head

Remove the cylinder head as described on page B.43.

Remove Sump

Remove the sump as described on page B.53.

Remove Piston and Connecting Rod

Remove the split pins from the connecting rod bolt nuts and unscrew nuts. Remove the connecting rod cap, noting the corresponding cylinder numbers on the connecting rod and cap. Remove the connecting rod bolts and withdraw the piston and connecting rod from the top of cylinder block.

OVERHAUL

Pistons are supplied complete with gudgeon pins which have been selectively assembled and are, therefore, not interchangeable one with another.

The pistons fitted to an engine should not vary one with another by more than 2 drams (3·5 grammes).

Gudgeon Pin Fitting

Gudgeon pins are a finger push fit in the piston at normal room temperature, 68°F (20°C).

When actually removing or refitting the gudgeon pin, the operation should be effected by immersing the piston, gudgeon pin and connecting rod little end in a bath of hot oil. When the piston and little end have reached a sufficient temperature (230°F, 110°C) the gudgeon pin can be moved into position. Always use new circlips on assembly.

When assembling the engine, centralise the small end of the connecting rod between the gudgeon pin bosses in the piston and ensure that the connecting rod mates up with the crankshaft journal without any pressure being exerted on the rod.

Piston Grades

The following selective grades are available in standard size pistons only. When ordering standard size pistons the identification letter of the selective grade should be clearly stated. Pistons are stamped on the crown with the letter identification and the cylinder block is also stamped on the top face adjacent to the bores.

Grade Identification Letter	To suit cylinder bore size
F	3·6250–3·6253″ (90·625–90·632 mm.)
G	3·6254–3·6257″ (90·635–90·642 mm.)
H	3·6258–3·6261″ (90·645–90·652 mm.)
J	3·6262–3·6265″ (90·655–90·662 mm.)
K	3·6266–3·6269″ (90·665–90·672 mm.)

Oversize Pistons

Oversize pistons are available in the following sizes:—

+0·010″ (0·25 mm.), +0·020″ (0·51 mm.), +0·030″ (0·76 mm.)

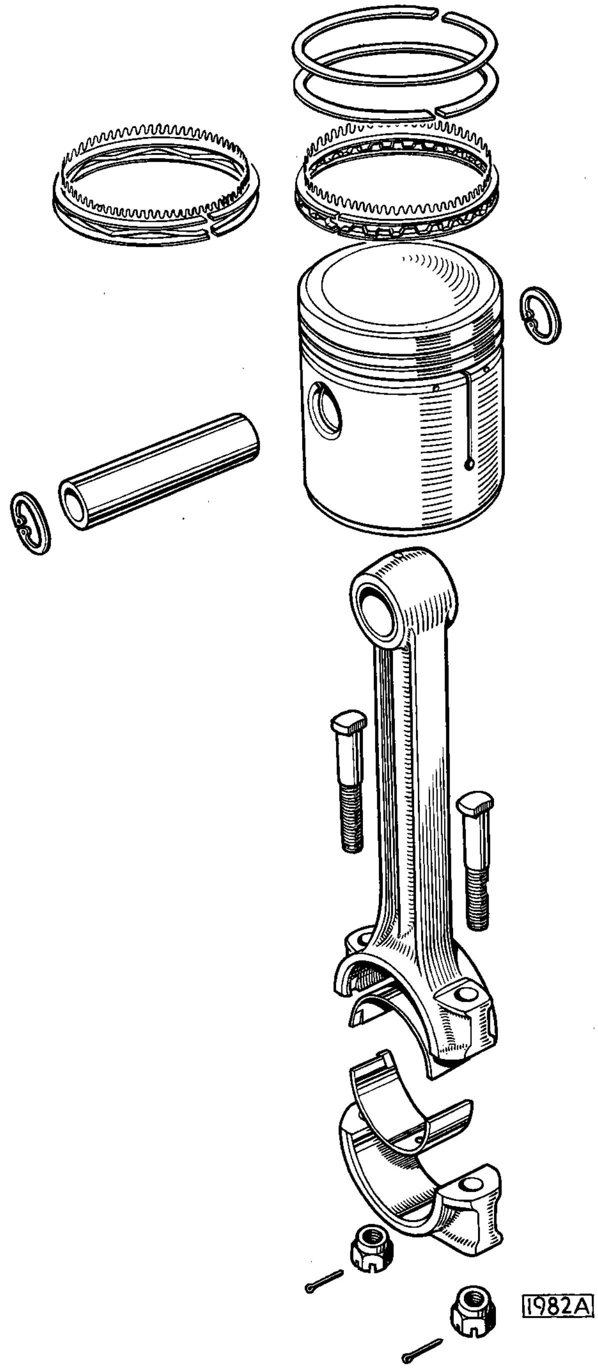


Fig. 44. Exploded view of the piston and connecting rod.

There are no selective grades in oversize pistons as grading is necessary purely for factory production methods.

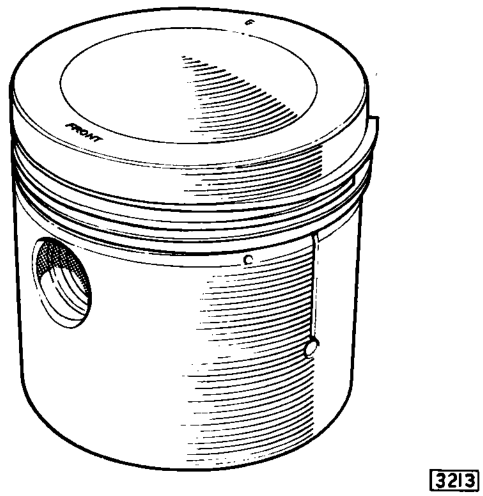


Fig. 45. *Identifications marks on piston.*

Piston Rings

Check the piston ring gap with the ring as far down the cylinder bore as possible. Push the ring down the bore with a piston to ensure that it is square and measure the gap with a feeler gauge. The correct gaps are as follows:—

Compression rings 0·015–0·020″ (0·38–0·51 mm.).

Oil control ring (Maxiflex) 0·015–0·033″ (0·38–0·83 mm.).

With the compression rings fitted to the piston check the side clearance in the grooves which should be 0·001–0·003″ (0·025–0·076 mm.).

One of the compression rings is hard chrome plated and this ring must be fitted to the top groove in the piston.

Tapered Periphery Rings

All engine units are fitted with tapered periphery piston rings in at least one position and these must be fitted the correct way up.

The narrowest part of the ring must be fitted uppermost; to assist in identfying the narrowest face a letter "T" or "Top" is marked on the side of the ring to be fitted uppermost.

The oil control ring consists of the two steel rails with a spacer between the two. These rails are held together on an assembly with an adhesive. The expander, which is fitted inside the oil control ring, should be assembled with the two lugs positioned in the hole directly above the gudgeon pin bore.

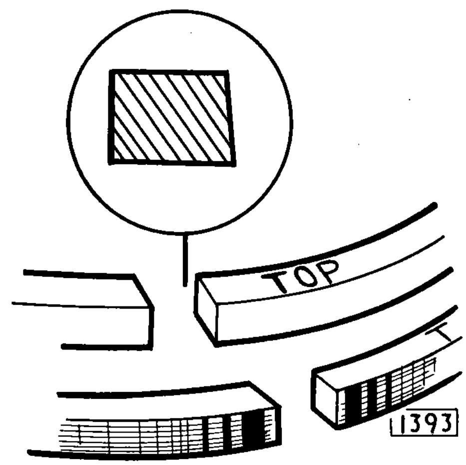


Fig. 46. *Showing the identification marks on the tapered periphery compression rings.*

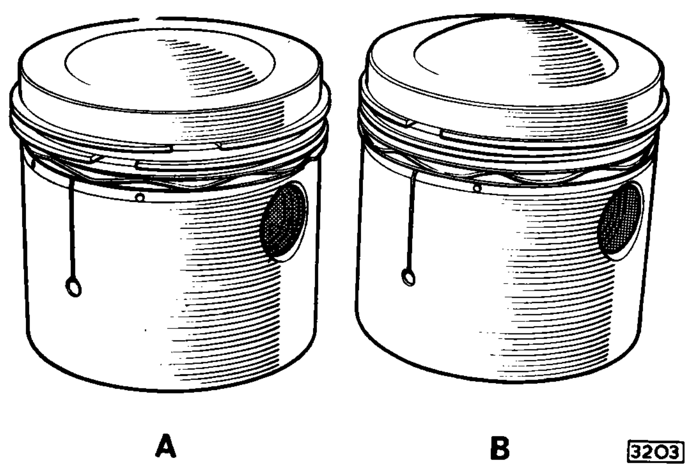


Fig. 47. 4.2 Mark 10 pistons.
"A"—8 : 1 compression ratio;
"B"—9 : 1 compression ratio.

REFITTING

Pistons and connecting rods must be fitted to their respective cylinders (piston and connecting rods are stamped with their cylinder number, No. 1 being at the rear) and the same way round in the bore.

The pistons must be fitted with the split on the left-hand or exhaust side of the engine. To facilitate correct fitting the piston crowns are marked "Front", see Fig. 45.

Use a piston ring clamp when entering the rings into the cylinder bore.

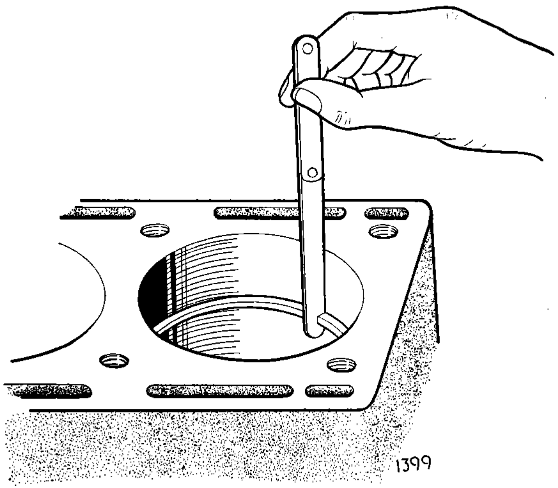


Fig. 48. Checking the piston ring gap.

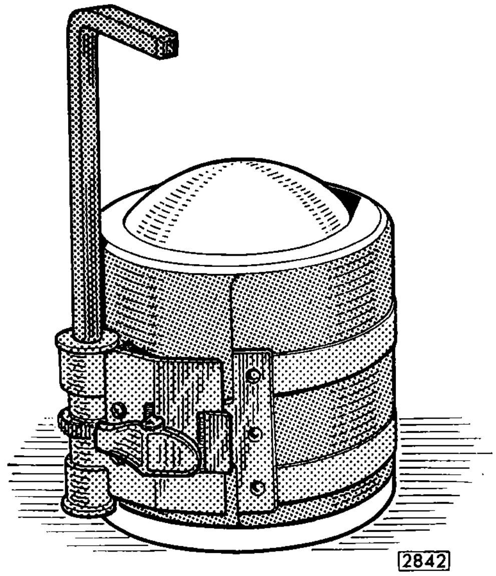


Fig. 49. Using a piston ring clamp for refitting a piston. (Churchill Tool No. 38U3).

The cap must be fitted to the connecting rod so that the cylinder numbers stamped on each part are on the same side.

Tighten the connecting rod nuts to a torque of 37 lb.ft. (5·1 kgm.)

SPARKING PLUGS

SERVICE PROCEDURE

To maintain peak sparking plug performance, plugs should be inspected, cleaned and re-gapped at regular intervals of 3,000 miles, (5,000 KM). Under certain fuel and operating conditions, particularly extended slow speed town driving, sparking plugs may have to be serviced at shorter intervals.

Disconnect the ignition cables from all sparking plugs.

Loosen the sparking plugs about two turns anti-clockwise using the proper sized deep-socket wrench.

Blow away the dirt from around the base of each plug.

Remove the sparking plugs and place them in a suitable holder, preferably in the order they were in the engine.

ANALYSING SERVICE CONDITIONS

Examine the gaskets to see if the sparking plugs were properly installed. If the gaskets were excessively compressed, installed on dirty seats or distorted, leakage has probably occurred during service which would tend to cause overheating of the sparking plugs. Gaskets properly installed will have flat clean surfaces. Gaskets which are approximately one-half their original thickness will be satisfactory but thinner ones should be renewed.

Examine the firing ends of the sparking plugs, noting the type of the deposits and the degree of electrode erosion. The typical conditions illustrated may indicate the use of a sparking plug with an incorrect heat range or faulty engine and ignition system operation. Remember that if sufficient voltage is not delivered to the sparking plug, no type of plug can fire the mixture in the cylinder properly.

Normal Condition

Look for powdery deposits ranging from brown to greyish tan. Electrodes may be worn slightly. These are signs of a sparking plug of the correct heat range used under **normal** conditions, that is mixed periods of high speed and low speed driving. Cleaning and re-gapping of the sparking plugs is all that is required.

Normal Condition

Watch for white to yellowish powdery deposits. This usually indicates long periods of constant speed driving or a lot of slow speed city driving.

Fig. 50. Normal condition.

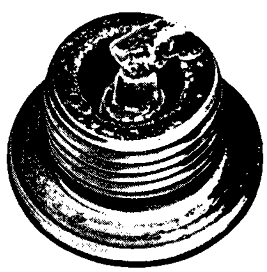


Fig. 51. Oil fouling.

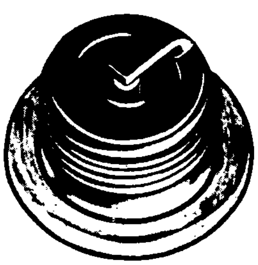


Fig. 52. Petrol fouling.

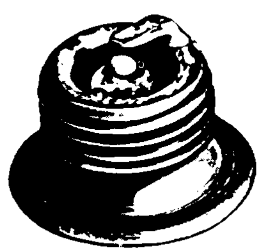


Fig. 53. Badly burned sparking plug.

These deposits have no effect on performance if the sparking plugs are cleaned **thoroughly** at approximately 3,000 miles (5,000 Km.) intervals. Remember to "wobble" the plug during abrasive blasting in the Champion Service Unit. Then file the sparking surfaces vigorously to expose bright clean metal.

Oil Fouling

This is usually indicated by wet, sludgy deposits traceable to excessive oil entering the combustion chamber through worn cylinders, rings and pistons, excessive clearances between intake valve guides and stems, or worn and loose bearings, etc. Hotter sparking plugs may alleviate oil fouling temporarily, but in severe cases engine overhaul is necessary.

Petrol Fouling

This is usually indicated by dry, fluffy black deposits which result from incomplete combustion. Too rich an air-fuel mixture, excessive use of the mixture control or a faulty automatic choke can cause incomplete burning. In addition, a defective coil, contact breaker points, or ignition cable, can reduce the voltage supplied to the sparking plug and cause misfiring. If fouling is evident in only a few cylinders, sticking valves may be the cause. Excessive idling, slow speeds, or stop-and-go driving, can also keep the plug temperatures so low that normal combustion deposits are not burned off. In the latter case, hotter plugs may be installed.

Burned or Overheated Condition

This condition is usually identified by a white, burned or blistered insulator nose and badly eroded electrodes. Inefficient engine cooling and improper ignition timing can cause general overheating. Severe service, such as sustained high speed and heavy loads, can also produce abnormally high temperatures in the combustion chamber which necessitate the use of colder sparking plugs.

File the sparking surfaces of the electrodes by means of a point file. If necessary, open the gaps slightly and file vigorously enough to obtain bright, clean, parallel surfaces. For best results, hold the plug in a vice.

Reset the gaps using the bending fixture of the Champion Gap Tool. Do not apply pressure on the centre electrode as insulator fractures may result. Use he bending fixture to obtain parallel sparking surfaces for maximum gap life.

Visually inspect all sparking plugs for cracked or chipped insulators. Discard all plugs with insulator fractures.

Test the sparking ability of a used sparking plug on a comparator.

Clean the threads by means of hand or power-driven wire brush. If the latter type is used, wire size should not exceed 0·005" (0·127 mm.) diameter. Do not wire brush the insulator nor the electrodes.

Clean gasket seats on the cylinder head before installing sparking plugs to ensure proper seating of the sparking plug gasket. Then, using a new gasket, screw in the plug by hand finger-tight.

Note: If the sparking plug cannot be seated on its gasket by hand, clean out the cylinder head threads with a clean-out tap or with another used sparking plug having three or four vertical flutes filed in its thread. Grease the tap well to retain chippings which may fall into the combustion chamber. Tighten the sparking plugs to a torque of 27 lb.ft. (3.73 kgm.).

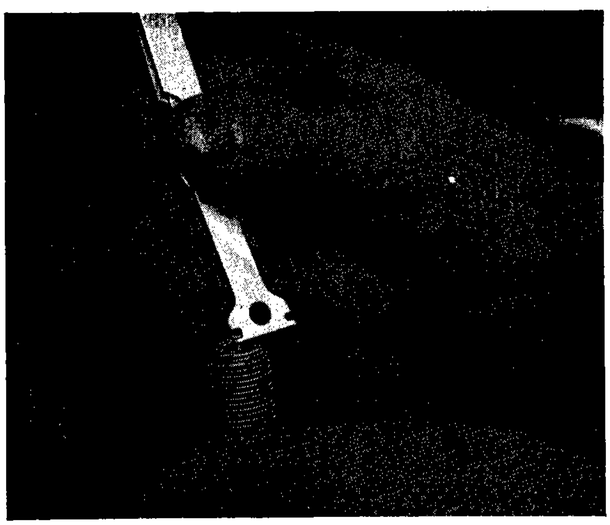


Fig. 54. Setting the gap with the special tool.

STANDARD GAP SETTING

The sparking plug gap settings recommended in this Service Manual have been found to give the best overall performance under all service conditions. They are based on extensive dynamometer testing and experience on the road, and are generally a compromise between the wide gaps necessary for best idling performance and the small gaps required for the best high speed performance.

All plugs should be reset to the specified gap by bending the side electrode only, using the special tool available from the Champion Sparking Plug Company.

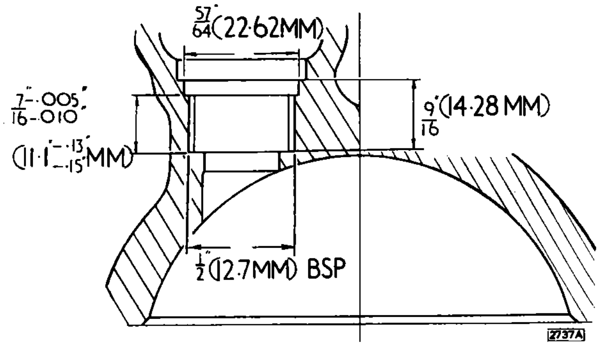


Fig. 55. Boring and tapping instructions.

SPARKING PLUG INSERTS

When it becomes necessary to fit a sparking plug insert (C.22381) in the event of a stripped thread, proceed as follows:—

(a) Bore out the stripped thread to 0·75" (19·05 mm.) diameter and tap ½" B.S.P. as shown in Fig. 55.

(b) Make a counterbore $^{57}/_{64}$"(22·62mm.) diameter to take the larger diameter of the insert as shown in Fig. 55.

(c) Fit the screwed insert ensuring that it sits firmly on the face at the bottom of the thread.

(d) Drill and ream a ⅛" (3·17 mm.) diameter hole $\frac{3}{16}$" (4·76 mm.) deep between the side of the insert and the cylinder head as shown in Fig. 56.

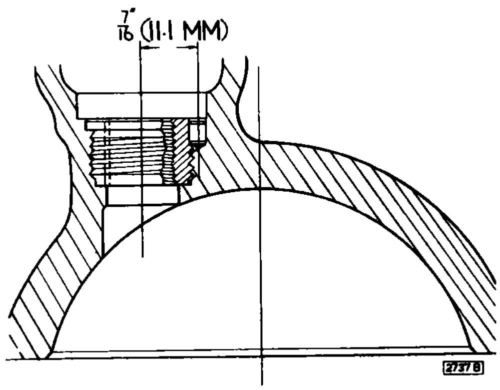


Fig. 56. Fitting the screwed insert.

(e) Drive in the locking pin and make sure that the pin is below the surface as in Fig. 56.

(f) To secure, peen over the aluminium on the chamfered portion of the insert and also the locking pin.

TAPPETS, TAPPET GUIDES AND ADJUSTING PADS

The chilled cast iron tappets are of cylindrical form and run in guides made of austenitic iron which are shrunk into the cylinder head. A steel pad for adjustment of the valve clearance is sandwiched between the underside of the tappet and top of the valve stem. The pads are available in a range of thicknesses, rising in 0·001" (0·025 mm.) steps, from 0·085"–0·110" (2·16–2·79 mm.) and are etched on the surface with the letter "A" to "Z" each letter indicating an increase in size of 0·001" (0·025 mm.) (See page B.64).

REMOVAL OF TAPPETS AND ADJUSTING PADS

Remove the camshafts as described on page B.34. The tappets can now be withdrawn with a suction valve grinding tool.

Remove the adjusting pads. If valve clearance adjustment is not being carried out the adjusting pads must be refitted to their original positions.

OVERHAUL

Examine the tappets and tappet guides for signs of wear. The diametrical clearance between the tappet and tappet guide should be 0·0008"–0·0019" (0·02–0·05 mm.).

Examine the adjusting pads for signs of indentation. Renew if necessary with the appropriate size when making valve clearance adjustment on reassembly.

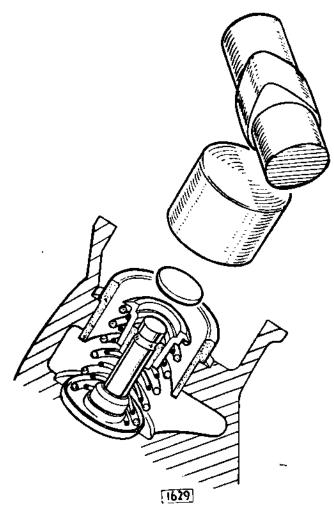


Fig. 57. Showing the tappet and adjustment pad.

Tappet Guide Replacement

If it is found necessary to replace the tappet guides they must be fitted in accordance with the following instructions and only genuine factory replacement parts used.

(a) Remove the old tappet guide by boring out until the guide collapses. Take care not to damage the bore for the guide in the cylinder head.

(b) Carefully measure the diameter of the tappet guide bore in the cylinder head at room temperature 68°F (20°C).

(c) Grind down the 1·643″ (41·73 mm.) outside diameter of tappet guide to a diameter of 0·003″ (0·08 mm.) larger than the tappet guide bore dimension, that is to give an interference fit of 0·003″ (0·08 mm.).

(d) Also grind off the same amount from the "lead-in" at the bottom of tappet guide. The reduction in diameter from the adjacent diameter should be 0·0032–0·0057″ (0·08–0·14 mm.).

(e) Heat the cylinder head in an oven for half an hour from cold to a temperature of 300°F (150°C).

(f) Fit the tappet guide, ensuring that the lip at top of guide beds evenly in the recess.

(g) After fitting, ream tappet guide bore to a diameter of

$1\frac{3}{8}'' \begin{smallmatrix} +0{\cdot}0007'' \\ -0{\cdot}0000'' \end{smallmatrix}$ $(34{\cdot}925 \begin{smallmatrix} +0{\cdot}018 \text{ mm.}) \\ -0{\cdot}000 \text{ mm.}) \end{smallmatrix}$

Note: It is essential that, when reamed, the tappet guide bore is concentric with the bore of the valve guide.

THE TIMING GEAR

The camshafts are driven by Duplex endless roller chains in two stages.

The first stage or bottom timing chain drives the larger wheel of a double intermediate sprocket; the second stage or top timing chain passes round the smaller wheel of the intermediate sprocket, both camshaft sprockets, and is looped below an idler sprocket.

The idler sprocket has an eccentric shaft for top timing chain tension adjustment and the bottom chain is automatically tensioned by an hydraulic tensioner bolted to the cylinder block. Rubber vibration dampers are located at convenient points around the chains.

REMOVAL

Remove the cylinder head as described on page B.41.

Remove the radiator, cowl, header tank and cooling fan (as described in Section D "Cooling System").

Remove the damper as described on page B.38.

Withdraw the split cone.

Remove the sump as described on page B.21.

Unscrew the set bolts and nuts, and remove the water pump from the timing cover.

Note the gasket between the pump and the timing cover.

Remove the timing cover as described on page B.22.

Remove the bottom timing chain tensioner as described on page B.22.

Unscrew the four setscrews securing the front mounting bracket to the cylinder block.

Remove the two screwdriver slotted setscrews securing the rear mounting bracket; these setscrews secure the intermediate damper bracket.

The timing gear assembly can now be removed.

DISMANTLING

Remove the nut and serrated washer from the front end of the idler shaft, and withdraw the plunger and spring.

Remove the four nuts securing the front mounting bracket to the rear bracket. Withdraw the front bracket from the studs.

Remove the bottom timing chain from the large intermediate sprocket.

To remove the intermediate sprockets, remove the circlip from the end of the shaft in the mounting bracket. Press the shaft out of the bracket, and withdraw the sprockets from the shaft.

OVERHAUL

If the chains show signs of stretching or wear, new ones should be fitted. Replace any sprockets and dampers that show signs of wear.

ASSEMBLING

Fit the eccentric shaft to the hole in the front mounting bracket. Insert the spring and locking plunger for the serrated plate to the hole in the front mounting bracket. Fit the serrated plate and secure with the shakeproof washer and nut. Fit the idler sprocket (21 teeth) to the eccentric shaft.

Fit the intermediate sprocket (20 and 28 teeth) to the shaft with the larger sprocket forward and press the shaft through the lower central hole in the rear mounting bracket. Secure with the circlip at the rear of bracket.

Fit the top timing chain (longer chain) to the small intermediate sprocket and the bottom timing chain (shorter chain) to the large intermediate sprocket.

Loop the upper timing chain under the idler sprocket and offer up the front mounting bracket to the rear mounting bracket with the two chain dampers interposed between the brackets.

Fit the intermediate damper to the bottom of the rear mounting bracket with two screwdriver slotted setscrews and shakeproof washers.

Pass the four securing bolts through the holes in the brackets, chain dampers and spacers noting that shakeproof washers are fitted under the bolt heads. Secure the two mounting brackets together with four nuts and shakeproof washers.

REFITTING

Refitting the remainder of the assembly is the reverse of the removal procedure

When refitting the timing chain tensioner refer to page B.62.

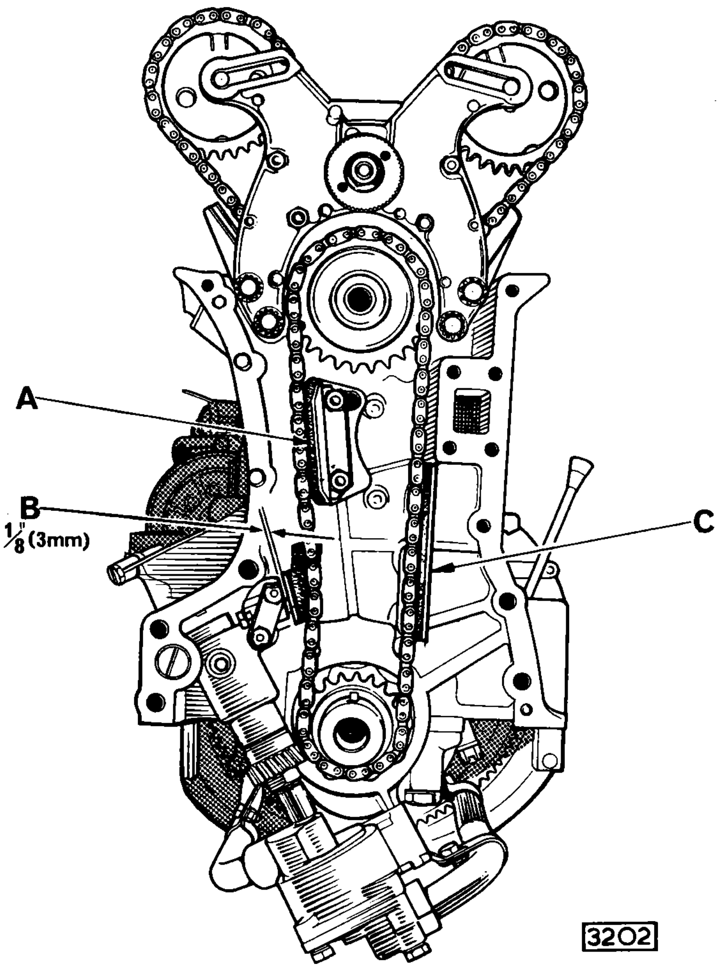
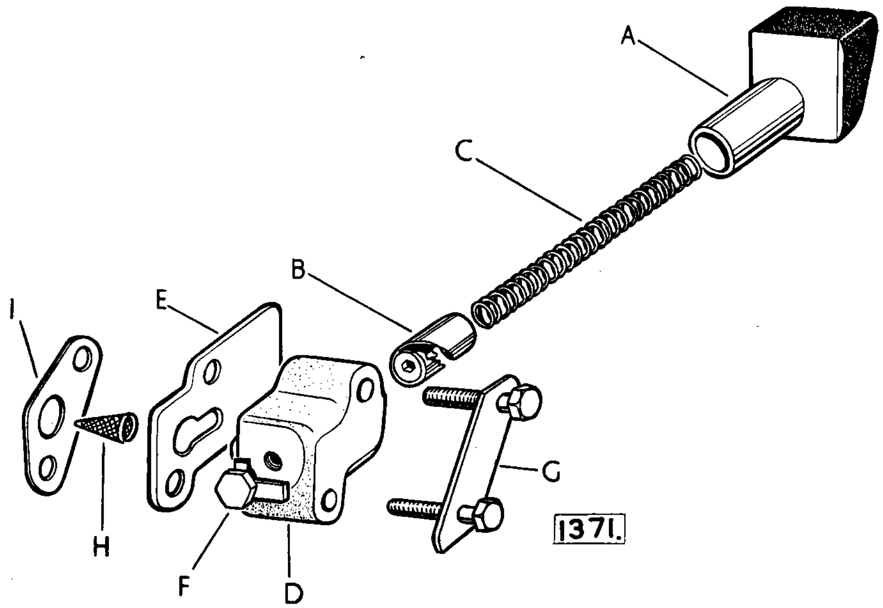


Fig. 58. When fitting a new lower timing chain, set the intermediate damper (A) in light contact with the chain when there is ⅛" (3 mm) gap between the rubber slipper and the tensioner body. In the case of a worn chain the gap (B) may have to be increased to avoid fouling between the chain and the cylinder block. Set the lower damper (C) in light contact with the chain.



A	Plunger	F	End plug and tap washer
B	Restraint cylinder	G	Body
C	Spring	H	Gauze filter
D	Adjuster body	I	Shim
E	Backing plate		

Fig. 59. Exploded view of the bottom timing chain tensioner.

THE BOTTOM CHAIN TENSIONER

The bottom timing chain tensioner is of hydraulic type and consists of an oil resistant rubber slipper mounted on a plunger (A, Fig. 59) which bears on the ouside of the chain. The light spring (C) cased by the restraint cylinder (B) and the plunger, in combination with oil pressure holds the slipper head against the chain keeping it in correct tension.

Return movement of the slipper head is prevented by the limit peg at the bottom end of the plunger bore engaging the nearest tooth in the helical slot of the restraint cylinder. The oil is introduced into the adjuster body (D) via a small drilling in the locating spigot and passes through a hole in the slipper head to lubricate the chain. The backing plate (E) provides a suitable face along which the slipper head can work.

REMOVAL

Proceed as described under "Timing Gear—Removal" on page B.60 until the chain tensioner is accessible.

Remove the bottom plug which provides access to the hexagonal hole in the end of the restraint cylinder. Insert an Allen key (0·125″ A/F) (3·1 mm.) into this and turn the key in a clockwise direction until the slipper head remains in the retracted position. Remove the securing bolts and detach the adjuster. A conical filter is fitted in the oil feed hole in the cylinder block and this should be removed and cleaned in petrol.

REFITTING

Fit the conical filter to the oil feed hole in the cylinder block.

Fit shims as necessary, between the backing plate and cylinder block so that the timing chain runs centrally along the rubber slipper.

Fit the tab washer and two securing bolts. Tighten the bolts and tap the tab washers against the bolt heads.

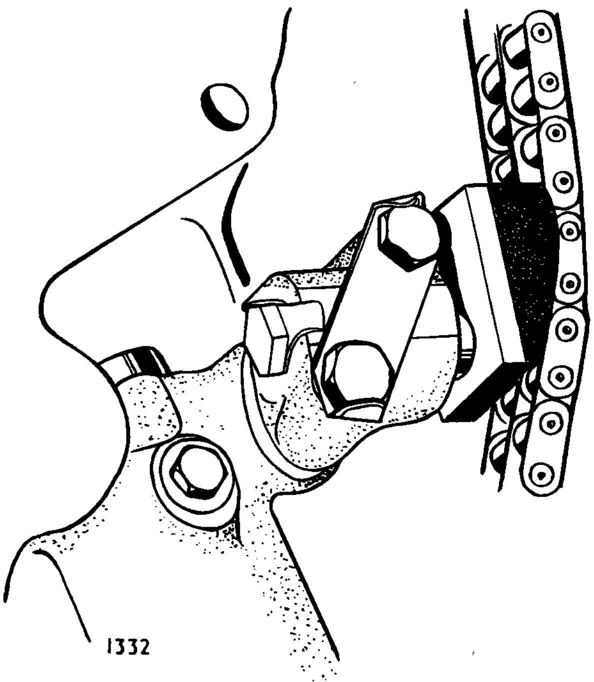


Fig. 60. Showing the bottom timing chain tensioner in position.

It is important that no attempt is made to release the locking mechanism until the adjuster has been finally mounted in the engine **WITH THE TIMING CHAIN IN POSITION.**

Remove the hexagon headed plug and tab washer from the end of the body. Insert the Allen key into the hole until it registers in the end of the restraint cylinder. Turn the key clockwise until the tensioner head moves forward under spring pressure against the chain. Do not attempt to turn the key anti-clockwise, nor force the tensioner head into the chain by external pressure.

Refit the plug and secure the tab washer.

THE VALVES AND SPRINGS

The inlet valves are of silicon chrome steel and the exhaust valves are of austenitic steel. Double coil valve springs are fitted and are retained by a valve collar with split cotters.

Warning° As the valves in the full open position protrude below the cylinder head joint face, the cylinder head must not be placed joint face downwards directly on a flat surface; support the cylinder head on wooden blocks, one at each end.

REMOVAL

Remove the cylinder head as described on page B.41.

Remove Valves

With the cylinder head on the bench, remove the inlet manifold and the revolution counter generator.

Remove the four bearing caps from each camshaft and lift out the camshafts (note mating marks on each bearing cap).

Remove the 12 tappets and adjusting pads situated between tappets and valve stems. Lay out the tappets and pads in order, to ensure that they can be replaced in their original guides.

Obtain a block of wood the approximate size of the combustion chambers and place this under the valve heads in No. 1 cylinder combustion chamber. Press down the valve collars and extract the split cotters. Remove the collars, valve springs and spring seats. Repeat for the remaining five cylinders. Valves are numbered and must be replaced in the original locations, No. 1 cylinder being at the rear, that is, the flywheel end.

OVERHAUL

Valves

Examine the valves for pitting, burning or distortion and reface or renew the valves as necessary. Also reface the valve seats in the cylinder head and grind the valves to their seats using a suction valve tool. When refacing the valves or seat inserts do not remove more metal than is necessary to clean up the facings.

The valve seat angles are as follows: inlet and exhaust 45°.

Renew valves where the stem wear exceeds 0·003″ (0·08 mm.). The clearance of the valve stem in the guide when new is 0·001–0·004″ (0·25–0·10 mm.)

Valve Springs

Test the valve springs for pressure, either by comparison with the figures given in the "Valve Spring Data" or by comparison with a new valve spring.

To test against a new valve spring, insert both valve springs end to end between the jaws of a vice or under a press with a flat metal plate interposed between the two springs. Apply a load to compress the springs partly and measure their comparative lengths.

When fitting valve springs to the cylinder head compress springs using Churchill Tool No. J.6118.

VALVE CLEARANCE ADJUSTMENT

When checking the valve clearances, the camshafts must be fitted one at a time. If one camshaft is rotated when the other camshaft is in position, fouling is likely to take place between the inlet and exhaust valves. Obtain and record all valve clearances by using a feeler gauge between the back of each cam and the appropriate valve tappet.

Correct valve clearances are:

Inlet	0·004″ (0·10 mm.)
Exhaust	0·006″ (0·15 mm.)

Adjusting pads are available rising in 0·001″ (0·03 mm.) sizes from 0·085–0·110″ (2·16–2·79 mm.) and are etched on the surface with the letter "A" to "Z", each letter indicating an increase in size of 0·001″ (0·03 mm.) Should any valve clearance require correction, remove the camshaft, tappet and adjusting pad. Observe the letter etched on the adjusting pad if visible. If the letter is not visible measure the pad with a micrometer and should the recorded clearance for this valve have shown say 0·002″ (0·05 mm.) excessive clearance select a new adjusting pad bearing a letter two lower than the original pad.

As an example, assume that No. 1 inlet valve clearance is tested and recorded as 0·007″ (0·18 mm). On removal of the adjusting pad, if this is etched with the letter "D" then substitution with a pad bearing the letter "G" will correct the clearance for No. 1 inlet valve.

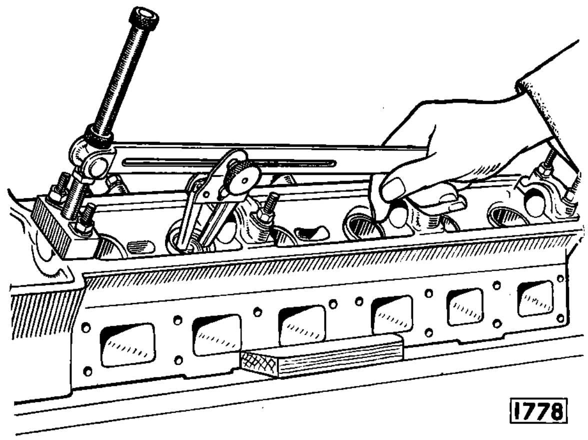


Fig. 61. Fitting the valve springs utilising the valve spring compressing tool (Churchill Tool No. J.6118).

Valve adjusting Pads

	ins.	mm.
A	0·085	2·16
B	0·086	2·18
C	0·087	2·21
D	0·088	2·23
E	0·089	2·26
F	0·090	2·29
G	0·091	2·31
H	0·092	2·34
I	0·093	2·36
J	0·094	2·39
K	0·095	2·41
L	0·096	2·44
M	0·097	2·46
N	0·098	2·49
O	0·099	2·51
P	0·100	2·54
Q	0·101	2·56
R	0·102	2·59
S	0·103	2·62
T	0·104	2·64
U	0·105	2·67
V	0·106	2·69
W	0·107	2·72
X	0·108	2·74
Y	0·109	2·77
Z	0·110	2·79

When fitting the camshafts prior to fitting the cylinder head to the engine it is most important that the keyway in the front bearing flange of each camshaft is perpendicular (at 90°) to the adjacent camshaft cover face before tightening down the camshaft bearing cap nuts. Tighten the camshaft bearing cap nuts to a torque of 15 lb.ft. (2·0 kgm).

REFITTING

Before attempting to refit the cylinder head refer to the instructions given on page B.42.

THE VALVE GUIDES

The valve guides are of cast iron and are chamferred at the upper ends. The outside diameter of the guide is reduced at the upper end to provide a "lead-in" when fitting the guide to the cylinder head. The inlet and exhaust guides are of different lengths, the inlet being the shorter of the two.

REPLACEMENT

Examine the valve guides for evidence of wear in the bore. The clearance between the valve stem and the guide when new is 0·001–0·004″ (0·025–0·10 mm.).

If it is found necessary to replace worn valve guides they must be fitted in accordance with the following instructions and only genuine factory replacement parts used.

(a) Press out, or drive out with a piloted drift, the old valve guide from the top of the cylinder head.

(b) Ream the valve guide bore in the cylinder head to a diameter of:—

$$0{\cdot}505'' \begin{matrix} +0{\cdot}0005'' \\ -0{\cdot}0002'' \end{matrix} (12{\cdot}83 \text{ mm.} \begin{matrix} +0{\cdot}012 \text{ mm.)} \\ -0{\cdot}005 \text{ mm.)} \end{matrix}$$

(c) Heat the cylinder head by immersing in boiling water for 30 minutes.

(d) Coat the valve guide with graphite grease and press in, or drive in with a piloted drift, from the combustion chamber end. The correct fitted position for both inlet and exhaust guides is with the the top of guide (chamferred end) $\frac{5}{16}''$ (8 mm.) above the spot facing for the valve spring seat. (See Fig. 63).

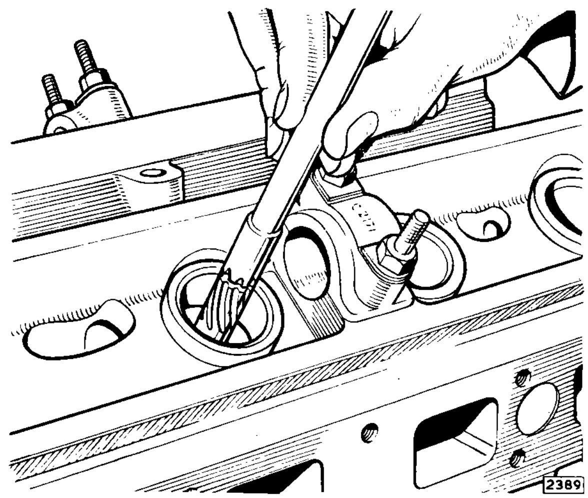


Fig. 62. Reaming the bores in the cylinder head with special tool Part No. J.18 to take service replacement valve guides.

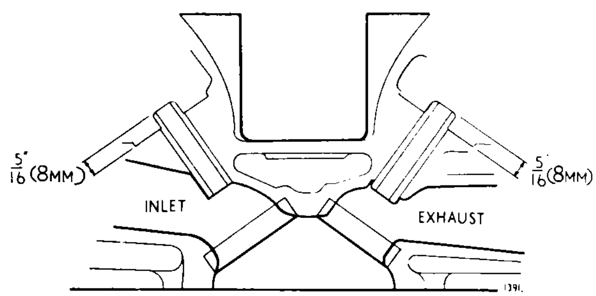


Fig. 63. Showing the fitted position of the valve guides.

THE VALVE SEAT INSERTS

The valve seat inserts are centrifugally cast iron and are shrunk into the cylinder head.

REPLACEMENT

If it is found necessary to replace the valve seat inserts they must be fitted in accordance with the following instructions and only genuine factory replacement parts used.

(a) Remove the old valve seat insert by boring out until the insert collapses. Take care not to damage the recess for the insert in the cylinder head.

(b) Carefully measure the diameter of the insert recess in the cylinder head at room temperature 68°F (20°C).

(c) Grind down outside of the insert to a diameter of 0·003″ (0·08 mm.) larger than the recess dimension, that is, to give an interference fit of 0·003″ (0·08 mm.).

(d) Heat the cylinder head in an oven for one hour from cold at a temperature of 300°F (150°C).

(e) Fit the insert, ensuring that it beds evenly in its recess.

(f) After the valve seat insert has been fitted the following instructions should be carried out to ensure that the valve clearance can be obtained within the range of the adjusting pads, that is, 0·085–0·0110″ (2·16–2·79 mm.).

(i) Assemble the camshafts to the cylinder head. Fit the appropriate valve to the insert in question and, with the valve seat faces touching, check the distance between the top of the valve stem and the **back** of the cam. This should be 0·320″ (8·13 mm.) **plus** the appropriate valve clearance. (The figure of 0·320″ (8·13 mm.) includes an allowance for an adjusting pad thickness of 0·095″ (2·41 mm.)–0·097″ (2·46 mm.) which will, if necessary, permit the fitting of thicker or thinner adjusting pads when making the final valve clearance adjustment).

(ii) If the distance is greater than the figure of 0·320″ (8·13 mm.), plus the appropriate valve clearance, grind the valve seat of the insert with suitable valve grinding equipment until the correct distance is obtained.

Example: Assume that the valve insert in question is an exhaust and the distance between the top of the valve stem and the back of the cam is found to be 0·344″ (8·74 mm.).

Adding the exhaust valve clearance of 0·006″ (0·15 mm.) to 0·320″ (8·14 mm.) equals 0·326″ (8·28 mm.). In this case the valve seat of the insert will have to be ground down to reduce the distance between the top of the valve stem and the back of the cam by 0·018″ (0·46 mm.) that is, 0·344″ minus 0·326″ (8·74 minus 8·28 mm.).

(iii) After assembling the cylinder head, check and adjust the valve clearances in the normal manner.

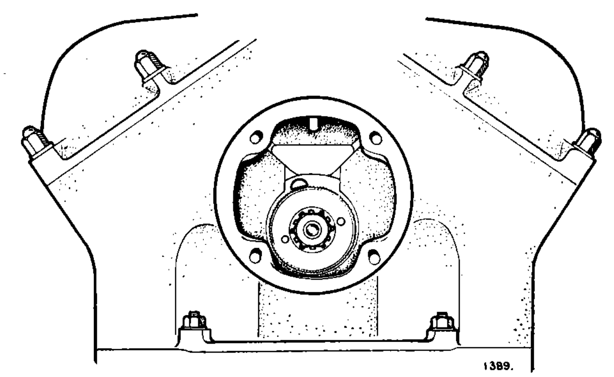


Fig. 64. Showing the serrated plate for adjustment of the top timing chain tension.

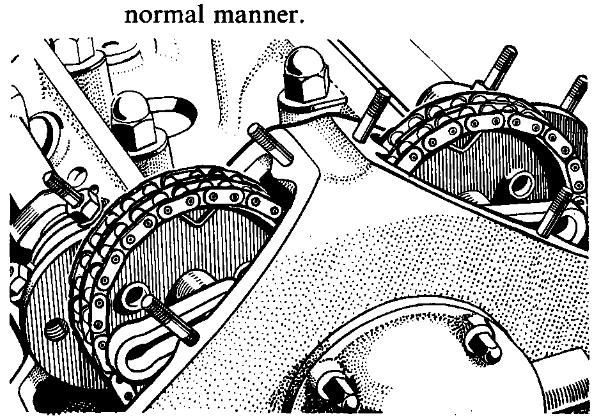


Fig. 65. Showing the camshaft sprockets disconnected from the camshafts.

VALVE TIMING

Turn the engine so that No. 6 (front) piston is exactly in the T.D.C. position on compression stroke (firing position) that is, with the distributor rotor arm opposite No. 6 cylinder segment. (See Fig. 14).

See Fig. 67 for location of T.D.C. marks.

It is important to tension the top timing chain before attempting to check or set the valve timing. Proceed as follows:

Through the breather aperture in the front of the cylinder head slacken the locknut securing the serrated plate (Fig. 64).

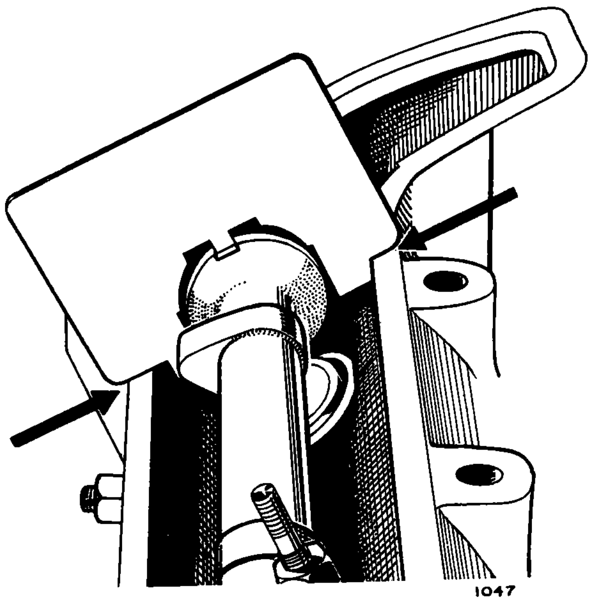


Fig. 66. The valve timing gauge in position. Ensure that the gauge is sealed at the points indicated by the arrows.

Tension the chain by pressing the locking plunger inwards and rotating the serrated plate by the two holes in an anti-clockwise direction. Turn the engine each way slightly and recheck the chain tension. When correctly tensioned there should be slight flexibility on both outer sides below the camshaft sprockets, that is, the chain must not be dead tight. Release the locking plunger and securely tighten the locknut.

Remove the locking wire from the setscrews securing the camshaft sprockets. Note the positions of the **inaccessible** setscrews and rotate the engine

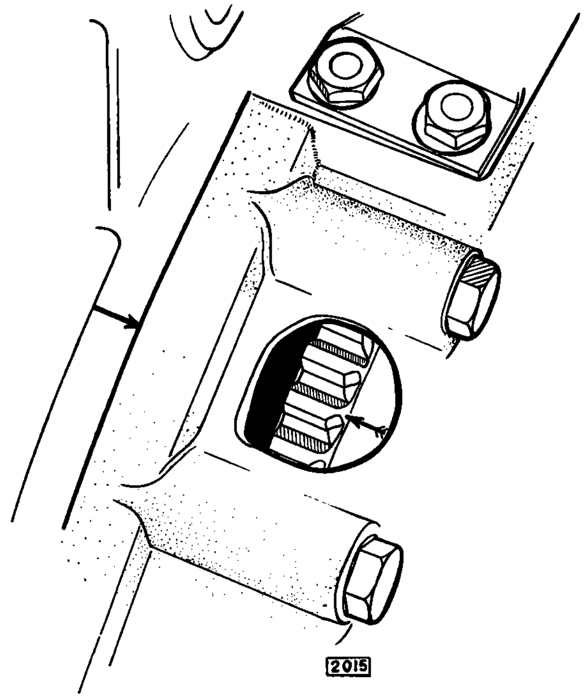


Fig. 67. Showing the location of the Top Dead Centre marks on the left-hand side of the combined engine and transmission unit.

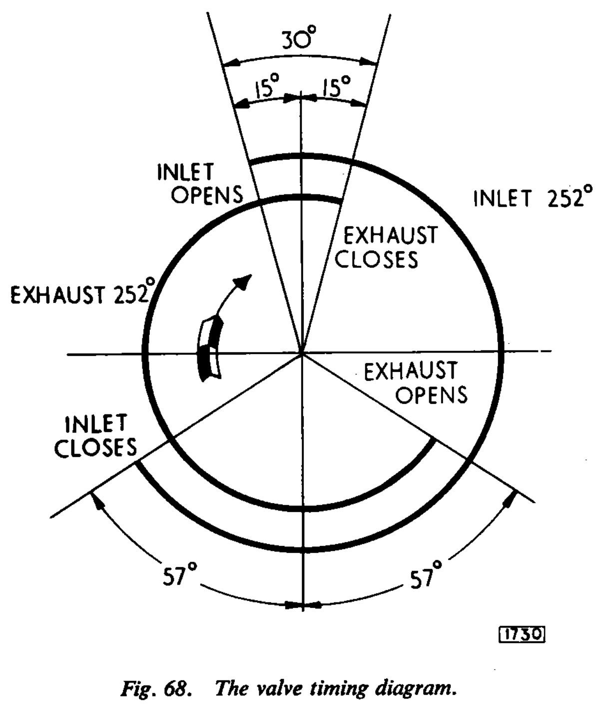


Fig. 68. The valve timing diagram.

until they can be removed. Remove the setscrew from each sprocket and turn the engine back to the T.D.C. position with the No. 6 firing and remove the remaining screws. Tap the camshaft sprockets off the flanges of the camshafts.

Accurately position the camshafts with the valve timing gauge (Part No. C.4015) and check that the T.D.C. marks are in exact alignment.

Withdraw the circlips retaining the adjusting plates to the camshaft sprockets and press the adjusting plates forward until the serrations disengage. Replace the sprockets on the flanges of camshafts and align the two holes in the adjuster plate with the two tapped holes in each camshaft flange. Engage the serrations of the adjuster plates with the serrations in the sprockets.

Note: It is most important that the holes are in exact alignment, otherwise when the setscrews are fitted, the camshafts will be moved out of position. If difficulty is experienced in aligning the holes exactly the adjuster plates should be turned through 180°, which due to the construction of the plate will facilitate alignment.

Fit the circlips to the sprockets and one setscrew to the accessible holes in each adjuster plate. Turn the engine until the other two holes are accessible and fit the two remaining setscrews.

Finally, recheck the timing chain tension and valve timing in this order. Secure the four setscrews for camshaft sprockets with new locking wire.

ENGINE MOUNTINGS

The engine is supported at the front on two rubber mountings which are attached to brackets on the front subframe. The rear is supported on a coil spring mounted in a channel support which is bolted to the body floor. An extension of the spring retainer passes through a rubber bush in the channel support.

FRONT ENGINE MOUNTINGS

Removal

Support the engine by the lifting straps. Unscrew the large set bolt and remove the large set bolt together with the spring washer and plain washer.

Raise the engine so that the front mounting brackets are just clear of the mounting rubbers.

Remove the two bolts and self-locking nuts securing the front engine mounting to the support bracket on the body side members. Repeat for the other side.

Refitting

Refitting is the reverse of the removal procedure.

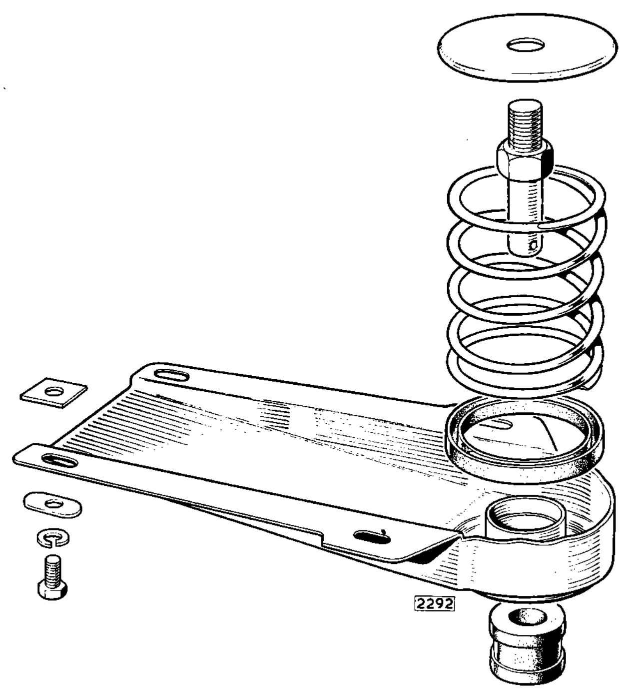


Fig. 69. The rear engine mounting.

REAR ENGINE MOUNTING

Removal

Using a jack, support the rear engine mounting. Remove the four securing setscrews, spring washers and oval washers and lower the jack slowly to release the tension on the mounting spring. Remove the mounting and mounting spring ensuring that the four square packing pieces situated between the mounting and the body are not mislaid.

Refitting

Refitting is the reverse of the removal procedure.

THE ENGINE STABILISER

The engine stabiliser is situated at the rear of the engine and consists of a rubber/steel mounting attached to the body which is connected to brackets on the clutch housing via a rubber bushed link pin. The link pin is threaded at its upper end and is connected to the rubber mounting by means of flanged washers and a self-locking nut.

ADJUSTMENT

It is MOST IMPORTANT that the stabiliser is assembled in the following manner, as failure to observe this procedure may cause engine vibration and/or fouling of the gearbox in its cowl, due to the engine having been pulled up on its mountings.

(a) Screw the lower flanged washer (D. Fig. 70) up the stabiliser pin until the flange contacts the bottom of the stabiliser rubber mounting (C). The washer is slotted on its upper face and can be screwed up the pin by engaging a thin bladed screwdriver in the slot through the centre hole of the rubber mounting.

(b) Fit the upper flanged washer (B) and tighten down with the self-locking nut (A).

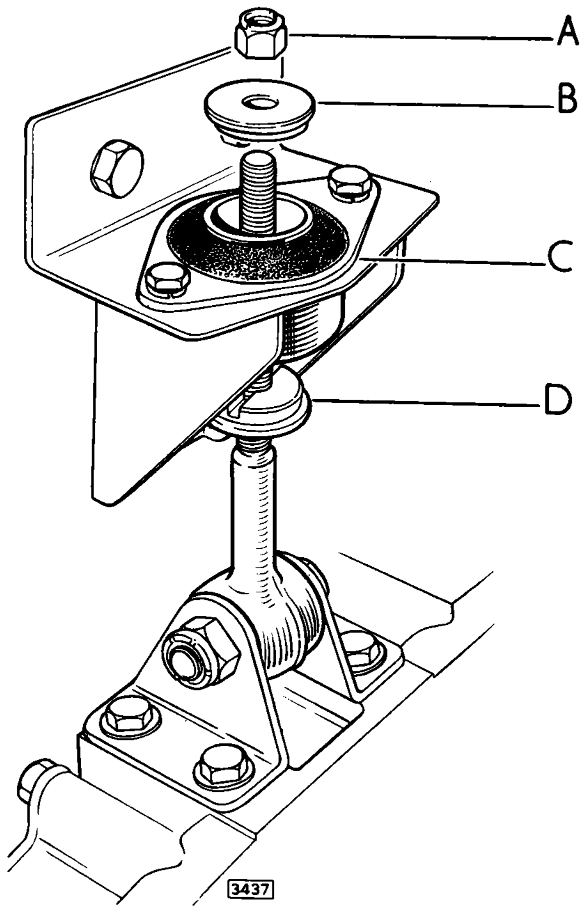


Fig. 70. The engine stabiliser.

AIR CLEANER

The air cleaner which is of the paper element type is attached to the wing valance. The cleaner is attached to the air intake elbow by means of a flexible air hose. Servicing instructions are given in "Routine Maintenance" on page B.15

REMOVAL

Detach the flexible air hose connecting the air cleaner to the air intake elbow having removed the rubber joint from the elbow and the hose clip from the air cleaner cover plate.

Turn the two quick release screws securing the air cleaner cover plate anti-clockwise through 90° and withdraw the air cleaner element. Remove the thumb nut and retainer plate from the base of the unit and withdraw the element.

REFITTING

Refitting is the reverse of the removal procedure.

SPECIAL TOOLS

Description

Timing Chain Adjuster (J.2)*

Crankshaft Rear Oil Seal Sizing Tool (J.17)*

Valve Spring Compressor (J.6118)*

Valve Guide Reamer (J.18)*

Piston Ring Compressor (38.U3)*

* Churchill Tool Number.

SECTION C

CARBURETTERS
AND FUEL SYSTEM

4·2 MARK 10 MODEL

INDEX

CARBURETTERS

THE FUEL SYSTEM

CARBURETTERS

DESCRIPTION

The 4·2 Mark 10 is fitted with triple S.U. HD8 type carburetters. The enrichment device for starting consists of an auxiliary carburetter attached to the front carburetter.

The jet, which is fed through its lower end, is attached to a synthetic rubber diaphragm by means of the jet cup and jet return spring cup, the centre of the diaphragm being compressed between these two parts; at its outer edge it is held between the diaphragm casing and the float chamber arm. The jet is controlled by the jet return spring and the jet actuating lever, the latter having an external adjusting screw which limits the upward travel of the jet and thus controls the mixture adjustment; screwing it in (clockwise) enriches the mixture, and unscrewing it weakens the mixture.

Throttle spindle glands

Provision is made for the use of the throttle spindle glands consisting of the cork gland itself, a dished retaining washer, a spring and a shroud. This assembly should not require servicing and can only be removed by dismantling the throttle spindle and disc.

Idling

The carburetter idles on the main jet and the mixture is conducted along the passage way connecting the choke space to the other side of the throttle disc.

The quantity of the mixture passing through the passage way and, therefore, the engine idling speed, is controlled by the "slow-run" valve. It follows that, when idling, the throttle remains closed against the bore of the carburetter.

DATA

Type	S.U. HD 8 (triple)
Size	2″ (5·08 cm.)
Jet needle type	UM
Jet size	0·125″ (3·17 mm.)
Auxiliary starting carburetter-needle type	425/8

Note: The jet needle type is stamped on the side or top face of the parallel portion of the needle. The auxiliary starting carburetter needle is stamped with the large number (e.g. 425) on the shoulder of the needle, with the small number on the parallel portion of the needle.

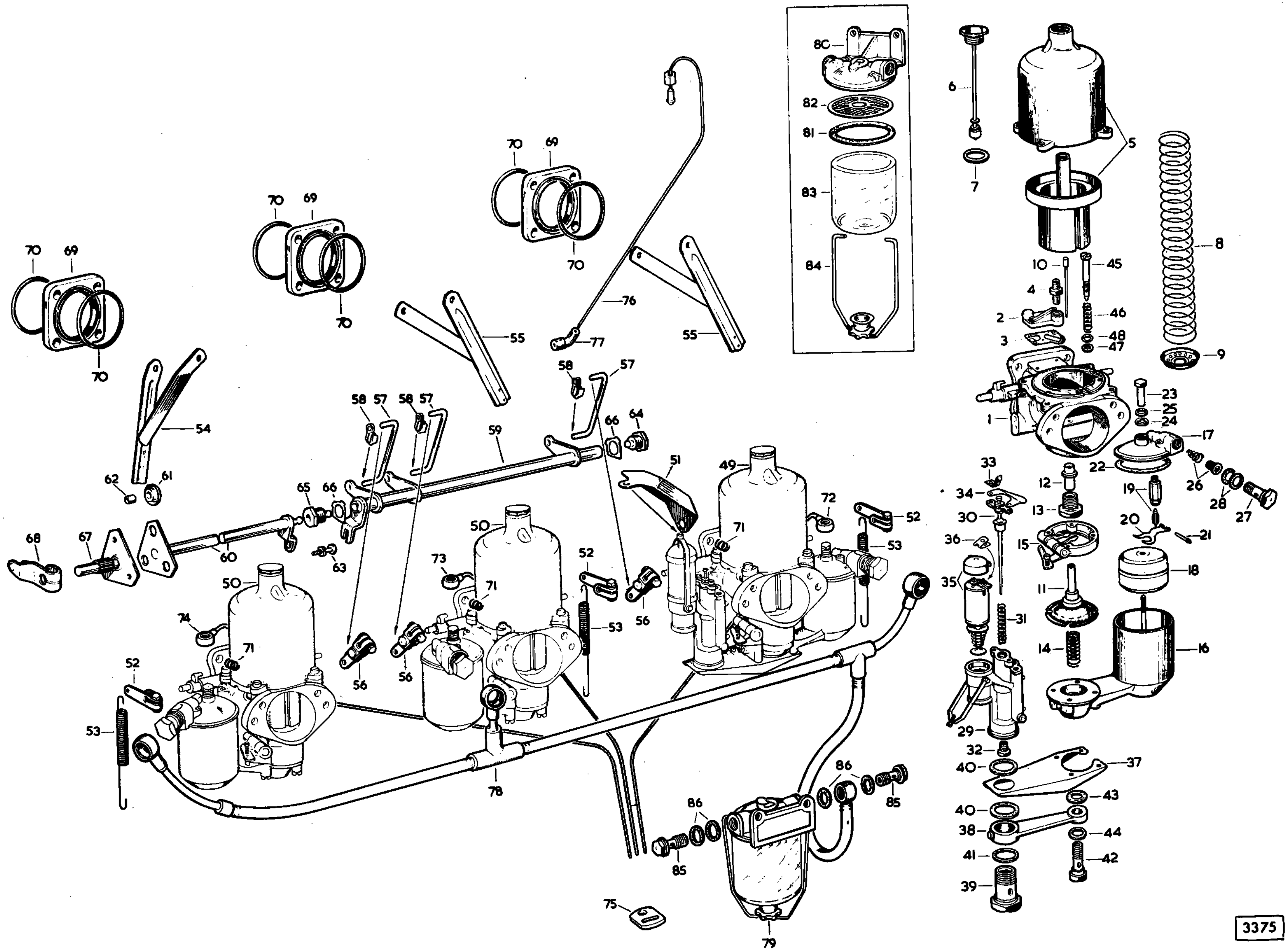


Fig. 1. Exploded view of carburetter, fuel connections and control linkage.

Key to Fig. 1

1. Carburetter body
2. Adaptor plate
3. Gasket
4. Ignition union
5. Suction chamber and piston
6. Damper
7. Fibre washer
8. Spring
9. Skid washer
10. Jet needle
11. Diaphragm
12. Jet bearing
13. Nut
14. Spring
15. Jet unit housing
16. Float chamber
17. Float chamber lid
18. Float
19. Float needle seating and needle
20. Float needle lever
21. Spindle
22. Gasket
23. Cap nut
24. Fibre serrated washer
25. Packing washer
26. Filter
27. Banjo bolt
28. Fibre washer
29. Auxiliary starter carburetter body
30. Auxiliary starter carburetter needle
31. Spring
32. Jet
33. Spring finger
34. Dust shield
35. Solenoid
36. Spring clip
37. Bracket
38. Connecting arm
39. Banjo bolt
40. Fibre washer
41. Fibre washer
42. Banjo bolt
43. Fibre washer
44. Aluminium washer
45. Valve
46. Spring
47. Gland washer
48. Dished washer
49. Front carburetter
50. Centre and rear carburetters.
51. Petrol shield
52. Lever
53. Throttle return spring
54. Anchor bracket
55. Anchor bracket
56. Lever assembly
57. Link
58. Clip
59. Front slave shaft
60. Intermediate slave shaft
61. Grommet
62. Distance piece
63. Pin
64. Adaptor
65. Adaptor
66. Tab washer
67. Rear slave shaft
68. Lever
69. Distance piece
70. "O" ring
71. Spring
72. Overflow pipe
73. Overflow pipe
74. Overflow pipe
75. Clip
76. Suction pipe
77. Neoprene elbow
78. Petrol feed pipe
79. Petrol filter
80. Filter casting
81. Gasket
82. Filter gauze
83. Glass bowl
84. Retaining strap
85. Banjo bolt
86. Fibre washer

ROUTINE MAINTENANCE

EVERY 3,000 MILES (5,000 KM.)

Lubricate Carburetter Piston Damper

Each carburetter is fitted with a hydraulic piston damper which, unless periodically replenished with oil, will cause poor acceleration and spitting back through the carburetter on rapid opening of the throttle.

To replenish with oil, unscrew the cap on top of suction chambers and lift out the damper valve which is attached to the cap. Fill the hollow piston spindle, which can be seen down inside the bore of the suction chamber, with S.A.E. 20 engine oil.

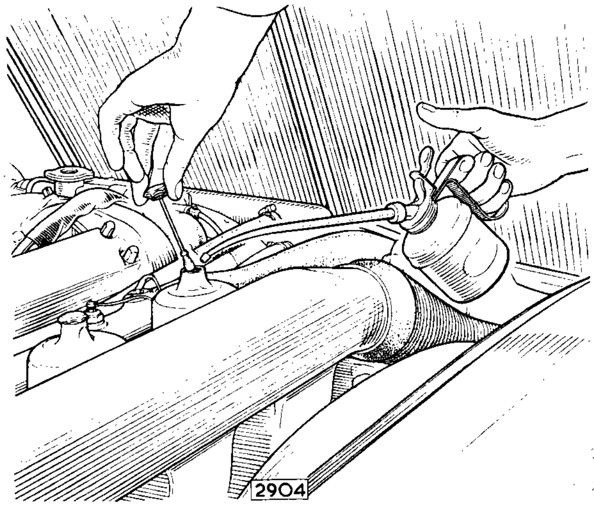


Fig. 2. Topping up an hydraulic damper.

Checking Carburetter Slow Running

(a) Cars fitted with synchromesh gearbox.

The idling speed of the engine when fully warmed up should be set at 700 r.p.m.

Note: If the idling speed is less than 700 r.p.m. or if the engine is not idling smoothly, chatter from the constant mesh gears may be noticeable.

(b) Cars fitted with automatic transmission

The idling speed of the engine when fully warmed up should be set at 500 r.p.m. with P or N selected—there will be a slight reduction of idling speed when D1 or D2 is engaged.

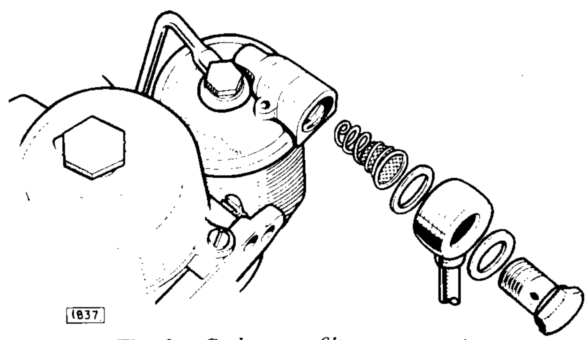


Fig. 3. Carburetter filter components.

EVERY 6,000 MILES (10,000 KM.)

Cleaning Carburetter Filters

Removal of the bolt securing the petrol pipe banjo union to each float chamber will expose the filters. Remove the filters and clean in petrol; do not use a cloth as particles will stick to the gauze.

When refitting, insert the filter with the spring first and ensure that the fibre washers are replaced one to each side of the banjo union.

Fuel Feed Line Filter

The filter is attached to the right-hand wing valance and is of the glass bowl type with a flat filter gauze.

At the recommended intervals, or more frequently if the glass bowl shows signs of becoming full of sediment, slacken the locking nut, swing the retaining clip to one side and remove the bowl, sealing washer and filter gauze.

Clean the filter gauze and bowl by washing in petrol. Examine the sealing washer and if necessary fit a new one.

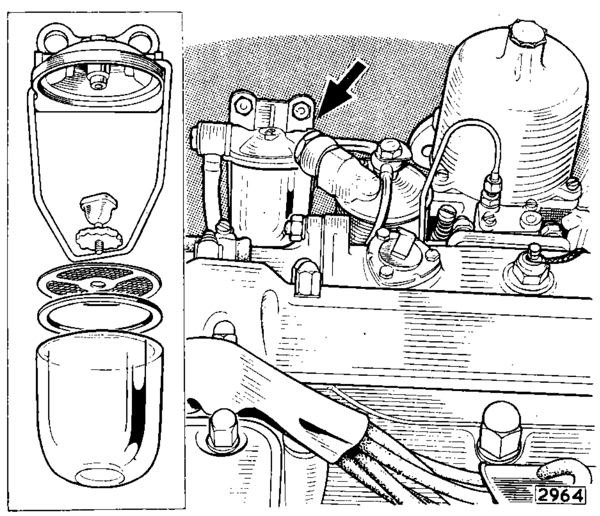


Fig. 4. Fuel feed line filter.

CARBURETTERS

Rubber "O" rings are fitted between the carburetters and manifold flanges, consequently, it is of the utmost importance that no attempt should be made to remove the carburetters from the manifolds whilst in position in the car.

Removal

Remove the earth lead from the battery.

Drain the cooling system.

Remove the air cleaner flexible hose.

Disconnect the breather pipe situated between the front and middle carburetters.

Remove the six nuts and shakeproof washers retaining the air intake box. Withdraw the air intake box and collect the three joints fitted between the intake box and carburetter flanges. Remove the three banjo bolts and six fibre washers retaining the petrol pipe.

Remove the vacuum advance pipe from the front carburetter by unscrewing the union nut.

Disconnect the throttle rod at the rear end of the inlet manifold balance pipe. Disconnect the green/blue cable at the temperature transmitter unit.

Disconnect the green/black cable at the thermostat switch and the green/black, green cables at the auxiliary starter carburetter.

Slacken the clips and disconnect the top water hose and by-pass hoses from the inlet manifold water jacket.

Slacken the clips at the rear of the inlet manifold water pipe and heater unit.

Disconnect the vacuum pipe from the base of the water valve.

Remove the nut at the base of the water valve and withdraw the water valve and heater hoses.

Slacken the clips and remove the two vacuum pipes from the T-piece at the rear of the inlet manifold balance pipe.

Remove the setscrew retaining the float chamber drain pipes to the oil filter body.

Remove the nuts and spring washers securing the inlet manifolds to the cylinder head.

Detach the heater pipe clips and cable retaining clips on the bottom manifold studs.

Withdraw the manifolds and carburetters.

Disconnect the throttle return springs.

Disconnect the throttle links which are clipped to the throttle spindle levers.

Unscrew the union retaining the auxiliary starter carburetter induction tract.

Remove the four self-locking nuts, washers and springs from each carburetter.

Remove the throttle spring brackets.

Remove the three carburetters and note carefully the position of the two rubber "O" rings and the aluminium distance piece on each manifold.

Refitting

Refitting is the reverse of the removal procedure but note should be taken of the following points:—

(a) the "O" rings should be inspected for any signs of deterioration, that is, cuts, swelling or perishing of the rubber.

(b) the self-locking nuts should be screwed down until they meet the stud shoulder and stop turning. It should be possible to flex the carburetters up and down very slightly.

CLEANING THE SUCTION CHAMBER AND PISTON

This should be done at intervals of approximately twelve months or if the carburetter is dismantled for any reason. After detaching, clean the main inside bore of the suction chamber and the two outside diameters of the piston with a rag moistened in fuel or thinners. Reassemble in a dry and clean condition with a few spots of thin oil on the piston rod only. DO NOT use metal polish to clean the suction chamber and piston.

CARBURETTER TUNING

Before tuning the carburetters, the sparking plugs gaps and contact breaker gaps should be checked and adjusted if necessary. The distributor centrifugal advance mechanism and vacuum advance operation should be checked and ignition timing set to the figure given under "General Data", with the centrifugal advance mechanisms in the static position. For final road test, adjustment of not more than six clicks of the micrometer adjustment at the distributor to either advance or retard is permitted. The ignition setting is important since if retarded or advanced too far the setting of the carburetters will be affected. As the needle size is determined during engine development, tuning of the carburetters is confined to the correct idling setting.

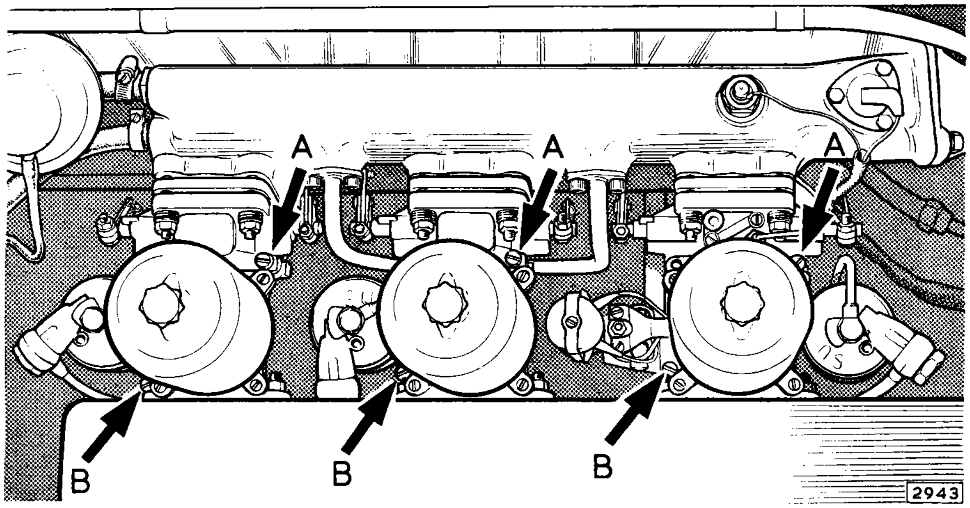


Fig. 5. Carburetter tuning. "A"—*slow running volume screw.* "B"—*mixture adjusting screw.*

If after tuning the carburetters, the idling setting and engine performance is not satisfactory, it will be necessary to check the cylinder compressions and the valve clearances.

Tuning

The air intake should be removed and the engine run until it has attained its normal operating temperature. Release the three pinch bolts securing the two piece throttle levers to the carburetter throttle spindles.

Taking one carburetter at a time close each throttle butterfly valve fully by rotating the throttle spindle in a clockwise direction looking from the front; with the throttle held closed tighten the pinch bolt keeping the two piece throttle lever in the midway position.

Repeat for the other two carburetters, then operate the accelerator linkage and observe if all the throttles are opening simultaneously by noting the movement of the full throttle stops at the left-hand side of the throttle spindles.

Note: On initial movement of the accelerator linkage there should be a limited amount of lost motion at the throttle spindles; this ensures that all the throttle butterfly valves can return to the fully closed position.

Screw down the slow running volume screws (A, Fig. 5) on to their seatings and then unscrew 2 full turns. Remove the piston and suction chambers. Unscrew the mixture adjusting screws (B) until each jet is flush with the bridge of its carburetter. Replace the pistons and suction chambers and check (by means of the piston lifting pin) that each piston falls freely on to the bridge of its carburetter. Turn down the mixture adjusting screws $2\frac{1}{2}$ turns.

Restart the engine and adjust to the desired idling speed of 500 r.p.m. by moving each slow running volume screw an equal amount. By listening to the hiss in the intakes, adjust the slow running screws until the intensity of the hiss is similar on all intakes. This will synchronise the mixture flow of the three carburetters.

When this is satisfactory the mixture should be adjusted by screwing all the mixture adjusting screws up (weaker) or down (richer) by the same amount until the fastest idling speed is obtained consistent with even firing.

As the mixture is adjusted, the engine will probably run faster and it may therefore be necessary to screw down the slow running volume screws in order to reduce the speed.

Now check the mixture strength by lifting the piston of the front carburetter by approximately $\frac{1}{32}''$ (0·8 mm.) when, if:—

(a) the engine speed increases and *continues to run faster*, this indicates that the mixture is too rich.

(b) the engine speed immediately decreases, this indicates that the mixture is too weak.

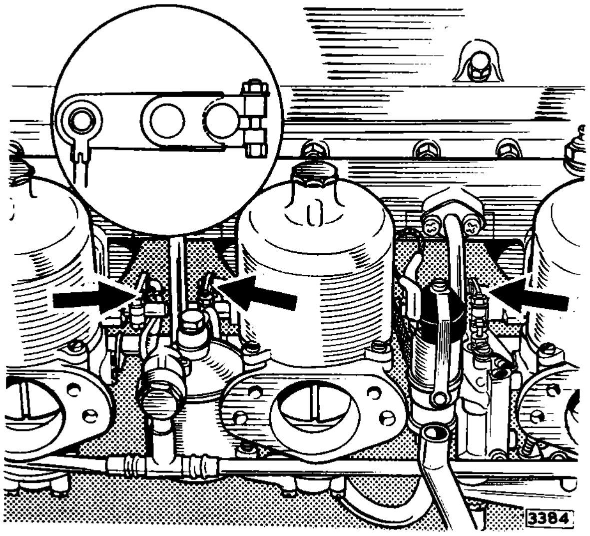


Fig. 6. Indicating the two-piece throttle levers. Inset shows a lever in the midway position.

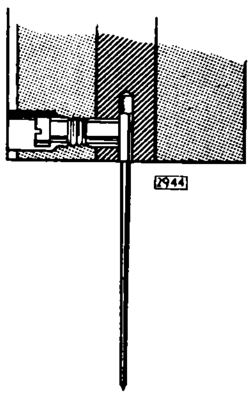


Fig. 7. Positioning the jet needle with the shoulder flush with the base of the piston.

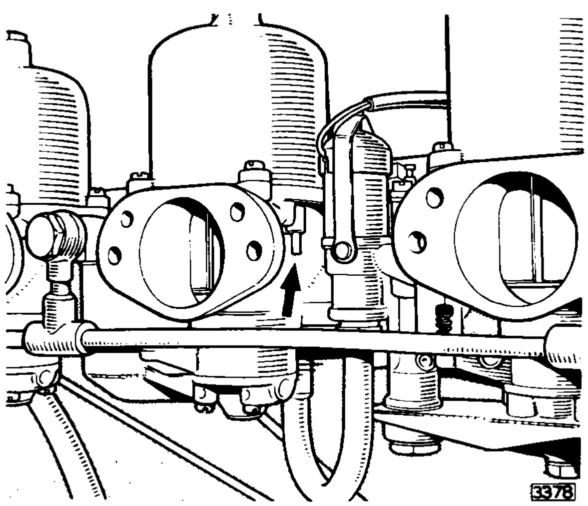


Fig. 8. The carburetter piston lifting pin; the first part of the movement is spring loaded free travel.

(c) the engine speed *momentarily* increases very slightly, this indicates that the mixture is correct.

Repeat the operation at the remaining two carburetters and after adjustment recheck the front carburetter since the carburetters are inter-dependent.

When the mixture is correct, the exhaust note should be regular and even. If it is irregular with a splashy type of misfire and colourless exhaust, the mixture is too weak. If there is a regular or rhythmical type of misfire in the exhaust beat together with a blackish exhaust, then the mixture is too rich.

Float Chamber Fuel Level

When the fuel level setting is correct a $\frac{7}{16}$" (11·1 mm.) test bar will just slide between the lid face and the inside curve of the float lever fork when the needle valve is in the "shut-off" position (see Fig. 9).

If the float lever fails to conform with this check figure, it must be carefully bent at the start of the fork section, in the necessary diιection, for correction. Take care to keep both prongs of the fork level with each other and maintain the straight portion of the lever dead flat.

When setting the fuel lever ensure that the spring loaded plunger (A) in the "Delrin" needle is not compressed.

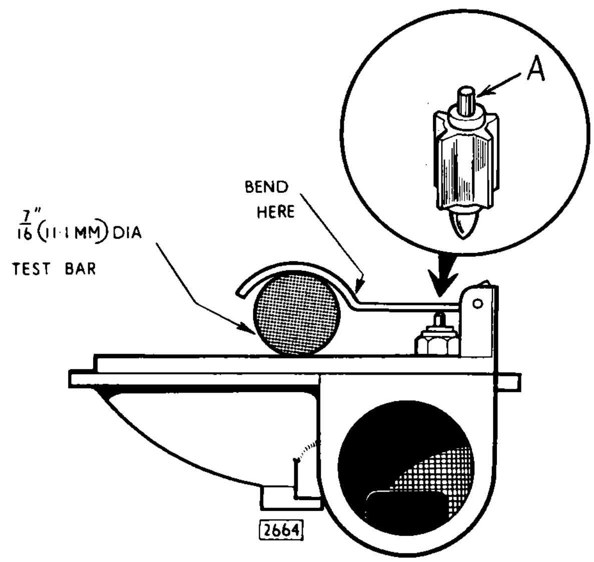


Fig. 9. Checking the float lever setting, which controls the fuel level in the float chamber.

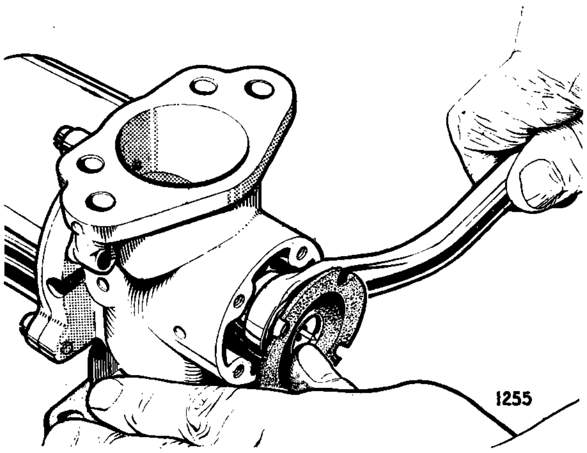


Fig. 10. Centring the jet.

CENTRING THE JET

Warning: Take care not to bend the carburetter needle when carrying out this operation.

Remove the carburetter from the engine as described on page C.7.

Remove the four setscrews securing the float chamber to the carburetter body. Remove the float chamber, jet housing and jet. Remove the hydraulic damper.

With a ring spanner slacken the jet locking nut approximately half a turn. Replace the jet and diaphragm assembly.

The jet is correctly centred when the piston falls freely and hits the jet "bridge" with a metallic click. To centre the jet, push the jet and diaphragm assembly as high as possible with the hand and with a pencil or rod gently press the piston down on to the jet bridge; centralisation will be facilitated if the side of the carburetter body is tapped lightly. Tighten the jet locking nut.

The actual centring must be carried out with the setscrew holes in the jet diaphragm and carburetter in alignment. After tightening the jet locking nut, the jet diaphragm must be kept in the same position relative to the carburetter body; the simplest way to do this is to mark one of the corresponding jet diaphragm and carburetter body setscrew holes with a soft pencil. Failure to do this may cause the centralisation to be upset.

Check that the centralisation is correct by noting if there is any difference in the sound of the piston hitting the jet bridge with the jet in its highest and lowest positions. If there is any difference in the sound, the procedure for centralising the jet will have to be repeated.

If difficulty in centring the jet is encountered after carrying out the above procedure, the jet needle can be lowered slightly in the piston to make the centralising effect more positive. The needle must, however, be restored to the normal position when checking the centralisation.

THE AUXILIARY STARTING CARBURETTER

DESCRIPTION (Fig. 11)

The enrichment apparatus for starting is, in effect, an auxiliary carburetting system. The main body casting (1) containing a solenoid-operated valve and fuel metering system is a separate unit attached by means of a ducted mounting arm to the base of the front carburetter.

Fuel is supplied to the base of the jet (9), which is obstructed to a greater or lesser degree by the tapered slidable needle (10).

When the device is in action air is drawn from atmosphere through the air intake (7) and thence through the passage (8), being carburetted with fuel as it passes the jet (9). The mixture is thence carried upwards past the shank of the needle (10) through the passage (14) and so past the aperture provided between the valve (3) and its seating (2). From here it passes directly to the inlet manifold through an external feed pipe.

The device is brought into action by energizing the winding of the solenoid (5) from the terminals (6). The centrally located iron core (4) is thus raised magnetically, carrying with it the ball-jointed disc valve (3) against the load of the small conical spring and thus uncovering the aperture provided by the seating (2).

Considering the function of the slidable needle (10), it will be seen that this is loaded upwards in its open position by means of the light compression spring (11) which abuts against a disc (12) attached to the shank of the needle. The needle continues upwards through the vertically adjustable stop (13) and finally terminates in an enlarged head.

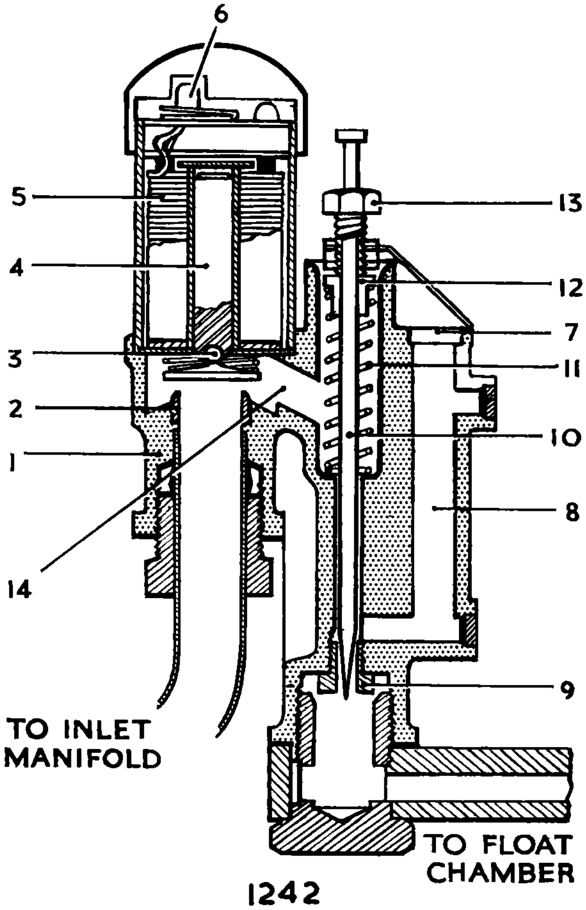


Fig. 11. Section view of the auxiliary starting carburetter.

Depression within the space surrounding the spring (11) is directly derived from that prevailing in the induction tract, and this exerts a downward force upon the disc (12), which is provided with an adequate clearance for its surrounding bore. This tends to overcome the load of the spring (11) and to move the needle downwards, thus increasing the obstruction afforded by the tapered section which enters the jet (9).

The purpose of this device is to provide two widely different degrees of enrichment, the one corresponding to idling or light cruising conditions and the other to conditions of open throttle or full-power operation. In effect, under the former conditions the high induction depression prevailing will cause the disc (12) to be drawn downwards, drawing the tapered needle into the jet (9), while under the latter, the lower depression existing in the induction tract will permit the collar to maintain its upward position with the needle withdrawn from the jet.

The tuning elements concerned in this device are the size and degree of taper of the lower end of the needle (10), the diameter of the disc (12), the load provided by the spring (11) and the degree of movement permitted to the needle assembly, as determined by the adjustment of the stop (13).

The solenoid (5) is energized by means of a thermostatically operated switch housed in the inlet manifold water jacket. This is arranged to bring the apparatus into action at temperatures about 30–35°C. (86–95°F.).

ADJUSTMENT

The engine must be at its normal running temperature before any attempt is made to tune the auxiliary enrichment device.

As it can generally be assumed that the tapered form of the needle (10), the strength of the spring (11), and the diameter of the disc (12) have already been appropriately chosen, tuning is generally confined to the adjustment of the stop screw (13). It will be appreciated that the main purpose of this adjustment is to limit the downward movement of the needle, the head of which abuts against the upper surface of the stopscrew at the lower extremity of its travel. The final downward movement of this needle determines, as has been described, the degree of enrichment provided under idling conditions with the auxiliary carburetter in operation. An appropriate guide to its correct adjustment in this respect is provided by energizing the solenoid when the engine has already attained its normal temperature. The stop screw (13) should then be so adjusted that the mixture is distinctly, although not excessively, rich, that is to say, until the exhaust gases are seen to be black in colour, but just short of the point where the engine commences to run with noticeable irregularity.

Anti-clockwise rotation of the stop screw will raise the needle under these conditions and increase the mixture strength, while rotation in the opposite direction will have the opposite effect. In order to energize the solenoid under conditions when the thermostatic switch will normally have broken the circuit, it is merely necessary to short-circuit the terminal of the thermostatic switch directly to earth with a screwdriver and flick open the throttles when the starting device will be heard to come into operation with a pronounced hissing noise.

THERMOSTATIC SWITCH—REMOVAL

The thermostatic switch which controls the operation of the auxiliary starting carburetter is situated at the front end of the inlet manifold water jacket.

Remove the electrical cable from the switch by removing the chrome plated domed nut.

If the radiator filler cap is securely tightened no appreciable amount of water will escape when he auxiliary starting carburetter switch is removed. Alternatively, a small amount of water can be drained from the radiator.

Remove the three securing setscrews and washers and withdraw the switch and the cork gasket.

REFITTING

Refitting is the reverse of the removal procedure. A new cork gasket must be fitted when the switch is replaced. If any water has been drained from the radiator or has escaped during the removal of the switch, the radiator should be topped up to the correct level.

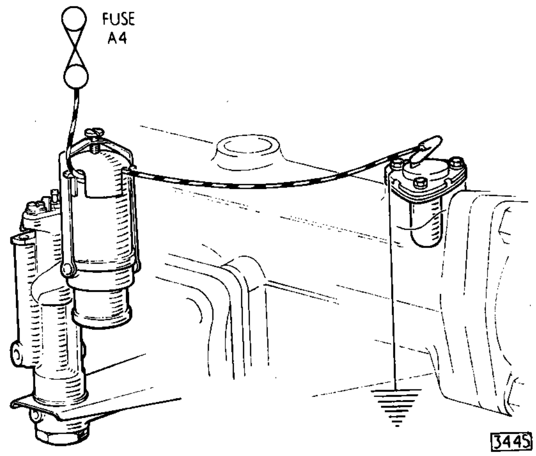


Fig. 12. Wiring circuit for the auxiliary starter carburetter to the thermostatic switch.

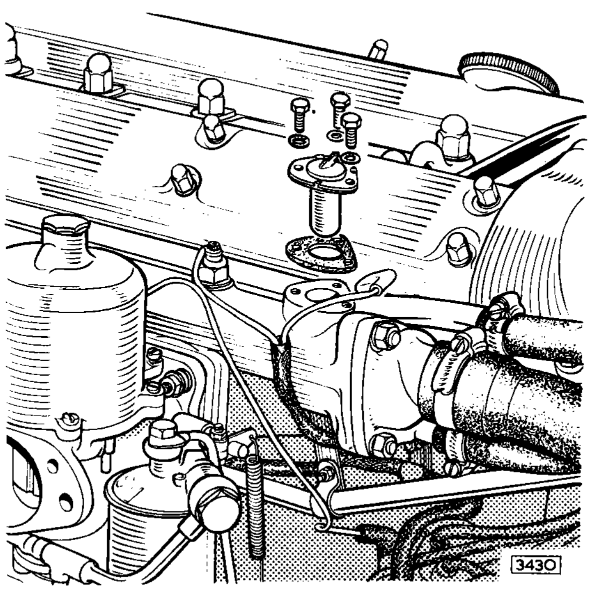


Fig. 13. The removal of the auxiliary starting carburetter thermostatic switch.

THE FUEL SYSTEM

THE PETROL PUMP

DESCRIPTION (Fig. 14)

The pump consists of three main assemblies, the main body casting (A); the diaphragm armature and magnet assembly (M) contained within the housing; and the contact breaker assembly housed within the end cap (T2). A non-return valve assembly (C) is affixed to the end cover moulding to assist in the circulation of air through the contact breaker chamber.

The main fuel inlet (B) provides access to an inlet air bottle (I) while access to the main pumping chamber (N) is provided by an inlet valve assembly. This assembly consists of a Melinex valve disc (F) permanently assembled within a pressed-steel cage, held in position by a valve cover (E.1).

The outlet from the pumping chamber is provided by an identical valve assembly which operates in the reverse direction. Both inlet and outlet valve assemblies together with the filters are held in position by a clamp plate (H). The valve assemblies may be removed by detaching the clamp plate (H) after removing the self-tapping screws. A filter (E) is provided on the delivery side of the

WARNING: If at any time, it becomes necessary to blow through the fuel feed pipes the outlet pipes must be disconnected from the pumps. Failure to observe this procedure will cause the Melinex valves to be displaced or damaged.

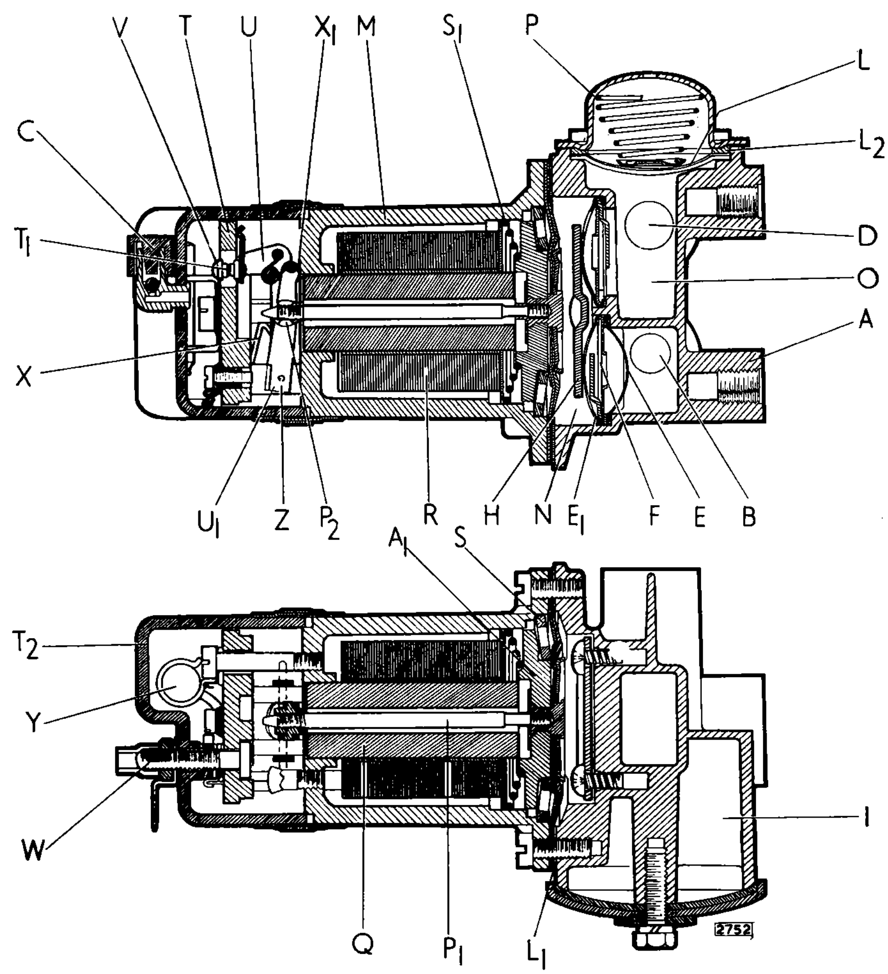


Fig. 14. The petrol pump.

inlet valve assembly. The delivery chamber (O) is bounded by a flexible plastic spring loaded diaphragm (L) contained by the vented cover (P). Sealing of the diaphragm (L) is provided by the rubber sealing ring (L2).

The magnetic unit consists of an iron coil housing, an iron core (Q), an iron armature (A1) provided with a central spindle (P1) which is permanently united with the diaphragm assembly (L1), a magnet coil (R) and a contact breaker assembly consisting of parts (P2), (U1), (U), (T1), (V). Between the coil housing and the armature are located 11 spherically edged rollers (S). These rollers locate the armature (A1) centrally within the coil housing and permit freedom of movement in a longitudinal direction.

The contact breaker consists of a bakelite pedestal moulding (T) carrying two rockers (U) and (U1) which are both hinged to the moulding at one end by the rocker spindle (Z). These rockers are interconnected at their top ends by means of two small springs arranged to give a throw-over action. A trunnion (P2) is carried by the inner rocker and the armature spindle (P1) is screwed into this trunnion. The outer rocker (U) is fitted with two tungsten points which contact with corresponding tungsten points which form part of the spring blade (V) connected to one end of the coil. The other end of the coil is connected to a terminal (W) while a short length of flexible wire (X) connecting the outer rocker to one of the screws holding the pedestal moulding onto the coil housing, provides an earth return to the body of the pump. It is important that the body of the pump be effectively earthed to the body of the vehicle by means of the earthing terminal provided on the flange of the coil housing.

OPERATION

When the pump is at rest the outer rocker (U) lies in the outer position and the tungsten points are in contact. Current passes from the Lucar connector (W) through the coil and back to the blade (V), through the points and to earth, thus energising the coil and attracting the armature (A1). The armature, together with the diaphragm assembly, then retracts thereby sucking petrol through the inlet valve into the pumping chamber (N). When the armature has travelled nearly to the end of its stroke, the throw-over mechanism operates and the outer rocker moves rapidly backwards, thus separating the points and breaking the circuit.

The spring (S1) then re-asserts itself forcing the armature and diaphragm away from the coil housing. This action forces petrol through the delivery valve at a rate determined by the requirements of the engine. As the armature nears the end of its stroke the throw-over mechanism again operates, the tungsten points remake contact and the cycle of operations is repeated.

The spring blade (V) rests against the small projection moulding (T) and it should be set so that, when the points are in contact, it is deflected away from the moulding. The gap at the points should be approximately 0·030″ (0·75 mm.) when the rocker (U) is manually deflected until it contacts the end face of the coil housing.

REMOVAL

Remove both inlet and outlet pipes from the side of the pump by withdrawing the banjo bolt and washers. Disconnect the electrical feed cable to the pump by unscrewing the knurled knob on the end of the pump. Disconnect the earth cable from the side of the pump. Remove the two self-locking nuts attaching the pump to the bracket and withdraw the two washers from each stud. The pump can now be withdrawn from the bracket leaving the two rubber grommets in position. The rubber grommets in the bracket should be examined for deterioration and replaced if necessary, otherwise excessive petrol pump noise may result.

REFITTING

Refitting is the reverse of the removal procedure.

DISMANTLING (Fig. 15)

Contact Breaker

Remove the insulated sleeve (33), terminal nut (32) and connector (31), together with its shakeproof washer.

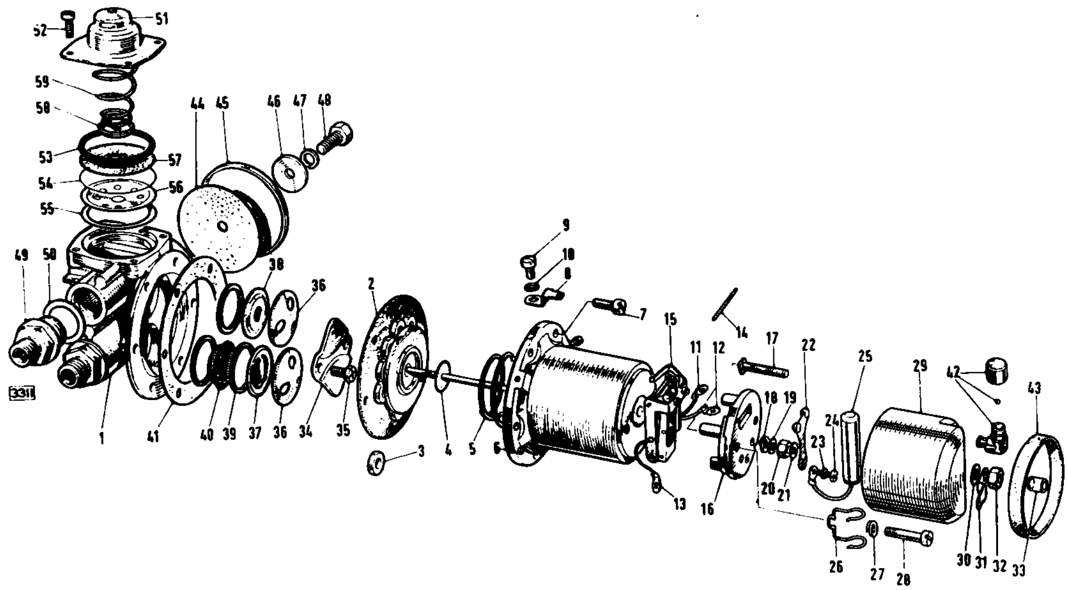


Fig. 15. Exploded view of the petrol pump.

1. Pump body
2. Diaphragm and spindle assembly
3. Armature centralising roller
4. Impact washer
5. Armature spring
6. Coil housing
7. Screw
8. Earth connector
9. Screw
10. Spring washer
11. Terminal tag
12. Terminal tag
13. Earth tag
14. Rocker pivot pin
15. Rocker mechanism
16. Pedestal
17. Terminal stud
18. Spring washer
19. Lead washer
20. Terminal nut
21. Washer
22. Contact blade
23. Washer
24. Screw
25. Condenser
26. Clip
27. Spring washer
28. Screw
29. End cover
30. Shakeproof washer
31. Lucar connector
32. Nut
33. Insulating sleeve
34. Clamp plate
35. Screw
36. Valve cap
37. Inlet valve
38. Outlet valve
39. Sealing washer
40. Filter
41. Diaphragm gasket
42. Vent valve
43. Sealing band
44. Inlet air bottle cover joint
45. Inlet air bottle cover
46. Dished washer
47. Spring washer
48. Screw
49. Outlet connection
50. Fibre washer
51. Cover (delivery flow smoothing device)
52. Screw
53. "O" ring
54. Diaphragm barrier
55. Sealing washer
56. Diaphragm plate
57. Rubber diaphragm
58. Spring end cap
59. Diaphragm spring

Remove the tape seal (if fitted) and take off the end-cover.

Unscrew the 5 B.A. screw (24) which holds the contact blade (22) to the pedestal (16) and remove the condenser (25) from its clip. This will allow the washer (23), the long-coil lead (11), and the contact blade to be removed.

Coil Housing and Diaphragm

Unscrew the coil housing securing screws (7), using a thick-bladed screwdriver to avoid damaging the screw heads.

Remove the earthing screw (9).

The coil housing (6) may now be removed from the body (1). Next remove the diaphragm and spindle assembly (2) by taking hold of the diaphragm and unscrewing it anti-clockwise until the armature spring (5) pushes the diaphragm away from the coil housing. It is advisable to hold the housing over the bench so that the 11 brass rollers (3) will not fall on the floor. The diaphragm and its spindle are serviced as a unit and should not be separated.

Pedestal and Rocker

Remove the end-cover seal washer (21), unscrew the terminal nut (20), and remove the lead washer (19).

This will have flattened on the terminal tag and thread and is best cut away with cutting pliers or a knife. Unscrew the two 2 B.A. screws (28), holding the pedestal to the coil housing, remove the earth terminal tag (13) together with the condenser clip (26). Tip the pedestal and withdraw the terminal stud (17) from the terminal tag (12). The pedestal (16) may now be removed with the rocker mechanism (15) attached.

Push out the hardened steel pin (14) which holds the rocker mechanism to the pedestal and separate the two.

Body and Valves

Unscrew the two Phillips screws (35) securing the valve clamp plate (34), remove the valve caps (36), valves (37) and (38), sealing washers, and filter (40).

Note: Dismantling of the delivery flow-smoothing device should only be undertaken if the operation of it is faulty, and if the necessary equipment for pressure-testing after assembly is available. On this understanding proceed as follows:—

Remove the four 4 B.A. screws (52) securing delivery flow-smoothing device vented cover (51), remove the cover, the diaphragm spring (59), rubber "O" ring (53), spring cap (58), diaphragm (57), barrier (54), diaphragm plate (56) and sealing washer (55).

Remove the single 2 B.A. screw (48), securing the inlet air bottle cover (45). Remove the cover and gasket (44).

Unscrew the inlet and outlet connections.

INSPECTION

If gum formation has occurred in the fuel used in the pump, the parts in contact with the fuel will have become coated with a substance similar to varnish. This has a strong stale smell and may attack the neoprene diaphragm. Brass and steel parts so affected can be cleaned by being boiled in a 20 per cent solution of caustic suds, dipped in a strong nitric acid solution and finally washed in boiling water. Light alloy parts must be well soaked in methylated spirits and then cleaned.

Clean the pump and inspect for cracks, damaged joint faces, and threads.

Examine the plastic valve assemblies for kinks or damage to the valve plates. They can best be checked by blowing and sucking with the mouth.

Check that the narrow tongue on the valve cage, which is bent over to retain the valve and to prevent it being forced out of position, has not been distorted but allows a valve lift of approximately $\frac{1}{16}$" (1·6 mm).

Examine the delivery flow-smoothing device diaphragm, barrier, plate, spring, and spring cap for damage. If in doubt, renew the diaphragm.

Examine the inlet air bottle cover for damage.

Examine the valve recesses in the body for damage and corrosion; if it is impossible to remove the corrosion, or if the recess is pitted, the body must be discarded.

Clean the filter with a brush and examine for fractures, renew if necessary.

Examine the coil lead tag for security and the lead insulation for damage.

Examine the contact breaker points for signs of burning and pitting; if this is evident, the rocker assembly and spring blade must be renewed.

Examine the pedestal for cracks or other damage, in particular to the narrow ridge on the edge of the rectangular hole on which the contact blade rests.

If fitted, examine the non-return vent valve in the end-cover for damage, ensure that the small ball valve is free to move.

Examine the diaphragm for signs of deterioration.

Renew the following parts: all fibre and cork washers, gaskets, and "O" section sealing rings, rollers showing signs of wear on periphery, damaged bolts, and unions.

ASSEMBLY

Pedestal and Rocker

Note: The steel pin which secures the rocker mechanism to the pedestal is specially hardened and must not be replaced by other than a genuine S.U. part.

Invert the pedestal and fit the rocker assembly to it by pushing the steel pin (14) (Fig. 15) through the small holes in the rockers and pedestal struts. Then position the centre toggle so that, with the inner rocker spindle in tension against the rear of the contact point, the centre toggle spring is above the spindle on which the white rollers run. This positioning is important to obtain the correct "throw-over" action; it is also essential that the rockers are perfectly free to swing on the pivot pin and that the arms are not binding on the legs of the pedestal.

If necessary the rockers can be squared up with a pair of thin-nosed pliers.

Assemble the square-headed 2 B.A. terminal stud to the pedestal, the back of which is recessed to take the square head.

Assemble the 2 B.A. spring washer (1) (Fig. 16), and put the terminal stud through the 2 B.A. terminal tag (2), then fit the lead washer (3) and the coned nut with its coned face to the lead washer. (This makes better contact than an ordinary flat washer and nut). Tighten the 2 B.A. nut and finally add the end-cover seal washer (5).

Assemble the pedestal to the coil housing by fitting the two B.A. pedestal screws (6), ensuring that the spring washer (7) on the left-hand screw (9 o'clock position) is between the pedestal and the earthing tag (8). When a condenser is fitted, its wire clip base is placed under the earthing tag and the spring washer is dispensed with.

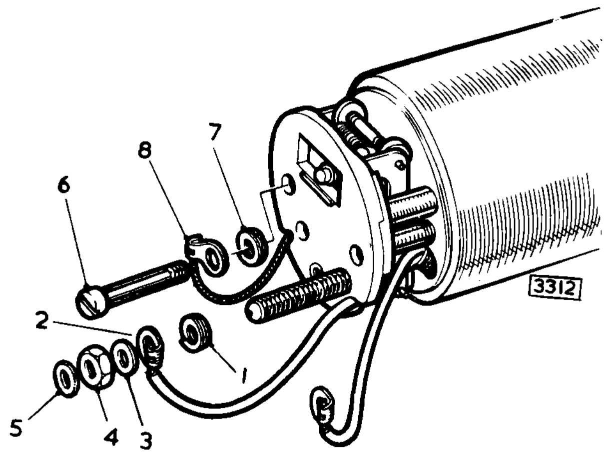


Fig. 16. Attaching the pedestal to the coil housing.

Tighten the screws, taking care to prevent the earthing tag (8) from turning, as this will strain or break the earthing flex. Do not overtighten the screws or the pedestal will crack.

Do not fit the contact blade at this stage.

Diaphragm Assembly

Place the armature spring into the coil housing with its larger diameter towards the coil (Fig. 15).

Before fitting the diaphragm make sure that the impact washer is fitted to the armature. (This is a small neoprene washer that fits in the armature recess). Do not use jointing compound or dope on the diaphragm.

Fit the diaphragm by inserting the spindle in the hole in the coil and screwing it into the threaded trunnion in the centre of the rocker assembly.

Screw in the diaphragm until the rocker will not "throw-over"; this must not be confused with jamming the armature on the coil housing internal steps.

Fit the 11 brass centralizing rollers by turning back the diaphragm edge and dropping the rollers into the coil recess. The pump should be held in the left hand, rocker end downwards, to prevent the rollers from falling out.

On later-type rocker mechanisms with adjustable fingers fit the contact blade and adjust the finger settings as described under those headings, then carefully remove the contact blade.

Holding the coil housing assembly in the left hand in an approximately horizontal position (see Fig. 17), push the diaphragm spindle in with the thumb of the right hand, pushing firmly but steadily. Unscrew the diaphragm, pressing and releasing with the thumb of the right hand until the rocker just "throws over". Now turn the diaphragm back (unscrew) to the nearest hole and again 4 holes (two-thirds of a complete turn). The diaphragm is now correctly set.

Press the centre of the armature and fit the retaining fork at the back of the rocker assembly. This is done to prevent the rollers from falling out when the coil housing is placed on the bench prior to fitting the body, and is not intended to stretch the diaphragm before tightening the body screws.

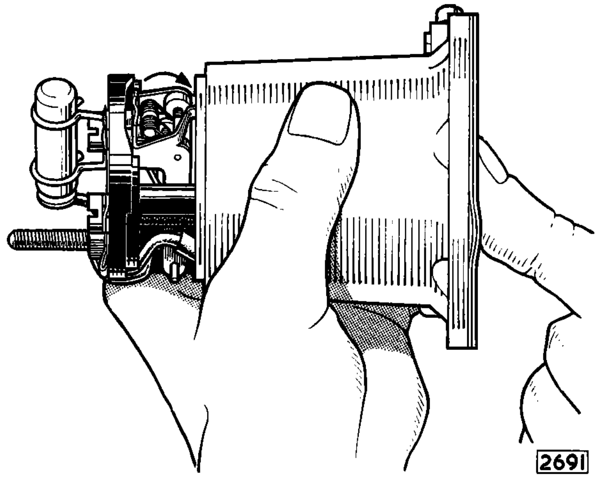


Fig. 17. Checking the "throw-over" of the toggle mechanism.

Body Components

In the AUF 300 range of pumps the valve assemblies are retained internally in the body by a clamp plate secured with self-tapping screws. The inlet valve recess in the body is deeper than the other recess to allow for the filter and extra washer. Another feature of these pumps is the incorporation of an air bottle on the inlet and a flow-smoothing device on the delivery side.

The inlet air bottle is a chamber in the body casting blanked off by a simple cover and joint washer held by a single screw. The delivery flow-smoothing device is formed by a perforated metal plate which is in contact with a plastic barrier backed by a rubber diaphragm, all held in position by a spring and end-cap retained by a vented cover. This assembly seals the delivery chamber in the body.

Screw in the inlet and outlet connections with their sealing rings. Assemble the outlet valve components into the outlet recess in the following order, first a joint washer, then the valve, tongue side downwards, then the valve cap.

Assemble the inlet valve into the inlet recess as follows: first a joint washer, then the filter, dome side downwards, then another joint washer, followed by the valve assembly, tongue side upwards, then the valve cap.

Take care that both valve assemblies nest down into their respective recesses, place the clamp plate on top, and tighten down firmly to the body with the two screws.

Replace the inlet air bottle cover with its joint washer and tighten down the central screw.

Place the sealing washer in the bottom of the delivery flow-smoothing device recess, (see Fig. 15) follow this with the perforated diaphragm plate, dome side downwards, then the plastic barrier, followed by the rubber diaphragm. Insert the "O" section sealing ring into the recess and ensure that it seats evenly. Place the diaphragm spring, large end towards the vented cover, into the cover, place the spring end-cap on the small end of the spring, pass the assembly tool through the cover, spring, and end cap and turn it through 90° so that tension may be applied to the spring during assembly. Finally fit the spring and cap assembly onto the diaphragm, tighten the four retaining screws, and release the assembly tool. The pump should be pressure-tested after disturbance of the flow-smoothing device.

Body attachment

Fit the joint washer to the body, aligning the screw holes.

Offer up the coil housing to the body, ensuring correct seating between them.

Line up the six securing screw holes, making sure that the cast lugs on the coil housing are at the bottom, insert the six 2 B.A. screws finger-tight. Fit the earthing screw with its Lucar connector.

Remove the roller retaining fork before tightening the body securing screws, making sure that the rollers retain their position; a displaced roller will cut the diaphragm. It is not necessary to stretch the diaphragm before tightening the securing screws.

Tighten the securing screws in sequence as they appear diametrically opposite each other.

Contact Blade (Fig. 18)

Fit the contact blade and coil lead to the pedestal with the 5 B.A. washer and screw. When a condenser is fitted the tag on it is placed under the coil lead tag.

Adjust the contact blade so that the contact points on it are a little above the contact points on the rocker when the points are closed also that when the contact points make or break, one pair of points wipes over the centre line of the other in a symmetrical manner. As the contact blade is provided with a slot for the attachment screw, some degree of adjustment is possible.

Tighten the contact blade attachment screw when the correct setting is obtained.

Contact Gap Setting

Check that when the outer rocker is pressed onto the coil housing, the contact blade rests on the narrow rib or ridge which projects slightly above the main face of the pedestal. If it does not, slacken the contact blade attachment screw, swing the blade clear of the pedestal, and bend it downwards a sufficient amount so that when repositioned it rests against the rib lightly, over-tensioning of the blade will restrict the travel of the rocker mechanism.

Check the lift of the contact blade tip above the top of the pedestal with a feeler gauge, bending the stop-finger beneath the pedestal, if necessary, to obtain a lift of 0·035± 0·005 in. (0·9± 0·13 mm.).

Check the gap between rocker finger and coil housing with a feeler gauge, bending the stop-finger, if necessary, to obtain a gap of 0·070± 0·005 in. (1·8± 0·13 mm.).

End-cover

Tuck all spare cable into position so that it cannot foul the rocker mechanism. Ensure that the end-cover seal washer is in position on the terminal stud, fit the bakelite end-cover and lock washer, secure with the brass nut, fit the terminal tag or connector, and the insulated sleeve.

The pump is now ready for test.

After test replace the rubber sealing band over the end cover gap and seal with adhesive tape. This may be removed to improve ventilation when the pump is mounted internally in a moisture-free region but **must** be retained otherwise.

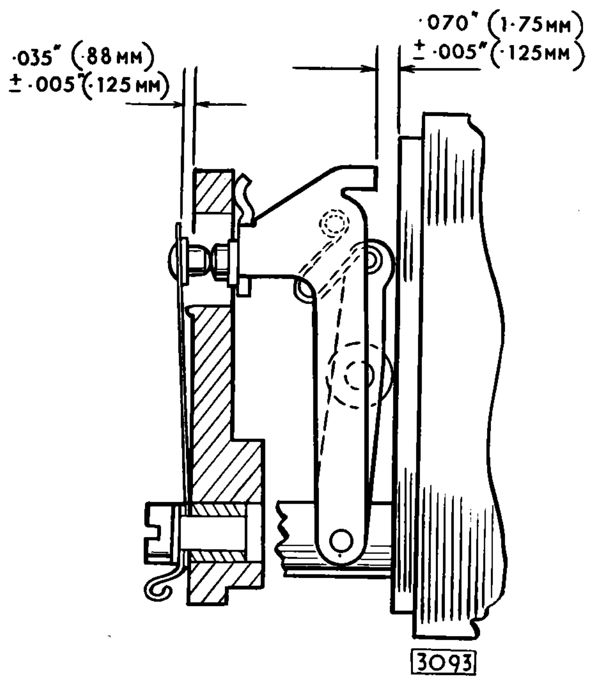


Fig. 18. Rocker and contact clearances.

THE FUEL TANKS

REMOVAL (Fig. 19)

Disconnect the battery negative terminal. Drain the tank by removing the drain plug (7) situated underneath the car. Remove the eight self-tapping screws and the trim panel covering the petrol tank. In the case of the right-hand tank it will be necessary to remove the spare wheel and tool kit.

Remove the four setscrews and washers securing the diagonal tank locating bracket in position. Remove the fuel pump cables from the terminal, noting that like colours are connected.

Remove the fuel pipe banjo bolts (31) and fibre washers (32) from the front of the tanks. Remove the fuel gauge wires. Slacken the filler pipe clips (17) and push the rubber pipes (16) up the filler necks.

Remove the overflow pipes (18) and withdraw the fuel tanks.

REFITTING

Refitting is the reverse of the removal procedure.

Key to Fig. 19

1. R.H. petrol tank
2. Gauge element unit (R.H.)
3. L.H. petrol tank
4. Gauge element unit (L.H.)
5. Sealing ring
6. Locking ring
7. Drain plug
8. Washer
9. Bracket assembly (R.H.)
10. Bracket assembly (L.H.)
11. Rubber pad
12. Rubber pad
13. Rubber pad
14. Sealing ring
15. Rubber pad
16. Hose
17. Clip
18. Vent tube (R.H.)
19. Vent tube (L.H.)
20. Sleeve nut
21. Baffle
22. Grommet
23. Drain tube
24. Clip
25. Petrol pump
26. Clip
27. Rubber packing
28. Rubber mounting
29. Petrol pipe assembly
30. Petrol pipe assembly
31. Banjo bolt
32. Fibre washer
33. Petrol pipe assembly
34. Petrol pipe assembly
35. Banjo bolt
36. Fibre washer
37. Clip
38. T-piece
39. Petrol pipe assembly
40. Grommet
41. Clip
42. Clip
43. Clip
44. Petrol filter
45. Filter casting
46. Seating washer
47. Filter gauze
48. Glass bowl
49. Retaining strap
50. Banjo bolt
51. Fibre washer
52. Feed pipe assembly
53. Banjo bolt
54. Fibre washer

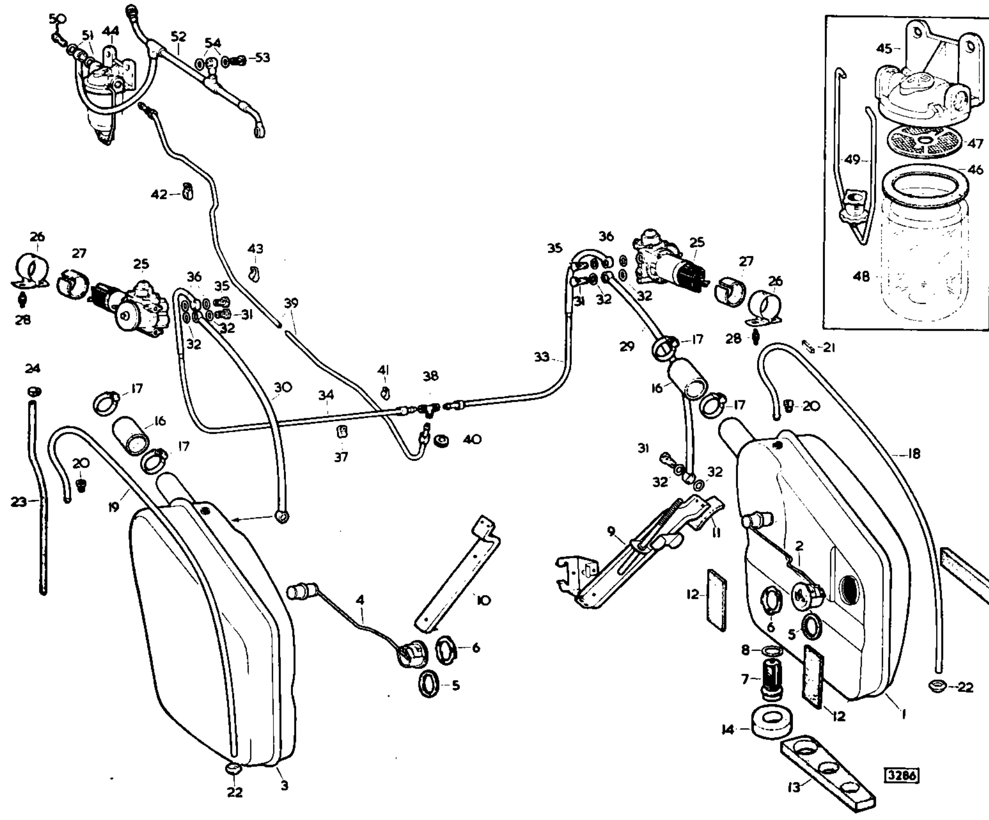


Fig. 19. Exploded view of the fuel system.

SECTION D

COOLING SYSTEM

4·2 MARK 10 MODEL

INDEX

INDEX *(continued)*

COOLING SYSTEM

Water circulation is assisted by an impeller type pump mounted on the front cover of the engine, the system being pressurised and thermostatically controlled. Water is circulated from the right-hand side of the cross-flow radiator by the water pump and flows through the cylinder block and cylinder head water passages to the radiator header tank by way of the inlet manifold water jacket. The cooling fan is driven through a fluid coupling which slips at a pre-determined engine speed.

When the engine is stationary the fan is free to rotate and it should not be assumed that the fan belt is slipping.

DATA

	Imp. pints	U.S. pints	Litres
Total capacity—including heater	$24\frac{1}{2}$	$29\frac{1}{2}$	14
Water pump—type		Centrifugal	
—drive		Belt	
Fan belt—angle of 'V'		40°	
Fan—number of blades		12	
Fan to engine speed ratio		Fan drive through the fluid coupling unit	
Cooling system control		Thermostat	
Thermostat data		See page D.11	

Radiator cap:

Make and type	AC—relief valve
Release pressure	7lb. per sq. in. (0·49 kg./cm^2)
Release depression	1 lb. (0·452 kg.)

ROUTINE MAINTENANCE

DAILY

Checking Radiator Coolant Level

Every day check the level of the coolant in the radiator header tank and if necessary top up to the bottom of the filler neck.

Soft water should be used if available; hard water produces scale which in time will affect the cooling efficiency of the system.

Care must be taken when removing the filler cap if the engine is hot; it is advisable to protect the hands against escaping steam. Turn the cap slowly anti-clockwise until the resistance of the safety stop is felt. Leave the cap in this position until all pressure is released before removing completely.

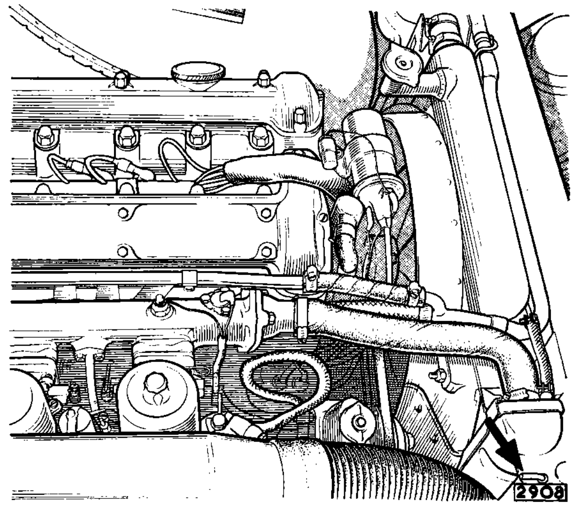


Fig. 1. Radiator drain tap remote control.

PERIODICALLY

Care of the Cooling System

The entire cooling system should occasionally be flushed out to remove sediment. To do this, open the radiator block and cylinder block drain taps and insert a water hose into the radiator filler neck. Allow the water to flow through the system, with the engine running at a fast idle speed (1,000 r.p.m) to cause circulation, until the water runs clear.

Since deposits in the water will in time cause fouling of the surfaces of the cooling system with consequent impaired efficiency it is desirable to retard this tendency as much as possible by using water as nearly neutral (soft) as is available. One of the approved brands of water inhibitor may be used with advantage to obviate the formation of deposits in the system.

Check the radiator water level after running the engine and top up if necessary.

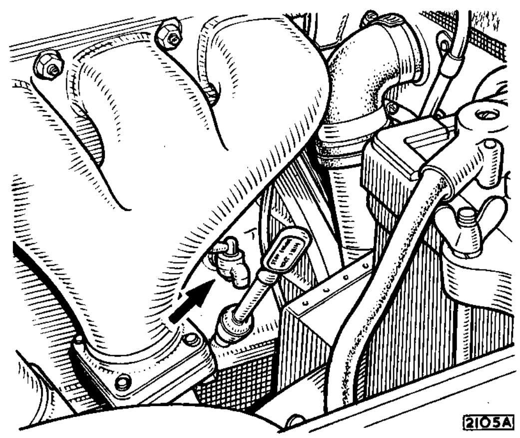


Fig. 2. Cylinder block drain tap.

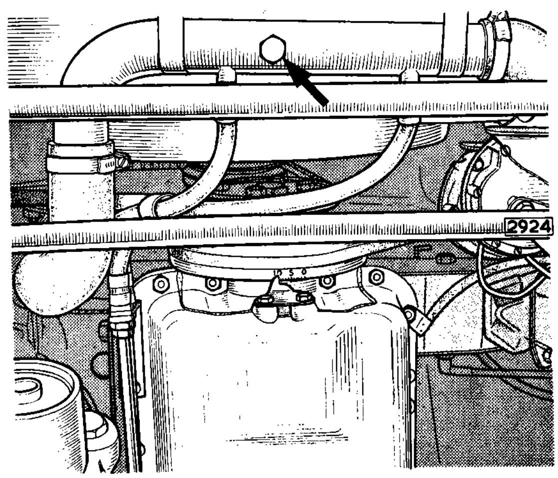


Fig. 3. Drain plug under radiator.

Refilling the Cooling System—Important

When refilling the cooling system following complete drainage, depress the 'HEAT' button to allow the heater system to be filled with coolant. Re-check the level after running engine for a short period.

FROST PRECAUTIONS

ANTI-FREEZE—IMPORTANT

During the winter months it is strongly recommended that an anti-freeze compound with an inhibited Ethylene Glycol base is used in the proportions laid down by the anti-freeze manufacturers. It should be remembered that if anti-freeze is not used it is possible, owing to the action of the thermostat, for the radiator to "freeze-up" whilst the car is being driven, even though the water in the radiator was not frozen when the engine was started.

Before adding anti-freeze solution the cooling system should be cleaned by flushing.

The cylinder head gasket must be in good condition and the cylinder head nuts pulled down correctly, since if the solution leaks into the crankcase a mixture will be formed with the engine oil which is likely to cause blockage of the oil ways with consequent damage to working parts. Check the tightness of all water hose connections, water pump and manifold joints. To ensure satisfactory mixing, measure the recommended proportions of water and anti-freeze solution in a separate container and fill the system from this container, rather than add the solution direct to the cooling system.

When filling the cooling system, open the heater control tap by placing the temperature control on the console in the "HOT" position (later cars "HEAT" button). Check the radiator water level after running the engine and top up if necessary. If topping up is necessary during the period in which anti-freeze solution is in use, this topping up must be carried out using anti-freeze solution or the degree of protection provided may be lost. Topping up with water will dilute the mixture possibly to an extent where damage by frost will occur.

ENGINE HEATER

Provision is made on the right-hand side of the cylinder block for the fitment of an American standard engine heater element No. 7, manufactured by James B. Carter Ltd., Electrical, Heating and Manufacturing division, Winnipeg, Manitoba, Canada, or George Bray & Co. Ltd., Leicester Place, Blackman Lane, Leeds 2, England.

RADIATOR

The radiator is of the cross-flow type and it is pressurised by means of a filler cap. The filler cap incorporates a pressure relief valve to hold a pressure of up to 7 lb./sq. in. above atmospheric pressure inside the system. When the pressure rises above 7 lb./sq. in. the spring loaded valve lifts off its seat and the excess pressure escapes via the overflow pipe. As the water temperature falls again a small valve incorporated in the centre of the pressure valve unit opens and restores atmospheric pressure, should a depression be caused by a fall in the temperature of the water.

By raising the pressure inside the cooling system, the boiling point of the water is raised, thus reducing risk of water loss from boiling.

REMOVAL (Fig. 4)

Release the radiator cap and drain the radiator and cylinder block.

Slacken the hose clips securing the water hoses (27), (29), (25). Slacken the hose clips securing the water hose from the water pump to the bottom of the radiator.

Remove the two self-locking nuts and washers securing the top of the radiator.

Remove the two self-locking nuts and washers securing the bottom of the radiator to the sub-frame. Collect the mounting rubbers (2).

Remove the radiator carefully making sure that the fan blades do not foul the radiator matrix.

Note: When automatic transmission is fitted disconnect the two oil cooler pipes from the bottom water pipe (34 Fig. 4).

REFITTING

Refitting is the reverse of the removal procedure but care must be taken to ensure that the mounting rubbers are in position on the mounting studs.

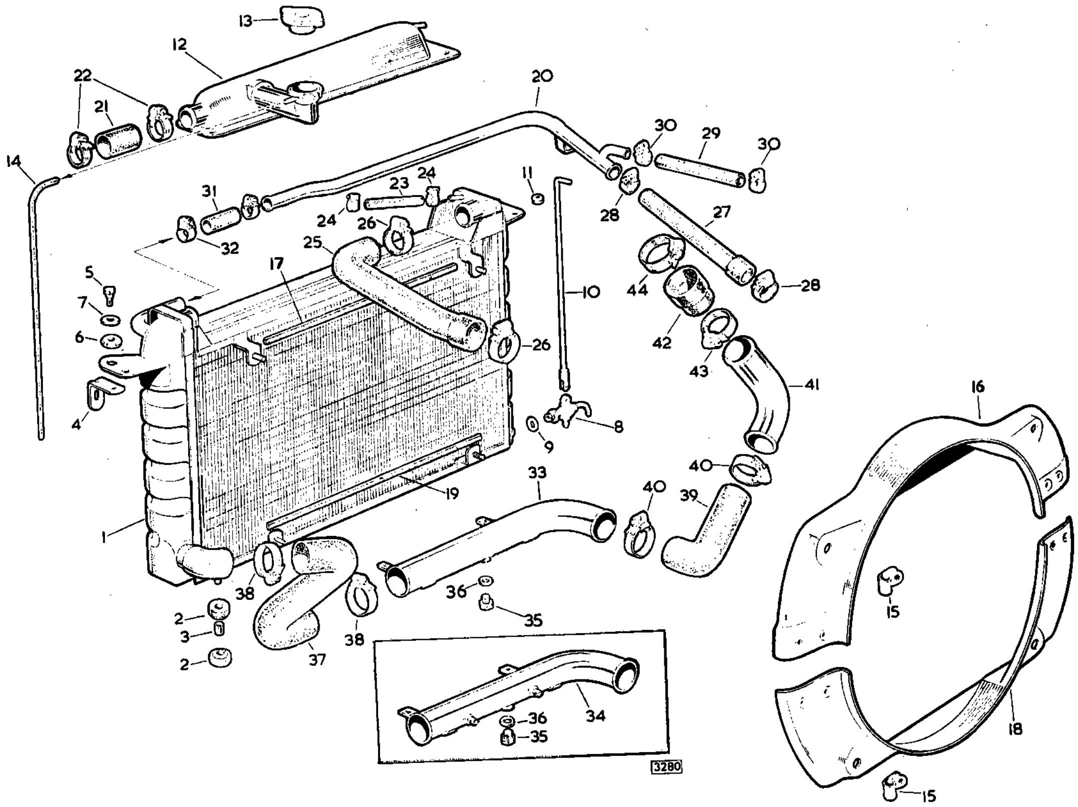


Fig. 4. The radiator components (early cars).

1. Radiator block
2. Rubber mounting pad
3. Distance tube
4. Mounting bracket
5. Shouldered bolt
6. Grommet
7. Special washer
8. Drain tap
9. Fibre washer
10. Control rod
11. Grommet
12. Radiator header tank
13. Filler cap
14. Rubber overflow pipe
15. Clip
16. Fan cowl (upper)
17. Seal (polyurethane)
18. Fan cowl (lower)
19. Seal (polyurethane)
20. By-pass pipe
21. Hose
22. Clip
23. Vent hose
24. Clip
25. Top hose
26. Clip
27. By-pass hose
28. Clip
29. Hose
30. Clip
31. Hose
32. Clip
33. Bottom water pipe
34. Bottom water pipe (automatic transmission)
35. Drain plug
36. Fibre washer
37. Hose
38. Clip
39. Hose
40. Clip
41. Intermediate water pipe
42. Hose
43. Clip
44. Clip

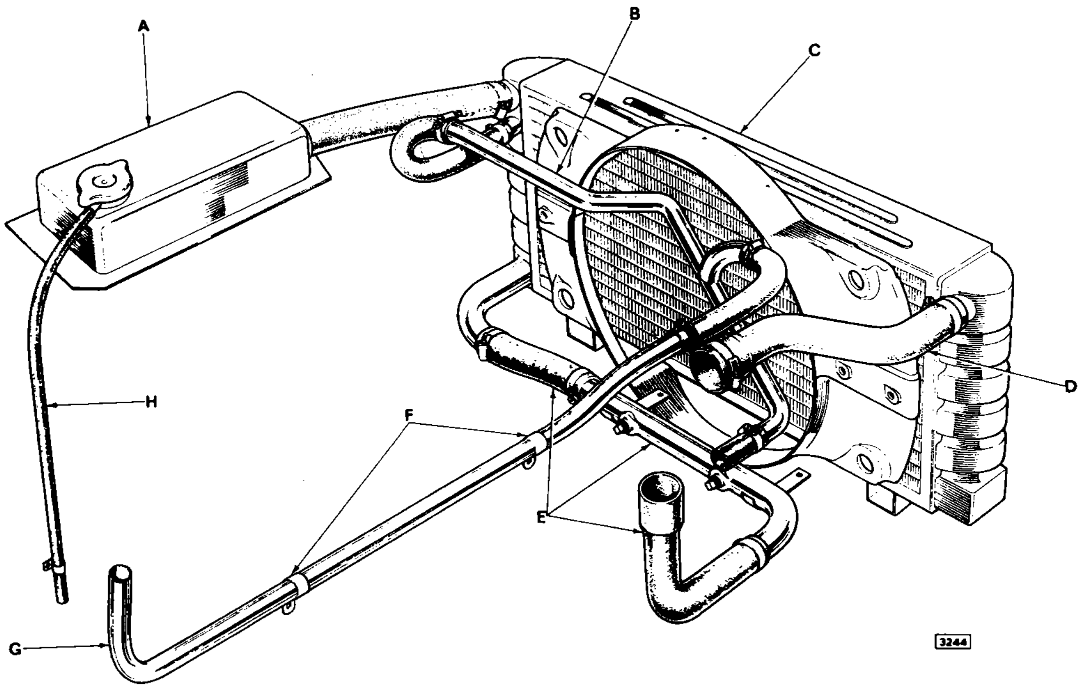


Fig. 5. The radiator components (later cars).

A Radiator header tank
B By-pass pipe
C Radiator block
D Top hose
E Bottom water pipe and hoses
F Securing clips
G Heater return pipe
H Rubber overflow pipe

RADIATOR COWL

Removal (Fig. 4)

Drain off sufficient water from the header tank (12) of the radiator to permit the removal of the top hoses.

Remove the two self-locking nuts, washers and overflow pipe clip (15) securing the cowl to the top of the radiator.

Remove the four setscrews, nuts and washers securing the two halves of the cowl together.

Remove the upper half of the radiator cowl (16).

Remove the two self-locking nuts, washers and overflow pipe clip (15) securing the lower half of of the cowl.

Remove the lower half of the cowl (18).

Refitting

Refitting is the reverse of the removal procedure.

FAN

Removal

Remove the upper half of the radiator cowl as previously described.

Slacken the adjustment bolt in the steering pump supporting strap and press the jockey pulley in towards the engine. Remove the fan belt.

Remove the four nuts and spring washers securing the fan unit to the fan hub.

Remove the four nuts and shakeproof washers securing the fan unit to the fan pulley.

The fan unit and the fan can now be removed.

Refitting

Refitting is the reverse of the removal procedure.

FAN BELT

Removal

Remove the upper half of the radiator as described under "Radiator Cowl".

Slacken the adjustment bolt in the steering pump supporting strap and press the jockey pulley in towards the engine to remove the fan belt.

Refitting

Refitting is the reverse of the removal procedure but ensure that the belt is not stretched over the pulleys by any means other than by hand. If a tool is used to lever the belt on or off, the endless cords in the belt may be broken. Ensure that there is no slack in the fan belt when tightening the steering pump supporting strap. The jockey pulley will provide any tension required as the fan belt stretches.

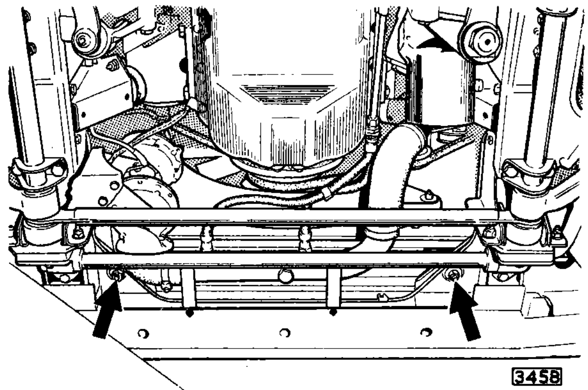


Fig. 6. Radiator lower securing nuts.

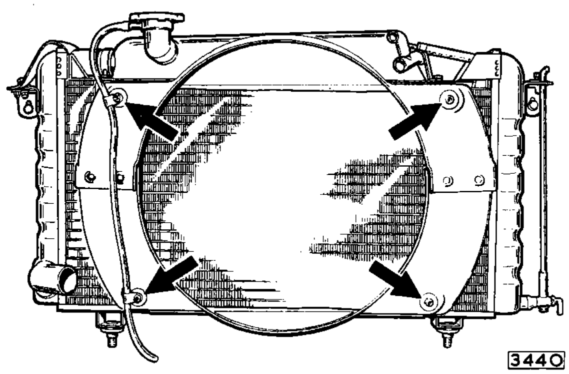


Fig. 7. Radiator cowl securing nuts.

THERMOSTAT

This is a valve incorporated in the cooling system which restricts the flow of coolant through the radiator until the engine has reached its operating temperature. Thus rapid warming up of the engine and, in cold weather, an early supply of warm air to the interior of the car via the heater is provided.

REMOVAL

Drain sufficient water from the system to allow the level to fall below the thermostat by operating the drain tap situated at the bottom left-hand side of the radiator block. Slacken the hose clip and remove the top water hose on the water outlet pipe.

Remove the two nuts and spring washers securing the water outlet pipe.

Remove the water outlet pipe and lift out the thermostat noting the gasket between the outlet pipe and the thermostat housing.

CHECKING

Thoroughly clean the thermostat and check that the small hole in the valve is clear. Check the thermostat for correct operation by immersing in a container of cold water together with a thermometer and stirrer. Heat the water, keeping it well stirred and observe if the characteristics of the thermostat are in agreement with the data given under "Thermostat Temperatures".

REFITTING

Refitting is the reverse of the removal procedure.

Always fit a new gasket between the water outlet pipe and the thermostat housing. Ensure that the recess in the thermostat housing and all machined faces are clean.

THERMOSTAT DATA

Start Operating Temperature	Fully Open Temperature	Remarks
159°F (70·5°C)	168°F (75·5°C)	
174°F (78·8°C)	183°F (83·7°C)	High setting for extreme winter conditions

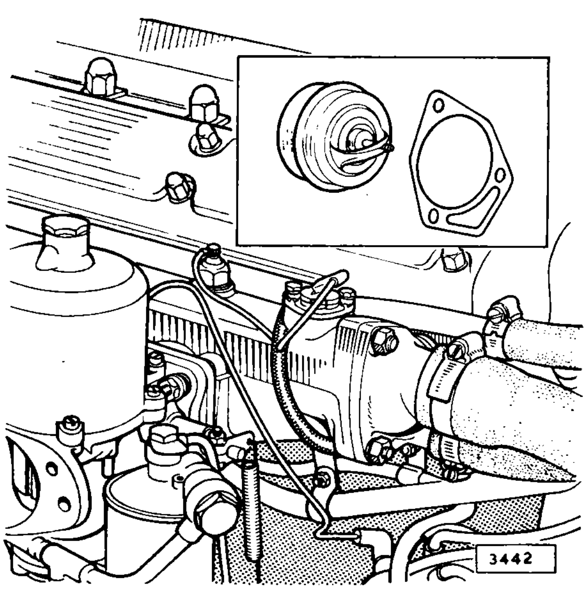


Fig. 8. The thermostat.

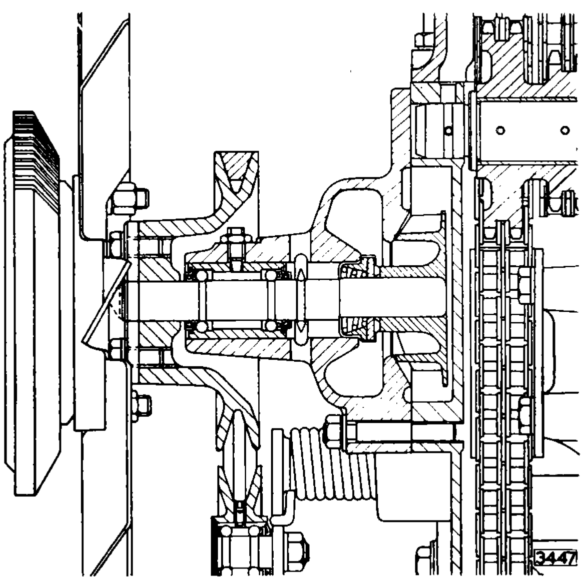


Fig. 9. Sectioned view of the water pump.

WATER PUMP

The water pump is of the centrifugal vane impeller type, the impeller being mounted on a steel spindle which in turn runs in a double row of ball bearings. These are sealed at their ends to exclude all dirt and to retain the lubricant.

The main seal of the pump spindle is located in the pump housing by a metal cover and the carbon face maintains a constant pressure on the impeller by means of a thrust spring inside the seal.

A hole drilled in the top of the casting acts as an air vent and leads into an annular groove in the casting into which stray water is directed by means of a rubber thrower on the pump spindle. A drain hole at the bottom of the groove leads away any water and prevents seepage into the bearing.

REMOVAL

Drain the cooling system.

Detach the water hoses.

Remove the two self-locking nuts, washers and overflow pipe clip securing the upper half of the fan cowl in position.

Remove the four setscrews, washers and nuts securing the upper fan cowl to the lower.

Remove the upper half of the fan cowl.

Remove the fan belt by slackening off the steering pump and relieving the tension of the jockey pulley.

Remove the fan as already described under "Fan Removal".

Remove water pump pulley.

Unscrew the six bolts, three nuts and spring washers securing the water pump to the timing cover.

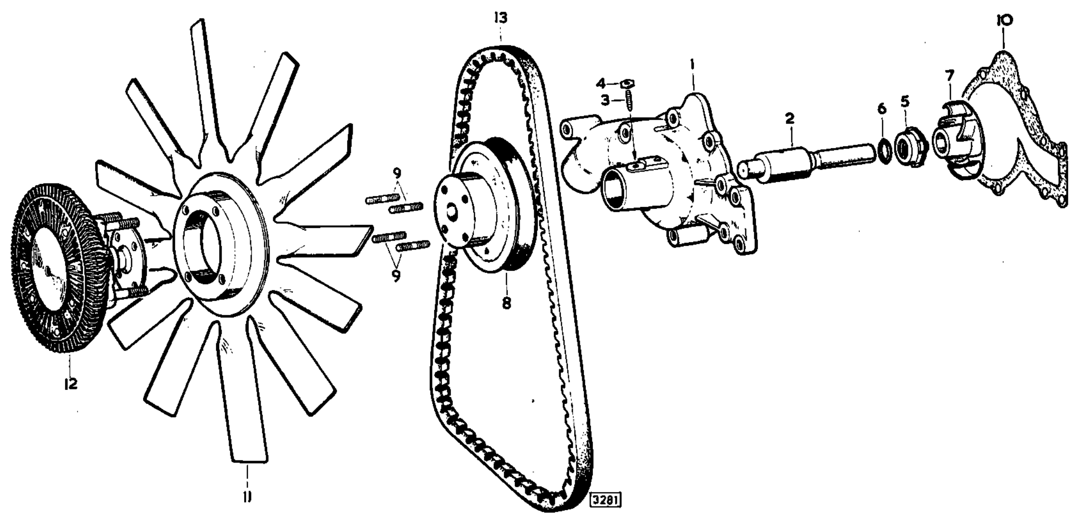


Fig. 10. Exploded view of water pump and fan.

1. Water pump body
2. Spindle and bearing
3. Lockscrew
4. Locknut
5. Seal
6. Thrower
7. Impeller
8. Pulley
9. Stud
10. Gasket
11. Fan
12. Automatic fan unit
13. Belt

DISMANTLING

Remove the water pump pulley by means of a suitable extractor as shown in Fig. 11.

Slacken off the locknut (4 Fig. 10) and remove lockscrew (3 Fig. 10).

Remove the spindle and impeller assembly from the pump body. This assembly must not be pushed out by means of the shaft or the bearing will be damaged. A tube measuring $1\frac{3}{32}''$ (27·77 mm.) outside diameter and $\frac{31}{32}''$ (24·61 mm.) inside diameter must be used as shown. (Fig. 12).

CHECKING

Thoroughly clean all parts of the pump, except the spindle and bearing assembly, in a suitable cleaning solvent.

The bearing is a permanently sealed and lubricated assembly and therefore must not be washed in a solvent.

Inspect the bearing for excessive end play and remove any burrs, rust or scale from the shaft with fine emery paper. Prevent emery dust from entering the bearing by covering with a cloth.

If there are any signs of wear or corrosion in the bearing bore or on the face in front of the impeller, the housing should be renewed.

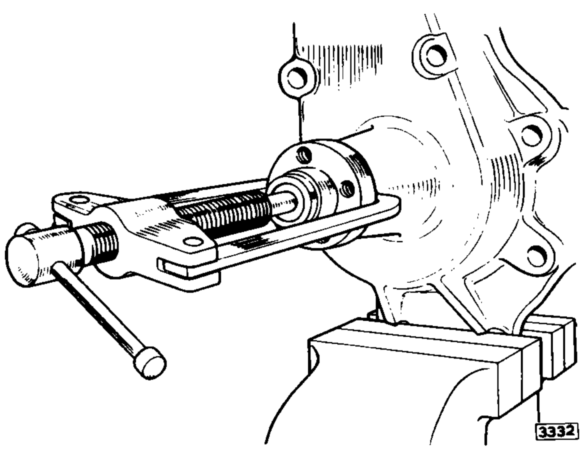


Fig. 11. Withdrawing the fan hub from the spindle.

REASSEMBLY

Install the shaft and bearing assembly into the pump body from the rear and line up the location hole in the bearing with the tapped hole in the body. Fit the locating screw and locknut. Place the rubber thrower in its groove on the spindle in front of the seal.

Coat the outside of the brass seal housing with a suitable water resistant jointing compound and fit into the recess in the pump body.

Press on the impeller as shown in Fig. 13 until the rear face of the impeller is flush with the end of the spindle.

Press the water pump pulley onto the spindle until it is flush with the end of the shaft. (Fig. 14).

REFITTING

Refitting is the reverse of the removal procedure although care should be taken to renew the water pump to timing cover gasket, lightly smearing with grease before fitting. Refit the fan belt as previously described.

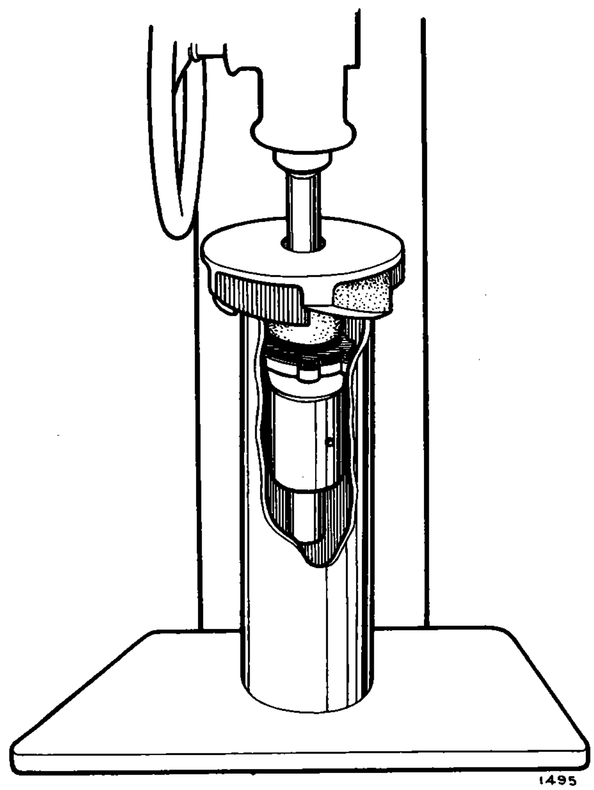


Fig. 12. Removing the water pump impeller from the pump spindle.

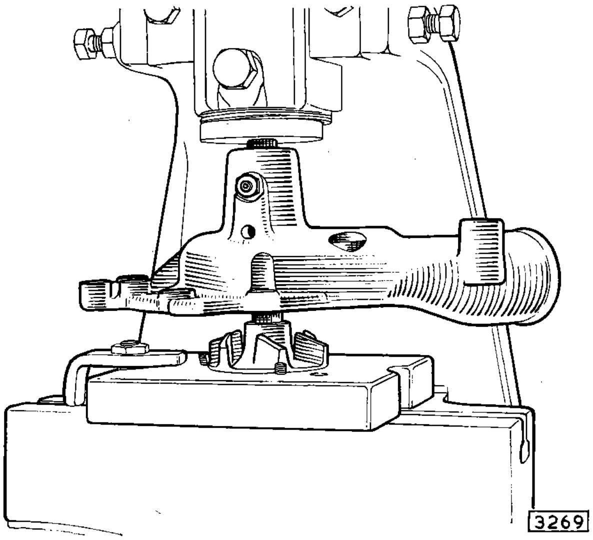


Fig. 13. Fitting the impeller.

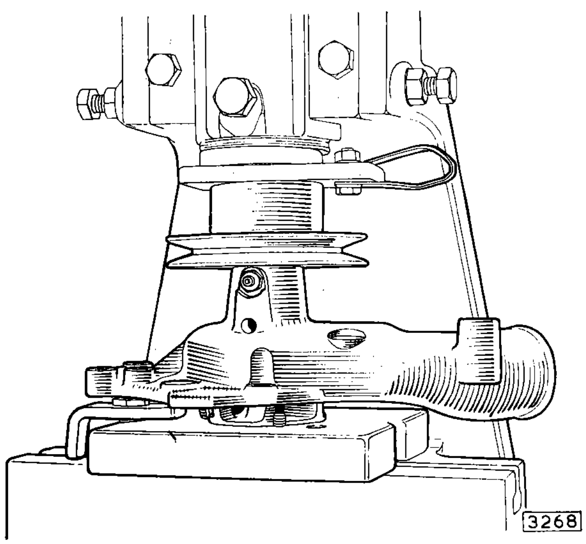


Fig. 14. Pressing the water pump pulley onto the spindle.

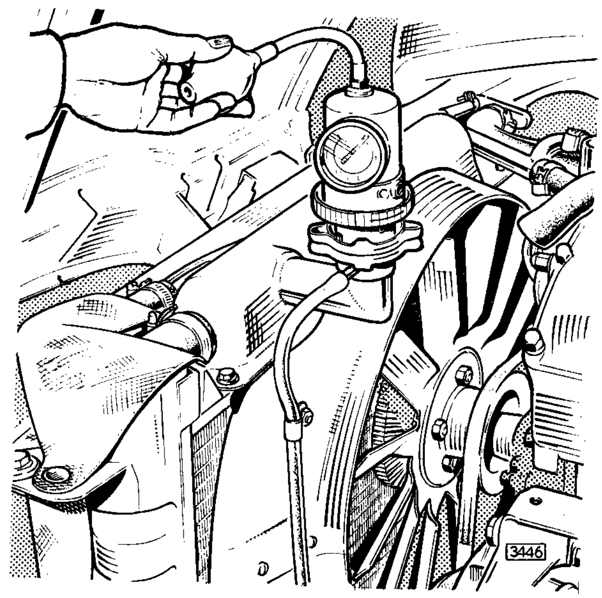


Fig. 15. Pressure testing the cooling system.

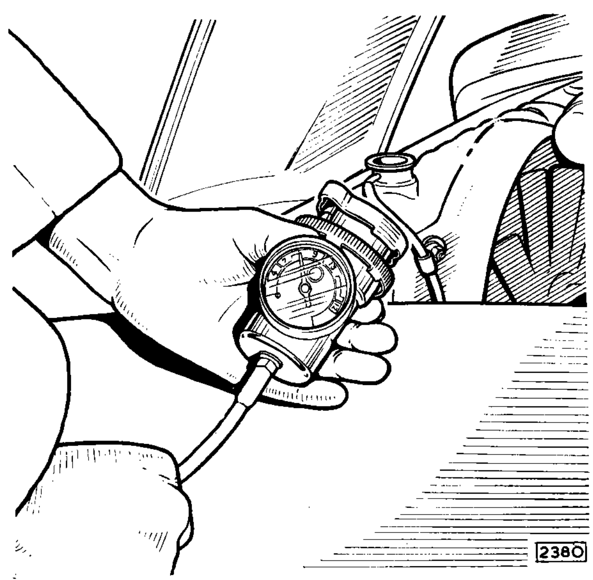


Fig. 16. Pressure testing the radiator cap.

WATER TEMPERATURE GAUGE

The indicator head is fitted in the instrument panel and operates on a thermal principle using a bi-metal strip surrounded by a heater winding.

The transmitter unit is mounted in the inlet manifold water jacket adjacent to the thermostat.

For a full description and a fault analysis of this instrument refer to section P "Electrical and Instruments".

PRESSURE TESTING RADIATOR CAP AND COOLING SYSTEM

The radiator cap and cooling system can be pressure tested and checked for leaks with the aid of the A.C. Delco Cooling Systems Tester RCT–1 (see Figs. 15, 16).

This equipment is obtainable from A.C.–Delco Division of General Motors.

SECTION E

CLUTCH

4·2 MARK 10 MODEL

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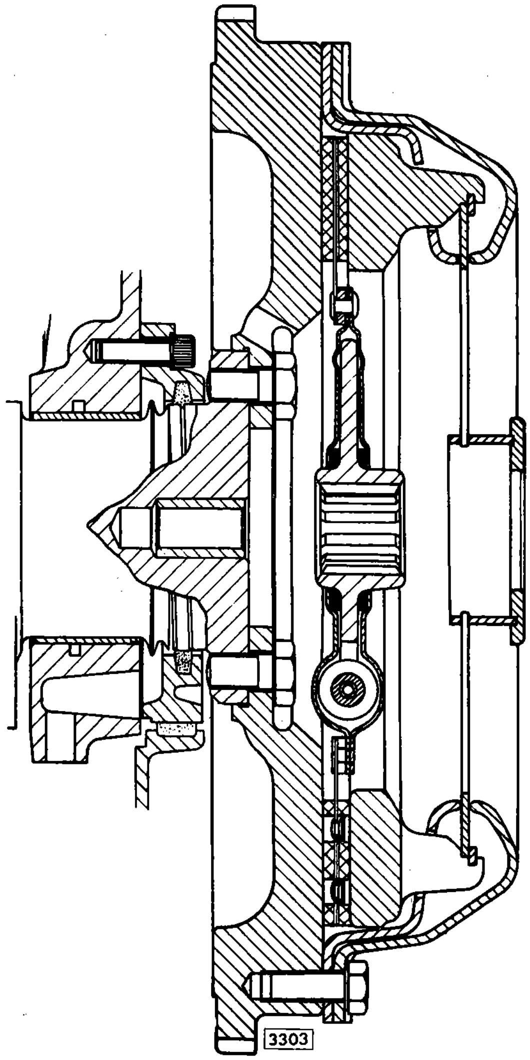


Fig. 1. Section of the diaphragm spring clutch.

CLUTCH

DESCRIPTION

A diaphragm spring clutch is fitted consisting of a spring assembly held flexibly in the lugs of the pressure plate by a spring retaining ring and pivotting on a fulcrum formed by the rims of the clutch cover and the driving plate. Depressing the clutch pedal actuates the release ring causing a corresponding depression of the diaphragm. The lever action of the spring pulls the pressure plate from the driven plate, thus freeing the clutch.

DATA

Make	Laycock
Model	10″ Diaphragm Clutch
Release Ring Travel	0·40″ (10 mm.)
Clutch Release Bearing	Graphite
Operation	Hydraulic

ROUTINE MAINTENANCE

WEEKLY

Check Fluid Level

The clutch is operated hydraulically from a master cylinder situated at the rear of the engine compartment on the driver's side of the car. The hydraulic fluid is stored in a reservoir also situated on the driver's side of the car and the level should be ½″ (12 mm.) below the bottom of the filler neck.

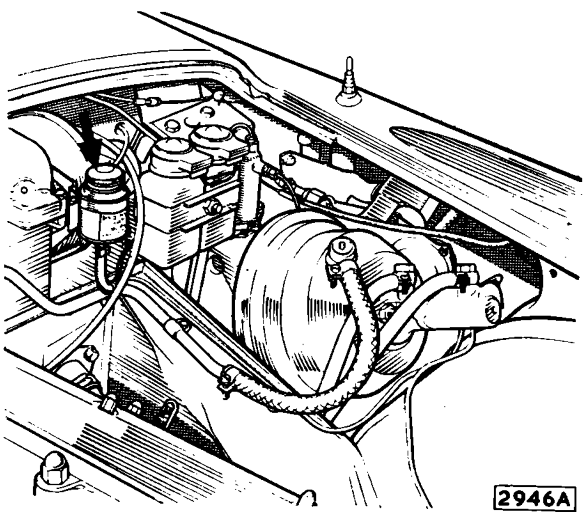


Fig. 2. Clutch fluid reservoir—left-hand drive.

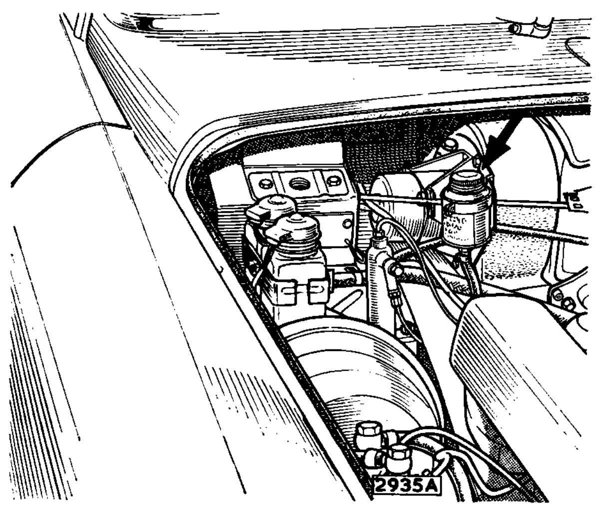


Fig. 3. Clutch fluid reservoir—right-hand drive.

EVERY 3,000 MILES (5,000 KM.)

Clutch Free Travel (Early cars only)

There should be $\frac{1}{16}$" (1·5 mm) free travel measured on the operating rod between the slave cylinder and clutch withdrawal lever.

This free travel is most easily felt, after removal of the fork return spring, by moving the operating rod towards the slave cylinder and then returning towards the withdrawal lever to its fullest extent. Adjustment is effected by slackening the locknut and turning the operating rod.

Screwing the rod into the knuckle joint will increase the free travel; screwing the rod out will decrease the free travel. Always replace the return spring after adjustment.

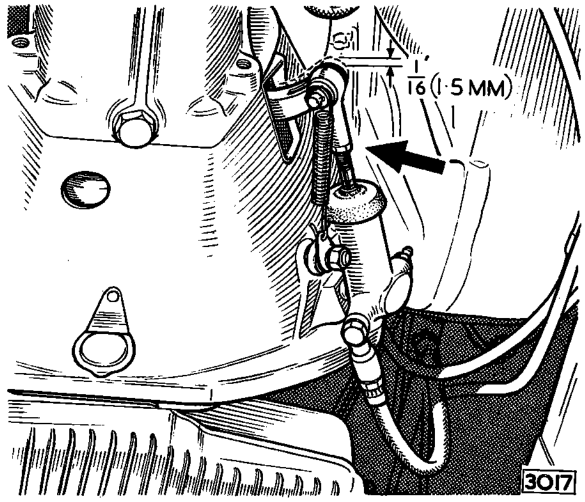


Fig. 4. On early cars, the adjustment of the clutch free travel is effected at the rod between the slave cylinder and withdrawal lever. In the case of later cars no such adjustment is necessary as normal clutch wear is automatically compensated for by means of an hydrostatic clutch operating slave cylinder.

Recommended Hydraulic Fluids

Dunlop Disc Brake Fluid (S.A.E. 70 R3).

Where this is not available, only fluid guaranteed to conform to S.A.E. 70 R3 specification, which is fully miscible with Dunlop Disc Brake Fluid, may be used as an alternative.

HYDRAULIC SYSTEM—GENERAL INSTRUCTIONS

If it is necessary to dismantle any part of the clutch system (that is, either the master cylinder or the slave cylinder), the operation must be carried out under conditions of scrupulous cleanliness. Clean the mud and grease off the unit before removal from the vehicle and dismantle on a bench covered with a sheet of clean paper. Do not swill a complete unit, after removal from the car, in paraffin or trichlorethylene (trike) as this would ruin the rubber parts and, on dismantling, give a misleading impression of their original condition. Do not handle the internal parts, particularly rubbers, with dirty hands.

Place all metal parts in a tray of clean brake fluid to soak; afterwards dry off with a clean fluffless cloth and lay out in order on a sheet of clean paper. Rubber parts should be carefully examined and if there is any sign of swelling or perishing they should be renewed; in any case it is good policy to renew all rubbers. The main castings may be swilled in any of the normal cleaning fluids but all traces of the cleaner must be dried out before assembly.

All internal parts should be dipped in clean brake fluid and assembled wet, as the fluid acts as a lubricant.

When assembling the rubber parts use the fingers only.

BLEEDING THE SYSTEM

"Bleeding" the clutch hydraulic system (expelling the air) is not a routine maintenance operation and should only be necessary when a portion of the hydraulic system has been disconnected or if the level of the fluid in the reservoir has been allowed to fall. The presence of air in the hydraulic system may result in difficulty in engaging gear owing to the clutch not disengaging fully.

Fill up the reservoir with brake fluid exercising great care to prevent the entry of dirt. Attach a rubber bleed tube to the nipple on the slave cylinder on the right-hand side of the clutch housing and allow the tube to hang in a clean glass jar partly filled with brake fluid. Unscrew the nipple one complete turn. Depress the clutch pedal slowly, tighten the bleeder nipple before the pedal reaches the end of its travel and allow the pedal to return unassisted.

Repeat the above procedure, closing the bleed nipple at each stroke, until the fluid issuing from the tube is entirely free of air, care being taken that the reservoir is replenished frequently during this operation, for should it be allowed to become empty more air will enter.

On completion, top up the reservoir to the bottom of the filler neck.

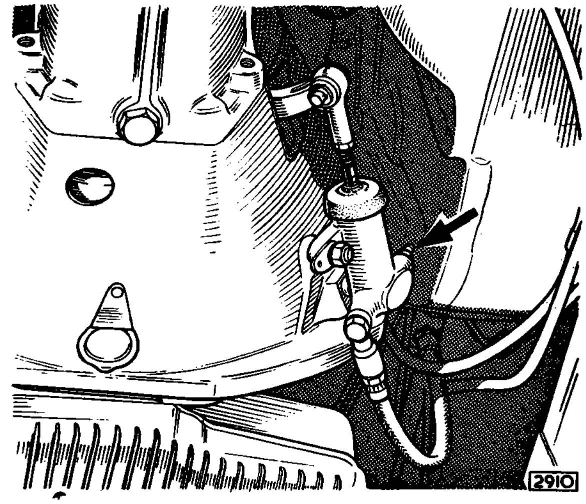


Fig. 5. The clutch slave cylinder bleed nipple. The slave cylinder shown is the type fitted to later cars which can be identified by the absence of a return spring.

Do not on any account use the fluid which has been bled through the system to replenish the reservoir as it will have become aerated.

Always use fresh fluid straight from the tin. Use only recommended fluid.

FLUSHING THE SYSTEM

Should the fluid in the system become thick or "gummy" after many years in service, or after a vehicle has been laid up for some considerable time, the system should be drained, flushed and re-filled. It is recommended that this should be carried out once every five years.

Pump all fluid out of the hydraulic system through the bleeder screw of the clutch cylinder. To the bleeder screw on the slave cylinder connect one end of a rubber tube, and allow the other end to fall into a container, slacken the screw one complete turn and pump the clutch pedal by depressing it quickly and allowing it to return without assistance; repeat, with a pause in between each operation, until no more fluid is expelled. Discard the fluid extracted.

Fill the supply tank with industrial methylated spirit and flush the system as described above. Keep the supply tank replenished until at least a quart of spirit has passed through the bleeder screw.

Remove the master cylinder and pour off any remaining spirit. Refit the master cylinder, re-fill with clean brake fluid and "Bleed" the system.

Note: If the system has been contaminated by the use of mineral oil, etc., the above process will not prove effective. It is recommended that the various units, including the pipe lines, be dismantled and thoroughly cleaned and that all rubber parts, including flexible hoses should be renewed. The contaminated fluid should be destroyed immediately.

REMOVING AND REFITTING A FLEXIBLE HOSE

In some cases, the cause of a faulty clutch may be traced to a choked flexible hose. Do not attempt to clear the obstruction by any means except air pressure, otherwise the hose may be damaged. If the obstruction cannot be cleared the hose must be replaced by a new one.

REMOVAL

To renew a flexible hose, adopt the following procedure:—

Unscrew the tube nut from the hose union, then unscrew the locknut and withdraw the hose from the bracket. Disconnect the hose at the other end.

REFITTING

When refitting a hose, first ensure that it is not twisted or "kinked" **(this is MOST IMPORTANT)** then pass the hose union through the bracket and, whilst holding the union with a spanner to prevent the hose from turning, fit the locknut and the shakeproof washer; connect up the pipe by screwing on the tube-nut.

THE MASTER CYLINDER

The master cylinder is mechanically linked to the clutch pedal and provides the hydraulic pressure necessary to operate the clutch. The components of the master cylinder are contained within the bore of a body (6) which at its closed end has two 90° opposed integral pipe connection bosses.

Integrally formed around the opposite end of the cylinder is a flange provided with two holes for the master cylinder attachment bolts. In the unloaded condition a spring loaded piston (4) carrying two seals (13) (5) is held against the underside of a circlip retained dished washer (3) at the head of the cylinder. A hemispherically ended push-rod (1) seats in a similarly formed recess at the head of the piston. A fork end on the outer end of the push-rod provides for attachment to the pedal. A rubber dust excluder (2) the lip of which seats in a groove, shrouds the head of the master cylinder to prevent the intrusion of foreign matter.

A cylindrical spring support (12) locates around the inner end of the piston and a small drilling in the end of the support is engaged by the stem of a valve (11). The larger diameter head of the valve locates in a central blind bore in the piston. The valve passes through the bore of a vented spring support (8) and interposed between the spring support and an integral flange formed on the valve is a small coiled spring (9). A lipped rubber seal (10) registers in a groove around the end of the valve. This assembly forms a recuepration valve which controls fluid to and from the reservoir.

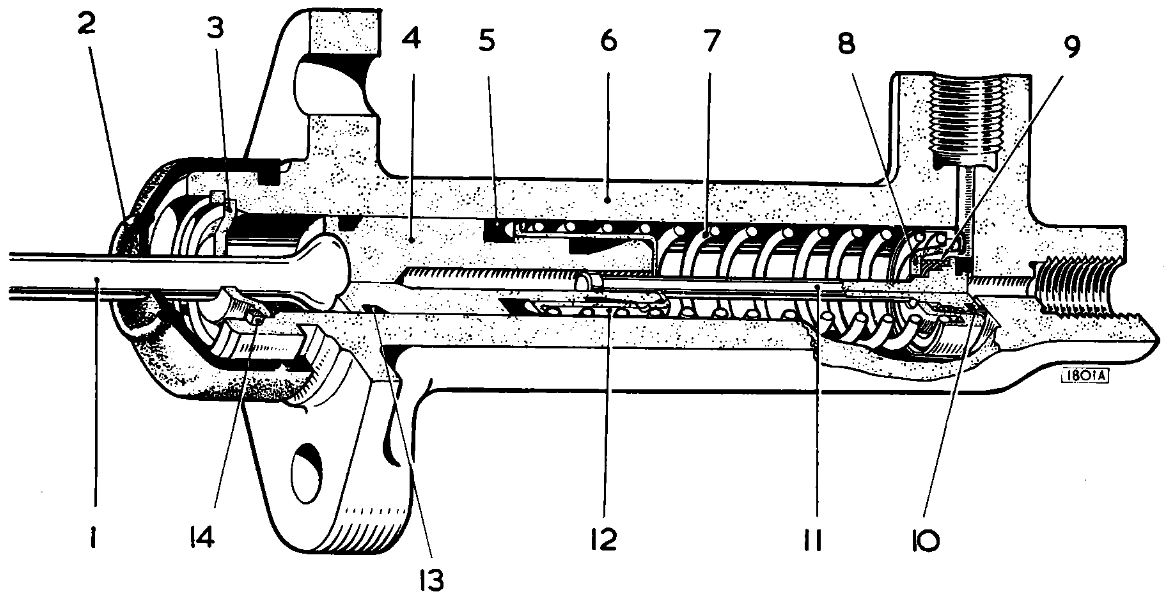
When the foot pedal is in the OFF position the master cylinder is fully extended and the valve is held clear of the base of the cylinder by the action of the main spring. In this condition the master cylinder is in fluid communication with the reservoir, thus permitting recuperation of any fluid loss sustained, particularly during the bleeding operation.

When a load is applied to the foot pedal the piston moves down the cylinder against the compression of the main spring. Immediately this movement is in excess of the valve clearance the valve closes under the influence of its spring and isolates the reservoir. Further loading of the pedal results in the discharge of fluid under pressure from the outlet connection, via the pipe lines to the clutch slave cylinder.

Removal of the load from the pedal reverses the sequence, the action of the main spring returns the master cylinder to the extended position.

REMOVAL

Drain the clutch reservoir and detach the inlet and outlet pipes from the clutch master cylinder, by unscrewing the two union nuts. Detach the master cylinder push-rod from the clutch pedal from inside the car by removing the split pin and withdrawing the clevis pin. Remove the clutch master cylinder from the housing situated inside the engine compartment by removing two nuts.



1. Push rod
2. Rubber dust excluder
3. Dished washer
4. Piston
5. Rubber seal
6. Body
7. Spring
8. Spring support
9. Valve spring
10. Rubber seal
11. Valve
12. Spring support
13. Rubber seal
14. Circlip

Fig. 6. Sectioned view of the master cylinder.

RENEWING THE MASTER CYLINDER SEALS

Ease the dust excluder clear of the head of the master cylinder.

With suitable pliers remove the circlip; this will release the push rod complete with dished washer.

Withdraw the piston and remove both seals.

Withdraw the valve assembly complete with springs and supports. Remove the seal from the end of the valve.

Lubricate the new seals and the bore of the cylinder with brake fluid, fit the seal to the end of the valve ensuring that the lip registers in the groove. Fit the seals in their grooves around the piston.

Insert the piston into the spring support, ensuring that the head of the valve engages the piston bore.

Lubricate the piston with Castrol Rubber Grease H 95/59 and slide the complete assembly into the cylinder body taking particular care not to damage or twist the seals. The use of a fitting sleeve is advised.

Position the push-rod and depress the piston sufficiently to allow the dished washer to seat on the shoulder at the head of the cylinder. Fit the circlip and check that it fully engages the groove.

Fill the dust excluder with clean Castrol H95/59 Rubber Grease.

Reseat the dust excluder around the head of the master cylinder.

MASTER CYLINDER PUSH-ROD—FREE TRAVEL

To ensure that this piston returns to the fully extended position clearance is provided between the enlarged head of the push-rod, the piston and dished washer. As this washer also forms the return stop for the clutch pedal, no means of adjustment is necessary.

REFITTING

Secure the master cylinder to the vehicle by fitting the fixing nuts at the flange. Connect the pipes to the inlet and outlet connections, the push rod to the pedal, and bleed the system. Check for leaks by depressing the clutch pedal once or twice and examining all hydraulic connections.

1. Spring
2. Cup filler
3. Cup
4. Body
5. Piston
6. Circlip
7. Rubber boot

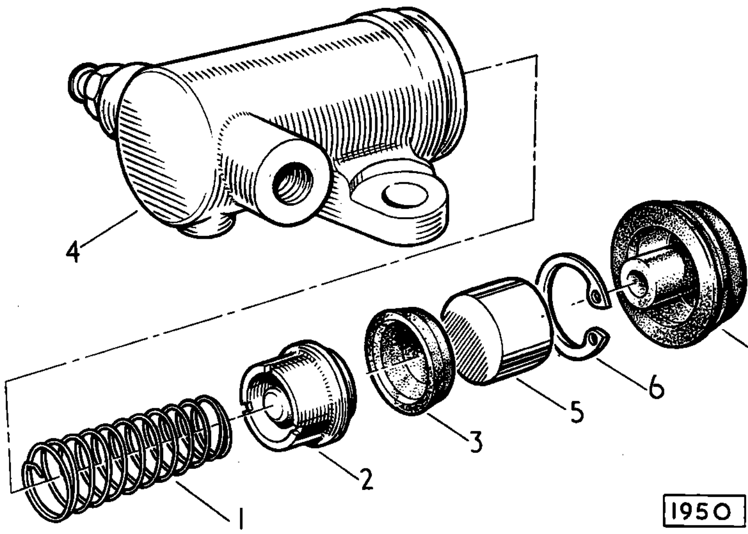


Fig. 7. Exploded view of the clutch slave cylinder.

THE SLAVE CYLINDER

The clutch slave cylinder consists of a body (4) which incorporates two threaded connections and is bored to accommodate a piston (5) against the inner face of which a rubber cap (3) is loaded by a cup filler (2) and a spring (1); the travel of the piston is limited by a circlip (6) fitted in a groove at the end of the bore. A rubber boot (7) through which a push-rod passes, is fitted on to the body to prevent the intrusion of dirt or moisture.

One of the connections in the body receives a pipe from the clutch master cylinder, whilst the other is fitted with a bleeder screw.

REMOVAL

To remove from the vehicle, disconnect the pipe, detach the rubber boot from the body and remove the fixing screws; leave the push-rod attached to the vehicle. If the boot is not being renewed it may be left on the push-rod.

DISMANTLING

Remove the circlip (6) from the end of the bore and apply a low air pressure to the open connection to expel the piston (5) and the other parts; remove the bleeder screw.

ASSEMBLING

Prior to assembly, smear all internal parts and the bore of the body with Rubberlube.

Fit the spring (1) in the cup filler (2) and insert these parts, spring uppermost, into the bore of the body (4). Follow up with the cup (3), lip leading, taking care not to turn back or buckle the lip; then insert the piston (5), flat face innermost, and fit the circlip (6) into the groove at the end of the bore.

REFITTING

Fit the rubber boot (7) on the push-rod, and offer up the slave cylinder to the vehicle, with the push-rod entering the bore. Secure the cylinder with the fixing screws and stretch the large end of the boot into the groove on the body. Fit into their respective connections the bleeder screw and the pipe from the clutch master cylinder.

"Bleed" the clutch as described on page E.7.

THE CLUTCH UNIT

DESCRIPTION (Fig. 8).

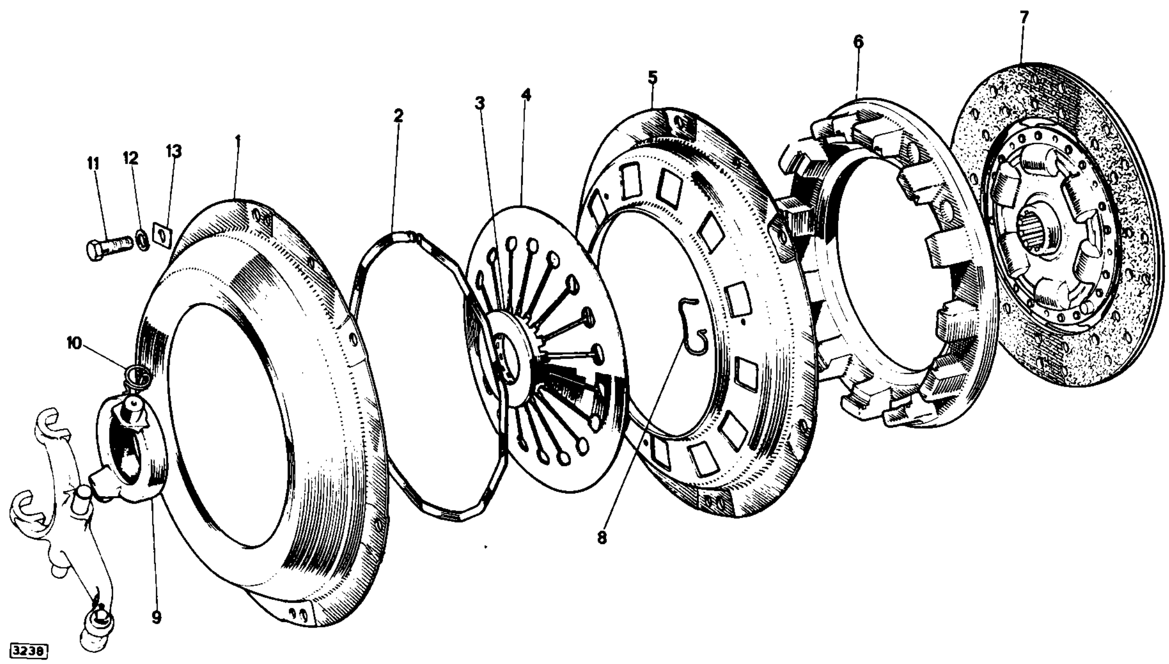
The driven plate assembly (7) is of the flexible centre type in which a splined hub is indirectly attached to a disc and transmits the power and overrun through a number of coil springs held in position by shrouds.

The cover assembly consists of a pressed steel cover (1) and a cast iron pressure plate (6) loaded by a spring assemb'y.

The spring assembly consists of a diaphragm spring (4) and a release ring (3) which is held flexibly in the lugs of the pressure plate by means of a spring retaining ring (2).

Balancing of the clutch assembly is effected by drilling holes in the loose cover plate and by fitting balance weights (13).

A graphite release bearing (9) is shrunk into a bearing cup which is mounted on the throw-out forks and held by the release bearing retainer springs.



1. Cover	8. Retaining clip
2. Retaining ring	9. Release bearing
3. Release ring	10. Spring clip
4. Diaphragm spring	11. Set pin
5. Driving plate	12. Spring washer
6. Pressure plate	13. Balance weight
7. Driven plate	

Fig. 8. Exploded view of diaphragm clutch.

GENERAL INSTRUCTIONS

To enable the balance of the assembly to be preserved after dismantling there are corresponding paint marks on the cover plate and driving plate. In addition, there are corresponding reference numbers stamped in the flanges of the cover and driving plate.

When reassembling ensure that the markings coincide and that, when refitting the clutch to the flywheel, the letter "B" stamped adjacent to one of the dowel holes coincides with the "B" stamped on the edge of the flywheel.

The clutch is balanced in conjunction with the flywheel by means of loose balance pieces which are fitted under the appropriate securing bolt. Each balance piece must be refitted in its original position, the number stamped on the balance weight corresponding to the number stamped on the cover plate. There are three balance weights stamped 1, 2 and 3, the weight stamped 3 being the heaviest.

If the graphite release bearing ring is badly worn it should be replaced by a complete bearing assembly.

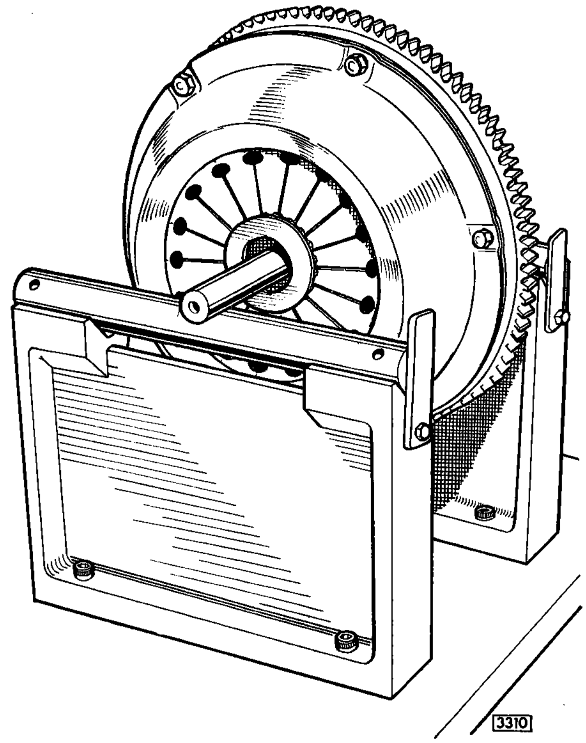


Fig. 9. Clutch and flywheel balancing.

CLUTCH REMOVAL

In order to remove the clutch, the engine and gearbox must first be removed (see Section B—Engine Removal).

Remove gearbox and clutch housing from engine.

Remove the bolts securing the clutch to the flywheel and withdraw the clutch assembly.

DISMANTLING

Before dismantling the clutch ensure that the balance weight is retained.

Remove the retaining ring and dismantle.

If the clutch is faulty, it should be replaced as a complete assembly but, should this not be practicable, to dismantle completely proceed as follows:—

(a) Mark all parts to ensure that they are assembled in the same relative position.

(b) Place the clutch face downwards on the bench.

- (i) Lift off the cover.
- (ii) Remove the retaining ring.
- (iii) Lift out the diaphragm spring.
- (iv) Remove the three spring clips.
- (v) Lift the driving plate off the pressure plate.

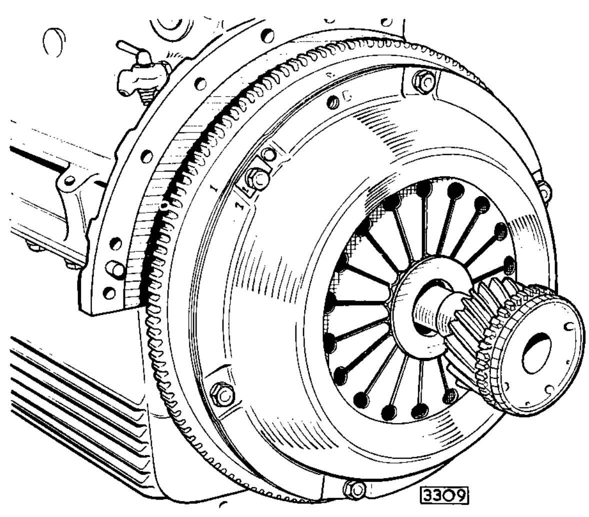


Fig. 10. Centralising the driven plate on the flywheel by means of a dummy shaft.

(c) Examine all parts, paying particular attention to the following points:—
    (i) Check for excessive clearance between the pressure plate lugs and the looating apertures in the driving plate.
    (ii) Check for heat discolouration, distortion or surface damage at pressure plate face.
    (iii) Check for wear on driven plate facings.
    (iv) Check for loss of cushion on the spring segments between the facings.

ASSEMBLING

It is essential that all major components be returned to their original positions if the balance of the assembly is to be preserved.

Apply a trace of molybdenum disulphide or zinc based grease to the sides of the pressure plate lugs, fulcrum points for the diaphragm spring on the pressure plate, driving plate and cover.

REFITTING

Place the driven plate on the flywheel taking care that the larger part of the splined hub faces the gearbox. Centralise the plate on the flywheel by means of the dummy shaft (a constant pinion shaft may be used for this purpose). Secure the cover assembly with the six setscrews and spring washers, tightening the screws a turn at a time by diagonal selection. Ensure that the "B" stamped adjacent to one of the dowel holes coincides with the "B" stamped on the periphery of the flywheel.

CONDITION OF CLUTCH FACINGS

The possibility of further use of the friction facings of the clutch is sometimes raised, because they have a polished appearance after considerable service. It is natural to assume that a rough surface will give a higher fractional value against slipping, but this is not correct.

Since the introduction of non-metallic facings of the moulded asbestos type, in service, a polished surface is a common experience, but it must not be confused with a glazed surface which is sometimes encountered due to the conditions discussed below.

The ideal smooth or polished condition will provide a normal contact, but a glazed surface may be due to a film or a condition introduced, which entirely alters the frictional value of the facings. These two conditions might be simply illustrated by the comparison between a polished wood, and a varnished surface. In the former the contact is still made by the original material, whereas in the latter instance, a film of dried varnish is interposed between the contact surfaces.

The following notes are issued with a view to giving useful information on this subject:—

(a) After the clutch has been in use for some little time, under perfect conditions (that is, with the clutch facings working on true and polished or ground surfaces of correct material, without the presence of oil, and with only that amount of slip which the clutch provides for under normal conditions) then the surface of the facings assumes a high polish, through which the grain of the material can be clearly seen. This polished facing is of mid-brown colour and is then in a perfect condition.

(b) Should oil in small quantities gain access to the clutch in such a manner as to come in contact with the facings it will burn off, due to the heat generated by slip which occurs under normal starting conditions. The burning off of this small amount of lubricant, has the effect of gradually darkening the facings, but, provided the polish on the facings remains such that the grain of the material can be clearly distinguished, it has very little effect on clutch performance.

(c) Should increased quantities of oil or grease obtain access to the facings, one or two conditions, or a combination of the two, may arise, depending upon the nature of oil, etc.

(i) The oil may burn off and leave on the surface facings a carbon deposit which assumes a high glaze and causes slip. This is a very definite, though very thin deposit, and in general it hides the grain of the material.

(ii) The oil may partially burn and leave a resinous deposit on the facings, which frequently produces a fierce clutch, and may also cause a "spinning" clutch due to a tendency of the facings to adhere to the flywheel or pressure plate face.

(iii) There may be a combination of (i) and (ii) conditions, which is likely to produce a judder during clutch engagement.

(d) Still greater quantities of oil produce a black soaked appearance of the facings, and the effect may be slip, fierceness, or judder in engagement, etc., according to the conditions. If the conditions under (c) or (d) are experienced, the clutch driven plate should be replaced by one fitted with new facings, the cause of the presence of the oil removed and the clutch and flywheel face thoroughly cleaned.

FAULT FINDING

SYMPTOM	CAUSE	REMEDY
Drag or Spin	(a) Oil or grease on the driven plate facings	Fit new facings
	(b) Misalignment between the engine and splined clutch shaft	Check over and correct the alignment
	(c) Air in clutch system	"Bleed" system
	(d) Bad external leak between the clutch master cylinder and the slave cylinder	Renew pipe and unions
	(e) Excessive clearance between the slave cylinder and clutch withdrawal lever (early cars only).	Adjust to $\frac{1}{16}''$ (1·58 mm.) clearance (early cars only)
	(f) Warped or damaged pressure plate or clutch cover	Renew defective part
	(g) Driven plate hub binding on splined shaft	Clean up splines and lubricate with small quantity of high melting point grease such as Duckham's Keenol
	(h) Distorted driven plate due to the weight of the gearbox being allowed to hang on clutch plate during assembly	Fit new driven plate assembly using a jack to take overhanging weight of the gearbox
	(i) Broken facings of driven plate	Fit new facings, or replace plate
	(j) Dirt or foreign matter in the clutch	Dismantle clutch from flywheel and clean the unit, see that all working parts are free **CAUTION:** Never use petrol or paraffin for cleaning out clutch

FAULT FINDING (continued)

SYMPTOM	CAUSE	REMEDY
Fierceness or Snatch	(a) Oil or grease on driven plate facings	Fit new facings and ensure isolation of clutch from possible ingress of oil or grease
	(b) Misalignment	Check over and correct alignment
	(c) Worn out driven plate facings	New facings required
Slip	(a) Oil or grease on driven plate facings	Fit new facings and eliminate cause
	(b) Seized piston in clutch slave cylinder	Renew parts as necessary
	(c) Master cylinder piston sticking	Free off piston
Judder	(a) Oil, grease or foreign matter on driven plate facings	Fit new facings or driven plate
	(b) Misalignment	Check over and correct alignment
	(c) Bent splined shaft or buckled driven plate	Fit new shaft or driven plate assembly
Rattle	(a) Damaged driven plate (b) Excessive backlash in transmission (c) Wear in transmission bearings (d) Bent or worn splined shaft (e) Release bearing loose on throw out fork	Fit new parts as necessary
Tick or Knock	Hub splines worn due to misalignment	Check and correct alignment then fit new driven plate
Fracture of Driven Plate	(a) Misalignment distorts the plate and causes it to break or tear round the hub or at segment necks	Check and correct alignment and introduce new driven plate
	(b) If the gearbox during assembly be allowed to hang with the shaft in the hub, the driven plate may be distorted, leading to drag, metal fatigue and breakage	Fit new driven plate assembly and ensure satisfactory re-assembly
Abnormal Facing Wear	Usually produced by overloading and by excessive clutch slip when starting	In the hands of the operator

SECTION F

GEARBOX AND OVERDRIVE

4·2 MARK 10 MODEL

INDEX

GEARBOX

OVERDRIVE

INDEX *(continued)*

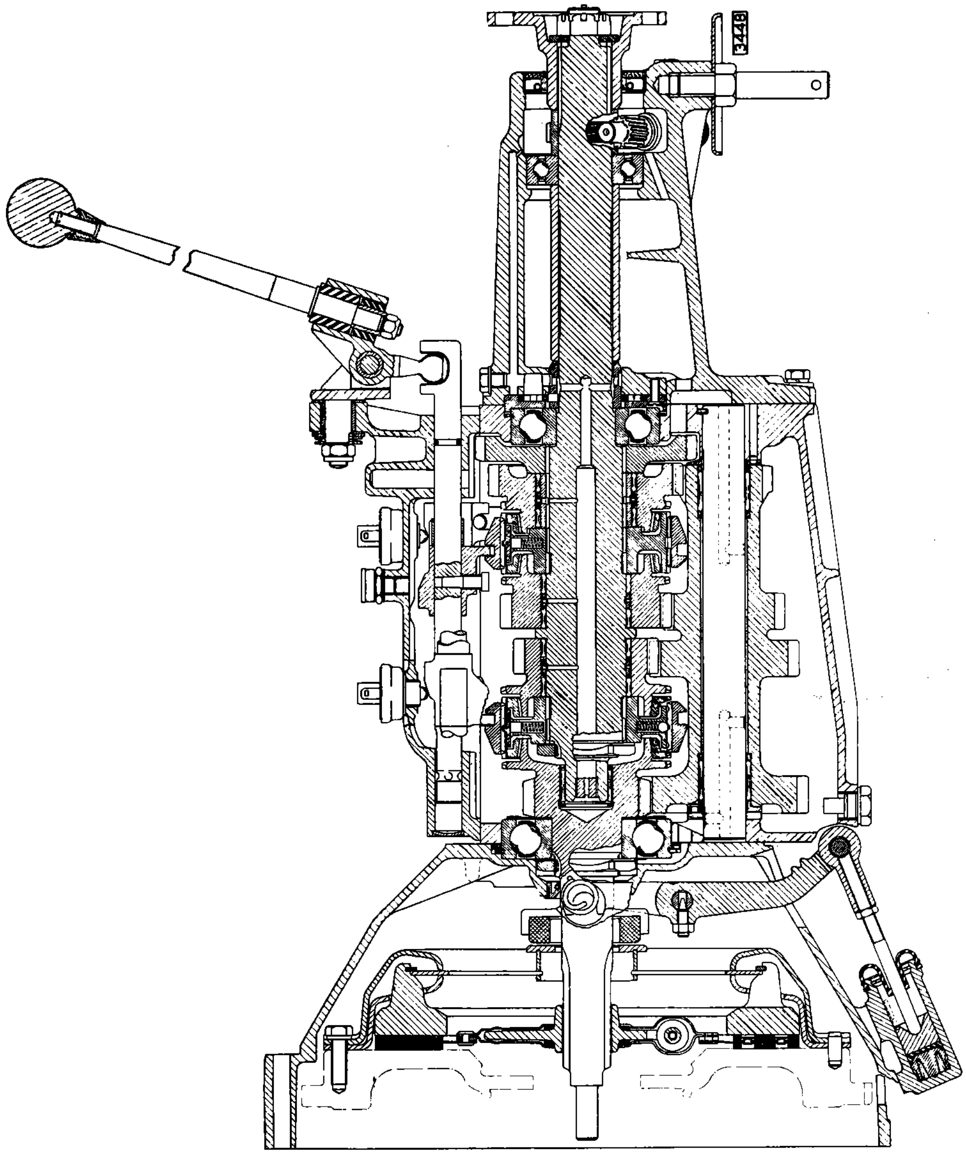


Fig. 1. Longitudinal section of clutch and gearbox.

GEARBOX AND OVERDRIVE

The gearbox is of the four speed type with baulk-ring synchromesh on all forward gears. With the exception of reverse, the detents for the gears are incorporated in the synchro assemblies; the three synchro balls engaging with grooves in the operating sleeve. The detent for reverse gear is a spring loaded ball which engages on a groove in the selector rod.

Two interlock balls and a pin located at the front of selector rods prevent the engagement of two gears at the same time.

The overdrive (fitted as an optional extra) is of the Laycock de Normanville type and it is dealt with separately at the end of this section.

DATA

Identification number	**EJ 001 onwards**
Ratios	
1st gear	3·04:1
2nd gear	1·973:1
3rd gear	1·328:1
4th (top) gear	1·00:1
Reverse	3·49:1
1st gear—end float on mainshaft	0·005″ – 0·007″ (0·13 – 0·18 mm.)
2nd gear—end float on mainshaft	0·005″ – 0·008″ (0·13 – 0·20 mm.)
3rd gear—end float on mainshaft	0·005″ – 0·008″ (0·13 – 0·20 mm.)
Countershaft gear unit end float	0·004″ – 0·006″ (0·10 – 0·15 mm.)

Mobil	Castrol	Shell	Esso	B.P.	Duckham	Regent Caltex/Texaco
Mobilube GX 90	Castrol Hypoy	Spirax 90 E.P.	Esso Gear Oil G.P. 90 1/40	Gear Oil SAE 90 E.P.	Hypoid 90	Multigear Lubricant EP 90

	CAPACITY		
	Imperial	**U.S.**	**Litres**
Gearbox	2½ pints	3 pints	1·5
Gearbox and Overdrive	4 pints	4¾ pints	2·25

ROUTINE MAINTENANCE

EVERY 3,000 MILES (5,000 KM.)

Gearbox Oil Level

Check the level of the oil in the gearbox with the car standing on level ground.

A combined level and filler plug is fitted on the left-hand side of the gearbox. Clean off any dirt from around the plug before removing it.

The level of the oil should be to the bottom of the filler and level plug hole.

The filler plug is accessible from inside the car through an aperture in the left-hand vertical face of the gearbox cowl. To obtain access to the plug remove the seat cushion, slide the seat rearwards to the full extent; lift the front carpet and roll forward to expose the two snap fasteners retaining the gearbox cowl covering to the fioor.

Release the snap fasteners and raise the panel. Remove the front aperture cover now exposed and insert a tubular wrench through the aperture to remove the plug.

In the interests of cleanliness always cover the carpets before carrying out lubrication.

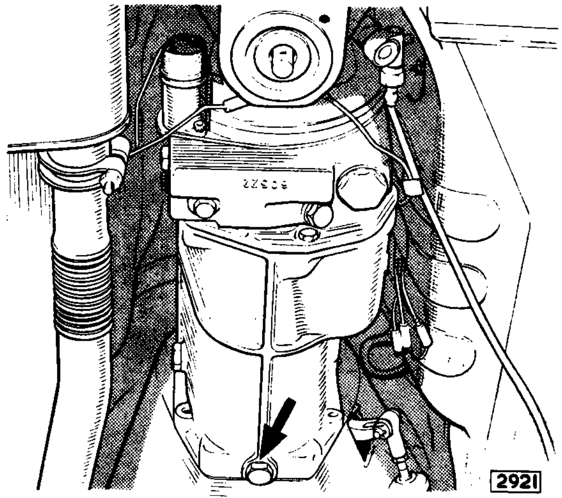


Fig. 2. Gearbox drain plug.

EVERY 12,000 MILES (20,000 KM.)

Changing the Gearbox Oil

The draining of the gearbox should be carried out at the end of a run when the oil is hot and therefore will flow more freely. The drain plug is situated at the front end of the gearbox casing.

After all the oil has drained replace the drain plug and refill the gearbox with the recommended grade of oil through the combined filler and level plug hole situated on the left-hand side of the gearbox casing; the level should be to the bottom of the hole.

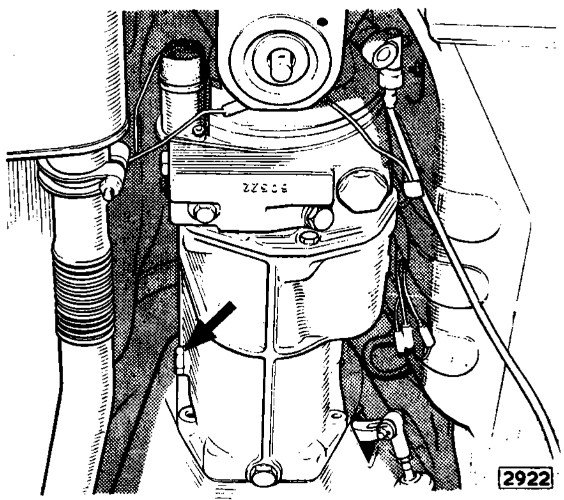


Fig. 3. Gearbox filler and level plug.

GEARBOX DISMANTLING

REMOVAL OF CLUTCH HOUSING

Detach the springs and remove the carbon thrust bearing.

Unscrew the two nuts and remove the clutch slave cylinder.

Remove the Allen screw, push out the fulcrum pin and detach the clutch fork.

Tap back the locking tabs and break the locking wire and remove the eight setscrews.

Detach the clutch housing.

REMOVAL OF TOP COVER

Place the gear lever in neutral.

Remove the eight setscrews and two nuts and lift off the lid.

REMOVAL OF REAR EXTENSION

Engage first and reverse gears to lock the unit.

Remove the split pin and unscrew the flange nut.

Withdraw the flange.

Remove the four setscrews and detach the rear cover.

Remove the speedometer pinion bush assembly after unscrewing the retaining bolt.

Withdraw the speedometer driving gear from the mainshaft.

Remove the seven setscrews and withdraw the extension.

Collect the distance piece and oil pump driving pin.

REMOVAL OF COUNTERSHAFT

Remove the fibre plug from the front of the countershaft.

Drive out the countershaft from the front of the casing.

Important Ensure that the rear washer (pegged to casing) drops down in a clockwise direction looking from the rear to avoid trapping the washer with the reverse gear when driving the mainshaft forward (see Fig. 4). This is effected by rocking the gearbox casing and moving the reverse lever backwards and forwards, or by pushing the washer down with a piece of wire bent at right angles

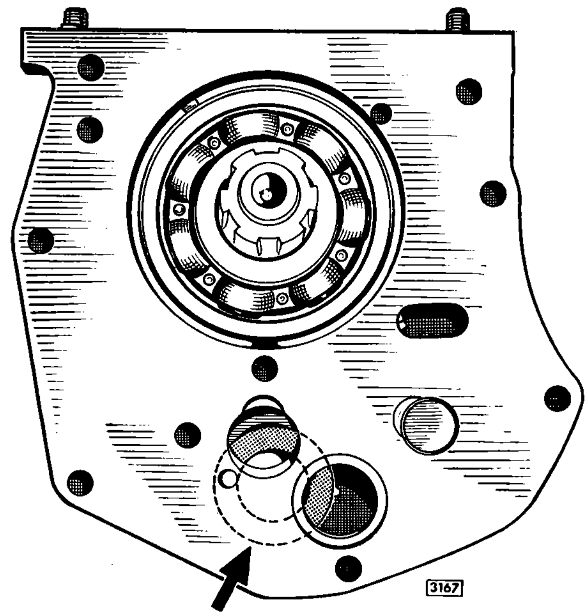


Fig. 4. Ensure that the rear washer (indicated by arrow) drops down in a clockwise direction.

Rotate the constant pinion shaft until the cutaway portions of the driving gear are facing the top and bottom of the casing otherwise the gear will foul the countershaft.

With the aid of two levers ease the constant pinion shaft forward until it can be withdrawn (see Fig. 5).

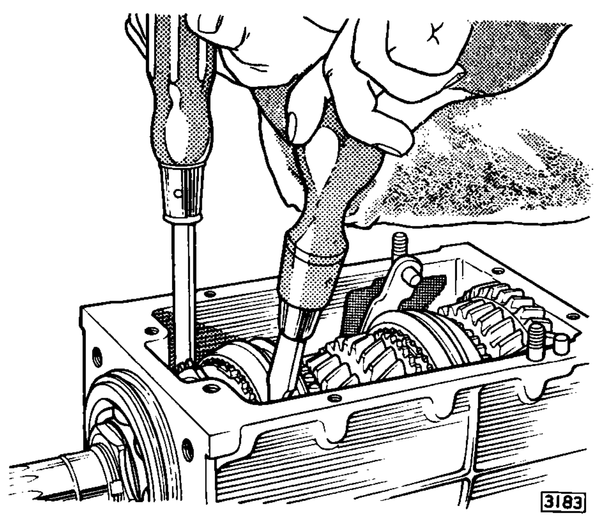


Fig. 5. With aid of two levers ease the constant pinion shaft forward.

REMOVAL OF MAINSHAFT

Rotate the mainshaft until one of the cutaway portions in 3rd/Top synchro hub is in line with the countershaft (see Fig. 6), otherwise the hub will foul the constant gear or the countershaft.

Tap or press the mainshaft through the rear bearing ensuring that the reverse gear is kept tight against the first gear. (see Fig. 7).

After removal of the rear bearing from the casing fit a hose clip to the mainshaft to prevent the reverse gear from sliding off. (see Fig. 8).

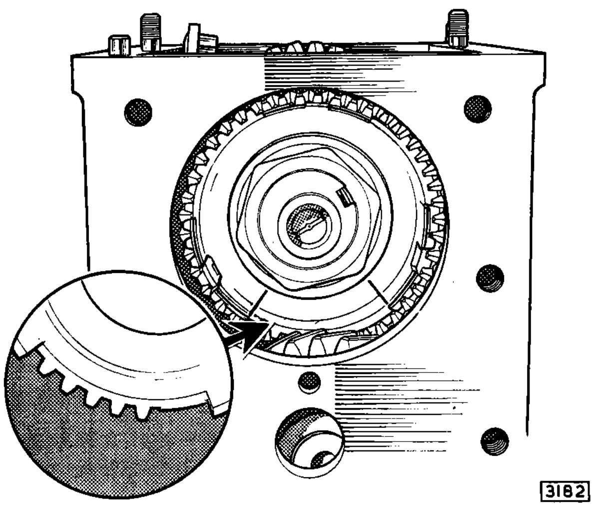


Fig. 6. Rotate the mainshaft until one of the cutaway portions in 3rd/Top synchro hub is in line with the countershaft.

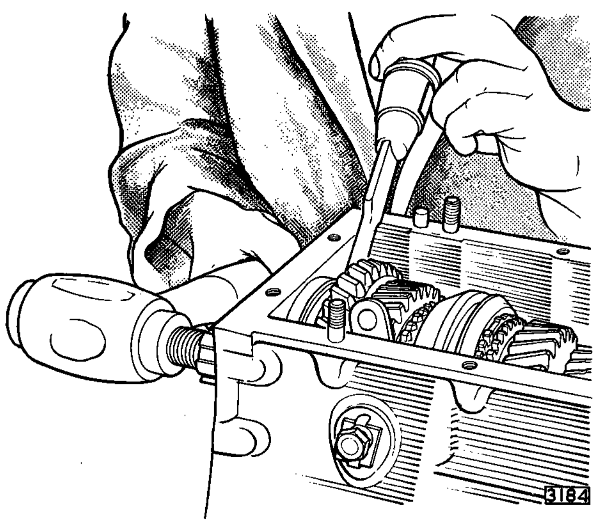


Fig. 7. Tapping the mainshaft through the rear bearing.

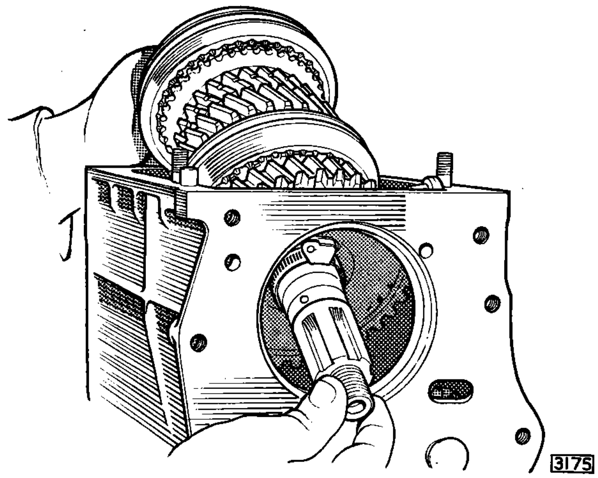


Fig. 8. Removal of the mainshaft. Note that the hose clip is fitted to the mainshaft to retain the reverse gear.

Slacken the reverse lever bolt until the lever can be moved to the rear.

Lift out the mainshaft forward and upward.

Lift out the countershaft gear unit and collect the needle bearings.

Withdraw the reverse idler shaft and lift out the gear.

DISMANTLING THE MAINSHAFT

Note: The needle rollers are graded on diameter and must be kept in sets for the respective positions.

Remove the hose clips.

Withdraw the reverse gear from the mainshaft.

Withdraw the 1st gear and collect the 120 needle rollers, spacer and sleeve.

Withdraw the 1st/2nd synchro assembly and collect the two loose synchro-rings.

Withdraw the 2nd speed gear and collect the 106 needle rollers leaving the spacer on the mainshaft.

Tap back the tab washer and remove the large nut retaining the 3rd/Top synchro assembly to the mainshaft.

Withdraw the 3rd/Top synchro assembly from the mainshaft and collect the two loose synchro-rings.

Withdraw the 3rd speed gear and collect the 106 needle rollers and spacer.

DISMANTLING THE SYNCHRO ASSEMBLY

Completely surround the synchro assembly with a cloth and push out the synchro hub from the the operating sleeve. Collect the synchro balls and springs, and the thrust members, plungers and springs.

DISMANTLING TOP COVER

Unscrew the self-locking nut and remove the double coil springs, washer, flat washer and fibre washer securing the gear lever to the top cover.

Withdraw the gear lever and collect the remaining fibre washer.

Remove the locking wire and unscrew the selector rod retaining screws.

Withdraw the 3rd/Top selector rods and collect the selector, spacing tube and interlock ball. Note the loose interlock pin at the front end of the 1st/2nd selector rod.

Withdraw the reverse selector rod and collect the reverse fork, stop spring and detent plugs.

Withdraw the 1st/2nd selector rod and collect the fork and short spacer tube.

GEARBOX RE-ASSEMBLY

CHECKING COUNTERSHAFT END FLOAT

Push the countershaft as far forward as possible and check the clearance between the rear thrust washer and the countershaft gear cluster as illustrated in Fig. 9. The clearance should be 0·004–0·006″ (0·10–0·15 mm.) and is adjusted by means of the parallel sided thrust washer at the front end of the countershaft. This washer is available in the following thicknesses:—

Part Number	Thickness
C.1862/3	0·152″ (3·86 mm.)
C.1862	0·156″ (3·96 mm.)
C.1862/1	0·159″ (4·04 mm.)
C.1862/2	0·162″ (4·11 mm.)
C.1862/4	0·164″ (4·17 mm.)

Withdraw the countershaft and remove the gear cluster and thrust washers.

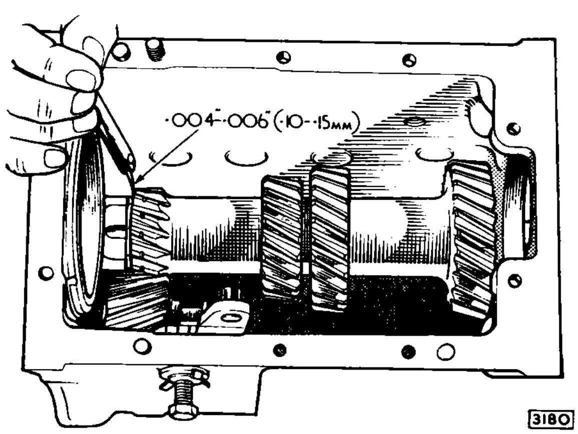


Fig. 9. Checking the clearance between the rear thrust washer and the countershaft gear cluster.

ASSEMBLING THE SYNCHRO ASSEMBLIES

The assembly procedure for the 1st/2nd and 3rd/Top synchro assemblies is the same.

Note: Although the 3rd/Top and 1st/2nd synchro hubs are similar in appearance they are not identical and to distinguish them a groove is machined on the edge of the 3rd/Top synchro hub (see Fig. 10).

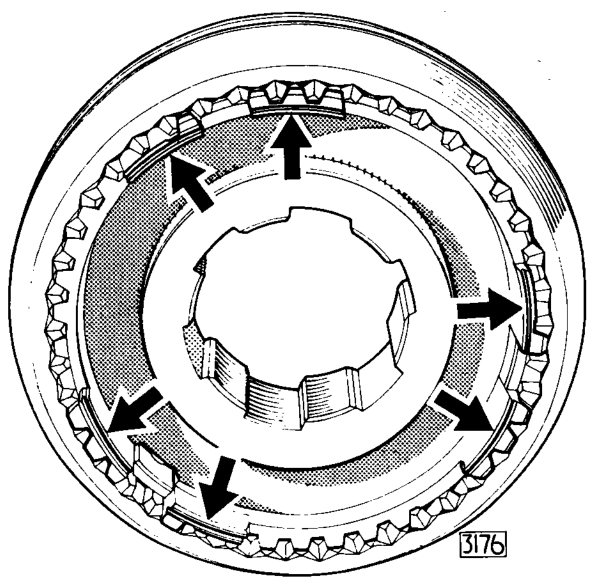


Fig. 10. Identification grooves—3rd/Top synchro assembly.

Assemble the synchro hub to the operating sleeve with.

(i) The wide boss of the hub on the opposite side to the wide chamfer end of the sleeve (see Fig. 11).

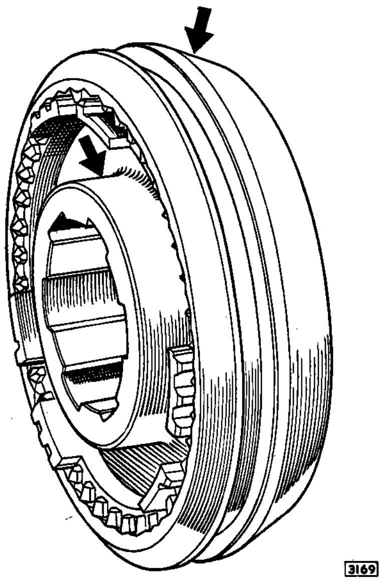


Fig. 11. Assembly of synchro hub.

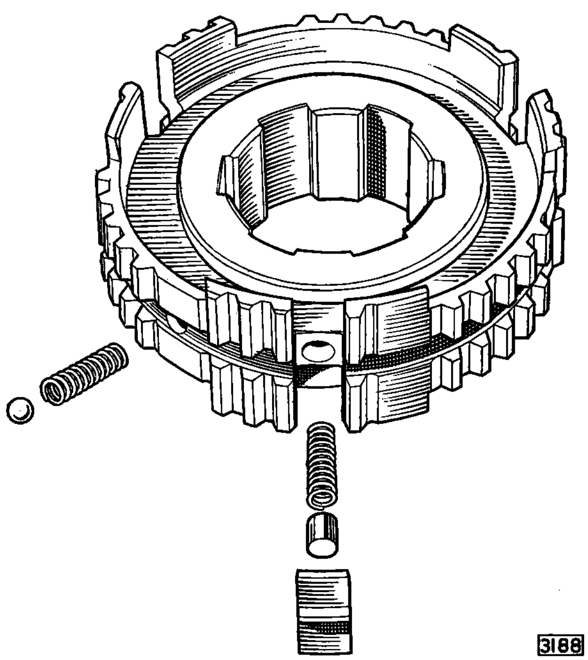


Fig. 12. Showing the relative positions of the detent ball, plunger and thrust member.

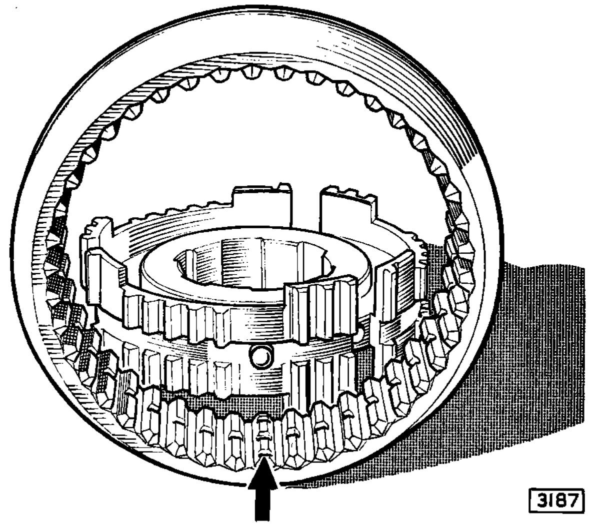


Fig. 13. Fitting the synchro hub in the sleeve.

(ii) The three balls and springs in line with the teeth having three detent grooves (see Fig.13).

Pack up the synchro hub so that holes for the ball and springs are exactly level with the top of the operating sleeve. (see Fig. 14).

Fit the three springs, plungers and thrust members to their correct positions with grease; press down the thrust members as far as possible. Fit the three springs and balls to the remaining holes with grease.

Compress the springs with a large hose clip or a piston ring clamp as shown in Fig. 15 and carefully lift off the synchro assembly from the packing piece.

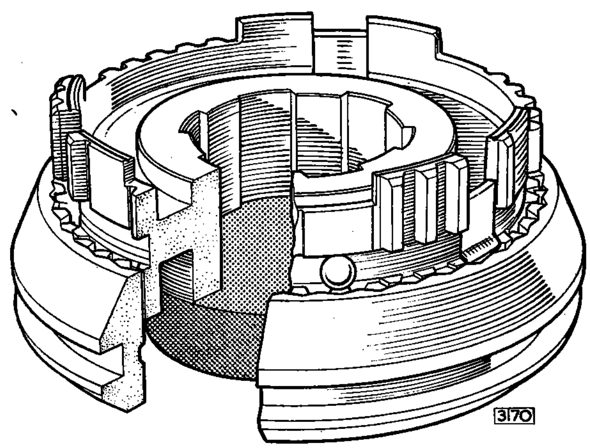


Fig. 14. Fitting the springs, plungers and thrust members.

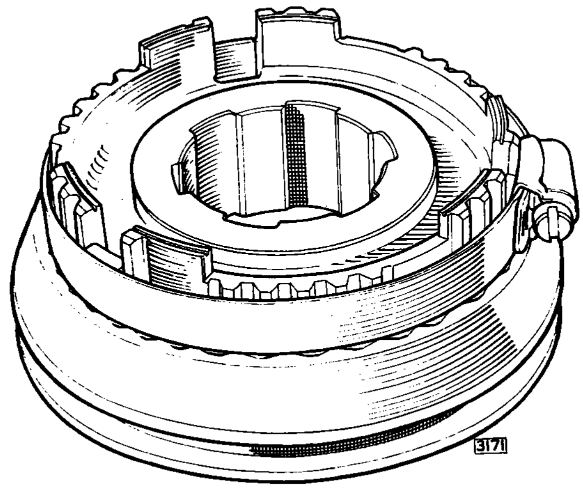


Fig. 15. Compressing the springs.

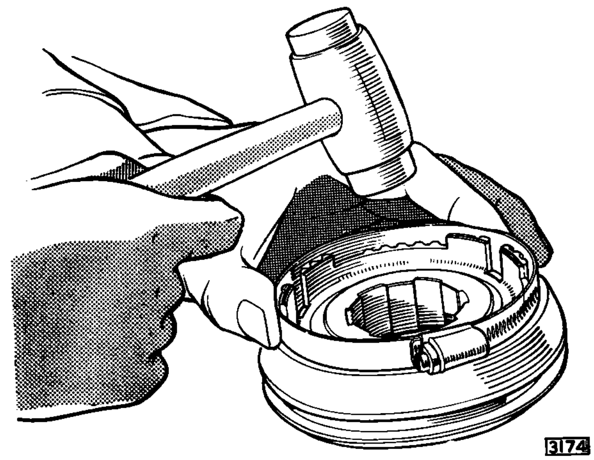


Fig. 17 Tapping the hub into position.

Depress the hub slightly and push down the thrust members with a screwdriver until they engage the neutral groove in the operating sleeve (see Fig. 16).

Finally tap the hub down until the balls can be heard and felt to engage the neutral groove (see Fig. 17).

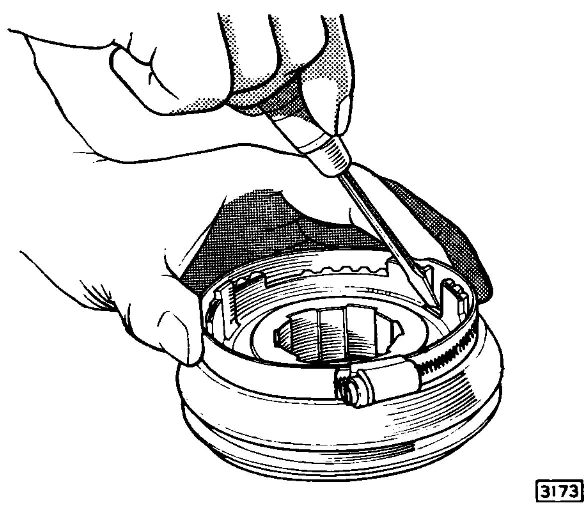


Fig. 16. Pushing down the thrust members.

ASSEMBLING THE MAINSHAFT

The re-assembly of the mainshaft is the reverse of the dismantling instructions but the following instructions should be noted.

(a) The end floats of the gears on the mainshaft is given in 'Data' at the beginning of this section and if found to be excessive the end float can only be restored by the fitting of new parts.

(b) The needle rollers which support the gears on the mainshaft are graded on diameter and rollers of one grade only must be used for an individual gear. The grades are identified by /1, /2, and /3 after the part number.

(c) Fit a hose clip to prevent the reverse gear from sliding off when assembling the mainshaft to the casing.

ASSEMBLING THE GEARS TO THE CASING

Refit the reverse gear and idler shaft.

Fit the retaining ring needle rollers (29 each end) to the countershaft with grease.

Make up a dummy shaft from an old countershaft $8\frac{1}{4}''$ (20·95 mm.) long by 0·980" (24·89 mm.) diameter.

Fit the two thrust washers to front end of the countershaft with grease.

Enter the dummy shaft into the countershaft gear cluster so that the shaft retains the front thrust washers.

Fit the pegged rear thrust washer to its boss on the casing with grease (see Fig. 18).

Carefully lower the countershaft to the bottom of the casing.

Fit a new paper gasket to the front face of the casing.

Enter the mainshaft through the top of the casing and pass the rear of the shaft through the bearing hole.

Enter the constant pinion shaft at the front of the casing with the cutaway portions of the tooth driving member at the top and bottom.

Tap the constant pinion shaft into position and enter the front end of the mainshaft into the spigot bearing.

Hold the constant pinion shaft in position and with a hollow drift tap the rear bearing into position.

Mesh the countershaft with the mainshaft by one of the following methods:

(a) Use a wire hook to lift the countershaft into position.

(b) Turn the gearbox upside down and rotate the constant pinion shaft and mainshaft slightly until the countershaft meshes.

(c) If a dummy shaft is not used the countershaft can be lifted up into mesh with a thin rod inserted through countershaft bore in the front face of the casing, but if this method is adopted care must be taken not to displace the needle rollers and thrust washer.

Enter the countershaft from the rear of the casing and push out the dummy shaft (see Fig. 19). Fit the woodruff key to locate the countershaft to the casing.

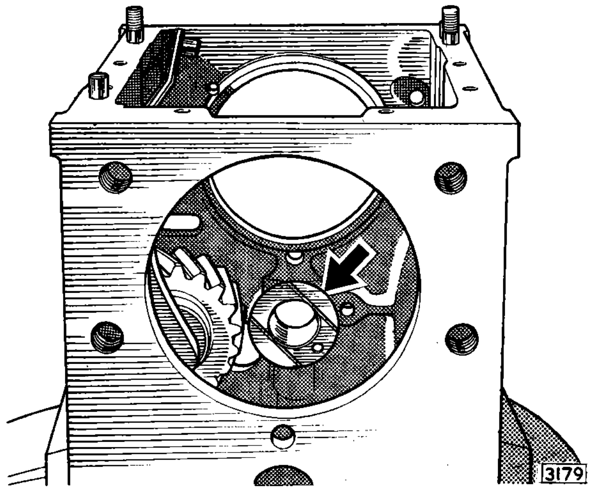


Fig. 18. Fitting the rear thrust washer.

REFITTING REAR EXTENSION

Fit a new paper gasket to the rear face of the casing.

Offer up the rear extension and secure with the seven screws.

Fit the speedometer driving gear to the mainshaft.

Fit the speedometer driven gear and bush with the hole in the bush in line with the hole in the casing and secure with the retaining bolt.

Fit a new gasket to the rear cover face.

Fit a new oil seal to the rear cover with the lip facing forward.

Fit the rear cover to the extension noting that the setscrew holes are offset.

Fit the four bolts to the companion flange, slide on the flange and secure with flat washer and split pin.

RE-ASSEMBLING THE TOP COVER

(see Fig. 21)

Re-assembly of the top cover is the reverse of the dismantling instructions. When assembling the selector rods do not omit to fit the interlock balls and pin.

Renew the 'O' rings on the selector rods.

To adjust the reverse plunger fit the plunger and spring.

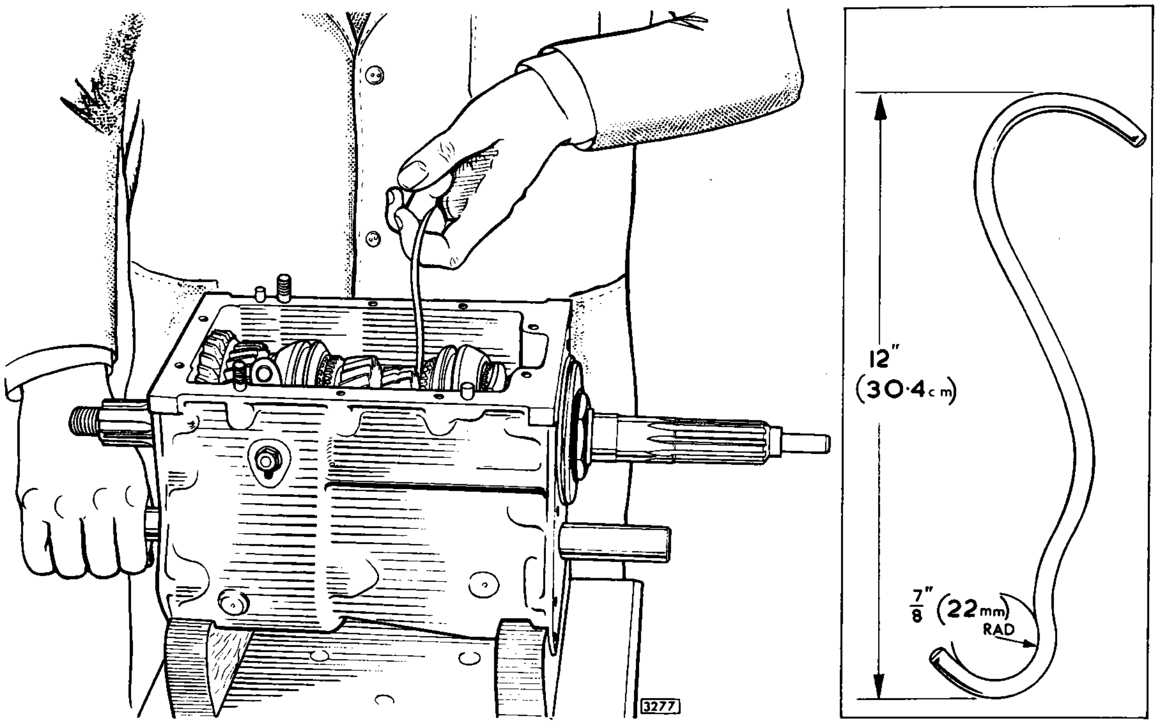


Fig. 19. Using a wire hook to lift the countershaft into position.

Fit the ball and spring and start the screw and locknut; press the plunger inwards as far as possible and tighten the screw to lock the plunger.

Slowly slacken the screw until the plunger is released and the ball engages with the circular groove in the plunger. Hold the screw and tighten the locknut.

FITTING THE TOP COVER

Fit a new paper gasket.

Ensure that the gearbox and the top cover are in the neutral position.

Ensure that the reverse idler gear is cut of mesh with the reverse gear on the mainshaft by pushing the lever rearwards.

Engage the selector forks with the grooves in the synchro assemblies.

Secure the top cover with the nuts and bolts noting that they are of different lengths.

REFITTING THE CLUTCH HOUSING

Refitting the clutch housing is the reverse of the removal procedure.

Fit a new oil seal to the clutch housing with the lip of the seal facing the gearbox. The oil seal has a metal flange and should be pressed in fully.

The two clutch housing securing bolts adjacent to the clutch fork trunnions are secured with locking wire; the remainder are secured with tab washers.

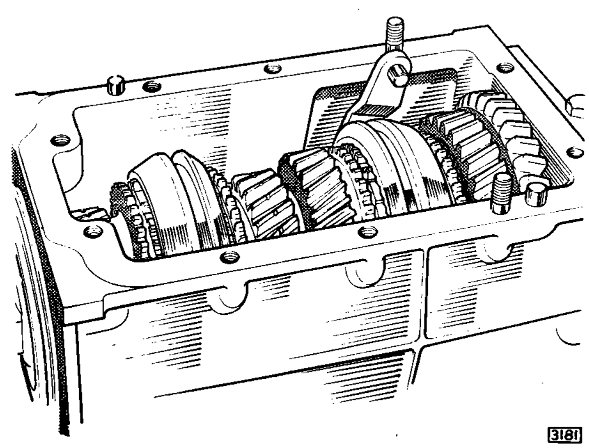


Fig. 20. Re-assembled gearbox prior to refitting the top cover.

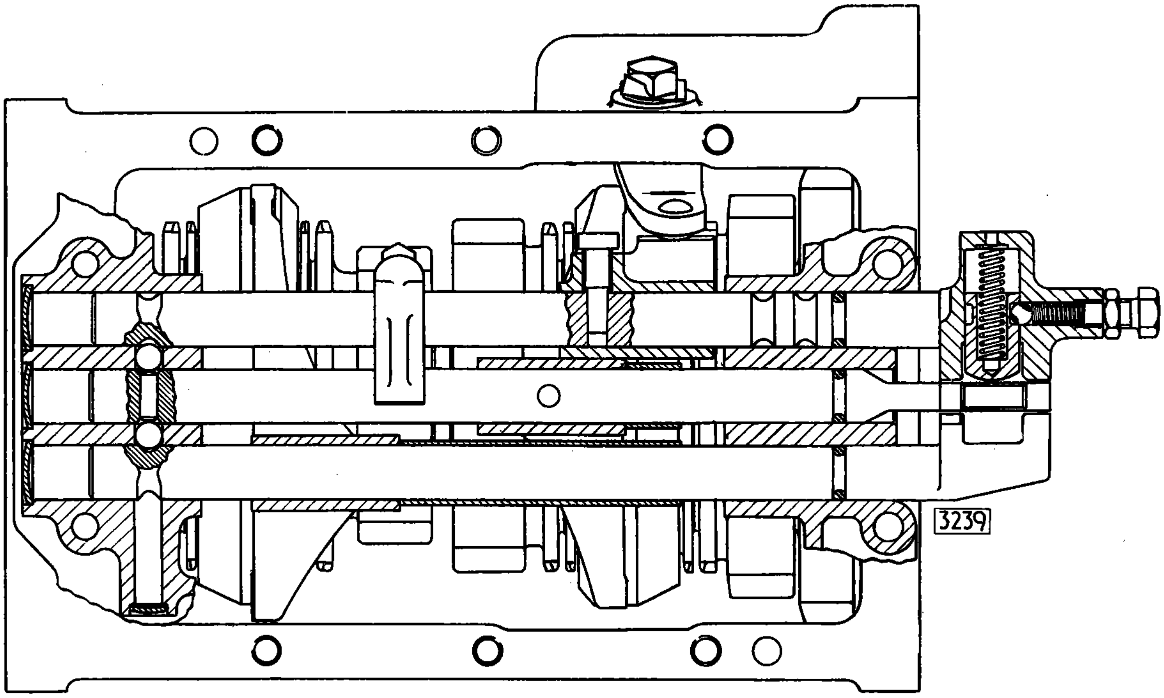


Fig. 21. Plan view of gearbox with top cover removed to show selector arrangement.

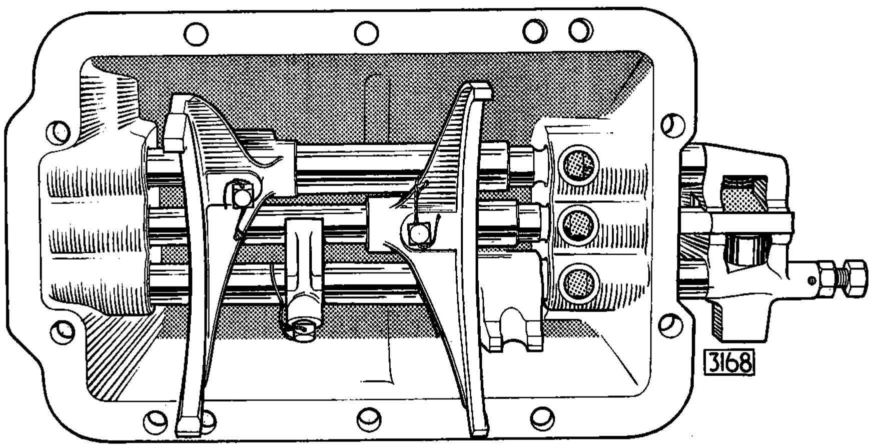


Fig. 22. View of the underside of the top cover.

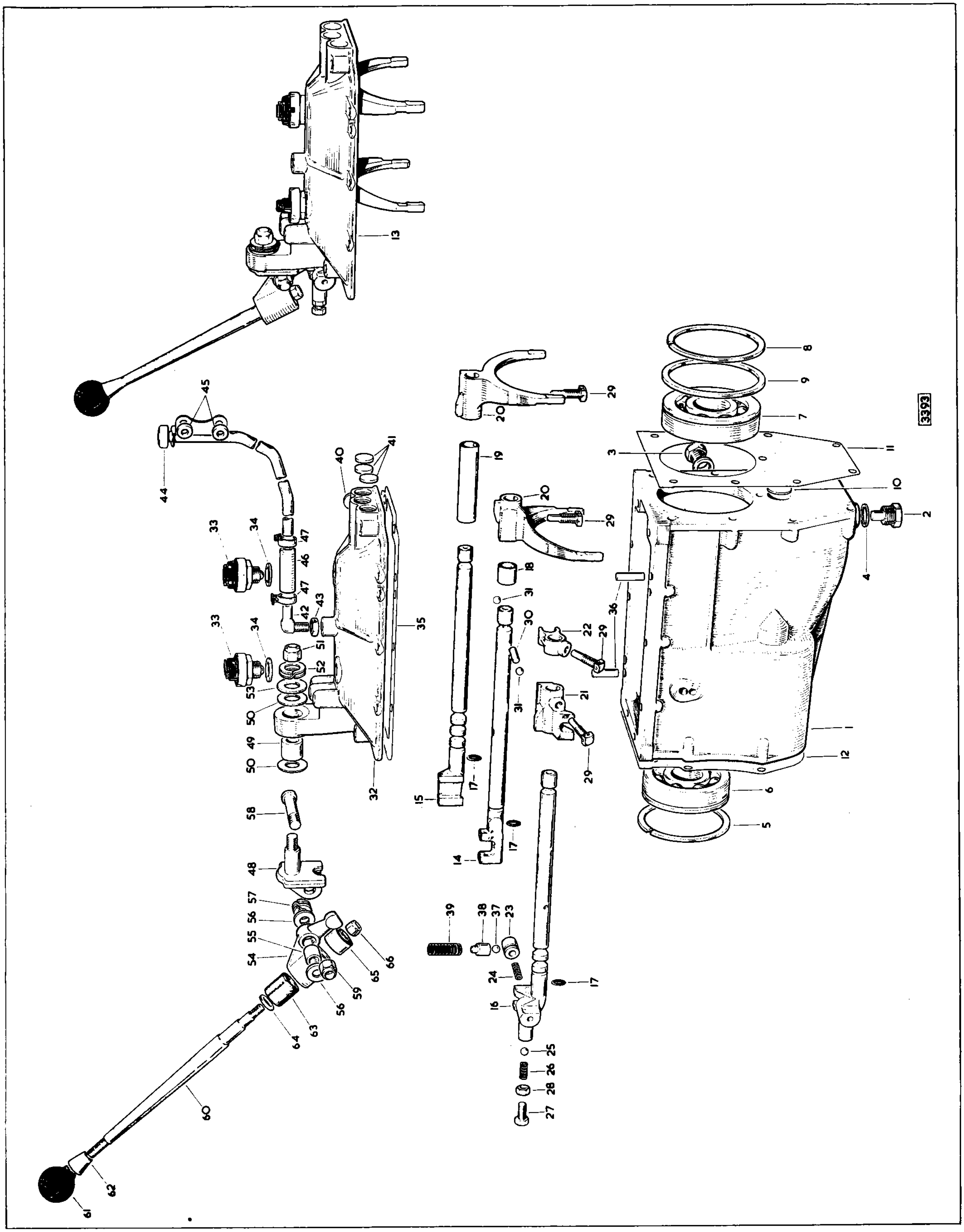


Fig. 23. Gearbox assembly.

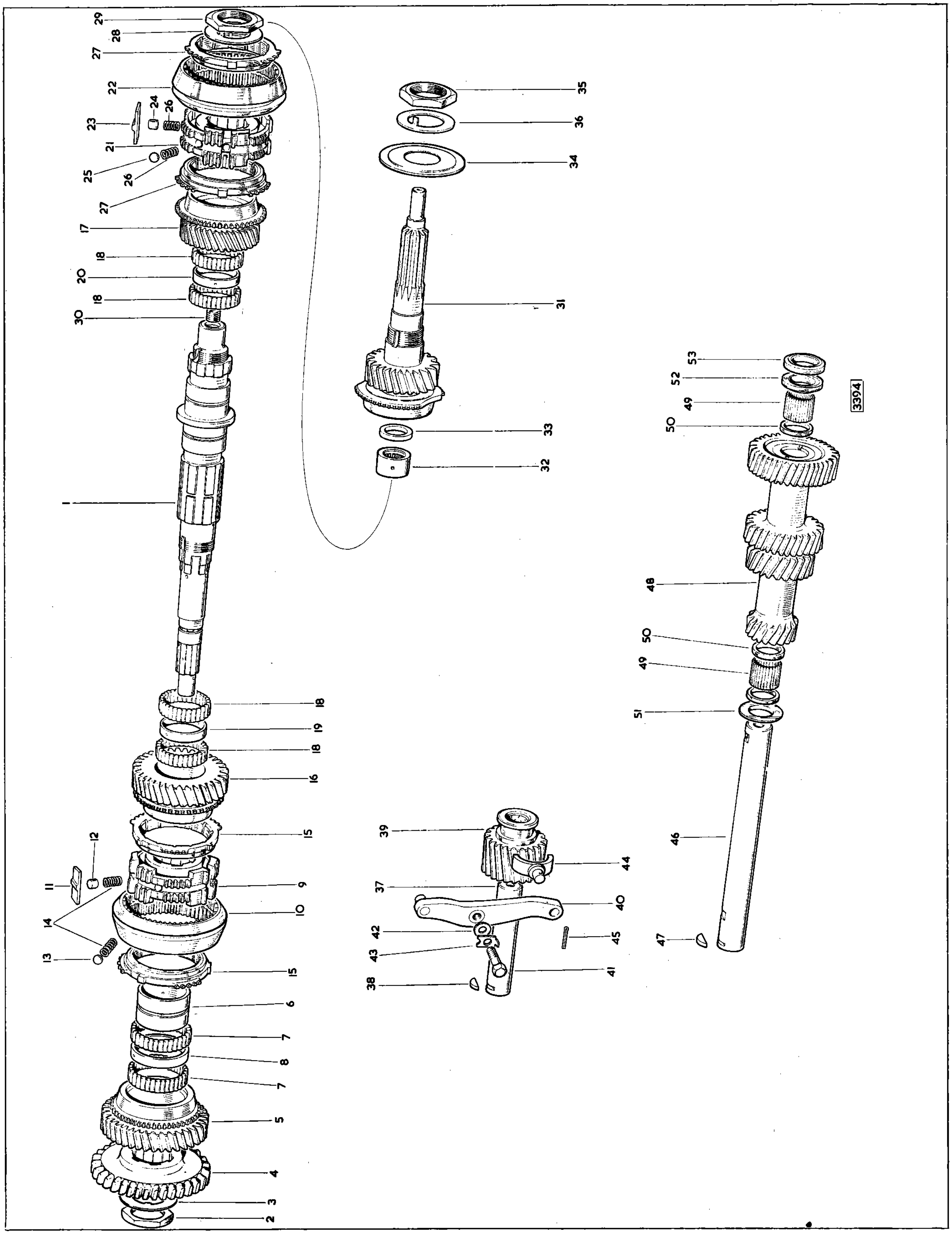


Fig. 24. Gear train.

Key to Fig. 23

1. Gearbox casing
2. Oil drain plug
3. Oil filter plug
4. Fibre washer
5. Circlip
6. Ball bearing
7. Ball bearing
8. Circlip
9. Collar
10. Fibre washer
11. Gasket
12. Gasket
13. Remote control
14. Striking rod, 1st/2nd gears
15. Striking rod, 3rd/Top gears
16. Striking rod, reverse gear
17. "O" ring
18. Stop
19. Stop
20. Change-speed fork
21. Change-speed fork
22. Locating arm
23. Plunger
24. Spring
25. Ball
26. Spring
27. Set screw
28. Nut
29. Dowel screw
30. Roller
31. Ball
32. Top cover
33. Switch
34. Gasket
35. Gasket
36. Dowel
37. Ball
38. Plunger
39. Spring
40. Welch washer
41. Welch washer
42. Breather elbow
43. Nut
44. Gearbox breather assembly
45. Distance piece
46. Hose
47. Clip
48. Pivot jaw
49. Bush
50. Fibre washer
51. Self-locking nut
52. Spring washer
53. "D" washer
54. Selector lever
55. Bush
56. Fibre washer
57. Spring washer
58. Pivot pin
59. Self-locking nut
60. Change-speed lever
61. Knob
62. Cone
63. Upper bush
64. Washer
65. Lower bush
66. Self-locking nut

Key to Fig. 24

1. Mainshaft
2. Nut
3. Tab washer
4. Reverse gear
5. 1st speed gear
6. Bearing sleeve
7. Needle roller
8. Spacer
9. Synchro hub
10. Operating sleeve
11. Thrust member
12. Plunger
13. Detent ball
14. Spring
15. Synchro ring
16. 2nd speed gear
17. 3rd speed gear
18. Needle roller
19. Spacer
20. Spacer
21. Synchro hub
22. Operating sleeve
23. Thrust member
24. Plunger
25. Detent ball
26. Spring
27. Synchro ring
28. Nut
29. Tab washer
30. Plug
31. Constant pinion shaft
32. Roller bearing
33. Spacing
34. Oil thrower
35. Nut
36. Tab washer
37. Reverse spindle
38. Key
39. Reverse idler gear
40. Lever assembly
41. Set screw
42. Fibre washer
43. Tab washer
44. Reverse slipper
45. Split pin
46. Countershaft
47. Key
48. Gear unit (cluster)
49. Needle roller
50. Retaining ring
51. Thrust washer (rear)
52. Thrust washer (front)
53. Thrust washer (outer)

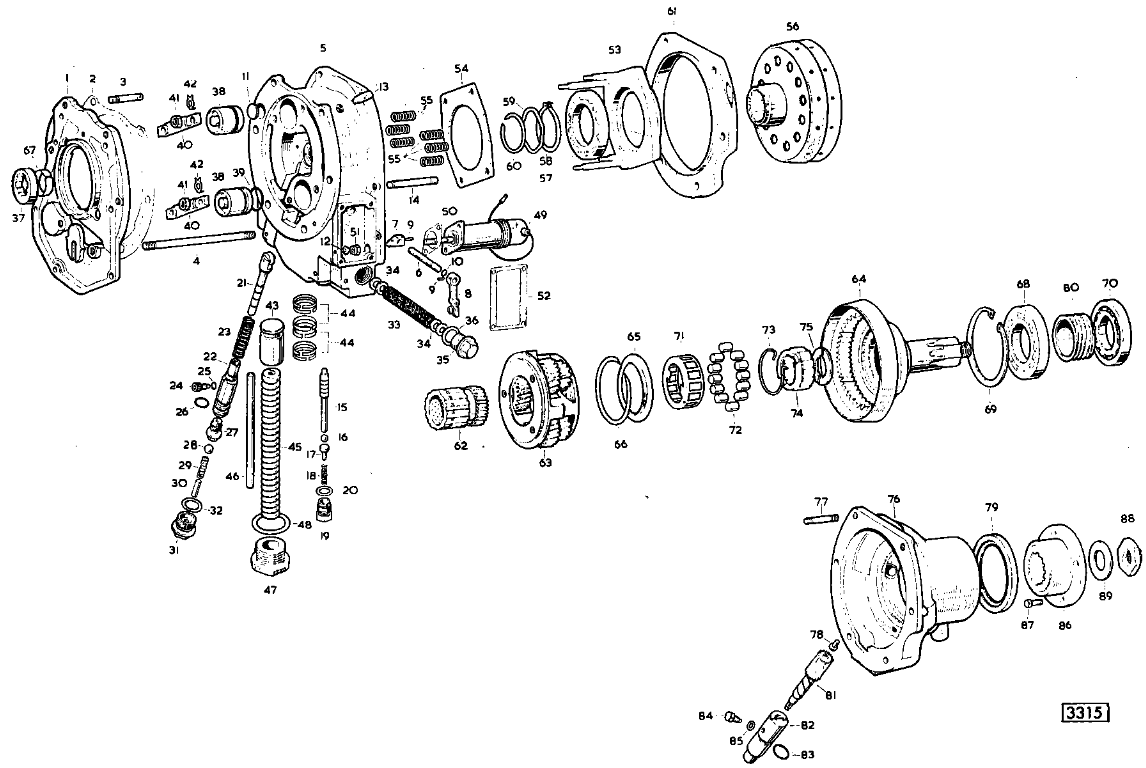


Fig. 25. Exploded view of the front and rear casing assemblies.
(Overdrive)

1. Adaptor plate
2. Gasket
3. Stud
4. Stud
5. Front casing
6. Main operating valve shaft
7. Cam
8. Lever
9. Roll pin
10. "O" ring
11. Welch washer
12. Rubber stop
13. Breather
14. Stud
15. Main operating valve
16. Ball, $\frac{5}{16}$" dia.
17. Plunger
18. Spring
19. Plug
20. Copper washer
21. Oil pump plunger
22. Body
23. Spring
24. Screw
25. Fibre washer
26. "O" ring
27. Non-return valve body
28. Ball, $\frac{7}{32}$" dia.
29. Spring
30. Support rod
31. Plug
32. Copper washer
33. Filter
34. Magnetic ring
35. Plug
36. Washer
37. Oil pump operating cam
38. Operating piston
39. "O" ring
40. Bridge piece
41. Nut
42. Tab washer
43. Accumulator piston
44. Piston ring
45. Spring
46. Support rod
47. Plug
48. Washer
49. Solenoid
50. Gasket
51. Nut
52. Gasket
53. Thrust ring
54. Retaining plate
55. Springs
56. Sliding member
57. Ball bearing
58. Circlip
59. Corrugated washer
60. Snap ring
61. Brake ring
62. Sunwheel
63. Planetary carrier
64. Annulus
65. Oil thrower
66. Spring ring
67. Spring clip
68. Ball bearing
69. Circlip
70. Ball bearing
71. Cage for uni-directional clutch
72. Roller
73. Cage spring
74. Inner member
75. Thrust washer
76. Rear casing
77. Stud
78. Thrust button
79. Oil seal
80. Speedometer driving gear
81. Speedometer driven gear
82. Bearing assembly
83. "O" ring
84. Screw
85. Copper washer
86. Flange
87. Bolt
88. Slotted nut
89. Washer
90. Split pin

OVERDRIVE

DESCRIPTION

The Laycock de Normanville overdrive unit consists of a hydraulically controlled epicyclic gear housed in a casing at the rear of the gearbox.

When engaged, the overdrive reduces the engine speed in relation to the road speed thus permitting high road speeds with low engine revolutions. Consequently, the use of the overdrive results in fuel economy and reduced engine wear.

The overdrive is operated by an electric solenoid controlled by a switch mounted on the steering column.

Overdrive can only be engaged when the car is top gear.

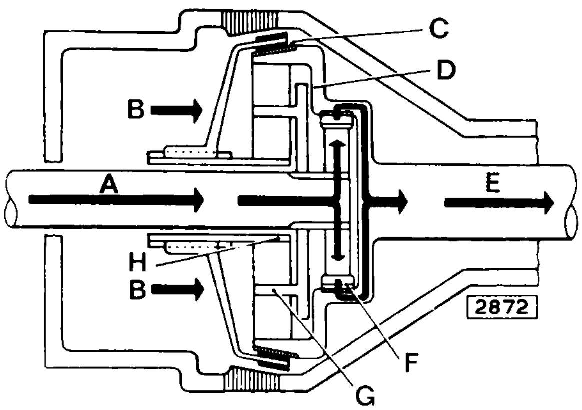


Fig. 26. In direct drive.

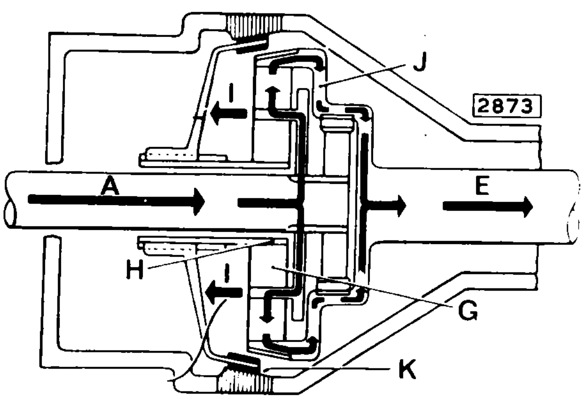


Fig. 27. In overdrive.

METHOD OF OPERATION (Fig. 25)

Power Input

The power input enters the overdrive unit through the extension to the gearbox driven shaft and by means of cam (37) operates the plunger-type hydraulic pump (21). This, in turn, builds up pressure against the spring loaded piston (43) in the accumulator cylinder placed across the bottom of the main casing.

The Sun-Wheel

The sun-wheel (62) is integral with an inner member (74) which is free to rotate on the input shaft. Immediately behind the sun-wheel and splined to the gearbox driven shaft is the planetary carrier (63) in which are mounted the three planet wheels.

The Uni-directional Clutch

This operates from the input shaft onto which is splined the inner member (74). The other components of this clutch are the rollers (72) and the outer member which is attached to the combined annulus and output shaft (64). The drive is transmitted from the input shaft through the clutch inner member and the rollers which are forced up the inner members' inclined faces wedging the whole clutch solid. The clutch then drives the annulus output shaft.

Key to Figs. 26 and 27

A From gearbox
B Spring pressure
C Annulus and sunwheel locked
D Annulus
E To propeller shaft
F Uni-directional clutch
G Planet wheel and carrier
H Sunwheel
I Hydraulic pressure
J Annulus overdriven by planet wheels
K Locked cone clutch holds sunwheel

The Cone Clutch

The cone clutch (56) is mounted on the sliding member on which it is free to slide. The cone clutch springs (55), which hold the inner lining in contact with the corresponding cone of the annulus (64), maintain the clutch in the direct drive position. This prevents a free-wheel condition when the car tries to overrun the engine. Engine braking is, therefore, always available.

Power is transmitted by way of the cone clutch, inner lining and the annulus when the reverse gear is engaged as the uni-directional clutch is inoperative.

Hydraulic Operation

Overdrive is brought into operation by rotating the operating shaft thus lifting the operating valve. This action allows the stored hydraulic pressure in the accumulator to be applied to the two pistons (38). The pistons move the clutch (56) forward away from the annulus (64) overcoming the springs (55). During the forward movement of the clutch the drive from the engine to the wheels is maintained by the roller clutch.

The hydraulic operation causes the outer lining of the cone clutch to contact the brake ring (61), bringing the sun-wheel and sleeve (62) to rest.

This action is effected without shock as the clutch is oil immersed. The input drive now passes from the gearbox driven shaft to the planet carrier (63) and the rotation of the planet wheels around the stationary sun-wheel causes both the annulus and the output shaft to be driven faster than the input shaft. In this condition the outer member of the roller clutch over-runs the inner member (74).

Because the sun-wheel can move neither backwards nor forwards there is always engine braking available in overdrive gear.

ROUTINE MAINTENANCE

Overdrive Oil Level—Lubricant

The oil for the lubrication and operation of the overdrive unit is fed from the gearbox casing and therefore checking the gearbox oil level will also check the level of oil in the overdrive unit, but as this unit is hydraulically controlled extra attention should be paid to exercising absolute cleanliness when replenishing with oil.

It is also important that the oil level is not allowed to fall appreciably otherwise the operation of the overdrive may be affected.

Oil Changing

Although the oil for the overdrive unit is common with that in the gearbox, draining oil from the gearbox will not drain the overdrive unit.

When draining the gearbox; the filter plug, situated in the side of the overdrive unit, should be removed together with the filter and magnetic washers.

Thoroughly wash the filter gauze and magnetic washers.

When dry, refit the filter, magnetic washers and filter plug. Fully tighten the filter plug and refill the gearbox and overdrive unit with oil through the gearbox filler and level plug hole.

Particular attention should be paid to maintaining absolute cleanliness when filling the gearbox and overdrive with oil as any foreign matter entering may seriously affect the operation of the overdrive.

EVERY 3,000 MILES (5,000 KM.)

Check the oil level of the gearbox and overdrive. Top up as necessary through the filler and level plug hole in the side of the gearbox casing.

The level of the oil should be to the bottom of the filler and level plug hole.

EVERY 12,000 MILES (20,000 KM.)

Remove the gearbox drain plug and the overdrive filter plug. When draining the gearbox, the overdrive filter and magnetic washers should be cleaned.

After refilling the gearbox and overdrive with oil, recheck the level after the car has been run, since a certain amount of oil will be retained in the hydraulic system of the overdrive unit.

DATA

	Dimensions	Clearances
PUMP		
Plunger diameter	0·3742/0·3746″ (9·36/9·37 mm.)	0·0002/0·0016″ (0·005/0·04 mm.)
Pump body bore	0·3748/0·3758″ (9·37/9·397 mm.)	0·002/0·0016″ (0·005/0·04 mm.)
PUMP ROLLER BUSH		
Outside diameter of bush	0·3736/0·3745″ (9·34/9·36 mm.)	0·0005/0·0023″ (0·125/0·0575 mm.)
Inside diameter of roller	0·3750/0·3759″ (9·375/9·389 mm.)	0·0005/0·0023″ (0·0125/0·0575 mm.)
Inside diameter of bush	0·2510/0·2518″ (6·275/6·295 mm.)	0·0007/0·0020″ (0·0175/0·050 mm.)
Outside diameter of pin	0·2497/0·2502″ (6·24/6·225 mm.)	0·0007/0·0020″ (0·0175/0·050 mm.)
ACCUMULATOR		
Piston diameter	1·3732/1·1241″ (34·33/28·10 mm.)	0·0004/0·0023″ (0·01/0·0575 mm.)
Bore diameter	1·3745/1·3755″ 34·363/34·39 mm.)	0·0004/0·0023″ (0·01/0·0575 mm.)
OPERATING VALVE		
Valve diameter	0·2494/0·2497″ (6·235/6·243 mm.)	0·0003/0·0012″ (0·0075/0·03 mm.)
Bore diameter	0·2500/0·2506″ (6·25/6·252 mm.)	0·0003/0·0012″ (0·0075/0·03 mm.)
OVERDRIVE MAINSHAFT		
Diameter at oil transfer bush	1·1544/1·1553″ (28·86/28·88 mm.)	0·0029/0·0048″ (0·072/0·12 mm.)
Inside diameter of bush	1·1582/1·1592″ (28·96/28·98 mm.)	0·0029/0·0048″ (0·072/0·12 mm.)
Diameter at sunwheel	1·1544/1·1553″ (28·86/28·88 mm.)	0·0029/0·0048″ (0·072/0·12 mm.)
Inside diameter of sunwheel bush	1·1582/1·1592″ (28·96/28·98 mm.)	0·0029/0″0048″ (0·072/0·12 mm.)
Diameter of spigot bearing	0·6235/0·6242″ (15·58/15·61 mm.)	0·0008/0·0025″ (0·02/0·0625 mm.)
Inside diameter of spigot bearing	0·6250/0·6260″ (15·63/15·65 mm.)	0·0008/0·0025″ (0·02/0·0625 mm.)

MISCELLANEOUS

Clutch movement from direct to overdrive .. 0·080″/0·120″ (2 – 3 mm.)

HYDRAULIC PRESSURE

520/540 lb./sq in. (36·560/37·966 kg./sq. cm.)

DISMANTLING

If trouble should arise necessitating dismantling the unit, it will be necessary to remove the overdrive unit from the car. The engine, gearbox and overdrive unit are removed together.

Remove the gearbox and clutch housing from the engine.

Detach the clutch housing from the gearbox casing.

BEFORE COMMENCING ANY DISMANTLING OPERATIONS IT IS IMPORTANT THAT THE HYDRAULIC PRESSURE IS RELEASED FROM THE SYSTEM. DO THIS BY OPERATING THE OVERDRIVE 10–12 TIMES.

REMOVING THE OVERDRIVE FROM THE GEARBOX

The overdrive unit is separated from the gearbox at the joint between the gearbox rear extension and the overdrive front casing which are attached by seven studs.

REMOVAL

The unit is split at the rear face of the adaptor casing. There is no spring tension to release and, after removing the nuts on the securing studs, the overdrive can be withdrawn off the mainshaft, leaving the adaptor in place.

DISMANTLING

The overdrive can be divided into four main assemblies:

(a) Front casing and brake ring.
(b) Clutch sliding member.
(c) Planet carrier and gear train.
(d) Rear casing and annulus

Important: SCRUPULOUS CLEANLINESS MUST BE MAINTAINED THROUGHOUT ALL SERVICE OPERATIONS. EVEN MINUTE PARTICLES OF DUST, DIRT OR LINT FROM CLEANING CLOTHS MAY CAUSE DAMAGE OR, AT BEST, INTERFERE WITH CORRECT OPERATION.

Prepare a clean area in which to lay out the dismantled unit and some clean containers to receive the small parts.

Hold the overdrive with front casing uppermost in a vice fitted with suitable soft jaws.

Release the tab washers locking the four $\frac{1}{4}''$ (6·25 mm.) nuts retaining the operating piston bridge pieces. Remove the nuts, tab washers and bridge pieces.

Loosen the solenoid by the two screws to allow the front casing to be removed.

Remove the four nuts which secure the front and rear casings. Separate the two casings. The brake ring is spigotted into each half and may remain attached to the front half. In order to separate the brake ring from the casing a few taps with a mallet will suffice.

Lift out the clutch sliding member complete with the thrust ring, bearing and sun-wheel.

Lift out the planet carrier and gear train.

Front Casing and Brake Ring

Remove the operating valve plug and lift out the spring, plunger and ball. Remove the operating valve as described on page F. 28.

Remove the operating pistons by gripping the centre boss with a pair of pliers and applying a rotary pull.

The Solenoid

To take off the solenoid, first remove the rectangular cover plate by removing the four screws. Remove the two screws securing the solenoid which can then be pulled off. Ease the plunger out of the yoke of the valve operating lever.

The Accumulator

Access to the accumulator is gained by removing the large plug from the bottom of the unit on the off side. The length of thread on the plug is sufficient to allow all compression to be released from the spring before the plug is completely unscrewed. The accumulator spring will come out with the plug and inside the spring will be found a support pin.

The accumulator piston has a groove inside the bore and a piece of stiff wire can be hooked into this to enable the piston to be withdrawn.

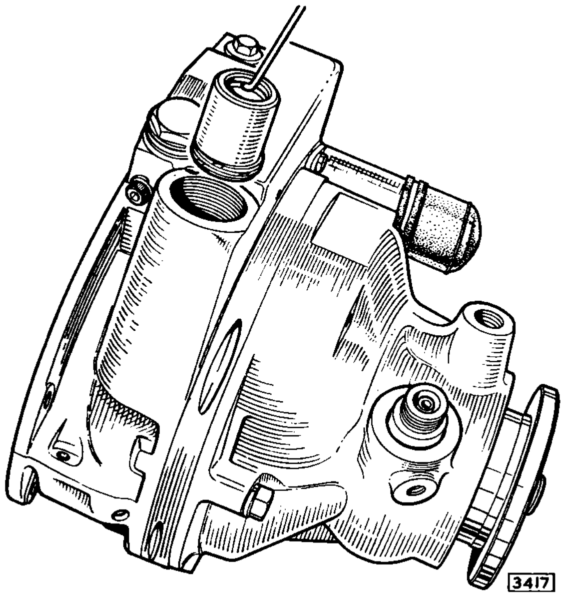


Fig. 28. Removing the accumulator piston.

The Pump Non Return Valve

This valve is accessible when the centre plug in the bottom of the unit is removed. Unscrew the valve body using tool number L.183A.

Remove the spring, support pin and $\frac{7}{32}$" (5·56 mm.) dia. ball.

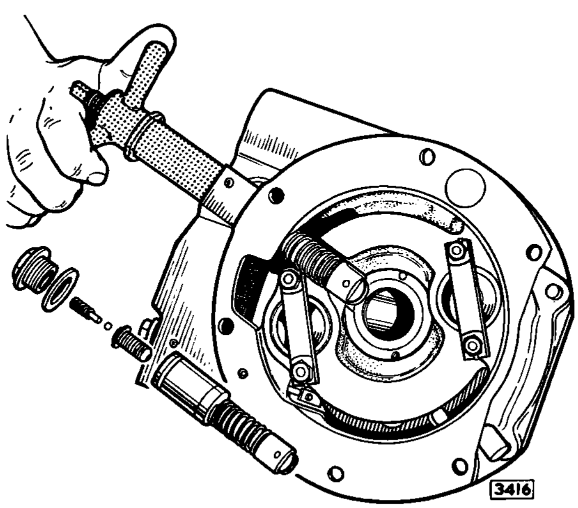


Fig. 29. Removing the pump non-return valve. The valve components are shown exploded.

The Pump

Remove the locating screw (24 Fig. 25).

The pump body can now be extracted using tool number L.183A and adaptor L.183A-2. The plunger and spring will also come out when the body is withdrawn.

Oil Filter

Unscrew the plug which is situated immediately below the solenoid cover plate. The cylindrical gauze filter can then be withdrawn. Four magnetic plastic rings are used in the filter assembly, two being located in the recess in the plug and two in the recess in the casing.

Remove the circlip from the sunwheel and then slide off the corrugated washer and sliding member.

Planet Carrier Assembly

Inspect all the gear teeth for any signs of damage or chipping and assess the fit of the assembled bearings for any excessive clearance.

Planet gears are not available as separate items, therefore if damage or wear is apparent a new planet carrier assembly should be fitted.

Rear Casing and Annulus (Fig. 25)

To dismantle the assembly proceed as follows:

(a) remove spring ring (66) and oil thrower (65).

(b) remove the uni-directional clutch (71, 72) by placing the special assembly ring (Tool L.178) centrally over the front face of the annulus and lifting the inner member of the uni-directional clutch up into it. This will ensure that the rollers do not fall out of the retaining cage.

(c) place the parts in a suitable container.

Alternatively, if dismantling further, remove the assembly ring and allow the rollers to come out. The hub will then come readily from the cage, exposing the spring. Remove the bronze thrust washer fitted between the hub of the uni-directional clutch and the annulus.

To remove the annulus:

(a) remove the speedometer dowel screw (84).

(b) withdraw the speedometer drive bush (82) and pinion (81).

(c) remove the coupling flange (86) and remove oil seal if necessary.

(d) press the annulus forward out of the rear casing.

The front and rear bearings will remain in the rear casing with the speedo-driving gear sandwiched between them.

(e) remove circlip (69) and then drive out the speedo driving gear and rear bearing. The front bearing can then be driven out.

Important: EACH PART SHOULD BE THOROUGHLY CLEANED AND EXAMINED AFTER THE UNIT IS DISMANTLED.

INSPECTION

FRONT CASING AND BRAKE RING (Fig. 25)

Inspect the front casing for cracks or other damage. Examine the bores of the operating cylinders and accumulator for scores or other wear.

Check for signs of leaks from the plugged ends of the oil passages. Ensure that the sealing disc in the front face of the casing is tight and not leaking.

Inspect the centre bush for wear or damage.

Check operating pistons (38) for signs of scores and replace sealing ring (39) if there is any sign of damage or distortion.

Check the pump roller and its bronze bush for any undue wear. The roller pin is secured by a mills pin $\frac{1}{16}''$ (1·6 mm.) dia. driven vertically into the curved portion of the pump plunger fork. This pin can be sheared by driving the roller pin through the fork.

Check pump plunger for wear and scores.

Check pump body bore for wear and scores. Check the valve seat and ball to ensure that they are free from nicks and scratches.

Check the pump spring (23) for distortion.

Check the accumulator piston for signs of wear or scores. Check that there are no broken piston rings.

Check the accumulator spring for distortion or collapse.

Inspect the operating valve for distortion or collapse. See that it slides easily in the bore of the front casing. Check that the ball seat is clean and free from scratches. Check that the restrictor jet is clear. Check the ball and spring for distortion.

Clean the filter thoroughly in petrol. Remove all metallic particles from the magnetic rings.

Check brake ring (61) for signs of wear, scoring or cracks.

CLUTCH SLIDING MEMBER (Fig. 25)

Inspect the clutch linings on the clutch sliding member for any signs of excessive wear or charring. If excessive wear or charring is apparent, replace the sliding member complete. It is not possible to fit new linings only as the faces have to be fine machined to an accurate angle after rivetting.

Inspect the pins for the bridge pieces on the thrust ring (53) and check that they are tight and not distorted.

Inspect the ball race (57) and ensure that it rotates smoothly as this can otherwise be a source of noise when running in direct gear.

Inspect the clutch springs (55) for any sign of damage or collapse.

PLANET CARRIER AND GEAR TRAIN (Fig. 25)

If not previously inspected under DISMANTLING the gears and bearings should be inspected.

Inspect the teeth on the sunwheel (62) for sign of damage or chips. If the bush is worn, a new gear complete must be fitted as the bore has to be machined concentric with gear teeth after sub-assembly.

REAR CASING AND ANNULUS (Fig. 25)

Ensure that the rollers of the uni-directional clutch (72) are not chipped and that the inner and outer members are free from damage. Check that the cage, particularly the two ears, is not damaged. Check that the spring is not distorted or broken.

Inspect the bronze washers fitted between the uni-directional clutch and the annulus.

Inspect the gear teeth of the annulus (64) for damage.

Inspect the conical surface for signs of wear. A bronze spigot bearing is fitted in the annulus under the uni-directional clutch. Inspect this for wear. This bearing has to be machined after sub-assembly and therefore cannot alone be replaced in the field. Where necessitated by bearing damage, a new annulus must therefore be used.

Inspect the output shaft ballraces (68) and (70). Confirm that they rotate smoothly.

Inspect the rear oil seal (79). If it is necessary to remove the seal, a new one must always be fitted.

Inspect the teeth of the speedometer pinion (81) for wear.

RE-ASSEMBLY

FRONT CASING AND BRAKE RING

Insert the pump plunger, spring and body in the central holes in the bottom of the casing (see Fig. 29) taking care to locate the flat of the plunger against the thrust button which is situated below the centre bush. Tap the pump body home until the annular groove lines up with the locating screw hole in the casing and then insert the screw through the fibre washer and tighten, ensuring that the dowel locates in the groove. Re-seat the non-return valve ball by lightly tapping it with a copper drift and then screw in the non-return valve body using Tool No. L.304. Fit the ball spring, support pin, copper washer and plug, tightening same while ensuring that the spring is located in the plug recess.

Accumulator

Carefully insert the piston into the casing, using Tool No. L.304. Insert the spring and support pin. Fit the fibre washer and plug. Ensure that the spring is located in the plug recess together with any packing washers that were fitted originally and then tighten.

OPERATING PISTONS

When inserting the operating pistons, carefully ease the rubber sealing rings into the cylinder bores. The centre bosses of the pistons face towards the front of the unit.

OPERATING VALVE

Insert the operating valve into the casing, ensuring that the hemispherical end engages on the flat of the small cam on the operating shaft. Drop in the $\frac{5}{16}''$ dia. (7·93 mm.) ball, plunger and spring. Screw in and tighten the operating valve plug, ensuring that the copper washer is located correctly.

OIL FILTER

Fit two magnetic plastic rings in the recess in the casing and then insert the filter. A further two magnetic plastic rings are fitted in the recess of the plug. Screw in the plug together with the copper washer and, ensuring that the filter is located at either end, tighten up.

The front casing, less solenoid, is now complete and ready for assembly to the rest of the unit.

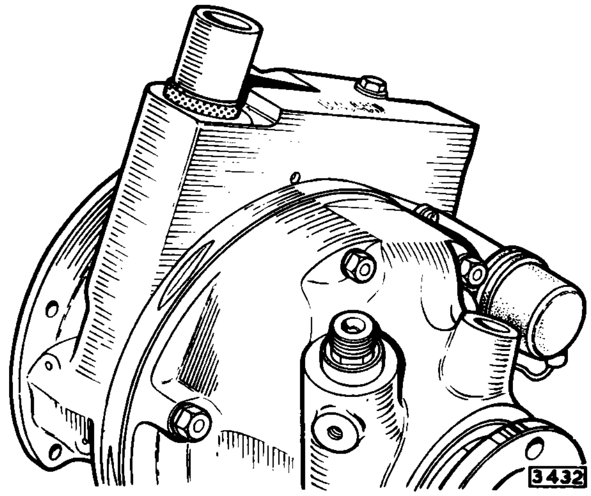


Fig. 30. Refitting the accumulator piston using the special Tool No. L.304.

REAR CASING AND ANNULUS

Press the front bearing into the rear casing using Part No. L.303 ensuring that its outer track abuts against the shoulder in the casing and then fit the retaining circlip. Support the inner race of the bearing using Part No. L.303 and then press in the annulus until the bearing abuts on the locating shoulder. Fit the speedometer driving gear and using Tool No. L303, press the rear bearing onto the tail shaft and into the casing simultaneously. Press in the rear oil seal using Tool No. L.305 until it is flush with the end of the rear casing. Press on the coupling flange after first fitting the bolts and then fit washer and slotted nut. Tighten to a torque of 1200–1560 lb. in. (13·82–22·11 kg. cm) and fit the split pin. Insert the speedometer pinion gear and bush after ensuring that the 'O' ring is serviceable. Turn the annulus to engage the gear if necessary, align the holes in the casing and bush. Fit the locating screw and copper washer.

Assembling and Fitting Uni-directional Clutch

Assemble the spring into the roller cage of the uni-directional clutch. Fit the inner member into the cage and engage it on the other end of the spring. Engage the slots of the inner member with the tongues on the roller cage and ensure that the spring rotates the cage so that, when the rollers are fitted, they will be propelled up the inclined faces of the inner member. The cage is spring loaded anti-clockwise when viewed from the front.

Place the assembly, front end downwards, into the special assembly ring, Tool No. L.178, and fit the rollers through the slots in the tool, turning the clutch clockwise until all the rollers are in place, see Fig. 31.

Replace the uni-directional clutch assembly using the special tool to enter the rollers into the outer member in the annulus. Fit the oil thrower and retaining circlip.

PLANET CARRIER AND GEAR TRAIN

Special care must be taken when re-assembling the planet carrier assembly to the annulus and sun-wheel. Turn each gear respectively until a dot marked on one tooth of the large gear is positioned radially outwards (see Fig. 32).

Insert the sunwheel to mesh with the planet gears, keeping the dots in the same position, and then insert this assembly to mesh with the internal gear in the annulus. Insert the dummy mainshaft Tool No. L.185A engaging in the planet carrier and uni-directional clutch splines.

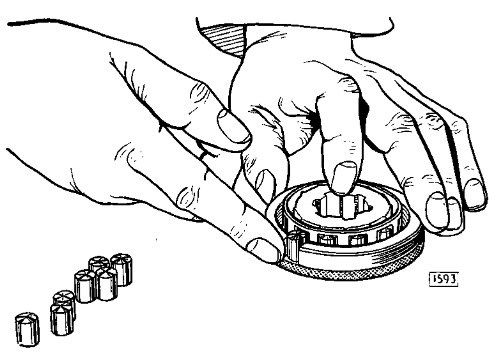


Fig. 31. Assembling the uni-directional clutch using Part No. L.178.

CLUTCH SLIDING MEMBER

Press the thrust bearing into the thrust ring and press this assembly onto the hub of the clutch sliding member, taking care not to damage the linings. Secure the assembly in position by fitting the circlip contact with the annulus and then fit the corrugated washer and circlip.

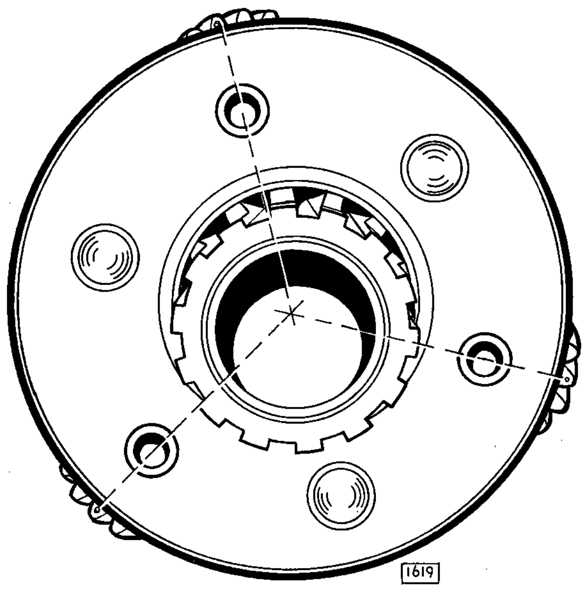


Fig. 32. Assembly of the planet gears—note the positions of the marked teeth.

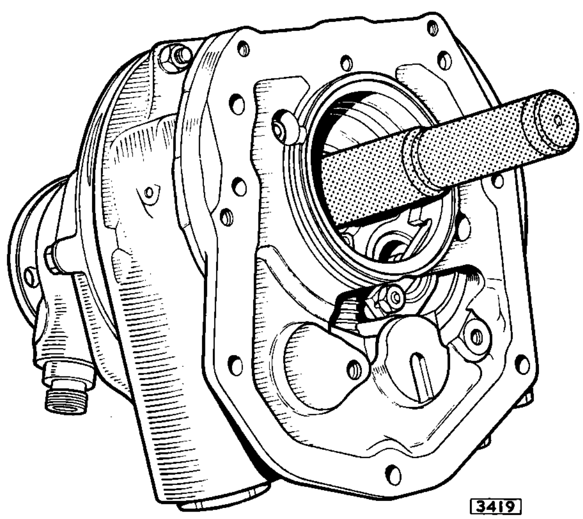


Fig. 33. Using the dummy mainshaft Part No. L185A.

FINAL ASSEMBLY

Fit the retaining plate over the bolts of the thrust ring bearing assembly. Smear liquid jointing compound onto both faces of the brake ring flange and tap this home into the front casing. Insert the clutch return springs in the front casing. Offer up the front casing and brake ring to the rear casing, ensuring that the thrust ring bolts pass through the holes in the front casing without binding. The clutch spring pressure will be felt as the two casings go together and the four nuts should be progressively tightened until the faces meet. Fit the two bridge pieces, nuts and new tab washers.

Fit the solenoid plunger in the fork of the operrating lever and, after fitting a gasket to the solenoid flange, fasten the solenoid to the casing by means of the two securing screws.

Adjust the solenoid operating lever as described on page F.28.

Secure solenoid gasket and cover plate with four setscrews and lockwashers.

The overdrive is now complete and ready for fitting to gearbox.

REFITTING THE OVERDRIVE TO THE GEARBOX

Place the overdrive unit upside down in a vice.

Remove the dummy mainshaft from the overdrive. The splines will now be correctly lined up and it is most important that the coupling flange is not turned until the unit has been fitted to the gearbox.

Check that the cam is not unduly worn and that the flat spring ring on the gearbox mainshaft is not distorted and does not protrude above the crown of the splines.

Rotate the shaft to position the cam with its highest point uppermost. The lowest point will now coincide with the overdrive pump roller. The mainshaft should not be turned again until the overdrive has been fitted and it is advisable to engage bottom gear.

Fit a new paper joint to the overdrive front face. Fit the gearbox carefully to the overdrive ensuring that the pump roller rides on the cam which is chamfered for this purpose and that the overdrive pushes right up to the face of the adaptor by hand pressure only. If the overdrive will not meet the adaptor face by about $\frac{5}{8}''$ (15·88mm.) it means that the splines have become mis-aligned. In such a case remove the overdrive again and re-align the splines by rotating the inner member of the unidirectional clutch in an anti-clockwise direction. This can be done with a long screwdriver. Recheck by inserting the dummy mainshaft again.

When the overdrive has been fitted, tighten up the four nuts on the front casing flange and also the two nuts on the long studs which go right through the rear casing.

BEFORE COMMENCING ANY DISMANTLING OPERATIONS IT IS IMPORTANT THAT THE HYDRAULIC PRESSURE IS RELEASED FROM THE SYSTEM. DO THIS BY OPERATING THE OVERDRIVE 10–12 TIMES.

Switch the ignition on, engage top gear and operate the overdrive switch when the solenoid will be heard to energise.

THE OPERATING VALVE

DESCRIPTION

The valve plug is located at the bottom of the unit on the same side as the solenoid and it is accessible from beneath the car. Unscrew the valve plug with a $\frac{5}{8}''$ A/F spanner; if very tight, a sharp tap on the head will facilitate. Remove the spring, plunger and ball. The operating valve can be removed by inserting a piece of stiff wire in the central bore and drawing it down. Care must be taken to avoid damaging the seating at the bottom of the valve. Near the top of the valve will be seen a small hole breaking through the central bore (Fig. 34). This is for the exhaust of oil from the operating cylinders. Ensure that this is not choked.

SOLENOID ADJUSTMENT

The operating valve is lifted by a cam on a transverse shaft. The solenoid operates a lever attached to this shaft. When the solenoid is operated, the valve must be fully opened.

The solenoid box is located on the left hand side of the unit and it is accessible from beneath the car.

Remove the rectangular solenoid cover plate which is secured by four screws. The solenoid lever which has a $\frac{3}{16}''$ dia. (4·76 mm.) hole for setting purposes is now disclosed.

Move the lever until a $\frac{3}{16}''$ dia. (4·76 mm.) pin pushed through the hole in the lever registers in the hole in the casing.

Screw the nut on the plunger until, when the plunger is pushed right home in the solenoid, the nut just contacts the fork of the lever.

Remove the $\frac{3}{16}''$ (4·76 mm.) dia. pin.

Recheck by energising the solenoid and checking the alignment of the holes. When the solenoid is energised the correct consumption should be about 1 ampere. If it is 15–20 amperes it is an indication that the solenoid plunger is not moving far enough to switch from the operating to the holding coil of the solenoid and the lever must be adjusted.

THIS IS IMPORTANT AS HIGH CURRENT WILL CAUSE SOLENOID FAILURE.

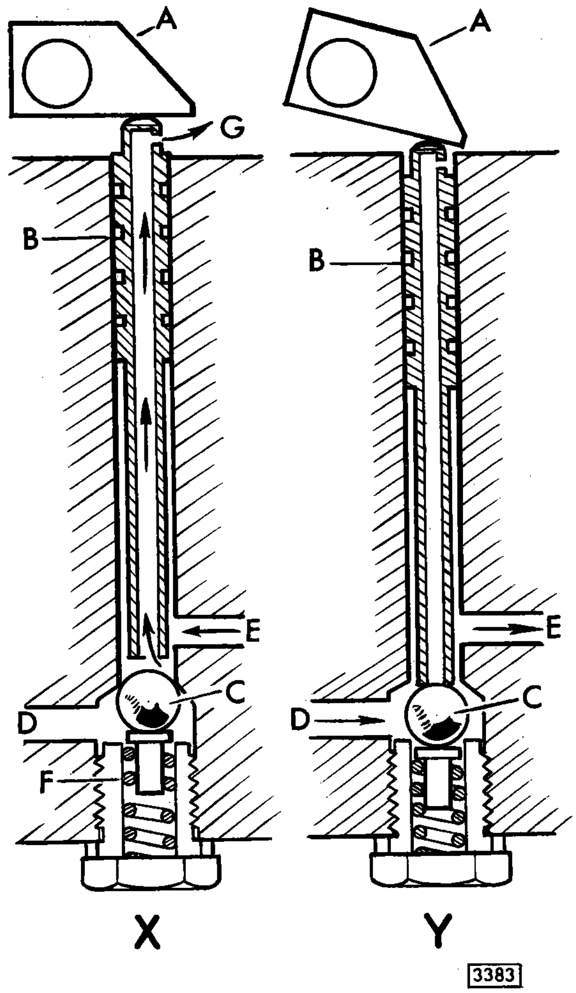


Fig. 34. The operating valve.

"X"—shows the position of the operating valve in direct drive. In this position the ball C is held on the seat in the casing by the valve spring F and isolates the supply D from the operating cylinders E.

"Y"—shows the position of the operating valve in the overdrive position, the valve has been lifted, by action of the solenoid causing the cam A to rotate, lifting the ball off the seat in the casing and sealing off the top of the valve. This allows oil under pressure to transfer from port D to the operating cylinders E.

On returning to direct drive, the oil is exhausted down the hollow stem of the valve B and through the restrictor G.

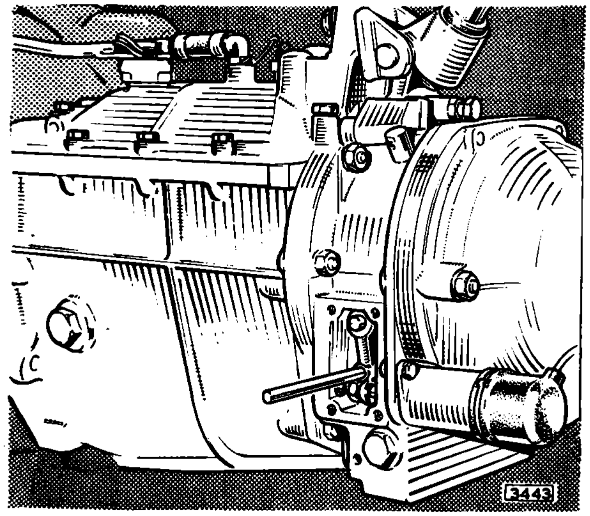


Fig. 35. Solenoid adjustment.

STICKING CLUTCH

If overdrive cannot be disengaged after carrying out the procedure outlined on page F.32 this is probably due to a sticking cone clutch. This trouble can be experienced with a new unit due to insufficient "bedding-in" of the clutch but it is unlikely to occur on a unit which has been in service for some time.

The clutch can usually be freed by giving the brake ring several sharp blows with a hide mallet. This can be done from underneath when the car is on a hoist.

THE ELECTRICAL CIRCUIT

As many operational failures are due to corroded terminals and faulty wiring, wiring and connections should be checked first.

Good earth connections are essential on all earthed components. This applies particularly to the solenoid because of the heavy current passed momentarily each time the overdrive is engaged.

Incorrect adjustment of the solenoid, resulting in the failure of the main winding contacts to open, may cause damage to the solenoid.

Check that the in-line fuse has not blown (this fuse is located behind the side fascia panel). Replace with an 8 amp. fuse if necessary.

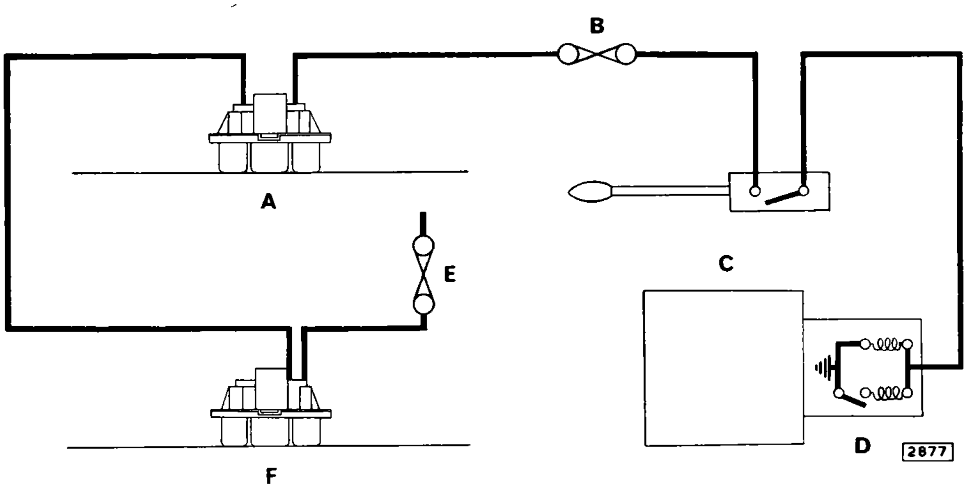


Fig. 36. Circuit diagram.

A.	Top gear switch	D.	Solenoid
B.	Fuse (overdrive in-line)	E.	Fuse (ignition auxiliary)
C.	Manual switch	F.	Reverse lamp switch

TESTING OIL PRESSURE

Release the hydraulic pressure by switching on the ignition, engaging top gear and operating the overdrive switch several times. Remove the operating valve plug and replace it with the hydraulic test equipment, which has a pressure gauge reading to 800 lb./sq. in. (56·24 kg./sq. cm.)

Jack up the rear wheels of the car securely, start the engine, engage top gear and run up to about 20 m.p.h. (32 K.p.h.) on the speedometer. Hydraulic pressure should then be recorded. Check the pressure in direct and overdrive.

Failure to register pressure with overdrive selected may indicate that the pump not-return requires cleaning and re-seating.

Hydraulic pressure should be 520—540 lb./sq. in. (36·5 kg./sq. cm. — 37·97 kg./sq. cm.)

THE PUMP VALVE

If the unit fails to operate after re-seating the operating valve, check that the pump is working. Jack up the rear wheels of the car securely, remove the operating valve plug and, using a clean receptacle, catch any oil which may spill from the valve chamber.

Start up the engine, engage top gear and, with the engine running slowly, watch for oil being pumped into the valve chamber. If none appears the pump is not functioning and its non-return valve should be cleaned. A flow of oil does not necessarily mean that the hydraulic pressure is correct.

It is most important that any oil lost from the valve chamber is poured back into the gearbox when the operating valve plug has been replaced.

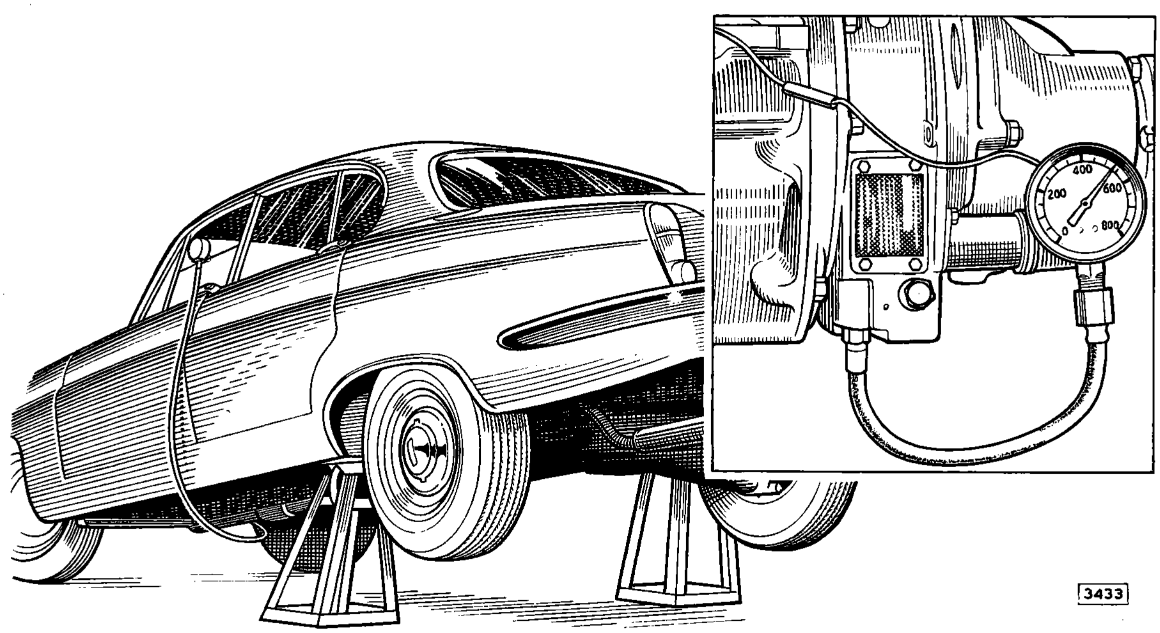


Fig. 37. Testing the oil pressure.

The pump valve is accessible from underneath the unit when the centre plug is removed, Fig. 34. Unscrew the valve body, carefully clean the ball and the valve seating. Reseat the ball by tapping it sharply on to its seating.

Note: The in-line fuse is not fitted on some early models.

Switch on reverse light and check that main fuse, No. 8, has not blown.

If neither fuse has blown check that current is available at the solenoid. Disconnect the cable at the solenoid junction and connect a test lamp in circuit. Switch on overdrive. If current is available as indicated by test bulb illumination, renew the solenoid unit.

If current is NOT available, reconnect the solenoid and short out the top gear switch terminals. Renew the switch if the solenoid now operates.

If the solenoid does not operate replace the control switch by substitution and recheck. Renew control switch if faulty.

OPERATING INSTRUCTIONS

When brought into operation, the overdrive reduces the engine speed in relation to the road speed. This permits high road speed with low engine revolutions resulting in fuel economy and reduced engine wear.

OPERATION

The overdrive will operate in top gear only and is brought into action by means of the lever behind the steering wheel on the right-hand side of the column. Operate the lever clockwise to engage the overdrive and anti-clockwise to bring the drive into top (4th) gear.

When the overdrive is in operation the word "Overdrive" in the quadrant behind the steering wheel becomes illuminated. When the sidelights are switched on, the light is automatically dimmed.

Use of the clutch pedal when changing into or out of overdrive is unnecessary but to ensure maximum smoothness of operation, particularly when changing down from overdrive to top gear, the accelerator pedal should be slightly depressed.

Do NOT bring the overdrive into operation at high speed with a wide throttle opening; release the accelerator momentarily when engaging overdrive.

For driving in towns, heavy traffic, or hilly country when the maximum flexibility and low speed performance is required the overdrive manual switch should be placed in the "Out" position which will bring the drive into normal top gear ratio.

For normal driving in open country the overdrive should be brought into operation when the required cruising speed has been obtained.

The following table gives the relationship between engine revolutions per minute to road speed in miles and kilometres per hour for top gear and overdrive:

Road Speed		Engine Revolutions per minute	
Kilometres per hour	Miles per hour	Top Gear 3·77	Overdrive 2·933
16	10	493	383
32	20	986	766
48	30	1480	1150
64	40	1972	1532
80	50	2465	1915
96	60	2960	2300
112	70	3451	2681
128	80	3944	3064
144	90	4440	3450
160	100	4930	3830
176	110	——	4213
192	120	——	4596

Note: The figures in these tables are theoretical and actual figures may vary slightly from those quoted due to such factors as tyre wear, pressures, etc.

SPECIAL TOOLS

Description

Dummy Mainshaft (L.185A)*

Pump Body Remover (Main Tool—L.183A)*

Pump Body Remover Adaptor (L.183A—2)*

Assembly Ring for Uni-directional Clutch (L.178)*

Annulus Bearing Replacer (L.303)*

Accumulator Piston Replacer (L.304)*

Rear Casing Oil Seal Replacer (L.305)*

*Churchill Tool Number.

FAULT FINDING

When an overdrive unit does not operate properly it is advisable to check the level of the oil and, if below the low level mark, top up with fresh oil and test the unit again before making any further investigations.

Faulty units should be checked for defects in the order listed below.

If the electrical control does not operate, the electrical circuit should be checked from the diagram.

OVERDRIVE DOES NOT ENGAGE

(a) Insufficient oil in the gearbox.
(b) Solenoid not operating due to fault in electrical system.
(c) Solenoid operating lever out of adjustment.
(d) Insufficient hydraulic pressure due to pump non-return valve incorrectly seating (probably dirt on seat).
(e) Insufficient hydraulic pressure due to worn accumulator.
(f) Pump not working due to choked filter.
(g) Pump not working due to damaged pump roller or cam.
(h) Leaking operating valve due to dirt on ball seat.
(i) Damaged parts within the unit requiring removal and inspection.

OVERDRIVE DOES NOT DISENGAGE

Important: If the overdrive does not release, do NOT reverse the car, otherwise extensive damage may be caused.

(a) Fault in electrical control system.
(b) Solenoid sticking
(c) Blocked restrictor jet in operating valve.
(d) Solenoid operating lever incorrectly adjusted.
(e) Sticking clutch.
(f) Damaged gears, bearing or sliding parts within the unit.

CLUTCH SLIP IN OVERDRIVE

(a) Insufficient oil in gearbox.
(b) Solenoid lever out of adjustment.
(c) Insufficient hydraulic pressure due to pump non-return valve incorrectly seating (Probably dirt on seat).
(d) Insufficient hydraulic pressure due to worn accumulator.
(e) Operating valve incorrectly seated.
(f) Worn or glazed clutch lining.

Clutch slip in reverse or free wheel condition on overdrive

(a) Solenoid operating lever out of adjustment.
(b) Partially blocked restrictor jet in operating valve.
(c) Worn or burnt inner clutch lining.

Note: Before removing any of the valve plugs it is essential to operate the solenoid several times in order to release all hydraulic pressure from the system. To do this, engage in top gear, switch on the ignition and operate the overdrive control switch several times.

SECTION FF

AUTOMATIC TRANSMISSION

(Model 8)

4·2 MARK 10 MODEL

CONTENTS

CONTENTS (continued)

GENERAL DATA

GEAR RATIOS

Maximum ratio of torque converter	2·00 : 1
1st gear reduction	2·40 : 1
2nd gear reduction	1·46 : 1
3rd gear	1·00 : 1
Reverse gear reduction	2·00 : 1

SHIFT SPEEDS

Selector Position	Throttle Position	Upshifts 1-2	Upshifts 2-3	Downshifts 3-2	Downshifts 3-1	Downshifts 2-1
				M.P.H.		
D1	Minimum	6–7	10–12	6–12	—	3–6
	Full	31–36	54–58	18–31	—	—
	Kickdown	42–46	66–73	59–67	16–20	16–20
D2	Minimum	—	10–12	6–12	—	—
	Full	—	54–58	18–31	—	—
	Kickdown	—	66–73	59–67	—	—
L	Zero	—	—	60	—	9–17
				K.P.H.		
D1	Minimum	10–11	16–19	10–19	—	5–10
	Full	50–58	87–93	29–50	—	—
	Kickdown	68–74	106–117	95–108	26–32	26–32
D2	Minimum	—	16–19	10–19	—	—
	Full	—	87–93	29–50	—	—
	Kickdown	—	66–73	95–108	—	—
L	Zero	—	—	97	—	14–27

NOTE: Shift points are approximate and not absolute values. Reasonable deviations from the above values are permissible.

IMPORTANT NOTICE

ANY QUERIES ON THE USE, UPKEEP OR REPAIR OF THIS TRANSMISSION MUST BE REFERRED TO THE SERVICE DIVISION OF JAGUAR CARS LIMITED AND IN NO CIRCUMSTANCES TO THE MANUFACTURERS OF THE TRANSMISSION. SPARE PARTS ARE LIKEWISE AVAILABLE ONLY FROM JAGUAR CARS LIMITED AND NOT FROM THE TRANSMISSION MANUFACTURERS.

TIGHTENING TORQUE FIGURES

	lb. ft.	kgm.
Front pump to transmission case bolts	17 – 22	2·35 – 3·04
Front servo to transmission case bolts	30 – 35	4·15 – 4·70
Rear servo to transmission case bolts	40 – 45	5·53 – 6·22
Centre support to transmission case bolts	20 – 25	2·76 – 3·46
Upper valve body to lower valve body bolts	4 – 6	0·55 – 0·83
Control valve body to transmission case bolts	8 – 10	1·11 – 1·38
Pressure regulator assembly to transmission case bolts	17 – 22	2·35 – 3·04
Extension assembly to transmission case bolts	28 – 33	3·87 – 4·56
Oil pan to transmission case bolts	10 – 13	1·38 – 1·80
Case assembly-gauge hole plug	10 – 15	1·38 – 2·07
Oil pan drain plug	25 – 30	3·46 – 4·15
Rear band adjusting screw lock nut	35 – 40	4·70 – 5·53
Front band adjusting screw lock nut	20 – 25	2·76 – 3·46
Detent lever attaching nut	35 – 40	4·70 – 5·53
Companion flange nut	90 –120	12·44 –16·58
Bearing retainer to extension housing bolts	28 – 33	3·87 – 4·56

	lb. in.	kgm.
Front pump cover attaching screws	25 – 35	0·29 – 0·40
Rear pump cover attaching screws ¼″ (6·30 mm.)	50 – 60	0·58 – 0·69
Rear pump attaching screws Nos. 10–24	20 – 30	0·24 – 0·35
Governor inspection cover attaching screws	50 – 60	0·58 – 0·69
Governor valve body to counterweight screws	50 – 60	0·58 – 0·69
Governor valve body cover screws	20 – 30	0·24 – 0·35
Pressure regulator cover attaching screws	20 – 30	0·24 – 0·35
Control valve body screws	20 – 30	0·24 – 0·35
Control valve body plug	10 – 14	0·11 – 0·16
Control valve lower body plug	7 – 15	0·08 – 0·17

SPECIAL SERVICE TOOLS

Service tools are not available from Borg-Warner Limited. Distributors and Dealers should obtain the following tools illustrated in this manual from Messrs. V. L. Churchill & Co. Limited, London Road, Daventry, Northants.

Description

Mainshaft end play gauge (CB.W.33)*

Electric tachometer (642)*

Rear clutch spring compressor (C.B.W 37A* used with W.G. 37)

Hydraulic pressure test gauge equipment (C.B.W. 1A* used with adaptor C.B.W. 1A—5A

Spring beam torque wrench (used in conjunction with the following adaptor) (C.B.W. 547A—50*)

Rear band adjusting adaptor (C.B.W. 547A—50—2)*

Torque screwdriver (used in conjunction with the following adaptor) (C.B.W 548)*

Front band adjusting adaptor (C.B.W. 548—2)*

Front band setting gauge (C.B.W. 34)*

Circlip pliers (used with "J" points) (7066)*

Bench cradle (C.W.G. 35)

Rear clutch piston assembly sleeve (C.W.G. 41)

Front clutch piston assembly sleeve (C.W.G. 42)

Rear pump discharge tube remover (C.W.G. 45)

* *Note that these tools are also used on the Borg-Warner model 35 transmission unit.*

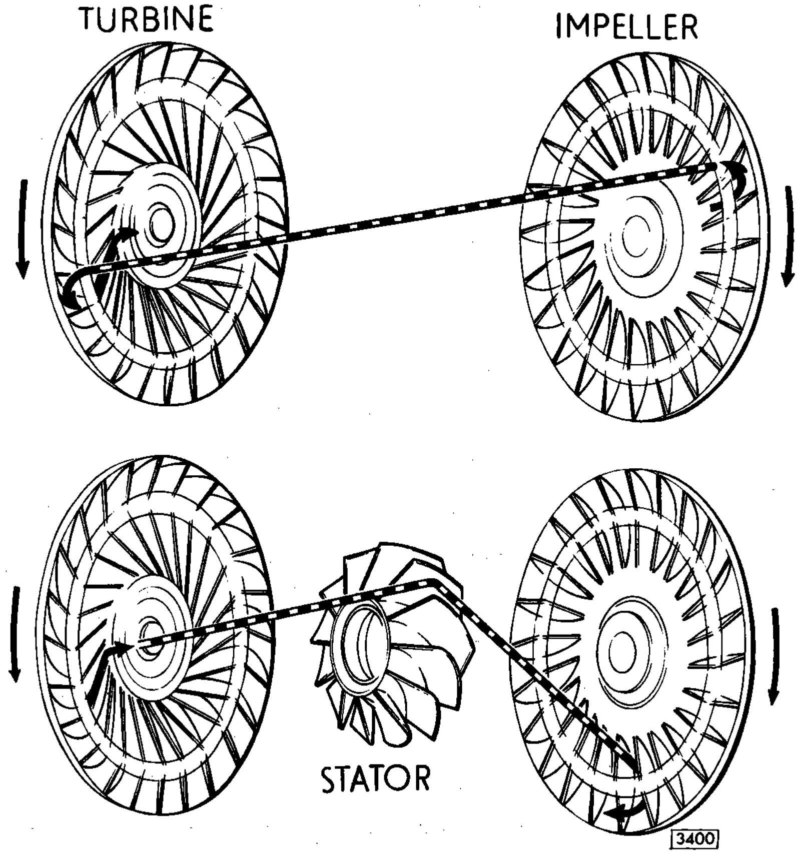


Fig. 1. Torque converter—principle of operation.

DESCRIPTION AND OPERATION

The Model 8 automatic transmission incorporates a fluid torque converter in place of the usual flywheel and clutch. The converter is coupled to a hydraulically operated planetary gearbox which provides three forward ratios and reverse. All forward ratios are automatically engaged in accordance with accelerator position and car speed.

Overriding control by the driver is available upon demand for engine braking by manual selection of "L".

TORQUE CONVERTER

The feature of using a hydraulic converter in conjunction with a three-speed automatic gearbox provides a means of obtaining a smooth application of engine power to the driving wheels and additional engine torque multiplication to the 1st and 2nd gears of the gearbox.

The converter also provides extreme low-speed flexibility when the gearbox is in 3rd gear and, due to the ability of multiplying engine torque, it provides good acceleration from very low road speed without having to resort to a down-shift in the gearbox.

Torque multiplication from the converter is infinitely variable between the ratios of 2:1 and 1:1. The speed range, during which torque multiplication can be achieved, is also variable, depending upon the accelerator position.

The hydraulic torque converter for use in conjunction with the automatic gearbox has a mean fluid circuit diameter of 11″ (27·9 cm).

It is of the single-phase, three-element type, comprising an impeller connected to the engine crankshaft, a turbine connected to the input shaft of the gearbox, and a stator mounted on a sprag-type one-way clutch supported on a fixed hub projecting from the gearbox case.

THE GEAR SET

The planetary gear set consists of two sun gears, two sets of pinions, a pinion carrier, and a ring gear. Helical, involute tooth forms are used throughout. Power enters the gear set via the sun gears. In all forward gears power enters through the forward sun gear; in reverse power enters through the reverse sun gear. Power leaves the gear set by the ring gear. The pinions are used to transmit power from the sun gears to the ring gear. In reverse a single set of pinions is used, which causes the ring gear to rotate in the opposite direction to the sun gear. In forward gears a double set of pinions is used to cause the ring gear to rotate in the same direction as the sun gear. The carrier locates the pinions in their correct positions relative to the sun gears and the ring gear (and also forms a reaction member for certain conditions). The various mechanical ratios of the gear set are obtained by the engagement of hydraulically operated multi-disc clutches and brake bands.

CLUTCHES

Multi-disc clutches operated by hydraulic pistons connect the converter to the gear set. In all forward gears the front clutch connects the converter to the forward sun gear; for reverse the rear clutch connects the converter to the reverse sun gear.

BANDS

Brake bands, operated by hydraulic servos, hold elements of the gear set stationary to effect an output speed reduction and a torque increase. In Lockup the rear band holds the planet carrier stationary and provides the 1st gear ratio of 2·40:1 and, in reverse, a ratio of 2·00:1. The front band holds the reverse sun gear stationary to provide the 2nd gear ratio of 1·46:1.

ONE-WAY CLUTCH

In D1, a one-way clutch is used in place of the rear band to prevent anti-clockwise rotation of the planet carrier, thus providing the 1st gear ratio of 2·40:1. This one-way clutch, allowing the gear set to freewheel in 1st gear, provides smooth ratio changes from 1st to 2nd, and vice versa.

Selector Position	Ratio	Applied	Driving	Held
L Lock-up	1st	Front Clutch Rear Band Sprag Clutch	Forward Sun	Planet Carrier
D1 Drive One	1st	Front Clutch Sprag Clutch	Forward Sun	Planet Carrier
L Lock-up D1 Drive One D2 Drive Two	2nd 2nd	Front Clutch Front Band	Forward Sun	Reverse Sun
D1 Drive One D2 Drive Two	3rd	Front Clutch Rear Clutch	Forward Sun Secondary Sun	
R Reverse	Reverse	Rear Clutch Rear Band	Reverse Sun	Planet Carrier

MECHANICAL POWER FLOW

First Gear (Lockup selected)

The front clutch is applied, connecting the converter to the forward sun gear. The rear band is applied, holding the planet carrier stationary, the gear set providing the reduction of 2·40:1. The reverse sun gear rotates freely in the opposite direction to the forward sun gear.

First Gear (Drive 1 selected)

The front clutch is applied, connecting the converter to the forward sun gear. The one-way clutch is in operation, preventing the planet carrier from rotating anti-clockwise; the gear set provides the reduction of 2·40:1. When the vehicle is coasting the one-way clutch over-runs and the gear set freewheels.

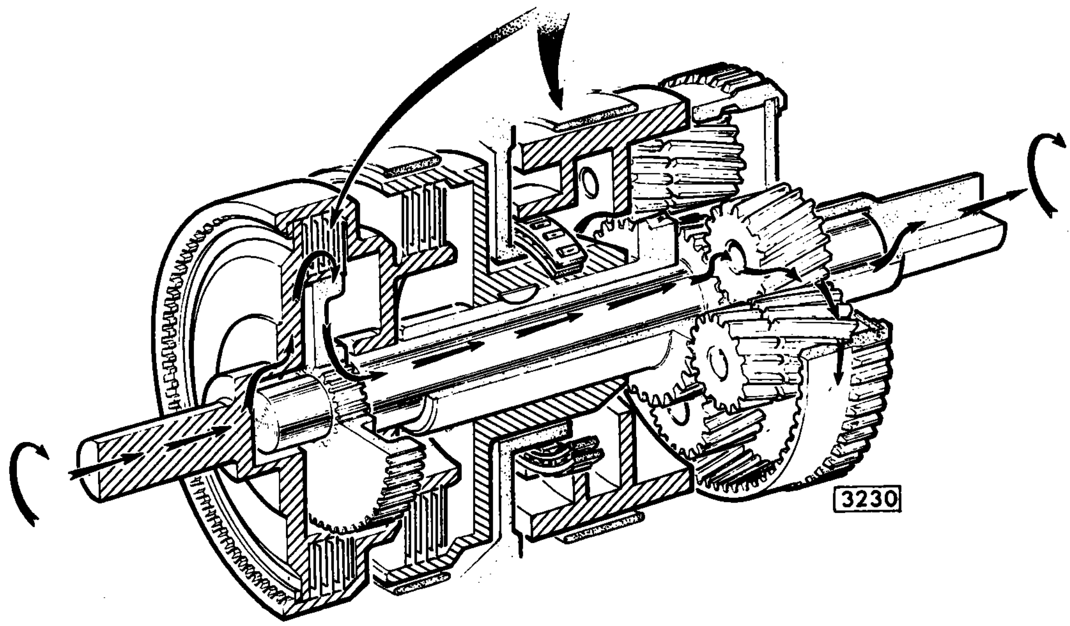


Fig. 2. Mechanical power flow—First gear (lockup) selected.

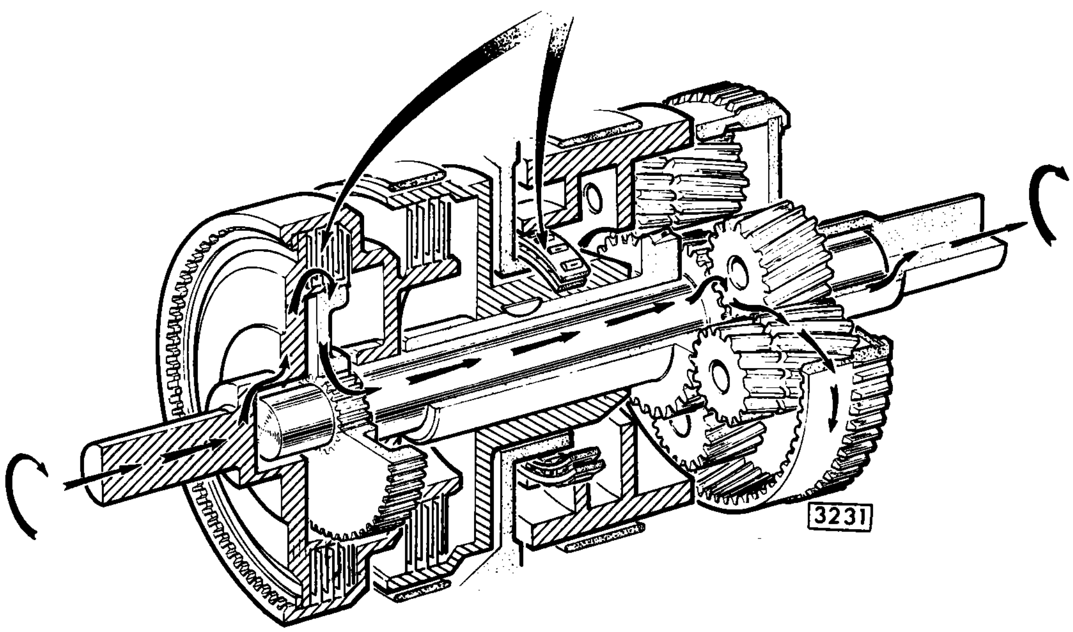


Fig. 3. Mechanical power flow—First gear (Drive 1) selected.

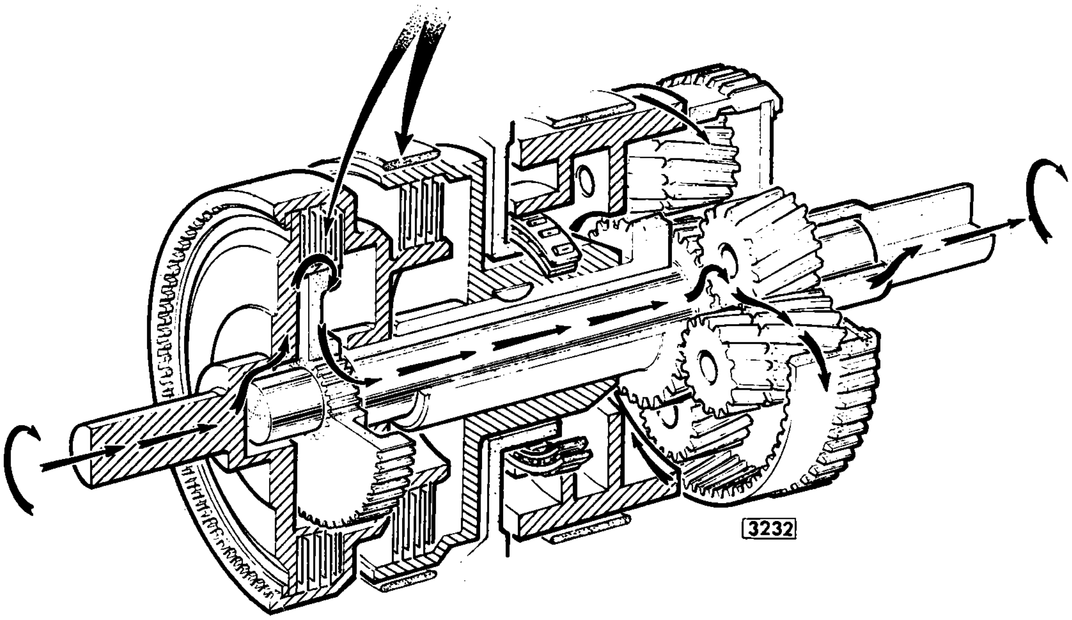


Fig. 4. Mechanical power flow—Second gear (Lock up or Drive 2) selected.

Second Gear (Lockup or Drive 2 selected)

Again the front clutch is applied, connecting the converter to the forward sun gear. The front band is applied, holding the reverse sun gear stationary; the gear set provides the reduction of 1·46:1.

Third Gear

Again the front clutch is applied, connecting the converter to the forward sun gear. The rear clutch is applied, connecting the converter also to the reverse sun gear; thus both sun gears are locked together and the gear set rotates as a unit, providing a ratio of 1:1.

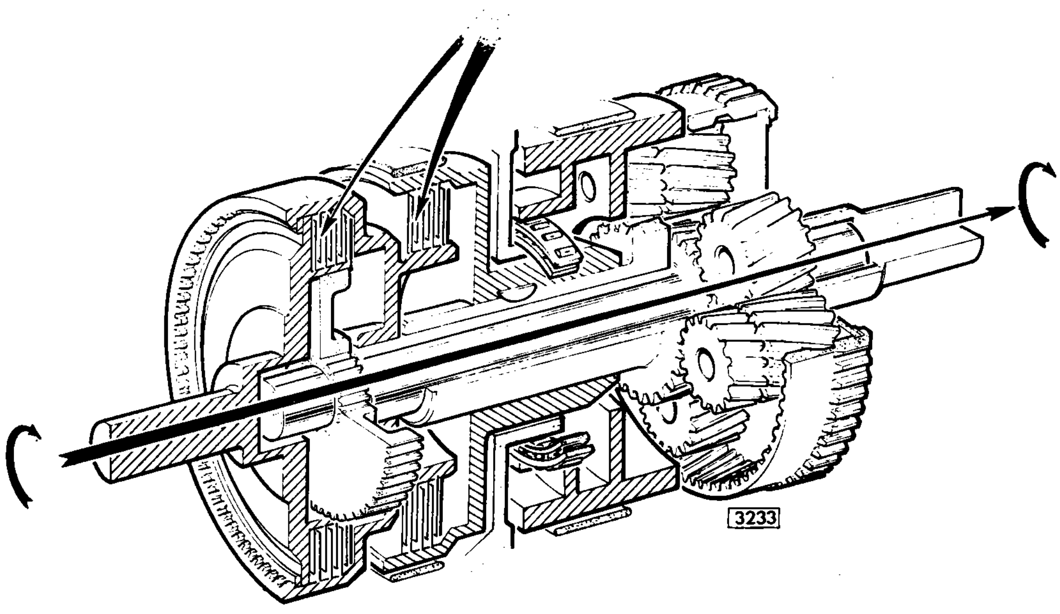


Fig. 5. Mechanical power flow—Third gear (D) selected.

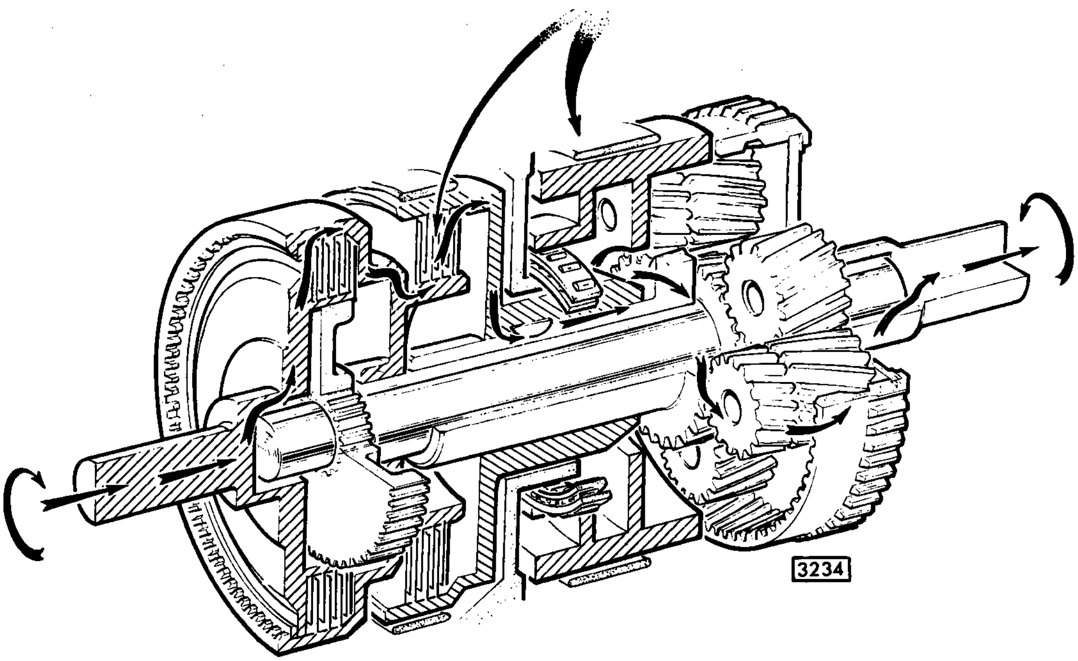


Fig. 6. Mechanical power flow—Reverse gear (R) selected.

Neutral and Park

In neutral the front and rear clutches are off, and no power is transmitted from the converter to the gear set. The front and rear bands are also released. In 'P' the Front Servo Apply and Release and rear servo circuits are pressurised for constructional reasons while the engine is running so that the rear band is applied.

Reverse Gear

The rear clutch is applied, connecting the converter to the reverse sun gear. The rear band is applied, holding the planet carrier stationary, the gear set providing the reduction of 2·00:1 in the reverse direction.

THE HYDRAULIC SYSTEM

The hydraulic system contains a front and rear pump, both of the internal/external gear pattern, picking up fluid from the oil pan through a common strainer. Shift control is provided by a centrifugally operated hydraulic governor on the transmission output shaft. This governor works in conjunction with valves in the valve bodies assembly located in the base of the transmission. These valves regulate fluid pressure and direct it to appropriate transmission components.

The Front Pump

The front pump, driven by the converter impeller, is in operation whenever the engine is running. This pump, through the primary and secondary regulator valves supplies the hydraulic requirements of the transmission with the engine running when the vehicle is stationary, as well as at low vehicle speeds before the rear pump becomes effective.

The Rear Pump

The rear pump is driven by the output shaft of the transmission. It is fully effective at speeds above approximately 20 m.p.h. (32 k.p.h.) and then supplies most of the hydraulic requirements.

If, due to a dead engine, the front pump is inoperative, the rear pump, above approximately 20 m.p.h. (32 k.p.h.), can provide all hydraulic requirements, thus enabling the engine to be started through the transmission.

The Governor

The governor, revolving with the output shaft, is essentially a pressure regulating valve which reduces line pressure to a value which varies with output shaft speed. This variable pressure is utilised in the control system to effect up and downshifts through the 1-2 and 2-3 shift valves. Rotation of the governor at low speeds causes the governor weight and valve to be affected by centrifugal force. This outward force is opposed by an opposite and equal hydraulic force produced by pressure acting on the regulating area of the governor valve. The governor valve is a regulating valve and will attempt to maintain equilibrium. Governor pressure will rise in proportion to the increase in centrifugal force caused by higher output shaft speed.

As rotational speed increases the governor weight moves outward to rest on a stop in the governor body, and can move no further. When this occurs a spring located between the weight and the valve becomes effective. The constant force of this spring then combines with the centrifugal force of the governor valve and the total force is opposed by governor pressure. This combination renders governor pressure less sensitive to output shaft speed variations.

It can be seen from the above that the governor provides two distinct phases of regulation, the first of which is a fast rising pressure for accurate control of the low speed shift points.

THE CONTROL SYSTEM

Neutral—Engine Running

When the selector is moved to the neutral position, the manual control valve is positioned so that control pressure cannot pass through the manual valve to the clutches or servos; therefore, the clutches and servos cannot apply. There is no transmission of power through the transmission in the neutral position.

The pressure regulation system, however, is functioning. With the engine running, the front pump is driven and fluid is picked up from the pan by the front pump inlet. Fluid, circulated by the front pump, is directed to the control pressure regulator. The primary regulator valve will maintain correct control pressure by expelling the excess fluid to feed the secondary regulator valve. The secondary regulator valve maintains correct pressure for converter feed and lubrication, then forces the excess fluid back to the pump inlet.

Control pressure is directed to the manual control valve, where it is blocked by two lands on the valve. Control pressure is also directed to the throttle valve and the downshift valve and, with the valves closed (accelerator at idle position), it is blocked by lands on the valves. Control pressure to the compensator valve is regulated by that valve, and compensating pressure is directed to the primary regulator valve.

First Gear, D1 Range

When the selector lever is placed in the D1 position, with the car standing still, and the engine running, the manual control valve is moved to admit control pressure to apply the front clutch.

Control pressure is also directed to the governor, but with the car standing st ll, the control pressure s blocked at the governor valve. Control pressure from the manual va ve is also directed to the 2-3 shift valve, but is blocked by a land on the valve. Control pressure from the manual valve is directed through another passage to the front servo apply side and from there through the 1-2 shift valve, servo orifice control valve, 2-3 shift valve and again servo orifice control valve to the front servo release side; also to the transition valve. With pressure on both sides of the front servo piston, the servo is held in a released position. The one-way clutch takes the reaction torque on the rear drum, thus eliminating need for rear servo action.

The front pump supplies the pressure to operate the transmission and this pressure is controlled as it was in the neutral position.

When the accelerator is depressed and the car starts to move, centrifugal force, acting on the governor weight and valve, moves the valve to regulate governor pressure, which is directed to the 1-2 shift valve, 2-3 shift valve, and plug, and the compensator valve. Movement of the accelerator also opens the throttle valve so that throttle pressure is directed to the modulator valve, orifice control valve, and the shift plug on the end of the 2-3 shift valve. Throttle pressure to the modulator valve is re-directed to the compensator valve to increase control pressure.

Throttle pressure to the shift plug on the 2-3 shift valve is reduced, and the reduced pressure is directed to the ends of the 1-2 shift valve and 2-3 shift valve. This reduced pressure on the shift valves opposes governor pressure.

Second Gear, D1 Range

As car speed increases, the governor pressure is increased so that the pressure is great enough to overcome the 1-2 shift valve spring and reduced throttle pressure on the end of the valve and move the valve. When the 1-2 shift valve moves, control pressure at the valve is shut off and the front servo

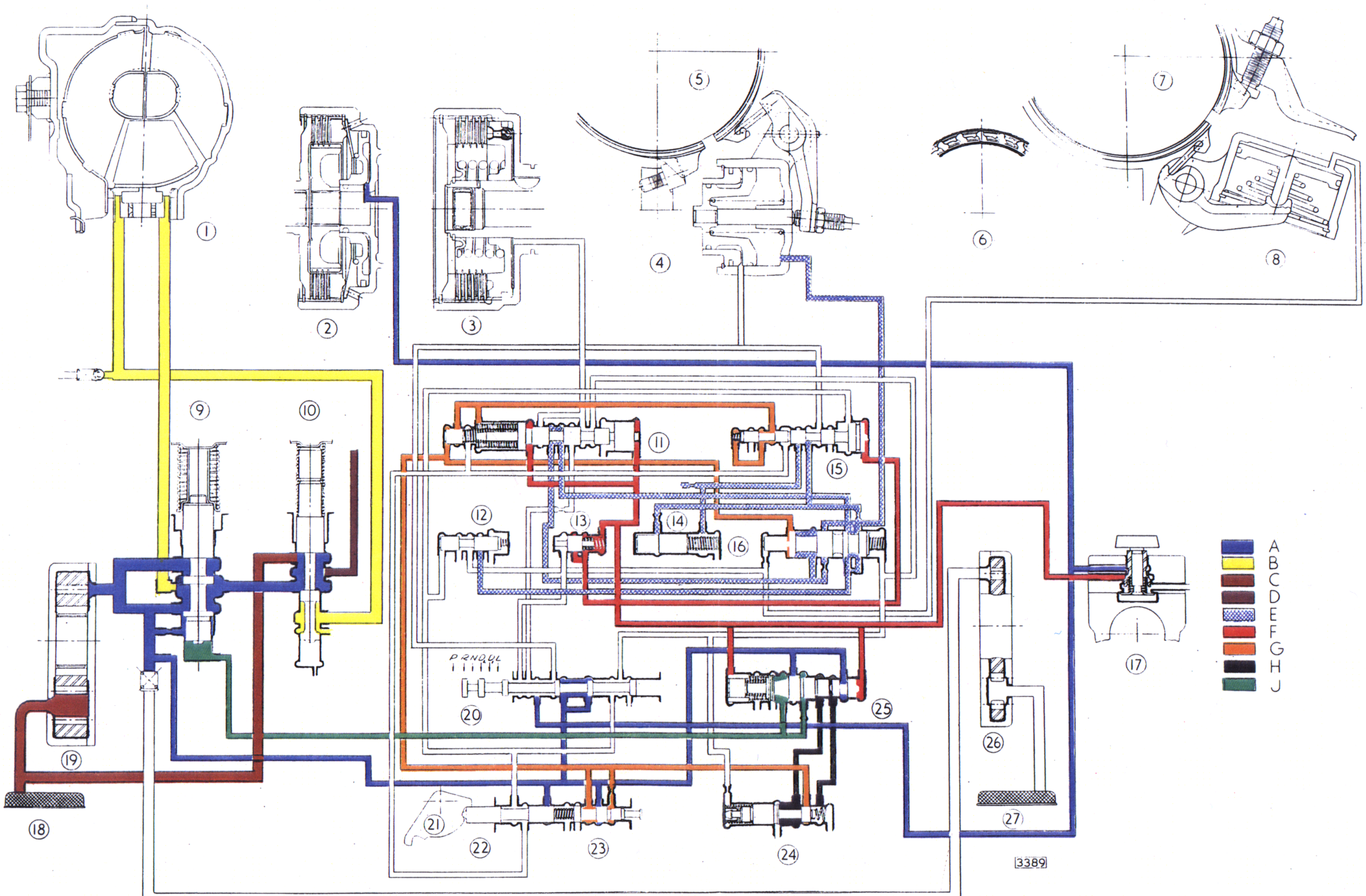


Fig. 7. The hydraulic circuits.
A—Control pressure B—Converter pressure C—Lubricating pressure D—Pump intake E—Exhaust F—Governor pressure G—Throttle pressure H—Modulator pressure J—Compensator pressure

release pressure is exhausted, first slowly through a restricting orifice and then fast through the front servo release orifice valve. This leaves the front clutch and the front band applied.

Third Gear, D1 or D2 Range

As car speed continues to increase, the governor pressure further increases so that the governor pressure overcomes the 2-3 shift valve spring and the reduced throttle pressure on the end of the 2-3 shift valve, causing the valve to move. When the valve moves, control pressure is admitted to the rear clutch through the annulus of the servo orifice control valve and to the release side of the front servo, thus applying the rear clutch and placing the front servo in the released position. This leaves the front clutch and the rear clutch applied.

As the governor pressure continues to increase, it acts against modulator pressure at the compensator valve to increase compensator pressure, and decrease control pressure.

Second Gear, D2 Range

When the selector lever is placed in the D2 (drive) position, with the car standing still and the engine running, control pressure passes through the manual valve to the D1 and D2 control valve, overcomes any governor pressure acting on this valve and passes through the valve to the governor pressure area of the 1-2 shift valve, thus positioning it in 2nd gear position.

All upshifts from 2nd gear ratio to direct will be similar to description of 3rd gear D1 range.

2-1 Kickdown, D1 Range

At car speeds up to approximately 20 m.p.h., (32 k.p.h.) after the transmission has shifted from 1st to 2nd or 3rd gear, the transmission can be downshifted to 1st gear by depressing the accelerator pedal beyond the wide open throttle position.

Movement of the accelerator to kickdown position causes the throttle cable to move the downshift valve to allow control pressure to pass through the downshift valve to another land on the 1-2 shift valve. The combination of control pressure and the 1-2 shift valve spring is sufficient to overcome governor pressure and return the valve to the 1st gear position. In this position, control pressure is admitted to the release side of the front servo. This places the front servo in the released position, leaving the front clutch applied and the one-way clutch holding the rear drum.

3-2 Kickdown, D1 or D2 Range

At car speeds between approximately 22 to 66 m.p.h. (35 to 106 k.p.h.) after the transmission has shifted to 3rd gear, the transmission can be downshifted from 3rd gear to 2nd gear by depressing the accelerator pedal beyond the wide open throttle position.

Movement of the accelerator causes the throttle cable to move the downshift valve to allow control pressure to pass through the downshift valve to the spring end of the 2-3 shift valve. The combination of control pressure at the end on the 2-3 shift valve and 2-3 shift valve springs is sufficient to overcome governor pressure to move the valve. When the valve is in 2nd gear position, control pressure to the rear clutch and through the servo orifice control valve to the release side of the front servo is shut off. The rear clutch circuit exhausts through the exhaust port of the manual control valve, whereas the front servo release circuit exhausts through the 1-2 shift valve, orifice and orifice valve. This leaves the front clutch and front band applied.

If the accelerator is left in the kickdown position, governor pressure will increase as the car speed increases until governor pressure is greater than the combined pressures on the 2-3 shift valve, and the transmission will again upshift to 3rd gear.

At speeds above approximately 66 m.p.h. (106 k.p.h.), the governor pressure is so great that the combined pressures on the 2-3 shift valve cannot overcome the governor pressure; therefore, there is no kickdown.

Lockup—First Gear

When the selector lever is placed in the Lockup position, the manual control valve is moved to admit through one port control pressure to the front clutch and governor feed; another port supplies both sides of the front servo, and also the rear servo, through the servo orifice control and transition valves. A third port supplies pressure to move the transition valve, and an additional land on the 1-2 shift valve. Control pressure to the front clutch and the rear servo applies the front clutch and rear band.

Key to Fig. 7

1. Converter
2. Front clutch
3. Rear clutch
4. Front servo
5. Front band
6. One-way clutch
7. Rear band
8. Rear servo
9. Primary regulator valve
10. Secondary regulator valve
11. 2nd and 3rd shift valve
12. Transition valve
13. D1 and D2 control valve
14. Front servo release orifice valve
15. 1st and 2nd shift valve
16. Servo orifice control valve
17. Governor
18. Screen
19. Front pump
20. Manual valve
21. Closed throttle
22. Downshift valve
23. Throttle valve
24. Throttle modulator valve
25. Compensator valves
26. Rear pump
27. Oil screen

In this position, there is no automatic upshift to a higher gear ratio, since the combination of control pressure on the 1-2 shift valve and the 1-2 shift valve spring is greater than governor pressure acting against the valve, so that the valve cannot move. The combination of control pressure on the 2-3 shift valve and the 2-3 valve springs is also greater than governor pressure acting against the valve so that the 2-3 shift valve cannot move.

Lockup—Second Gear

In L the manual control valve opens to exhaust the rear clutch and front servo release circuit from the 2-3 shift valve. This causes a downshift from 3rd gear whenever L is selected at speed. In this condition governor pressure will have moved the 1-2 shift valve; the result is that supply to the rear servo through the servo orifice control valve and transition valve is blocked and as front servo release pressure also exhausts through the 2-3 shift valve, the front band will be applied. This band, in conjunction with the front clutch, provides 2nd gear.

Reverse

When the selector lever is placed in the reverse position, the manual control valve moves to admit control pressure to the rear clutch, both sides of the front servo, and the rear servo. This applies the rear clutch and the rear band.

Control pressure is also directed to the modulator valve to move the valve so when the throttle valve is opened by depressing the accelerator, the throttle pressure passes through the modulator valve to two lands on the compensator valve to reduce compensating pressure, thus increasing control pressure.

High control pressure is desired in reverse, since the reaction forces increase appreciably and higher pressure is required to hold the rear drum.

MODEL 8 TRANSMISSION SUMMARY OF MANUAL VALVE CONTROL CIRCUITS THROUGH SHIFT VALVES

O — Open X — Exhaust

MANUAL VALVE PORT No.	P	R	N	D2 2nd	D2 3rd	D1 1st	D1 2nd	D1 3rd	L 1st	L 2nd	D1 - KD 3-2	D1 - KD 2-1	EXPLANATORY REMARKS
4 F C	X	X	X	O	O	O	O	O	O	O	O	O	Supplies Front Clutch and governor feed.
5 F S Apply ..	O	O	X	O	O	O	O	O	O	O	O	O	Supplies Front Servo apply side and 1-2 shift valve.
Release ..	O	O	X	X	O	O	X	O	O	X	X	O	Supplies Front Servo release side and transition valve for rear servo when 1-2 valve is in position 1. Exhausts in position 2 through 1-2 valve, orifice and front servo release orifice valve.
F Band	off	off	off	on	off	off	on	off	off	on	on	off	Front band is only applied (release side exhausted) when both the 1-2 and 2-3 valves are in position 2, see shift valve table below.
7 R C	X	O	X	X	X	X	X	X	X	X	X	X	Supplies Rear Clutch in R, renders throttle modulator valve inactive and moves SOCV.
3 2-3 VALVE ..	X	X	X	O	O	O	O	O	X	X	O	O	Supplies Rear Clutch and Front Servo release in D ranges with 2-3 valve in position 3.
6 TRANSITION VALVE	O	O	X	X	X	X	X	X	O	O	X	X	Control pressure moves transition valve and, through downshift valve, locks shift valves.
R Band	on	on	off	off	off	off	off	off	on	off	off	off	
12 D1 & D2 VALVE..	X	X	X	O	O	X	X	X	X	X	X	X	Control pressure moves D1 and D2 valve to place 1-2 valve in position 2.
SHIFT VALVE POSITIONS													
1-2	1	1	1	2	2	1	2	2	1	2	2	1	Provides 1-2 or 2-1 shift through governor pressure.
2-3	2	2	2	2	3	2	2	3	2	2	2	2	Provides 2-3 or 2-1 shift through governor pressure. Exhausts rear clutch circuit through manual valve and directs Front Servo release pressure.

DRIVING INSTRUCTIONS

SELECTOR

Operation of the automatic transmission is controlled by the driver through the selector lever mounted on the steering column behind the steering wheel. The quadrant markings, from left to right are P, R, N, D2, D1, L.

The selector lever can be moved freely between N—D2 and D1—L. To move the lever between D2 and D1 or to the P or N positions the lever must be lifted towards the steering wheel.

Warning: Neither P nor R should be engaged whilst the car is in motion.

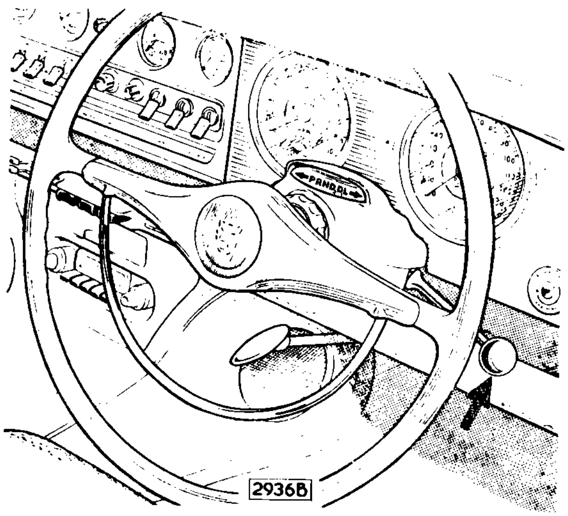


Fig. 8. The selector lever quadrant.

STARTING

A starter inhibitor switch ensures that the starter will operate only when the selector is in either the P or N position.

P (PARK)

In the Park position the gearbox is mechanically locked by the parking pawl, which engages with external teeth formed on the ring gear mounted to the driven shaft. No power is transmitted to the rear wheels.

Use of the Park position is recommended whenever the car is parked with or without engine running.

Do NOT select Park when the car is moving.

R (REVERSE)

The "R" position provides reverse ratio in the transmission. Do not select Reverse when the car is moving forward.

N (NEUTRAL)

In Neutral position no engine power is transmitted through the transmission. For safety the handbrake must be applied whenever Neutral is selected and the car is at rest.

D2 (DRIVE RANGE, SECOND GEAR START)

In the Drive "2" position the car starts from rest in second gear and operates automatically between second and third gears with upshifts and downshifts occurring according to car speed and accelerator position. At or below a preset maximum vehicle speed downshifts from 3rd to 2nd may be effected by fully depressing the accelerator to the kickdown position. First gear is not attainable as long as the selector is in this position. This position would be normally used for driving on slippery roads or when maximum acceleration is not desired. The car will not roll back on hills as long as the engine is running, so that D2 provides automatic " hill holding."

D1 (DRIVE RANGE, FIRST GEAR START)

In the Drive "1" position the car starts from rest in 1st gear and operates automatically through all three forward ratios with upshifts and downshifts occurring according to car speed and accelerator position. At or below preset maximums of vehicle speed downshifts may be effected from 3rd to 2nd, from 2nd to 1st, or directly from 3rd to 1st. This is accomplished by depressing the accelerator to the kickdown position.

L (LOCKUP)

Lockup position provides overriding control for either 1st or 2nd gear with engine braking in either ratio.

When starting from rest in the lockup position the transmission starts in 1st gear and remains in that gear regardless of road speed or accelerator position. Maximum engine braking is available in this gear.

DRIVING INSTRUCTIONS

With the transmission in 3rd gear in either D1 or D2 ranges the selection of L will bring an immediate downshift to 2nd gear. At closed throttle this will effect moderate engine braking. As speed is reduced to approximately 16 m.p.h. (26 k.p.h.), the transmission will downshift automatically from 2nd to 1st and maximum engine braking will be available. Once in 1st or 2nd gear, no upshift will be obtained until the selector lever is moved from the L position.

NORMAL DRIVING

During appropriate engine warm-up, apply the foot brake and move the selector lever to the desired forward or reverse position. Release the brake and depress the accelerator.

With the selector in one of the drive ranges the appropriate forward ratios up or down will be automatically provided by the transmission. Ratio changes will occur at speeds determined by accelerator position and torque demand.

Minimum accelerator position will result in upshifts occurring rather quickly as the car moves. Depression of the accelerator beyond minimum will delay upshifts to higher road speeds. With the accelerator in the kickdown position upshifts will occur at their maximum points.

INCREASED ACCELERATION

When full acceleration is required for passing or climbing hills, the accelerator is depressed to the kickdown position. Within limits preset in the transmission controls a downshift will occur. Kickdowns from 3rd to 2nd will occur below approximately 68 m.p.h. (109 k.p.h.). Kickdowns from 3rd, or 2nd, to 1st gear will occur below approximately 20 m.p.h. (32 k.p.h.).

ENGINE BRAKING

When descending steep hills, or in other circumstances requiring engine braking, use the foot brake to bring speed down to 60 m.p.h. (96 k.p.h.) or below. Move the selector lever to the L position; the transmission will immediately downshift to 2nd gear and thus provide engine braking. If the road speed is at or below approximately 16 m.p.h. (26 k.p.h.) when L position is selected the downshift will be directly from 3rd to 1st.

ROCKING THE CAR

If it becomes necessary to rock the car in order to remove it from mud, sand, snow, etc., hold the accelerator at a constant position to provide slight throttle opening. Rock the car backward and forward by alternately selecting the R and D2 positions.

STOPPING

To stop the car release the accelerator and apply the brakes. If the car is temporarily stopped for traffic lights, etc., the selector lever may be left in whatever forward range it is, but the foot or hand-brake should be applied to stop any tendency for the car to " creep."

PARKING

When the car is stationary select the P (Park) position and apply the handbrake.

Preparatory to restarting on a steep gradient, apply the brakes before disengaging P to prevent the car from rolling; disengagement of the parking pawl will be audible.

PUSH STARTING

It is possible to effect an engine start by pushing the car.

Select neutral, turn ignition to " on." Allow the car to attain a road speed of approximately 20 m.p.h. (32 k.p.h.) and hold the throttle approximately one-third open. Select D2 or L.

TOWING

The car may be towed with a dead engine in an emergency. Before towing be sure that the transmission fluid is at the correct level. Towing should be done with the transmission selector in the N position.

If the car is being towed because of transmission damage, the propeller shaft should be removed or towing should be done after lifting the rear wheels from the ground. Failure to observe this may result in further extensive transmission damage.

MAINTENANCE

It is most IMPORTANT that the following maintenance instructions are closely followed and absolute cleanliness is maintained when topping-up or filling the transmission.

It is **vitally important** when checking the fluid level that no dirt or foreign matter enters the transmission, otherwise trouble will almost certainly arise. Before removing the transmission dipstick, the surrounding area must be cleaned off to prevent dirt from entering the dipstick aperture. When filling the transmission with fluid ensure that the fluid container and funnel are perfectly clean.

In countries where ambient temperatures are unusually high, dust and/or mud must not be allowed to decrease the effective areas of the stoneguards in the converter housing or the slots in the transmission case. Also any foreign matter on the oil pan must be removed as it would act as a temperature insulator.

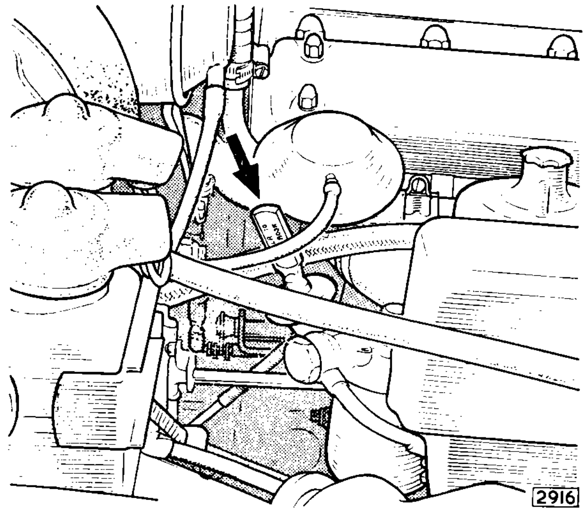


Fig. 9. Automatic transmission dipstick.

EVERY 3,000 MILES (5,000 KM.)

Check Transmission Fluid Level

The transmission filler tube is located on the right-hand side of the engine under the bonnet just forward of the bulkhead. Check the fluid level every 3,000 miles (5,000 km.).

Before checking the fluid level, the car should be on level ground and the transmission should be at the normal operating temperature.

Set the handbrake firmly and depress the foot brake. Select D1 position.

The engine should be at normal idle.

While the engine is running, remove the dipstick, wipe clean and replace in the filler tube in its correct position.

Withdraw immediately and check.

If necessary, add fluid to bring the level to the FULL mark on the dipstick. The difference between FULL and LOW marks on the stick represents approximately 1¼ pints (2 U.S. pints or 0·75 litres).

Be careful not to overfill.

If fluid is checked with the transmission cold, a false reading will be obtained and filling to the FULL mark will cause it to be overfilled.

If it is found necessary to add fluid frequently it will be an indication that there is a leakage in the transmission and it should be investigated immediately to prevent damage to the transmission.

Total fluid capacity (including cooler) 16 Imperial pints from dry (19 U.S. pints 9 litres).

Fluid Changing

The transmission fluid should be changed after the first 1,000 miles (1,600 km.) of operation. No periodic fluid changes are recommended except when other transmission service is necessary.

If the oil pan is removed for other service the fluid should be drained and replaced with fresh fluid.

RECOMMENDED AUTOMATIC TRANSMISSION FLUIDS

Mobil	Castrol	Shell	Esso	B.P.	Duckham	Regent Caltex/Texaco
Mobilfluid 200	Castrol T.Q.	Shell Donax T.6	Esso Automatic Transmission Fluid	Automatic Transmission Fluid Type A	Nolmatic	Texamatic Fluid

If these recommended lubricants are not available, only a transmission fluid conforming to the following specification should be used:—

Automatic Transmission Fluid, Type "A" or Type "A" Suffix "A"
(AQ—ATF)

Fluid Capacity

Automatic transmission unit (from dry):—
15 Imperial pints, 18 U.S. pints, 8½ litres.

ROAD TEST AND FAULT DIAGNOSIS

TESTING THE CAR

It is important to gain as much information as possible on the precise nature of any fault. In all cases the following road test procedure should be completely carried out, as there may be more than one fault.

Check that the starter will operate only with the selector in "P" and "N" and that the reverse light operates only in "R".

Apply the brakes and, with the engine at normal idling speed, select N-D, N-L, N-R. Transmission engagement should be felt in each position selected.

Check the engine stall speed (see converter diagnosis) with the transmission in "L" and "R". Check for slip or clutch break-away.

Note: Do not stall for longer than 10 seconds, or the transmission will overheat.

With the transmission at normal running temperature, select "D". Release the brakes and accelerate with minimum throttle opening. Check for 1 2 and 2-3 shifts.

Note: At minimum throttle opening the shifts may be difficult to detect. Confirmation that the transmission is in 3rd gear may be obtained by selecting "L", when a 3-2 downshift should be felt.

At just over 30 m.p.h. (48 k.p.h.), select "N", switch off the ignition and let the car coast. At 30 m.p.h. (48 k.p.h.) switch on the ignition and select "L". The engine should start through the rear wheels, indicating that the rear oil pump of the transmission is operating.

Stop and restart, using full-throttle acceleration, *i.e.* accelerator at the detent. Check for 1-2 and 2-3 shifts according to the shift speed chart.

At 26 m.p.h. (42 k.p.h.), in 3rd gear, depress the accelerator to full-throttle position. The car should accelerate in 3rd gear and should not down-shift to 2nd.

At 30 m.p.h. (48 k.p.h.), in 3rd gear, depress the accelerator to the kick-down position, *i.e.* through the detent. The transmission should down-shift to 2nd gear.

At 18 m.p.h. (29 k.p.h.), in 3rd gear, depress the accelerator to the kick-down position. The transmission should down-shift to 1st gear.

Stop and restart, using forced throttle acceleration (*i.e.* accelerator through the detent). Check for 1-2 and 2-3 shifts according to shift speed chart.

At 40 m.p.h. (64 k.p.h.), in 3rd gear, release the accelerator and select "L". Check for 3-2 down-shift and engine braking. Check for inhibited 2-1 down-shift and engine braking.

Stop, and with "L" still engaged, release the brakes and, using full throttle, accelerate to 20 m.p.h. (32 k.p.h.). Check for no slip or clutch break-away noise and no up-shifts.

Stop and select "R". Release the brakes and reverse, using full throttle if possible. Check for no slip or clutch break-away noise.

Stop on brakes facing downhill on gradient and select "P". Release the brakes and check that the parking pawl will hold the car. Re-apply brakes before disengaging the parking pawl. Repeat with car facing uphill.

Check that the selector is trapped by the gate in "Park" position.

At 30 m.p.h. (48 k.p.h.), in 3rd gear, D1, coast to a stop. Check roll out shifts for quality and speed in m.p.h. or k.p.h.

The front pump can be checked, with the selector in neutral, by revving the engine between idle and 2,000 r.p.m. A high pitched whine indicates a noisy front pump, a restricted front pump suction line, or a dirty oil screen.

At idle or slightly above idle speed in neutral, a gear whine indicates dragging front clutch plates. A tendency for the car to creep in neutral is a further indication of dragging front clutch plates. Check carefully, to avoid confusing this with front dump or engine noises.

PRESSURE TESTS

See " Throttle Cable Adjustment " section and ascertain correct adjustment of throttle cable and engine idle. The pressure gauge and tachometer are used to check transmission pressures, which should correspond to values given below.

Note Figures given in table are normal for transmission temperatures from 150° to 185°F only (65·5°C to 85°C).

Selector Position	Control Pressure Idle r.p.m.	Control Pressure Stall r.p.m.
D2	50–60	150–185
D1	50–60	150–185
L	50–60	150–185
R	50–60	190–210
N	55–60	—

Recording stall speed and stall pressures at the time the converter is being checked will reduce the overall stalling time, which should be kept to a minimum.

Pressures which have been recorded should be analysed as follows: Low pressure indicates leakage in the circuit tested. Low pressure in all selector positions would indicate leakage, faulty pump or incorrect pressure regulation. High pressures, in all selector positions, indicate faulty pressure regulation, incorrect cable adjustment or stuck valves.

FAULT DIAGNOSIS

Converter

If the general vehicle performance is below standard, check the engine stall speed with an accurate revolution indicator by applying maximum pressure on the foot brake pedal, selecting lock-up, and fully depressing the accelerator. If the engine stall speed is up to 300 r.p.m. below normal, the engine is not developing its full power.

Inability to start on steep gradients combined with poor acceleration from rest indicates that the converter stator one-way clutch is slipping. This condition permits the stator to rotate in an opposite direction to the turbine and torque multiplication cannot occur. Check the stall speed, and if it is more than 600 r.p.m. below normal the converter assembly must be renewed.

Below standard acceleration in 3rd gear above 30 m.p.h. (48 k.p.h.), combined with a substantially reduced maximum speed, indicates that the stator one-way clutch has locked in the engaged condition. The stator will not rotate with the turbine and impeller, therefore the fluid flywheel phase of the converter performance cannot occur. This condition will also be indicated by excessive overheating of the transmission, although the stall speed will remain normal. The converter assembly must be replaced.

Stall speed higher than normal indicates that the converter is not receiving its required fluid supply or that slip is occurring in the clutches of the automatic gearbox.

Note When checking stall speeds ensure that the transmission is at normal operating temperature. Do not stall for longer than 10 seconds, or the transmission will overheat.

The torque converters are sealed by welding and serviced by replacement only. No drain plug is provided as replenishment of fluid is not envisaged.

The stoneguards in the converter housing must be unobstructed.

Stall Speed Test

This test provides a rapid check on the correct functioning of the converter as well as the gearbox.

The stall speed is the maximum speed at which the engine can drive the torque converter impeller while the turbine is held stationary. As the stall speed is dependent both on engine and torque converter characteristics, it will vary with the condition of the engine as well as with the condition of the transmission. It will be necessary, therefore, to determine the condition of the engine in order to correctly interpret a low stall speed.

To obtain the stall speed, connect the tachometer to the engine and place it where it can easily be read from the driver's seat. Allow the engine and the transmission to attain normal working temperature, set the handbrake, chock the wheels and apply the foot brake. Select "L" or "R" and fully depress the accelerator. Note the reading on the revolution indicator.

NOTE: To avoid overheating, the period of stall test must not exceed 10 seconds.

R.P.M.	Condition Indicated
Under 1,000	Stator free wheel slip.
1,600–1,700	Normal.
Over 2,100	Slip in the transmission gearbox.

Air Pressure Checks

Air pressure may be used to test various transmission components in the car or on the bench. Care should be exercised when air pressure checks are being made to prevent blowing oil on the clothing or into the eyes.

Knowledge of various circuits should be acquired referring to Fig. 1. It is necessary to remove the valve body to complete these checks.

Apply air to the front clutch passage and the governor should click about the same time the clutch applies with different sounding click. Both front clutch and governor feed are on the same circuit.

Apply air to the rear clutch circuit and listen at the rear clutch to apply with a click.

Servo action may be watched as air is applied to apply circuits of each servo.

It can be assumed, that if air pressure checks indicate that clutches and servos are being applied normally with air pressure, then the trouble lies in the hydraulic system.

Clutch and Band Checks

To determine if a clutch or band has failed, without removing the transmission, is possible by following the procedure which follows: first study the chart showing the clutches or bands that are supposed to be applied in each gear ratio. Next shift to each ratio and determine if drive is obtained through the components in question. If a clutch or band functions in one selector position it is reasonable to assume that the element in question is normal and that trouble lies elsewhere. If the clutch or band is tried in two positions and no drive is obtained in either position, it can be assumed that the element in question is faulty. See table below; in all cases output is through the ring gear.

KEY TO THE FAULT FINDING CHART

1. Preliminary Checks in Car

A. Low fluid level.

B. Throttle cable incorrectly assembled oı adjusted.

C. Manual linkage incorrectly assembled or adjusted.

D. Engine idle speed.

E. Front band adjustment.

F. Rear band adjustment.

2. Hydraulic Faults

a. Oil tubes missing or broken.

b. Sealing rings missing or broken.

c. Valve body screws missing or not correctly tightened.

d. Primary valve sticking.

e. Secondary valve sticking.

f. Throttle valve sticking.

g. Compensator or modulator valve sticking.

h. Governor valve sticking, leaking or incorrectly assembled.

i. Orifice control valve sticking.

j. 1-2 shift valve sticking.

k. 2-3 shift valve sticking.

l. 2-3 shift valve plunger sticking.

m. Regulator.

3. Mechanical Faults

1. Front clutch slipping due to worn plates or faulty parts.
2. Front clutch seized or plates distorted.
3. Rear clutch slipping due to worn or faulty parts.
4. Rear clutch seized or plates distorted.
5. Front band slipping due to faulty servo, broken or worn band.
6. Rear band slipping due to faulty servo, broken or worn band.
7. One-way clutch slipping or incorrectly installed.
8. One-way clutch seized.
9. Broken input shaft.
10. Front pump drive tangs on converter hub broken.
11. Front pump worn.
12. Rear pump worn or drive key broken.
13. Converter blading and/or one-way clutch failed.
14. Front pump.
15. Parking linkage.
16. Planetary assembly.
17. Fluid distributor sleeve in output shaft.
18. Oil cooler and connections.
19. Rear pump.

FAULT DIAGNOSIS

	In Car	On Bench
ENGAGEMENT		
Harsh	B, D, c, d	2, 4
Delayed	A, C, D, E, F, a, c, d	b
None	A, C, a, c, d	b, 9, 10, 11, 13
No forward	A, C, a, c, d	B, 1, 4, 7
No reverse	A, C, F, a, c, j, k, h	b, 2, 3, 6
Jumps in forward	C, D, E, F	4, 7, 8
Jumps in reverse	C, D, E	2
No neutral	C, c	2
UPSHIFTS		
No. 1-2	C, E, a, c, d, f, g, h, j	b, 5, 17
No. 2-3	C, a, c, d, f, g, h, k, l	b, 3, 17
Shift points too high	B, C, c, d, f, g, h, j, k, l	b
Shift points too low	B, c, f, g, h, l	b
UPSHIFT QUALITY		
1-2 slips or runs up	A, B, C, E, a, c, d, f, g, k	b, 1, 5
2-3 slips or runs up	C, a, c, d, f, g, h, k, l	b, 3, 5
1-2 Harsh	B, C, E, c, d, f, g, h	1, 7, 8
2-3 Harsh	B, C, E, c, d, f	4
1-2 Ties up or grabs	F, c	4, 7, 8
2-3 Ties up or grabs	E, F, C	4
DOWNSHIFTS		
No. 2-1	B, C, c, h, j	7
No. 3-2	B, c, h, k	4
Shift points too high	B, C, c, f, h, j, k, l	b
Shift points too low	B, C, c, f, h, j, k, l	b
DOWNSHIFT QUALITY		
2-1 Slides		7
3-2 Slides	B, C, E, a, c, d, f, g	b, 3, 5
2-1 Harsh		b, 1, 7
3-2 Harsh	B, E, c, d, f, g, 5	3, 4, 5
REVERSE		
Slips or chatters	A, B, F, d, c, g	b, 2, 3, 6
LINE PRESSURE		
Low idle pressure	A, C, D, a, c, d	b, 11
High idle pressure	B, c, d, e, f, g	
Low stall pressure	A, B, a, c, d, f, g, h	b, 11
High stall pressure	B, c, d, f, g	

FAULT DIAGNOSIS (continued)

	In Car	On Bench
STALL SPEED		
Too low (200 r.p.m. or more)		13
Too high (200 r.p.m. or more)..	A, B, C, F, a, c, d, f	b, 1, 3, 6, 7, 9, 13
OTHERS		
No push starts	A, C, E, F, c	12
Transmission overheats..	E, F, e	1, 2, 3, 4, 5, 6, 13, 18
Poor acceleration		13
Noisy in neutral	m	2, 4
Noisy in park	m	14
Noisy in all gears	m	2, 4, 14, 16
Noisy during coast (30–20 m.p.h.)		16, 19
Park brake does not hold	C, 15	15

THROTTLE CABLE ADJUSTMENT

(See Fig. 10)

The importance of correct throttle cable adjustment cannot be over-emphasised. The shift quality and correct shift points are controlled by precise movement of the cable in relation to the carburetter throttle shaft movement.

Install a pressure gauge (BW1A) in the line pressure point at the left-hand side of the case accessible through a cover plate in the side of the transmission cowl. Use a pressure gauge with 0–200 lb./sq. in. range (0–14 Kg./cm.^{2}). Couple up an independent tachometer (Churchill Tool No. 642) and allow the car to reach normal operating temperature before attempting the adjustment. Do NOT use the car revolution counter for this check.

Set the handbrake and place the manual selector in D1 or D2 position.

Increase engine speed (while this is done also set the handbrake and hold the foot brake) until the tachometer reads 1,250 r.p.m. If the cable adjustment is correct, the line pressure gauge should read 72·5 $\pm$ 2·5 lb./sq. in. (5·097 $\pm$ ·176 kg./cm.^{2}) at this point. Adjustment, if necessary, is made at the end of the cable nearest the carburetters. With the carburetters at the hot idle position remove the cable from the lever by pulling the pin from the clevis. Next back off the locknut under the clevis. Pull the cable as far as it will go and holding it out, adjust the clevis by turning it further on to the cable or further off as required to the point where the clevis pin will just pass freely through the lever and the fork of the clevis. This is intended as a zero cable adjustment. From this point, unscrew the clevis approximately two full turns and temporarily recouple the clevis to the carburetter lever. If a recheck shows that the pressure at 1,250 r.p.m. is still not correct, change the cable length by screwing the clevis on or off in half turn increments until satisfactory pressure reading has been obtained.

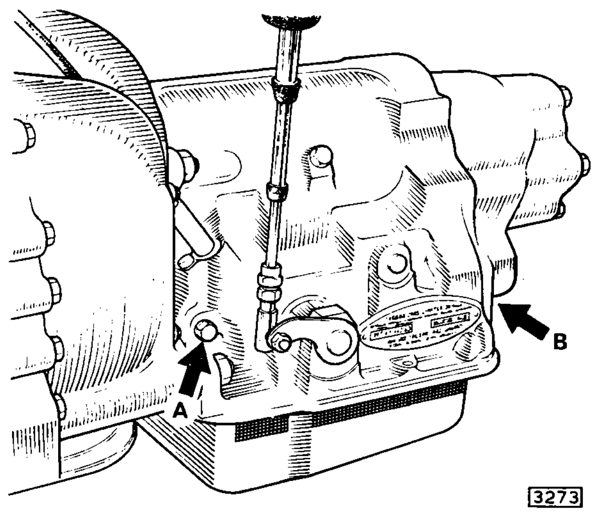


Fig. 10. Transmission pressure take-off point.

Screwing the clevis in the direction to lengthen the cable will increase the line pressure reading at 1,250 r.p.m. and turning it in the other direction (shortening the cable) will decrease the reading. After correct adjustment has been obtained, be sure to tighten the locknut behind the clevis.

One turn of the clevis is equal to approximately 9 lb./sq. in. (·633 kg./cm.^{2}).

Note: If the engine is removed and replaced the above check must be carried out.

MANUAL LINKAGE ADJUSTMENT

(See Fig. 11)

Place the selector lever in the D2 indicator position on the steering column (an assistant will be required to hold the lever in this position). Underneath the car at the gearbox selector lever, loosen the linkage cable locknut and remove the cable from the selector lever. Place the gearbox lever in the D2 detent position. This is most easily accomplished by moving the lever all the way to Lockup position and then moving back two detent positions. Adjust the cable end to fit freely onto the gearbox lever. Temporarily re-attach the cable to the lever. Next move the selector lever at the column through the various positions, checking that the indicator points to the correct selection. Check very carefully that the gating at L, R and P positions does not interfere with the gearbox lever setting at the detent positions. Always keep in mind that for correct operation, the gearbox detents must locate the gearbox lever positively. Once correct adjustment is established, be sure the linkage cable is secured to the gearbox lever and the locknut is tightened.

REMOVAL OF OIL PAN

Prior to front band adjustment or a check of internal parts the gearbox fluid must be drained and the oil pan removed. When this is done an inspection should be made. A few wear particles in the dregs of the fluid in the pan are normal. An excess of wear particles, whether ferrous or non-ferrous metal, or pieces of band lining material, would indicate that further checking should be done. A new gasket should be used when refitting the pan and the 14 attaching screws torqued to 10–15 lb. ft. (1·382–2·073 Kgm.). Always use fresh fluid when refilling.

FRONT BAND ADJUSTMENT

(See Fig. 12)

The front band should be adjusted after the 1,000 miles (1,600 km.) of operation and at 21,000 miles (35,000 km.) intervals thereafter.

Drain the oil by removing the oil filler connection and remove the oil pan. Loosen the adjusting screw locknut on the servo, apply lever and check that the screw turns freely in the lever. Install a ¼″ (6·4 mm.) thick gauge block between the servo piston pin and the servo adjusting screw, then tighten the adjusting screw with a suitable torque wrench or

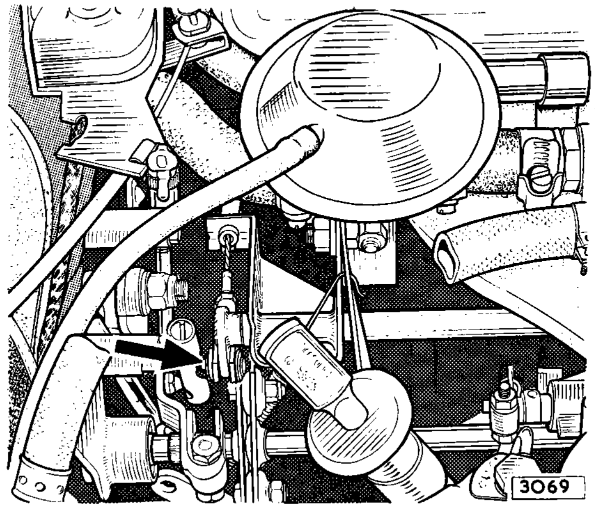


Fig. 11. Kickdown cable adjustment.

adjusting tool until 10 lb. ins. (0·12 Kgm.) is reached. Retighten the adjusting screw locknut to 20–25 lb. ft. (2·76–3·46 Kgm.). Remove the ¼″ (6·3 mm.) spacer.

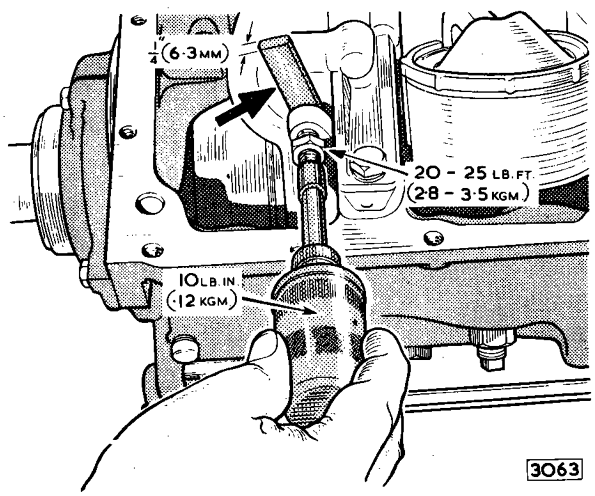


Fig. 12. Front band adjustment.

REAR BAND ADJUSTMENT

The rear band adjustment at 21,000 miles (35,000 km.) intervals is made externally, thus there is no need to remove the oil pan. To make the adjustment first loosen and back off the adjusting screw locknut three or four turns and then make sure that the adjusting screw works freely in the threads in the case. Turn the adjusting screw in with a torque wrench or special tool for this purpose to 10 lb. ft. (1·382 Kgm.) torque reading. Back the adjusting screw off $1\frac{1}{2}$ turns exactly, then retighten the locknut to 35–40 lb. ft. (4·84–5·53 Kgm.). The adjusting screw is on the right-hand side of the casing and an access hole is provided in the transmission cowl.

GOVERNOR

The governor can be inspected without removal of the oil pan. Remove the inspection cover and gasket. This will expose the governor, but the output shaft may have to be turned to position governor head at the opening. First check for freedom of the valve by pushing and pulling on the governor weight. If removal of the governor body is desired, take out the two screws which retain it, being careful that they are not dropped inside the extension housing. After removal of the body, dismantle it completely and clean all the parts. When reassembling the governor, torque the governor body plate screws to 20–30 lb. in. (0·24–0·36 Kgm.). When replacing the governor body on to the transmission, torque the screws which retain it to 50–60 lb. in. (0·60–0·72 Kgm.). Replace the governor inspection cover, using a new gasket and torque its retaining screws to 50–60 lb. in. (0·60–0·72 Kgm.).

It should be noted that if any of the four governor screws mentioned above are loose, the governor will not function correctly.

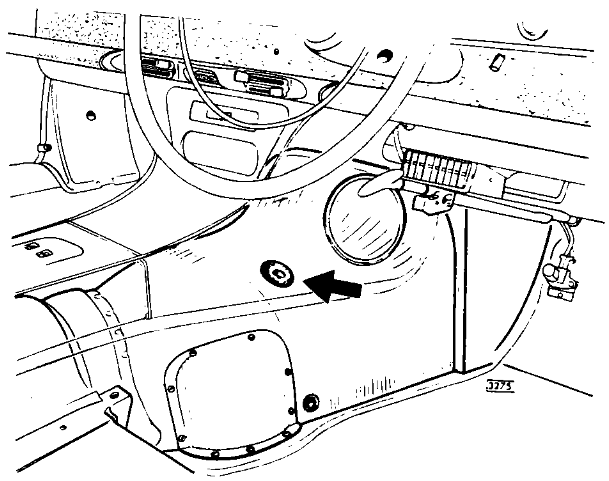


Fig. 13. Rear band adjustment. Access to the rear band adjuster is by way of the grommetted hole indicated by the arrow. It is first necessary to remove the console (for removal instructions see Section N).

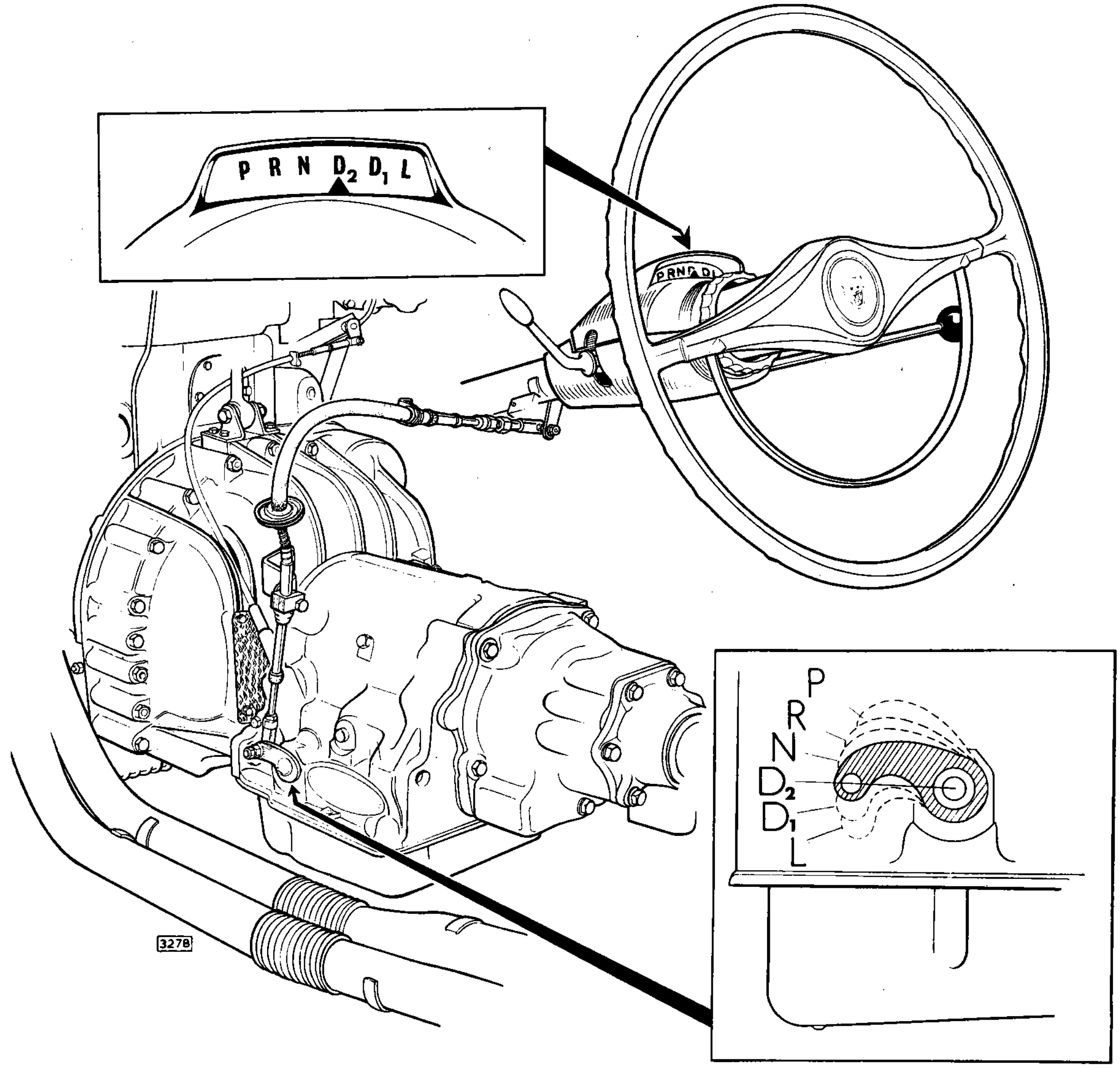


Fig. 14. Manual selector linkage adjustment.

TRANSMISSION—REMOVAL AND REFITTING

TRANSMISSION DISMANTLING AND ASSEMBLY

TRANSMISSION—REMOVAL AND REFITTING

To remove the transmission unit the engine can either be (A) removed from the car as a unit or (B) raised from the mountings at an angle of approximately 45°. Method "A" must be used if a transmission hoist is not available.

Method "B" can be used if a transmission hoist is available.

REMOVAL

Disconnect the battery.

Remove the bonnet.

Drain the engine sump.

Release the filler cap and drain the cooling system by turning the radiator tap remote control and the cylinder block drain tap. Conserve the coolant if an anti-freeze is in use.

Remove the water drain plug from the automatic transmission oil cooler beneath the radiator.

Release the hose clips and disconnect all hoses connecting the radiator and oil cooler to the engine and header tank (if air conditioning equipment is fitted).

Remove the radiator top sealing strip (if air conditioning equipment is fitted).

Remove the two bolts, nuts and washers securing the top of the radiator.

Remove the two self-locking nuts and washers securing the bottom of the radiator to the sub-frame. Collect the mounting rubbers.

Remove the radiator; care must be taken to ensure that the fan blades do not foul the radiator.

Release the clip on the air cleaner and detach the flexible pipe from the air cleaner to the carburetter air intake. Remove the plastic strap securing the coil H.T. lead to the flexible pipe.

Disconnect the fuel feed pipe from the front end of the fuel feed line filter.

Disconnect the H.T. lead from the centre of the coil on the right-hand wing valance.

Disconnect the cables from the alternator. Note the location of the cables for reference when refitting.

Disconnect the engine harness line plug and socket located on the right-hand wing valance.

Slacken the clip and remove two water hoses from the connections at the right-hand side of the heater unit.

Slacken the clip and remove the brake vacuum reservoir pipe from the rear of the carburetter manifold.

Remove three bolts and self-locking nuts and disconnect the carburetter throttle shaft from the control lever shaft.

Remove the rubber pipe from the heater water tap vacuum unit.

Disconnect the two vacuum pipes from the check valve on the heater vacuum reservoir situated on the right-hand wing valance.

Disconnect the throttle lever return spring from the engine.

Disconnect the cables from the revolution counter gearbox.

Disconnect the compressor clutch unit cable and remove the compressor if air conditioning equipment is fitted. Tie the unit away from the engine.

Warning: Do NOT disconnect the pipe unions from the compressor. Disconnecting these unions will necessitate recharging the system when refitting.

Remove the eight brass nuts securing the exhaust pipe flanges to the manifold and the bolt, nut and washer securing the pipe support bracket to the bell housing. Disconnect the exhaust pipes and collect the sealing rings.

Disconnect the earth strap at the left-hand front end of the sump.

Disconnect and remove the top horn.

From inside the car detach the console after removing the four thumb nuts and the two set-screws and nuts securing the console to the parcel tray.

Remove the nut securing the selector cable ball joint pivot pin to the selector lever on the steering column.

Release the two locknuts and withdraw the selector outer cable from the bulkhead bracket.

From underneath the car, unscrew the oil filter canister bolt, withdraw the canister and filter element. Disconnect the speedometer cable from the angle drive gearbox.

Withdraw the transmission unit dipstick, detach the filler tube from the transmission sump and drain the oil into a clean container.

Disconnect the battery cable from the starter motor.

Disconnect the oil cooler pipes from the oil cooler beneath the radiator and the transmission unit.

Place a jack under the engine rear mounting and remove the four setscrews, spring and oval washers securing the mounting to the body. Lower the jack slowly to relieve the tension on the mounting spring.

Remove the mounting and spring ensuring that the four square packing pieces between the mounting and the body are not misplaced.

Remove the four propeller shaft securing nuts and disconnect the universal joint from the transmission unit companion flange.

Sling the engine from the two loops between the cylinder head studs.

Note: If a single block and tackle only is available, position the hook above the front loop.

Remove the engine front mounting bolts.

Remove the self-locking nut and stepped washer from the stabilizer between the rear of the cylinder head and the bulkhead.

Lower the rear of the engine until the stabiliser bolt can be withdrawn.

Position the transmission hoist, if available, beneath the transmission unit.

Raise the front of the engine and lower the rear until the unit is supported on the hoist.

Remove the split pin, washers and joint pin, detach the outer cable from the support bracket and disconnect the kick-down cable from the operating shaft.

Remove the four setscrews and washers and withdraw the unit from the bell housing.

Place a clean tray beneath the torque converter to catch the oil which will drain away as the unit is removed.

If the engine is to be removed as a unit, support the engine on the lifting tackle, insert a trolley jack under the front of the car and support the transmission unit, having placed a piece of wood between the jack and the unit sump.

Remove the engine front mounting bolts, remove the self-locking nut and stepped washer from the stabiliser between the rear of the cylinder head and the bulkhead.

Lower the rear of the engine on the jack until the stabiliser can be withdrawn.

Raise the front of the engine on the lifting tackle, lower the rear on the jack and withdraw the engine forwards.

Ensure that the oil feed pipe to the camshafts at the rear of the cylinder head is not damaged and ensure that the ignition timing pointer at the front of the sump does not come into contact with the front body cross member.

REFITTING

Refitting is the reverse of the removal procedure.

Check the "Throttle Cable Adjustment" and the setting of "Manual Linkage" as described on Page 28.

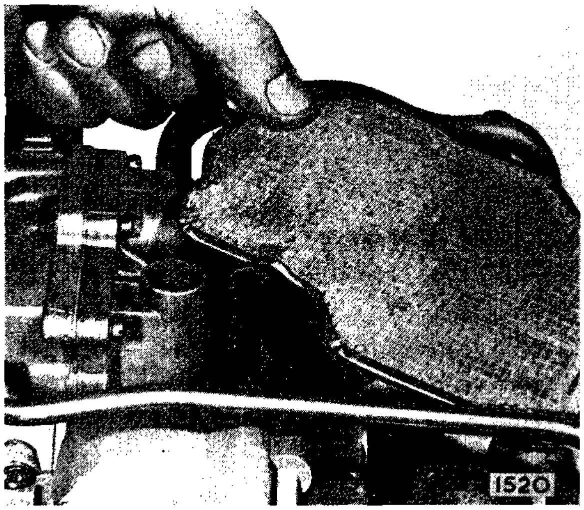


Fig. 15. Removing the screen from the rear suction tube.

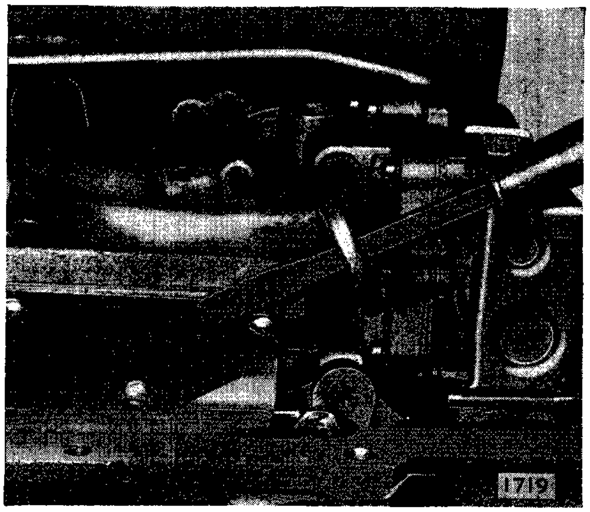


Fig. 16. Removing the compensator tube.

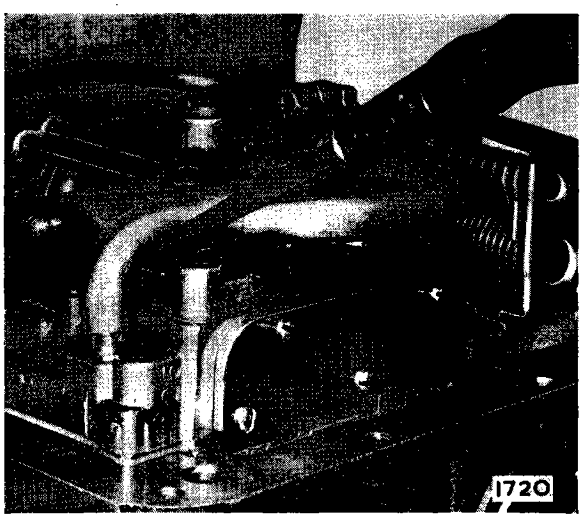


Fig. 17. Removing the line pressure tube.

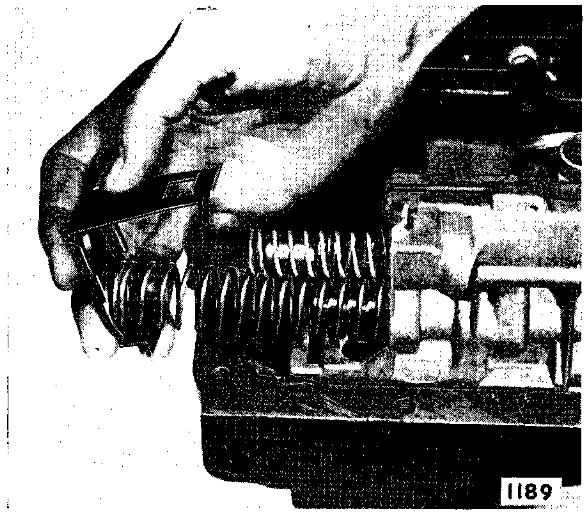


Fig. 18. Removing the pressure spring retainer.

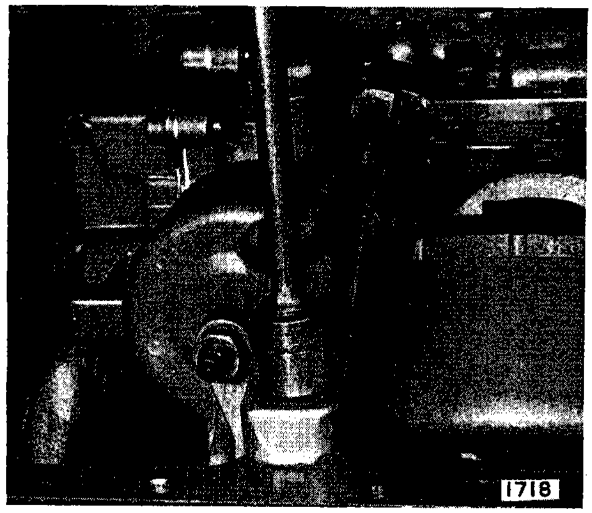


Fig. 19. Slackening the front servo screw.

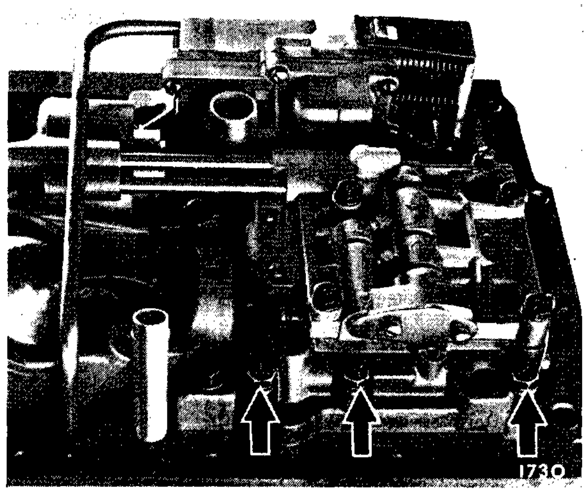


Fig. 20. Removing the valve body attaching capscrews.

TRANSMISSION
DISMANTLING AND ASSEMBLY

TRANSMISSION—DISMANTLING

Dismantling should not begin until the transmission exterior and work area have been thoroughly cleaned.

Place the transmission (bottom side up) on a suitable stand or holding fixture.

Remove the oil pan bolts, oil pan and oil pan gasket.

Remove the oil screen retaining clip, lift the oil screen off the regulator; then lift and remove the screen from the rear pump suction tube. (Fig. 15).

Use a screwdriver to pry the compensator tube from the valve body and regulator assemblies. (Fig. 16).

The control pressure tube should be prised from the valve body, then removed from the regulator. (Fig. 17).

Remove the rear pump suction tube by pulling and twisting it at the same time.

Carefully remove the pressure regulator spring retainer. Maintain pressure on the retainer to prevent distortion of the retainer, and sudden release of the springs. (Fig. 18).

Remove springs and spring pilots, but do not remove the regulator valves at this time. The valves will be protected as long as they remain in the regulator body.

Remove the two regulator attaching capscrews and lockwashers, then lift the regulator assembly from the transmission case. (Fig. 19).

Loosen the front and rear servo adjusting screw locknuts and adjusting screws. This will aid in dismantling, and later in assembling, the transmission.

Remove the three valve body attaching capscrews and lockwashers. (Fig. 20).

Loosen the front servo to case capscrew and lockwasher approximately ($\frac{5}{16}$"7·94 mm.).

Place the manual selector lever in park or reverse position. Lift the valve body until the throttle control rod will clear the manual detent lever, then remove the hook from the throttle cam using the index finger or a screwdriver.

Lift the valve body and servo until the valve body will clear the linkage and slide it off the servo apply and release tubes. (Fig. 21).

Remove the front servo apply and release tubes. (Fig. 22).

Remove the front servo bolt and lift the servo from the transmission catching the servo strut with the index and middle finger of the left hand. (Fig. 23).

Remove the two rear servo attaching capscrews and lockwashers, then lift the rear servo assembly from the transmission. (Fig. 24).

Remove the rear band apply and anchor struts.

Remove the rear pump outlet tube, using special extractor tool Part No. WG. 45

Check the end play at this time. Should the end play need correcting it will be done during assembly of the transmission.

Check End Play. Place an indicator against the end of the input shaft. Pry between the front of the case and the front clutch to move clutch assemblies to their extreme rearward position. Set the indicator to "0." Pry between the planet carrier and the internal gear with a screwdriver to move the clutches to their extreme forward position. Read the end play on the indicator. The allowable limits are 0·008"–0·044" (0·2–1·1 mm.). It is preferable to have approximately 0·020" (0·5 mm). Should correction be necessary, remove the output shaft, extension housing, and companion flange as an assembly so that the selective washer can be changed. Selective thrust washers are available in the following thicknesses:

0·061"– 0·063"	0·074"– 0·076"	0·092"– 0·094"
(1·53–1·58 mm.)	(1·85–1·90 mm)	(2·3–2·35 mm.)
0·067"– 0·069"	0·081"– 0·083"	0·105"– 0·107"
(1·68–1·73 mm.)	(2·03–2·08 mm.)	(2·63–2·68 mm.)

Place the shift selector in park position to hold the output shaft, then remove the companion flange nut, lockwasher, flat washer and flange.

Remove the bearing retainer capscrews, the bearing retainer and the bearing retainer gasket.

Slide the speedometer drive gear off the output shaft.

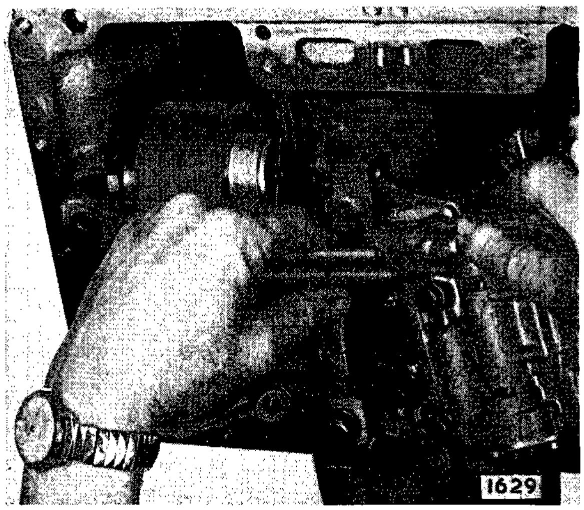


Fig. 21. Lifting the valve body to clear the front servo.

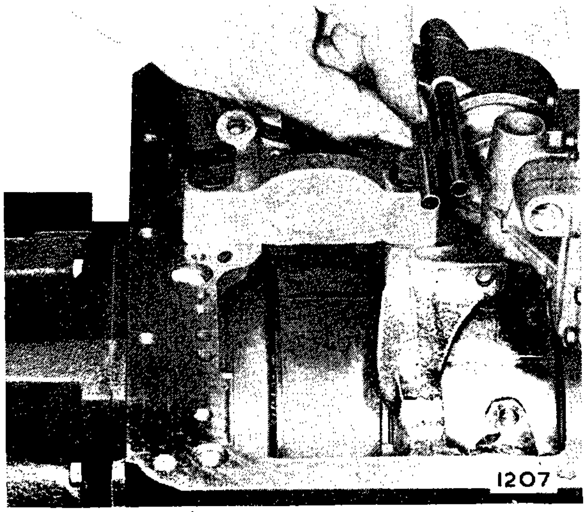


Fig. 22. Withdrawing the apply and release tubes.

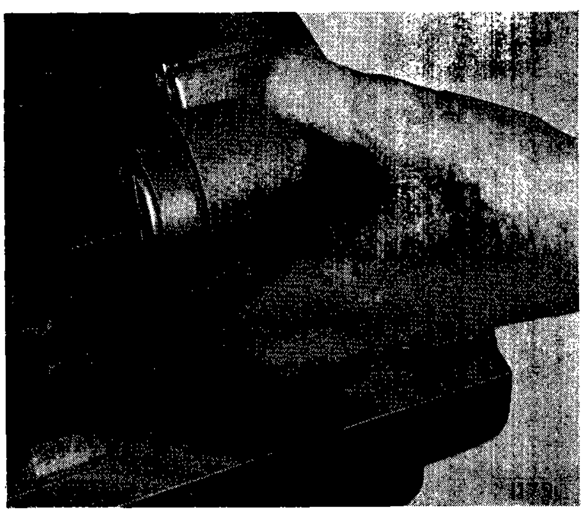


Fig. 23. Removing the front servo.

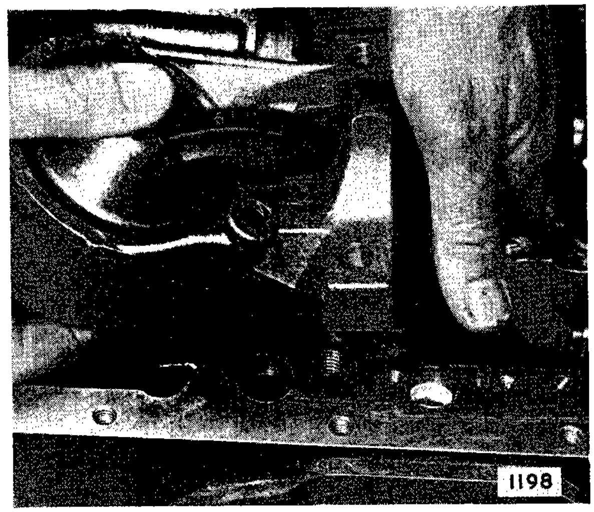


Fig. 24. Removing the rear servo.

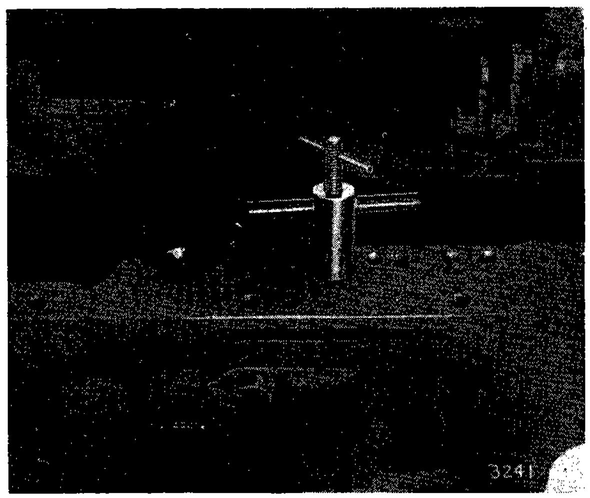


Fig. 25. Removing the rear pump outlet tube (Extractor Tool Part No. CWG 45).

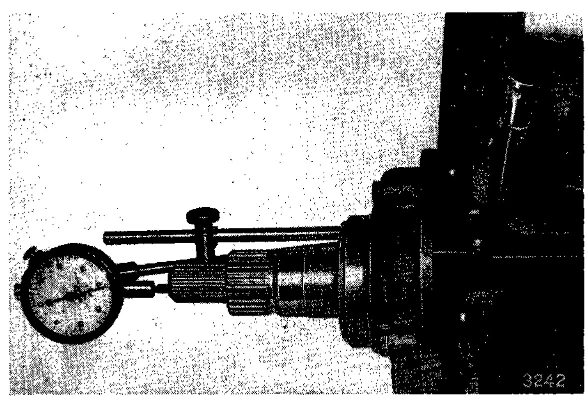


Fig. 26. Checking end play.

Remove the governor inspection cover and gasket.

Remove the five extension housing capscrews and remove the output shaft and extension housing assembly.

Remove the two hook type seal rings from the rear of the primary sun gear shaft. (Fig. 26).

Remove the selective thrust washer from the rear of the planet carrier. (Fig. 27).

Pull the planet carrier from the transmission. (Fig. 28).

Pull the rear band through the rear opening of the transmission. Hold the two ends of the band together with the left hand while pulling rearward through the rear of the case with the right hand. (Fig. 29).

Remove the two centre support bolts; one from each side of the case. (Fig. 30).

Remove the centre support, push on the end of the input shaft to start the rearward movement of the centre support.

Remove the front and rear clutch assemblies, placing them in a suitable stand for dismantling, Fig. 30. (The planet carrier can be used as a stand for dismantling and assembling the clutches).

Remove the front band (up and out of the case).

Remove the front pump oil seal. Use a seal puller or a punch.

Remove the four front pump attaching capscrews and lift off the front pump. (Fig. 32).

Remove the front pump oil seal ring from the case.

Front Pump

Remove the stator support attaching screw and remove the stator support (Fig. 33). Mark the top of the internal and external gears with marking ink or a crayon. Lift the gears from the pump body.

Inspect the pump body, the internal and external tooth gears, and stator support for scores, scratches and excessive wear.

Minor scratches and scores can be removed with crocus cloth or jeweller's rouge. However, parts showing deep scratches, scores or excessive wear should be replaced. If excessive wear or scoring is observed, replace the complete pump assembly (since the gears and body are carefully matched when built, these parts should not be interchanged or individually replaced).

Drive a new seal into the pump body until it bottoms.

Lubricate all pump parts with transmission fluid before assembly. Install the internal and external gears in the pump body with marks previously made in the upward position. Insert the stator support on the pump body and install the retaining screw. Torque the screw to 25–35 lb. in. (0·29–0·40 Kgm.). Check the gears for free movement.

Manual Linkage—Dismantling

Pull the retainer clip from the forward end of the linkage rod. (Fig. 34). Disconnect the rod from the manual valve detent lever. Release the detent ball and spring by rocking the manual valve lever to the extreme end of its travel. (Fig. 35). The ball will be released with considerable force, but can be caught in a shop towel or even in the hands. Remove the manual lever locknut, the manual valve detent lever, and then pull the manual control lever from the transmission. Prise the manual lever oil seal from the transmission case with a screwdriver.

Manual Linkage—Assembling

Install a new manual lever oil seal. Assemble the manual control lever through the transmission case boss. Place the manual valve detent lever and locknut on the manual control lever shaft. Rock the manual valve lever to its extreme travel, then install the detent spring. Place the ball in position on the spring, then using the lubrication tube to depress the ball and spring, rock the manual valve lever back over the ball and spring. Connect the linkage rod and insert the retainer spring clip.

Park Linkage—Dismantling

Pull the retainer clip from the rear of the parking brake linkage rod. Disconnect the linkage rod from the torsion lever. Remove the retainer spring from the torsion lever pin and slide the washer with the torsion lever off the pin. Tap the toggle lever rearward to loosen the pin retainer, then pull the retainer using snap ring pliers. (Fig. 36). The toggle lever pin and toggle lever can now be removed. (Fig. 37). A magnet may be used to pull the parking pawl anchor pin from the transmission case. The parking pawl is now free to be removed.

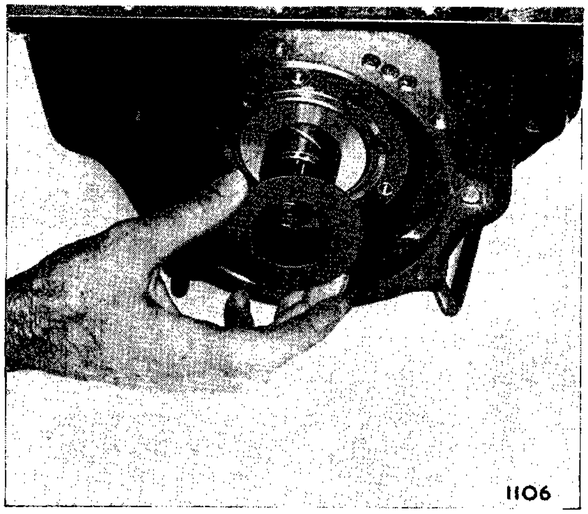


Fig. 27. Removing the selective thrust washer.

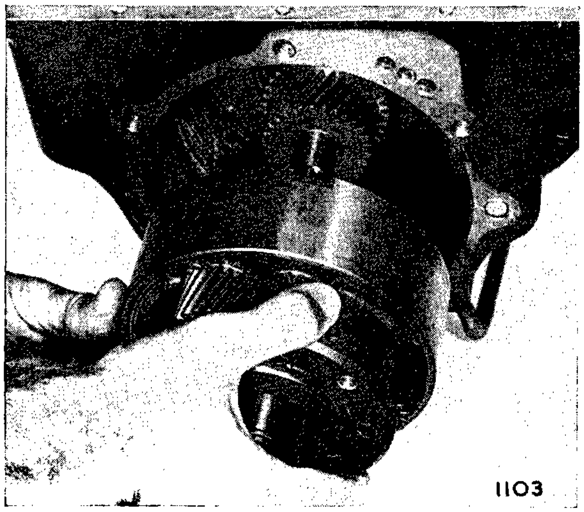


Fig. 28. Removing the planet carrier.

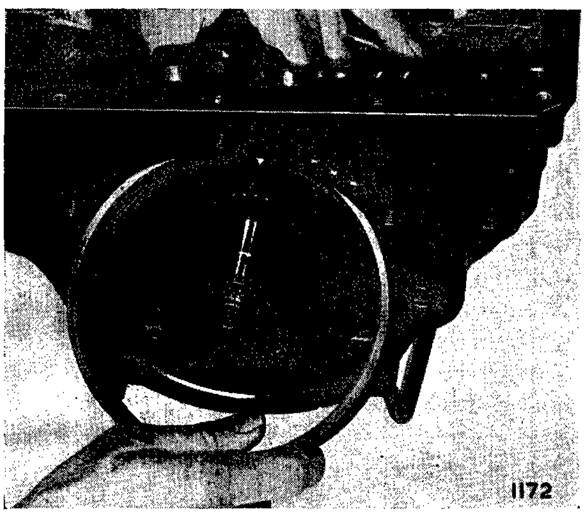


Fig. 29. Removing the rear band.

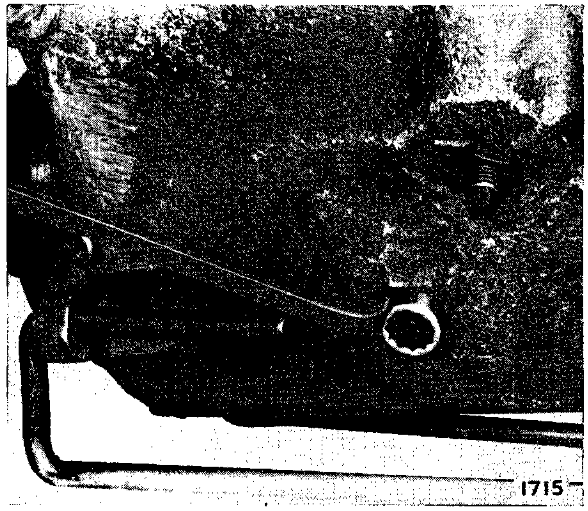


Fig. 30. Removing one of the centre support bolts.

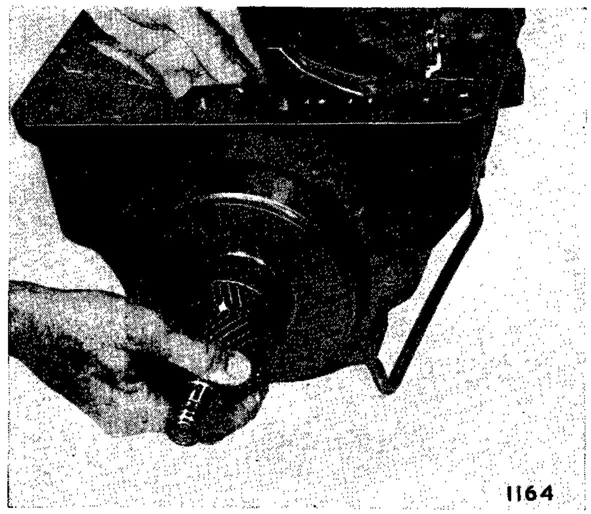


Fig. 31. Removing the clutch assemblies.

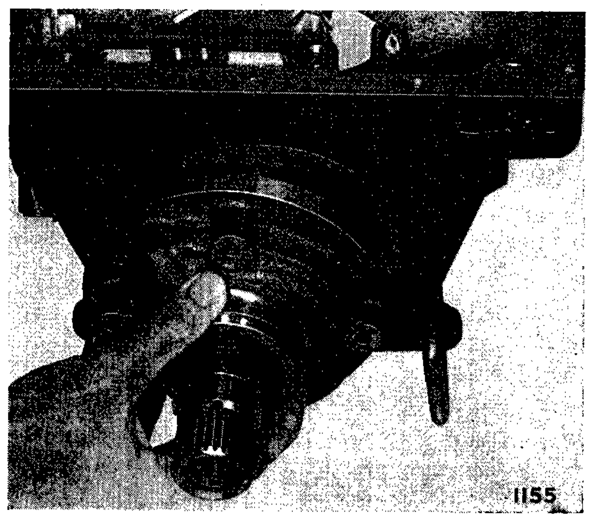


Fig. 32. Removing the front pump.

Parking Linkage—Assembling

Assemble the parking pawl and shaft. Use a new toggle lever retainer to assemble the toggle lever and toggle pin. Assemble the torsion lever on the torsion lever pin, then the washer, and then place the retainer spring on the torsion lever pin. Connect the linkage rod to the torsion lever and insert the spring clip.

Clutches—Dismantling

Place the clutch pack in a suitable stand. The planet carrier will work very well for this purpose.

Lift the complete front clutch assembly from the rear clutch and forward sun gear.

Remove the snap ring and lift the input shaft from the clutch cylinder. (The clutch hub thrust washer may stick to the input shaft.)

Lift the clutch hub and thrust washer from the clutch assembly.

Lift the front clutch plates and the pressure plate from the assembly.

Remove the clutch return spring snap ring and then the return spring. It is not necessary to compress this spring to remove the snap ring.

Compressed air applied to the clutch feed hole in the clutch hub will force the piston from the clutch cylinder. (Fig. 38).

Remove the rubber seal rings from the clutch hub and clutch piston.

Remove the two front clutch sealing rings from the forward sun gear shaft. (Fig. 40).

Remove the thrust washer and thrust plate from the shoulder of the rear clutch hub.

Lift the rear clutch assembly up and off the forward sun gear shaft.

Remove the rear clutch ring.

Remove the clutch pressure plate and the clutch plates.

Use the service tool to compress the clutch return spring, then remove the spring retainer snap ring. Release the spring, but do not permit the spring retainer to catch in the snap ring groove as the spring is being released. (Fig. 41).

Replace the forward sun gear shaft in the clutch hub, being careful not to break the cast iron sealing rings. The clutch piston can now be removed from the clutch cylinder by blowing compressed air through the rear clutch passage of the forward sun gear.

Remove the forward sun gear from the clutch cylinder and remove the two rear clutch sealing rings from their grooves in the shaft.

Remove the rubber seal rings from the clutch hub and the clutch piston.

Inspection of Clutches

Inspect all parts for burrs, scratches, cracks and wear. Check all the front clutch plates and the rear clutch friction plates for flatness. Check the rear clutch steel plates for proper cone. Lay plates on a flat surface when checking for flatness and cone. Cone should be 0·010″ to 0·020″ (0·25 to 0·5 mm.). Replace friction plates when wear has progressed so that the grooves are no longer visible. Replace all warped plates. Replace complete sets of steel or friction plates in any clutch. Do not replace individual plates. (Fig. 42).

Inspect the band surface of the front drum for scores. Inspect the clutch bushing and the needle bearing for wear and brinelling and for scores. The cast iron sealing rings are normally replaced. If the transmission is being rebuilt and has had little service, the rings may be re-used if they have not worn excessively and are not scratched or distorted.

Inspect the forward sun gear for broken or worn teeth. Inspect all journals and thrust surfaces for scores. Inspect all fluid passages for obstruction or leakage. Inspect the front clutch lubrication valve for freedom.

Clutches—Assembling

Place the planet carrier on the assembly bench. The carrier will be used as a stand to hold the clutch assemblies.

Place the forward sun gear in the carrier. Be sure thrust washer is on the shaft. (Fig. 43).

Assemble the rubber "O" ring in its groove on the rear clutch hub. (Fig. 44).

Assemble the square section rubber seal ring in its groove on the rear clutch piston. (Fig. 45).

Assemble the clutch piston in the rear clutch cylinder using Tool Part No. CWG. 41 to force it into position. Be sure to lubricate the seal rings so that they will assemble easier.

Place the rear clutch return spring and spring retainer in position on the clutch piston. The rear clutch spring fixture is then used to compress the spring, then the snap ring is assembled in its groove in the clutch.

Fig. 33. Removing the attaching set screw.

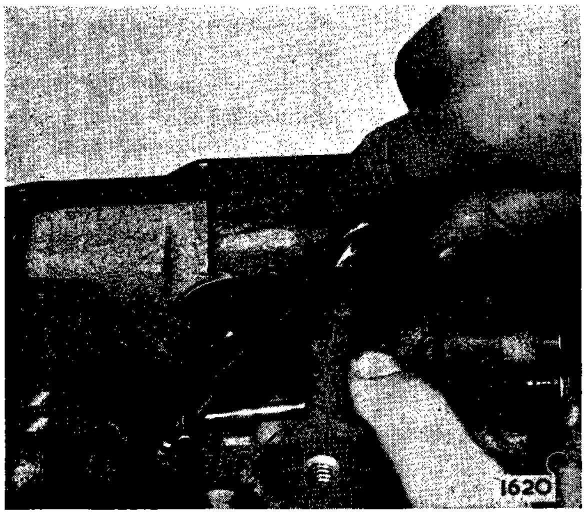


Fig. 34. Removing the retainer clip from the linkage rod.

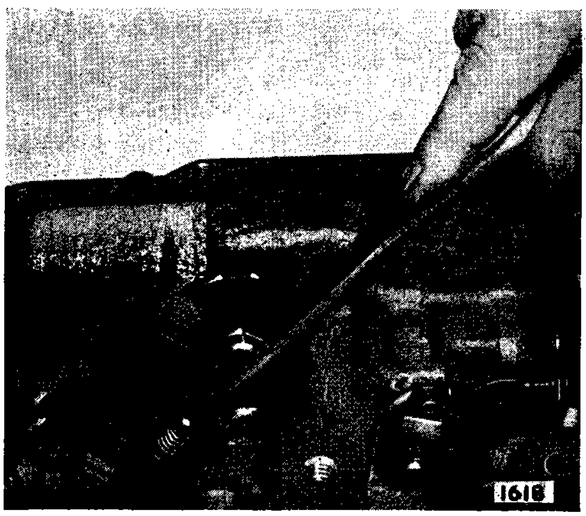


Fig. 35. Releasing the "detent" ball.

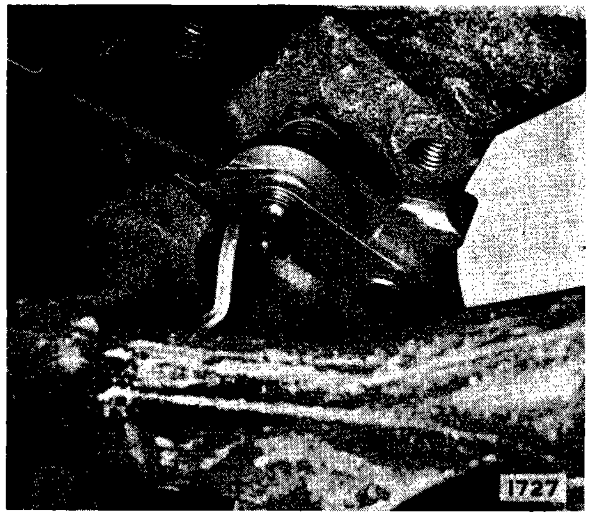


Fig. 36. Tapping the toggle lever rearwards.

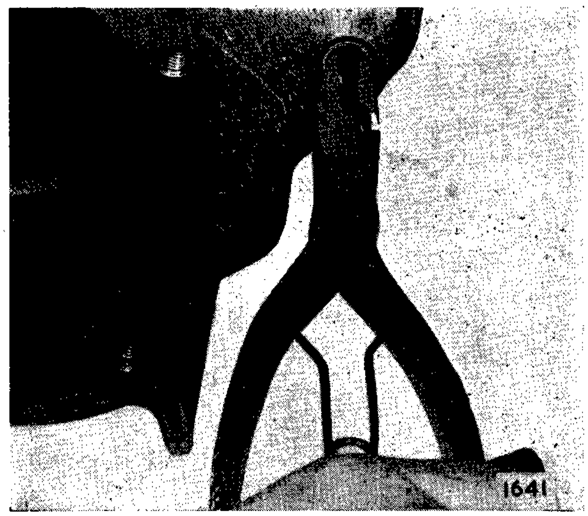


Fig. 37. Removing the toggle lever pin retainer.

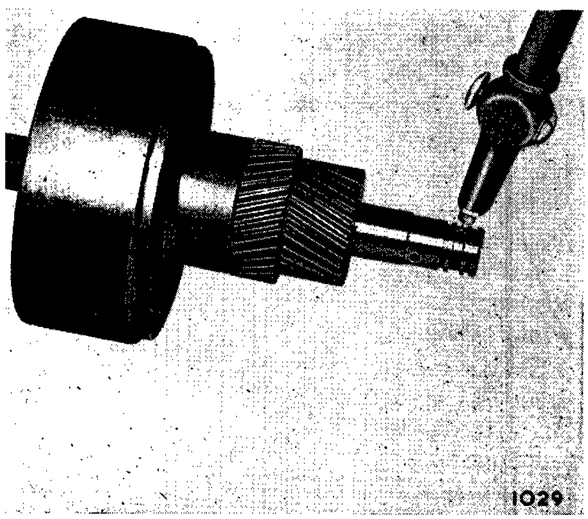


Fig. 38. Applying compressed air to the clutch feed hole.

Install the rear clutch cast iron sealing rings in their grooves on the forward sun gear. Be sure that the rings are free in the grooves. Centre each ring in its groove, so that ends do not overlap edges of groove.

Place the rear clutch piston and cylinder assembly over the forward sun gear and gently slide it down over the sealing rings. (Fig. 46).

Install a rear clutch steel plate with its concave face up or facing forward in the transmission. Note that these plates are identified by missing teeth on the O.D. and are not interchangeable with front clutch steel plates. (Fig. 47).

Install a rear clutch friction plate, then alternating with first a steel and then a friction plate, complete the clutch pack. (Fig. 48).

Install the rear clutch pressure plate.

Install the rear clutch snap ring. This ring has one tanged end. (Fig. 49).

Install the front clutch cast iron sealing rings in their grooves on the forward sun gear. Centre each ring in its groove so that ends do not overlap edges of the groove. (Fig. 50).

Install the front clutch cylinder thrust plate. (Fig. 51). Be sure flats on the washer match flats on shaft.

Install the front clutch cylinder thrust washer. (Fig. 52).

Assemble the front clutch hub "O" ring into its groove in the clutch hub.

Assemble the front clutch piston square section rubber sealing ring in the groove of the clutch piston.

Install the clutch piston into the clutch cylinder after thoroughly lubricating the parts. Press the piston into position using Tool Part No. WG 42.

Install the front clutch belleville spring and snap ring. This snap ring is thicker than the other two clutch snap rings and has two tanged ends instead of one.

Assemble the front clutch assembly over the forward sun gear shaft and into the rear clutch, being careful not to distort or break the cast iron sealing rings. Use a short oscillating movement to engage splines of the rear clutch friction plates. (Fig. 53).

Install the front clutch pressure plate. (Fig. 54).

Install the front clutch hub, followed by front clutch hub thrust washer. (Fig. 55).

Install a front clutch friction plate over the splines of the hub. (Fig. 56). Next, install a front clutch outer plate, meshing splines in the cylinder, alternating, as above, complete assembly of plates. (Fig. 57).

Assemble the input shaft to the front clutch cylinder.

Assemble the snap ring that holds the input shaft in place. (Fig. 58).

Place the thrust washer on the input shaft and the clutch assemblies are complete. (Fig. 59).

Centre Support

The centre support is serviced as an assembly. Therefore, there is no disassembly or assembly procedure.

Inspect the support for burrs or distortion, the race bearing surface for scores or scratches.

Pinion Carrier Assembly

The pinion carrier is serviced as an assembly. Therefore, there is no disassembly or assembly procedure.

Inspect the band surface and the inner and outer bushings for scores. Rotate pinions on their shafts to check for freedom of movement and for worn or broken teeth. Use a feeler gauge to check pinion end play. End play should be 0·010″ to 0·020″ (·25 to ·5mm.). Inspect pinion shafts for tightness to the planet carrier.

Sprag Clutch

A sprag-type one-way clutch assembly is incorporated in the planet carrier. The outer race is fitted in the planet carrier assembly and is held in place by a snap ring.

When installing the sprag clutch, the flange side of the sprag cage is located down into the outer race of the planet carrier assembly with the copper tension springs toward the centre support.

After the planet carrier and sprag assemblv are installed in the case, the planet carrier will freewheel when turned counterclockwise and lock when turned clockwise (from the rear).

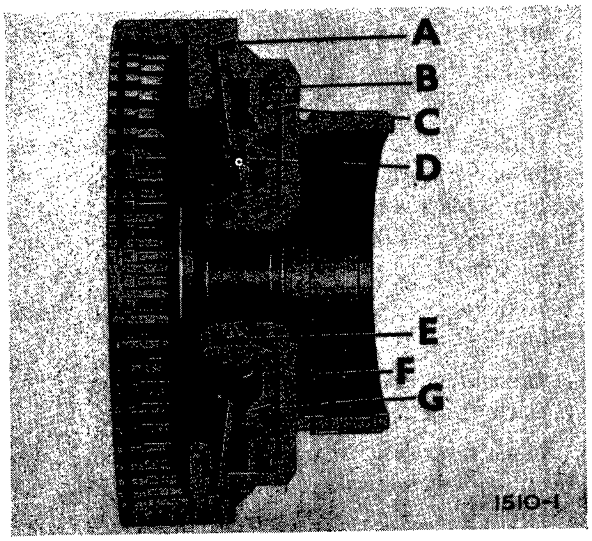


Fig. 39. Sectioned view of front clutch drum.

A Clutch spring ring
B Sealing ring
C $\frac{3}{16}''$ steel ball
D Clutch spring
E Sealing ring
F Cylinder
G Piston

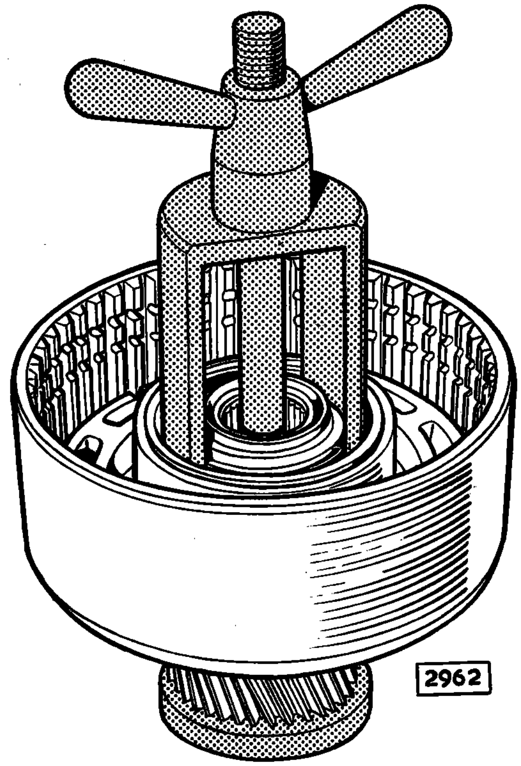


Fig. 41. Dismantling the clutch using the special tool (Part No. CBW 37A).

Fig. 40. Removing the two front clutch sealing rings.

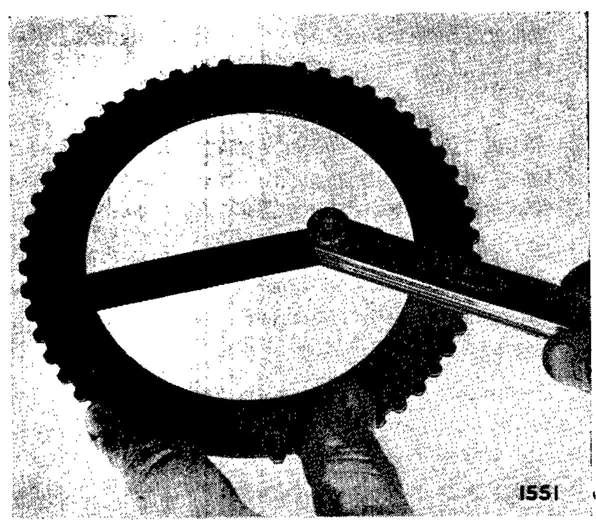


Fig. 42. Checking a clutch plate.

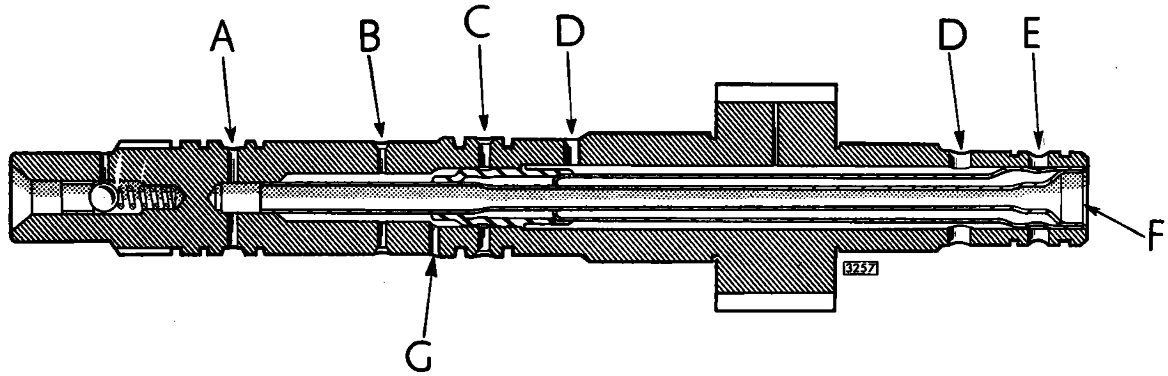


Fig. 43. Longitudinal section of the forward sun gear showing the oil ways. A,F—Front clutch; C,E—Rear clutch; B,D,G—Lubrication.

Fig. 44. Placing the forward sun gear on the carrier.

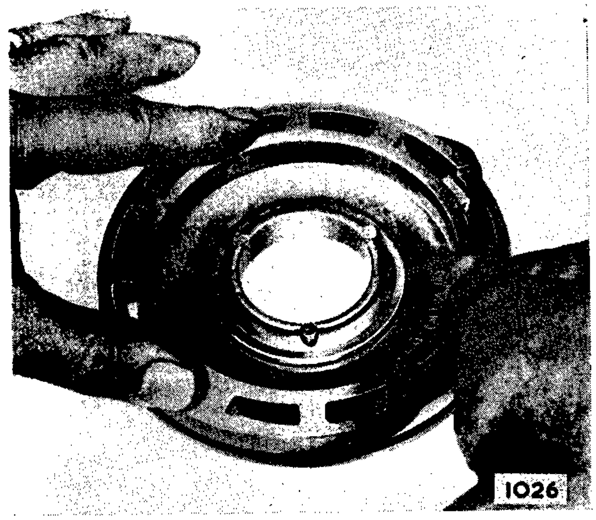


Fig. 46. Fitting the rear clutch piston sealing ring.

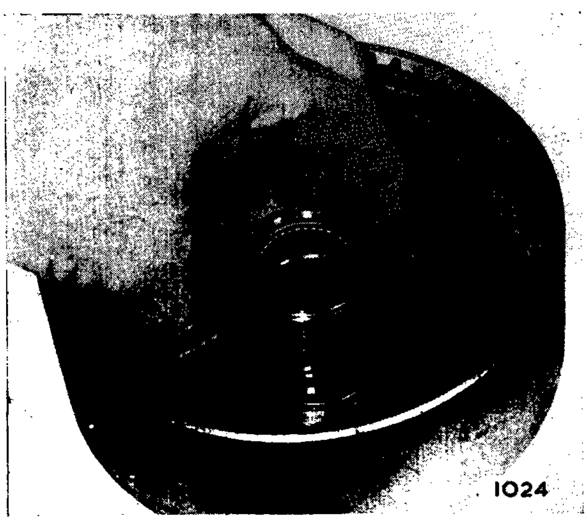


Fig. 45. Fitting the "O" ring on the rear clutch hub.

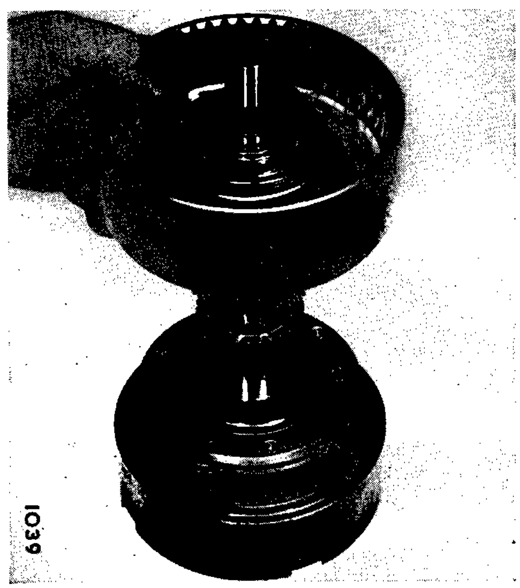


Fig. 47. Fitting the rear clutch piston and cylinder.

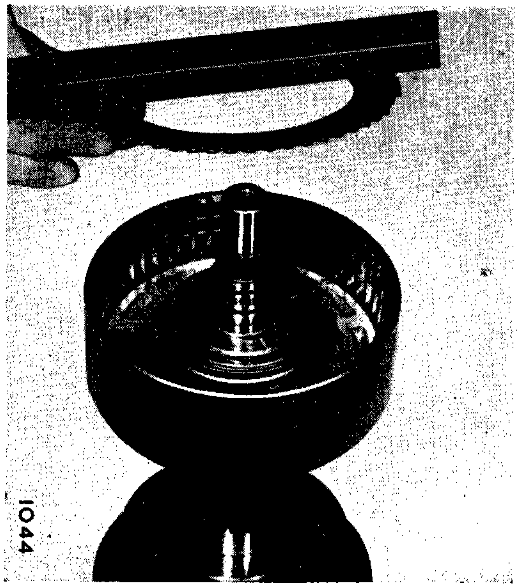


Fig. 48. Fitting a rear clutch steel plate.

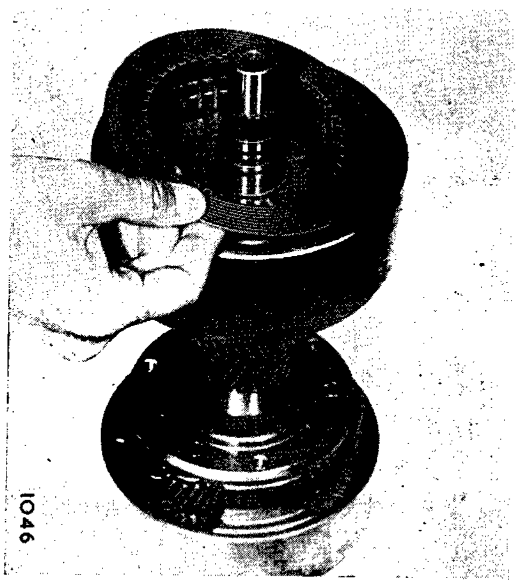


Fig. 49. Fitting a rear clutch friction plate.

Fig. 50. Fitting the snap ring.

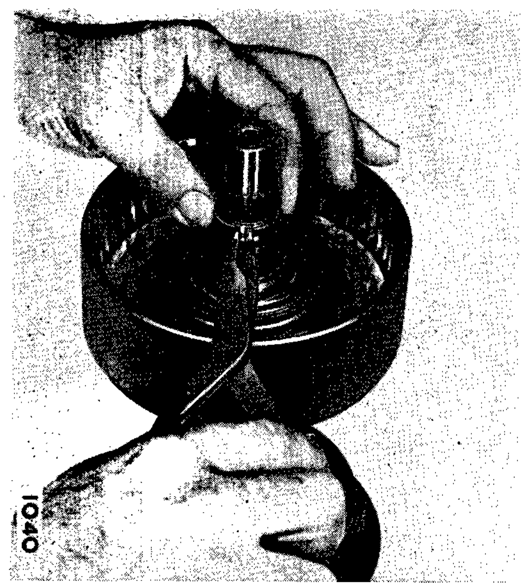


Fig. 51. Fitting the sealing rings.

Slide the oil collector and tubes from the shaft.

Remove the four sealing rings.

Remove the governor snap ring, governor and governor drive ball from the output shaft.

Lift the rear pump from the shaft and remove the rear pump drive key.

The snap ring may be removed and the output shaft removed from the ring gear; however, this is not necessary unless replacing one of these parts.

Inspect the output shaft thrust surfaces and journals for scores and the internal gear for broken teeth. Check the ring grooves, splines and gear teeth for burrs, wear, or damage. The output shaft is a two-piece assembly and is serviced separately. Inspect the distributor and sleeve mating surfaces for excessive wear and for burrs, scores or leakage.

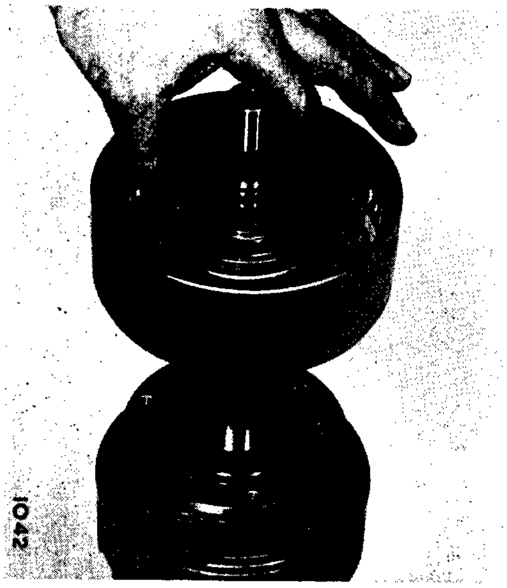


Fig. 52. Fitting the front thrust plate.

Fig. 54. Assembling the front clutch.

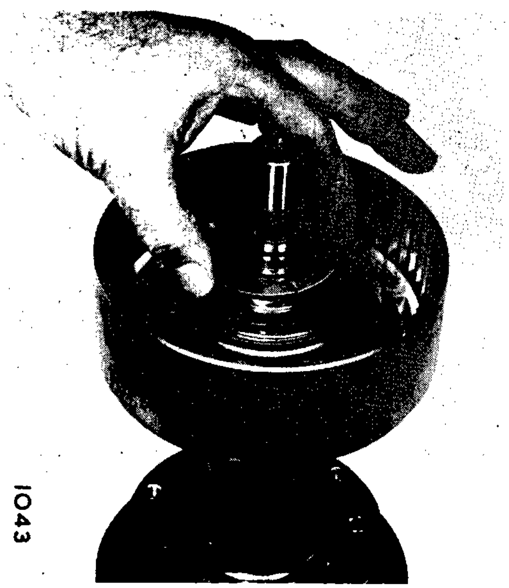


Fig. 53. Fitting the front clutch cylinder thrust washer.

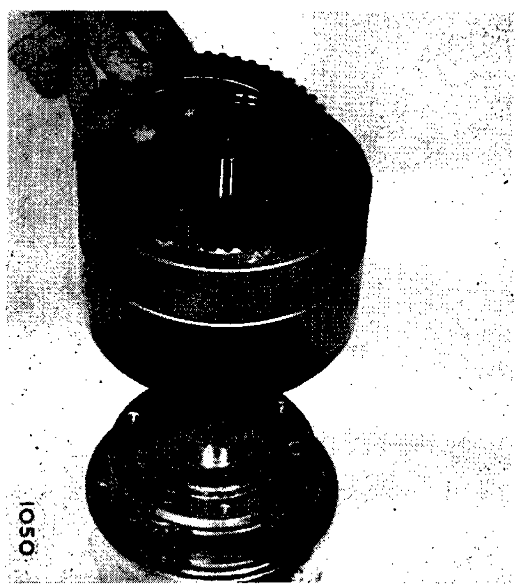


Fig. 55. Fitting the front pressure plate.

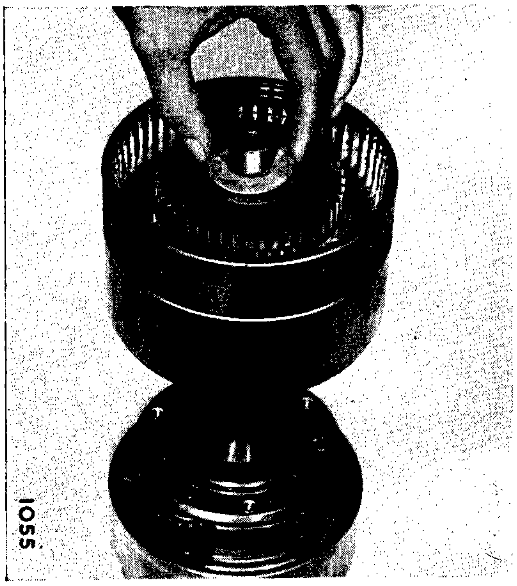


Fig. 56. Fitting the front clutch hub thrust washer.

Fig. 57. Fitting a front friction plate.

Fig. 58. Fitting a front clutch outer plate.

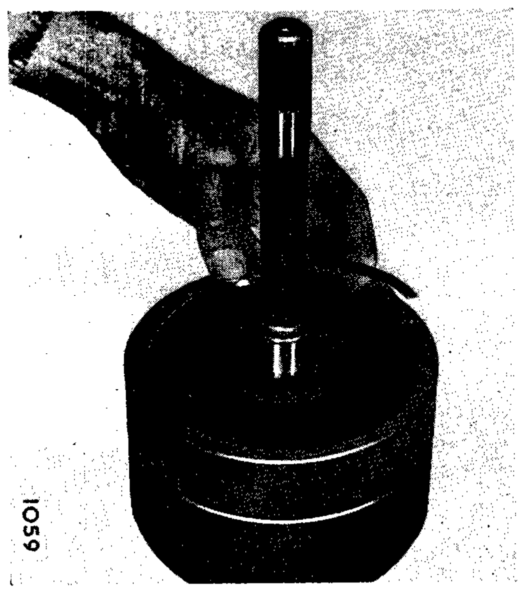


Fig. 59. Fitting the snap ring.

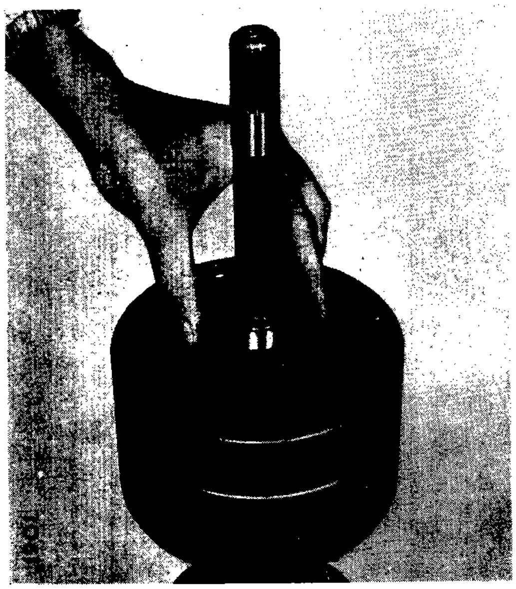


Fig. 60. Placing the thrust washer in position.

Governor

Remove the governor body cover plate attaching screws and remove the plate. Remove the governor body attaching screws, then remove the body from the counterweight. Slide the retainer from the governor weight and remove the spring. Remove the valve and weight from the governor body.

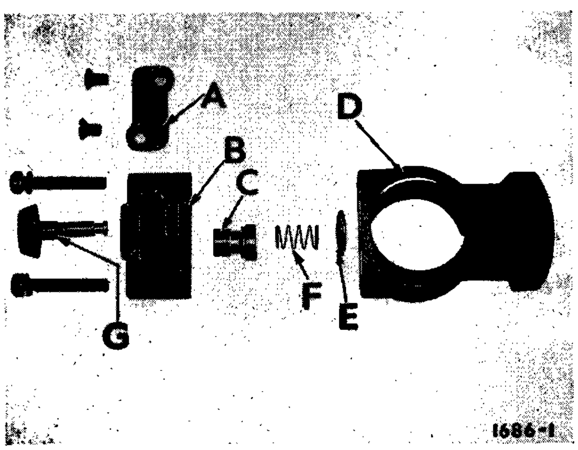
Inspect the governor weight, valve and bore for scores. Minor scores may be removed with crocus cloth. Replace the governor valve, weight or body if deeply scored. Check for free movement of the weight and valve in the bore. Inspect all fluid passages in the governor body and counterweight for obstruction. All fluid passages must be clean. Inspect the mating surfaces of the governor body and counterweight for burrs and distortion. Check governor spring retainer washer for burrs. The mating surfaces must be smooth and flat.

Re-install governor body cover plate, torqueing screws to 20–30 lb. in. (0·24 to 0·35 Kgm.).

Install the governor valve in the bore of the bodys Install the weight in the governor valve. Compresf the spring and slide the retainer onto the stem ol the weight and release the spring tension. Instal. the governor body on the counterweight.

Note: Make sure the fluid passages in the body and counterweight are aligned.

Torque the governor body attaching screws to 50–60 lb. in. (0·58 to 0·69 Kgm.).



A Governor body cover plate
B Governor body
C Valve
D Counter weight
E Spring retainer
F Spring
G Weight

Fig. 61. Exploded view of the governor.

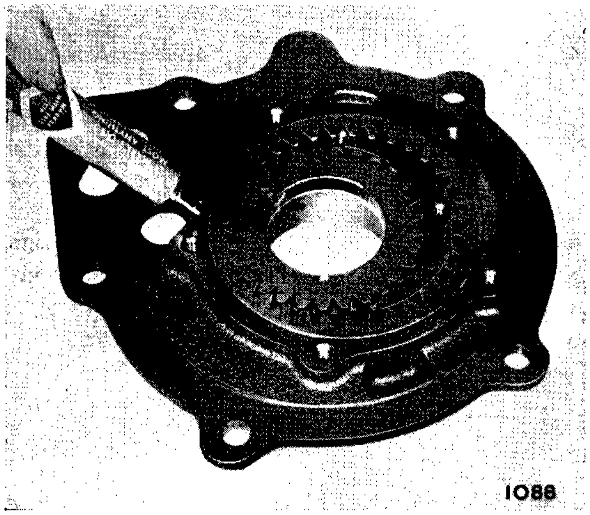


Fig. 62. Marking the top face of the gears.

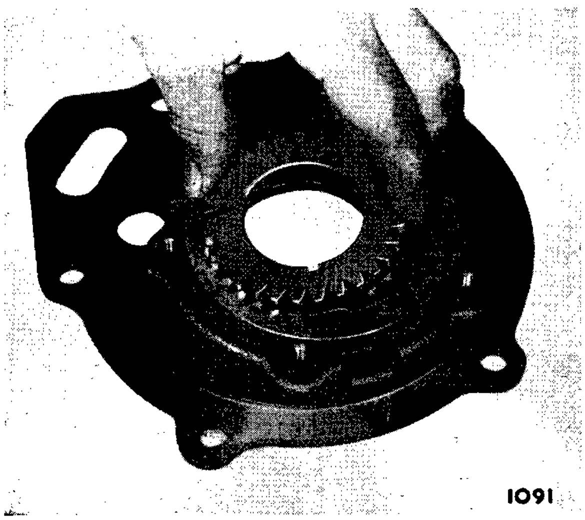


Fig. 63. Replacing the gears.

Rear Pump

Remove the screws and lockwashers from pump cover and remove the cover. Mark the top face of the gears with marking ink or a crayon to assure correct re-installation of gears upon assembly, Fig. 61. Remove the drive and driven gears from the pump body.

Inspect the gear pockets and crescent of the pump body for scores or pitting. Inspect the bushing and drive and driven gear bearing surfaces for scores. Check all fluid passages for obstructions and clean if necessary. Inspect the mating surfaces, gear teeth, pump body and cover for burrs. If any pump parts are defective beyond minor burrs or scores, which cannot be removed with crocus cloth, replace complete pump as a unit.

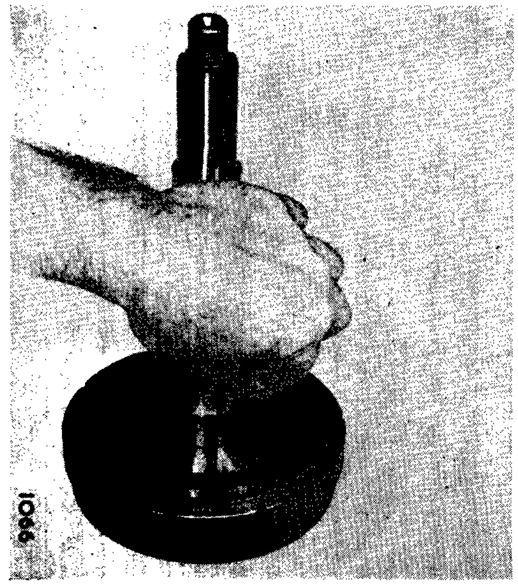


Fig. 64. Fitting the rear pump drive key.

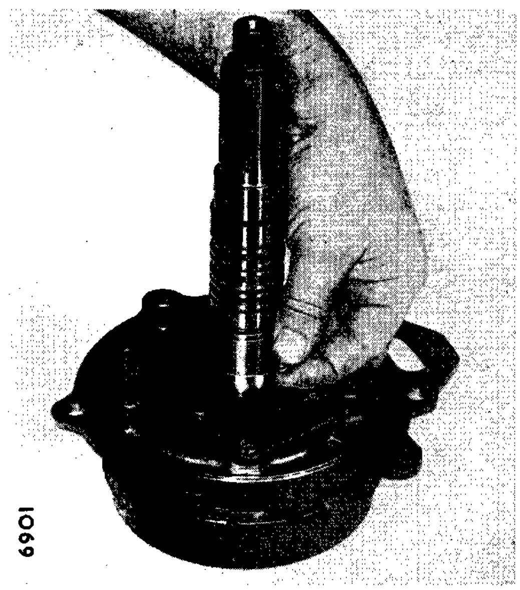


Fig. 65. Fitting the governor drive ball.

Lubricate parts with transmission fluid and replace both gears with the marks facing upward. Install the pump cover, attaching screws and lock-washers. Tighten the $\frac{1}{4}''$ (6·4 mm.) screws to 50–60 lb. in. (0·58 to 0·69 Kgm.) torque and the number 10-24 screw to 20–30 lb. in. (0·24 to 0·35 Kgm.) torque.

Check the pump for free movement of the gears.

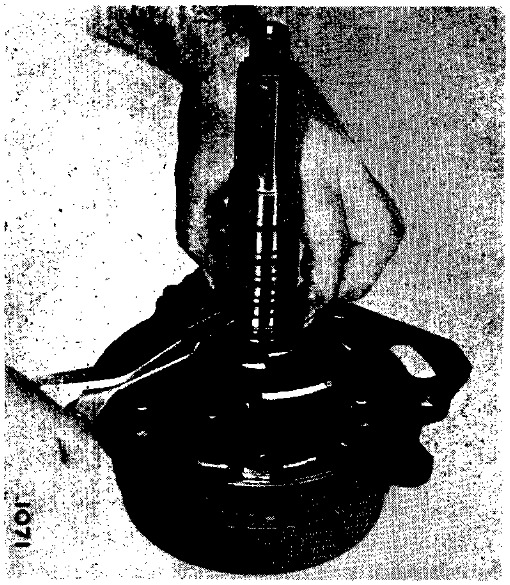


Fig. 66. Fitting the snap ring.

Output Shaft and Rear Pump—Assembling

Install the rear pump drive key in the output shaft. (Fig. 63).

Install rear pump assembly over the shaft, key slot in rear pump drive gear slides over key.

Install the governor drive ball into the recess in the output shaft, using a spot of petrolatum to hold in place. (Fig. 64).

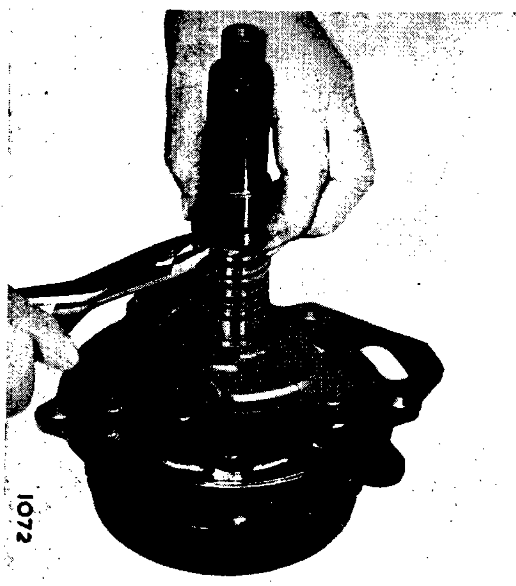


Fig. 67. Fitting the output shaft sealing rings.

Fig. 68. Installation of the oil collector sleeve and tube.

Install governor assembly, with plate on the governor body down (facing pump assembly). Install snap ring to lock governor in place. (Fig. 65).

Install the four output shaft sealing rings, making sure they are free in their grooves. (Fig. 66).

Install oil collector sleeve and tube assembly. Compress each ring with the fingers and carefully slide the sleeve over them. (Fig. 67).

Assemble the bearing spacer washer against the shoulder on the output shaft. (Fig. 68).

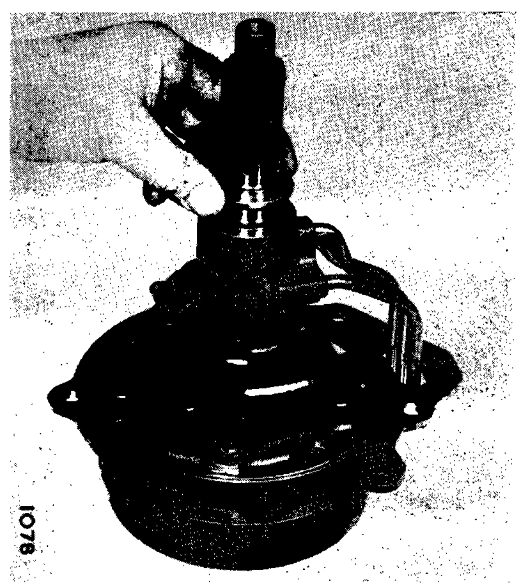


Fig. 69. Fitting the bearing spacer washer.

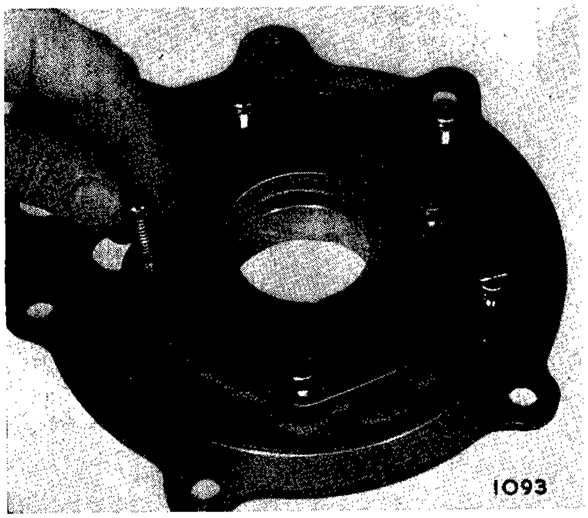


Fig. 70. Replacing the rear pump plate screws.

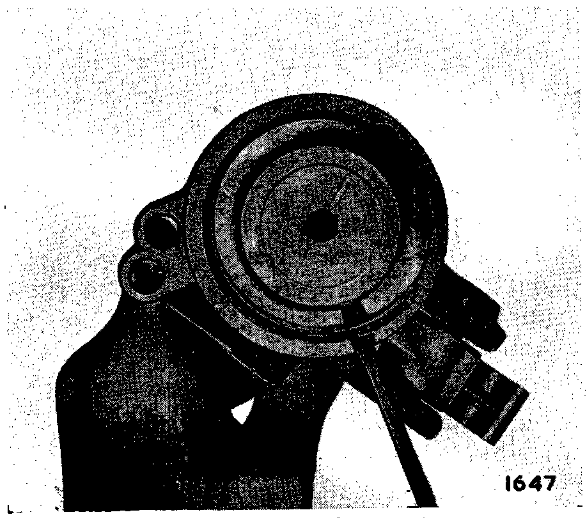


Fig. 71. Removing the snap ring.

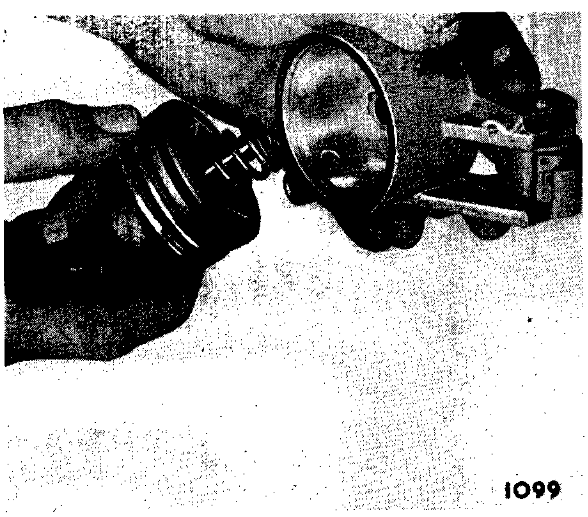


Fig. 72. Assembling the front servo.

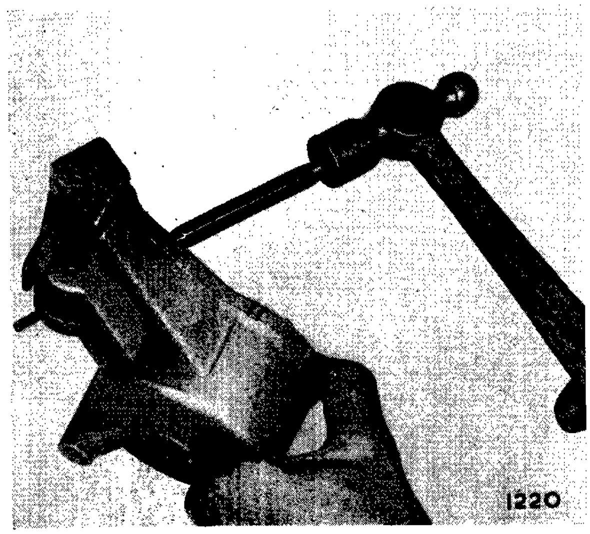


Fig. 73. Removing the rear servo roll pin.

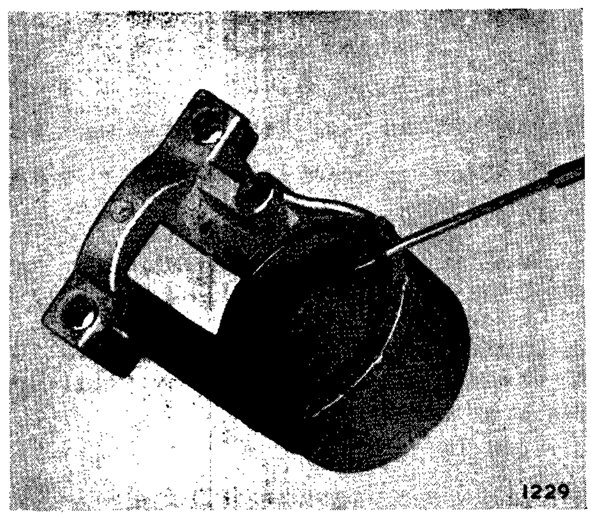


Fig. 74. Dismantling the rear servo.

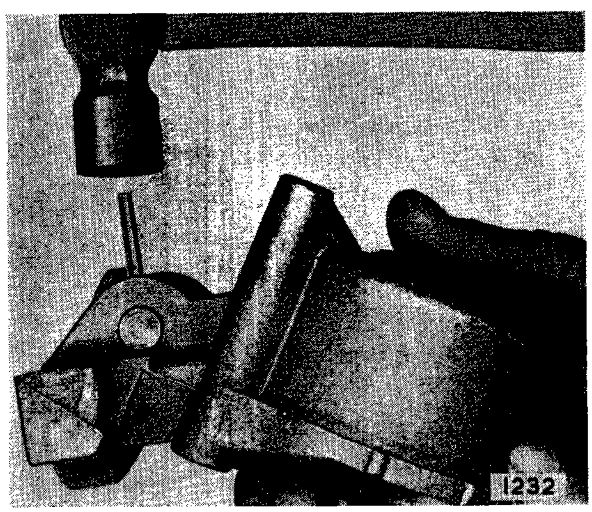


Fig. 75. Replacing the roll pin.

Front Servo—Dismantling

Use a small screwdriver to remove the snap ring Pull the sleeve and piston from the servo body.

Remove the piston from the servo sleeve.

Remove all sealing rings.

If the servo lever needs attention, it may be removed by first driving the roll pin from the servo and then removing the pivot pin and lever. Use a $\frac{1}{8}$" (3·1 mm.) drift punch to remove the roll pin.

Inspect the servo parts for cracks, scratches and wear. Check the adjusting screw for freedom in the lever. Check the lever for freedom of movement.

Front Servo—Assembling

Assemble the servo lever, pivot pin and the roll pin.

Assemble the sealing rings on the sleeve and piston.

Assemble the piston to the sleeve, place the spring in the piston, and assemble the sleeve, piston and spring into the housing.

Replace the snap ring.

Rear Servo—Dismantling

Remove the actuating lever roll pin with a $\frac{1}{8}$" (3·1 mm.) drift punch.

Remove the lever and shaft.

Depress the spring retainer while removing the snap ring.

Remove the servo release spring, piston and rubber "O" ring.

Inspect the servo body for cracks, burrs and obstructed passages and the piston bore and stem for scores. Inspect the actuating lever and shaft for wear and brinnelling.

Rear Servo—Assembling

Lubricate all parts of the servo with transmission fluid before starting assembly.

Install a new "O" ring and then install piston in the servo body.

Install the release spring, retainer and snap ring.

Replace the servo lever, shaft and roll pin.

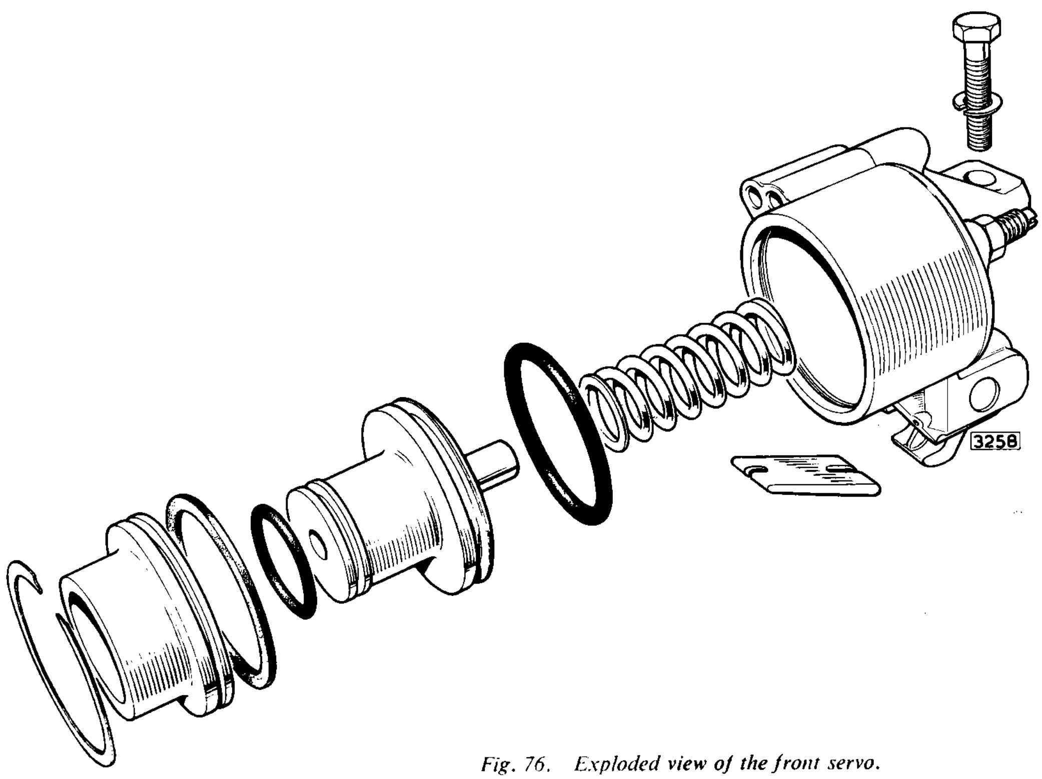


Fig. 76. Exploded view of the front servo.

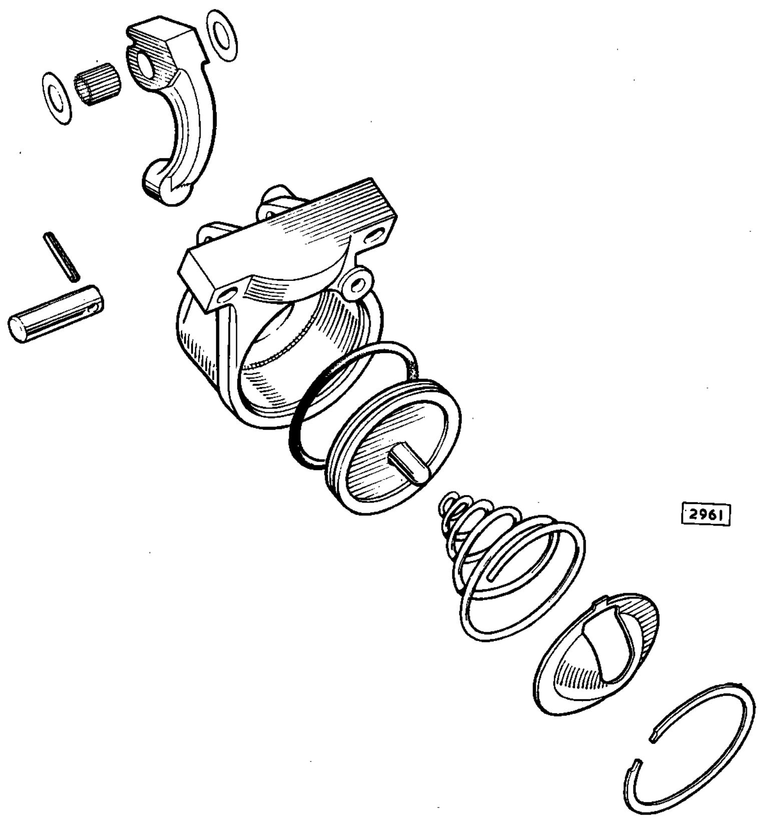


Fig. 77. Exploded view of the rear servo.

Pressure Regulator

Remove the valves from the regulator body. Remove the regulator body cover attaching screws and remove the cover. Remove the separator plate from the regulator body.

Wash all parts thoroughly in cleaning solvent and dry with compressed air. Inspect the regulator body and cover mating surfaces for burrs. Check all fluid passages for obstructions. Inspect the control pressure and converter pressure valves and bores for burrs and scores. Remove all burrs carefully with crocus cloth. Check free movement of the valves in their respective bores. The valves should fall freely into the bores when both the valve and bore are dry. Inspect the valve springs for distortion.

When assembling, be careful to avoid damaging the parts. Replace the separator plate and then the cover on the regulator body. Install the torque of the attaching screws to 20–30 lb. in. (0·24–0·35 Kgm.).

Insert the valves in the pressure regulator body.

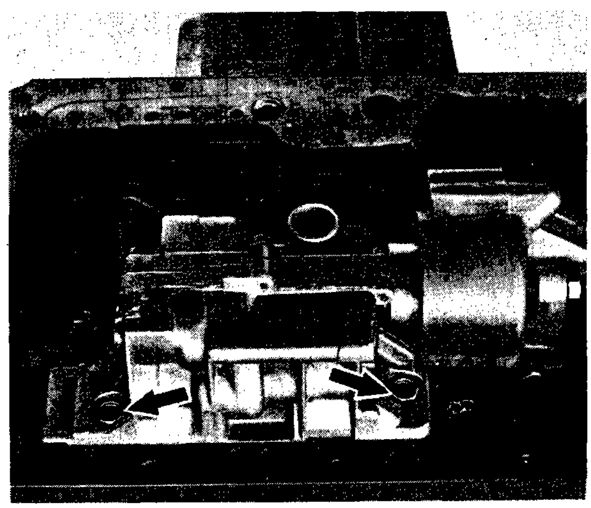


Fig. 78. Tightening regulator retaining screws.

Valve Body—Dismantling

During dismantling of the control valve assembly, avoid damage to the valve parts and keep the parts clean. Place the valve parts and the assembly on a clean surface while performing the dismantling operation.

Remove the manual valve from the upper valve body.

Remove the four cap screws that retain the valve bodies.

Remove the cover and separator plates from the valve bodies. The body plate is attached to the lower valve body by a cheese head screw and to the upper valve body by a cheese head and flat head screw. The separator plate and the lower valve body cover are held together by two cheese head screws.

Remove the front upper valve body plate retained by two screws. Remove the compensator valve plug, sleeve, springs and valve. Remove the modulator valve and spring assembly. The outer spring is retained to the modulator valve by a stamped retainer. The spring may be removed by tilting and pressing outward on the retainer.

Remove the downshift valve and spring.

Remove the rear upper valve body plate and throttle return spring retained by three screws to the body. Then remove the compensator cut back valve and the throttle valve.

Remove the four screws that retain the end body to the lower body. Remove the 2-3 shift valve inner and outer springs and the 2-3 shift valve. Remove the orifice control valve and spring and the transit on valve spring and valve. Remove the orifice control valve plug and the 2-3 shift valve plug from the end body. The end body plate should be removed for cleaning the end body.

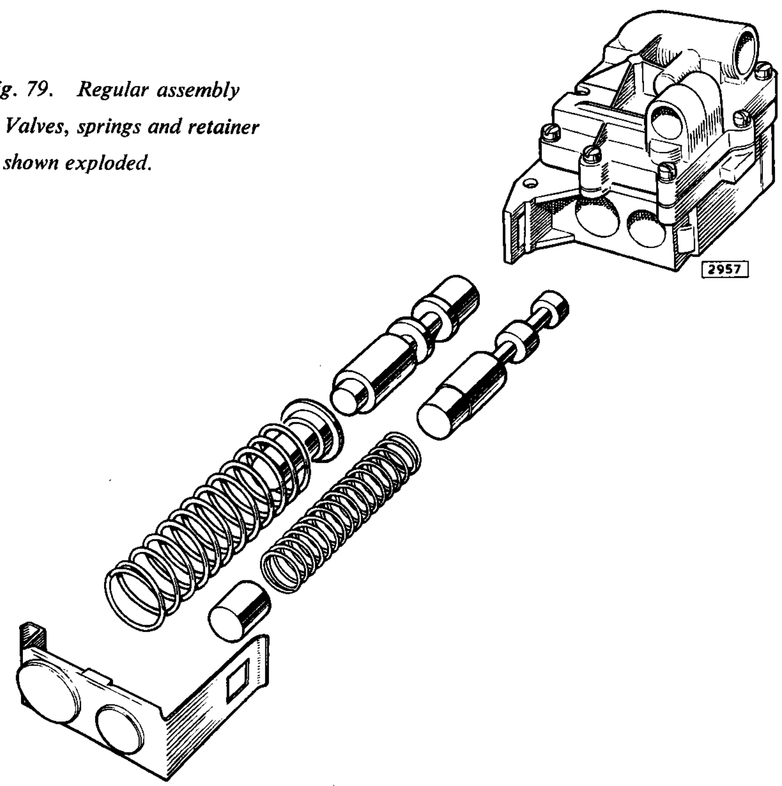
Remove the four cheese head screws that retain the lower valve body side plate. Remove the 2-3 governor plug, the D1 and D2 control valve spring and valve.

The rear pump check valve, spring and sleeve generally should not be removed. The sleeve may be removed with snap ring pliers, if necessary.

Remove the end plate from the lower valve body cover. Then remove the 1-2 shift valve and spring and the front servo release orifice valve and spring.

Note: When removing all plates, be sure to hold the plates until screws are removed and release slowly as they are spring loaded.

Fig. 79. Regular assembly Valves, springs and retainer shown exploded.



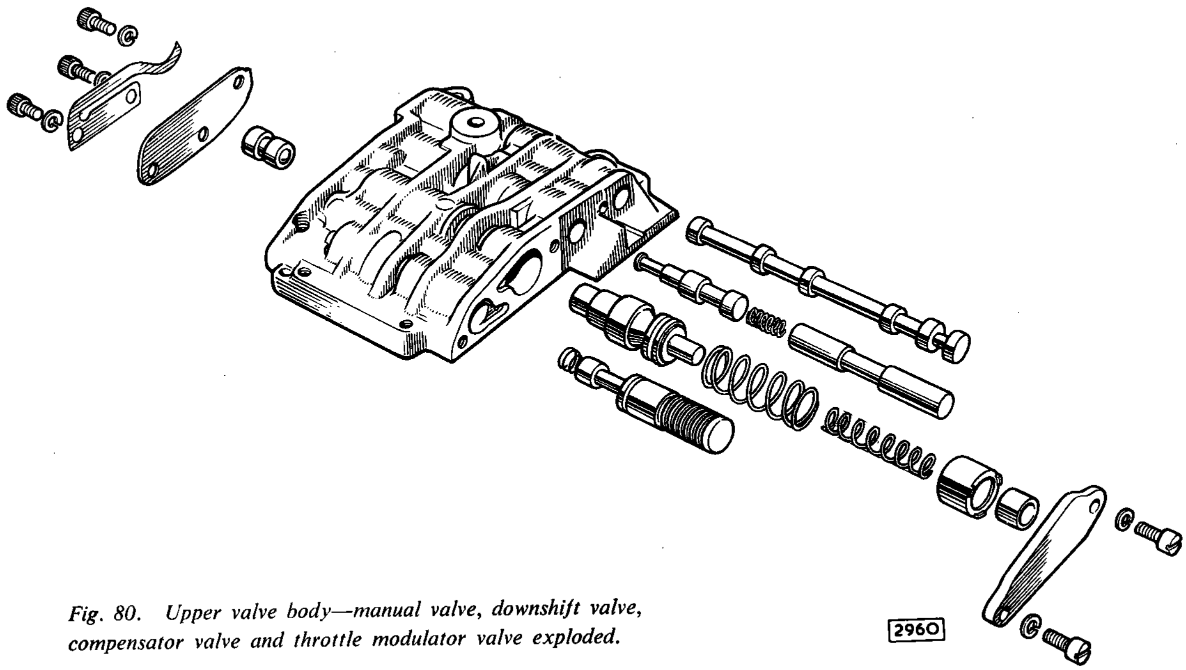


Fig. 80. Upper valve body—manual valve, downshift valve, compensator valve and throttle modulator valve exploded.

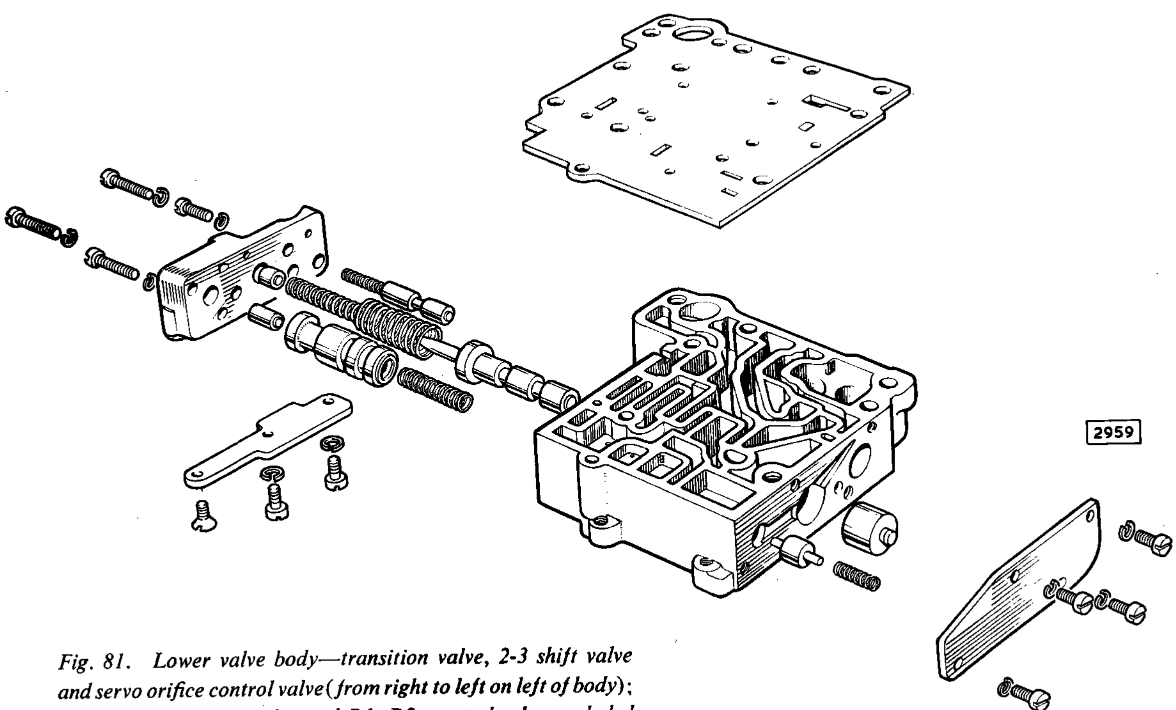


*Fig. 81. Lower valve body—transition valve, 2-3 shift valve and servo orifice control valve (**from right to left on left of body**); 2nd and 3rd governor plug and D1, D2, **control valve exploded** on right of body.*

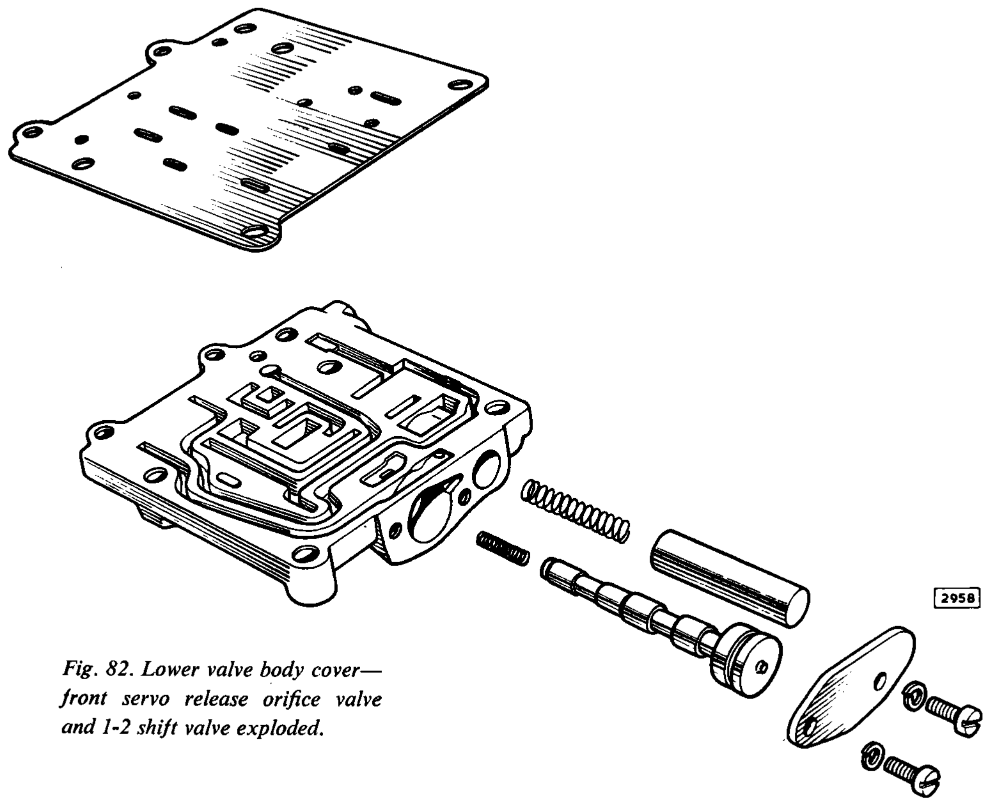


Fig. 82. Lower valve body cover—front servo release orifice valve and 1-2 shift valve exploded.

Inspection

Clean all parts thoroughly in a cleaning solvent, then dry them with compressed air. Inspect all fluid passages for obstructions. Inspect the check valve for free movement. Inspect all mating surfaces for burrs and distortion. Inspect all plugs and valves for burrs and scores.

Note: Crocus cloth can be used to polish the valves and plugs if care is taken to avoid rounding the sharp edges.

Valve Body—Assembling

When assembling the control valve bodies, always use the following procedure:

Install the valve body plate on the upper valve body (retained by one cheese head and one flat head screw). Do not tighten the screws. If the rear pump check valve sleeve, valve and spring were removed from the lower valve body, install them, carefully staking the sleeve in the bore with the smooth end against the valve.

Place the upper body on the lower body and install the cheese head screw, but do not tighten the screw.

Place the lower valve body separator plate and cover on the lower valve body and install the two cheese head screws, leaving them loose.

Install the four cap screws and lockwashers; torque the four screws to 72 lb. in. then tighten the cheese head screws and flat head screw to 20–30 lb. in. (0·23–0·35 Kgm.).

Try all valves dry in their respective bores, rotating them to make sure that they are free before final assembly in the valve body. If any sticking or binding occurs, the valve bodies will have to be separated and each surface lapped on crocus cloth, using a surface plate or a glass plate, to ensure against low or high spots or a warped condition.

Note: Lubricate all valves and plugs with automatic transmission fluid before final assembly in their respective bores.

Install the 1-2 shift valve spring and valve in the lower valve body cover. Install the front servo release orifice valve spring and valve and the cover end plate with two cheese head screws.

Install the range control valve and spring, the governor plug, and then install the side plate with four cheese head screws.

Install the orifice control valve spring and valve, the 2-3 shift valve, the 2-3 shift valve inner and outer springs, the transmission valve, and spring in the lower valve body.

Replace the end body plate using one flat head and two cheese head screws and torque to 20–30 lb. in. (0·23–0·35 Kgm.). Install the orifice control valve plug and the 2-3 shift valve plug in the lower valve body end body. Install the end body to the lower valve body, guiding the 2-3 shift valve inner spring into the 2-3 shift valve plug. Three long and one short special cheese head screws are used to retain the end body.

Note: Make sure the inner spring is piloted on the 2-3 shift valve plug.

Install the modulator valve and spring assembly. Install the compensator valve, compensator inner and outer springs, compensator plug and sleeve (be sure end of sleeve with the three protrusions is toward the plate and the smooth end to the spring in the upper valve body). Assemble the plate which is retained by two cheese head screws.

Install compensator cut-back valve in the rear end of the upper body. Install the rear plate so that the edge of the plate fits into the band of the throttle valve and install one screw to hold the rear plate in place. Install the throttle return spring and install the two remaining cheese head screws.

Install the manual valve. Torque on all cheese head screws should be 20–30 lb. in. (0·23 to 0·35 Kgm.).

TRANSMISSION ASSEMBLING

Lubricate all parts, as they are assembled, with the same fluid used for filling the transmission. Petrolatum can be used sparingly to hold gaskets or thrust washers in position during assembly.

Wash the transmission case and dry with compressed air.

Install a new front pump to case gasket, then install the front pump. Torque the four attaching cap screws to 17–22 lb. ft. (2·35 to 3·04 Kgm.).

Install the front band through the bottom of the case, positioning the band so that the anchor end is aligned with the anchor in the case.

Install the front clutch, rear clutch and forward sun gear assembly into the case. Handle the clutch assemblies in a manner that will prevent the clutches being pulled apart.

Install the centre support in the transmission case with the three positioning holes aligned with the holes in the case.

Install the centre support cap screws with the rolled edge of each lockwasher towards the case. Torque to 20–25 lb. ft. (2·76 to 3·46 Kgm.).

Install the rear band through the rear of the case. Be sure that the end with the depression or dimple is placed toward the adjusting screw.

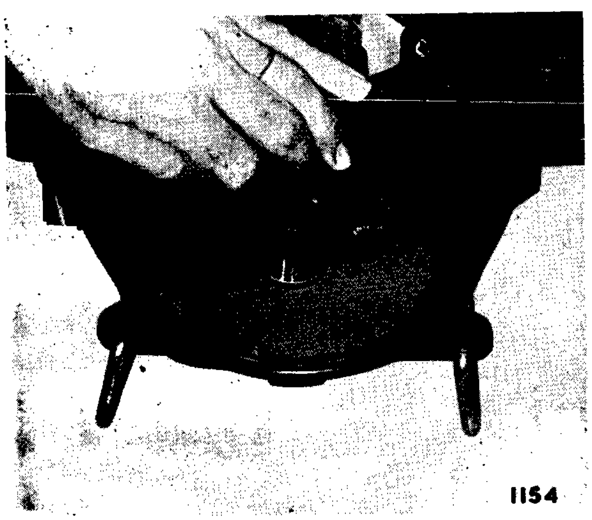


Fig. 83. Fitting a new front pump gasket.

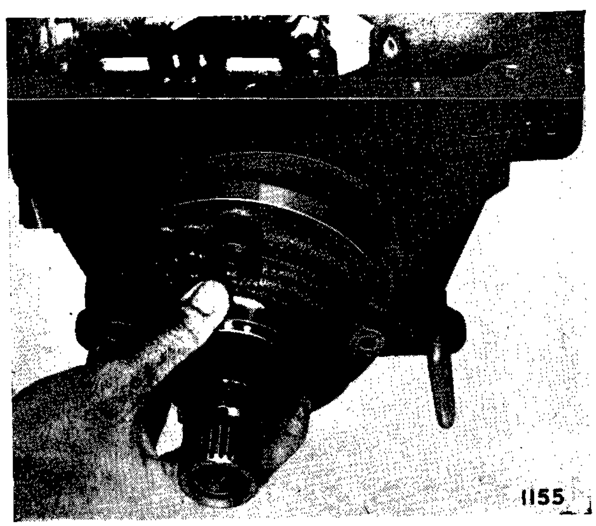


Fig. 84. Installing the front pump.

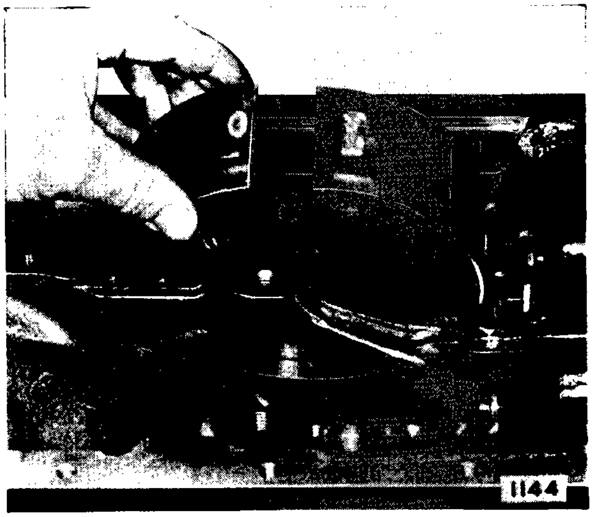


Fig. 85. Installing the front pump.

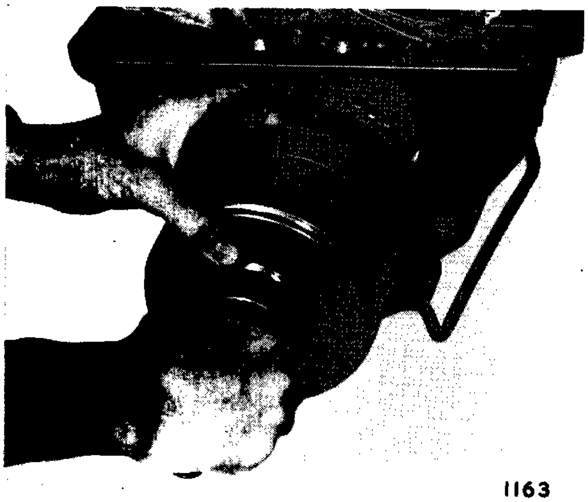


Fig. 86. Installing front clutch, rear clutch and forward sun gear.

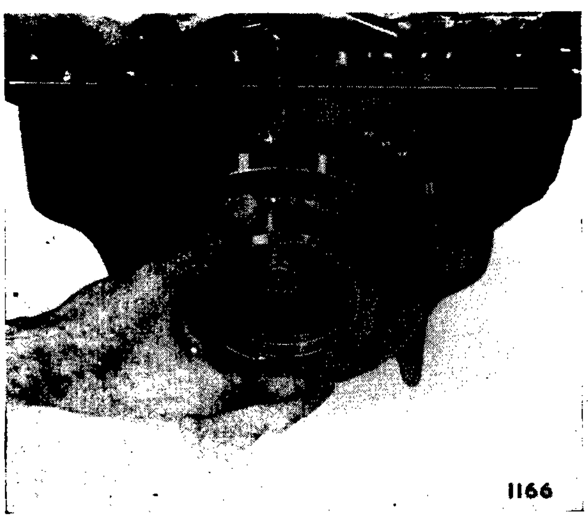


Fig. 87. Installing the centre support.

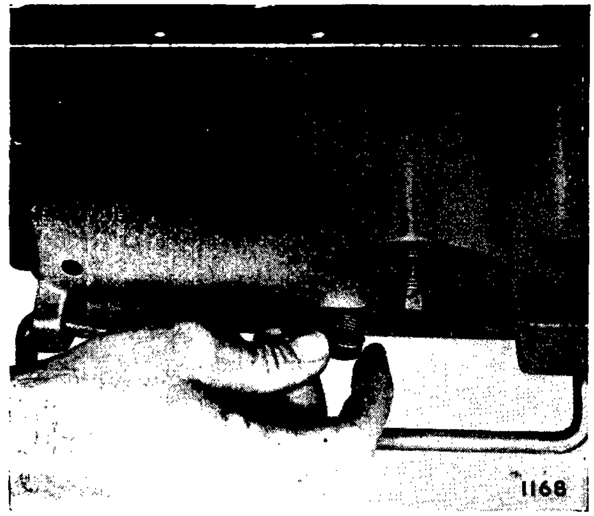


Fig. 88. Fitting the centre support cap screws.

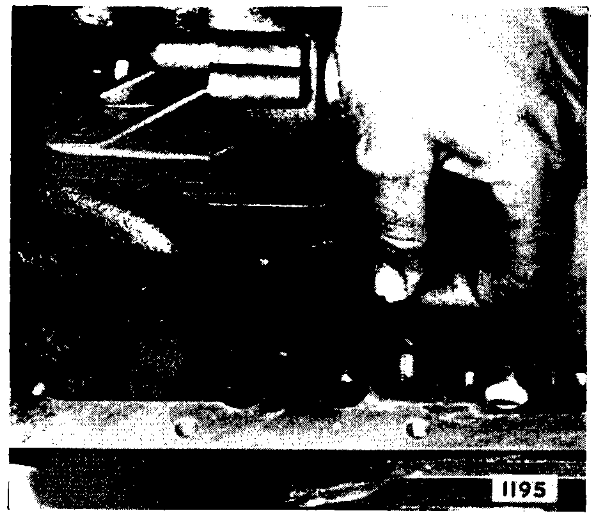


Fig. 89. Fitting the rear band.

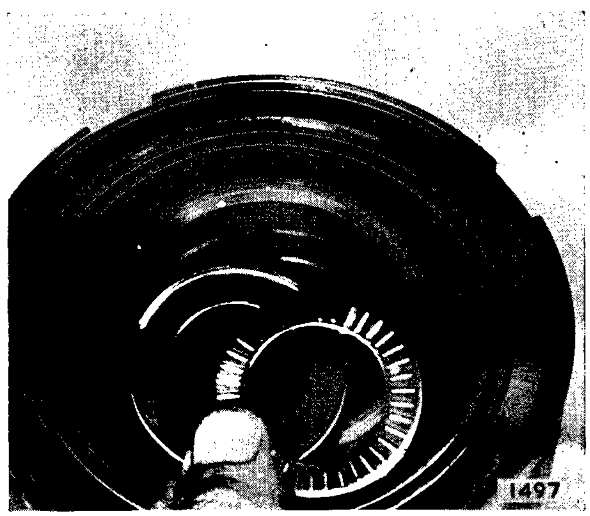


Fig. 90. Fitting the thrust plate and needle bearing.

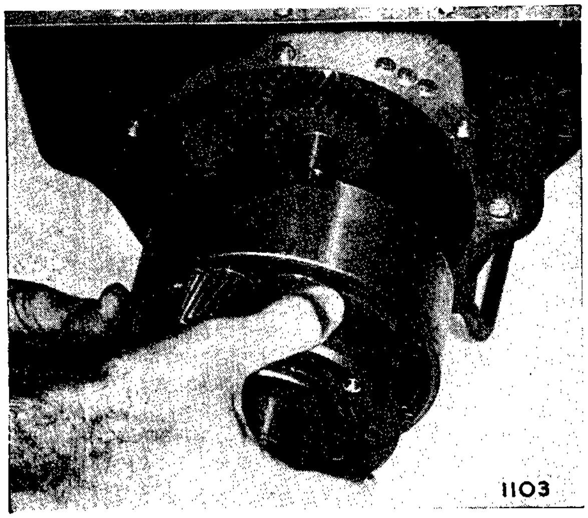


Fig. 91. Assembling the carrier over the sun gear.

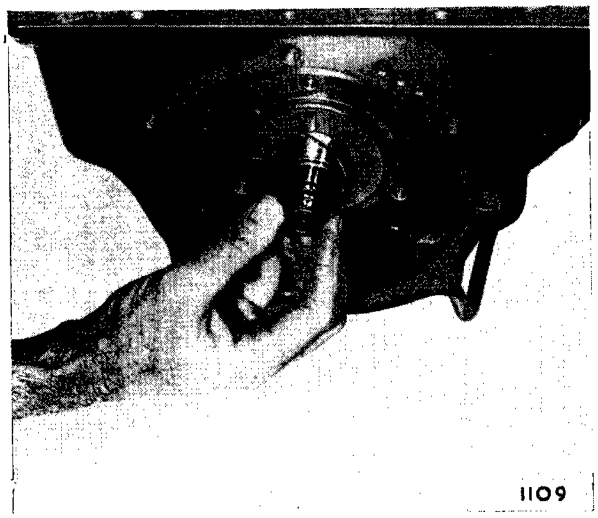


Fig. 92. Fitting the sealing rings.

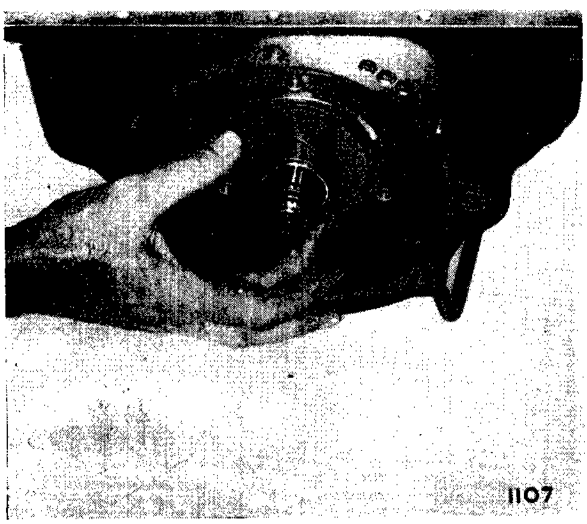


Fig. 93. Fitting washer on rear of planet carrier.

Use petrolatum sparingly to hold the forward sun gear thrust plate and needle bearing in the planet carrier, while the carrier is assembled over the sun gear.

Install the hook type seal rings on the rear of the forward sun gear. Check the rings for free movement in their grooves.

Choose a selective washer to give the correct end play (end play determined during dismantling is used to determine the need for a different thrust washer). Install washer on the rear of the planet carrier.

Use petrolatum to hold the rear pump to case gasket to the rear of the case.

Install the ring gear and output shaft assembly. Align the three oil tubes as the assembly is moved into position and tap them into position.

Place the rear pump to extension housing gasket in position, then assemble the extension housing. Torque the five extension housing cap screws to 28–33 lb. ft. (3·87 to 4·56 Kgm.).

Install the bearing snap ring, and then tap the ball bearing into position in the extension housing and on the output shaft (be sure spacer washer is on shaft ahead of bearing).

Slide the speedometer drive gear on the output shaft.

Install rear seal in bearing retainer. Assemble the bearing retainer and its gasket.

Install the companion flange, flat washer, lock-washer and nut. Torque the nut to 90–120 lb. ft. (12·44–16·58 Kgm.).

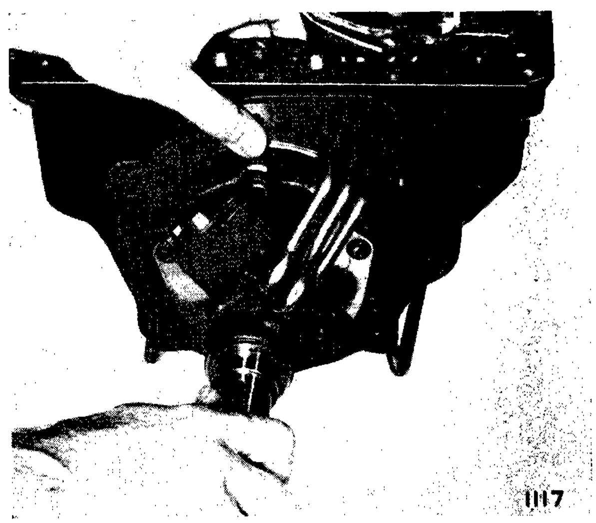


Fig. 94. Aligning the three oil tubes.

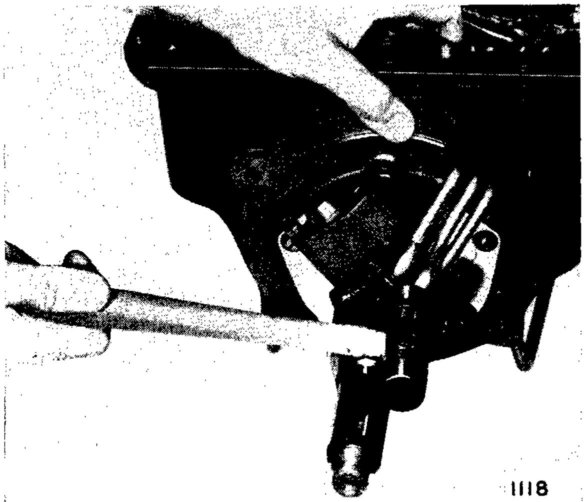


Fig. 95. Tapping the output shaft assembly into position.

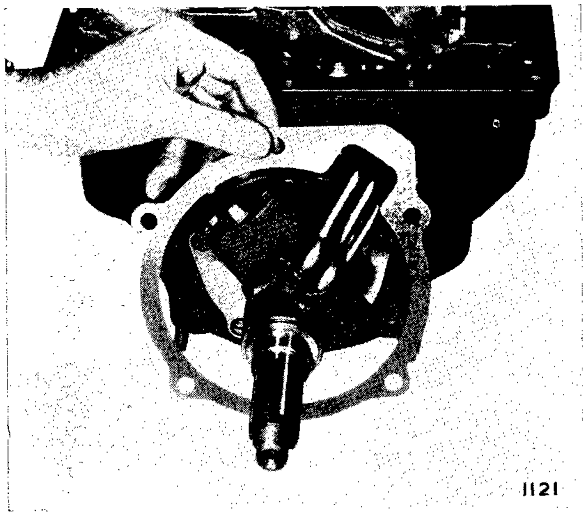


Fig. 96. Fitting the rear extension gasket.

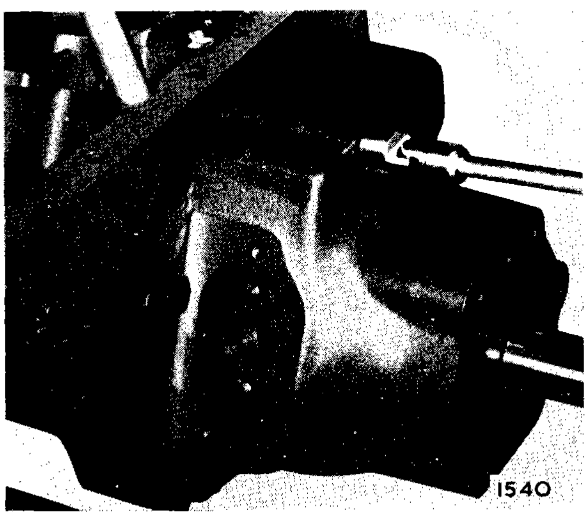


Fig. 97. Tightening the extension housing cap screws.

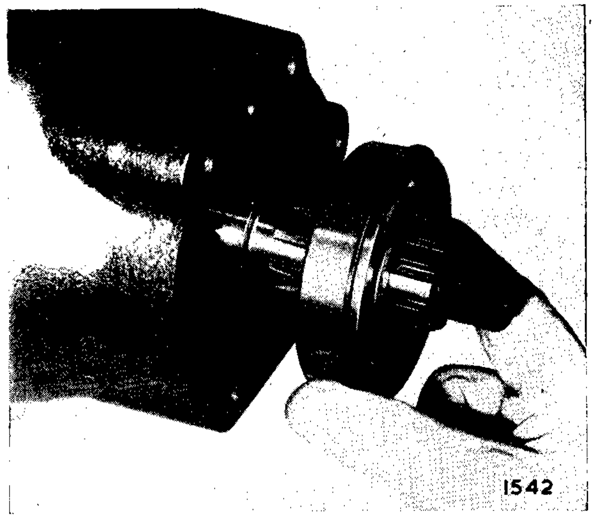


Fig. 98. Fitting the ball bearing on the output shaft.

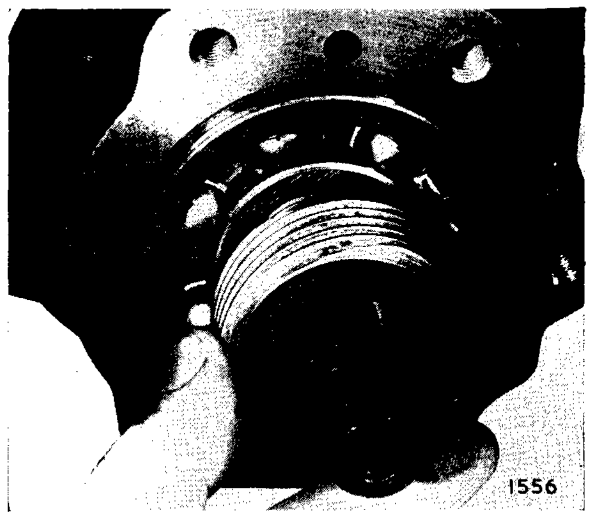


Fig. 99. Fitting the speedometer drive gear.

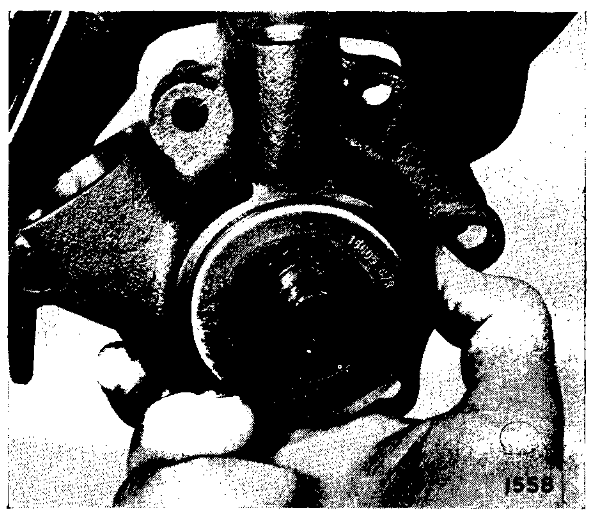


Fig. 100. Fitting the bearing retainer.

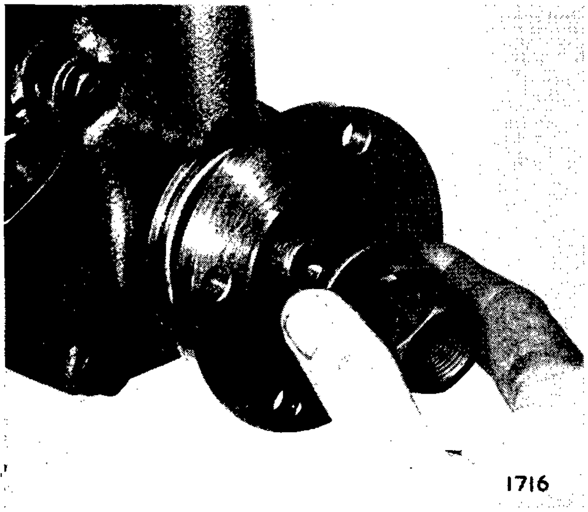


Fig. 101. Fitting the companion flange.

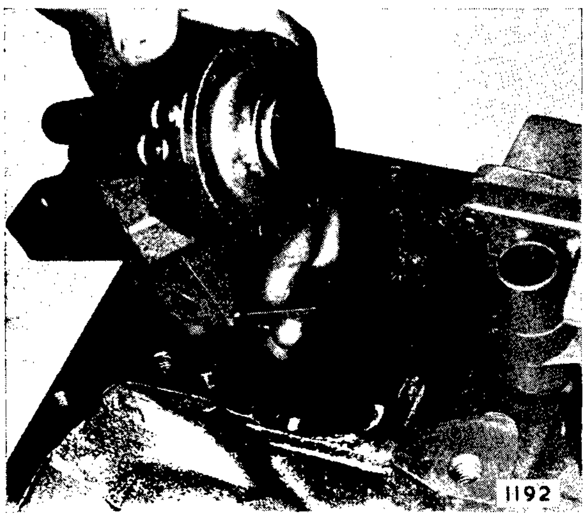


Fig. 102. Installing the front servo.

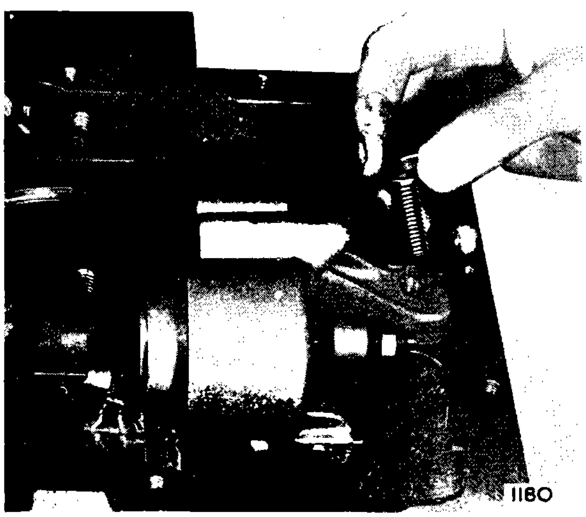


Fig. 103. Fitting the attaching cap screw.

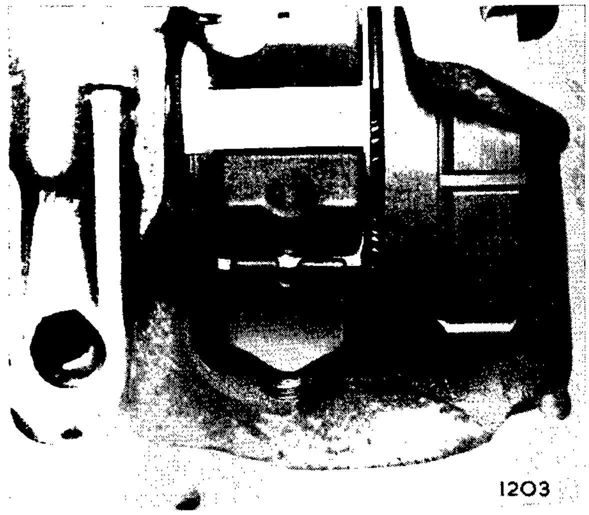


Fig. 104. Engaging the servo anchor strut.

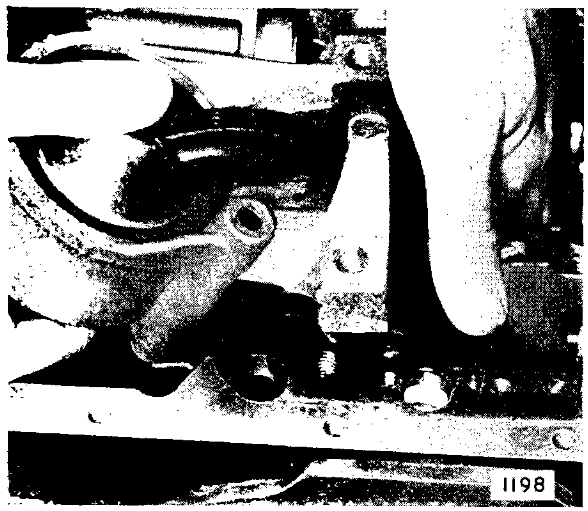


Fig. 105. Fitting the rear servo.

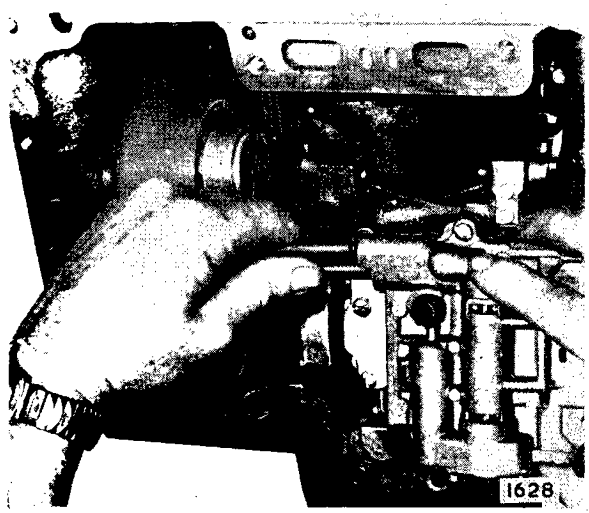


Fig. 106. Fitting the servo tubes.

Front Servo Installation

Rotate the front band into position so that the anchor end is positioned over the anchor pin in the case. Position the servo strut with the slotted end aligned with the servo actuating lever, and hold it in position with the middle and index fingers of the left hand. Engage the end of the band with the small end of the strut, then position the servo over the dowel pin. Install the attaching cap screw but do not screw it in more than two or three threads at this time.

Rear Servo Installation

Position the servo anchor strut over the adjusting screw, then rotate the rear band to engage this strut. Place the servo actuating lever strut with the notched end to the band and lift the other end with index finger or a screwdriver, while locking the servo lever over the strut. Install the long pointed bolt in the forward servo hole so that it will engage the centre support. The other shorter bolt is used in the rear position. Torque the bolts to 40–50 lb. ft. (5·53–6·91 Kgm.).

Valve Body Installation

Place the manual selector in park or reverse position. Carefully align the valve body with the servo ubes and gently slide the valve body further onto the tubes.

The front servo must be pulled up off the dowel to allow easy assembly. Be careful at this point—the servo apply strut may become disengaged from the servo. Before seating the valve body on the case, install the nipple end of the throttle cable into the throttle cam.

Next, align the manual valve with the inside lever pin and the valve body will then drop into position. Torque the three valve body attaching cap screws to 8–10 lb. in. (0·09–0·12 Kgm.).

Torque the front servo attaching cap screw to 30–35 lb. ft. (4·15–4·84 Kgm.) and adjust the front servo.

Replace the control pressure tube, by first assembling the long straight end into the regulator, then rocking the tube downward into the control valve body. If too much resistance is encountered, it will help to loosen the control body attaching cap screws until the tube can be assembled.

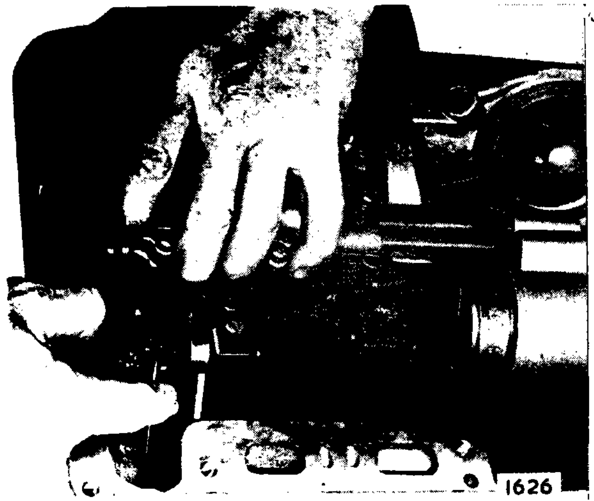


Fig. 107. Positioning the valve body.

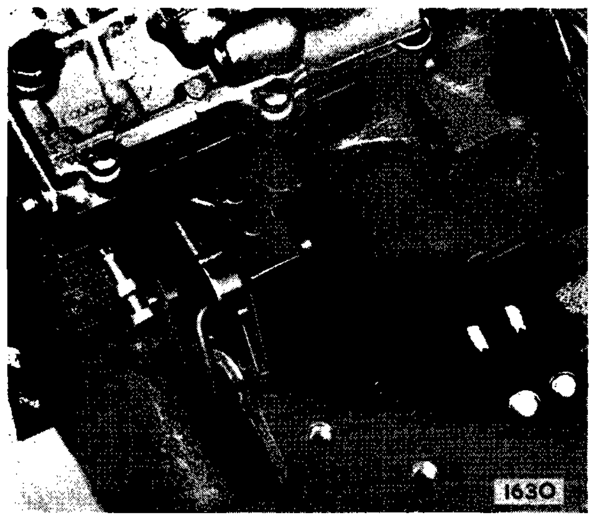


Fig. 108. The valve body in position.

Pressure Regulator Installation

Assemble the regulator, with the valves in position in their bores, to the case with the attaching cap screws.

Torque cap screws to 17–22 lb. ft. (2·35–3·04 Kgm.). Install both springs and guides, then install the spring retainer.

Install the front servo apply and release tubes in the servo.

Install the rear pump inlet and outlet tubes, using new "O" rings.

Replace the compensator tube by aligning one end with the pressure regulator and the other end with the control valve body and then tap it into position.

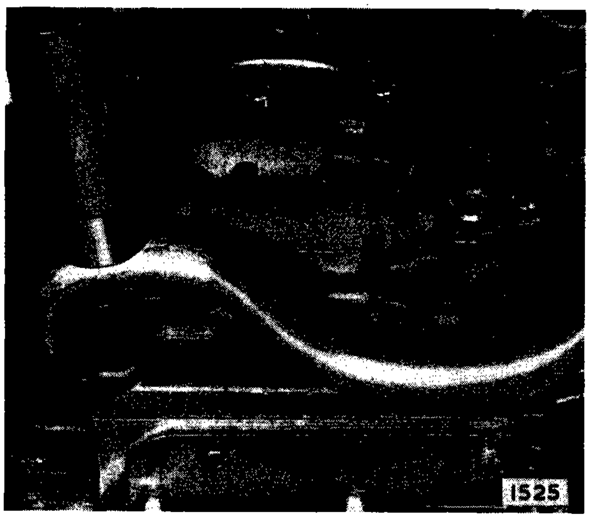


Fig. 109. Replacing the control pressure tube.

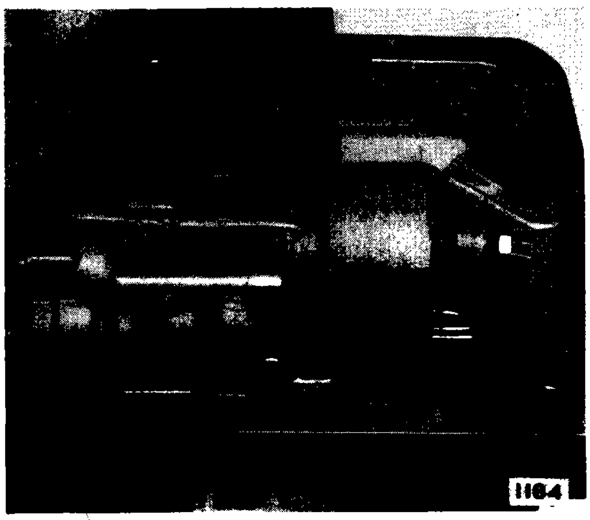


Fig. 110. The pressure regulator installed.

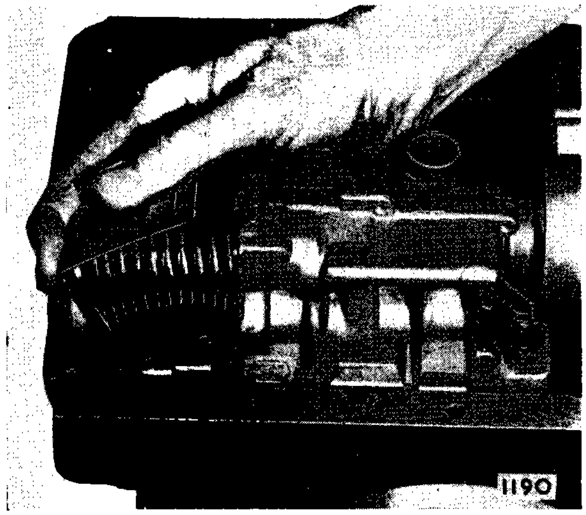


Fig. 111. Fitting the pressure regulator springs.

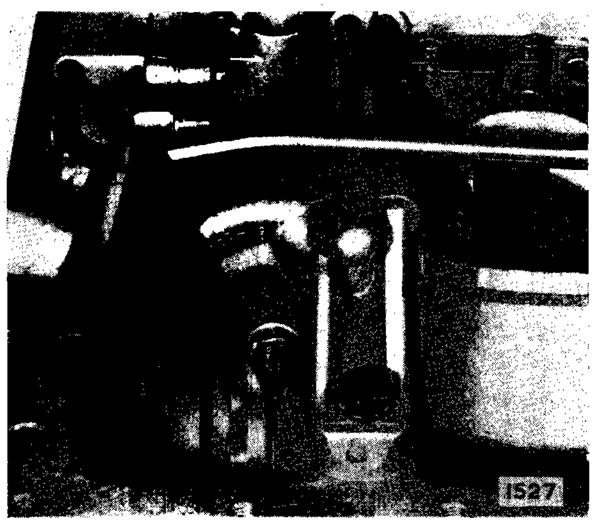


Fig. 112. Fitting the lubrication tube.

Assemble the long end of the lubrication tube into the rear pump, then rock the other end into position and tap it into the pressure regulator assembly.

Replace the front band lubrication tube. Be sure tube is aligned so that the open end will direct oil onto the front drum surface at the front band gap. Tube should point at approximately the centre of the gap.

Assemble the oil screen assembly onto the rear pump inlet tube and then rock into position over the front pump inlet on the pressure regulator assembly. Hook the screen retainer under the lube tube, lay across screen, and snap onto compensator tube.

Install the oil pan gasket, the oil pan and torque the 14 cap screws to 10–20 lb. ft. (1·38–2·76 Kgm.).

Adjust the rear band.

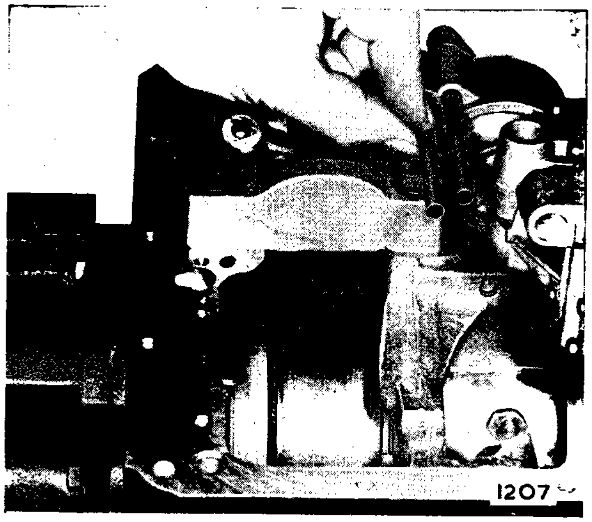


Fig. 113. Fitting the apply and release tubes.

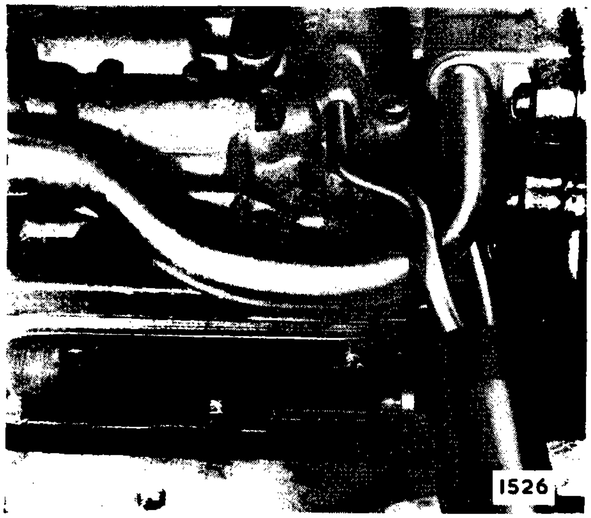


Fig. 114. Replacing the compensator tube.

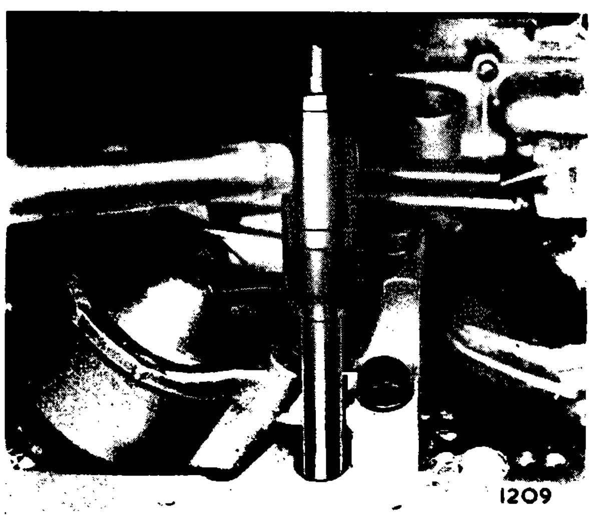


Fig. 115. Fitting the rear pump inlet tube.

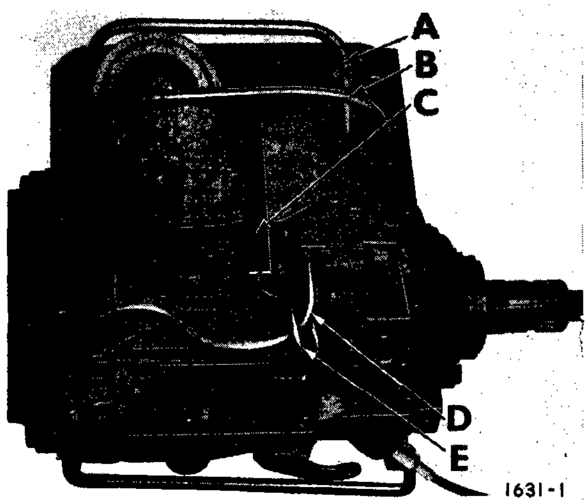


Fig. 116. View of Model 8 transmission inverted with oil pan removed.

A Front brake band oil tube
B Rear pump to regulator oil tube
C Retaining clip
D Control pressure oil tube
E Compensator oil tube

CONVERTER AND CONVERTER HOUSING

When installing the converter housing, the maximum allowable runout should not exceed 0·010" (0·25 mm.) for bore or face indicator readings relative to crankshaft centre line; however, it is preferable to have less than 0·006" (0·015 mm.) reading for both.

When installing the transmission to the converter housing and converter assembly, be certain that the converter lugs are properly aligned with the front pump drive gear, so that the parts will not be damaged by forcing impeller hub drive tangs against the pump drive gear lugs.

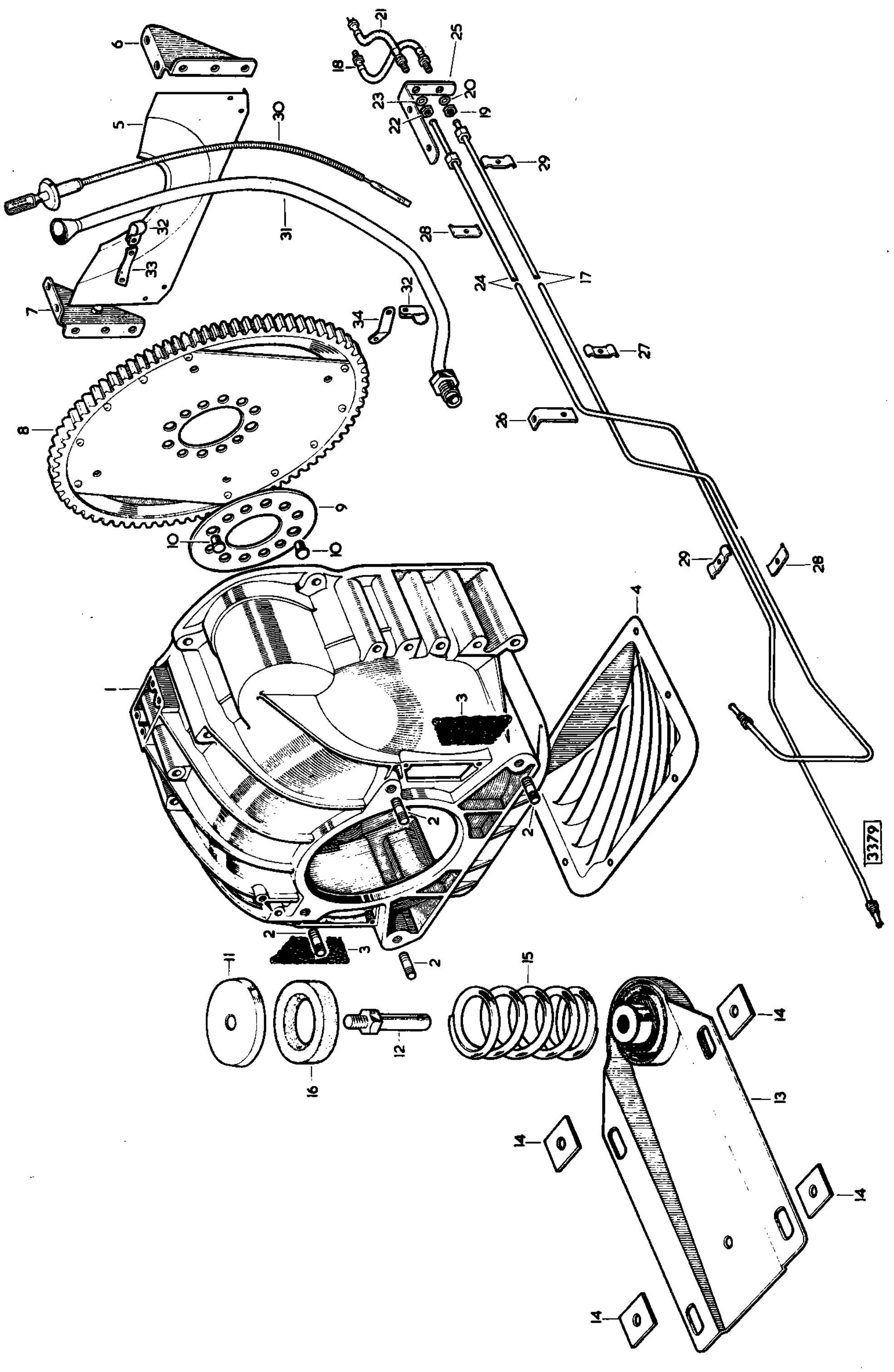


Fig. 117. Converter housing, transmission mounting, etc.

Key to Fig. 117

1. Converter housing
2. Stud
3. Stoneguard
4. Bottom cover
5. Front cover
6. Support bracket R.H.
7. Support bracket L.H.
8. Drive plate
9. Reinforcement plate
10. Dowel
11. Retainer
12. Pin
13. Channel support
14. Packing piece
15. Coil spring
16. Seat (rubber)
17. Oil outlet pipe
18. Flexible hose
19. Locknut
20. Shakeproof washer
21. Flexible hose
22. Locknut
23. Shakeproof washer
24. Oil return pipe
25. Bracket
26. Bracket
27. Clip
28. Clamp
29. Clip
30. Transmission
31. Tube assembly
32. Clip
33. Strut
34. Screw

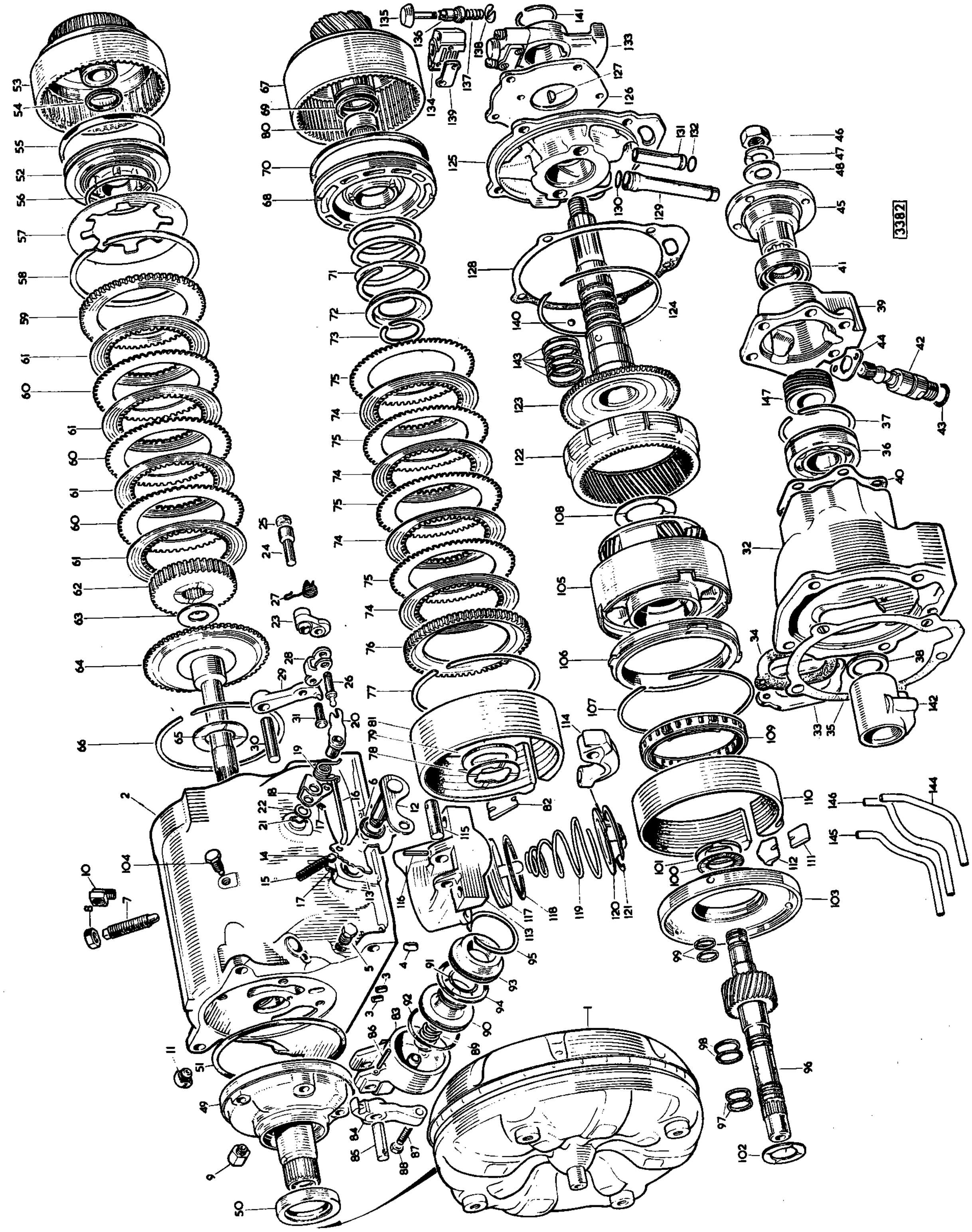


Fig. 118. Exploded view of the Model 8 transmission.

Key to Fig. 118

1. Converter
2. Transmission case
3. Plug
4. Dowel
5. Plug
6. Oil seal
7. Screw
8. Nut
9. Union
10. Union
11. Breather
12. Manual control shaft
13. Lever
14. Ball
15. Spring
16. Link
17. Clip
18. Torsion lever
19. Spring
20. Forked lever
21. Clip
22. Washer
23. Toggle lever
24. Toggle pin
25. Plug
26. Ball pin
27. Spring
28. Link
29. Pawl
30. Pivot pin
31. Pin
32. Extension case
33. Cover plate
34. Gasket
35. Gasket
36. Bearing
37. Snap ring
38. Spacing washer
39. Speedo driven gear housing
40. Gasket
41. Oil seal
42. Speedometer driven gear
43. "O" ring
44. Plate
45. Flange
46. Nut
47. Lockwasher
48. Special washer
49. Front pump
50. Oil seal
51. Sealing ring
52. Piston
53. Cylinder
54. Sealing ring
55. Sealing ring
56. Split ring
57. Spring
58. Snap ring
59. Pressure plate
60. Clutch plate
61. Clutch plate
62. Hub
63. Thrust washer
64. Input shaft
65. Thrust washer
66. Snap ring
67. Front drum
68. Piston
69. Sealing ring (inner)
70. Sealing ring (outer)
71. Spring
72. Spring seal
73. Snap ring
74. Clutch plate (friction)
75. Clutch plate (drive)
76. Pressure plate
77. Snap ring
78. Thrust washer (bronze)
79. Thrust washer
80. Needle bearing
81. Brake band (front drum)
82. Servo strut
83. Front servo body
84. Lever
85. Pivot pin
86. Roll pin
87. Screw
88. Nut
89. Return spring
90. Piston
91. "O" ring (small)
92. "O" ring (large)
93. Piston sleeve
94. Sealing ring
95. Snap ring
96. Forward sun gear
97. Sealing ring (front)
98. Sealing ring (centre)
99. Sealing ring (rear)
100. Thrust bearing
101. Thrust bea, ing race
102. Thrust washer (bronze)
103. Centre support
104. Screw
105. Planetary gears and rear drum
106. Outer race
107. Snap ring
108. Thrust washer
109. One-way clutch
110. Brake band (rear drum)
111. Servo strut
112. Anchor strut
113. Body (rear servo)
114. Lever
115. Shaft
116. Roll pin
117. Piston
118 "O" ring
119. Return spring
120. Plate
121. Snap ring
122. Ring gear
123. Mainshaft
124. Snap ring
125. Rear pump
126. Plate
127. Key
128. Gasket
129. Oil inlet tube
130. "O" ring
131. Oil outlet tube
132. "O" ring
133. Governor
134. Governor body
135. Governor weight
136. Governor spring
137. Spring
138. Retainer
139. Cover plate
140. Ball
141. Snap ring
142. Oil collector sleeve
143. Piston ring
144. Oil collector tube (front)
145. Oil collector tube (intermediate)
146. Oil collector tube (rear)
147. Speedometer drive gear

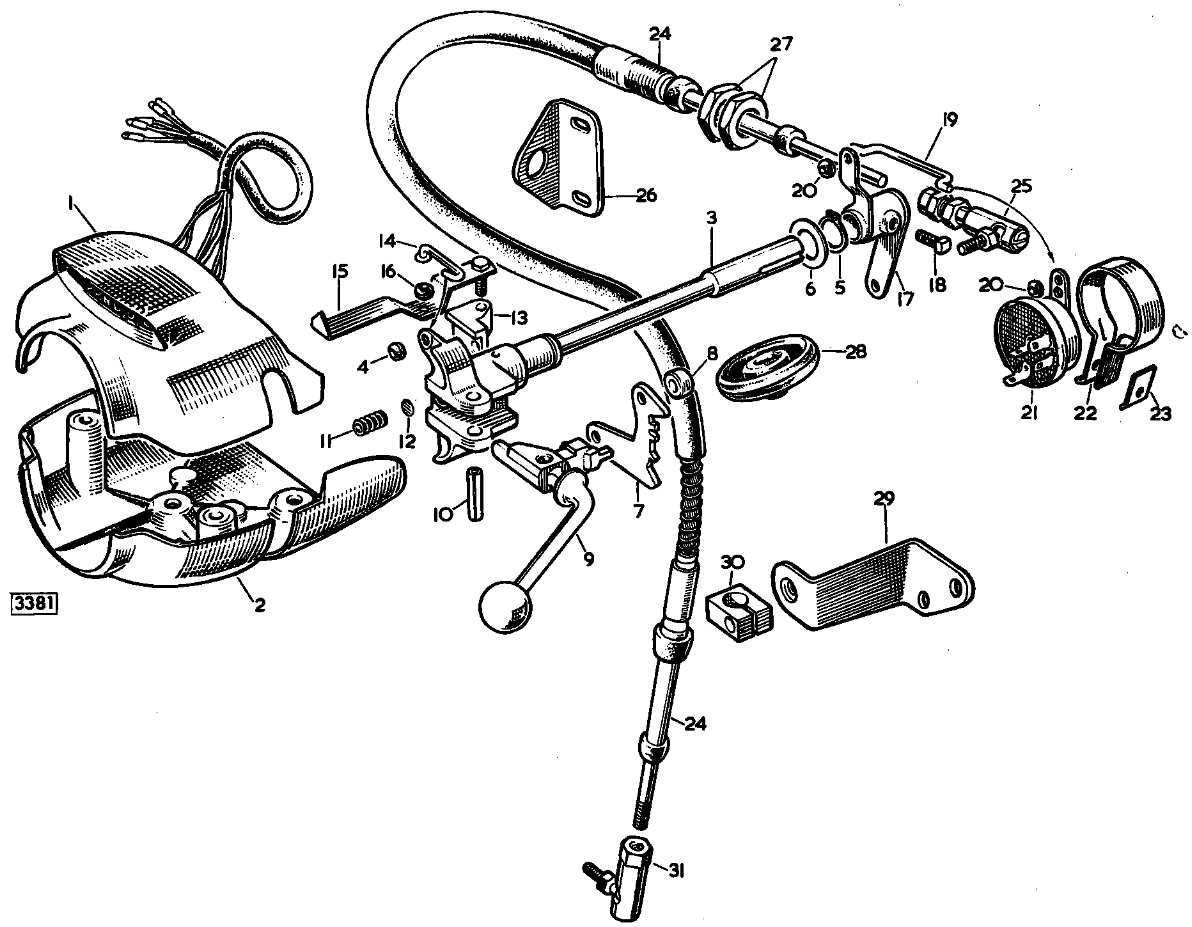


Fig. 119. The automatic transmission controls.

1. Upper switch cover
2. Lower switch cover
3. Selector lever housing and shaft
4. Grommet
5. Circlip
6. Washer
7. Gate
8. Distance piece
9. Selector lever
10. Pivot pin
11. Spring
12. Shim
13. Indicator arm bracket
14. Link
15. Gear indicator arm
16. Grommet
17. Lever assembly
18. Locking screw
19. Link
20. Grommet
21. Reverse light and starter cut-out switch
22. Clip
23. Stiffening angle
24. Gear control cable
25. End fitting
26. Abutment bracket
27. Nut
28. Grommet
29. Abutment bracket
30. Clamp
31. End fitting

SECTION G

PROPELLER SHAFTS

4·2 MARK 10 MODEL

INDEX

PROPELLER SHAFTS

DESCRIPTION

A divided propeller shaft of the open type is fitted, the rear end of the front shaft being supported in a rubber mounted ball bearing. The rear shaft has a universal joint at each end and a sliding spline encased in a rubber gaiter.

ROUTINE MAINTENANCE

The propeller shaft universal joints, sliding spline and rubber mounted centre bearing are prepacked with grease and require no periodic maintenance.

FRONT PROPELLER SHAFT

Position a jack under the rear engine mounting and raise it until contact is just made with the rear engine mounting bracket.

Mark the position of the rear mounting bracket in relation to the floor to facilitate reassembly.

Remove the four bolts, shakeproof washers and plain washers.

Lower the jack with great care until the coil spring is free.

Collect the four steel packing pieces located between the rear mounting bracket and floor.

Remove the four self-locking nuts from the front propeller shaft to gearbox flange.

Remove the four self-locking nuts from the rear flange of the front propeller shaft.

Compress the rear propeller shaft on the splines and lower the front end.

Remove the two self-locking nuts and washers from the front propeller shaft centre bearing bracket.

Disengage the centre bearing bracket from the body and, note the number of washers between the bearing bracket and tunnel floor.

Withdraw the front propeller shaft towards the back of the car.

REFITTING

Refitting is the reverse of the removal procedure. Propeller shaft flanges must be clean and locate with the spigot on the opposite flange.

REAR PROPELLER SHAFT

REMOVAL

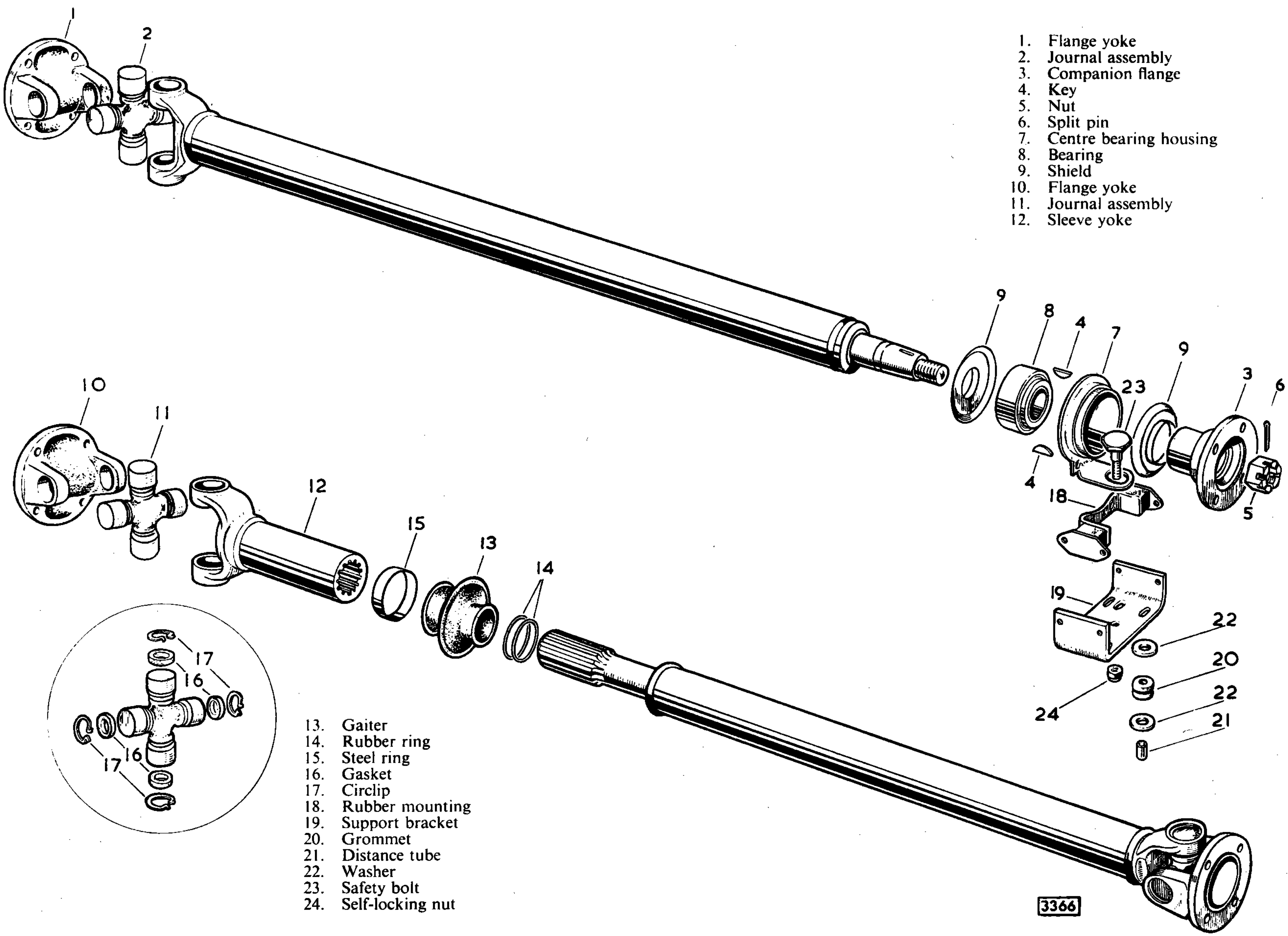
Remove the four self-locking nuts attaching the rear propeller shaft to the front propeller shaft.

Remove the four self-locking nuts attaching the propeller shaft to the rear axle assembly.

Compress the sliding splines and remove the propeller shaft.

REFITTING

Refitting is the reverse of the removal procedure. It is important to have clean propeller shaft flange faces and make sure that the spigot on one flange locates with the spigot on the other flange.



1. Flange yoke
2. Journal assembly
3. Companion flange
4. Key
5. Nut
6. Split pin
7. Centre bearing housing
8. Bearing
9. Shield
10. Flange yoke
11. Journal assembly
12. Sleeve yoke
13. Gaiter
14. Rubber ring
15. Steel ring
16. Gasket
17. Circlip
18. Rubber mounting
19. Support bracket
20. Grommet
21. Distance tube
22. Washer
23. Safety bolt
24. Self-locking nut

Fig. 1. Exploded view of the propeller shafts.

CENTRE BEARING

The centre bearing consists of a ball bearing pressed into a housing which has a plate attached; this assembly is mounted on the tail of the front propeller shaft with a dust shield interposed between the housing and shaft tubing. The bearing is retained on the shaft by a flange coupling which is bolted to the companion flange on the rear propeller shaft.

REMOVAL

Remove the front propeller shaft complete with the centre bearing as described on Page G.3.

DISMANTLING

The flange coupling is retained on the front propeller shaft by two Woodruff keys and is secured by a castellated nut and split pin.

Remove the split pin and castellated nut.

Draw off the flange coupling and remove the woodruff keys. Remove the outer shield.

Drive the shaft through the bearing and housing and press the bearing out of the housing.

Remove the two self-locking nuts and bolts securing the body mounting bracket to the propeller shaft bearer plate.

Remove the four setbolts and shakeproof washers securing the mounting rubbers to the body mounting bracket.

Withdraw the mounting rubbers from the body mounting bracket.

REASSEMBLY

Reassembly is the reverse of the dismantling procedure.

REFITTING

Refitting is the reverse of the removal procedure. Note the procedure detailed under the heading "Divided Propeller Shaft Alignment".

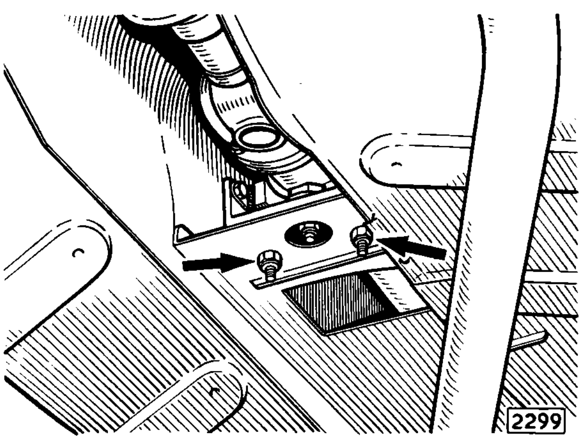


Fig. 2. Showing the centre bearing bracket securing bolts.

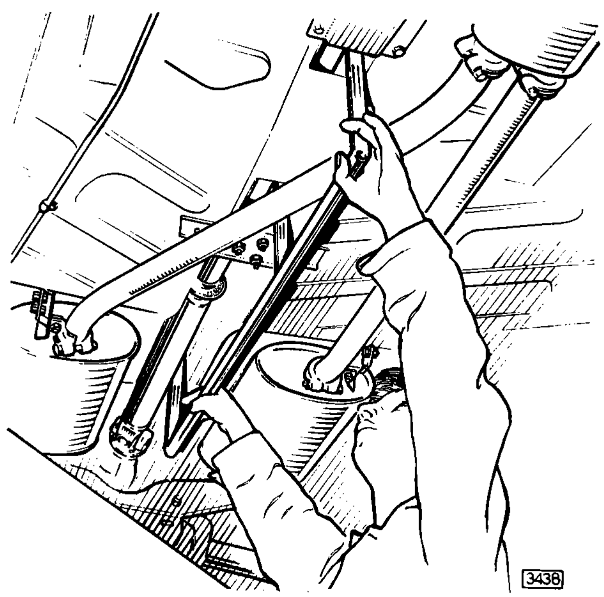


Fig. 3. Checking the horizontal alignment.

DIVIDED PROPELLER SHAFT ALIGNMENT

The alignment of the divided propeller shaft is most important and if removal of the engine or front propeller shaft has taken place, the following checks should be made on replacement. Failure to do so may result in transmission judder when taking up the drive from a standing start.

Note: Before carrying out any checking or rectification work.

(a) Ensure that the engine stabiliser at the rear of the cylinder head is disconnected. To disconnect the engine stabiliser, remove the self-locking nut and flanged washer from the top of the stabiliser. Screw the lower washer down the centre pin by engaging a thin bladed screwdriver in the slot in the washer through the centre hole of the rubber mounting.

(b) Check that the rear engine mounting spring is not distorted. Note that the holes in the rear engine mounting cradle are slotted.

CHECKING THE ALIGNMENT—IN THE HORIZONTAL PLANE

To check the alignment it is advisable to make up a simple checking jig as shown in Fig. 4. The jig consists of 3 pieces of flat bar $8'' \times \frac{7}{8}'' \times \frac{3}{16}''$ ($20{\cdot}5 \times 2{\cdot}2 \times 0{\cdot}48$ cm.) which are welded, exactly in line, to a piece of tube $1\frac{1}{2}''$ (3·8 cm.) outer diameter at the distances shown in the illustration.

Offer up the jig to the front and rear propeller shafts as illustrated in Fig. 3, to check the propshafts in the horizontal plane. All three legs should contact the propeller shafts.

REMEDY

If any adjustment is necessary, add or subtract shim washers between the centre bearing bracket and propeller shaft tunnel (see Fig. 1). Add shims to raise and remove to lower the centre bearing.

CHECKING THE ALIGNMENT—IN THE VERTICAL PLANE

Using a jig already mentioned under "Checking the Alignment—in the Horizontal Plane", place it in contact with the sides of the front and rear propeller shafts (see Fig. 5).

An alternative method of checking the alignment is to use three plumb bobs and sight along three cords. Two cords should be positioned at the front and rear of the propeller shaft tube and the remaining cord at the rear end of the rear propeller shaft tube.

REMEDY

Alignment of the propeller shafts is carried out at the centre bearing bracket by the two elongated holes through which the setscrews pass to secure the bracket to the body floor. The position of the centre bearing bracket can then be adjusted to allow the propeller shafts to be aligned.

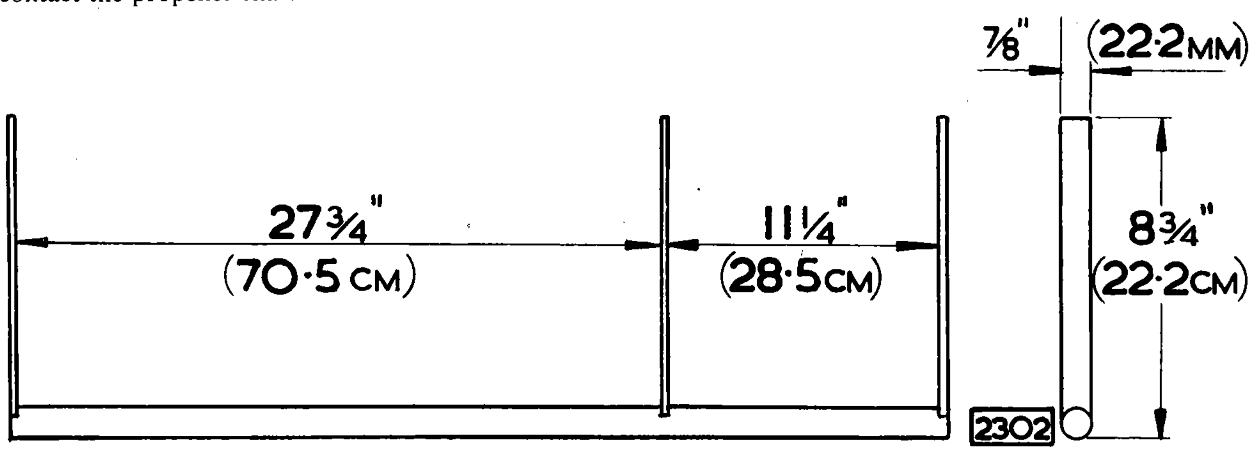


Fig. 4. The propeller shaft alignment jig.

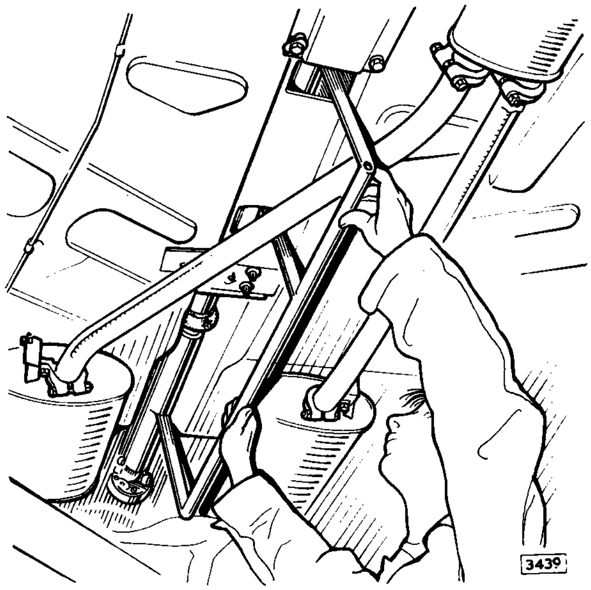


Fig. 5. *Checking the vertical alignment.*

ADJUSTMENT OF ENGINE STABILISER

After having carried out the above procedure adjust the stabiliser as follows:

(a) Screw the lower flanged washer up the stabiliser pin **until the flange contacts the bottom of the stabiliser rubber mounting.** The washer is slotted on its upper face and can be screwed up the pin by engaging a thin bladed screwdriver in the slot through the centre hole of the rubber mounting.

(b) Fit the upper flanged washer and tighten down with the self-locking nut.

Failure to observe the above procedure may cause engine vibration and/or fouling of the gearbox in its cowl owing to the engine being pulled up on its mountings.

THE UNIVERSAL JOINTS

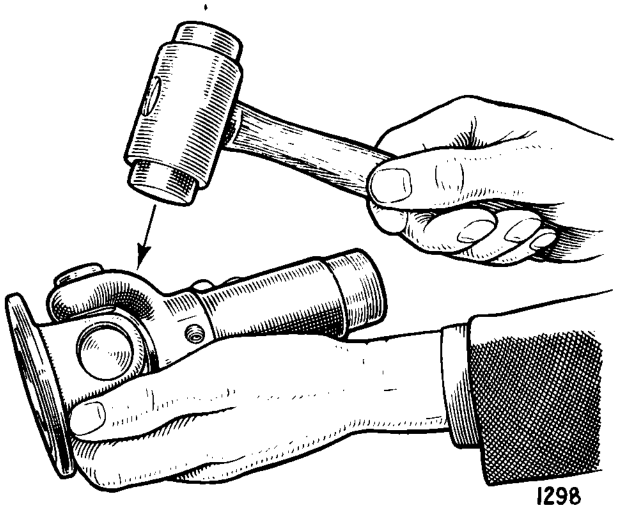


Fig. 6. *Tapping the yoke to remove the bearing.*

EXAMINE AND CHECK FOR WEAR

The parts most likely to show signs of wear after long usage are the bearing races and spider journals. Should looseness in the fit of these parts, load markings or distortion be observed they should be renewed as a unit as worn needle bearings used with a new spider journal or new needle bearings with a worn spider journal will wear more rapidly, making another replacement necessary in a short time.

It is essential that the bearing races are a light drive fit in the yoke trunnion.

In the rare event of wear having taken place in the yoke cross holes, the holes will have become oval and the yokes must be removed.

In the case of wear of the cross holes in a fixed yoke, which is part of the tubular shaft, only in cases of emergency should these be replaced. They should normally be replaced by a complete assembly.

The other parts likely to show signs of wear are the splined sleeve yoke and splined shaft. A total of 0·004″ (0·1 mm.) circumferential movement, measured on the outside diameter of the spline, should not be exceeded. If wear has taken place above this limit the complete propeller shaft should be replaced.

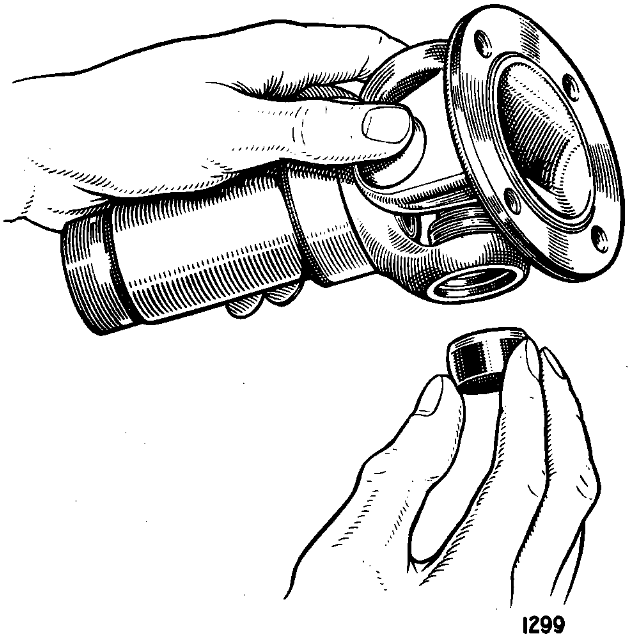


Fig. 7. Withdrawing the bearing from the universal joint.

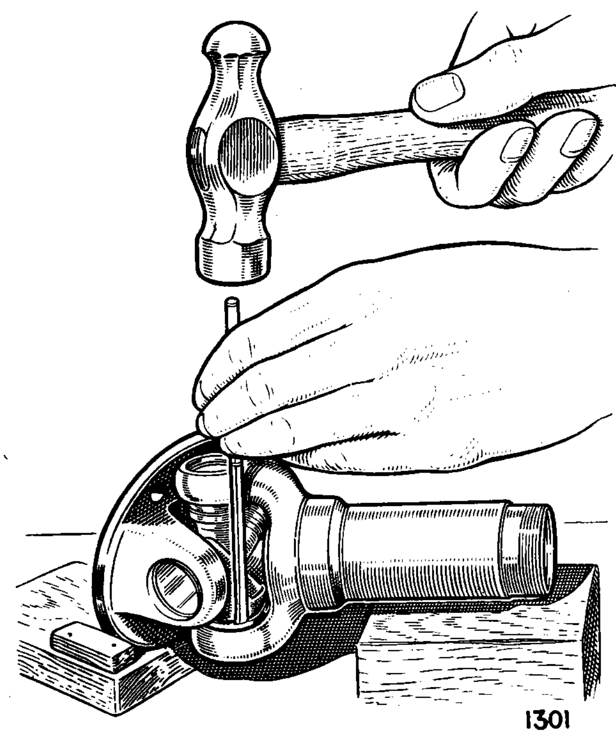


Fig. 8. Tapping a bearing out with a small diameter bar.

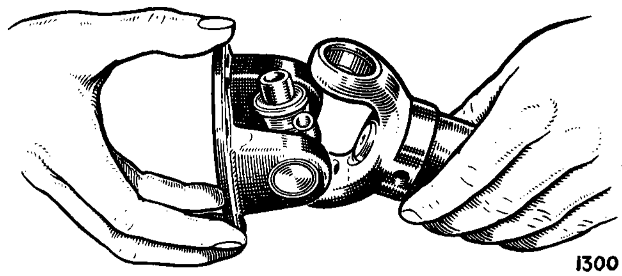


Fig. 9. Separating the universal joint yokes.

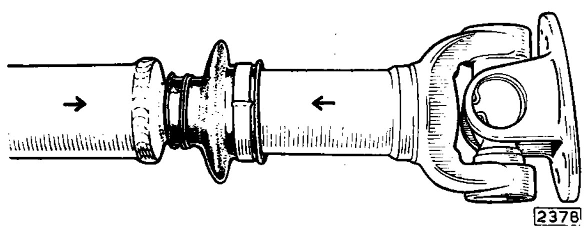


Fig. 10. Showing the arrows on the sliding joint and drive shaft.

DISMANTLING

To remove the sliding joint from the splined shaft, unscrew the dust cap and pull back the cork washer.

Clean the paint and dirt from the rings and top of bearing races. Remove all the snap rings by pinching together with a pair of pliers and prising out with a screwdriver. If a ring does not snap out of its groove readily, lightly tap end of bearing race to relieve the pressure against the ring.

Hold the joint in the hand and with a soft nosed hammer tap the yoke lug as shown in Fig. 6.

The top bearing will gradually emerge and can finally be removed with the fingers (see Fig. 7).

If necessary, tap the bearing race from inside with a small diameter bar, taking care not to damage the bearing race (see Fig. 8).

Repeat this operation for the opposite bearing. The splined sleeve yoke or flange yoke can now be removed. Rest the two exposed trunnions on wood or lead blocks, then tap yoke with a soft nosed hammer to remove the two remaining bearing races. Wash all parts in petrol.

ASSEMBLING

Insert the journal cross into the flange yoke, tilting it to engage in the yoke bores.

Fill each bearing bush one-third full with grease of the type recommended.

Fit one of the bearing races in the yoke bore, and using a soft, round drift about $\frac{1}{32}''$ (0·8 mm.) smaller in diameter than bearing diameter, tap it into the yoke bore. Fit a circlip and ensure it is correctly located in the groove.

Assemble the opposite bearing into the yoke bore introducing the bearing from the bottom. Repeat this operation for the other two bearings, and fit new circlips.

Wipe off any superfluous grease from the last unassembled peg prior to fitting the last race.

Proceed to fit the unit package assembly at the other end in a similar manner.

Ensure that all the circlips are sitting correctly in their respective grooves. Check the races are bearing against the circlip. Check for free movement of the journals.

Important

When replacing the sliding joint it must be refitted with its yoke in line with the fixed yoke at the end of the propeller shaft tube. Arrows are stamped on the two parts to facilitate alignment. (See Fig. 10).

SECTION H

REAR AXLE

4·2 MARK 10 MODEL

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INDEX *(continued)*

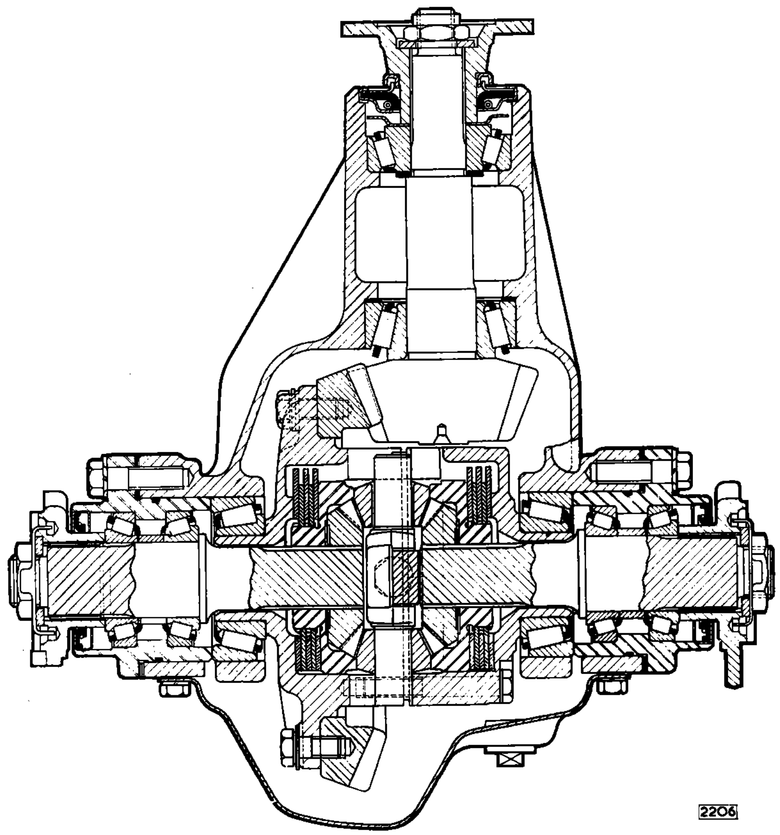


Fig. 1. Sectioned view of the rear axle unit (early cars).

REAR AXLE

DESCRIPTION

The rear axle unit (Fig. 1) is of the Salisbury 4.HU type. It is mounted independently from the hubs and road wheels and is fitted with the Thornton "Powr-Lok" differential unit. Short drive shafts with universal joints at each end are coupled to the axle output shafts. These output shafts also provide a mounting for the discs of the inboard mounted disc brakes.

The axle gear ratio is stamped on a tag attached to the assembly by one of the rear cover screws. The axle serial number is stamped on the underside of the gear carrier housing.

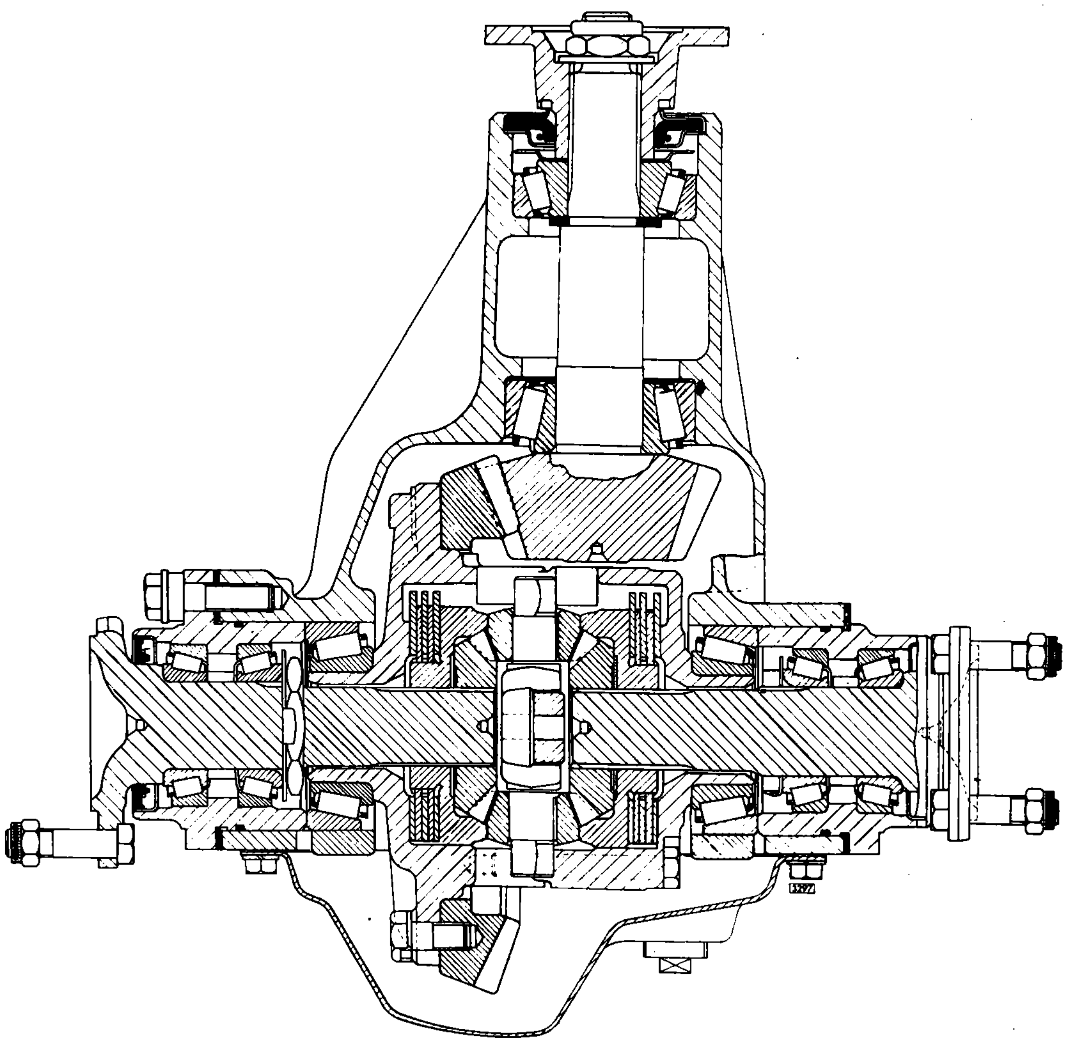


Fig. 2. Sectioned view of the rear axle unit (later cars).

DATA

Output shaft end float	0·001" – 0·003" (0·02 – 0·07 mm.)
Differential bearing preload	0·006" – 0·010" (0·15 – 0·25 mm.) total shim allowance
Pinion bearing preload	8 – 12 lb. in. (0·09 – 0·14 kgm.).
Backlash	As etched on drive gear— 0·004" (0.10 mm.)
Tightening torque	
—Drive gear bolts	70 – 80 lb. ft. (9·7 – 11·1 kgm.).
—Differential bearing cap bolts	60 – 65 lb. ft. (8·3 – 9·0 kgm.).
—Pinion nut	120 – 130 lb. ft. (16·6 – 18·0 kgm.).
Thornton "Powr-Lok" differential bolts	40 – 45 lb. ft. (5·5 – 6·2 kgm.).

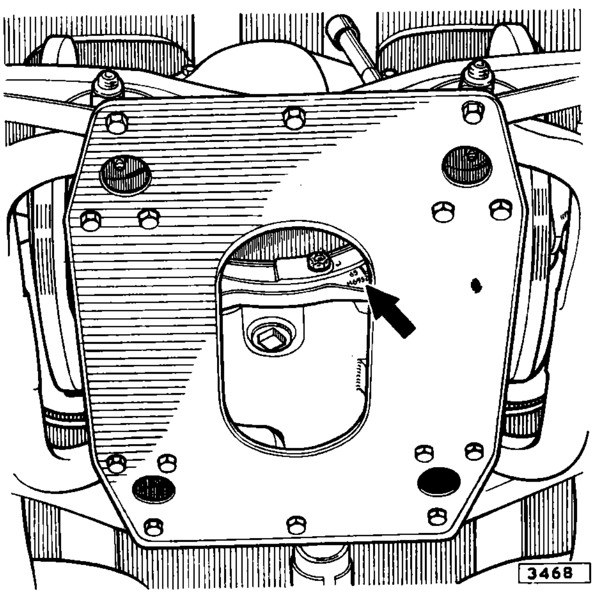


Fig. 3. Location of the axle serial number.

Axle ratios

Standard model	3·54:1 (46 × 13)
Automatic transmission model	3·54:1 (46 × 13)
Overdrive model	3·77:1 (49 × 13)

Reconditioning Scheme (Great Britain only)

Although full servicing instructions for the rear axle are given in this section it is recommended that, wherever possible, advantage is taken of the factory reconditioning scheme particularly in view of the intricate adjustments and the number of special tools required.

Reconditioned axles are supplied on an exchange basis and comprise an axle complete less half shafts, hubs and brake details; rear axles for overhaul should therefore be returned in this condition.

Recommended Lubricants

Component	**Mobil**	**Castrol**	**Shell**	**Esso**	**B.P.**	**Duckham**	**Regent** Caltex/ Texaco
Rear axle	Mobilube GX 90	Castrol Hypoy	Spirax 90 EP	Esso Gear Oil GP 90/140	Gear oil SAE 90 EP	Hypoid 90	Multigear Lubricant EP 90
Rear wheel bearings	Mobilgrease MP	Castrolease LM	Retinax A	Esso Multi-purpose Grease H	Energrease L2	LB10	Marfak All Purpose

Capacities

Imperial	**U.S.**	**Litres**
$2\frac{3}{4}$ pints	$3\frac{1}{4}$ pints	1·5

ROUTINE MAINTENANCE

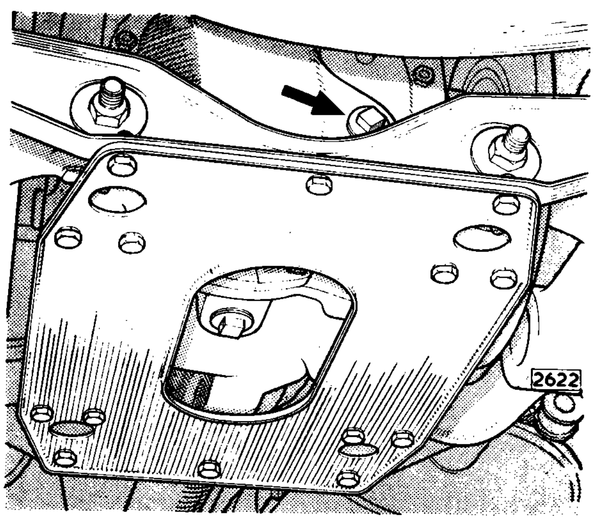


Fig. 4. Rear axle level and er plug.

EVERY 3,000 MILES (5,000 KM.)

Checking Rear Axle Oil Level

Check the level of the oil in the rear axle with the car standing on level ground.

A combined filler and level plug is fitted in the rear of the axle casing accessible from underneath the car. Clean off any dirt from around the plug before removing .

The level of the oil should be to the bottom of the filler and level plug hole; use only HYPOID oil of the correct grade and since different brands may not mix satisfactorily, draining and refilling is preferable to replenishing if the brand of oil in the axle is unknown.

Rear Axle Half Shafts

The rear axle half shafts are fitted with "sealed for life" universal joints and do not require periodic lubrication.

EVERY 12,000 MILES (20,000 KM.)

Changing the Rear Axle Oil

The draining of the rear axle should be carried out at the end of a run when the oil is hot and will therefore flow more freely. The drain plug is situated in the base of the differential casing.

After the oil has drained, replace the drain plug and refill the rear axle with the recommended grade of oil after removal of the combined filler and level plug situated in rear cover.

The level of the oil should be to the bottom of the filler and level plug hole when the car is standing on level ground.

Use only HYPOID oil of the correct grade.

REAR AXLE—OIL CHANGING

Do NOT drain and refill the rear axle at the first 1,000 mile (1,600 km.) free service. Change the rear axle oil after the car has completed 6,000 miles (10,000 km.) and thereafter at the recommended intervals.

THE AXLE UNIT

REMOVAL

The following removal and refitting operations are described assuming the rear suspension is removed from the car. If it is possible for the operations to be carried out with the rear suspension in position on the car the fact will be noted in the text.

Remove the rear suspension assembly from the car (as described in Section K "Rear Suspension"). Invert the suspension assembly on a bench and remove the 14 bolts securing the tie plate. Remove the tie plate and disconnect the four hydraulic damper and spring units. Remove the four self-locking nuts securing the half shaft universal joint to the brake disc and axle output shaft flange. Owing to heat dissipation from the brake disc, it is most important that the locknuts fitted on the output shaft flange studs are of the metal and not nylon self-locking type. Withdraw the half shaft from the bolts noting the number of camber shims. Remove one self-locking nut from the inner wishbone fulcrum shaft and drift out the shaft. Remove the hub, half shaft, wishbone and radius arm assembly and repeat the procedure at the other side. Disconnect the hydraulic feed pipes at the brake calipers. Turn the suspension assembly over and remove the locking wire from the four differential carrier mounting bolts. Unscrew the mounting bolts and remove the cross beam from the differential carrier by tilting forward over the nose of the pinion.

REFITTING

Refitting is the reverse of the removal procedure, it should be noted however, that the inner wishbone fulcrum shaft self-locking nut should be tightened to a torque of 55 lb. ft. (7·6 kgm.). The four differential carrier mounting bolts on the top of the cross beam should be tightened to a torque of 75 lb. ft. (10·4 kgm.).

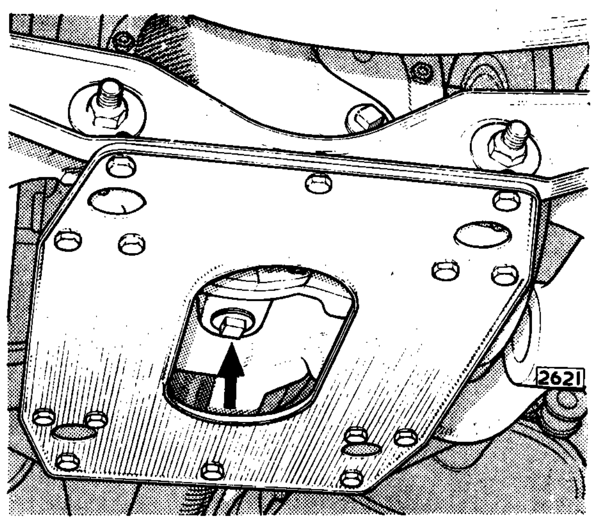


Fig. 5. Rear axle drain plug.

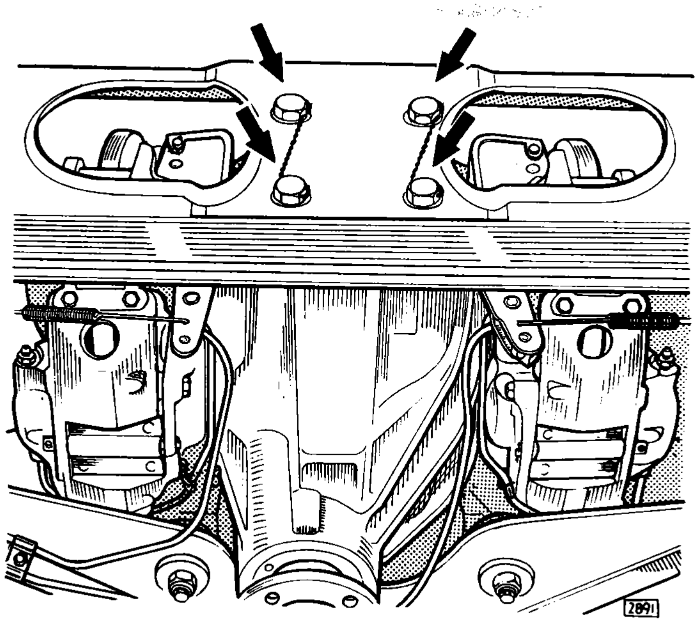


Fig. 6. Showing the axle casing top mounting bolts.

THE REAR HUBS

REMOVAL

It is not necessary to remove the rear suspension unit from the car to carry out this operation.

Jack up and support the rear end of the car and remove the appropriate road wheel. Withdraw the split pin and remove the castellated nut and washer from the half shaft. Using the extractor, Special Tool No. JD IC as shown in Fig. 8, withdraw the hub and hub carrier assembly from the splined end of the half shaft retaining the inner oil seal track and end float spacer. Remove the lower wishbone outer fulcrum shaft (as described in Section K "Rear Suspension") and remove the hub and hub carrier assembly.

Note: Since it is necessary to press the hub assembly onto the half shaft before refitting the rear suspension assembly, remove the half shaft as follows:— Remove the front hydraulic damper and spring unit (as described in Section K "Rear Suspension"). Remove the four steel type self-locking nuts securing the half shaft inner universal joint to the axle shaft output flange and brake disc. Withdraw the half shaft from the bolts noting the number of camber shims fitted.

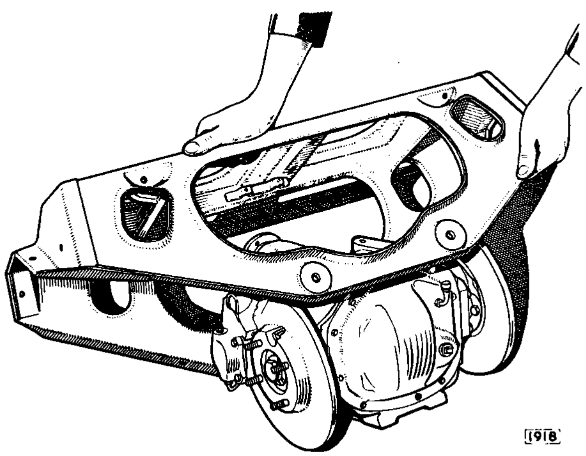


Fig. 7. Removing the cross beam from the axle unit.

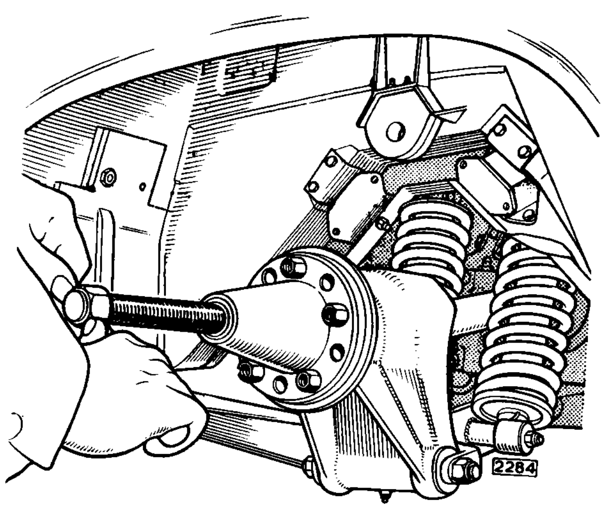


Fig. 8. Removing the rear hub with the extractor (Churchill Tool No. JD.IC).

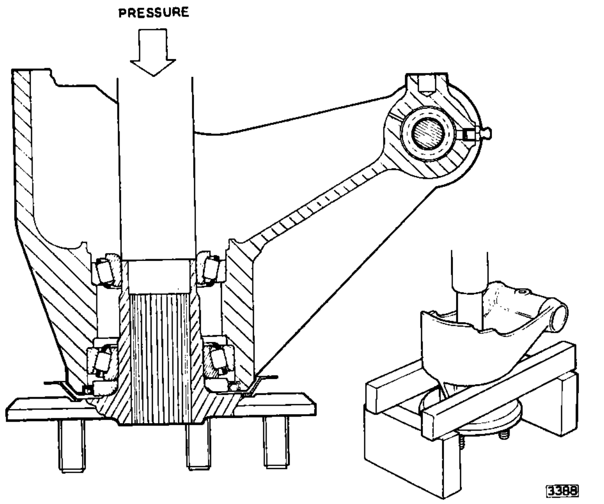


Fig. 9. Pressing the hub from the hub carrier

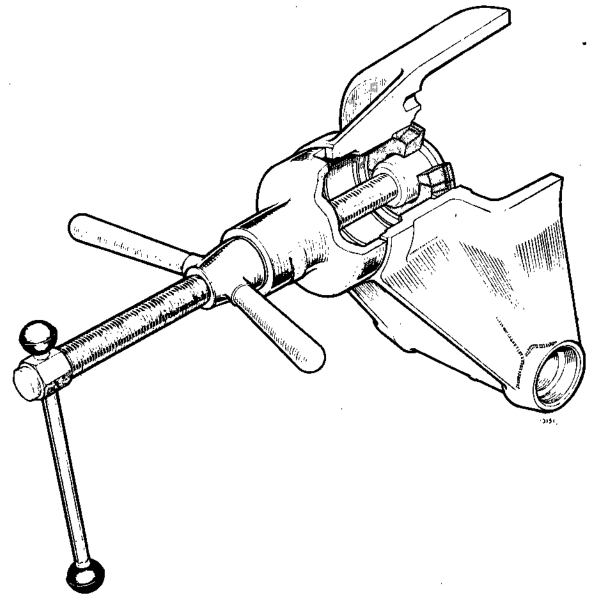


Fig. 11. Replacing the hub bearing outer races using the special tool, Churchill Tool No. J.20A with adaptor Churchill Tool No. J.20A—1.

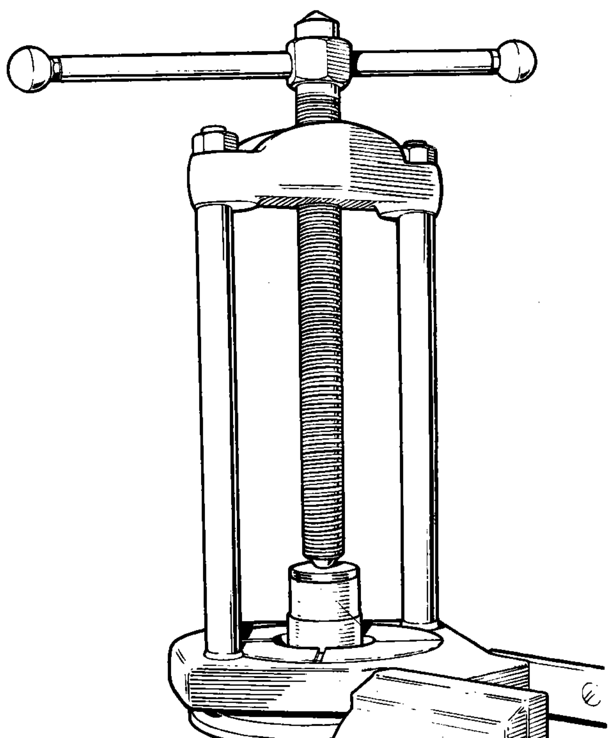


Fig. 10. Removing the inner race from the hub using Churchill Tool No. J.16B with multi-purpose hand press Churchill Tool No. SL.14.

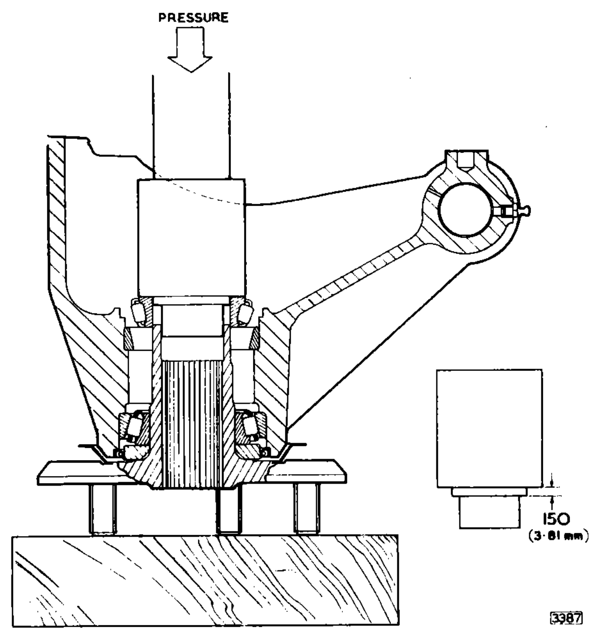


Fig. 12. Pressing in the hub inner bearing inner race using the master spacer (Churchill Tool No. J.15).

DISMANTLING

Invert the hub carrier so that the inner hub bearing is at the top and press out the hub (Fig. 9) with the outer bearing inner race and the outer oil seal track in place, discarding the outer oil seal. Remove the three setscrews and withdraw the water deflector. Prise out the inner oil seal and remove the inner bearing inner race (Fig. 10). Drift out the outer races of the inner and outer bearings if necessary. Withdraw the outer bearing inner race with a suitable extractor.

ASSEMBLING

If new bearings are to be fitted, press new inner and outer bearing outer races into the hub carrier ensuring that they seat correctly in their recesses.

With the hub carrier held so that the outer bearing will be at the top, place the outer bearing inner race in position and press the outer oil seal into its recess (Fig. 11). Fit the water deflector and press the hub with the outer oil seal track in position into the outer bearing inner race until the hub is fully home.

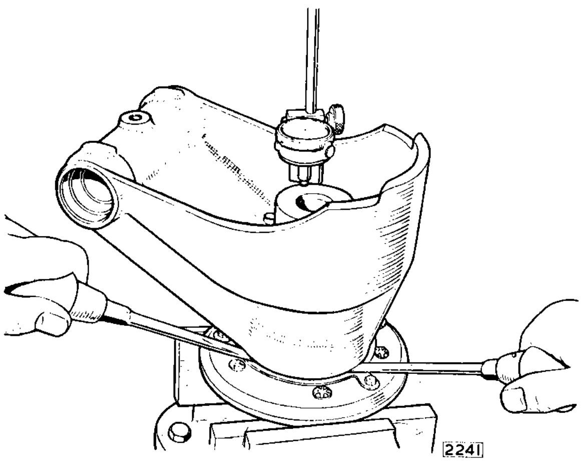


Fig. 13. Checking the hub bearing end-float with a dial test indicator (Churchill Tool No. J.13).

Hub Bearing End Float

Hold the hub and hub carrier vertically in a hand press with the inner end of the hub uppermost. Place the inner bearing inner race on the hub, fit the master spacer (Special Tool No. J.15) into the race and press the race onto the hub (Fig. 12) until the master spacer contacts the hub. This will ensure a certain amount of end float. Remove the hub and hub carrier from the hand press and secure in a vice in order to measure the end float.

With the inner end of the hub uppermost, and the master spacer in position as before, fit a dial gauge (Special Tool No. J.13) to the hub as shown in Fig. 13. Tap the hub carrier downwards, zero the dial gauge and using two screwdrivers or similar levers between the hub and hub carrier, move the hub carrier upwards to its fullest extent. Note the reading on the dial gauge. Having determined the measured end float, a spacer must be fitted in place of the special collar to give an end float of 0·002″–0·006″ (0·051 –0·152 mm.). Spacers are supplied in thicknesses of 0·109″ – 0·151″ (2·77 – 3·87 mm.) in steps of 0·003″ (0·076 mm.) as shown in the following table:—

Spacer Letter	**Thickness** inches	mm.
A	0·109	2·77
B	0·112	2·85
C	0·115	2·92
D	0·118	3·00
E	0·121	3·07
F	0·124	3·15
G	0·127	3·23
H	0·130	3·30
J	0·133	3·38
K	0·136	3·45
L	0·139	3·53
M	0·142	3·61
P	0·145	3·68
Q	0·148	3·75
R	0·151	3·87

For example, assume the end float measured to be 0·025″ (0·64 mm.). Subtract the nominal end float of 0·004″ (0·10 mm.) from the measured end float giving 0·021″ (0·53 mm.). Since the Master Spacer is 0·150″ (3·81 mm.) thick, the thickness of the spacer to be fitted will be 0·150″ – 0·021″ i.e. 0·129″ (3·28 mm.). The nearest spacer is 0·130″ (3·30 mm.) so a letter H spacer should be fitted.

When the hub assembly and half shaft have been refitted to the rear suspension the end float should be checked using the dial indicator as shown in Fig. 15.

Fitting the Hub Assembly to the Half Shaft

To fit the hub assembly to the half shaft it will be necessary to use a hand-press (see Fig. 14). Ensure that both the splines of the half shaft and the hub are free of grease by using a suitable solvent. Place the inner oil seal track and end float spacer on the half shaft. Apply a drop or two of "Loctite" (available in 10 cc. bottles, Part No. 9035) to the half shaft splines for about an inch from the threaded end using a small paint brush to ensure even spreading. Only use "Loctite" sparingly as no additional benefit will be achieved by using large amounts. Introduce the half shaft into the hub and engage the splines. Place the assembly on the hand-press and press the hub onto the half shaft. Fit the washer and castellated nut, tighten to 140 lb. ft. (19·3 kgm.) torque and fit the split pin.

Note: To obtain the best results from the "Loctite" sealant, the joint should be allowed to set for 4 to 12 hours, that is, this period should be allowed to elapse before the car is run.

REFITTING

The hub assembly and half shaft are refitted to the rear suspension as described under "Half shaft Refitting".

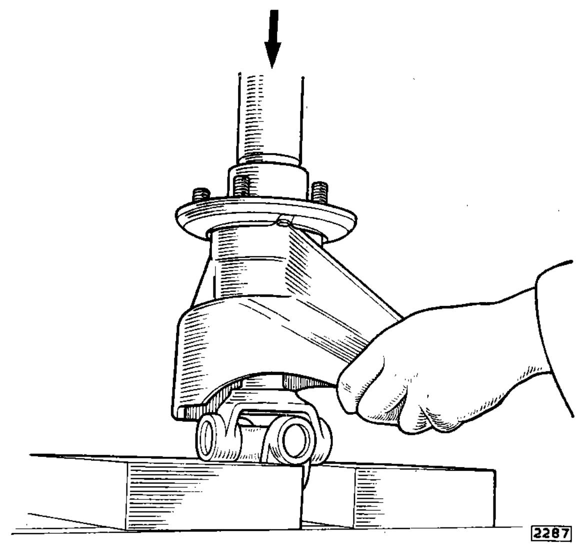


Fig. 14. Fitting the hub to the halfshaft using a press

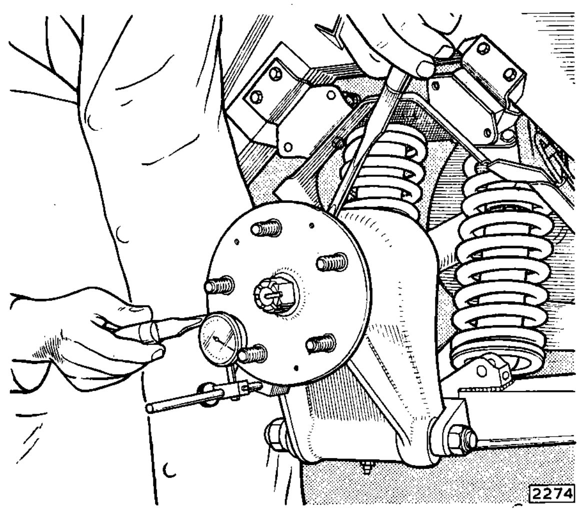


Fig. 15. Checking the hub bearing end-float when in position (Churchill Tool No. J.13).

THE HALFSHAFTS

REMOVAL

Proceed as described under Rear Hub Removal until the hub assembly can be withdrawn. Remove the front hydraulic damper and spring unit (as described in Section K "Rear Suspension"). Remove the four steel type self-locking nuts securing the half shaft inner universal joint to the axle output shaft flange and brake disc. Withdraw the half shaft from the bolts noting the number of camber shims fitted.

REFITTING

Refit the hub assembly to the half shaft as described in the Rear Hub section and proceed as follows:—

Replace the camber shims and place the half shaft and hub into position with the half shaft inner universal joint over the four bolts. Fit the four steel-type self-locking nuts and tighten up. Refit the front hydraulic damper and spring unit (as described in Section K "Rear Suspension").

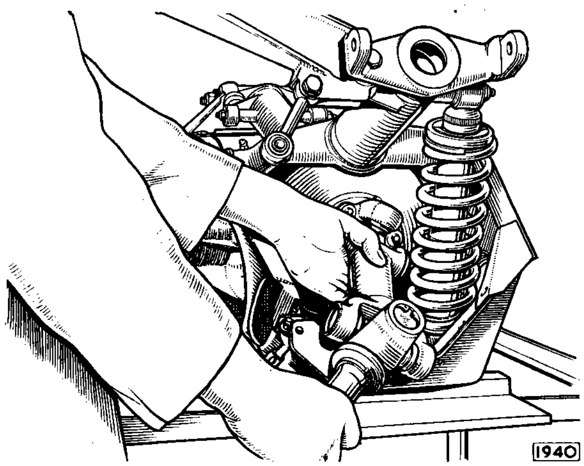


Fig. 16. Withdrawing the half-shaft

Refit the lower wishbone outer fulcrum shaft (as described in Section K "Rear Suspension"). If the half shaft has been renewed, it will be necessary to refer to Section K "Rear Suspension" for checking the wheel camber.

THE UNIVERSAL JOINTS

EXAMINE AND CHECK FOR WEAR

The part most likely to show wear after long usage are the bearing races and spider journals. Should looseness in the fit of these parts, load markings or distortion be observed, they should be renewed as a unit, as worn needle bearings used with a new spider journal or new needle bearings with a worn spider journal will wear more rapidly, making another replacement necessary in a short time.

It is essential that the bearing races are a light drive fit in the yoke trunnion.

In the rare event of wear having taken place in the yoke cross holes, the holes will have become oval and the yokes must be removed.

In the case of wear of the cross holes in a fixed yoke, which is part of the tubular shaft, only in a case of emergency should these be replaced. They should normally be replaced by a complete assembly.

DISMANTLING

Clean the paint and dirt from the rings and top of bearing races. Remove all the snap rings by pinching together with a pair of pliers and prising out with a screwdriver. If a ring does not snap out of its groove readily lightly tap the end of the bearing race to relieve the pressure against the ring.

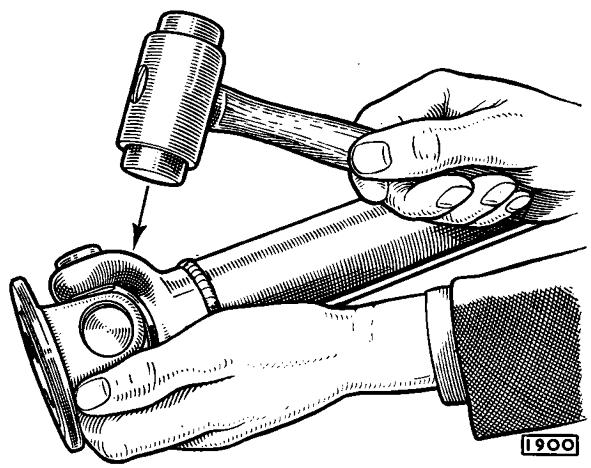


Fig. 17. Tapping the yoke to remove the bearing.

Hold the joint in the hand and with a soft nosed hammer tap the yoke lug as shown in Fig. 17.

The bearing will gradually emerge and can finally be removed with the fingers (see Fig. 18).

If necessary tap the bearing race from inside with a small diameter bar taking care not to damage the bearing race (see Fig. 19).

Repeat the operation for the opposite bearing. The flange yoke can now be removed. Rest the two exposed trunnions on wood or lead blocks, then tap the yoke with a soft nosed hammer to remove the two remaining bearing races. Wash all parts in petrol.

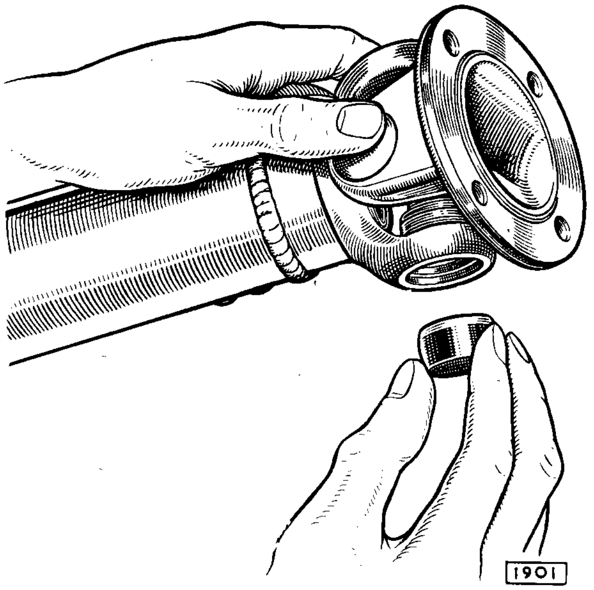


Fig. 18. Withdrawing the bearing from the universal joint.

ASSEMBLING

Insert the journal in the yoke holes and using a soft round drift with a flat face $\frac{1}{32}$" (0·8 mm.) smaller in diameter than the hole in the yoke, tap the bearings into position. Repeat this operation for the other three bearings. Fit new snap rings and ensure that they are correctly located in their grooves. If the joint appears to bind, tap lightly with a wooden mallet to relieve any pressure of the bearings on the end of the journal.

Should any difficulty be encountered when assembling the needle rollers in the housing, smear the wall of the race with vaseline. It is advisable to install new cork gaskets and gasket retainers on the spider assembly using a tubular drift.

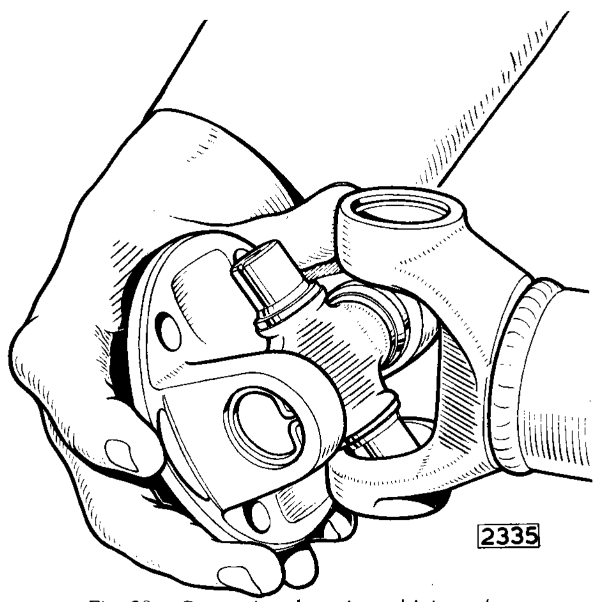


Fig. 20. Separating the universal joint yoles.

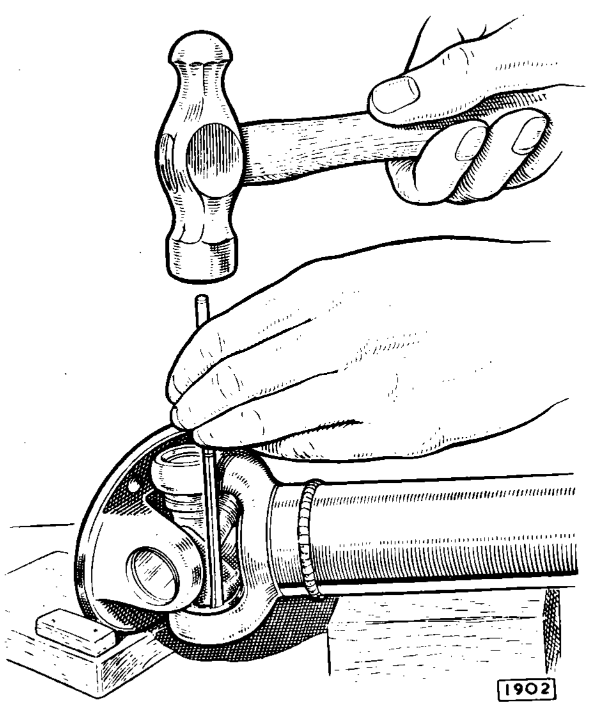


Fig. 19. Tapping out a bearing with a small diameter bar.

THE DIFFERENTIAL UNIT

The Thorton "Powr-Lok" limited slip differential is fitted as standard.

Warning

When a car is equipped with a Thornton "Powr-Lok" differential the engine must NOT be run with the car in gear and one wheel off the ground, otherwise, owing to the action of the differential, the car may drive itself off the jack or stand.

If it is desired to turn the transmission by running the engine with the car in gear **both** wheels must be jacked up clear of the ground.

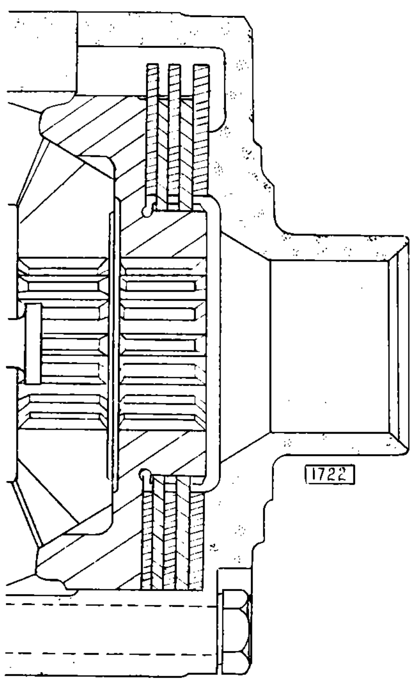


Fig. 21. Section of the differential unit showing the friction discs and plates.

DESCRIPTION

The limited slip differential has two pinion shafts with two mates to each shaft. The pinion shafts are mounted at right angles to each other but do not make contact at their intersection. Double ramps with flat surfaces at each end of the pinion shafts, mate with similar ramps in the differential case. Clearance in the differential case permits slight peripheral movement at the ends of the pinion shafts.

When a driving force is applied to the differential case, the pinion shafts, pinion mates and differential side gears splined to the axle shafts, rotate as a unit. Resistance to turning at the wheel forces the pinion shafts to slide up the differential case ramps, pushing the pinion shafts and side gears apart. As the pinion shafts move apart they apply load to the clutch plates thus restricting turning between the axle shafts and the differential case. Both axle shafts have now become clutched to the differential case to a varying degree dependent upon the amount of torque transmitted. This in effect locks the axle shafts to the differential case, in the normal straight ahead driving position, which reduces spinning of either rear wheel should it leave the road or encounter poor traction such as ice, snow, sand, loose gravel or oil patches.

Due to the lateral movement of the pinion shafts in the differential case, a little more backlash may be apparent in a limited slip rear axle. Slight chatter may also occur when one wheel is on a slippery surface, this is due to surge torque.

PRINCIPLE OF OPERATION

The conventional differential divides the load equally between both driving wheels. In this connection, it should be remembered that the conventional differential will always drive the wheel which is easiest to turn. This is a definite disadvantage under adverse conditions of driving where the traction of one wheel is limited.

The main purpose of the limited slip differential is to overcome this limit-action. Many times the torque of the slipping wheel is provided to the driving wheel, thus permitting improved operation under all conditions of driving. The torque is transmitted from the differential case to the cross pins and differential pinions to the side gears in the same manner as torque is applied in the conventional differential.

The driving forces move the cross pins B, Fig. 22, up the ramp of the cam surfaces C, applying a load to the clutch rings D and restricts turning of the differential through the friction clutches E. This provides a torque ratio between the axle shafts which is based on the amount of friction in the differential and the amount of load that is being applied to the differential.

When turning a corner, this process is in effect partially reversed. The differential gears become a planetary set, with the gear on the inside of the curve becoming the fixed gear of the planetary. The outer gear of the planetary over-runs as the outside wheel on the curve has a further distance to travel. With the outer gear over-running and the inner gear fixed, the pinion mates A, Fig. 23 are caused to rotate, but inasmuch as they are restricted by the fixed gear, they first must move pinion mate shafts B back down the cam surface C relieving the thrust loads on the plate clutches E. Thus when turning the corner, the differential, for all practical purposes, is similar to a conventional differential and the wheels are free to rotate at different speeds.

On straight driving, the clutches are engaged and thus prevent momentary spinning of the wheels when leaving the road or when encountering poor traction. In turning a corner, the load is relieved from the clutch surface so that wear is reduced to a minimum.

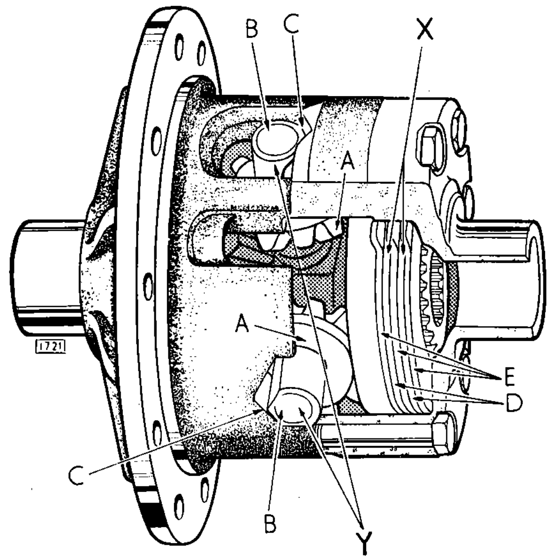


Fig. 22. The operation of the limited slip differential (straight driving)

A—pinion mates
B—cross pins
C—cam surfaces
D—clutch rings
E—friction clutches
X—Clutch rings engaged (both sides)
Y—Pins move up ramps under load

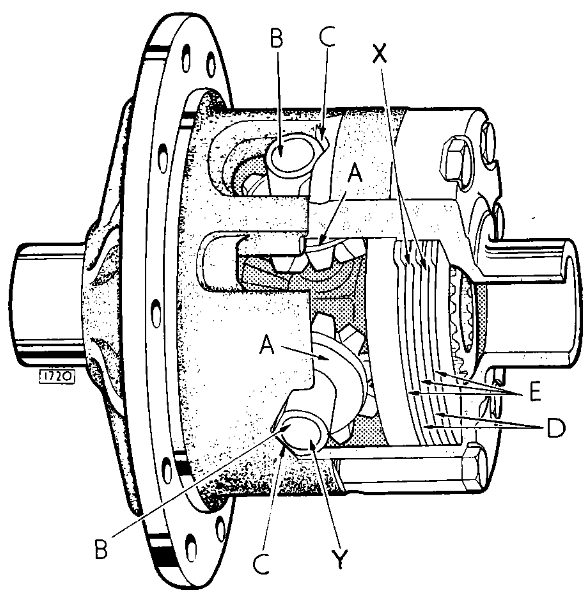


Fig. 23. The operation of the limited slip differential (cornering).

X—Engaging force released

Power Flow in Forward Driving

Under normal starting and operating conditions the torque or power flow in both the limited slip and conventional type differential is transmitted equally to each axle shaft and wheel. However, when sudden patches of ice, loose gravel or oil are encountered, the limited slip differential will not permit the wheel with the lesser traction to spin, gain momentum and swerve the car when a dry surface is regained.

Power Flow in Turns

In turning, the limited slip differential gives normal differential action and permits the outer wheel to turn faster than the inner wheel. At the same time the differential applies the major driving force to the inside rear wheel, improving tability and cornering.

Power Flow with Poor Traction

When traction conditions under the rear wheels are dissimilar, the driving force with an ordinary differential is limited by the wheel with the poorer traction. Typically, in this situation, the wheel with the poorer traction spins and the vehicle remains immobile. The limited slip differential enables the wheel with the better traction to apply the major driving force to the road.

Action on Rough Roads

Bumps do not adversely affect wheel action when wheels are controlled by the limited slip differential. The free wheel does not spin and gain momentum. There is no sudden wheel stoppage to cause car swerve or tyre scuffing and wheel hop is reduced.

THE OUTPUT SHAFTS

REMOVAL (Early Cars)

Remove the brake caliper and disc as described under "Removing the Differential Assembly from the Carrier".

Unscrew and remove the five bolts securing the output shaft bearing housings, bearings and adjustment shims, noting the number of pre-load shims.

DISMANTLING

Unlock the tab washer and remove the nut, tab washer and plain washer. Press the output shaft with the inner bearing inner race, spacing sleeve and endfloat shims in position through the flange and bearing housing. If it is necessary to replace the bearings, remove the endfloat shims and spacing collar, using a suitable extractor withdraw the inner bearing inner race from the shaft. Drift out the inner bearing outer race and using a suitable sized tube on the outer race, press out the complete outer bearing and the oil seal. If it is necessary to reset the output shaft endfloat, withdraw the oil seal and the outer bearing inner race.

ASSEMBLING

Press in the new inner and outer bearing outer races ensuring that they are fully home in the recesses. The races must be fitted so that the bearings will be opposed. Press the inner bearing inner race on to the shaft ensuring that it is fully home against the shoulder and that the race is fitted the correct way round. Fit the spacing sleeve and the endfloat shims. Fit the output shaft into the bearing housing and place the outer bearing inner race on the shaft from the opposite end. Do not fit the oil seal at this stage. Fit the output shaft flange with the plain washer and a new tab washer, fit the nut and tighten.

Check the endfloat with a dial gauge, this should be 0·001" – 0·003" (0·025 – 0·076 mm.). Should adjustment be necessary remove the flange nut, tab and plain washers and withdraw the flange and outer bearing inner race. Add or remove shims to obtain the correct clearance. Adding shims increases the endfloat and removing shims decreases it. When the correct endfloat is obtained replace the outer bearing inner race and press a new oil seal into position, flush with the casing and with the lip inwards. Refit the flange and the plain tab washers ensuring that the two tags on the tab washer locate in the holes on the flange. Tighten the nut and turn one or more tabs up securing the nut. Ensure that these tabs lie as flat on the nut as possible.

REFITTING

See "Differential Bearing Preload and Drive Gear Adjustment," page H.25.

REMOVAL (Later Cars)

Unscrew evenly the five bolts securing the output shaft bearings housings. As the bolts emerge they bear against the flange, which is an integral part of the drive shaft, thus withdrawing the drive shaft together with the bearing housing, bearings, spacer and adjustment shims. Note the number of pre-load shims.

DISMANTLING

Unlock the tab washer, and remove the nut from the drive shaft.

Press the drive shaft through the bearing housing thus removing the bearing inner races and the oil seal.

Drift out the inner and outer bearing outer races.

ASSEMBLING

Press in the new inner and outer bearing outer races ensuring that they are fully home in the recesses. The races must be fitted so that the bearings are opposed i.e. the thin lips on the outer races should face outwards.

Place the oil seal on the drive shaft and press the outer bearing inner race into the shaft. Fit the pre-load shims and spacing sleeve.

Fit the bearing housing with securing bolts in position.

Refit the inner bearing inner race, fit the tab washer, ensuring that the tag locates in the groove in the drive shaft and lock up the assembly by means of the nut.

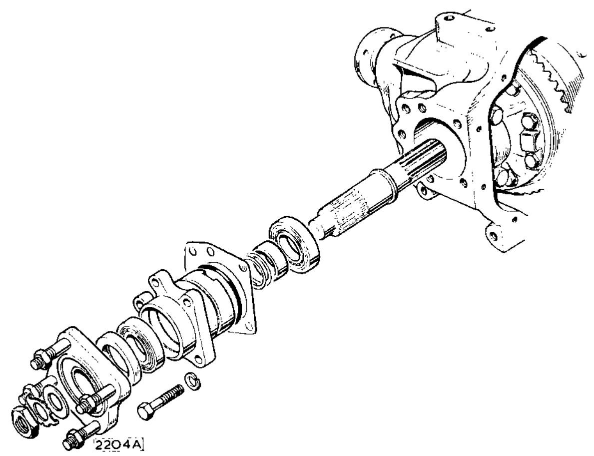


Fig. 24. The output shaft components (early type)

Lock the nut securely by means of the tabs on the tab washer. Ensure that the tabs lie as flat as possible on the nut.

REFITTING

See "Differential Bearing Preload and Drive Gear Adjustment," page H.25.

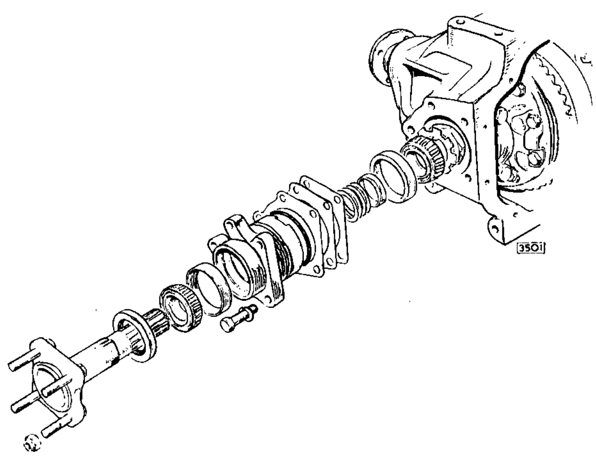


Fig. 25. The output shaft components (later cars).

REMOVING THE DIFFERENTIAL ASSEMBLY

FROM THE CARRIER

Remove the axle as described on page H.8.

Knock up the locking tabs and unscrew the brake caliper mounting bolts.

Remove the caliper noting the number of small round shims between the caliper and differential carrier bracket. Remove the brake discs.

Drain the lubricant from the gear carrier and remove the gear carrier rear cover. Flush out the unit thoroughly so that the parts can be carefully inspected.

Unscrew the five bolts securing the output shaft bearing housing. Withdraw the output shaft, bearing housing, bearings and adjustment shims noting the number of preload shims.

Repeat for the other drive shaft. Remove the two bolts holding each differential bearing cap and withdraw the differential unit.

Pinion Removal

Remove the pinion nut and washer. Withdraw the universal joint companion flange with a suitable puller. **PRESS** the pinion out of the outer bearing. It is important that the pinion should be pressed out, not driven out, to prevent damage to the outer bearing. The pinion having been pressed from its outer bearing may now be removed from the differential casing.

Note: Keep all shims intact.

Remove the pinion oil seal together with the oil slinger and outer bearing cone. Examine the outer bearing for wear and if replacement is required extract the bearing outer race. If the correct tool is not available and the bearing cup is to be scrapped it is possible to drive out the cup, the shoulder locating the bearing being recessed to facilitate this operation. Remove the pinnion inner bearing outer race as shown in Fig. 27 if the bearing requires replacement or adjustment of the pinion setting is to be undertaken. Take care of the shims fitted between the bearing cup and the housing abutment face. If the inner bearing is to be replaced it may be driven out but the correct service tool should be used when the bearing is removed in order to carry out pinion setting adjustment.

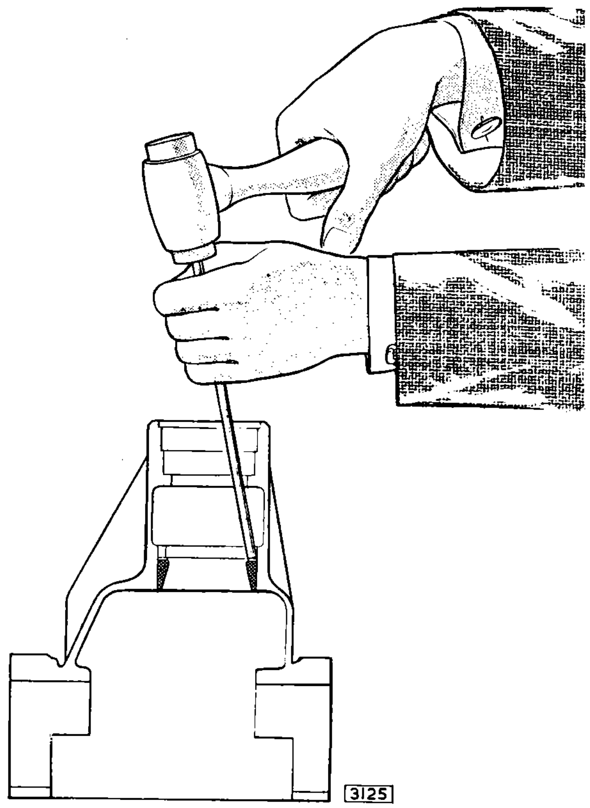


Fig. 27. Driving out the pinion bearing outer race if the special tool is not available.

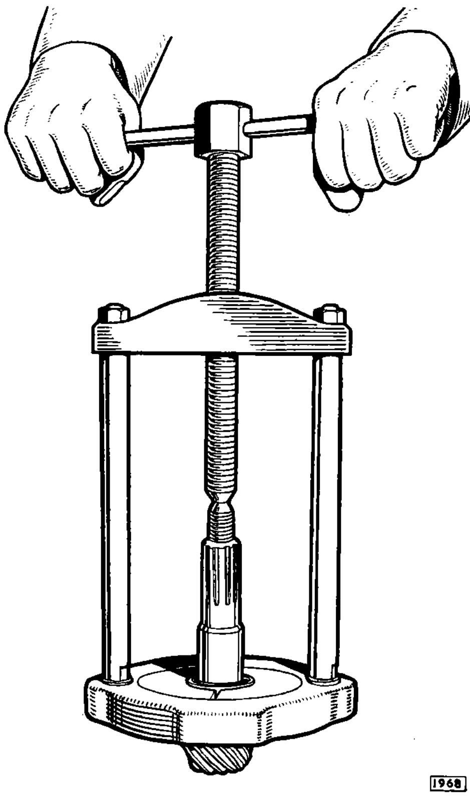


Fig. 28. Withdrawing the pinion inner bearing using Churchill Tool No. SL.14 with adaptor No. SL.14—3.

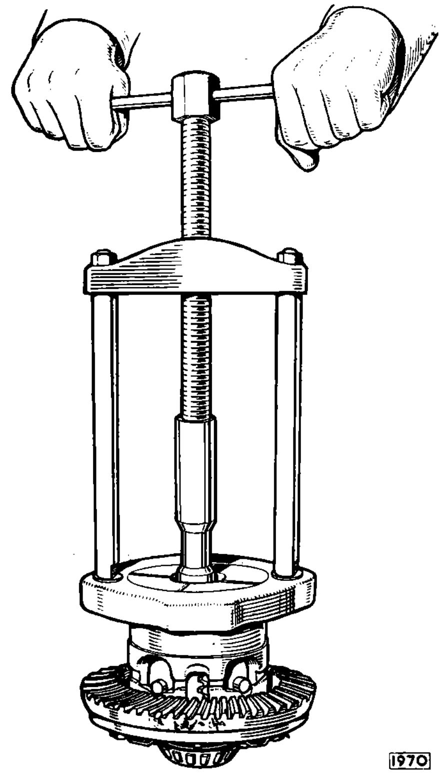


Fig. 30. Withdrawing a differential bearing using Churchill Tool Part No. SL.14 with adaptor No. SL.14—3.

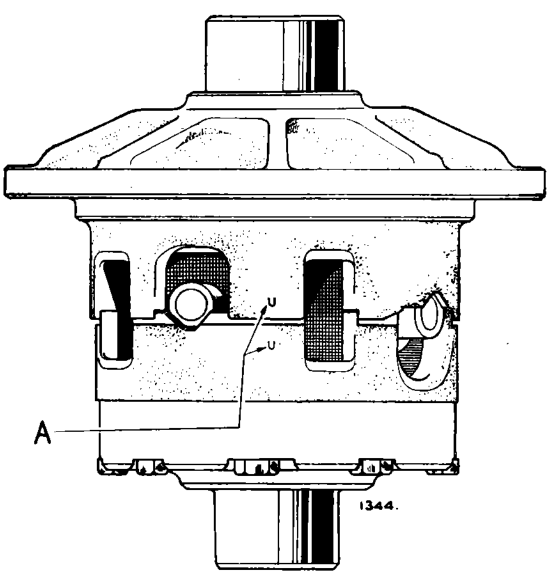


Fig. 29. Mating marks 'A' on the differential casing.

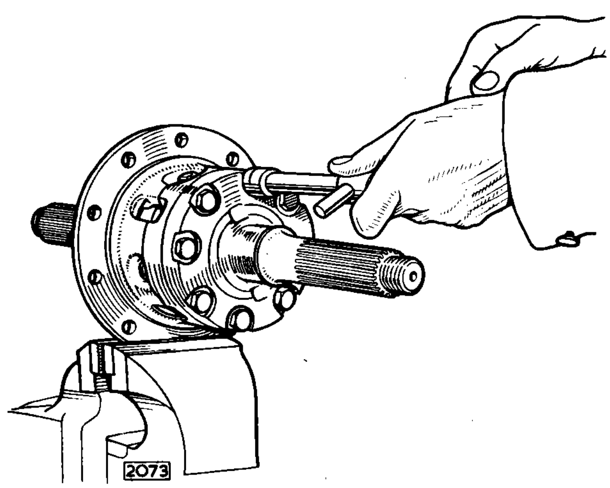


Fig. 31. Tightening the differential casing bolts with the output shaft in position.

DISMANTLING THE DIFFERENTIAL UNIT

Knock back the locking tabs from the drive gear securing setscrews. Remove the securing setscrews and tap the drive gear from the differential case with a rawhide mallet.

In the absence of any mating or aligning marks as shown in Fig. 29, scribe a line across the two half casings to facilitate assembly.

Remove the eight bolts (9 Fig. 34) securing the two halves of the differential casing.

Split the casing and remove the clutch discs (3) and plates (2 and 4) from one side.

Remove the differential side gear ring (5).

Remove the pinion side gear (6) and the pinion mate cross shafts (7) complete with the pinion mate gears.

Separate the cross shafts (10).

Remove the remaining side gear and the side gear ring.

Extract the remaining clutch discs and plates.

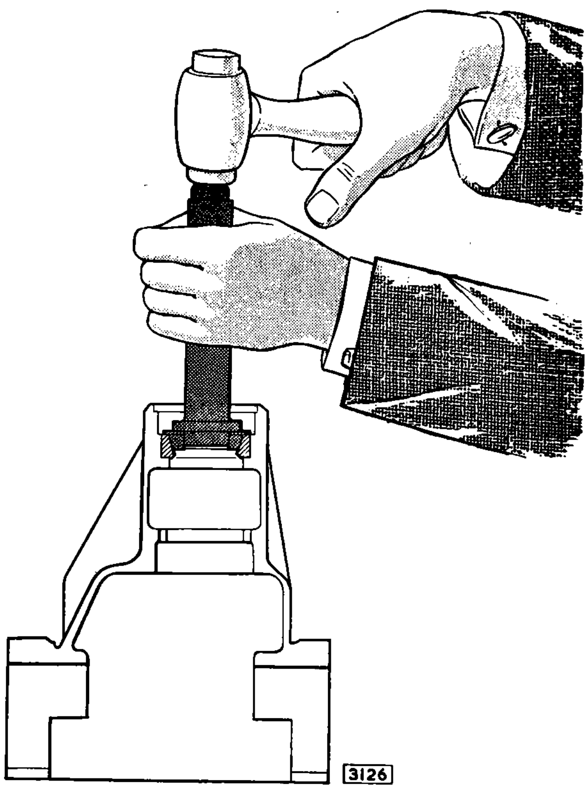


Fig. 32. Replacing a pinion outer bearing outer race using Churchill Tool Part No. 550 with adaptor Part No. SL.550—4.

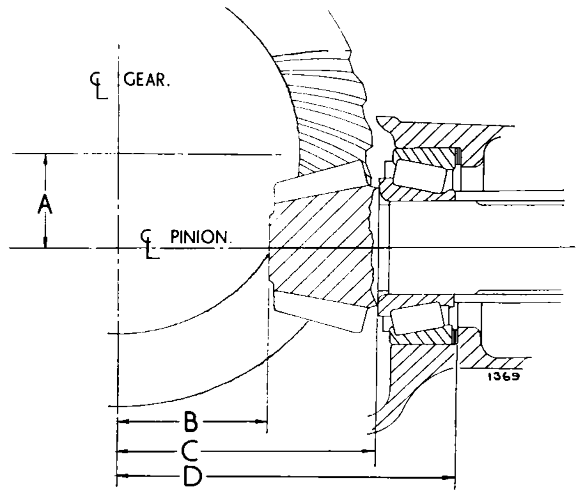


Fig. 33. Pinion setting distances.

ASSEMBLING THE DIFFERENTIAL UNIT

Refit the clutch plates and discs alternately into the flange of the casing.

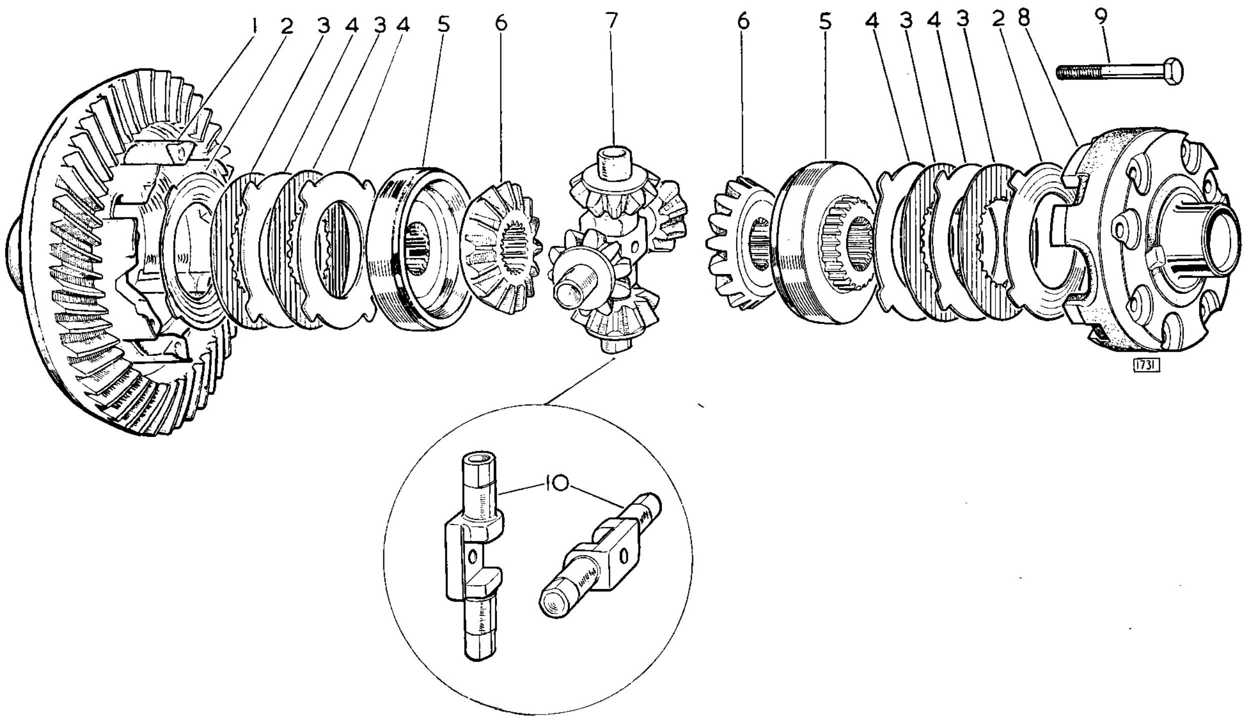
Fit the two "Bellville" clutch plates (i.e. curved plates) so that the convex side is against the differential casing (see Fig. 34).

Fit the side gear ring so that the serrations on the gear mesh with the serrations in the two clutch discs.

Place one of the side gears into the recess of the side gear ring so the splines in both align.

Fit the cross shafts together.

A.	Pinion Drop	1·5″	(38·1 mm.)
B.	Zero Cone Setting	2·625″	(66·67 mm.)
C.	Mounting Distance	4·312″	(108·52 mm.)
D.	Centre Line to Bearing Housing	5·495″ to 5·505″	(139·57 mm.) to (139·83 mm.)



1. Differential casing—flange half.
2. Dished clutch friction plate.
3. Clutch friction disc.
4. Clutch friction plate.
5. Side gear ring.
6. Bevel side gear.
7. Bevel pinion mate gear assembly.
8. Differential case—butt-on half.
9. Differential case bolt.
10. Pinion mate cross shaft.

Fig. 34. Exploded view of the "Powr-Lok" differential

Refit the pinion mate cross shafts complete with pinion mate gears ensuring that the ramps on the shafts coincide with the mating ramps in the differential case.

Assemble the remaining side gear and side gear ring so the splines in both align.

Refit the remaining clutch plates and discs to the side gear ring.

Offer up the butt-on half of the differential case to the flange held in accordance with the identification marks and position the tongues of the clutch friction plates so they align with the grooves in the differential case. Assemble the butt-on half to the flange half of the differential case with eight bolts but do not tighten at this juncture.

Check the alignment of the splines in the side gear rings and side gears by inserting two output shafts, then tighten the eight bolts to a torque of 40 – 45 lb. ft. (5·5 to 6·2 kgm.) while the output shafts are in position. Failure to observe this instruction will render it difficult or impossible to enter the output shafts after the eight bolts have been tightened.

Refit the drive gear to the differential case, having first ensured that the locating faces are not damaged, by aligning the bolt holes on the gear and case and tapping the gear into position with a rawhide mallet. Fit the securing setscrews using **NEW** locking straps and tighten to a torque of 70 to 80 lb. ft. (9·7 to 11·1 kgm.) knock up the tabs around the heads of the setscrews.

Checking for Wear

With one output shaft and the drive pinion locked, the other output shaft must not turn radially more than $\frac{3}{4}''$ (19mm.) measured on a 6″ (152 mm.) radius.

PINION ADJUSTMENT

DESCRIPTION

Refit the pinion outer bearing outer race using Tool No. 550 with the adaptor Part SL 550-4 Refit the pinion inner bearing outer race (as shown in Fig. 32) with the original shims in position between the outer race and its abutment shoulder.

Press the inner bearing inner race onto the pinion using a hand press and a length of tube. Ensure that the tube contacts only the inner portion of the race and not the roller retainer. Place the pinion into position, turn the gear carrier over and support the pinion with a suitable block of wood. Fit the original outer bearing shims to the pinion shank so that they seat on the shoulder of the shank.

Fit the outer bearing inner race, companion flange, washer and nut only, omitting the oil slinger and oil seal assembly and tighten the nut.

It will now be necessary to check the pinion cone setting as follows:—

Pinion Cone Setting

The correct pinion cone setting is marked on the ground end of the pinion as shown on the inset in Fig. 36. The serial number of the matched drive gear and pinion assembly is marked above the cone setting, it is most important that similarly

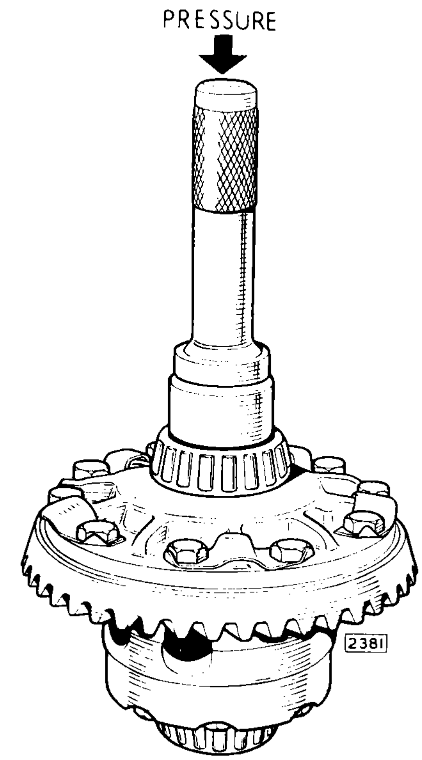


Fig. 35. Replacing the differential bearing using Churchill Tool No. 550 with adaptor SL.550—1.

marked drive gears and pinions are kept in their matched sets as each pair is lapped together at the factory. The letters on the left and right of the pinion should be disregarded.

Hold the gear carrier so that the ground end of the pinion is uppermost. Take the pinion cone setting gauge (Tool No. SL 3) and remove the magnetic keeper from the gauge post. Using the setting block on a surface plate as shown in Fig. 36 set the dial test gauge to zero on the 4 HA Setting.

Place the dial gauge post on the end of the pinion so that the plunger of the dial gauge registers in the differential bearing bore. Check the pinion cone setting by moving the gauge plunger in the differential bore; the actual reading being the minimum obtained. If the cone setting is correct, the reading on the dial gauge will be the same as the figure marked on the pinion end. For example, if the setting marked on the pinion is—2 then the reading on the dial gauge must also be—2.

If the pinion setting is incorrect, it will be necessary to remove the pinion assembly (as described on page H.19) and remove the pinion inner bearing outer race. Withdraw the shim pack and add or remove shims as necessary. Adding shims to the pack will decrease the gauge reading, that is, increase the number on the gauge if negative (—) and decrease the number if positive (+); removing shims will increase the reading; shims are available in 0·003", 0·005" and 0·010" (0·076, 0·127 and 0·254 mm.) thicknesses.

Example, assume the required pinion cone setting distance (marked on the pinion end) to be —2, if on checking with the dial gauge, the reading is —7 it will be necessary to remove a 0·005" (0·127 mm.) thick shim in order to reduce the gauge reading to —2.

Replace the inner bearing outer race, fit the pinion and check the cone setting as described on page H.21

When the correct pinion setting has been obtained, check the pinion bearing preload. There should be no end play in the pinion and a slight resistance to turning should be felt. The correct pinion bearing preload is given as a torque figure under "Data" on page H.6. Inadequate preload will result in pinion deflection under load whilst

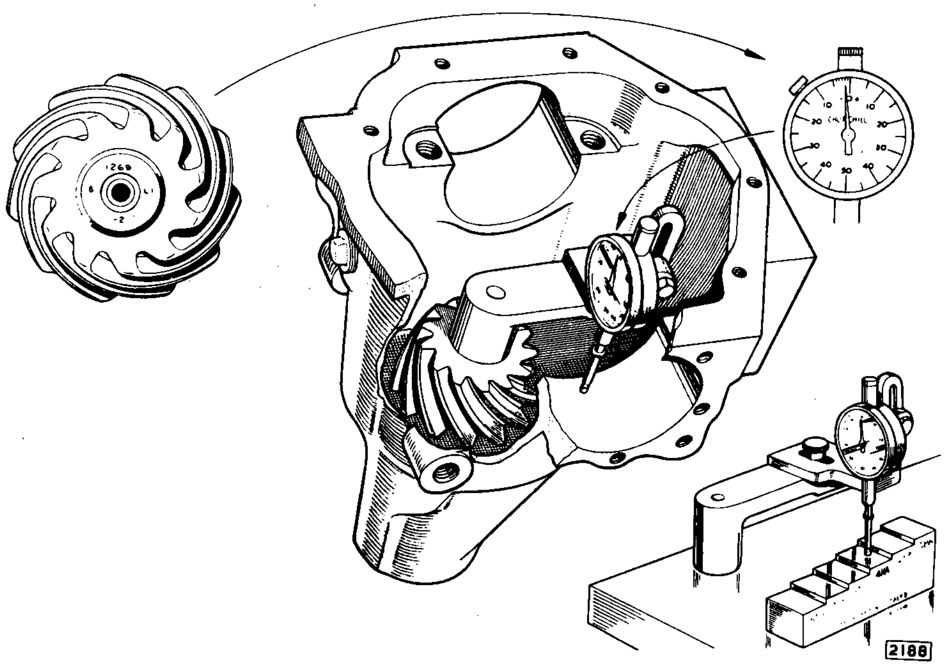


Fig. 36. Checking the pinion cone setting using Tool Part No. SL.3. Note the pinion setting marks located on the end of the pinion.

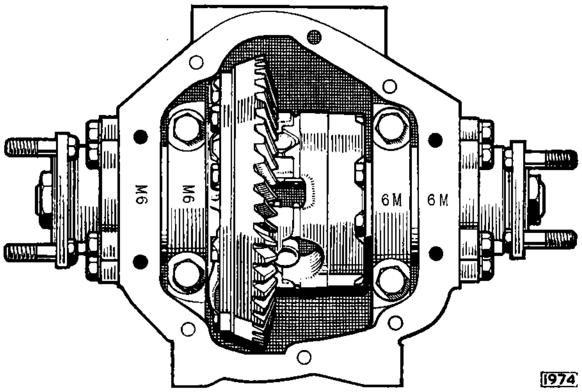


Fig. 37. Differential bearing cap markings.

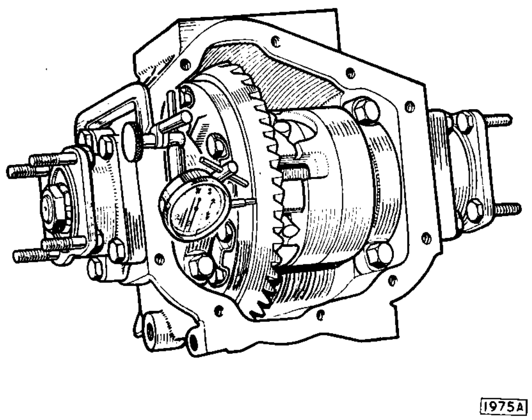


Fig. 38. Checking the drive gear run-out.

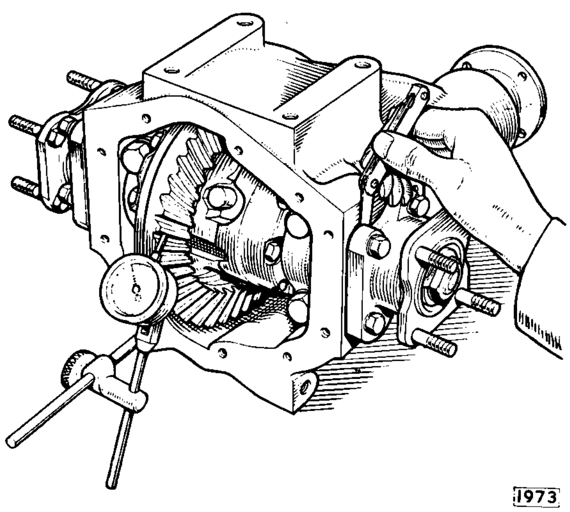


Fig. 39. Checking the backlash and drive gear location.

excessive preload will lead to pitting and failure of the bearings.

To adjust the preload, add or remove shims at the shim pack between the outer bearing inner race and the shoulder on the pinion shank. Removing shims will increase the preload and adding shims will decrease the preload; shims are available in thicknesses of 0·003″, 0·005″, 0·010″ and 0·030″ (0·76, 0·127, 0·254 and 0·762 mm.). It is most important that the shims behind the inner bearing outer race which control the pinion cone setting are not disturbed when setting the preload.

DIFFERENTIAL BEARING PRELOAD AND DRIVE GEAR ADJUSTMENT

With the pinion (less the oil seal and oil thrower) installed in the differential carrier, fit the differential assembly. Fit the differential bearing caps noting that the numerals marked on the bearing caps and the end cover face correspond as shown in Fig. 37. Fit the cap bolts and tighten to a torque of 60 to 65 lb. ft. (8·3 to 9·0 kgm.).

Drive Gear Runout

Mount a dial indicator on the gear carrier with the plunger of the gauge against the back face of the drive gear as shown in Fig. 38. Turn the drive gear by hand and check the run-out on the back face which should not exceed 0·005″ (0·13 mm.). If the run-out exceeds this figure, the differential assembly should be removed, the drive gear withdrawn from the assembly and the locating surfaces on the drive gear and differential casing cleaned and burrs removed.

Drive Gear Mesh Adjustment and Differential Bearing Preload Setting

Install the drive shafts without any shims between the drive shaft bearing housing and the differential carrier. Note the condition of the "O" ring on the bearing housing and renew if necessary. Fit three bolts evenly spaced around each bearing housing. Set up a dial indicator on the differential carrier with the plunger of the gauge against one of the drive gear teeth as nearly in line with the direction of tooth travel as possible (as shown in Fig. 39). Move the drive gear by hand to check the backlash: the correct backlash will be etched on the sloping face of the drive gear. If the backlash reading is incorrect, move the drive gear towards or away from the pinion as necessary until the correct backlash reading is obtained. To move the drive gear in the required direction, it will be necessary to tighten the bolts in the drive shaft housing on one side of the differential carrier and slacken the bolts on the other side.

When the correct backlash has been obtained, measure the gap between the drive shaft bearing housing and the differential carrier on each side using a set of feeler gauges. Note the gap, having first checked around the circumference of the housing to ensure that the gap is even, make up a shim pack to fill the gap on each side but subtract 0·003″ (0·076 mm.) from the pack to give the correct preload on the differential bearings. The shims are available in thicknesses of 0·003, 0·005, 0·010 and 0·030″ (0·076, 0·127, 0·254 and 0·762 mm.).

For example: Assume that the backlash etched on the drive gear is 0·007″ (0·178 mm.) when this figure has been obtained as described previously, the gap on one side is 0·054″ (1·37 mm.) and 0·046″ (1·17 mm.) on the other, then the amount of shims to be fitted will be 0·054 – 0·003″, that is, 0·051″ (1·30 mm.) and ·046 – 0·003″, that is, 0·043″ (1·09 mm.) to the other side.

Finally, fit the output shafts with the shims in position to the differential carrier, fit the five bolts to each housing and tighten up. The drive gear mesh adjustment should now be checked as described in "Tooth Contact" on page H.27.

FINAL ASSEMBLY

Remove the pinion flange nut, washer and the companion flange, and fit the oil thrower. Place the oil seal gasket into position in the oil seal recess, then fit the oil seal so that the lip of the seal faces inwards and the dust excluder flange is uppermost. Fit the installation collar Tool No. SL. 4 and tighten down the pinion nut and washer to drive the assembly home as shown in Fig. 40. Remove the installation collar, fit the companion flange, washer and pinion nut and tighten to a torque of 120 to 130 lb. ft. (16·6 to 18·0 kgm.).

Fit the differential carrier rear cover gasket, renewing if necessary, fit the rear cover and secure with setscrews and spring washers. Do not omit to refit the "Powr-Lok" (P.L.) and axle ratio tags which are also secured by the cover setscrews for identification purposes. Check that the drain plug is tightened and fill the axle with one of the recommended lubricants specified on page H.7. Replace the filler plug, check the tightness of the cover setscrews and check the complete unit for oil leaks.

Refit the brake discs and calipers, centralising the calipers by means of the adjusting shims (as described in Section L "Brakes"). Fit new tab washers to the mounting bolts, tighten the bolts to a torque of 55 lb. ft. (7·6 kgm.) and secure the bolt heads with the tab washers.

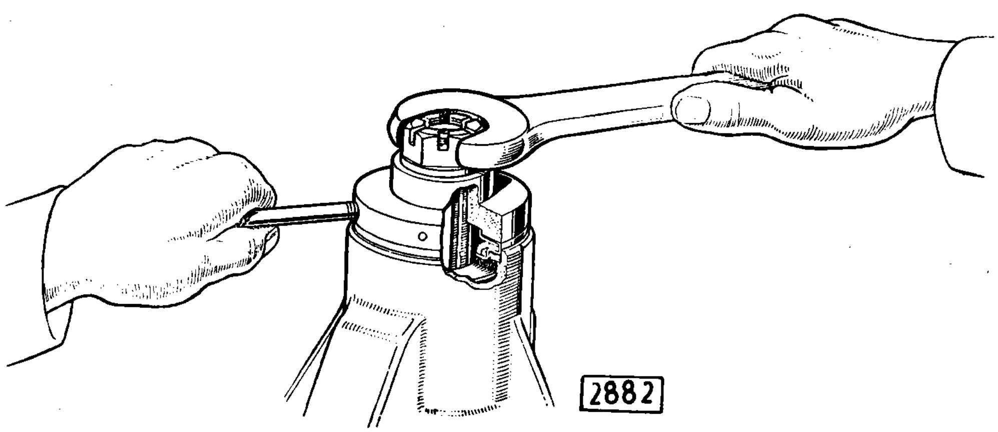


Fig. 40. Fitting the pinion oil seal using Tool Part No. SL.4.

TOOTH CONTACT

After setting the backlash to the required figure, use a small brush to paint eight or ten of the drive gear teeth with a stiff mixture of marking raddle, used sparingly, or engineers blue if preferred. Move the painted gear teeth in mesh with the pinion until a good impression of the tooth contact is obtained.

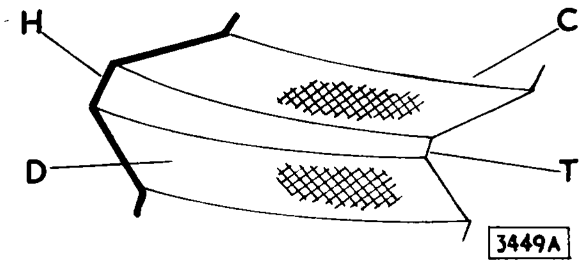


Fig. 41. Ideal contact.

IDEAL CONTACT

Fig. 41 shows the ideal tooth bearing impression on the drive and coast sides of the gear teeth. The area of contact is evenly distributed over the working depth of the tooth profile and is located nearer to the toe (small end) than the heel (large end). This type of contact permits the tooth bearing to spread towards the heel under operating conditions when allowance must be made for deflection.

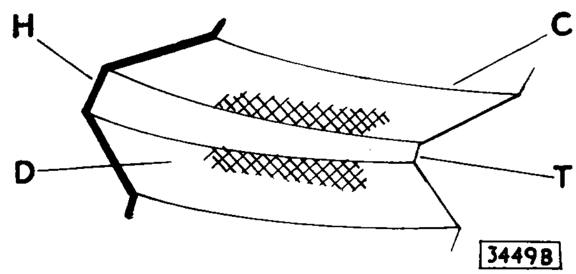


Fig. 42. High tooth contact.

HIGH TOOTH CONTACT

In Fig. 42 it will be observed that the tooth contact is heavy on the drive gear face or addendum, that is, high tooth contact. To rectify this condition, move the pinion deeper into mesh, that is, reduce the pinion inner race setting distance, by adding shims between the pinion inner bearing outer race and the housing and adding the same thickness of preload shims between the pinion bearing spacer, or the shoulder of the pinion shank and outer bearing inner race. This correction has a tendency to move the tooth bearing towards the toe on drive and heel on coast, and it may therefore be necessary after making this change to adjust the drive gear as described in the paragraphs on Toe Contact and Heel contact.

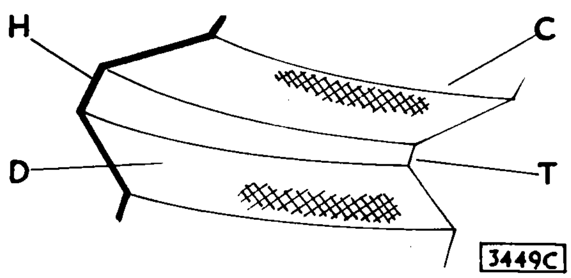


Fig. 43. Low tooth contact.

Keys to Figs. 41, 42 and 43.

H—Heel (outer end).
D—Drive
C—Coast.
T—Toe (inner end).

LOW TOOTH CONTACT

In Fig. 43 it will be observed that the tooth contact is heavy on the drive gear flank or dedendum, that is, low tooth contact. To correct, move the pinion out of mesh, that is, increase the pinion inner race setting distance by removing shims from between the pinion inner bearing outer race and housing, and removing the same thickness of preload shims from between the pinion bearing spacer or the shoulder on the pinion shank and the outer bearing inner race. The correction has a tendency to move the tooth bearing towards the heel on drive and toe on coast, and it may therefore be necessary after making this change to adjust the drive gear.

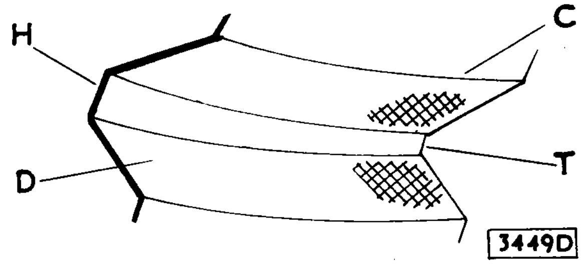


Fig. 44. Toe contact.

TOE CONTACT

Fig. 44 shows an example of toe contact which occurs when the bearing is concentrated at the small end of the tooth. To rectify this condition, move the drive gear out of mesh, that is, increase backlash, by transferring shims to the drive gear side of the differential from the opposite end.

HEEL CONTACT

Fig. 45 shows an example of heel contact which is indicated by the concentration of the bearing at the large end of the tooth. To rectify this condition move the drive gear closer into mesh, to reduce backlash, by removing shims from the drive gear side of the differential and adding an equal thickness of shims to the opposite side.

Note: Sufficient backlash for satisfactory operation must be maintained. If there is insufficient backlash the gears will at least be noisy and have a greatly reduced life, whilst scoring of the tooth profile and breakage may result. Therefore, always maintain a minimum backlash requirement of 0·004″ (0·10 mm.).

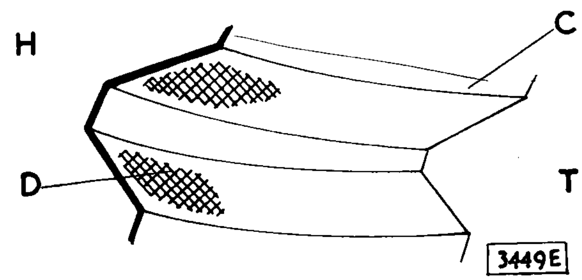


Fig. 45. Heel contact.

Key to Fig. 44 and 45.
H—Heel (outer end).
D—Drive.
C—Coast.
T—Toe (inner end).

BACKLASH

When adjusting backlash always move the drive gear as adjustment of this member has more direct influence on backlash, it being necessary to move the pinion considerably to alter the backlash a small amount – 0·005″ (0·13 mm.) movement on pinion will generally alter backlash 0·001″ (0·025 mm.).

DRIVE GEAR AND PINION MOVEMENT

Moving the drive gear out of mesh moves the tooth contact towards the heel and raises it slightly towards the top of the tooth.

Moving the pinion out of mesh raises the tooth contact on the face of the tooth and slightly towards the heel on drive, and towards the toe on coast.

SPECIAL SERVICE TOOLS

Description

Multi-purpose hand press (SL.14*)

Pinion bearing inner race remover (SL.14—1*)

Differential side bearing cone remover (SL.14—3*)

Rear hub outer bearing inner race remover (J.16B*)

Hub remover (JD.1C*)

Multi-purpose handle (550*)

Differential side bearing cone replacer (SL.550—1*)

Pinion outer bearing cup replacer (SL.550—4*)

Pinion inner bearing cup replacer (SL.550—5*)

Pinion cone setting gauge (SL.3*)

Pinion oil seal replacing collar (SL.4*)

Hub inner and outer bearing cup replacer (J.20A)*

Adaptor for above (J.20A—1*)

Hub end float master spacer (J.15*)

Hub endfloat dial gauge (J.13*)

*Churchill Tool Number

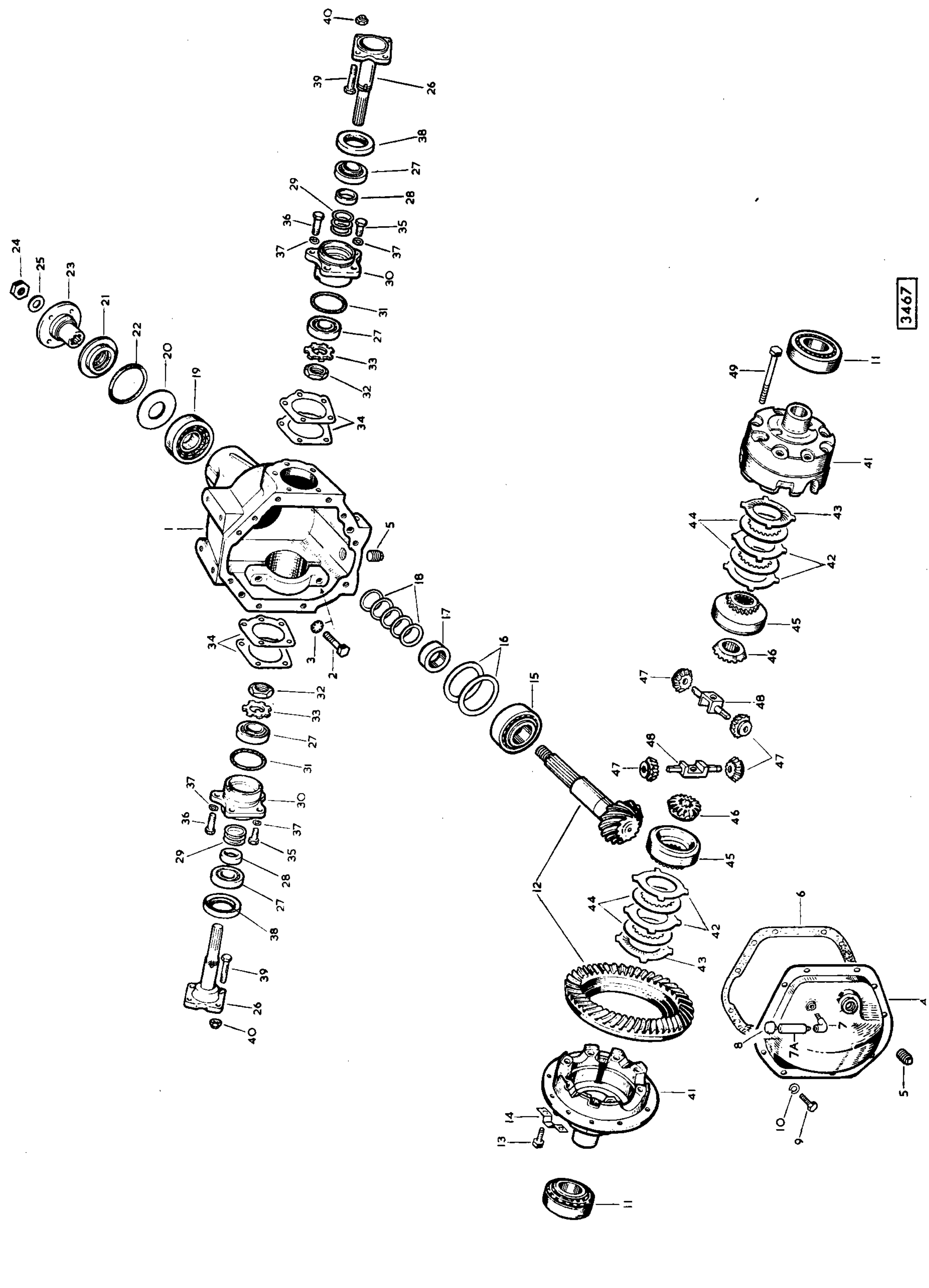


Fig. 46. Exploded view of the rear axle (later cars).

Key to Fig. 46.

1. Gear carrier.
2. Set screw.
3. Lockwasher.
4. Cover.
5. Plug.
6. Gasket.
7. Elbow. 7a. Extension.
8. Breather.
9. Setscrew.
10. Lockwasher.
11. Roller bearing.
12. Crown wheel and pinion.
13. Setscrew.
14. Lock strap.
15. Roller bearing.
16. Inner shim.
17. Distance washer.
18. Outer shim.
19. Roller bearing.
20. Oil flinger.
21. Oil seal.
22. Gasket.
23. Companion flange.
24. Nut.
25. Washer.
26. Drive shaft and flange.
27. Roller bearing.
28. Spacing collar.
29. Shim.
30. Housing.
31. 'O' ring.
32. Nut.
33. Tab washer.
34. Shim.
35. Bolt.
36. Bolt.
37. Lockwasher.
38. Oil seal.
39. Bolt.
40. Self-locking nut.
41. Differential case.
42. Friction plate (flat).
43. Friction plate (dished).
44. Friction disc.
45. Ring.
46. Side gear.
47. Pinion mate gear.
48. Shaft.
49. Bolt.

SECTION I

STEERING

4·2 MARK 10 MODEL

INDEX

INDEX *(continued)*

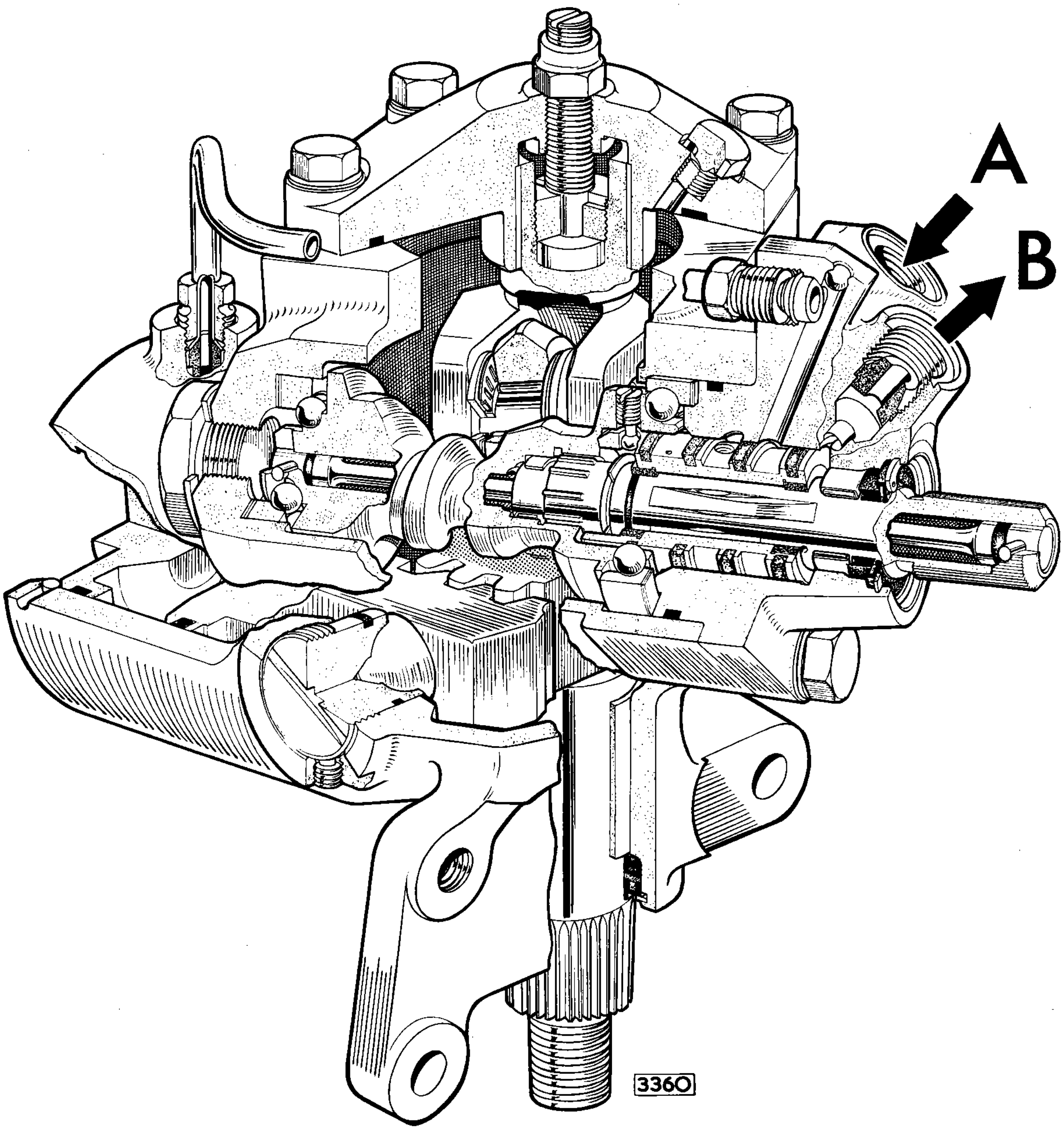


Fig. 1. Cutaway section of steering box.

"A"—Low pressure connection.
"B"—High pressure connection.

STEERING

DESCRIPTION

The power assisted steering system consists of two separate components, the steering gear (or box) and the pump. The two are connected together by a pair of flexible hoses. The pump is contained within its own reservoir so that the oil flow is as follows:—

From the output side of the pump to the steering gear, this is the pressure hose.

From the steering gear back to the pump reservoir, this is the return hose. The feed from the reservoir to the pump occurs within the unit.

The pump is situated on the right-hand front of the engine and is belt-driven, the belt tension being regulated by a spring loaded jockey pulley. A continuous flow of oil is pumped through the system while the engine is running, but pressure builds up only when the steering wheel is subjected to steering effort.

DATA

Steering Gear

Make	Adwest Engineering Ltd.
Type	Marles Varamatic —Hour glass and roller with hydraulic servo cylinder.
Steering gear ratio on centre	21·6:1
Steering gear ratio on lock	13:1
Number of turns—lock to lock	2¾
Turning Circle	37ft. 0in. (11·28 m.)

Oil pump

Make	Saginaw
Location	Right-hand front of engine
Operating pressure	1110–1250 lb/sq. in. (77–87·5 kg./cm^2.)

Recommended Lubricants

Mobil	Castrol	Shell	Esso	B.P.	Duckham	Regent Caltex/Texaco
Mobil Fluid 200	Castrol T.Q.	Shell Donax T6	Esso Automatic Transmission Fluid	Automatic Trans-mission Fluid Type A	Nolmatic	Texamatic Fluid

OPERATION

STEERING GEAR

The steering gear operates on an "hour glass" cam and roller principle, with a hydraulic control valve embodied in the input shaft of the cam. The hydraulic assistance is supplied by a servo piston operating in a cylinder which is integral with the steering box casting. A rack, projects from this piston and the rack teeth mesh with a sector of a spur gear which is machined on a projection from the sector shaft.

The "hour glass" cam is a hardened steel component and its track (or thread) is machined with a varying helix angle, so that the pitch is non-constant. A roller carried in the sector shaft meshes with this track and the assembly is responsible for providing the variable ratio. The ratio curve is highest (that is, lowest geared), "on centre". At this point the ratio is 21·6:1 and it reduces rapidly towards either lock where its value becomes 13:1. This drop in ratio occurs almost entirely within half a turn from the straight ahead position and it is this feature which provides the steering with the same sensitivity for all speeds.

THE VALVE

This is a rotary type control valve and it is made up of two parts. The valve rotor, which is also the input shaft to the steering gear, has six grooves machined in it. These grooves lie between six grooves in the valve sleeve when no load is applied to the steering wheel, the rotor being centred in the sleeve by a torsion bar. When steering effort is applied at the wheel this is transmitted to the rotor which, in turn, transmits the effort to the hour glass cam by means of the torsion bar. The torsion bar is, however, slender and the manual effort causes it to twist, thus allowing the rotor to rotate within the sleeve. The relative movement of the grooves in the rotor to the grooves in the sleeve causes a hydraulic pressure build up on one, or the other, side of the servo piston and this assists in turning the steering.

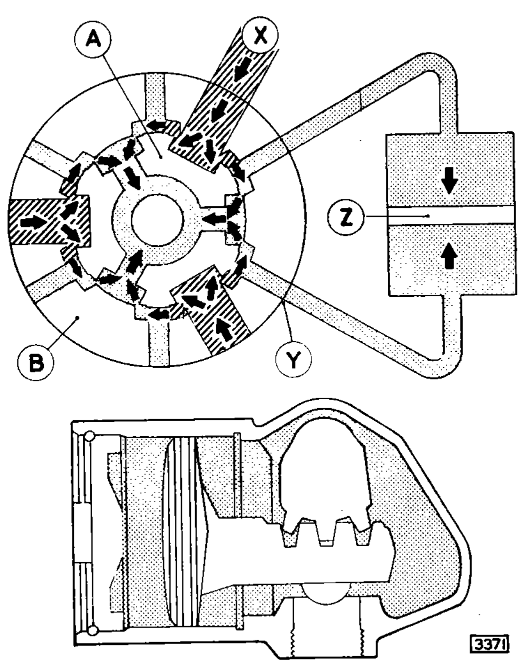


Fig. 2. Operating diagram of the rotor valve (straight ahead).

A—Rotor *B—Sleeve* *X—Pump pressure* *Y—Reservoir pressure* *Z—Equilibrium*

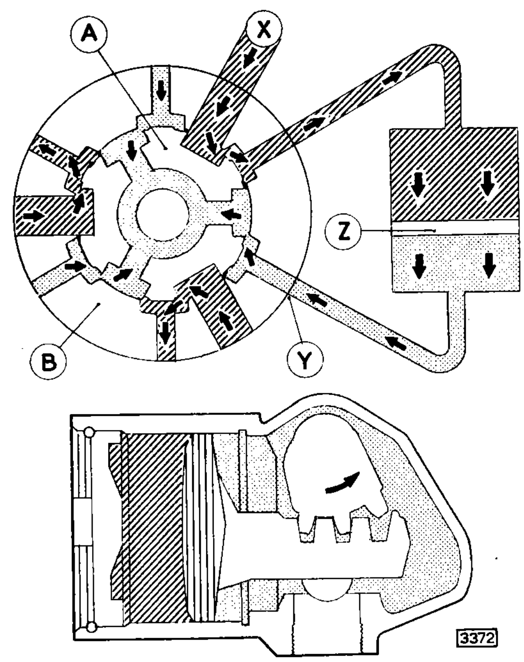


Fig. 3. Operating diagram of the rotor valve (steering turned).

A—Rotor *B—Sleeve* *X—Pump pressure* *Y—Reservoir pressure* *Z—Pressure displacement*

ROUTINE MAINTENANCE

EVERY 3,000 MILES (5,000 KM.)

Checking the Reservoir Oil Level

The only regular maintenance required for the power steering system is that of checking the oil level every 3,000 miles (5,000 km.).

The oil reservoir is mounted on the right-hand side of engine. It is important that absolute cleanliness is observed when replenishing with oil as any foreign matter that enters may affect the hydraulic system.

Clean the area around the filler cap and then remove the cap by turning anti-clockwise.

Check the level of oil and top up if necessary with the recommended grade. The level of oil must be up to the "Full" mark when the oil is warm.

Important: The oil level MUST NOT be allowed to fall below the low mark on the dipstick, otherwise air will be drawn into the hydraulic system causing lumpiness and erratic behaviour.

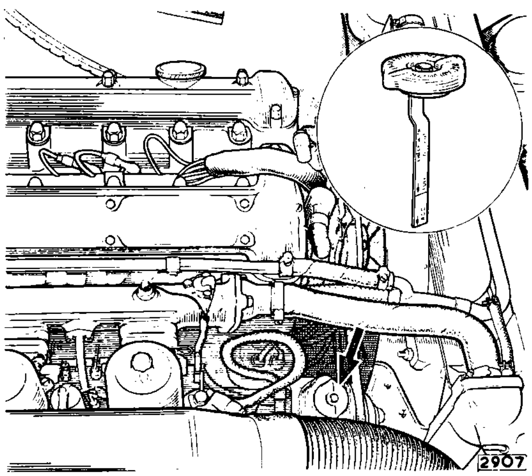


Fig. 4. Power steering oil reservoir.

EVERY 6,000 MILES (10,000 KM.)

Steering Tie-Rods

Lubricate the ball joints at the ends of the two steering tie-rods with the recommended lubricant. A bleed hole is provided in each ball joint; the hole is covered by a nylon washer which lifts under pressure and indicates when sufficient lubricant has been applied. The tie-rods are situated at the rear of the front suspension cross-member. When carrying out this operation examine the rubber seals at the ends of the ball housings to see if they have become displaced or split. In this event they should be repositioned or replaced as any dirt or water that enters the ball joint will cause premature wear.

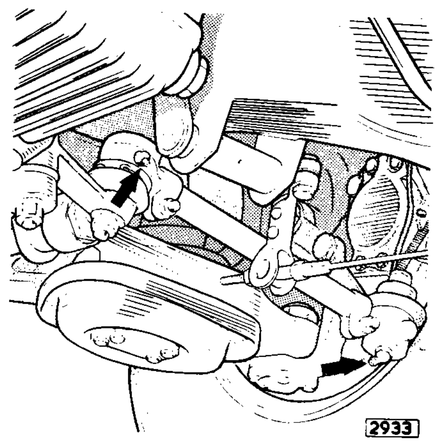


Fig. 5. Steering tie rod grease nipples.

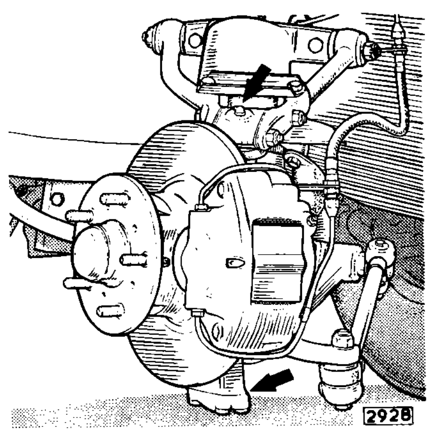


Fig. 6. Wheel swivel grease nipples.

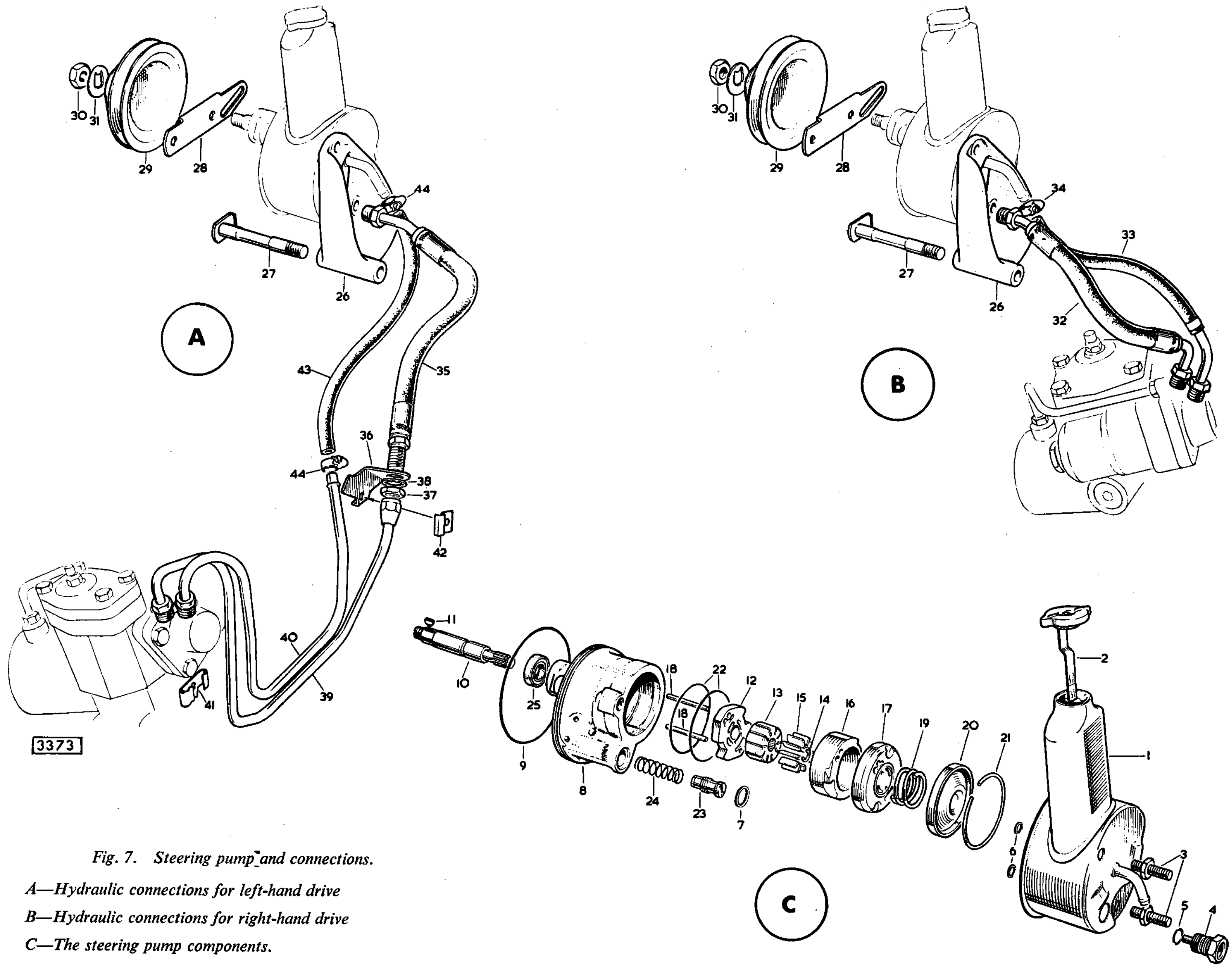


Fig. 7. Steering pump and connections.

A—Hydraulic connections for left-hand drive

B—Hydraulic connections for right-hand drive

C—The steering pump components.

Wheel Swivels

Lubricate the nipples (four per car) fitted to the top and bottom of the wheel swivels. A bleed hole is provided in each ball joint; the hole is covered by a nylon washer which lifts under pressure and indicates when sufficient lubricant has been applied.

The nipples are accessible from underneath the front of the car.

Front Wheel Alignment

Check the front wheel alignment as described on page I.34.

Steering Idler Housing Assembly

The idler housing is pre-packed with grease which only requires replenishing if the idler assembly is dismantled for overhaul.

Key to Fig. 7

1.	Reservoir assembly	23.	Flow control valve
2.	Filler cap	24.	Spring
3.	Stud	25.	Oil seal
4.	Outlet union	26.	Mounting bracket
5.	"O" ring	27.	Bolt
6.	Small seal	28.	Adjusting link
7.	Large seal	29.	Pulley
8.	Pump body	30.	Nut
9.	"O" ring	31.	Tab washer
10.	Driving shaft	32.	High pressure hose
11.	Key	33.	Low pressure hose
12.	Thrust plate	34.	Clip
13.	Rotor	35.	High pressure hose
14.	Clip	36.	Bracket
15.	Pump vane	37.	Locknut
16.	Pump ring	38.	Shakeproof washer
17.	Pressure plate	39.	High pressure pipe
18.	Pin	40.	Low pressure pipe
19.	Spring	41.	Clip
20.	End plate	42.	Clip
21.	Clip	43.	Low pressure hose
22.	"O" ring	44.	Clip

ADJUSTMENTS IN CAR

CENTRALISATION

This adjustment is carried out only when setting the front wheel alignment. Because of the varying ratio curve, it is most important that the steering gear is centralised whilst the toe-in is set. Set the steering into the straight ahead position and to centralise the gear remove the large hexagon plug ($1\frac{13}{16}''$ across the flats) which is situated on the front face of the gear housing. Fit the centralising gauge (Tool No. J.27) into the plug hole and ease home by turning the steering wheel to and fro. Front wheel alignment should than be carried out by adjusting the outer track rods only.

If a centralising gauge (Tool No. J.27) is not available it is possible to centralise the gear using the bolt groove on the splined input shaft. Proceed as follows:—

Set the front wheels pointing straight ahead, open bonnet and check that the pinch bolt, which connects the lower Universal Joint, to the steering gear input shaft, is vertical. It should be lying vertically on the right-hand side of the gear when viewed from the steering wheel (this applies to both LHD and RHD vehicles). Obviously if the bolt is not vertical, move the steering wheel until it is and then track front wheels by adjusting the outer track rods only.

SECTOR SHAFT ADJUSTMENT

If lost motion is present in the steering gear it is probably due to wear between the hour glass cam and roller. This lost motion is easily adjusted out as follows:—

With the steering pointing straight ahead, the engine switched off, the bonnet open and with driver's door open, hold the steering wheel with one hand, at the same time looking down onto the steering gear. In this position it is possible to see both the steering column and input shaft to the gear, whilst at the bottom of the bonnet space the drop arm or track rod should be visible. Oscillate the steering wheel to and fro so that the input shaft moves without movement occurring at the drop arm or track rod. If the rim of the steering wheel can be oscillated through more than $\frac{3}{8}''$ (9·5 mm.) before the drop arm starts to move, then the steering gear needs adjustment (this assumes that the various joints in the steering column assembly are free from back lash). Slacken off the self-locking nut on the top cover of the gear, at the same time preventing the adjuster screw from turning when the nut is slackened. Turn the adjuster screw in a clockwise direction until the lost motion has been reduced to $\frac{3}{8}''$ (9·5 mm.) at the rim of the wheel. Retighten the locknut whilst ensuring that the adjuster screw remains stationary. If this adjustment fails to remove the lost motion from the steering gear then the remedy will have to be affected with the gear removed from the car. However, before removal it is possible to ascertain the cause of the trouble by carrying out the following test:—

(a) With the power off oscillate the steering wheel as before but observe the gear input shaft for end float, that is, it should not move in and out of the gear housing. This type of movement can be felt rather than seen.

Note: If cam end float exists the steering gear will not only exhibit lost motion but it will also rattle when driving over anything but the smoothest of road surfaces.

(b) With the power off and the steering turned towards full lock, manually push the drop arm and sector shaft up and down; there should be no detectable movement. At the same time it is possible to check the sector shaft bearings for wear; there should be no appreciable lateral movement of the sector shaft when moved manually.

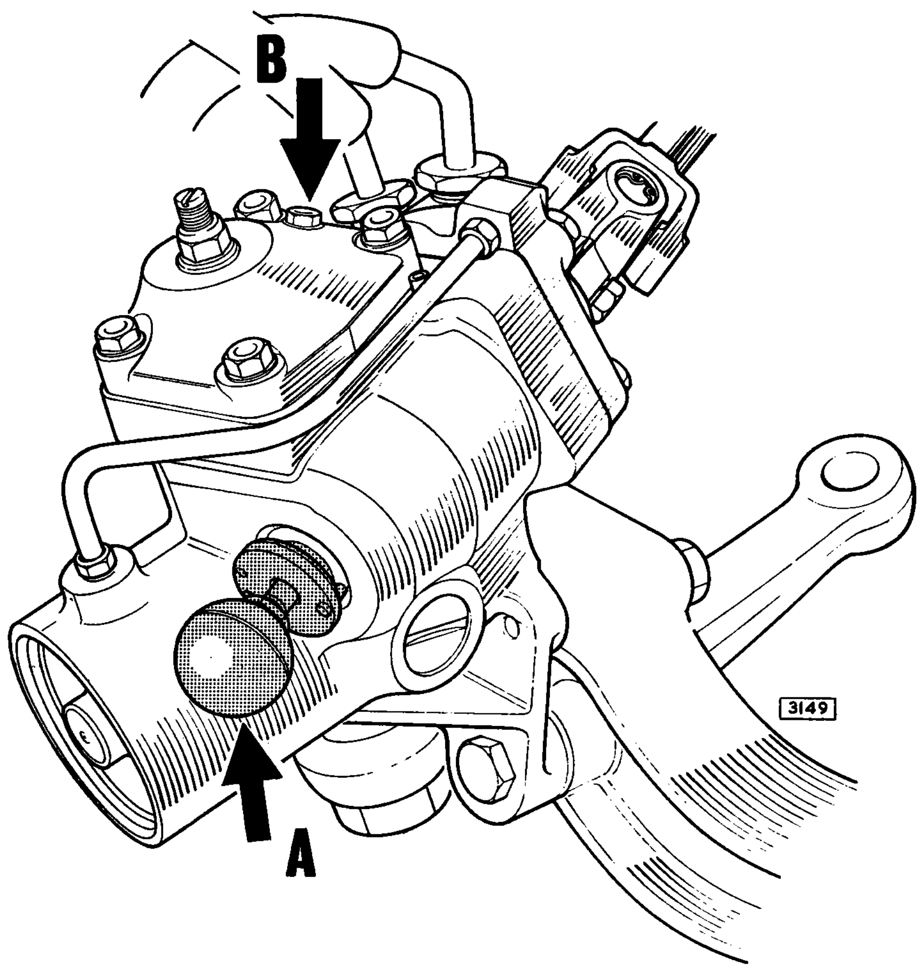


Fig. 8. Centralising the steering gear. Insert the special centralising gauge "A" so that the two pins engage with the two holes in the casting and the tongues engage with the slots in the wormshaft. "B" indicates bleed screw.

RACK ADJUSTMENT

In order to rectify certain knocking noises etc., (see Fault Finding Chart) it may be found necessary to remove any clearance between the teeth on the piston rack and the teeth on the sector shaft. New gears are built with the rack teeth pre-loaded into the sector shaft teeth and it is unlikely that its adjustment will be necessary during the first 80,000 miles (130,000 km.). However, if the symptons indicated in the fault finding chart are present then the rack can be adjusted in the following way:—

With the car on a ramp or over a pit and the steering set straight ahead, slacken the Allen screw which lies in the gear housing directly beneath the rack adjusting screw. Then with a screwdriver tighten the rack adjusting screw as far as possible and then slacken it back by $\frac{1}{8}''$ (3·2 mm.) measured at the circumference of the screw. Re-tighten the Allen screw so as to lock the assembly in position. Check the gear for smoothness and ease of return by driving at very low speed on a piece of smooth tarmac and by turning from full lock to full lock.

TRIMMING

If the steering suffers from a pulling in one direction or the other, it is possible to re-trim the gear without removing it from the car. It is most important that a preliminary check is carried out to ensure that the tyres are not the cause of this complaint. This is best done by changing the front tyres from one side to the other and if the pull changes direction then the trouble lies with one or both of the front tyres. If the pull remains unchanged by the above operation, then proceed as follows:—

(a) If pressure gauge test equipment is available then fit the gauges into the pressure line as described on page I.13. Set the steering to half a turn to the right from centre and, with the engine running, ensure that there is no load on the steering wheel. It is most important that there should be no torque (or twist) applied to the input shaft of the steering gear and since it is possible for steering column friction (stiffness) to cause a residual load when not touching the steering wheel, it is essential that this stiffness be eased into the neutral position. This is done by knocking the steering column nacelle repeatedly with a clenched fist. Starting from this neutral position the wheel should be turned first to the left then to the right, the 0–2000 lb/sq. in., gauge should be watched during this operation and it should be noted that the pressure rises with movement to the left and with movement to the right.

The amount of movement should be balanced and under no circumstances should the pressure drop from the neutral position before it commences to rise. If the pressure rise is not balanced then switch off engine, remove Allen screw on the top face of the gear housing between the transfer pipe and the top cover, insert a screwdriver into adjuster hole and feel for the trim pin screw by gently moving the steering wheel. Turn trim pin screw through 45° in a clockwise direction and replace Allen screw. Start engine and re-check trim on pressure gauge. If out-of-trim is increased then proceed as above but turn trim pin screw anti-clockwise by 90°. If out-of-trim is reduced, but still in the same sense, turn trim pin clockwise by a further increment. If out-of-trim is present but has changed its sense, then turn trim screw anti-clockwise by about 20°. Working in this way it should be possible to achieve a correctly trimmed gear, obviously the increments of turn applied to the screw progressively reduce as the trim becomes more equally balanced.

(b) If pressure gauge equipment is not available, test for out-of-trim as follows:—

Jack up the front wheels clear of the ground and with the engine **running** check that the steering does not turn itself onto one lock or the other.

Since the steering gear may have some stiffness or stickiness in the straight ahead position, due to build preloads, this self steering check should be carried out at a number of points towards left and right. If the wheel self steers in either direction the valve should be re-trimmed as described above.

A second check can be carried out. Jack the car, and with the front wheels off the ground and the engine running, attempt to turn the road wheels in either direction from straight ahead by pushing and pulling on the tyre. The effort required to turn the road wheel should be equal in either direction. If it is unbalanced then the valve is out-of-trim and requires adjustment.

Road test to confirm that retrimming has been successful.

CHECKING THE HYDRAULIC SYSTEM

A number of faults in the steering system can be caused by inefficiencies in the hydraulic circuit, see page I.37 for "Fault Finding" chart. The following checks can be carried out without removing any components from the car. Before starting any of this work the fluid should be checked for correct level and for lack of froth.

PUMP BLOW OFF PRESSURE

Fit pressure gauge into pressure line, start engine, ensure that idling speed is 500 R.P.M., turn steering onto full lock and continue to increase steering wheel effort until the pressure ceases to increase. The peak pressure should lay between 1100 and 1250 lb/sq. in., (77–87·5 kg./cm².) and it should not increase with increased engine R.P.M. If, however, the pressure is below 1100 lb/sq. in. at tickover but rises to the correct figure with increased engine speed then the trouble is caused by either a faulty flow control valve in the pump or by excessive internal leaking in the steering gear.

CHECKING FOR INTERNAL LEAKS IN STEERING GEAR

Disconnect return feed from gear to pump at pump end and plug reservoir entry with a suitable stopper, place end of return feed into pump reservoir, this operation will require an extension piece. Start engine, turn steering onto full lock, set engine R.P.M. to 750, apply increasing steering wheel effort until pump blows off, that is, apply a heavy torque to the steering wheel. Remove return feed pipe from reservoir and allow fluid to fill the container, being careful to keep the reservoir topped up from an alternative supply of fluid. Collect return pipe delivery for 30 seconds. If delivery exceeds $1\frac{1}{2}$ pints (0·85 litre) in 30 seconds then the internal leakage within the gear is excessively high and the internal seals should be replaced as described on page I.21. The operation should be repeated on the other lock, because under these conditions a different set of seals come into operation.

Note: If the results on test show acceptable internal leakage in gear and if either test (a) or test (b) show incorrect results, then replace the power steering pump.

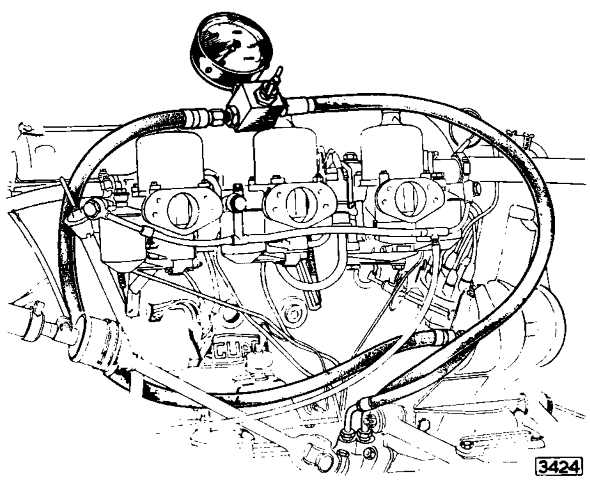


Fig. 9. Checking the hydraulic system.

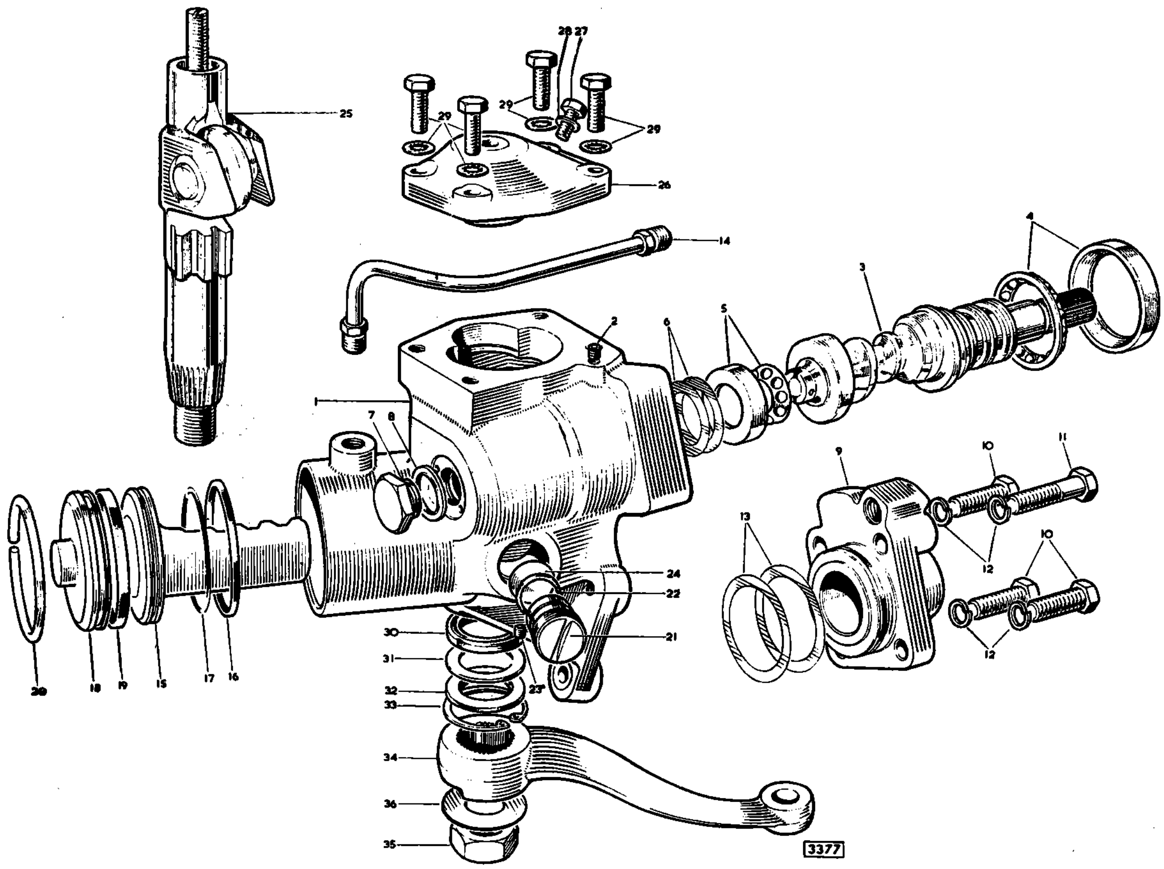


Fig. 10. The steering box components.

1. Steering box
2. Sealing screw
3. Valve and worm
4. Ball bearing
5. Ball bearing
6. Shims
7. Plug
8. Washer
9. Valve housing
10. Bolt (short)
11. Bolt (long)
12. Spring washer
13. Shims
14. Feed pipe
15. Piston and rack
16. Sealing ring
17. "O" ring
18. End plate
19. Seal
20. Clip
21. Plug
22. Seal
23. Locking screw
24. Thrust pad
25. Sector shaft and worm follower
26. Top cover
27. Bleed screw
28. Washer
29. Screw and lockwasher
30. Inner seal
31. Washer
32. Outer seal
33. Circlip
34. Drop arm
35. Nut
36. Tab washer

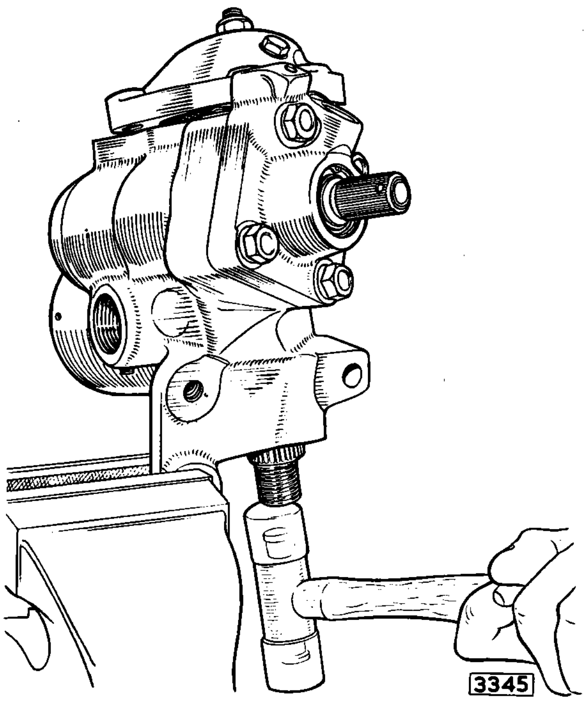


Fig. 11. Removing the sector shaft and top cover.

REMOVAL

The steering box can only be removed from beneath the chassis with the car on a ramp or over the pit.

Disconnect the high and low pressure pipe unions from the steering box unit and catch the oil which will drain away into a container.

Blank off the pipe and box unions to prevent the ingress of dirt.

Remove the nut and washer and disconnect the steering tie-rod ball joint from the steering arm using a suitable extractor.

Remove the pinch bolt securing the upper inner steering column to the top universal joint on the lower steering column.

Remove the spring clip from the retaining clamp situated at the lower end of the upper steering column. Turn the clamp through 90° and slide downwards to expose the plastic thrust bearing.

Withdraw the bearing through the outer column.

Mark the location of the inner column splines in relation to the universal joint for reference when refitting.

Pull the steering wheel and inner column upwards to clear the splines from the universal joint.

Remove two setscrews, two lockwashers and one bolt and nut securing the steering box unit with the front suspension cross-member and detach the unit with the lower steering column attached.

Remove the pinch bolt and withdraw the lower column from the steering unit.

Mark the location of the steering unit shaft splines in relation to the lower universal joint for reference when refitting.

Mark the location of the drop arm to the shaft splines.

Tap back the tab washer and remove the nut.

Withdraw the drop arm, using a suitable extractor.

DISMANTLING (See Fig.10)

Remove drop arm (34).

Remove plug (7) in centralising hole and drain gear by turning input shaft from lock to lock.

Remove feed pipe (14).

Set input shaft to straight ahead.

Slacken screw (21) and remove rack adjusting screw complete with thrust pad (24).

Undo four bolts (29) retaining top cover (26) with $\frac{9}{16}$"AF spanner and withdraw sectorshaft from gear housing.

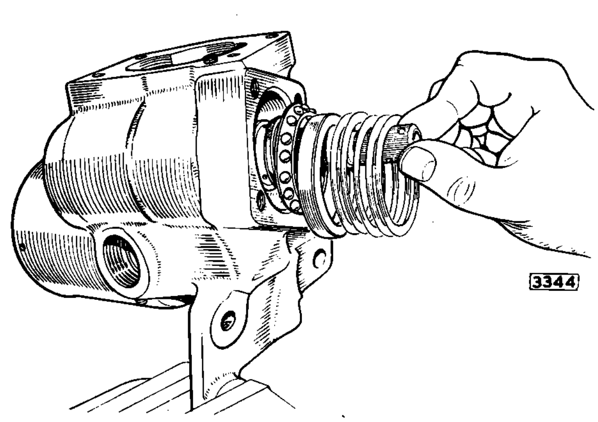


Fig. 12. Removing the valve and worm assembly.

Undo four bolts (10 and 11) retaining valve housing (9) using $\frac{5}{8}$" AF spanner and tap off valve housing with a mallet.

Remove assembly of valve and worm (3) by pulling the input shaft until assembly is withdrawn complete with the large ball bearing with cage and outer race (4). It is most important that none of the shims (13) between the outer race and valve housing are mislaid. Remove balls and cage (5) from bottom ball bearing and using an extractor to remove small outer race. It is important that none of the shims (6) behind the outer race are mislaid if they are present.

Remove the cylinder cover retainer ring (20) by forcing it out of its groove with a short $\frac{3}{16}$" (4·5 mm.) steel punch. Once out of the groove a screw-driver will ease it completely clear (Fig.13). Remove cylinder cover (18) complete with its seal. This operation is carried out by pulling on the boss in the centre of the cover with grips or pliers (See Fig.14).

Screw a long $\frac{1}{2}$" UNC bolt, or extractor into the tapped hole in centre of piston and rack (15) and withdraw assembly through open cylinder end (See Fig.15).

Separate top cover from sector shaft assembly (25) by removing the self-locking locknut and screwing cover off adjusting bolt.

The gear is now stripped down into its basic components as supplied for spares.

Note: It is most important that the relationship between the cam and valve sleeve is not disturbed by moving the trim screw (Fig.16).

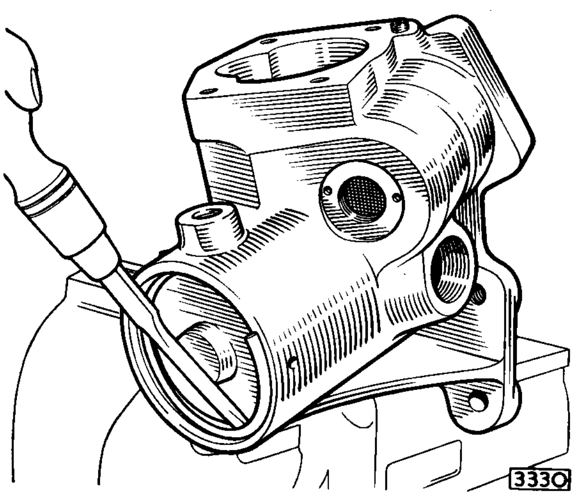


Fig. 13. Removing the cylinder cover retainer clip.

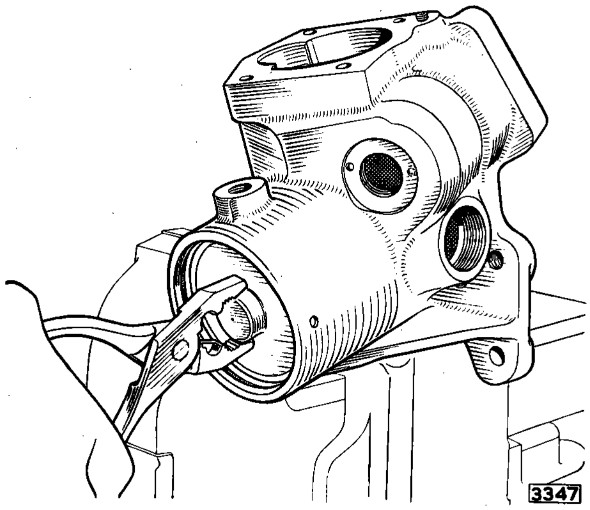


Fig. 14. Removing the cylinder cover.

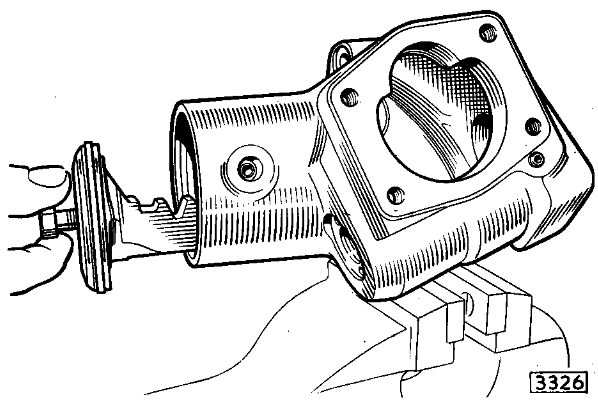


Fig. 15. Withdrawing the piston and rack assembly.

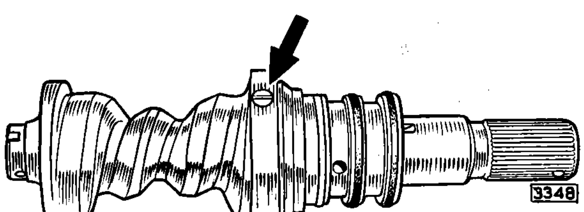


Fig. 16 The trim screw, indicated by the arrow, must not be disturbed when dismantling the steering unit.

EXAMINATION OF COMPONENTS

Sector Shaft Assembly

Check roller for preload on thrust bearings, it should be free to rotate, but slightly stiff, with **no** side play.

Check adjusting bolt for retention in the top of sector shaft. It should have no end float for preference but up to 0·005″ (0·13 mm.) is permissible. If excessive end float is present it is possible to adjust this out by tightening the screwed sleeve with a special screwdriver and re-peening threads of screwed sleeve through the hole in the side of the sector shaft.

Examine the three sector teeth for signs of excessive wear.

Examine bearing areas on top and bottom of sector shaft for excessive wear.

Examine seal area at bottom of sector shaft for wear, damage or grooving etc.

Cover Assembly

Examine sector shaft bush for signs of wear and replace if necessary.

Housing Assembly

Examine sector shaft bush and seal for wear and/or damage. Replace if necessary.

Examine hydraulic cylinder bore for damage, scoring and wear.

Valve and Worm Assembly

Examine the three teflon rings on the valve sleeve for damage. The rings should be a loose fit in their grooves and their outer diameter should be free from cuts, scratches and similar blemishes. Replace any damaged rings.

Examine cam and ball bearing tracks for damage and signs of wear. Replace if necessary.

Ensure that there is no relative movement at the trim pin between valve sleeve and worm.

Important: There must be no play between these components and the examination should be carried out with care.

Check that there is no wear in the torsion bar assembly pins by ensuring that there is no free movement between the valve rotor (or input shaft) and the worm.

Examine the needle bearing area towards the outer end of the rotor for damage and wear, similarly examine the seal area.

Piston and Rack

(a) Examine teflon ring for damage etc.
(b) Examine rack teeth for signs of undue wear.
(c) Examine back face of rack that is, behind the teeth for signs of wear caused by the rack adjuster pad.

Valve Housing

Examine bore for signs of wear or damage, particularly on rubbing surfaces of teflon rings.

Examine seal for damage.

Examine needle roller bearing for damage.

ASSEMBLING

Valve and Worm Assembly

It is important that the worm be centred in the gear housing to ensure the correct relationship between the ratio curve, the preload torque peak and the central position of the steering gear. During manufacture the critical dimension of both the cam and housing is measured in special fixtures this dimension is effectively the distance from the small ball race to the centre of the cam). The checking fixture shows the amount in thousands of an inch that the box is deep and also the amount that the cam is short. This error is etched on the cam and stamped on the box, hence, a cam which is

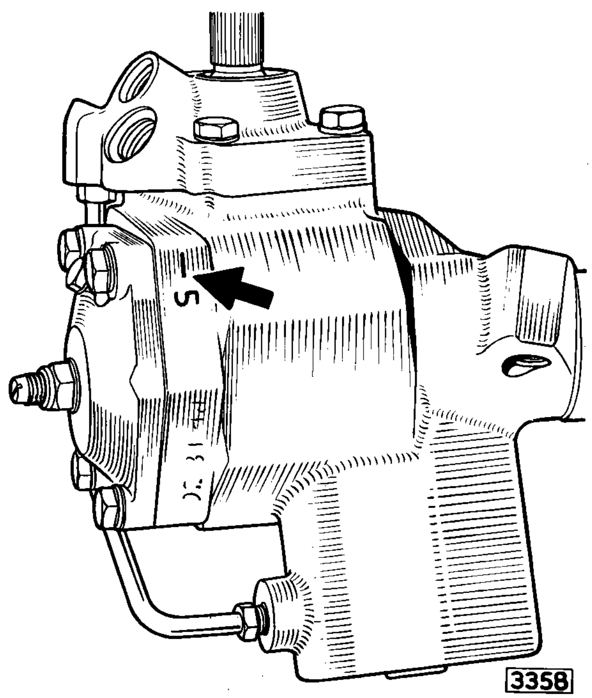


Fig. 17. The location of the depth reading to facilitate fitting the valve shaft shims.

0·006″ (0·15 mm.) short and a box which is 0·004″ (0·10 mm.) deep will need a tota of 0·010″ (0·25 mm.) shims to bring the datum into the correct position, that is, simply add the two datum errors together to give you the correct thickness of shims in "thou's" (0·001's). Having determined and selected the correct number of shims these should be placed in the bottom of the recess in the race housing.

Press ball bearing assembly and cage (small) into recess on top of shims.

Lower valve assembly and work into position.

Fit ball bearing assembly and cage (large) over top of worm.

Take valve housing assembly and remove large square sectioned "O" ring from the spigot.

Fit valve housing over valve rotor, protecting rotor seal from rotor splines with seal saver and check rotor (input shaft) for end float. Remove valve housing and add shims in sufficient quantities to provide a 0·0015″ (0·04 mm.) gap between the valve housing and the gear housing (See Fig.18). This gap should be measured whilst reasonable hand pressure is applied to the valve housing. Remove valve housing and refit square sectioned "O" ring. Refit valve housing and tighten down the four bolts. The tightening down operation should increase the torque on the input shaft by 2 lb.in. (0·02 kg.m.). If this torque increase is not achieved then the shim stack should be altered accordingly.

Rack and Piston Assembly

Always fit a new teflon piston ring, with rubber 'O' ring-piston underneath it in the groove.

Screw a long $\frac{1}{2}$″ UNC bolt into the tapped hole in centre of piston face.

Press the piston into its cylinder bore with its teeth facing the sector shaft bore so that the tips of the teeth are parallel to the sector shaft centre line. Push piston into bore until the piston top is 1·675″ (42·5 mm.) from the mouth of the cylinder (See Fig.19). In order to obtain this dimension it is necessary to remove the end plate.

Mis-align piston in bore so that the back face of the rack is hard up against the gear casing adjacent to the rack adjuster screw bore.

Sector Shaft Assembly

Remove self-locking nut from top of adjuster screw, screw cover assembly onto adjuster screw as far as it will go.

Fit seal saver onto splined end of sector shaft and insert sector shaft into gear housing with the roller positioned towards the middle of the cam (Fig.20). By manoeuvring the sector shaft it should be possible to engage the rack teeth and then by working the input shaft to and fro it should be possible to engage the cam and roller, after which operation the sector shaft can be pushed fully home. (See Fig.21).

Note: Ensure that the square sectioned "O" ring seal is fully home in its recess before the top cover is bolted down.

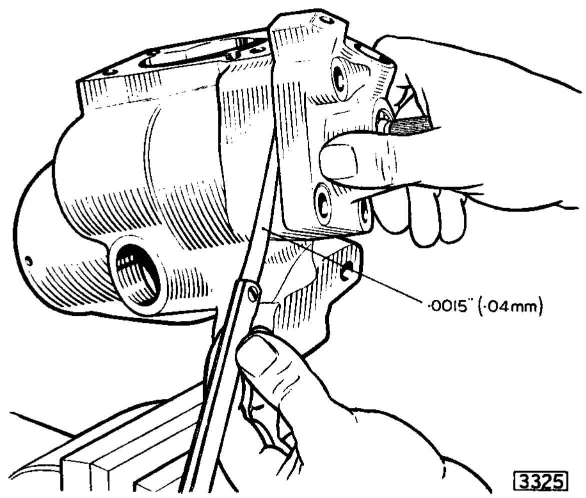


Fig. 18. Checking the gap between the valve and gear housings.

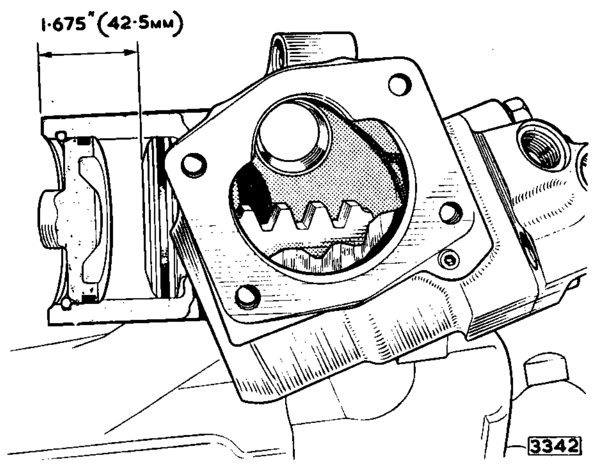


Fig. 19. Rack and pinion assembly.

Fit the four screws with spring washers and tighten, at the same time ensuring that the spigot of the top cover is hard up against its recess in the casing aperture. This is done by forcing the cover away from the worm bore, possibly tapping it with a hide mallet.

Remove the long bolt from the piston face.

Rack Adjuster Screw

Position pad in its seating in rack adjusting screw. Fit a new seal into its recess and offer assembly up into screwed bore in gear housing ensuring that the pad remains in position. The gear should be laid on its side and the assembly screwed up vertically. Fit rack screw loosely and fit locking screw into its tapped hole (See Fig.22).

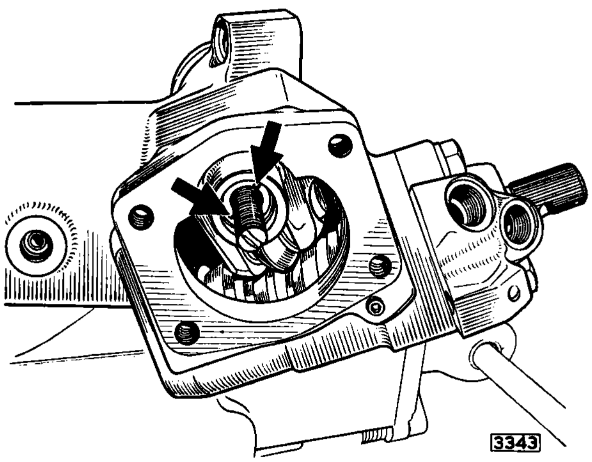


Fig. 20. Positioning the roller towards the middle of the cam. The arrows indicate the adjustment slots in the top of the sector shaft.

Cylinder Cover

Fit new seat to cylinder cover and press into cylinder bore.

Fit cylinder cover retainer ring.

Check on Correct Assembly

The gear has now been assembled so that it is in its central position and the sector shaft adjusting screw should be screwed down until there is virtually no back lash in the sector shaft. Check this by fitting the drop arm onto the end of sector shaft, hold adjusting screw stationary, screw down self-locking nut and tighten.

Remaining Parts

Fit feed pipe assembly.

Fit drop arm retaining nut and tab washer.

Adjustment of rebuilt gear

Sector Shaft Adjustment. This operation involves the lowering of the sector shaft so as to give the correct mesh between the roller (or follower) and the worm. Set the gear on centre using centralising plug (J.27). Remove the plug, slacken the self-locking nut and tighten adjuster screw until the input shaft feels slightly stiff as it passes through centre. (The increased stiffness over centre should be 4 lb.in. (0·04 kg.m.). Lock adjuster screw with self-locking nut.

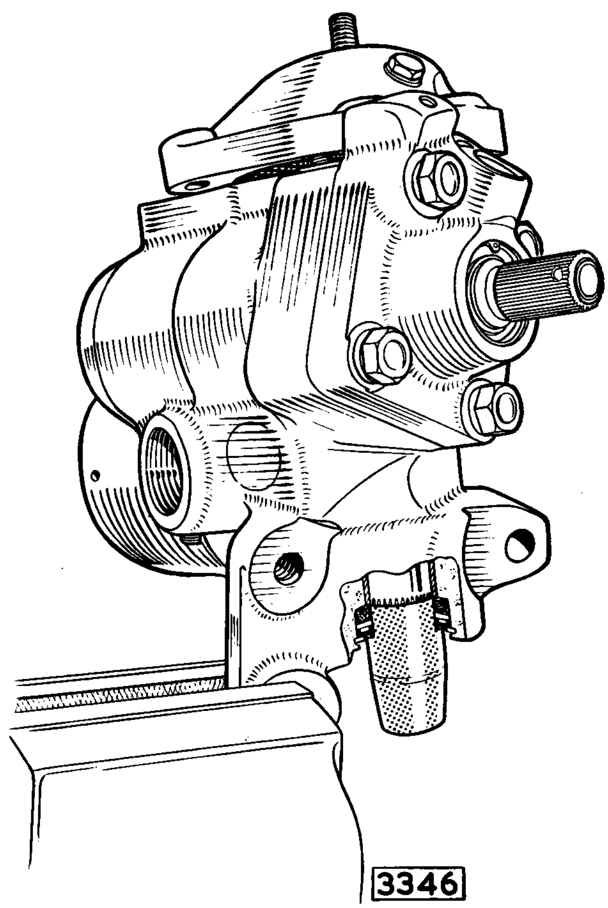
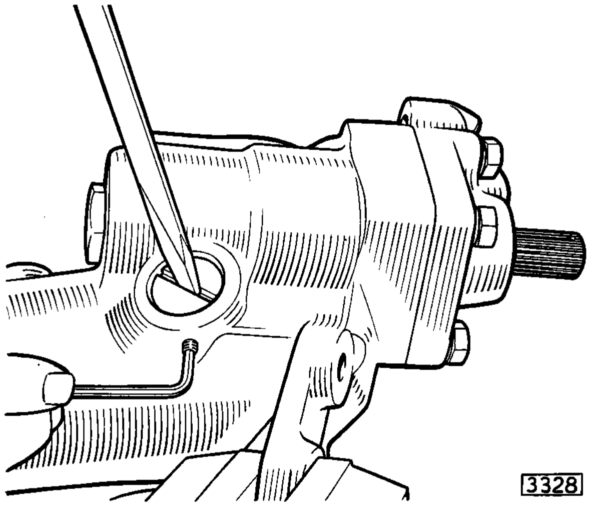


Fig. 21. Refitting the sector shaft using the special tool (Churchill Tool No. J.34).



3328

Fig. 22. Tightening the rack pad locking screw.

Rack Adjustment. This can be done to achieve zero clearance between the rack and sector teeth. Screw in rack adjuster screw until all free travel is taken up and apply a light torque to give the correct preload. Check that the gear is free from lock to lock by turning input shaft. Tighten rack screw further until movement on the input shaft becomes restricted, then back off adjuster screw until the restriction just disappears. Tighten the locking screw.

REFITTING

Refitting is the reverse of the removal procedure.

Refit the drop arm to the steering unit, check location marks as noted on removal. Renew tab washer if damaged.

Refit the lower steering column checking location marks as noted on removal.

Place the road wheels in the straight ahead position, refit the unit to the cross-member and reconnect the drop arm to the steering tie-rod ball joint.

Ensure that the steering wheel is in the central position, push the inner column down and connect to the universal joint on the lower column. Check the location marks as noted on removal.

Care must be taken to ensure that the horn contact does not catch the slip ring on the inner column. The contact may be lifted slightly with a screwdriver whilst the column is brought into position.

Refit the thrust bearing and replace the retaining clamp.

Fit a new spring clip and tighten securely by pinching the raised portion with a pair of pincers.

Depress the upper half of the top universal joint fully and raise $\frac{1}{4}''$ (0·6 mm.). Refit the pinch bolt.

Reconnect the high and low pressure hoses, care being taken to ensure that the connections are perfectly clean.

Refill the reservoir to the full mark on the dipstick with the recommended grade of Automatic Transmission Fluid and bleed the system as follows:

(a) Release the hexagon plug in the steering unit top cover.

(b) Start the engine and while running turn the steering from lock to lock a few times.

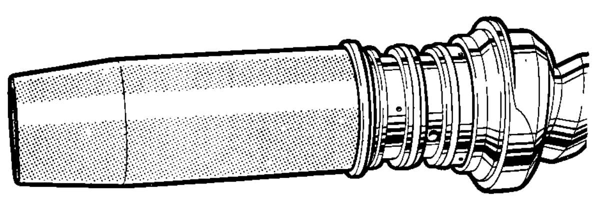
(c) Retighten the hexagon plug and check the fluid level in the reservoir. The correct level is to the full mark on the dipstick with the oil hot. Top up to the correct level with the recommended grade of fluid if necessary.

REPLACEMENT OF EXTERNAL SEALS

These operations are covered on page I.21, but the following points should be noted:—

Sector Shaft Seal. This should be replaced after the sector shaft has been withdrawn. Remove circlip and hook out back-up seal, washer and seal.

Rotor Seal. This operation should be carried out with the valve housing removed from the gear. Take care not to misplace any of the large shims between the valve housing and ball race.



3324

Fig. 23. Fitting a Teflon ring using the valve seal expander (Tool No. J.32).

REPLACEMENT OF INTERNAL SEALS

Dismantle the gear completely as described on page I.15.

To replace worn or damaged Teflon ring on the valve sleeve, proceed as follows:—

Cut old ring through with a sharp knife and remove from groove. Teflon rings have poor elastic properties. They can, however, be stretched and compressed if handled with care. To fit a ring into a particular groove slide the ring onto the Valve Seal Expander (Tool number J.32) and work it up to the large end. Slide the expander over the sleeve positioning the end cover over the groove. Push ring over the end of the expander into the groove (See Fig.23).

Note: The expander will not fit over the sleeve when the rings are fitted in their grooves, so that it may be necessary to remove good rings in order to replace faulty ones.

Now, having expanded the ring it is necessary to compress it into its groove. This is achieved by gently working the sleeve assembly into the valve seal compressor (Tool number J.33) starting with the end having the shallow taper and finishing with the other end, which has the steep taper (See Fig.24). When the compressor is withdrawn the rings should be fitting snugly in their grooves, they should be free to rotate, they should be free from cuts and blemishes and they should have slight interference with the bore of the valve housing into which they fit when the gear is assembled.

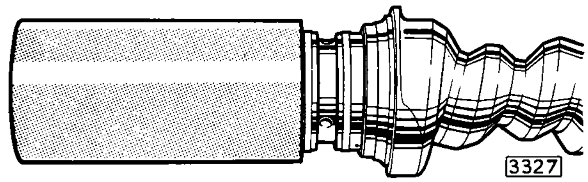


Fig. 24. The valve seal compressor (Tool No. 11180 in position).

Replacement of Piston Rings. If the Teflon piston ring is found to be damaged or worn, replace it with a new one. Cut the ring and remove from groove and remove rubber "O" ring which will be found underneath it. Expand a new rubber "O" ring and position it in the bottom of the groove, then take a new ring and fit it into one side of the groove, working round the groove in both directions in much the same way as a tyre is fitted to a wheel rim. Care should be taken to avoid stretching the ring excessively.

THE PRESSURE PUMP

The pressure pump, which provides the hydraulic pressure in the system, is of the vane type and incorporates a combined flow and relief valve. The pump, which is contained within its own reservoir, is mounted on the right-hand side of the engine; it is belt driven from the crankshaft pulley, the belt tension being automatically regulated by a spring loaded jockey pulley.

REMOVAL

Release the nut securing the pump mounting bracket bottom bolt and remove the setscrew and washer securing the adjusting link to the water pump.

Swing the pressure pump inboard, lift the jockey pulley against the spring pressure and remove the drive belt from the pump pulley.

Release the hose clip and disconnect the low pressure hose from the pump. Blank off the union to prevent the ingress of dirt and catch any escaping oil in a clean container.

Disconnect the high pressure hose from the pump connection and blank off the union.

Remove the two nuts and lockwashers from the pump mounting studs and withdraw the unit from the bracket. Note the location and number of the spacing washers between the pump and the mounting bracket for reference when refitting.

DISMANTLING

Drain the oil out of the pump and thoroughly clean the exterior.

Tap back the tab washer, remove the nut and withdraw the pulley.

Clamp the pump in a vice taking care not to exert undue pressure on the front hub as this may distort the shaft bushing.

Remove the outlet union (4 Fig.7) noting the "O" ring (5) in its recess. Remove the two mounting studs (3 Fig.7).

Detach the reservoir from the pump body.

Collect the three "O" rings (6 and 7 Fig.7) from their recesses in the pump body.

Remove the end plate retaining ring by pushing a pin through the hole in the pump body and levering out with a screwdriver (Fig.25).

Remove the end plate and spring (20 and 19 Fig.7). If the end plate sticks in the pump body a light tap will free it.

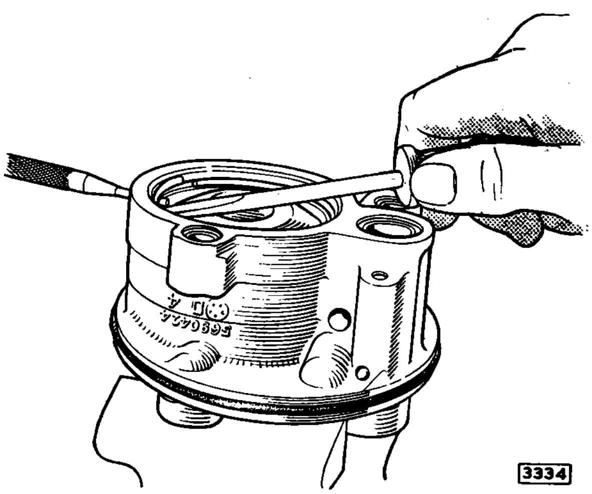


Fig. 25. Removing the end plate retaining ring.

Remove the end plate "O" ring (22 Fig.7) from its recess in the pump body.

Remove the flow control valve and spring (23 and 24 Fig.7).

Remove the key (11 Fig.7) from the shaft and gently tap the end until the pressure plate, pump ring, rotor and thrust plate (12) can be removed as an assembly (Fig.26).

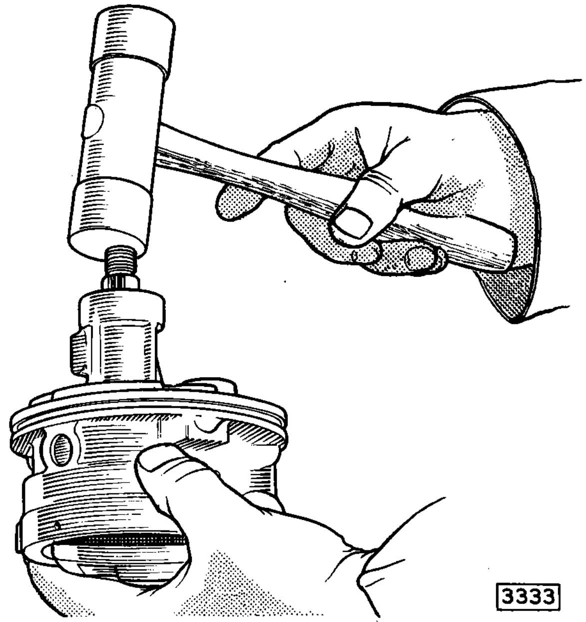


Fig. 26. Removing the pressure plate, pump ring and thrust plate assembly.

Remove the pressure plate "O" ring (22) from pump body.

Separate the components taking care not to damage the pump rotor vanes.

Remove the clip (14 Fig.7) and withdraw the rotor (13) and thrust plate (12).

Remove the shaft oil seal (25 Fig.7).

INSPECTION

Carefully clean all the parts except the "O" rings and shaft seal which should be replaced. Do not immerse any of the new seals in the cleaning solvent otherwise they may be damaged.

Check the pressure plate, thrust plate, and rotor for scoring. A high polish is always present on the faces as a result of normal wear—do not confuse this with scoring. Light scoring can be rectified by lapping.

Examine the contour surface of the pump ring for extreme wear. There may be some scuff marks and uniform wear but this is not detrimental. However, if chatter marks or grooves are present that can be felt with the finger both the ring and the vanes should be replaced.

Inspect the pump shaft and bushing; the bush is not supplied as a separate part.

The flow control valve must slide freely in the bore and if the valve tends to stick, check for burrs or foreign matter.

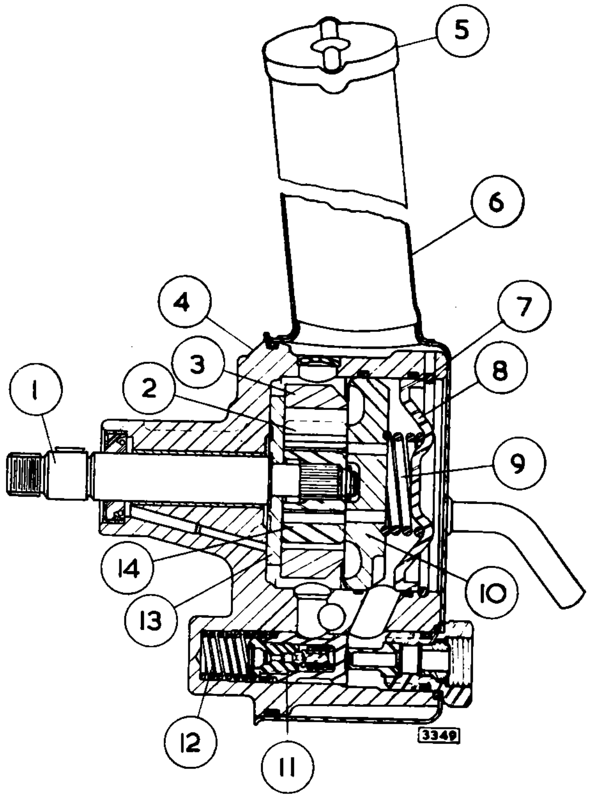


Fig. 27. Section of steering pump.

1. Driving shaft
2. Pump vane
3. Pump ring
4. Pump body
5. Filler cap
6. Reservoir
7. Oil seal
8. End plate
9. Spring
10. Pressure plate
11. Flow control valve
12. Spring
13. Thrust plate
14. Rotor

ASSEMBLING

Lubricate a new shaft seal with petroleum jelly and fit the seal to the pump body using a tube of suitable diameter. Insert the pump shaft, splined end first, from the hub end of the body.

Insert the dowel pins into the holes in the pump body.

Fit the thrust plate over the dowel pins with the ported face uppermost (Fig.28).

Fit the rotor to the splined shaft with the countersunk side downwards, that is, towards the thrust plate. The rotor must be free on the splines.

Fit the retaining clip to the groove in the end of the shaft.

Fit the pump ring to the dowel pins with the rotation arrow uppermost (see Fig.30).

Place the vanes in the rotor slots ensuring that the radiused edge of each vane faces towards the outside (Fig.31).

Smear the pressure plate "O" ring with petroleum jelly and install into lowermost groove in pump body.

Lubricate periphery of pressure plate with petroleum jelly and fit to the dowel pins with the circular recess for the spring uppermost. Push the plate down by means of a piece of tube applied at the outer edge. Do NOT press or tap the plate into position.

Smear the end plate "O" ring with petroleum jelly and install into its groove in the pump body.

Fit the spring (19 Fig.7) into the circular groove in the pressure plate (17).

Lubricate the periphery of the end plate with petroleum jelly to avoid damaging the "O" ring.

Place end plate in position with the retaining clip on top. Ensure that the gap in the clip is not opposite the hole used for removal.

Place the assembly under a press and apply pressure until the retaining clip can be sprung into the groove in the body (Fig. 33).

Ensure that the spring is fully wound onto the flow control valve and insert the valve, spring foremost into the bore in the pump.

Place new "O" rings for the reservoir retaining bolts and outlet union in position.

Smear the large reservoir "O" ring (9 Fig.7) with petroleum jelly and fit to the groove in the pump body.

Fit the reservoir to the pump body taking care not to displace the "O" rings.

Fit the reservoir retaining studs (3 Fig.7), outlet union (4) with "O" ring (5) located in the groove in the union.

Refit the pulley key and pulley and secure with the tab washer and nut.

REFITTING

Refitting is the reverse of the removal procedure.

Reconnect the high and low pressure hoses, care being taken to ensure that the connections are perfectly clean.

Fill the reservoir to the full mark on the dipstick with the recommended grade of Automatic Transmission Fluid and bleed by turning the pulley anti-clockwise a few times to dispel any air in the pump.

Lift the jockey pulley against the spring pressure and feed the drive belt over the jockey pulley. Move the pump outboard to the full extent of the elongated hole in the adjuster link and lock the securing screw.

Release the pulley jockey.

Bleed the complete system as follows:—

(a) Release the hexagon plug in the steering unit top cover.

(b) Start the engine and while running turn the steering from lock to lock a few times.

(c) Retighten the hexagon plug and check the fluid level in the reservoir. The correct level is to the full mark on the dipstick with the oil hot. Top up if necessary with the recommended grade of Automatic Transmission Fluid.

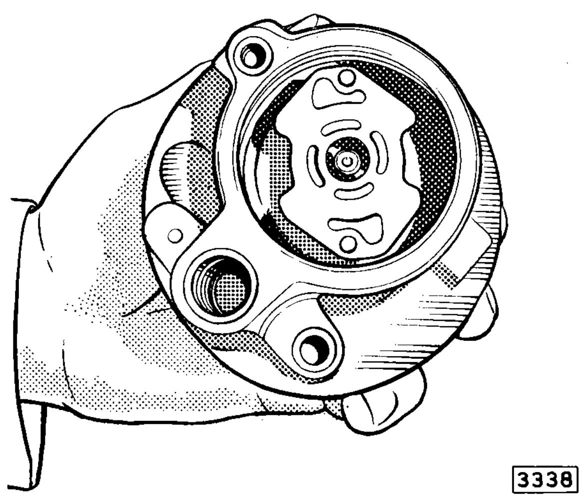


Fig. 28. Fitting the thrust plate over the dowel pins.

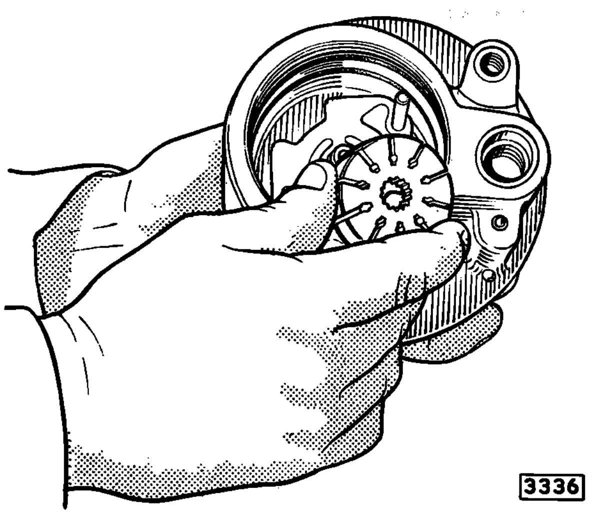


Fig. 29. Fitting the rotor to the splined shaft.

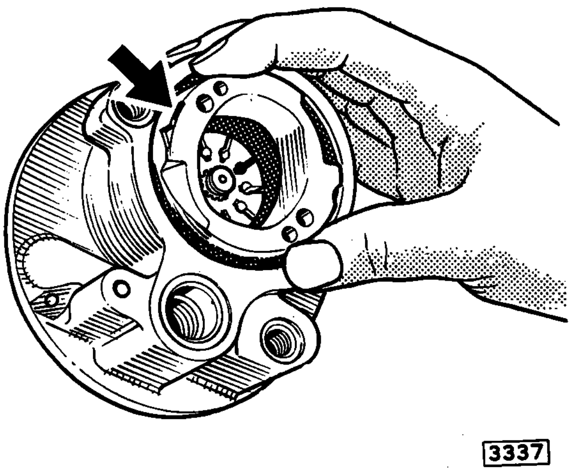


Fig. 30. Fitting the pump ring with arrow uppermost.

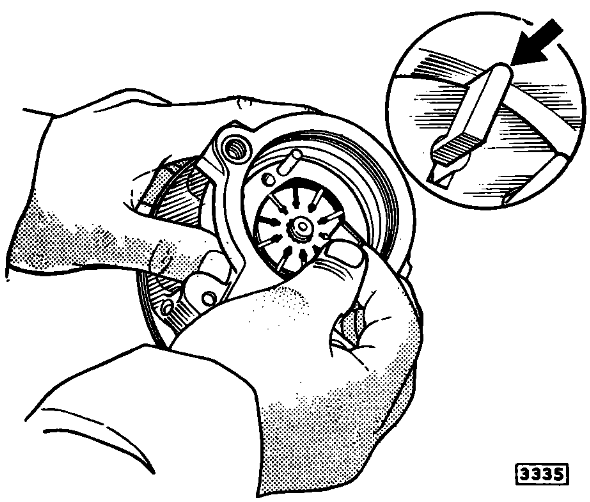


Fig. 31. Placing the vanes in the rotor slots.

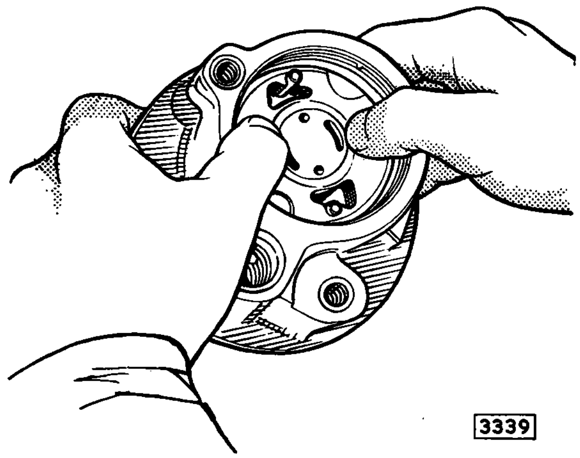


Fig. 32. Placing the end plate in position.

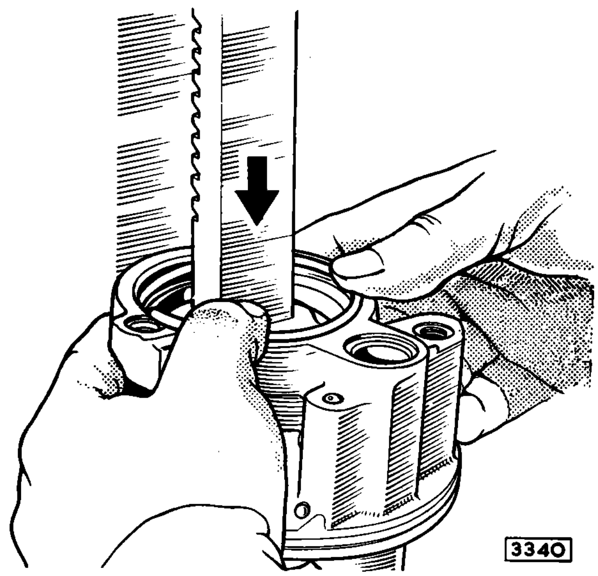


Fig. 33. Compressing the spring prior to final assembly.

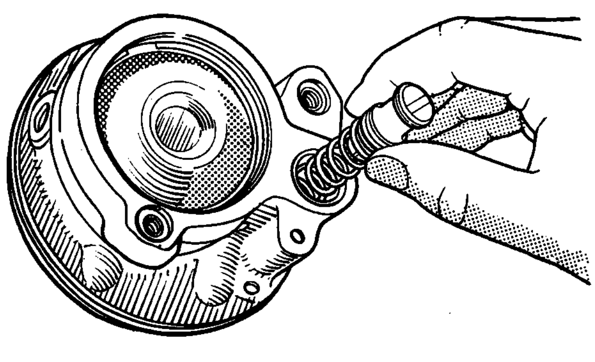


Fig. 34. Inserting the flow control valve.

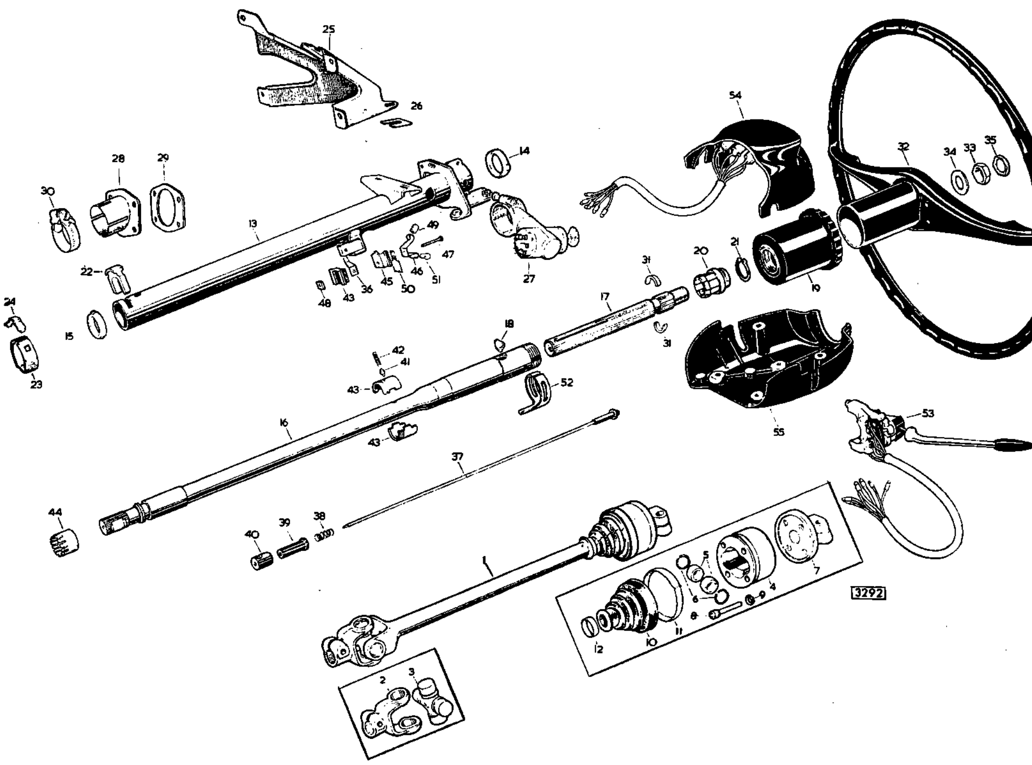


*Fig. 35. **Exploded view of the steering column.***

1. Lower steering column assembly
2. End yoke
3. Journal assembly
4. Socket
5. Nylon roller
6. Circlip
7. End plate
8. Screw
9. Spring washer
10. Gaiter
11. Clip
12. Clip
13. Outer tube assembly
14. Plastic bearing (top)
15. Plastic bearing (bottom)
16. Inner column
17. Shaft
18. Stop button
19. Locknut
20. Split collet
21. Circlip
22. Thrust bearing
23. Retaining ring
24. Spring clip
25. Upper bracket
26. Shim
27. Lock and ignition switch
28. Lower bracket
29. Gasket
30. Clip
31. Split cone
32. Steering wheel
33. Nut
34. Special washer
35. Palnut
36. Earth contact
37. Contact pin
38. Spring
39. Insulating bush (upper)
40. Insulating bush (lower)
41. Contact nipple
42. Spring
43. Rotor assembly
44. Slip ring
45. Contact holder
46. Contact
47. Bolt
48. Nut
49. Rubber sleeve
50. Insulating strip
51. Dowel eyelet
52. Striker plate
53. Direction indicator/headlamp flasher switch
54. Upper switch cover
55. Lower switch cover

STEERING WHEEL

REMOVAL

Withdraw four cheese-headed setscrews and washers from the underside of the steering wheel centre and detach the horn switch cover.

Remove the three screws and spring washers securing the horn ring to the steering wheel and detach the ring.

Remove the locknut, nut and plain washer securing the steering wheel to the inner shaft, withdraw the wheel and extract the split cone.

REFITTING

Refitting is the reverse of the removal procedure.

Slide the steering wheel on to the shaft splines so that the two spokes are horizontal when the road wheels are pointing straight ahead.

UPPER STEERING COLUMN

REMOVAL (Fig.35)

Disconnect the battery.

Remove the black plastic button from the bottom of the ash tray (or radio) surround panel and withdraw the slotted screw now exposed.

Detach the surround by pulling away the two peg fixings from the spring retainers located at the top corners of the panel.

Disconnect the cable from the radio (if fitted).

Remove the console from the gearbox tunnel after removing two thumb nuts from the rear end and two thumb nuts and drive screws beneath the parcel tray.

Remove the gear lever knob and lift the console over the gear lever. (Synchro-mesh gearboxes only).

If the car is equipped with electrically operated windows, insert a screwdriver under the 4 switch panel at the rear edge and lift clear of the spring/stud mounting. Withdraw rearwards away from the clip fixing and feed the panel through the aperture in the console.

Care must be taken not to damage the polished facia when removing or refitting.

Remove the picnic tray by withdrawing to the full extent and pressing the spring retaining clips on the back edge inwards.

Remove the two instrument panel retaining screws (top left and right-hand corners) and lower the instrument panel.

Detach the flasher unit from the parcel tray mounting.

Remove the six drive screws securing the parcel tray to the bulkhead, two central and two at each edge and lower the parcel tray to the floor.

Turn the road wheels to the straight ahead position. If retained in this position this will facilitate the refitting procedure.

Disconnect the wires from the flashing indicator/headlamp flashing switch at the snap connectors.

If an overdrive is fitted, disconnect the wires from the overdrive switch at the snap connectors.

Remove the two screws and washers securing the upper switch cover to the outer tube.

Lift off the upper switch cover and remove the three bulb holders from the back. Note the location of the bulbs for reference when refitting.

Disconnect the four cables from the inhibitor switch located on a bracket attached to the steering column. Note the location of the cables on the switch before disconnecting for reference when refitting. (Automatic transmission cars only).

Disconnect the gear selector control cable ball joint from the selector lever on the steering column (Automatic transmission cars only).

Disconnect the four cables from the steering column lock (if fitted) and ensure that the key is in the "Garage" (normal stop) position.

Note the location of the cables on the switch for reference when refitting.

Note: The switch unit cannot be removed from the outer column.

Remove the pinch bolt securing the inner column to the top universal joint on the lower steering column.

Remove the spring clip from the retaining clamp situated at the lower end of the upper column. Turn the clamp through 90° and slide downwards to expose the plastic thrust bearing.

Withdraw the bearing through the outer column.

Mark the location of the inner column splines in relation to the universal joint for reference when refitting.

Unscrew the clip securing the bottom of the steering column to the mounting bracket.

Remove the two bolts, nuts and washers securing the upper steering column to the body behind the side facia panel.

Withdraw the steering column.

DISMANTLING

Withdraw four cheese-headed setscrews and washers from the underside of the steering wheel centre and detach the horn switch cover.

Remove the three screws and spring washers securing the horn ring to the steering wheel and detach the ring.

Remove the locknut, nut and plain washer securing the steering wheel to the shaft inside the inner column.

Withdraw the steering wheel and extract the split cone.

Remove three setscrews and plain washers and detach the lower switch cover.

Unscrew the steering wheel locking nut and withdraw from the splined inner shaft.

Withdraw the inner column.

Withdraw the horn switch contact rod, spring and insulating bush.

Remove the two screws, serrated and square washers securing the flashing indicator switch striker ring.

Remove the stop button and withdraw the inner shaft from the inner column.

Slide off the horn pick up ring and remove the top and bottom half of the rubber rotor assembly.

Remove two setscrews and detach the flashing indicator switch from the outer column.

From chassis number 1D51137 RHD and 1D75679 LHD, including chassis number 1D51052–1D51103 RHD and 1D75628–1D75671 LHD, the steering column upper bearing can be adjusted for clearance by means of the indicator switch clamp.

To remove the switch release the locknut on the top fixing screw, withdraw both screws and collect the distance piece from the bottom fixing screw.

If the car is fitted with overdrive transmission remove the overdrive switch after withdrawing two setscrews, nuts and lockwasher.

If the car is fitted with automatic transmission remove the gear selector mechanism as follows:—

Remove the two setscrews and tapping plate securing the inhibitor switch carrier bracket and detach the switch from the operating link.

Release the square-headed locking screw and remove the lower selector lever from the selector shaft.

(a) Remove the two setscrews and tapping plate securing the inhibitor switch carrier bracket and detach the switch from the operating link.

(b) Release the square-headed locking screw and remove the lower selector lever from the selector shaft.

(c) Remove the setscrew, nut and washer securing the gear indicator arm bearing to the bracket on the outer column.

(d) Remove the circlip and washer from the underside of the shaft upper bearing and withdraw the lever and shaft.

(e) To remove the gear selector lever from the pivot bracket, drift out the hollow pivot pin, withdraw the lever and collect the return spring shims.

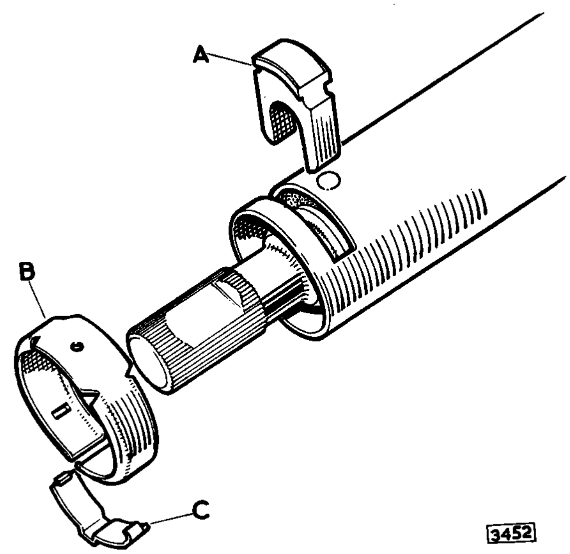


Fig. 36. The components of the upper inner steering column retainer.

A—Thrust bearing
B—Retaining ring
C—Spring clip.

(f) Depress the retaining lugs and withdraw the bearing bushes from the top and bottom of the outer tube.

(g) Remove the nut and bolt securing the two rubber contact holders, fibre insulating strip and the horn contact blade.

(h) Remove the two setscrews and lockwashers and remove selector quadrant and spacers.

REASSEMBLING

Replace the two bearing bushes ensuring that the lugs register in the holes in the outer column.

Replace the two rubber contact holders, fibre insulating strip and horn contact blade. Secure with the bolt and nut.

Refit the earth contact blade.

If the car is fitted with automatic transmission refit selector control as follows:—

(a) Refit the selector quadrant and spacers.

(b) Insert the shims and return spring in the pivot bracket, refit the selector lever and secure with the hollow pivot pin. Lightly grease the spring before fitting the lever.

(c) Pass the selector shaft through the top bearing, slide the plain washer and circlip over the shaft and feed the shaft through the bottom bearing. Secure in position with the plain washer and circlip.

(d) Refit the lower selector lever to the shaft and secure with the square-headed locking screw. Check that the shaft works freely in the bearings.

(e) Refit the gear indicator arm bearing to the bracket on the outer column.

(f) Reconnect the inhibitor switch to the operating link and secure to the mounting bracket. Do not tighten the setscrews at this stage.

(g) Refit the flashing indicator switch and secure with two setscrews and lockwashers. Lightly grease the moving parts of the switch with petroleum jelly.

If the steering column is fitted with an adjustable upper bearing (See page I.28 for commencement of chassis numbers) adjustment must be made when fitting the switch as follows:

Pass the fixing screws through the switch clamp and attach the spring washer and locknut to the upper screw and distance piece and flat washer to the bottom screw.

Feed the screws through the column brackets and attach the indicator switch.

Tighten the bottom screw fully.

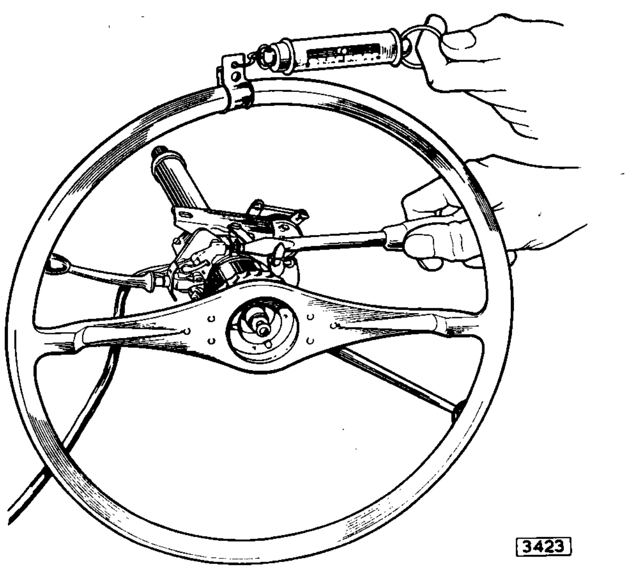


Fig. 37. Upper steering column top bearing adjustment points

Fit the inner column and temporarily attach the steering wheel.

Attach a spring balance to the steering wheel rim.

Tighten the top screw until the wheel will just turn with a pull of 5 ozs (141·7 grammes) registered on the balance (Fig.37).

Turn the locknut towards the clamp plate and lock the screw.

Two thicknesses of distance piece are available to compensate for any variation in the bore of the outer tube.

Grade "A" 0·188″ (4·7 mm.)

Grade "B" 0·166″ (4·06 mm.)

If the car is fitted with overdrive transmission refit the overdrive switch to the outer column.

Refit the spring and horn contact to the upper half of the rubber rotor. Refit the top and bottom halves of the rotor to the inner column and slide the horn slip ring over both halves with the serrations towards the bottom of the column.

Gently knock the serrations into the groove in the rotor until the slip ring is secure.

Slide the inner shaft into the inner column so that the slot in the shaft serrations aligns with the stop button hole in the inner column.

Screw the stop button into the inner column until the shaft binds on the button.

Slacken the button until the shaft moves freely.

Refit the indicator switch striker plate and adjust the position of the button to allow the edge of the plate to align with the squared portion.

The striker plate should be fitted with the striker peg towards the button of the column and on the opposite side to the stop button.

Turn the inner column until the striker retaining bolts are in the vertical position and set the striker peg so that it is just below the horizontal axis position.

Slide the inner column into the outer column, ensuring that the earth contact is not damaged.

Care must also be taken to ensure that the horn contact does not catch the slip ring on the inner column. The contact may be lifted slightly with a screwdriver whilst the column is brought into position.

Mount the lower switch cover on to the outer tube.

If the car is fitted with automatic transmission adjust the inhibitor switch as follows:—

(a) Select neutral ("N") on the gear selector quadrant and hold in this position.

(b) Rotate the switch in the clamp ring and move the bracket in the elongated holes until the small hole in the lever registers with the indent in the back of the switch.

(c) Tighten the clamp ring and bracket setscrews.

REFITTING

Ensure that the front road wheels are in the straight ahead position.

Feed the outer column through the bottom mounting bracket and secure to the top mounting bracket with the two bolts, nuts and washers.

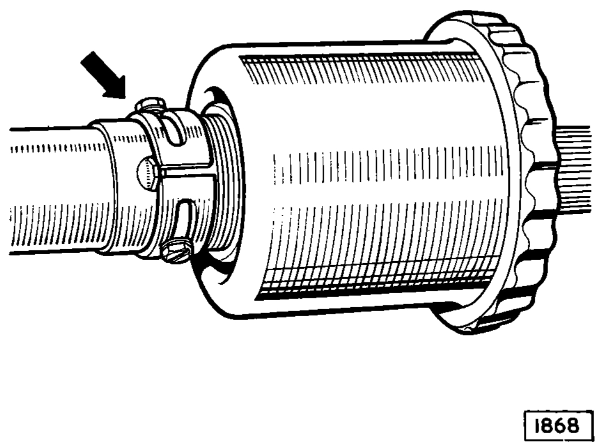


Fig. 38. Centralising the flashing indicator striker peg.

Tighten the jubilee clip securing the upper column to the lower mounting.

Turn the inner column and centralise the flashing indicator striker between the two arms on the indicator switch.

Engage the splines of the inner column with the internal splines of the lower column. Check the location mark as noted on removal.

Refit the thrust bearing and replace the retaining clamp.

Fit a new spring clip and tighten securely by pinching the raised portion with a pair of pincers.

Depress the upper half of top universal joint fully and raise ¼″ (6 mm.). Refit the pinch bolt.

Reconnect the flashing indicator switch wires in their correct colour sequence, using the wiring diagram as a reference.

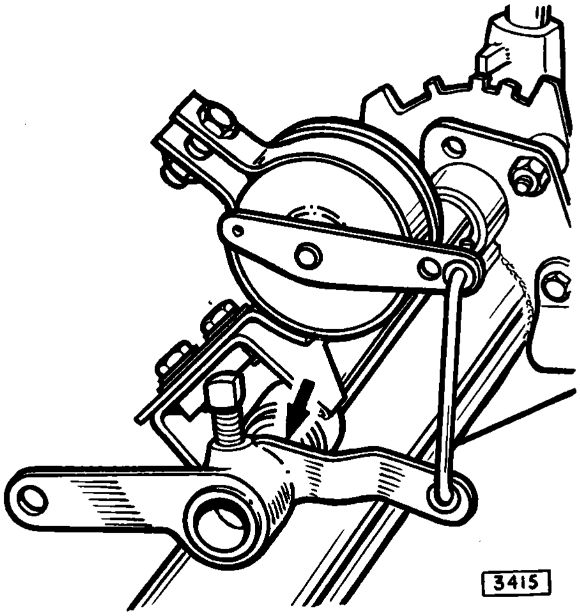


Fig. 39. Aligning the flat on the control rod with the setscrew in the transmission control bracket.

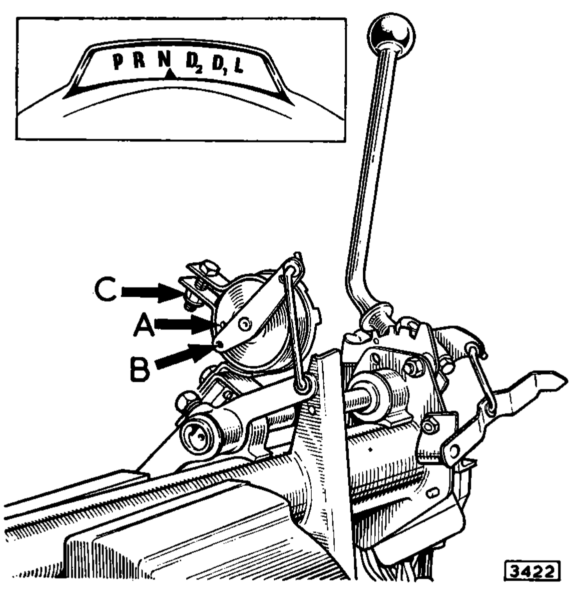


Fig. 40. Setting the starter/reverse inhibitor switch. (Automatic transmission models).

If the car is fitted with overdrive transmission reconnect the overdrive switch.

If fitted with automatic transmission reconnect the four wires to the inhibitor switch in their correct sequence as noted on removal.

Reconnect the gear selector control cable ball joint.

Reconnect the steering column lock cables (if fitted). Check with the wiring diagram.

Re-insert the warning light bulb holders in their correct sequence and refit the upper switch cover to the steering column.

Reconnect the horn switch wire to the slip ring contact.

Refit the parcel tray, console and instrument panel by reversing the removal procedure.

Place the split cone into the groove on the inner shaft with the tapered end towards the top of the shaft.

Refit the steering wheel with the two holes on the steering wheel centre boss towards the top.

Refit the plain washer, nut and locknut.

Secure the horn ring to the steering wheel centre boss with the three screws and spring washers.

Check that the horn switch contact rod has been refitted.

Refit the horn ring contact cover and secure with the four cheese-headed setscrews and lockwashers.

LOWER STEERING COLUMN

REMOVAL

Turn the road wheels to the straight ahead position. If retained in this position this will facilitate the refitting procedure.

Remove the spring clip from the retaining clamp situated at the lower end of the upper steering column. Turn the clamp through 90° and slide downwards to expose the plastic thrust bearing.

Withdraw the bearing through the outer column.

Note the location of the inner column splines in relation to the universal joint for reference when refitting.

Remove the pinch bolt securing the upper inner steering column to the top universal joint on the lower column.

Pull the steering wheel and inner column upwards to clear the splines from the universal joint.

Note the location of the lower column in relation to the steering unit shaft, remove the pinch bolt and detach the universal joint.

DISMANTLING AND REASSEMBLING

Remove four socket screws and detach the top cover from the universal joint.

Examine the nylon rollers, retained by circlips, and replace if necessary.

Repack the socket with suitable grease.

Refit the cover and secure with the four socket screws.

REFITTING

Check that the road wheels are in the straight ahead position.

Refit the lower universal joint to the steering unit shaft and secure with the pinch bolt.

Set the steering wheel so that the spokes are horizontal and the motif is upright.

Push the inner column down and connect to the universal joint on the lower column.

Care must be taken that the horn contact does not catch the slip ring on the inner column. The contact may be lifted slightly with a screwdriver whilst the column is brought into position.

Refit the thrust bearing and replace the retaining clamp.

Fit a new spring clip and tighten securely by pinching the raised portion with a pair of pincers.

Depress the upper half of the universal joint fully and raise ¼" (6 mm.). Refit the pinch bolt.

THE CENTRE TRACK ROD

The track rod ends incorporate rubber/steel bonded bushes. If the bushes show signs of deterioration they should be replaced.

REMOVAL

Remove the self-locking nuts and washers from the inner ball joint of each tie rod. Tap the ball pin out of each track rod end in which they are a taper fit.

Remove the self-locking nuts and washers securing the track rod ends to the drop arm and idler lever.

Tap the track rod ends out of the drop arm and idler lever in which they are a taper fit.

DISMANTLING

To remove the track rod ends, slacken the clamp at each end of the centre tube; unscrew each end from the tube noting that one end has a left-hand thread and the other a right-hand thread.

ASSEMBLING

When refitting the track rod ends to the centre tube, screw in each end **an equal amount** and adjust to a final length of 19½" (49·53 cm.) between track rod end centres.

Important: The centre track rod assembly must NOT be used for setting the toe-in.

THE OUTER TIE RODS

The outer tie rod ball joints cannot be dismantled and, if worn, new assemblies must be fitted.

REMOVAL

Remove the self-locking nuts and plain washers securing the tie rod to the steering arm and track rod end.

Tap the tie rod ball pins out of the steering arm and track rod end in which they are a taper fit.

DISMANTLING

To remove the tie rod ends, slacken the clamp at each end of the centre tube; unscrew each end from the tube noting that one end has a left-hand thread and the other a right-hand thread.

ASSEMBLING

When refitting the tie rod ends to the centre tube screw in each end **an equal amount of turns**. Adjust to a length of $11\frac{13}{16}$" (30·0 cm.).

The final adjustment of the tie rod lengths must be carried out when resetting the track as detailed on page I.34.

STEERING LOCK STOPS

No external lock stops are provided on the 4·2 Mark 10 model as stops are incorporated in the steering.

It is, therefore, ESSENTIAL if the steering unit has been dismantled that the centralising proce dure, as detailed under Front Wheel Alignment, page I.34, is carried out when refitting.

STEERING IDLER ASSEMBLY

1. End cap
2. Nut
3. Tab washer
4. "D" washer
5. Idler spindle
6. Bearing
7. Mounting bracket
8. Abutment washer
9. Bearing
10. Idler lever
11. Abutment ring
12. Washer
13. Nut
14. Seal retainer
15. Felt seal

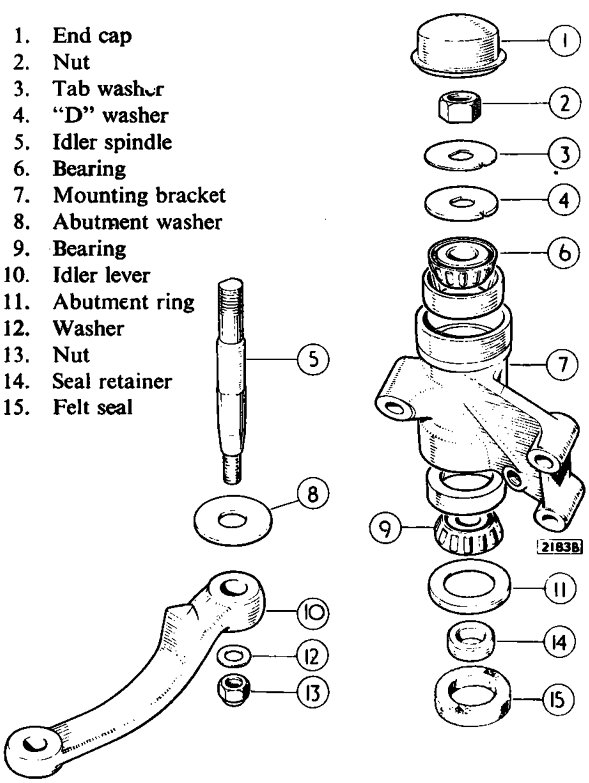


Fig. 41. The steering idler components.

REMOVAL

Remove the self-locking nut and washer securing the track rod end to idler lever. Drift out the track rod end from the idler lever in which it is a taper fit.

Remove the two setscrews and one long bolt attaching the steering idler bracket to the front suspension cross beam when the steering idler assembly can be detached.

DISMANTLING

Prise out the dust cap from the top of the idler bracket.

Tap back the tab washer and unscrew the nut at the top of the idler shaft.

The idler arm and shaft can now be withdrawn and the washers, felt seal, etc., removed. Remove the inner races of the taper roller bearings.

ASSEMBLING

Thoroughly clean out the inner races of the taper roller races and the idler housing. Repack the housing and bearings with one of the recommended greases.

Fit the lower bearing, distance piece, seal retainer and a new felt seal.

Place the large washer over the idler shaft and pass the shaft upwards into the housing.

Fit the upper bearing, "D" washer, tab washer and nut. Tighten the nut to a torque of 5 lb. ft. (0·7 kgm.). If a torque wrench is not available tighten the nut until rotation of the idler shaft by the idler arm feels "sticky" and then slacken back the nut one flat; lock the nut by means of the tab washer and refit the dust cap.

REFITTING

Refitting is the reverse of the removal procedure but it is important to ensure that the idler lever is in the straight ahead position before fitting the track rod end to the lever.

STEERING ARM

REMOVAL

Raise the car by placing a jack under the front suspension cross member and remove the road wheel.

Remove the self-locking nut and plain washer securing the tie rod to the steering arm. Drift out the tie rod ball pin from the steering arm in which it is a taper fit.

Unscrew the centre self-locking nut securing the stub axle shafts and steering arm to the carrier and remove the wired bolt attaching the end of the steering arm to the carrier. The steering arm can now be removed.

REFITTING

Refitting is the reverse of the removal procedure. Use new locking wire to secure the steering arm attachment bolt.

FRONT WHEEL ALIGNMENT

It is ESSENTIAL that the following instructions are observed and that the special steering box centralising gauge (J.27) is used, otherwise steering irregularities may result.

PROCEDURE

Note: The centre track rod assembly is set to a fixed length of $19\frac{1}{2}$" (49·53 cm.) and must NOT be used for setting the toe-in.
Each wheel must be adjusted individually by the outer tie-rod to half the total toe-in of 0–$\frac{1}{8}$" (0–3·17 mm.).

(a) Set the front wheels in the straight ahead position.

(b) Remove the large hexagon headed plug from the steering unit (catch the oil that will escape).

(c) Insert the special centralising gauge ("A" in Fig. 8) so that the two pins engage with the two holes in the casting and the tongues engage with the slots in the bottom of the wormshaft. This ensures that the steering box is in exactly the "straight-ahead" position and it may be necessary to turn the steering slightly to enable the gauge to be fitted.

(d) Adjust each front wheel individually by means of the outer tie-rod to give 0–$\frac{1}{16}$; (0–1·59 mm.) toe-in by one of the following methods:
 (i) Light beam equipment.
 (ii) Straight edge between front and rear wheels on one side with a $\frac{5}{8}$ (15·9 mm.) packing at front of rear tyre.* Repeat for other side. Check total toe-in of 0–$\frac{1}{8}$; (0–3·17 mm.) with normal wheel alignment equipment.

(e) Roll car backwards and forwards and recheck setting.

(f) Remove centralising gauge from steering unit and refit hexagon plug. Fill reservoir with Automatic Transmission fluid and bleed system by releasing the hexagon plug ("B" in illustration) on top cover, running engine and turning steering from lock to lock a few times.

* The straight edge should be supported as high as possible without fouling the body.

ACCIDENTAL DAMAGE

The following dimensional drawings are provided to assist in assessing accidental damage. A component suspected of being damaged should be removed from the car, cleaned off and the dimensions checked with those given in the appropriate illustration.

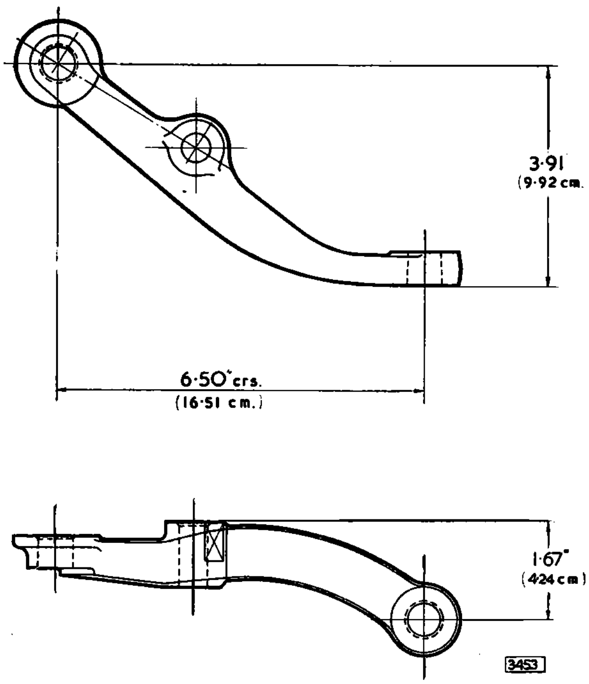


Fig. 42. The steering arm.

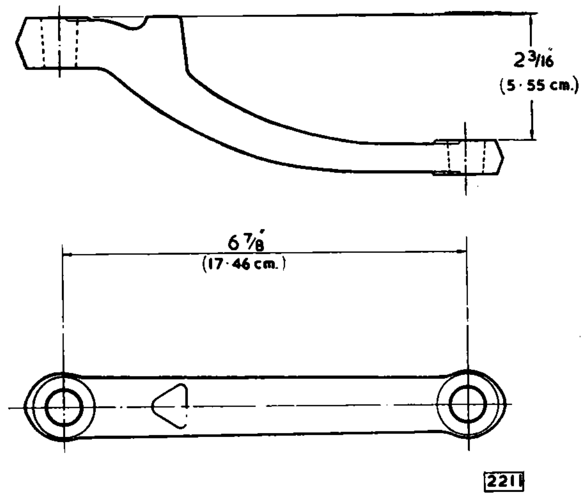


Fig. 43. The idler lever.

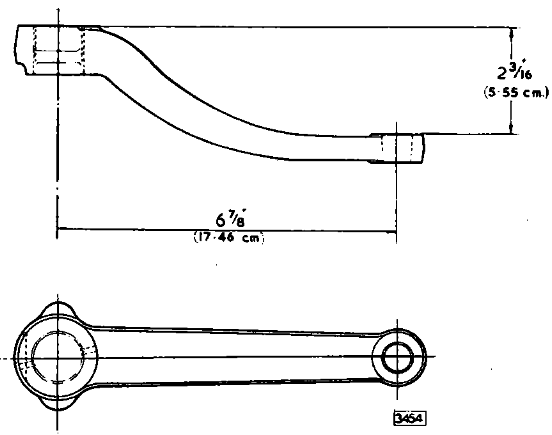


Fig. 44. The steering drop arm.

SPECIAL SERVICE TOOLS

Description

Steering box alignment tool (J.27)*

Valve seal expander (J.32)*

Valve seal compressor (J.33)*

Spline seal protector (J.34)*

* Churchill Tool Number.

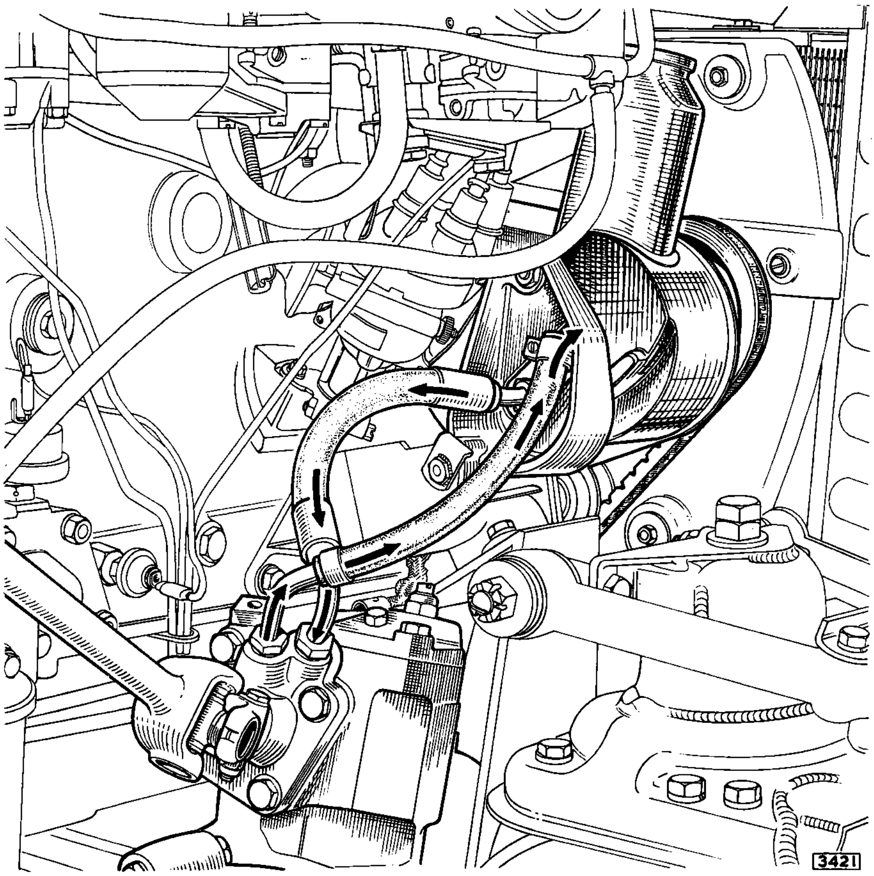


Fig. 45. Fluid flow, 4.2 Mk. 10 power steering.

FAULT FINDING CHART

Most Important: Always check that the Pump Fluid Reservoir is filled to the correct level before investigating any steering fault.

FAULT	POSSIBLE CAUSE	REMEDY
External oil leaks from steering gear.	Damage or wear to seals or incorrect tightening of unions and bolts.	It is most important that the source of leak be traced before any attempt is made to rectify. Once the leak is located tighten the units or bolts or replace seals as necessary.
External oil leaks from pump.	———	Check that the reservoir is not over filled.
Leak at reservoir.	"O" Ring damaged or "O" ring improperly installed.	Replace "O" ring.
Oil leak at pressure fitting or filler cap.	Not tightened sufficiently or damaged seals or hoses seat.	Tighten or replace as necessary.
Oil leak at pump shaft.	Worn or damaged seals or damaged shaft.	Replace as necessary.
Steering pulling to one side or the other.	Unbalanced front tyre pressures.	Adjust pressures.
	Faulty tyres. } Steering gear out of trim }	See paragraph "Trimming" in service notes. **Note:** If these remedies fail to cure the pull then check steering and suspension geometries.
Steering feels different to left and right but it does not actually pull.	Incorrectly centred gear, which means that the cam assembly will be on the wrong part of the ratio curve when driving straight ahead.	Remove plug from gear housing and fit centring tool, then re-track the vehicle with this in position. It may be necessary to re-align the steering wheel after carrying out this operation.
Heavy Steering		
(A) Heavy steering when driving.	Low tyre pressure.	Inflate.
	1. Tightness or stiffness in the steering column and/or steering joints and suspension joints.	Grease or replace.
	2. Steering gear adjusted too tight.	Re-adjust gear as necessary, see Service Notes.
(B) Heavy steering when parking.	1. Loose pump belt (nearly always accompanied by a squealing noise).	Adjust correctly.
	2. Insufficient pressure from pump due to restricted hoses or defective pump valve.	Remove restriction or check pump output pressure as described on page I.13 Service Instructions. Check that flow control valve is not stuck open and that valve is free to move.
	3. Insufficient pressure due to high leaks in steering gear.	Confirm high internal leaks by carrying out leak test as described on page I.13 of the Service Manual. If proven remove gear from car and replace seals.

FAULT	POSSIBLE CAUSE	REMEDY
Steering effort too light.	Worn torsion bar dowel pins or torsion bar broken.	Remove gear from car, remove cam and valve assembly from gear and check that the valve rotor has no free play relative to the valve sleeve. Replace as necessary.
Unbalance of steering effort varving irregularly.	1. Worn or loose trim pin. 2. Rotor sticking in valve sleeve.	Remove gear and replace cam and valve assembly. Remove gear from car and take cam and valve assembly out. Hold cam in hand and rotate rotor to and fro feeling for stickness, Replace if necessary.
Poor straight running.	1. Incorrect tyre pressures. 2. Incorrect toe-in. 3. Steering gear requires adjustment. (a) If there is lost motion on the steering wheel rim. (b) If the steering gear is too stiff due to over-adjustment.	Inflate. Check and reset if necessary. Adjust gear as described on page I.12 paragraph (b). Adjust gear correctly as above.
Noise Pump Noise. Steering Gear.	1. Belt loose indicated by squealing during parking manoeuvres. 2. Other pump noises are due to wear or damaged parts. **Note:** The pump pressure release valve is invariably noisy and it will be heard when the steering is turned hard on the lock stops. There are hissing noises present in most power steering systems, one of the most common is a sizzling sound which is most evident when parking. This noise does not effect the performance of the steering gear in any way. If the steering gear grunts when the steering wheel is being moved this could be caused by a faulty damping ring in the valve assembly.	Tighten belt. Replace the pump. There is no remedy to this noise. Do not replace the steering gear unless the hiss is extremely objectionable. The new gear might exhibit the same noise and so it is not always a cure for the objection. Remove gear from car and replace cam and valve assembly.

FAULT	POSSIBLE CAUSE	REMEDY
Rattles 1. General	1. Steering column joints.	These should be checked first before investigating steering gear.
2. A sharp light rattle which is felt when running straight ahead over anything but the smoothest roads, particularly noticeable at slow speed. Can be heard and felt at the steering wheel.	2. Input Shaft End Float. It should be possible to feel this end float on the cam whilst steering wheel is oscillated gently.	Remove gear from car and add shims between valve housing and the bearing outer race as described on page I.18, Assembling
3. As 2 but slightly muffled and caused by slightly rougher roads.	3. Sector Shaft End Float. This is due to clearance between the head of the adjuster screw and the sector shaft. End float can be felt between the sector shaft and the gear housing whilst the steering wheel is oscillated gently. Also a pointer to this fault is the fact that the rattle will be more prevalent during left hand corners with a RHD car and vice versa.	Remove gear from car and replace sector shaft assembly.
4. A heavy muffled flutter which appears particularly when running straight ahead over bumps in the road, best detected at 20 m.p.h. (32 k.m.). Also, steering will probably thump and pulse when the direction of movement of the steering wheel is changed rapidly.	Clearance between the piston rack teeth and the sector shaft teeth.	Tighten as per Service Instructions page I.11.

SECTION J

FRONT SUSPENSION

4·2 MARK 10 MODEL

INDEX

INDEX *(continued)*

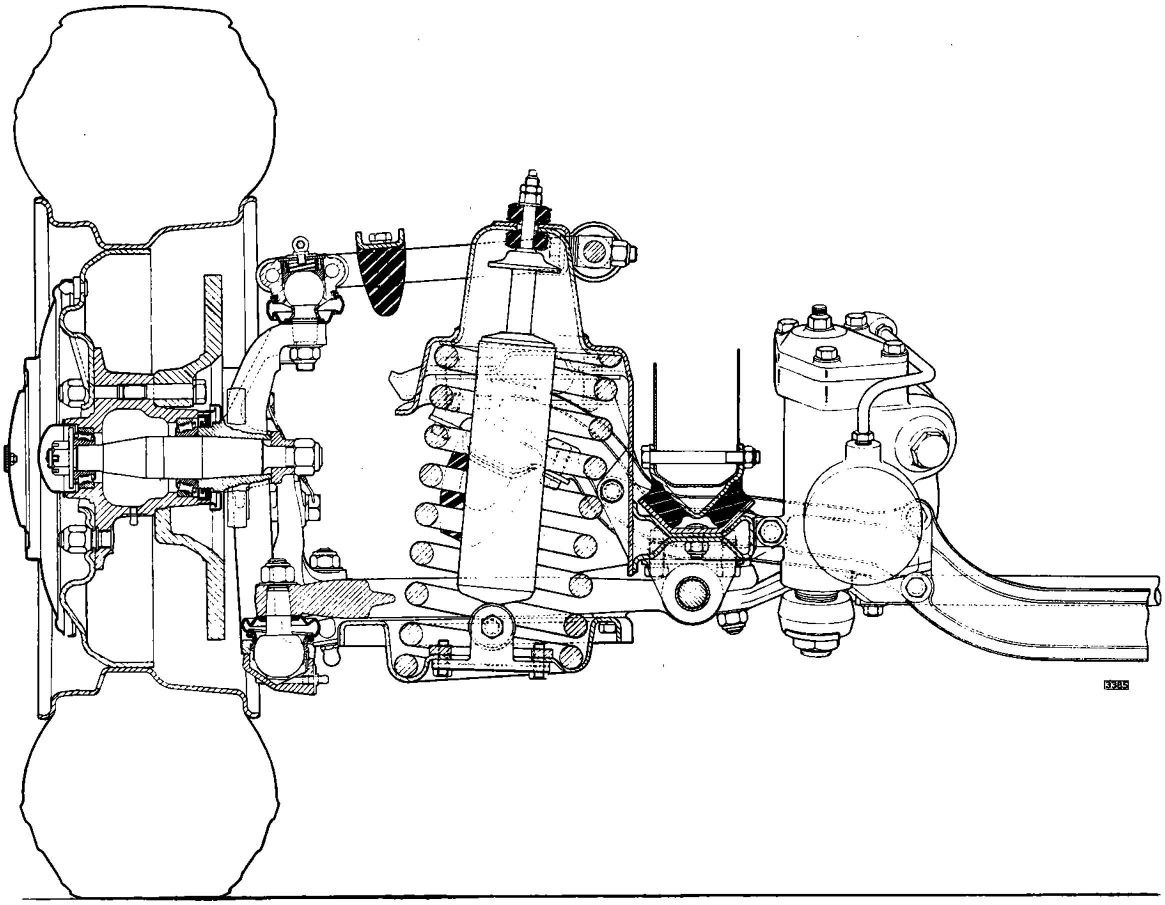


Fig. 1. Sectioned view of the front suspension.

FRONT SUSPENSION

DESCRIPTION

The front suspension assembly consists of a forged steel cross beam with fabricated pressed steel "turrets' bolted to either end. The power-assisted steering unit, idler assembly, track rod and tie rods are also attached to the cross beam. The lower wishbone fulcrum shafts which are attached to the underside of the turret assemblies are tied together at their front ends by means of a bar running transversely across the assembly.

The coil springs are housed in the "turrets" and are retained at the lower end by seat pans bolted to the lower wishbone.

Each coil spring is controlled by a direct acting hydraulic damper mounted in the centre of the spring. The top end of the damper is attached to the turret and the lower end of the damper is bolted to a mounting bracket which is in turn attached to the coil spring seat pan.

The upper wishbone levers are of forged steel and are mounted at the fulcrum shaft end on rubber/steel bonded bushes. The outer ends of the wishbone levers are bolted to the upper wishbone ball joint which is in turn attached to the stub axle carrier.

The lower wishbone is a one piece forging, the inner ends of which are mounted on rubber/steel bonded bushes. The outer end of the lower wishbone is bolted to the lower ball joint which in turn is attached to the stub axle carrier.

The wheel hub is supported on two tapered roller bearings the inner races of which fit on a shaft located in a tapered hole bored in the stub axle carrier.

An anti-roll bar fitted between the two lower wishbones, is attached to the chassis side members by rubber insulated brackets.

The front suspension assembly is attached to the body underframe at four points. The lower wishbone fulcrum shafts attached to the turret assemblies are attached in turn to the front ends of the chassis side members by means of flat rubber/steel bonded mountings. The rear end of the suspension assembly is attached to the chassis side members by means of two "V" shaped rubber/steel bonded mountings.

Data

Type	Independent—coil spring
Dampers	Telescopic hydraulic
Castor angle	$0° \pm \frac{1}{2}°$
Camber angle	$\frac{1}{2}° \pm \frac{1}{2}°$ positive
Swivel inclination	$3\frac{3}{4}°$

Recommended Lubricants

Component	Mobil	Castrol	Shell	Esso	B.P.	Duckhams	Regent Caltex/ Texaco
Wheel bearings Wheel swivels	Mobilgrease MP	Castrolease LM	Retinax A	Esso Multi-purpose Grease H	Energrease L2	LB.10	Marfak All purpose

ROUTINE MAINTENANCE

FRONT SUSPENSION

The front suspension wishbone levers and anti-roll bar are supported in rubber bushes which do not require attention.

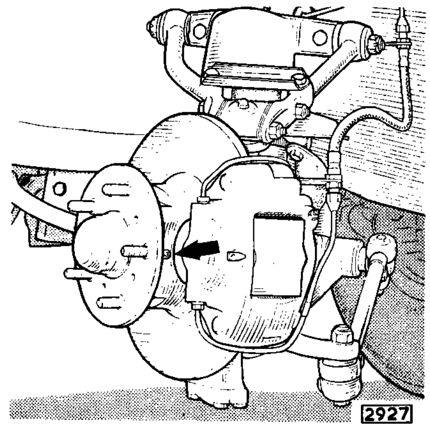


Fig. 2. The wheel swivel grease nipples.

FRONT SHOCK ABSORBERS

The telescopic hydraulic dampers are of the sealed type with no provision for adjustment or "topping up" with fluid.

EVERY 6,000 MILES (10,000 KM.)

Wheel Swivels

Lubricate the nipples (four per car) fitted to the top and bottom of the wheel swivels. A bleed hole is provided in each ball joint; the hole is covered by a nylon washer which lifts under pressure and indicates when sufficient lubricant has been applied.

The nipples are accessible from underneath the front of the car.

EVERY 12000 MILES (20,000 KM.)

Front Wheel Bearings

Removal of the wheels will expose a grease nipple in the wheel bearing hubs. Lubricate sparingly with the recommended grade of lubricant. Always thoroughly clean the grease nipple before applying the grease gun.

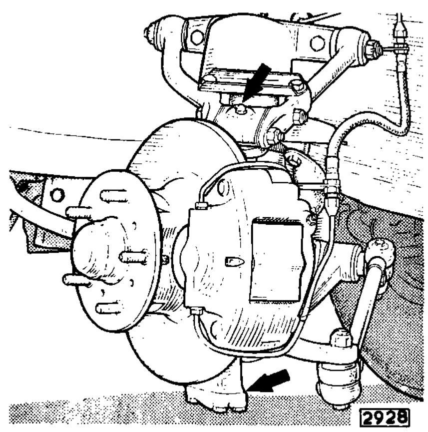


Fig. 3. Front hub grease nipple.

Wheel Bearing Adjustment

At the recommended intervals the end-float of the front and rear wheel hub bearings should be checked and, if necessary, reset.

FRONT SUSPENSION ASSEMBLY

REMOVAL

Jack up under the front suspension cross-member until the road wheels are clear of the ground. Remove the road wheels.

Support the weight of the car under the front jacking sockets by means of blocks not less than 16″ (40 cm.) in height, leaving the jack in position under the front cross-member.

Remove the four self-locking nuts securing the front suspension rear mountings to the chassis side members.

Remove the four bolts, washers and self-locking nuts securing the front mountings to the brackets at the front ends of the chassis side members.

Disconnect the two anti-roll bar mountings from the body underframe members.

Disconnect the flexible brake hoses at the brackets on the body.

Disconnect the two hoses at the power-assisted steering box, and allow the fluid to drain into a clean container.

Remove the clamping bolt securing the steering column universal joint to the steering box shaft.

Lower the front suspension cross-member assembly on the jack until the front suspension assembly can be drawn forward.

REFITTING

When refitting the front suspension cross-member assembly ensure that the brake discs are in the straight ahead position and that the steering wheel spokes are in the three and nine o'clock positions with the horn ring at the bottom.

After the front suspension assembly has been completely refitted it will be necessary to "bleed" the brake hydraulic system as described in Section L—"Brakes".

It is advisable to bleed the power-assisted steering system as detailed in Section I—"Steering".

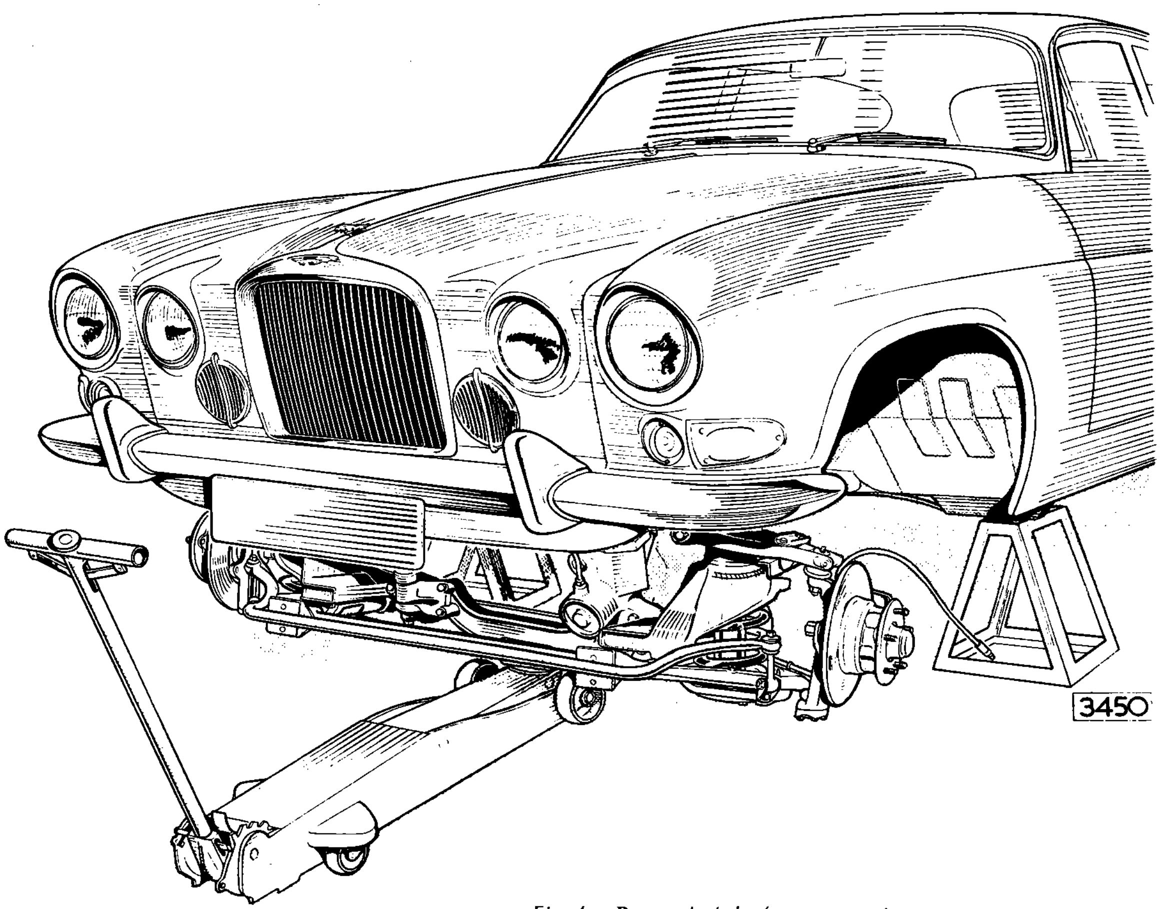


Fig. 4. Removal of the front suspension.

HYDRAULIC DAMPERS

The telescopic hydraulic dampers are of the sealed type with no provision for adjustment or "topping-up" with fluid. Therefore, in the event of a damper being unserviceable a replacement must be fitted.

Before fitting a damper to a car it is advisable to carry out the following procedure to "bleed" any air from the pressure chamber that may have accumulated due to the damper having been stored in a horizontal position. Hold the damper in its normal vertical position with the shroud uppermost and make several strokes (not extending more than halfway) until there is no lost motion and finish by extending the damper to its full length once or twice. Do not extend the damper fully until several short strokes have been made first. After the operation of "bleeding", the hydraulic dampers should be kept in their normal upright position until they are fitted to the car.

REMOVAL (FIG. 6)

Removal of the hydraulic dampers will be facilitated if the wishbones are kept approximately horizontal by placing either a piece of 2″×2″×8″ (5·1×5·1×20·3 cm.) angle iron or piece of wood of the same dimensions between the top wishbone and the fabricated turret. The wishbones may also be kept horizontal by supporting the outer end of the lower wishbone and partly lowering the jack to compress the road spring.

Jack up the car under the front suspension cross member until the wheels are clear of the ground and remove the road wheel.

Remove the locknut together with the securing nut from the damper top mounting and withdraw the outer washer, rubber buffer and inner washer, noting the difference between the inner and outer washers.

Knock back the tabs securing the heads of the four setscrews which attach the damper lower mounting bracket to the coil spring seat. Remove the four setscrews and withdraw the hydraulic damper.

REFITTING

Refitting is the reverse of the removal procedure.

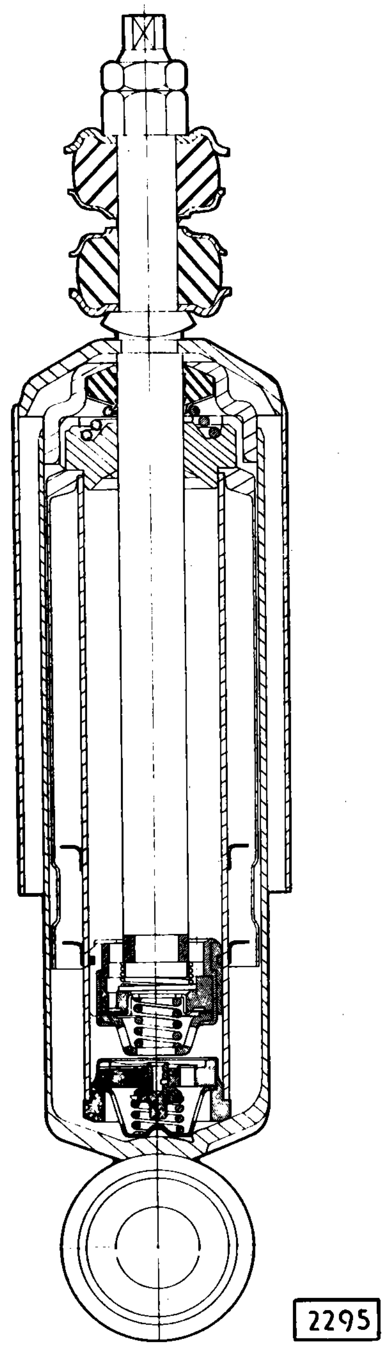


Fig. 5. Sectioned view of the hydraulic damper.

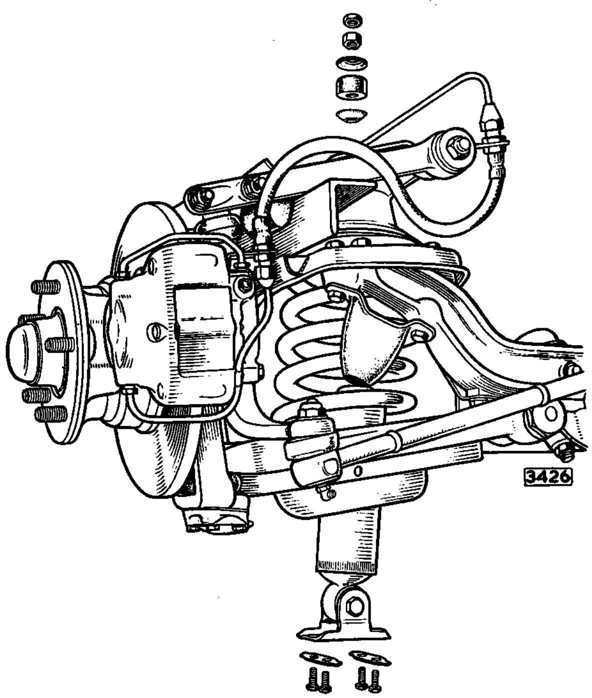


Fig. 6. Removing the shock absorber.

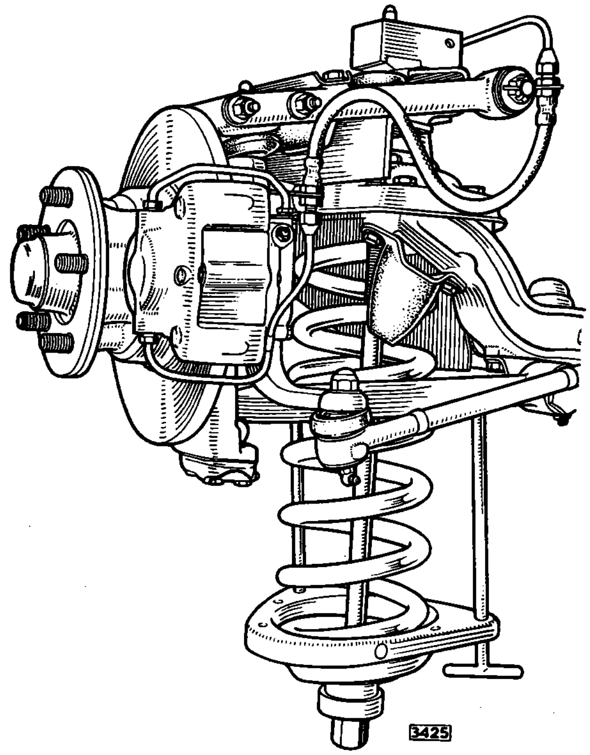


Fig. 7. Removing the coil spring using Tool No. JD.6B.

COIL SPRINGS

The coil springs are marked with coloured paint strips (which may be covered by tape) to denote springs of the same static load. It is, therefore, important that the two front springs fitted to a car are of the same colour code.

REMOVAL

Remove the hydraulic damper as described on page J.8.

Insert a suitable compressor (Tool No. JD.6B) through the centre of the spring and compress the spring sufficiently to relieve the load of the spring seat pan screws.

Remove the three self-locking nuts and bolts securing the anti-roll bar bracket to the lower wishbone and spring seat pan and detach the bracket. Remove the four setscrews and spring washers which secure the seat pan to the lower wishbone.

Release the coil spring compressor until the load of the spring is completely relieved. Completely unscrew the compressor and withdraw the coil spring and seat pan.

REFITTING

Refitting is the reverse of the removal procedure.

Alignment of the seat pan holes with the tapped holes in the lower wishbone will be facilitated if 8″ (20 cm.) long pilot studs (threaded $\frac{3}{8}$″ UNF) are used as shown in Fig. 7.

Coil Spring Packing Pieces

Packing pieces may be fitted above the coil springs of some cars, their purpose being to accommodate manufacturing variations in the springs which are graded into three groups and identified by a colour patch on the middle coil.

Colour Code of spring	Thickness of packing
Red	$\frac{1}{4}$″ (6·4 mm.)
Yellow	$\frac{1}{8}$″ (3·2 mm.)
Purple	None fitted

WHEEL HUBS

REMOVAL (FIG. 8)

Firmly apply the handbrake, jack up the front of the car and remove the road wheel. Disconnect the brake fluid feed pipe at the caliper.

Break the locking wire and remove the bolts securing the brake caliper to the stub axle carrier. Remove the caliper from the carrier noting the shims fitted at the mounting points for centralisation of the caliper on the brake disc.

Prise off the hub end cap and remove the split pin retaining the hub nut. Remove the slotted nut and plain washer from the end of the stub axle shaft. The hub may now be withdrawn by hand. Remove the four setpins and spring washers securing the brake disc, withdraw the disc ensuring that the inner water deflector is not damaged.

DISMANTLING

Extract the oil seal from the inner end of the hub. Withdraw the inner races of the taper roller bearings; if new bearings are to be fitted, the outer races may be drifted out, grooves being provided in the abutment shoulders of the hub. Do not disturb the inner water deflector, on the hub or the outer deflector on the stub axle carrier.

REFITTING

Refitting is the reverse of the removal procedure but it will be necessary to re-lubricate the bearings as detailed in "Routine Maintenance" at the beginning of this section and adjust the end float of the hub bearings as described under the next heading.

Refit the brake caliper, ensuring it is correctly aligned and bleed the brake hydraulic system as detailed in Section L "Braking System".

Bearing end-float adjustment

The correct end-float of the wheel bearings is 0·003"–0·005" (0·07–0·13 mm.) It is particularly important that the end-float does not exceed 0·005" (0·13 mm) otherwise the brakes may tend to drag and not function correctly.

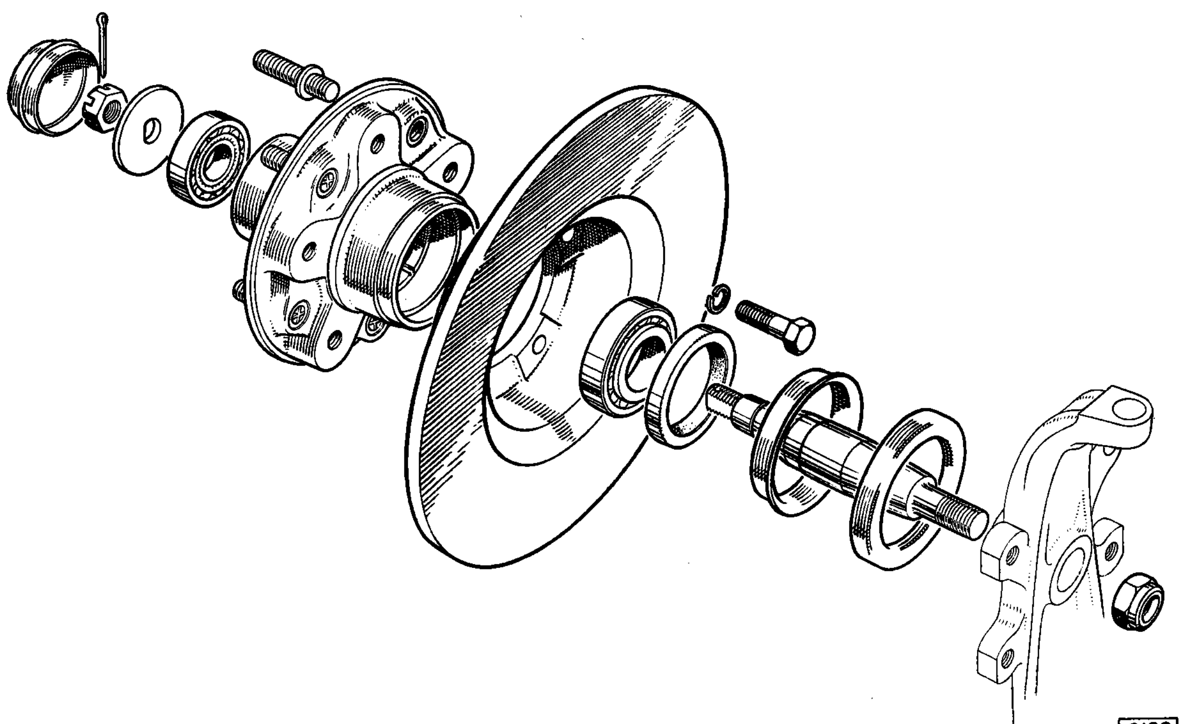


Fig. 8. Exploded view of the front wheel hub assembly.

The wheel bearing end-float can be measured with a dial indicator gauge, mounted with the plunger against the end of the hub. If a gauge is not available proceed as follows:—

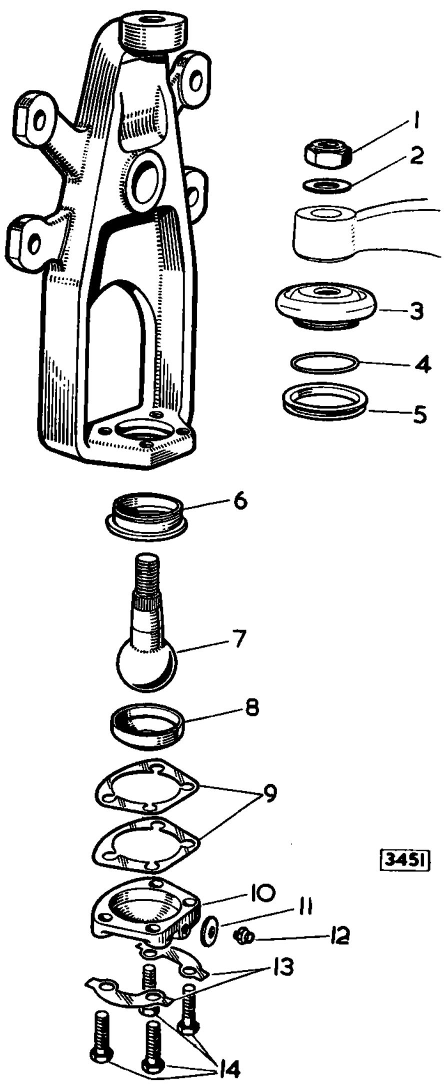
Tighten the hub nut until there is no end-float, that is when rotation of the hub feels slightly restricted.

Slacken back the hub nut between one and two flats depending on the position of the split pin hole relative to the slots in the nut.

Temporarily attach the road wheel and check that the wheel spins freely.

If satisfactory, fit a new split pin and turn over the ends.

STUB AXLE CARRIERS



REMOVAL

Jack up the suspension under the lower wishbone lever and remove the road wheel.

Disconnect the brake hydraulic fluid feed pipe from the caliper. Break the locking wire, remove the mounting bolts and withdraw the caliper noting the shims fitted at the mounting points. Remove the wheel hub complete with the brake disc as described under "Wheel hub removal" page J.10.

Remove the self-locking nut and plain washer securing the upper ball joint to the stub axle carrier. Drift out the ball pin from the stub axle carrier in which it is a taper fit.

Remove the self-locking nut and plain washer securing the lower ball joint to the wishbone. Drift out the ball pin from the lower wishbone, in which it is a taper fit and remove the stub axle carrier.

REFITTING

Refitting is the reverse of the removal procedure. Bleed the brake hydraulic system as described in Section L "Brakes".

Fig. 9. Exploded view of the lower wishbone ball joint.

1. Nut
2. Washer
3. Rubber gaiter
4. Ring
5. Plastic insert
6. Spigot
7. Ball pin
8. Socket
9. Shim
10. Cap
11. Washer
12. Grease nipple
13. Tab washers
14. Bolts

LOWER WISHBONE

REMOVAL

Jack the car up under the front cross beam and remove the road wheel.

Remove the coil spring as described on page J.9.

Remove the stub axle carrier as described on page J.11.

Remove the two bolts and self-locking nuts securing the front suspension front mounting to the chassis. Remove the self-locking nut at the front of the lower wishbone fulcrum shaft and withdraw the front mounting and rubber bush. Drift out the fulcrum shaft, supporting the transverse tie rod. The wishbone may now be withdrawn from below.

Fitting the Rubber/Steel Bushes

Drift out or press out the bush from the wishbone eye. Press the new bush into the eye, ensuring that the bush projects from each side by an equal amount. Fitting of the bush will be facilitated if a lubricant, made up of twelve parts of water to one part of liquid soap, is used.

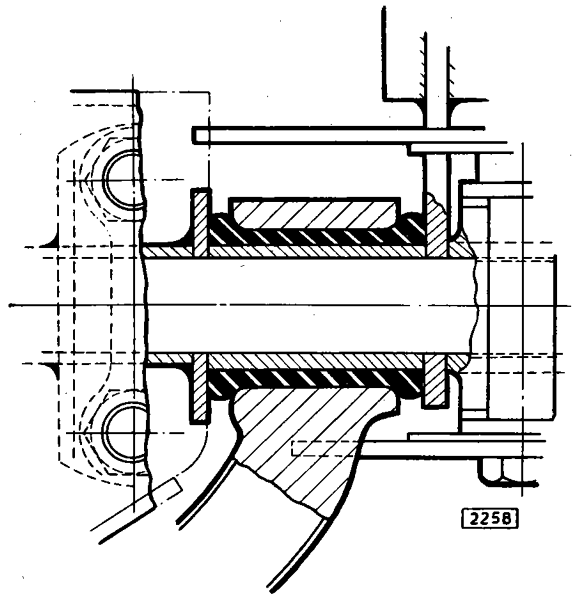


Fig. 10. Section through the lower rubber suspension bush.

REFITTING

Refitting is the reverse of the removal procedure. When refitting the fulcrum shaft, the car should be in the normal riding position before the self-locking nut at the front of the shaft is tightened and the front mounting is refitted. Omitting to carry out this procedure will result in undue torsional loading of the bushes with possible premature failure.

LOWER WISHBONE BALL JOINT

REMOVAL

Remove the stub axle carrier complete with the lower wishbone ball joint as described on page J.11.

DISMANTLING (FIG. 9)

Release the wire clip and remove the rubber gaiter. Withdraw the retainer from the top of the ball pin.

Tap back the tab washers (13) and unscrew the four setscrews (14) securing the ball pin cap (10) to the stub axle carrier.

Remove the cap, shims, ball pin socket, spigot and ball pin.

REASSEMBLING

Reassembling is the reverse of the dismantling procedure but, if necessary, re-shim the ball joint to obtain the correct clearance of 0·004"–0·006" (0·10–0·15 mm.).

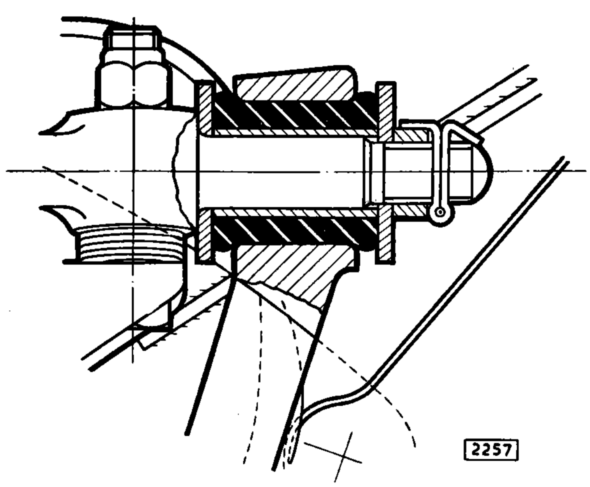


Fig. 11. Section through the upper rubber suspension bush.

Note: Shims should not be removed to take up excessive wear in the ball pin and socket; if these parts are badly worn, replacements should be fitted.

Adjustment of the ball joint

The correct clearance of the ball pin in its sockets is 0·004″–0·006″ (0·10–0·15 mm.). Shims for adjustment of the ball joint are available in 0·002″ (0·05 mm.) and 0·004″ (0·10 mm.) thicknesses.

To adjust the ball pin clearance to the correct figure, remove shims one by one until, with ball cap fully tightened, the ball is tight in its socket. Fit shims to the value of 0·004″–0·006″ (0·10–0·15 mm.) which should enable the shank of the ball pin to be moved by hand.

REFITTING

Refit the stub axle carrier complete with the lower wishbone ball joint as described on page J.11.

UPPER WISHBONE

REMOVAL

Jack the suspension up under the lower wishbone lever and remove the road wheel.

Remove the two bolts, plain washers and self-locking nuts securing the ball joint to the upper wishbone levers. Note the relative positions of the packing piece and the shims as these control the camber angle. Alternatively, remove the self-locking nut and drift the ball joint from the stub axle carrier in which it is a taper fit. Tie up the stub axle carrier to the suspension so that the flexible brake hose does not become extended.

Remove the two bolts and self-locking nuts which secure the upper wishbone fulcrum shaft to the suspension turret. Note the relative positions of the shims as these control the camber angle. Remove the upper wishbone assembly.

DISMANTLING

Remove the two setscrews and spring washers securing the rebound stop rubber to the upper wishbone levers.

Withdraw the split pins and remove the slotted nuts and plain washers which secure the wishbone levers to the fulcrum shaft. Remove the wishbone levers from the fulcrum shaft.

Fitting the Rubber/Steel Bushes

Drift out or press out the bush from the wishbone eye. Press the new bush into the eye, ensuring that the bush projects from each side by an equal amount. Fitting of the bush will be facilitated if a lubricant, made up of twelve parts of water to one part of liquid soap, is used.

REASSEMBLING

The reassembly of the upper wishbone assembly is the reverse of the dismantling procedure but the slotted nuts securing the wishbone levers to the fulcrum shaft must not be tightened until the upper wishbone assembly has been refitted and the full weight of the car is on the suspension. Omitting to carry out the procedure will result in undue torsional loading of the rubber bushes with possible premature failure.

REFITTING

Refitting is the reverse of the removal procedure.

UPPER WISHBONE BALL JOINT

The upper wishbone ball joint cannot be dismantled and, if worn, the complete assembly must be replaced.

REMOVAL

Jack up the car under the lower wishbone and remove the road wheel.

Remove the two bolts, self-locking nuts and plain washers securing the ball joint to the upper wishbone levers. Note the relative positions of the packing piece and shims as these control the castor angle.

Remove the self-locking nut and plain washer which secure the ball joint to the stub axle carrier.

The ball joint can now be drifted out of the stub axle carrier in which it is a taper fit.

Note: When carrying out the above operation do not allow the flexible brake hose to become extended; tie up the stub axle carrier to the cross-member turret.

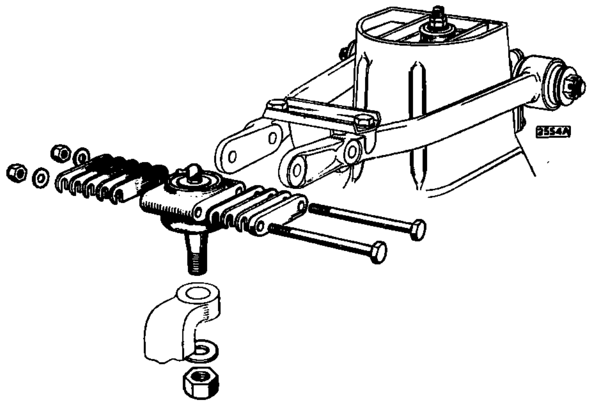


Fig. 12. Exploded view of upper ball joint and castor adjustment shims.

REFITTING

Refitting is the reverse of the removal procedure. Ensure that the packing piece and shims are refitted in their original positions otherwise the castor angle will be upset.

CASTOR ANGLE ADJUSTMENT

Check that the car is full of petrol, oil and water. If not, additional weight must be added to compensate for say, a low level of petrol (the weight of 10 gallons of petrol is approximately 80 lb.—36·0 kg.)

Ensure that the tyre pressures are correct and that the car is standing on a level surface.

Using an approved gauge, check the castor angle.

Castor angle . . . . . . $0° \pm \frac{1}{2}°$

Note: The two front wheels must be within a $\frac{1}{2}°$ of each other.

Adjustment is effected by either transposing the shims from the rear of the upper wishbone ball joint to the front, or transposing the packing piece and shim(s).

To decrease negative castor or increase positive castor transpose shims from the rear to the front; the holes in the shims are slotted and therefore it will only be necessary to slacken the two bolts securing the upper wishbone members to enable the shims to be removed.

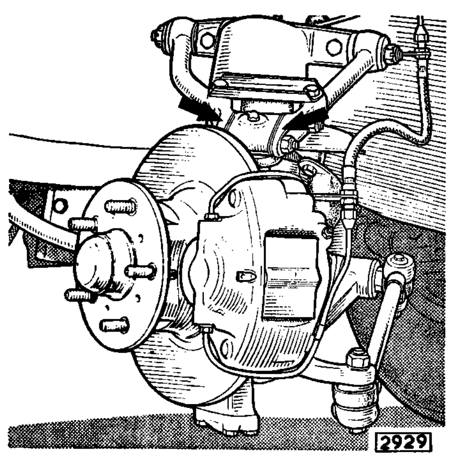


Fig. 13. Castor angle adjustment.

CAMBER ANGLE ADJUSTMENT

Check that the car is full of petrol, oil and water. If not, additional weight must be added to compensate for, say, a low level in petrol (the weight of 10 gallons of petrol is approximately 80 lb.—36·0 kg.)

Ensure that the tyre pressures are correct and that the car is standing on a level surface.

Camber angle $\frac{1}{2}°+\frac{1}{2}°$ positive.

Note: The camber angle for each wheel must not vary by more than $\frac{1}{4}°$.

Line up the front wheel bearing checked parallel to the centre line of the car. Using an approved gauge, check the camber angle. Rotate the wheel being checked through 180° and re-check.

Adjustment is effected by removing or adding shims at the top wishbone fulcrum shaft mountings. The holes in the shims are not slotted and it will be necessary to remove the bolt securing the fulcrum shaft to enable the shims to be removed, after supporting the lower wishbone at the outer mounting point. Inserting shims decreases positive camber; removing shims decreases negative camber or increases positive camber. Remove or add an equal thickness of shims from each position otherwise the castor angle will be affected. Shims for the adjustment of camber are of $\frac{1}{16}''$ (1·6 mm.) thickness and it should be noted that $\frac{1}{16}''$ (1·6 mm.) of shimming will alter the camber angle by approximately $\frac{1}{2}°$.

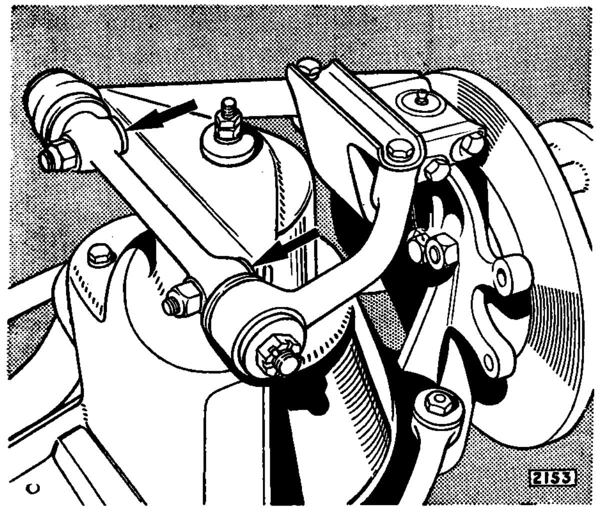


Fig. 14. Camber angle adjustment.

Note: It is most important that there are always an equal number of shims at each mounting bolt on a particular side.

ANTI-ROLL BAR

REMOVAL

Raise the front of the car so that work may be carried out underneath. Remove the four setscrews and spring washers securing the anti-roll bar support brackets to the front of the chassis side members. Remove the support brackets and the keeper plates which are fitted between the anti-roll bar bracket rubbers and the chassis.

Remove the bolt and self-locking nut securing the anti-roll bar link arm to the bracket on the coil spring seat. Repeat for the other side.

To separate the anti-roll bar from the link arms, remove the self-locking nuts, upper cup washers and rubbers. Care should be taken to replace the tubular spacer when refitting.

The anti-roll bar bracket rubbers are split to enable them to be removed.

Fitting the Link Arm Bush

Drift out or press out the bush from the link arm eye.

Press the new bush into the eye, ensuring that the bush projects from each side by an equal amount. Fitting of the bush will be facilitated if a lubricant, made up of 12 parts of water to one part of liquid soap, is used.

REFITTING

Refitting is the reverse of the removal procedure. It is important when attaching the support brackets to the chassis side members, to have the full weight of the car on the road wheels.

ACCIDENTAL DAMAGE

The dimensional drawings are provided to assist in assessing accidental damage. A component suspected of being damaged should be removed from the car, cleaned off and the dimensions checked and compared with those given in the appropriate illustration.

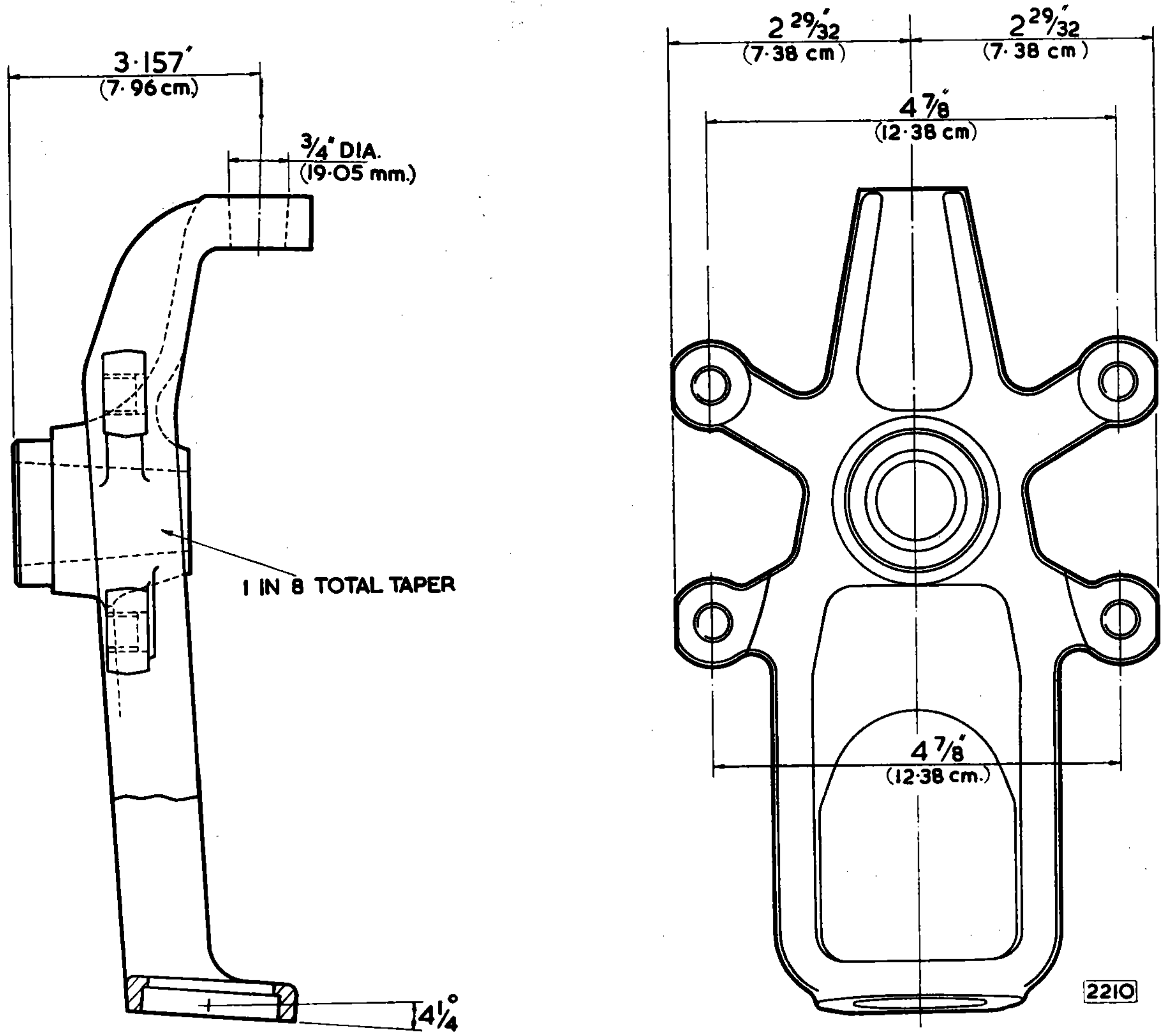


Fig. 15. The stub axle carrier.

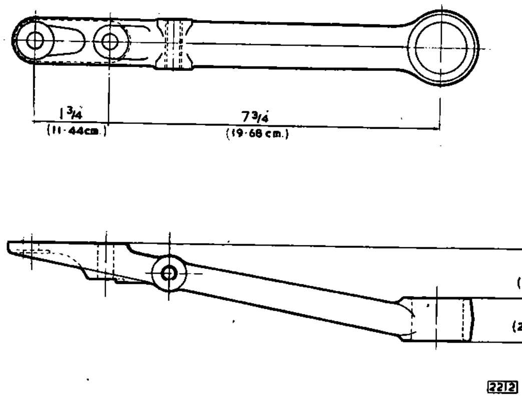


Fig. 16. The upper wishbone lever—rear.

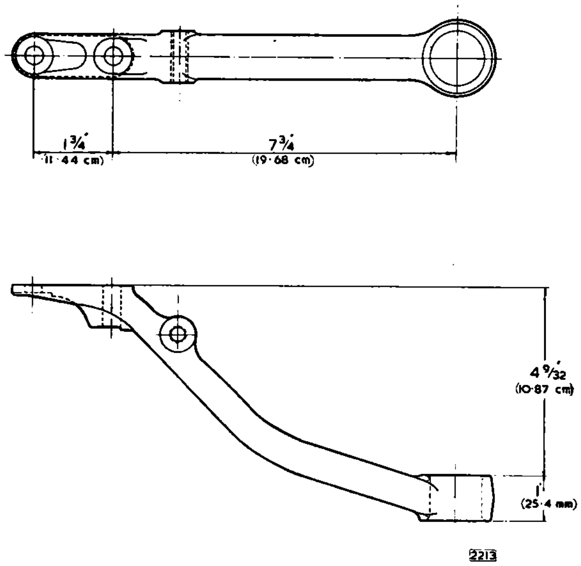


Fig. 17. The upper wishbone lever—front.

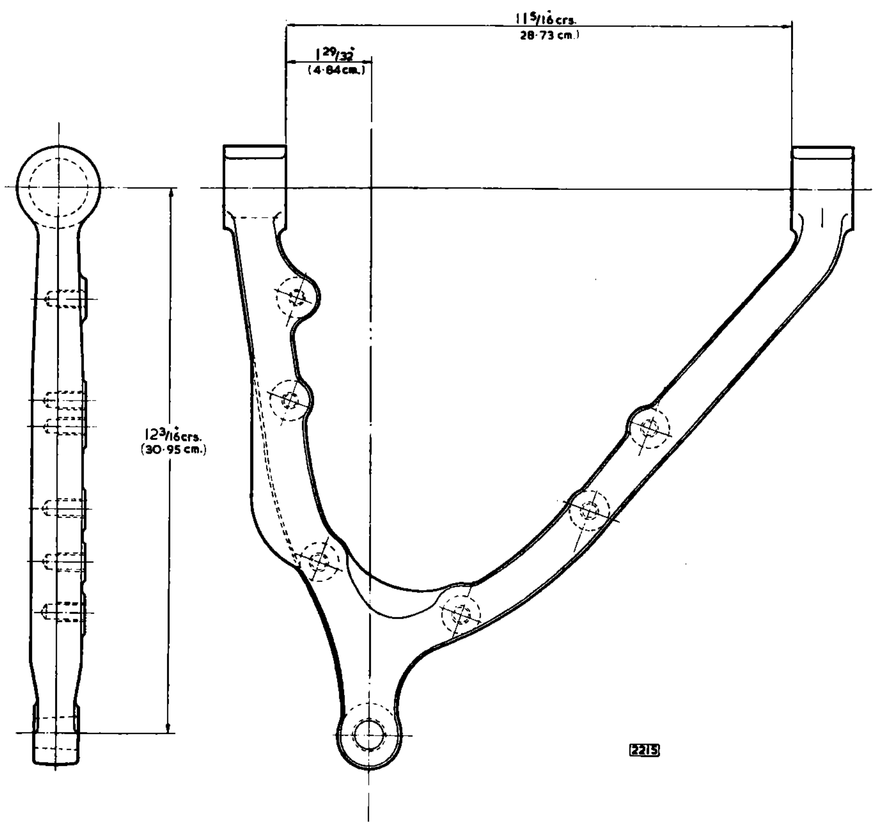


Fig. 18. The lower wishbone.

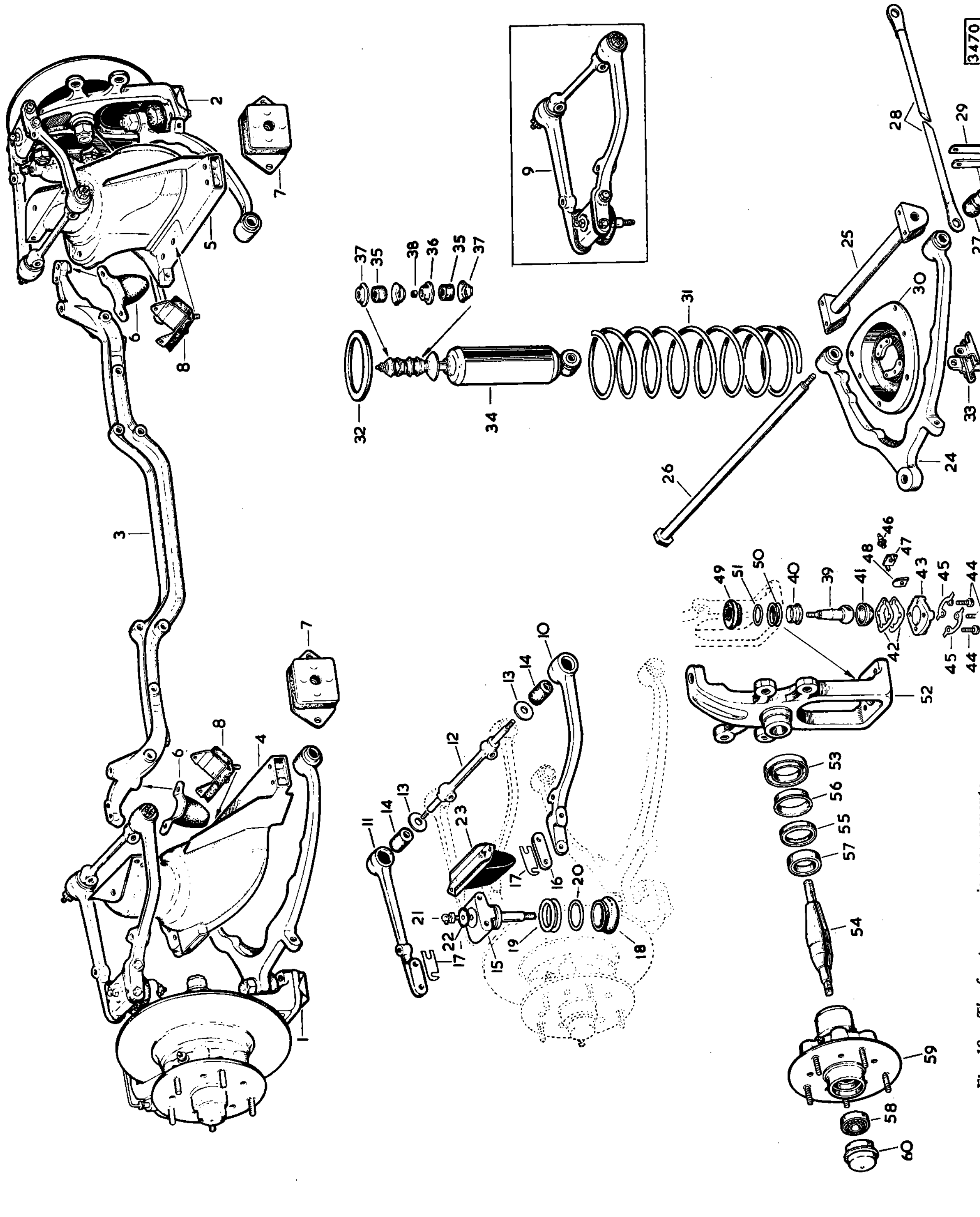


Fig. 19. The front suspension components.

Key to Fig. 19

1. R.H. front suspension
2. L.H. front suspension
3. Front suspension beam
4. Suspension bracket (R.H.)
5. Suspension bracket (L.H.)
6. Bump stop
7. Rubber mounting (front)
8. Rubber mounting (rear)
9. R.H. upper wishbone assembly
10. Upper wishbone lever (front)
11. Upper wishbone lever (rear)
12. Fulcrum shaft
13. Distance washer
14. Rubber bush
15. Ball joint
16. Distance piece
17. Shim
18. Rubber gaiter
19. Plastic insert
20. Ring
21. Grease nipple
22. Washer (nylon)
23. Rebound stop
24. R.H. lower wishbone assembly
25. Fulcrum tube and bracket
26. Fulcrum shaft
27. Safety bush
28. Cross tube
29. Check strap
30. Seat assembly
31. Front suspension coil spring
32. Packing ring
33. Bracket
34. Front shock absorber
35. Rubber buffer
36. Inner washer
37. Outer washer
38. Spacing collar
39. Ball pin
40. Spigot
41. Railko socket
42. Shim
43. Cap
44. Bolt
45. Tab washer
46. Grease nipple
47. Locating washer
48. Washer (nylon)
49. Rubber gaiter
50. Plastic insert
51. Ring
52. Stub axle carrier
53. Water deflector
54. Stub axle shaft
55. Oil seal
56. Water deflector
57. Inner bearing
58. Outer bearing
59. Front hub
60. Cap

SPECIAL SERVICE TOOLS

Description

Front Coil Spring Compressor (J.D. 6B*)

*Churchill Tool Number.

SECTION K

REAR SUSPENSION

4·2 MARK 10 MODEL

INDEX

INDEX *(continued)*

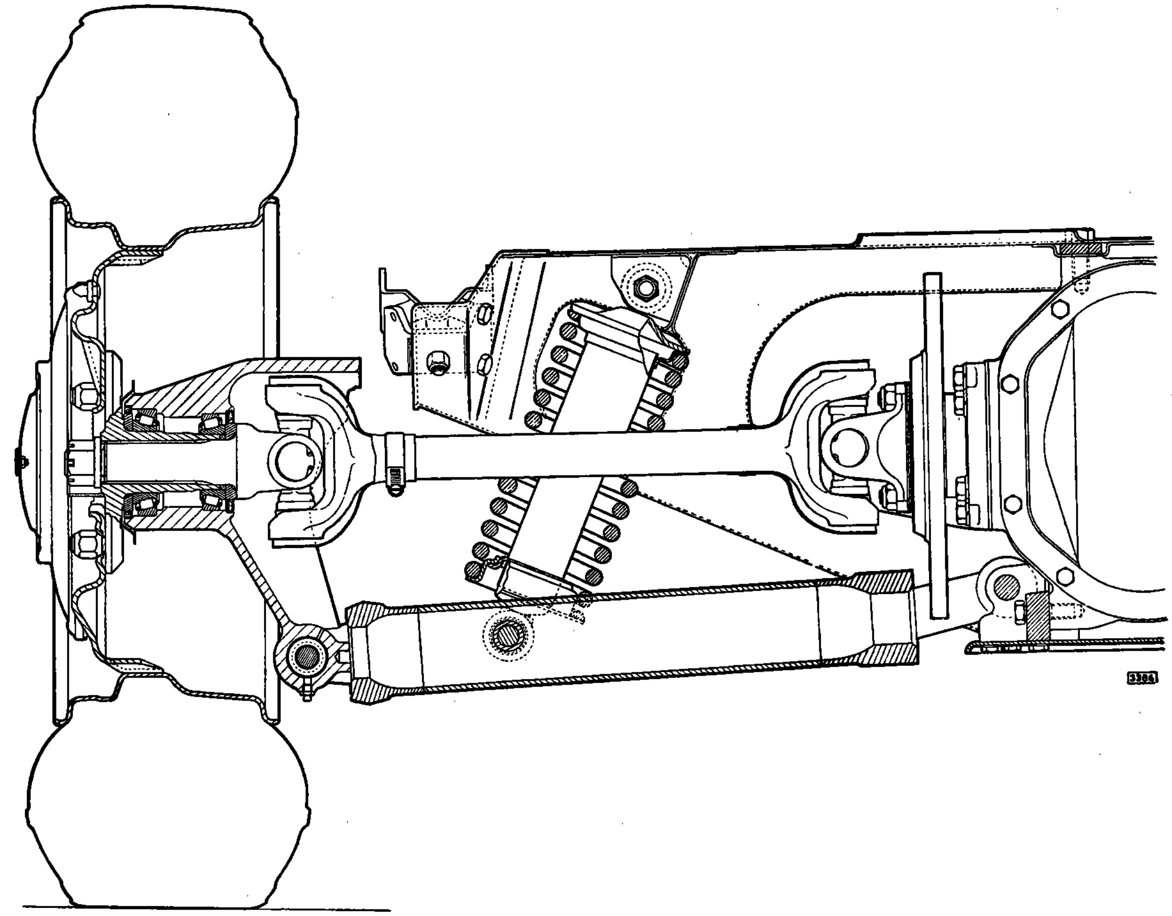


Fig. 1. Sectioned view of the rear suspension.

REAR SUSPENSION

DESCRIPTION

The rear wheels are located in a transverse plane by two links of which the top link is the half-shafts universally jointed at each end. The lower link is pivoted at the wheel carrier and at the crossbeam adjacent to the differential casing. To provide maximum rigidity in a longitudinal plane the pivot bearings at both ends of the lower link are widely spaced. The suspension medium is provided by four coil springs enclosing telescopic dampers, two being mounted on either side of the differential casing. The complete assembly is carried in a fabricated steel crossbeam. The crossbeam is attached to the body by four "Vee" rubber blocks and is located by radius arms. The radius arm pivots are rubber bushes mounted on each side of the car between the lower link and a mounting point on the body structure.

DATA

Rear road spring	
Free length (approx.)	12·525" (31·82 cm.)
Identification colour	Yellow
Number of coils (approx.)	10$\frac{1}{4}$
Wire diameter	0·475" (12·06 mm.)
Dampers	Telescopic
Road wheel movement from mid laden position	
Full bump	3$\frac{3}{4}$" (9·52 cm.)
Full rebound	3$\frac{3}{4}$" (9·52 cm.)
Track	58" (147·32 cm.)
Road wheel camber	$\frac{3}{4}^\circ \pm \frac{1}{4}^\circ$ negative

Recommended Lubricants

Component	Mobil	Castrol	Shell	Esso	B.P.	Duckhams	Regent Caltex/ Texaco
Wishbone pivots	Mobilgrease MP	Castrolease Medium or LM	Retinax A	Esso Multi-purpose Grease H	Energrease or L2	LB10	Marfak All purpose

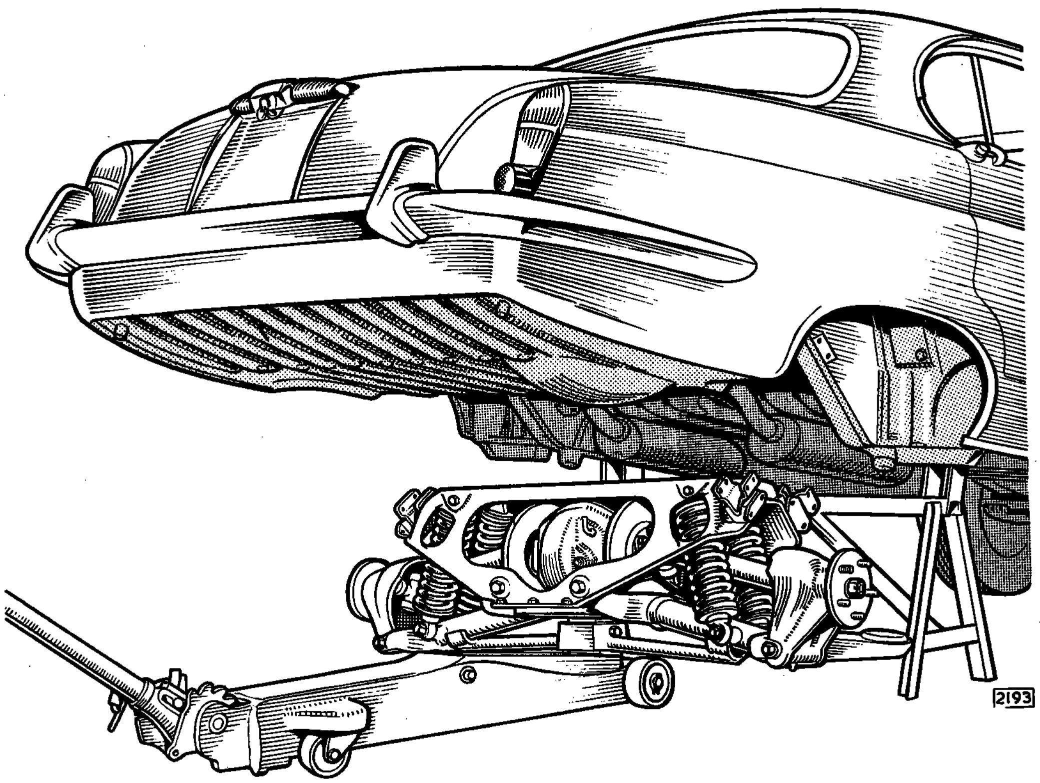


Fig. 2. Removal of the rear suspension assembly from the car.

ROUTINE MAINTENANCE

EVERY 6,000 MILES (10,000 KM.)

Outer Pivot Bearings

A grease nipple is located in the centre of the rear wishbone outer pivot. Lubricate sparingly with the recommended grade of lubricant. A bleed hole is provided, opposite the grease nipple, to indicate when an excess of lubricant has been applied. Always ascertain that the bleed hole is clear before carrying out operation.

Inner Pivot Bearing

Two grease nipples are provided located at either end of the wishbone fork. Lubricate sparingly with the recommended grade of lubricant.

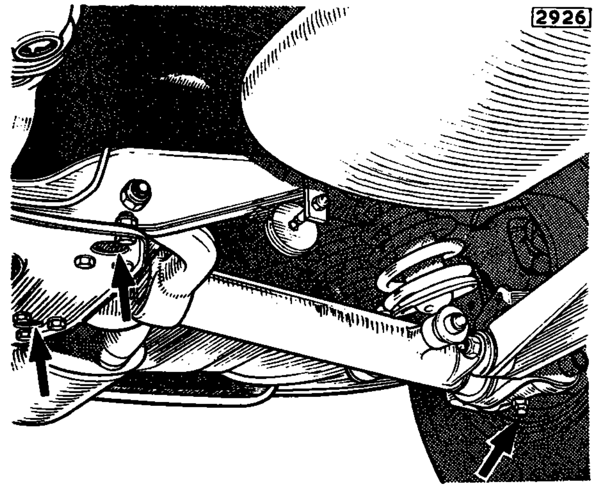


Fig. 3. Inner and outer pivot bearing grease nipples.

REMOVAL AND REFITTING

REMOVAL

Slacken the two clamp bolts which secure the muffler boxes to the rear silencers.

Remove the four nuts and washers retaining the muffler mounting rubbers to the underside of the car.

Withdraw the mufflers.

Remove the locking wire from the radius arm safety strap and securing bolt.

Unscrew the two bolts securing the safety strap to the body floor.

Remove the radius arm securing bolt and spring washer and remove the safety strap.

Withdraw the radius arm from the mounting post on the body.

Place a stout piece of wood approximately 9″ × 9″ × 1″ (22·8 cm. × 22·8 cm. × 25·4 mm.) between the rear suspension tie plate and the jack.

Jack up the rear of the car and place two chassis stands of equal height under the body forward of the radius arm mounting posts. Place blocks of wood between the chassis stands and the body to avoid damage.

Remove the rear road wheels.

Disconnect the flexible brake pipe at the connection on the body.

Remove the split pin, washer and clevis pin securing the handbrake cable to the handbrake caliper actuating levers mounted on the suspension cross beam.

Slacken the locknut and screw the outer handbrake cable screw out of the adjuster block.

Remove the four bolts and self-locking nuts securing the mounting rubbers at the front of the cross beam to the body frame. Remove the six self-locking nuts and four bolts securing the rear mounting rubbers to the cross beam.

Remove the four self-locking nuts and bolts securing the propeller shaft to the differential pinion flange.

Lower the rear suspension unit on the jack and withdraw the unit from under the car as shown in Fig. 2.

REFITTING

Refitting is the reverse of the removal procedure.

Check all mounting rubbers for deterioration.

Bleed the braking system as described in **Section** L, "Brakes."

If the radius arms have been removed the rear suspension should be at the normal riding height before tightening the radius arm securing nuts on the rear suspension wishbone. Refit the radius arms as described on page K.10.

IMPORTANT

The following removal and refitting operations are described assuming the rear suspension is removed from the car. If it is possible for the operations to be carried out with the rear suspension in position on the car the fact will be noted in the text.

ROAD SPRING AND HYDRAULIC DAMPER ASSEMBLY

REMOVAL

The road spring and hydraulic damper assembly may be removed from the car with the rear suspension assembly in position.

Remove the two self-locking nuts and washers securing the two hydraulic dampers to the wishbone.

Support the appropriate wishbone and drift out the hydraulic damper mounting pin, Fig. 5.

Remove the self-locking nut and bolt securing each hydraulic damper to the cross beam.

Withdraw the hydraulic damper and road spring assembly.

REFITTING

Refitting is the reverse of the removal procedure.

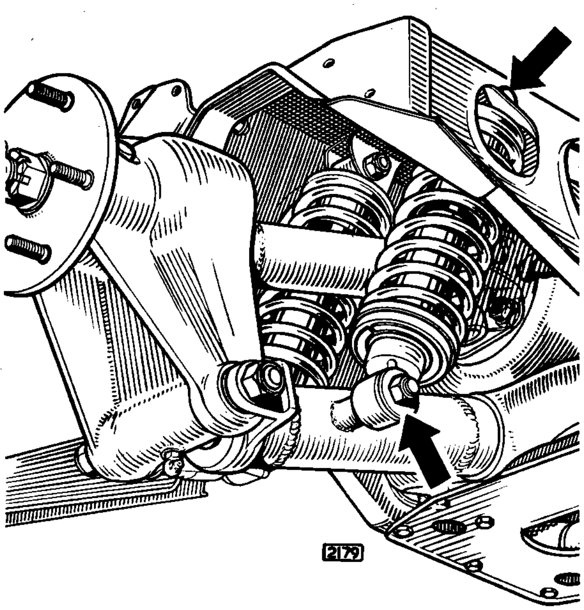


Fig. 4. Hydraulic damper mounting points.

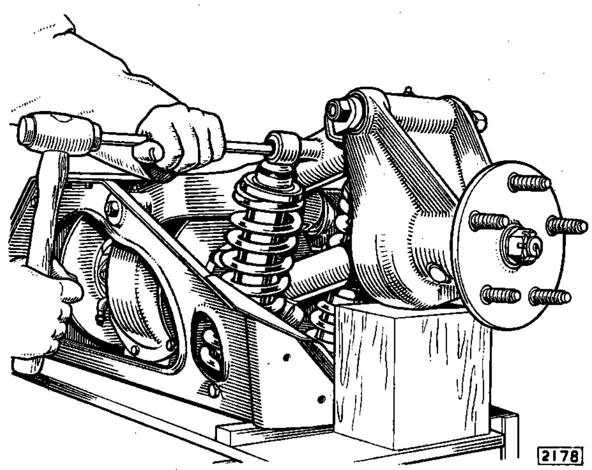


Fig. 5. Drifting out the hydraulic damper mounting pin.

HYDRAULIC DAMPERS

The telescopic hydraulic dampers are of the sealed type with no provision for adjustment or "topping-up" with fluid. Therefore, in the event of a damper becoming unserviceable, a replacement must be fitted.

Before fitting a damper to a car it is advisable to carry out the following procedure to "bleed" any air from the pressure chamber that may have accumulated due to the damper having been stored in the horizontal position. Hold the damper in its normal vertical position with the shroud uppermost and make several short strokes (not extending more than half way) until there is no lost motion. Finish by extending the damper to its full length once or twice. Do not extend the damper fully until several short strokes have been made first. After the operation of "bleeding", the hydraulic dampers should be kept in their normal upright position until they are fitted to the car.

REMOVAL

Remove the road spring and hydraulic damper as described on page K.8.

Utilizing a suitable press, Fig. 6, compress the road spring until the split collet can be removed from under the road spring retaining pad.

Carefully release the pressure on the road spring and withdraw the hydraulic damper.

On early cars an aluminium pad was fitted to either end of the spring. The pad fitted to the shrouded end of the damper was recessed to receive the shroud.

REFITTING

Compress the road spring, utilizing Churchill tool No. J.11A and SL.14, sufficiently to allow the hydraulic damper to be passed through the road spring and spring pad and split collet placed into position, see Fig. 6. Ensure that the split collet and spring pad are seating correctly. Release the pressure on the road spring.

On early cars fit the machined recessed aluminium pad to the shrouded end of the damper. Compress the road spring and fit the other aluminium pad and secure with the split collet. Release the pressure on the road spring.

Refit the road spring and hydraulic damper assembly as described on page K.8.

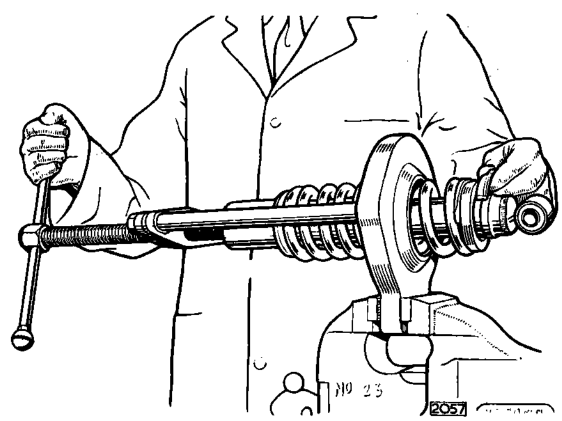


Fig. 6. Removing the rear road spring from the hydraulic damper with Tool Part No. J.11A in conjunction with Hand Press Tool No. SL.14.

RADIUS ARM

REMOVAL

Remove the locking wire from the radius arm safety strap and securing bolt.

Unscrew the two bolts securing the safety strap to the body floor.

Remove the radius arm securing bolt and spring washer and remove the safety strap.

Withdraw the radius arm from the mounting post on the body.

Remove one of the self-locking nuts securing the hub bearing assembly fulcrum shaft to the wishbone.

Drift out the fulcrum shaft from the wishbone and hub assembly as described on page K.11.

Remove the self-locking nut and bolt securing the radius arm to the wishbone and remove the radius arm.

Examine the radius arm mounting rubbers for deterioration.

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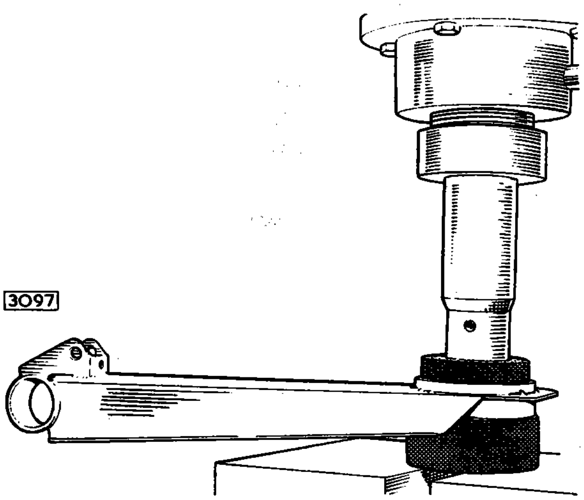

Fig. 7. Removing the large rubber bush.

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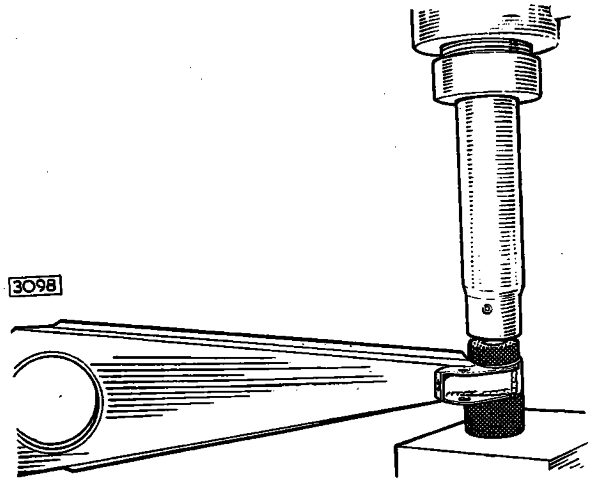
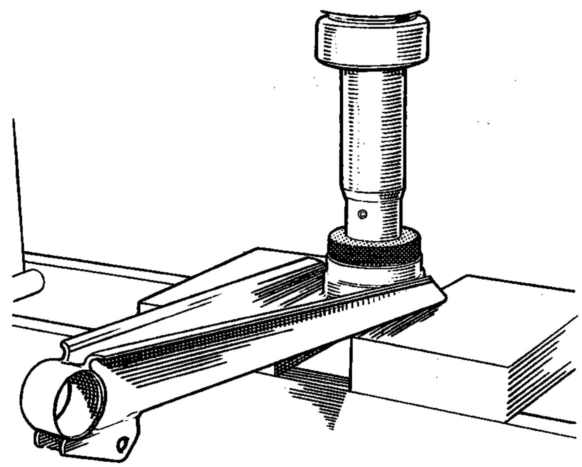


Fig. 8. Removing the small rubber bush.



3099

Fig. 9. Refitting the large rubber bush.

REFITTING

Refitting is the reverse of the removal procedure.

When replacing the large radius arm body mounting rubber, the two holes should be in the longitudinal position in the radius arm as shown in Fig. 9.

The rubbers on the wishbone mounted end of the radius arm can be pressed out. Ensure that the rubbers are refitted with an equal amount of space showing on each side of the radius arm.

When refitting the hub bearing assembly shaft refer to page K.14.

Refit the safety strap into position, refit the spring washer and radius arm securing bolt.

Refit the two bolts and nuts securing the safety strap to the body.

Tighten the radius arm securing bolt to 46 lb.ft. (6·36 kgm.) and pass the locking wire through the hole in the head of the bolt and secure round the safety strap.

WISHBONE

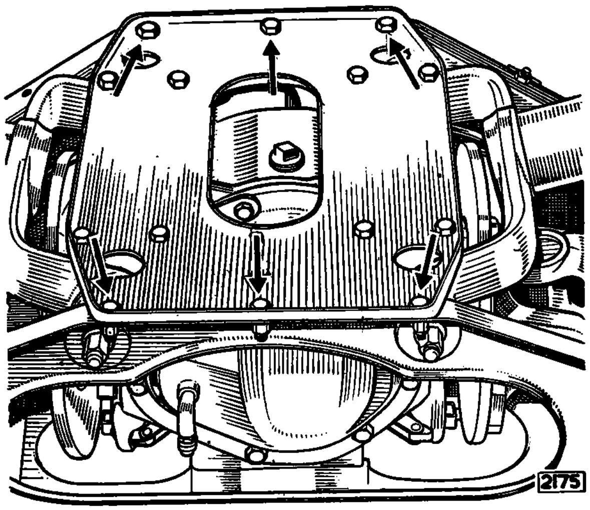


Fig. 10. Showing the six bolts which secure the tie plate to the cross beam.

REMOVAL

Remove the hydraulic dampers from the appropriate wishbone as described on page K.9.

Remove the six self-locking nuts and bolts securing the tie plate to the cross beam.

Remove the eight self-locking nuts and bolts securing the tie plate to the inner fulcrum wishbone mounting brackets and remove the tie plate.

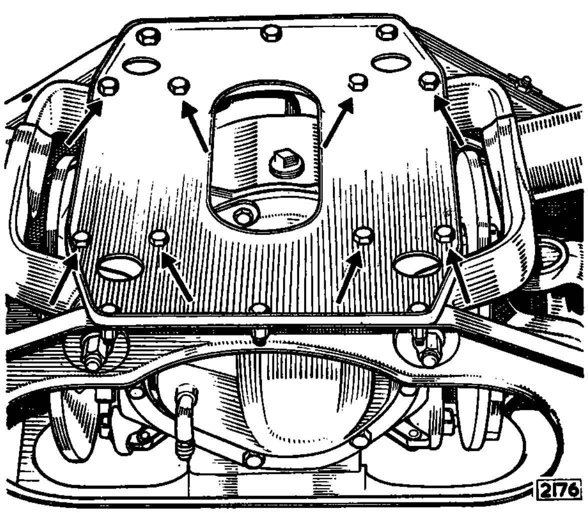


Fig. 11. Showing the eight bolts which secure the tie plate to the inner fulcrum mounting bracket.

Remove one of the self-locking nuts securing the hub bearing assembly fulcrum shaft to the wishbone and drift out the fulcrum shaft, see Fig. 12.

Separate the hub carrier from the wishbone. If any shims are fitted between the wishbone and hub assembly note the amount and position of the shims as it is essential to replace the exact amount in the correct position. To facilitate refitting slide a dummy fulcrum shaft Tool No. J.14 through the hub carrier.

Place a piece of sticky tape over each of the hub carrier assembly oil seal tracks to prevent them becoming displaced.

Remove the self-locking nut securing the radius arm to the wishbone. Withdraw the special thin headed bolt and remove the radius arm from the wishbone.

Remove the self-locking nut securing the wishbone fulcrum shaft to the cross beam.

Drift the inner fulcrum shaft out of the wishbone and inner fulcrum mounting bracket.

Withdraw the wishbone assembly and collect the four outer thrust washers, inner thrust washers, oil seals and oil retainers.

Examine the oil seals for deterioration.

Remove the two bearing tubes.

There is no need to remove the spacer fitted between the inner fulcrum mounting bracket unless the mounting bracket is to be replaced. To remove the spacer, tap out of position. To remove

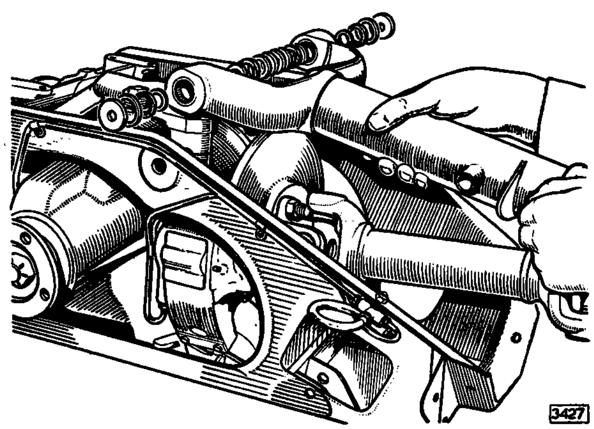


Fig. 12. The wishbone inner fork and components.

the needle rollers gently tap the needle cages out of the wishbone using a suitable drift. Remove the needle roller spacer.

REFITTING

If the needle rollers have been removed from the larger fork of the wishbone lever press one roller cage into position, with the engraving on the roller cage facing outwards.

Insert the roller spacing tube and press in the other roller cage.

Repeat for the other side.

Insert the bearing tubes. Smear the four outer thrust washers, inner thrust washers, oil seals and oil seal retainers with grease and place into position on the wishbone, see Fig. 12.

Offer up the wishbone to the inner fulcrum mounting bracket with the radius arm mounting bracket towards the front of the car. Align the holes and spacers. Press a dummy shaft Churchill Tool No. J.14 through each side of the cross beam and wishbone.

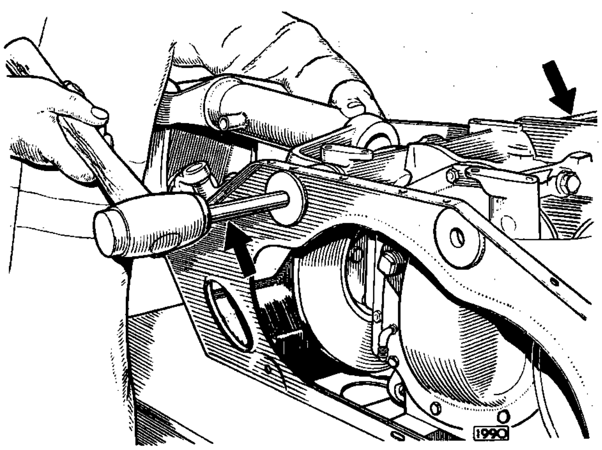


Fig. 13. Tapping the dummy shafts into position at the wishbone inner fulcrum.

The dummy shafts locate the wishbone, thrust washers, cross beam and inner fulcrum mounting bracket and facilitate refitting of the fulcrum shaft.

Smear the fulcrum shaft with grease and gently tap the shaft through the cross beam, wishbone and inner fulcrum mounting bracket. As the fulcrum shaft is tapped into position the short dummy shafts will be displaced from the opposite side. It will be found advantageous to keep a slight amount of pressure exerted on the dummy shafts as they emerge from the cross beam. This will

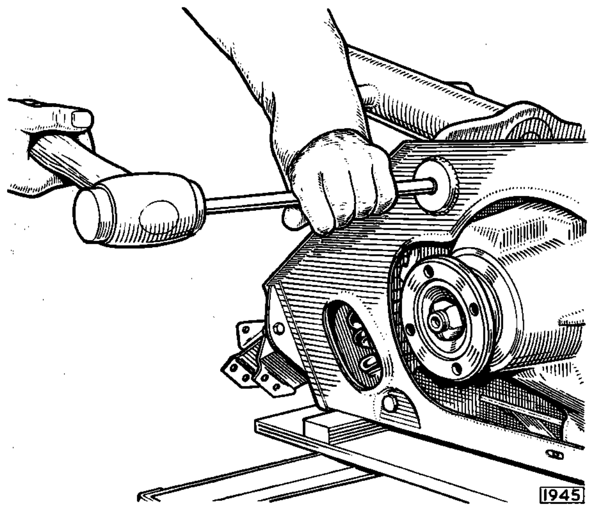


Fig. 14. Drifting the inner fulcrum shaft into position and displacing the dummy shafts.

reduce the tendency for the dummy shafts to be knocked out of position and allow a spacer or thrust washer to be displaced. If a washer or spacer becomes displaced it will be necessary to remove the fulcrum shaft, dummy shafts and wishbone and then repeat the operation.

When the fulcrum shaft is in position tighten the two self-locking nuts to 55 lb.ft. (7·60 kgm.) with a torque wrench.

Refit the eight bolts and self-locking nuts securing the tie plate to the inner fulcrum wishbone mounting bracket.

Refit the six bolts and self-locking nuts securing the tie plate to the cross beam.

Refit the radius arm to the wishbone as described on page K.10.

Remove the two pieces of sticky tape holding the oil seal tracks in position.

Offer up the wishbone to the hub assembly.

Using a dummy shaft, Churchil' Tool No. J.14, line up the wishbone hub assembly oil seal tracks and spacers. Smear the fulcrum shaft with grease and gently tap the fulcrum shaft into position and displace the dummy shaft.

It will be found advantageous to apply a small amount of pressure on the dummy bar against the fulcrum shaft to prevent the bar being knocked out of position and allowing a spacer to be displaced. If a spacer is displaced it may be necessary to repeat the operation.

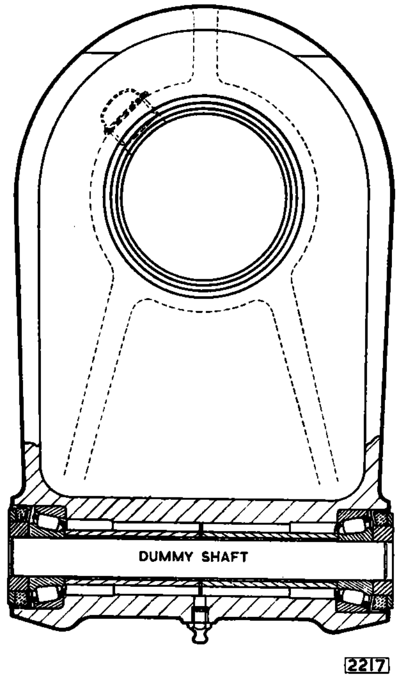


Fig. 15. Showing the dummy shaft in position in the hub carrier.

Slide the fulcrum shaft through the wishbone and hub carrier. Using feeler gauges check the amount of clearance between the hub carrier and the wishbone lever, see Fig. 19. If necessary fit sufficient shims between the hub carrier and the wishbone to centralize the hub carrier. Tighten the nuts on the fulcrum shaft to 55 lb.ft. (7·60 kgm.).

Check the rear suspension camber angle as described on page K.17.

Refit the hydraulic dampers as described on page K.9.

Refit the rear suspension as described on page K.7.

Re-lubricate the wishbone fulcrum shafts as described in "Routine Maintenance" at the beginning of this section.

WISHBONE OUTER PIVOT

REMOVAL

Support the hub carrier and wishbone.

Remove one of the self-locking nuts securing the outer-fulcrum shaft.

Drift out the fulcrum shaft, Fig. 16 and collect the shims, if any, between the hub carrier and the wishbone.

Separate the hub carrier and wishbone.

DISMANTLING

Remove the oil seal track and prise out the oil seals.

Remove the inner races of the tapered roller bearings by tapping out with the aid of a drift in the grooves provided.

Remove the spacer(s) and shims.

REASSEMBLY

Refit the inner races for the tapered roller bearings.

Fit the spacers and a known quantity of shims, this is necessary to obtain the correct bearing adjustment as described in the following paragraphs.

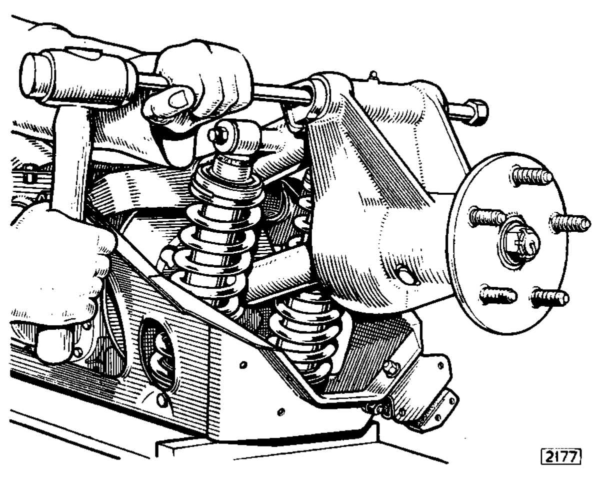


Fig. 16. Drifting out the wishbone outer fulcrum shaft.

Fit the tapered roller bearings and oil seal tracks.

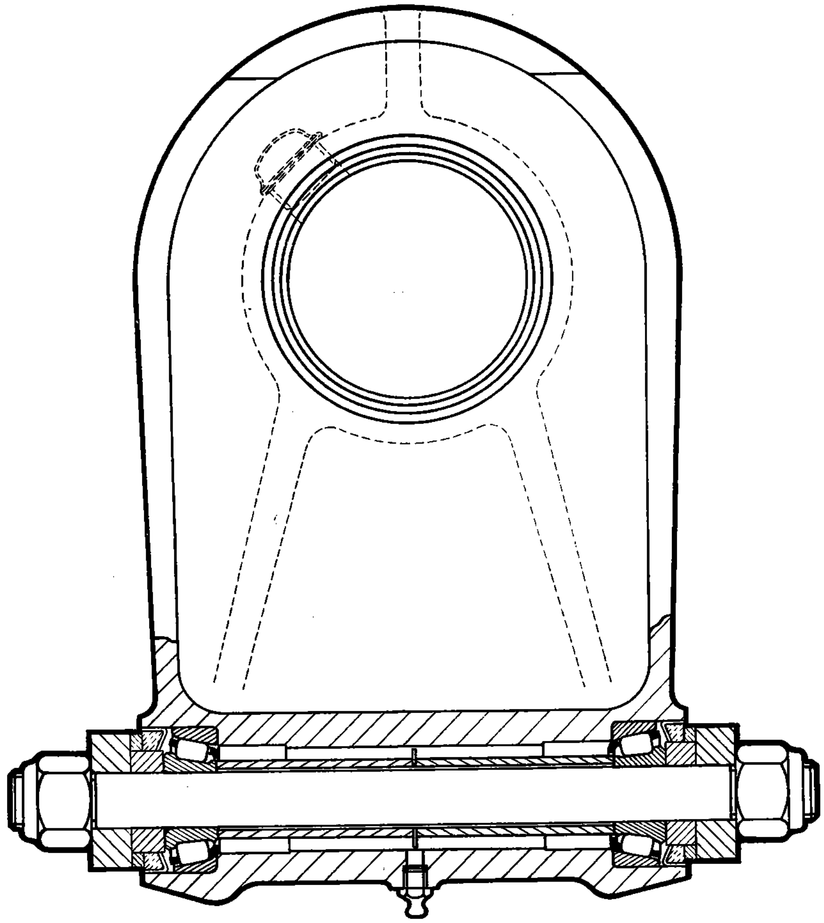


Fig. 17. Section through hub carrier and wishbone showing outer fulcrum shaft in position.

Bearing Adjustment

If it is necessary to adjust the tapered roller bearings it will be necessary to extract the hub from the rear axle half shaft as described in Section H "Rear Axle."

Bearing adjustment is effected by shims fitted between the two fulcrum shaft spacer tubes. The correct bearing adjustment is 0·000" – 0·002" (0·00 mm. – 0·05 mm.) pre-load.

Shims are available in sizes of 0·004" (0·101 mm.) and ·007" (0·17 mm.) thick and $1\frac{1}{8}$" (28·67 mm.) diameter.

A simple jig should be made consisting of a piece of plate steel approximately 7" × 4" × $\frac{3}{8}$" (17·7 cm. × 10·1 cm. × 9·5 mm.). Drill and tap a hole suitable to receive the outer fulcrum shaft. Place the steel plate in a vice and screw the fulcrum shaft into the plate and slide an oil seal track onto the shaft. Place the assembly into position on the fulcrum shaft minus the oil seals and with an excess of shims, of a known quantity, between the spacers. Place an inner wishbone fork outer thrust washer onto the fulcrum shaft so that it abuts the oil seal track. Fill the remaining space on the shaft with washers and secure with a nut. Tighten the nut to 55 lb.ft. (7·60 kgm.). Press the hub carrier assembly towards the steel plate using a slight twisting motion to settle the rollers onto the bearing surface. Maintain a steady pressure against the hub carrier and using a feeler gauge measure the amount of clearance between the large diameter washer and the machined face of the hub carrier.

Pull the hub carrier assembly towards the large diameter washer slightly rotating the carrier to settle the rollers onto the bearing surface. Maintain a steady pressure against the hub carrier and using feeler gauges measure the amount of clearance between the large diameter washer and the machined face of the hub carrier.

Subtract the one measurement from the other which gives the amount of end float present in the bearings.

Remove sufficient shims to obtain a reading of 0·000″ – 0·002″ (0·00 mm. – 0·05 mm.) preload.

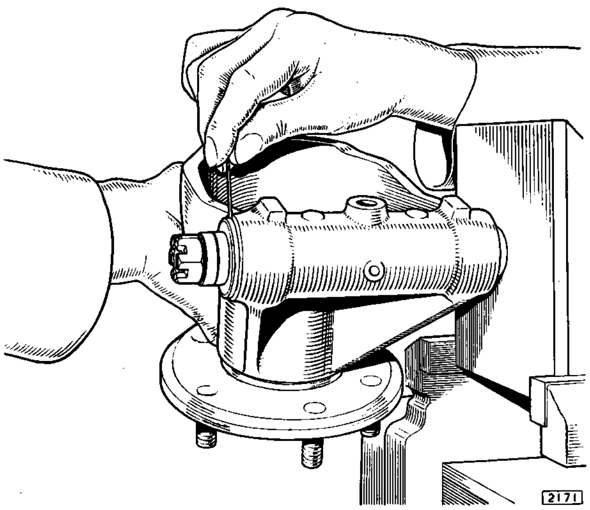


Fig. 18. Measuring the amount of clearance between the hub carrier and large washer to determine the end float in the bearings.

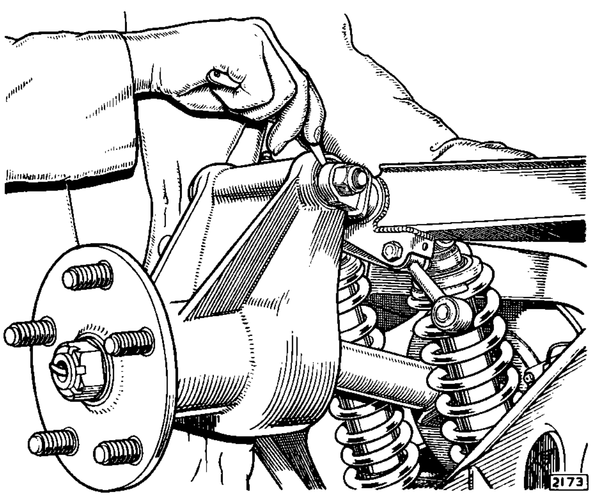


Fig. 19. Using feeler gauges to measure the clearance between the hub carrier oil seal tracks and wishbone fork.

Known quantity of shims 0·020″ (0·5 mm.).

Correct pre-load 0·000″ – 0·002″ (0·00 mm. – 0·05 mm.).

Mean 0·001″ (0·02 mm.).

Therefore 0·010″ + 0·001″ = 0·011″ (0·25 mm. + 0·02 mm. = 0·27 mm.) to be removed to give correct pre-load.

Refit the hub carrier to the half shaft as described in Section H "Rear Axle."

Fit new oil seals with the lips inwards and place the fulcrum shaft into position in the hub carrier.

Offer up the hub carrier to the wishbone. Chase the dummy shaft through the wishbone with the fulcrum shaft.

Using feeler gauges measure the gap between the oil seal track and the wishbone. Shims of 0·004″ (0·004 mm.) thickness by $1\frac{1}{8}$″ (22·2 mm.) diameter should be used.

Repeat for the other end and shim as necessary to centralize the hub carrier in the wishbone fork. The above procedure is to prevent the wishbone fork ends from closing inwards. Tighten the nuts on the fulcrum shaft to 55 lb.ft. (7·60 kgm.).

REFITTING

To facilitate refitting, slide a dummy shaft Tool No. J.14 through the hub carrier before offering up the wishbone to the hub carrier.

Refitting is the reverse of the removal procedure.

Re-lubricate the bearings as described in "Routine Maintenance" at the beginning of the section.

INNER FULCRUM WISHBONE MOUNTING BRACKET

REMOVAL

Remove the eight bolts and self-locking nuts securing the tie plate to the inner fulcrum wishbone mounting bracket.

Remove the six bolts and self-locking nuts securing the tie plate to the cross beam.

Remove one self-locking nut and drift out the inner fulcrum shaft.

Withdraw the forks of the wishbone from between the cross beam and inner fulcrum wishbone mounting bracket.

Collect the oil seal retainers, oil seals, inner and outer thrust washers and bearing tubes.

Remove the lock wire from the two setscrews which secure the inner fulcrum wishbone mounting bracket to the differential unit.

Remove the spacer between the inner fulcrum mounting bracket.

Remove the two setscrews and note the amount of shims between the bracket and the differential.

Remove the inner fulcrum wishbone mounting bracket.

REFITTING

When refitting the inner fulcrum wishbone mounting bracket, replace the same amount of shims between the differential casing and the bracket.

Shims are available in sizes of 0·005″ (0·127 mm.) and 0·007″ (0·177 mm.) thickness.

Hold the inner fulcrum wishbone mounting bracket in position between the cross beam.

Insert the fulcrum shaft through the cross beam and bracket. Screw the inner fulcrum bracket securing setscrews in two or three threads, enough to locate the bracket.

Insert the required amount of shims and tighten the two setscrews securing the inner fulcrum wishbone mounting bracket to the differential casing.

Secure the two setscrews with locking wire.

Tap the spacer, fitted between the inner fulcrum mounting bracket lugs, into position.

Withdraw the inner fulcrum shaft from the cross beam and fulcrum bracket.

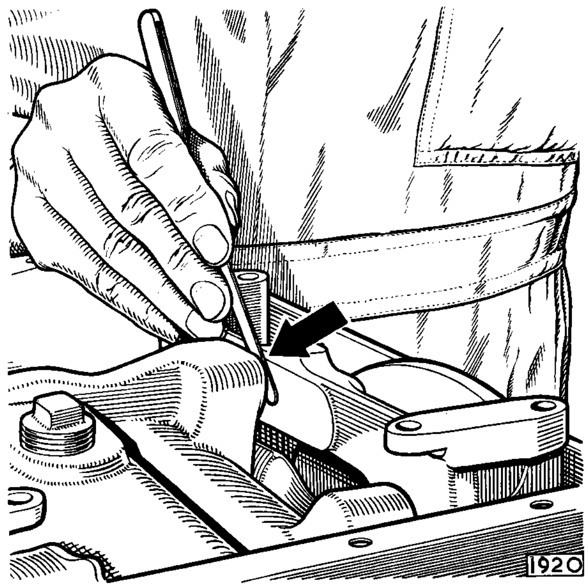


Fig. 20. Measuring the clearance between the inner fulcrum mounting bracket and the differential casing.

Offer up the wishbone to the inner fulcrum mounting bracket complete with bearing tubes, needle roller bearing and spacers, inner and outer thrust washers, oil seals and oil seal retainers. Ensure that the radius arm mounting bracket is towards the front of the car.

Align the holes and spacers. Press a dummy shaft through each side of the cross beam and wishbone.

The dummy shafts locate the wishbone, spacers, cross beam and inner fulcrum shaft.

Smear the fulcrum shaft with grease and gently tap the shaft through the cross beam, wishbone and inner fulcrum mounting bracket. As the fulcrum is tapped into position the short dummy shafts will be displaced from the opposite side. It will be found advantageous to keep a slight amount of pressure exerted on the dummy shafts as they emerge from the cross beam.

This will reduce the tendency for the dummy shafts to be knocked out of position and allow a spacer or thrust washer to be displaced. If a washer or spacer becomes displaced it will be necessary to remove the fulcrum shaft, dummy shafts and wishbone and then repeat the operation.

When the fulcrum shaft is in position tighten the two self-locking nuts to 55 lb.ft. (7·60 kgm.) with a torque wrench.

Refit the eight bolts and self-locking nuts securing the tie plate to the inner fulcrum wishbone mounting bracket.

Refit the six bolts and self-locking nuts securing the tie plate to the cross beam.

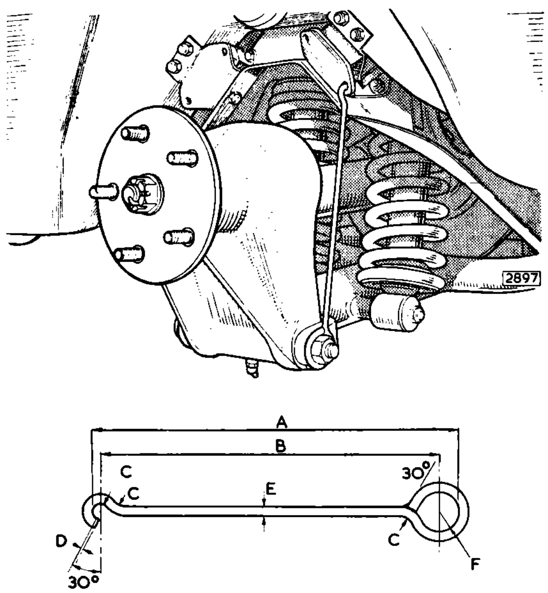
Refit the rear suspension unit as described on page K.7.

REAR WHEEL CAMBER ANGLE

ADJUSTMENT

To check the camber angle of the rear suspension it is necessary for the car's wheels to be on a flat surface and for the tyre pressures to be correct.

Check that the level of the oil and water is correct, the petrol tank full and the spare wheel is in position. If not, additional weight must be added to compensate for, say, a low level of petrol. The weight of 10 gallons of petrol is approximately 80 lbs. (3·60 kg.).



	INCHES	METRIC
A	9 1/32"	22·9 cm
B	8 3/16"	20·79 cm
C	1/4" RAD	6·3 mm
D	1/16"	1·5 mm
E	9/32"	7·1 mm
F	19/32" RAD	15·0 mm

Fig. 21. When checking the rear camber angle the rear suspension must be retained in the mid-laden position by means of the setting links (Churchill Tool No. J.25).

Owing to the variations in the camber angle with different suspension heights it is necessary to lock the rear suspension in the mid-laden position by means of two setting links (Jaguar Part No. 11189) as shown in Fig. 21.

To fit the setting links, hook one end in the lower hole of the rear mounting and depress the body until the other end can be slid over the hub carrier fulcrum nut. Repeat for the other.

With the car in this condition, the camber angle should be $\frac{3}{4}°$ negative $\pm\frac{1}{4}°$.

Note: The two rear wheels must be within $\frac{1}{4}°$ of each other.

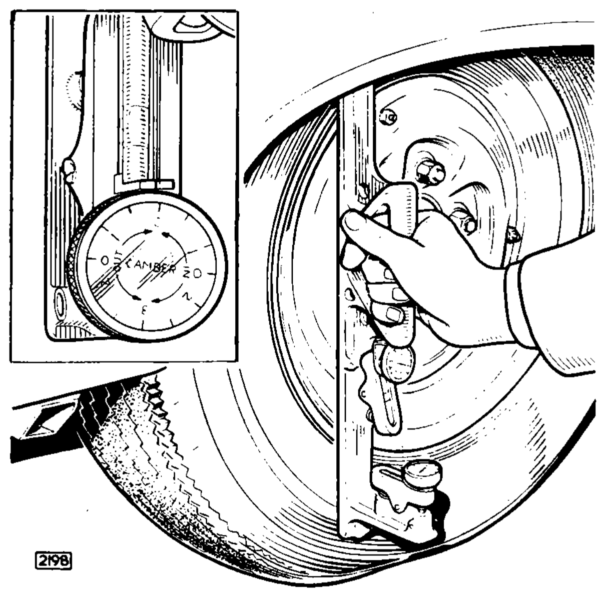


Fig. 22. Checking the rear wheel camber angle.

If the reading is incorrect it will be necessary to add or subtract shims between the half shaft and the brake disc. One shim 0·020″ (0·05 mm.) will alter the rear camber angle by approximately $\frac{1}{4}$°.

Jack up the car on the appropriate side and remove the rear road wheel.

Unscrew the four self-locking nuts securing the half shaft and the camber shims to the brake disc. Pull the hub and half shaft away from the shims sufficiently to clear the disc mounting studs. Remove or add shims as necessary.

Offer up the half shaft to the four disc mounting studs and secure with four self-locking nuts. Offer up the forward road spring and hydraulic damper assembly to the cross beam and secure with a bolt and self-locking nut.

Align the hydraulic damper and road spring assembly bottom mounting with the mounting pin in the wishbone and drift the pin through the assembly. Replace the plain washer and secure with a self-locking nut.

Replace the road wheel(s) and recheck the camber angle.

Warning: After completing the adjustment do not omit to remove the setting links from the suspension.

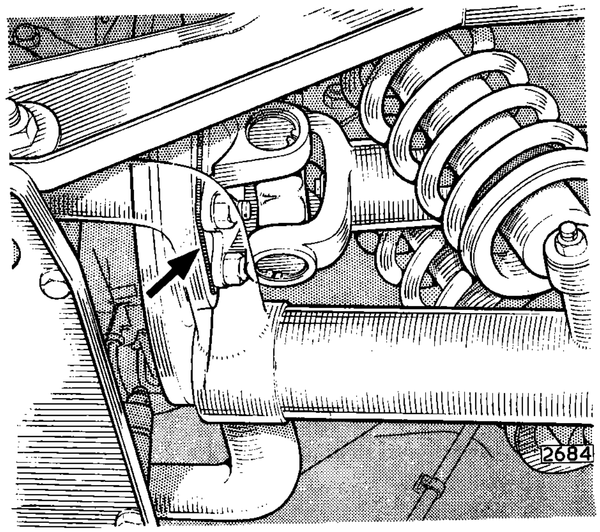


Fig. 23. The rear wheel camber angle is adjusted by means of shims indicated by the arrow.

SPECIAL TOOLS

Description

Rear spring shock absorber dismantling adaptor (J.11A)*

Rear wishbone pivot dummy shafts (J.14)* (2 off per set)

Radius arm bush remover and replacer (J.21)*

Rear camber setting links (J.25)*

* Churchill Tool Number

ACCIDENTAL DAMAGE

The dimensioned drawings below are provided to assist in assessing accidental damage. A component suspected of being damaged should be removed from the car, cleaned off, the dimensions checked and then compared with those given in the appropriate illustration.

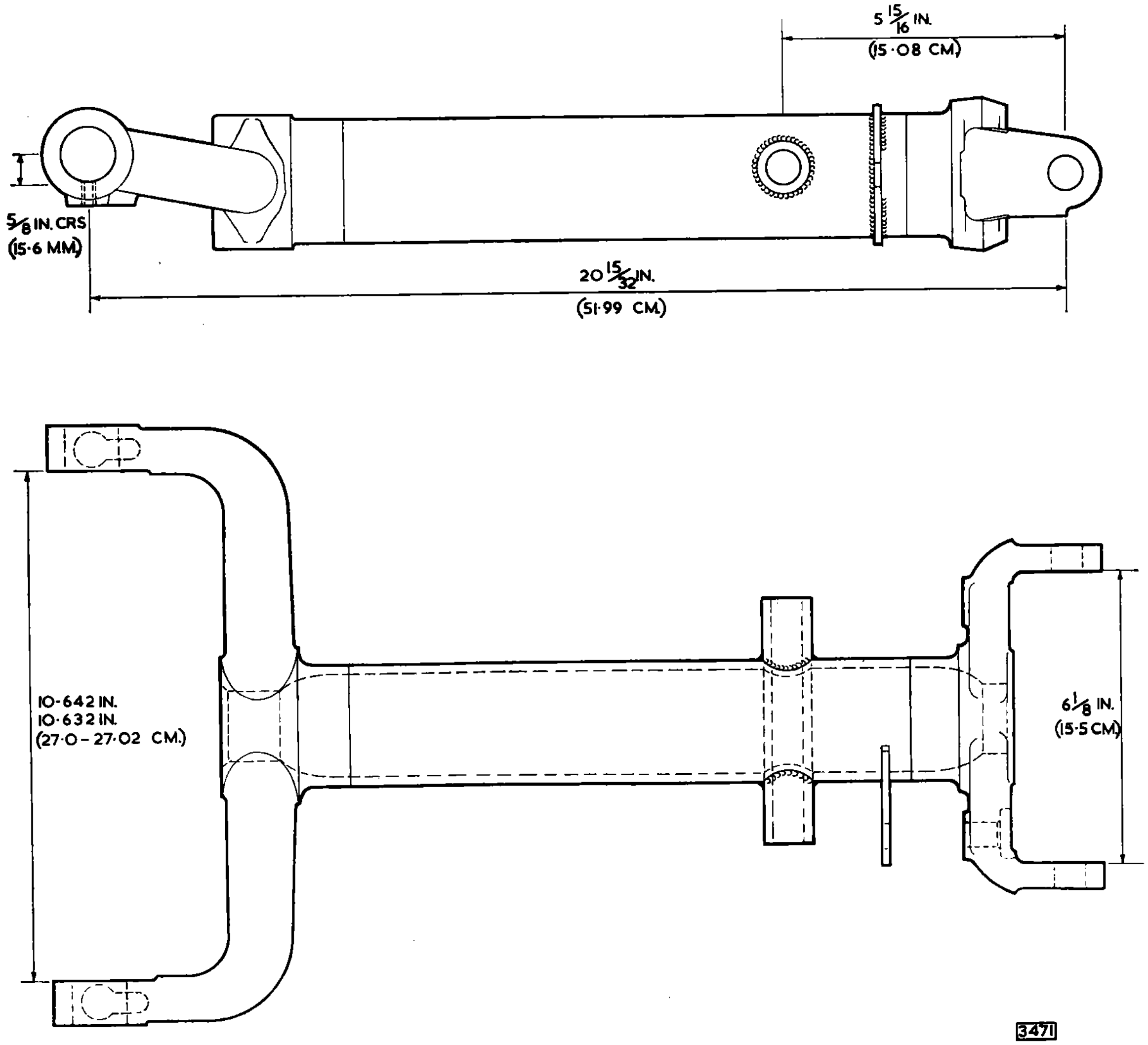


Fig. 24. The wishbone.

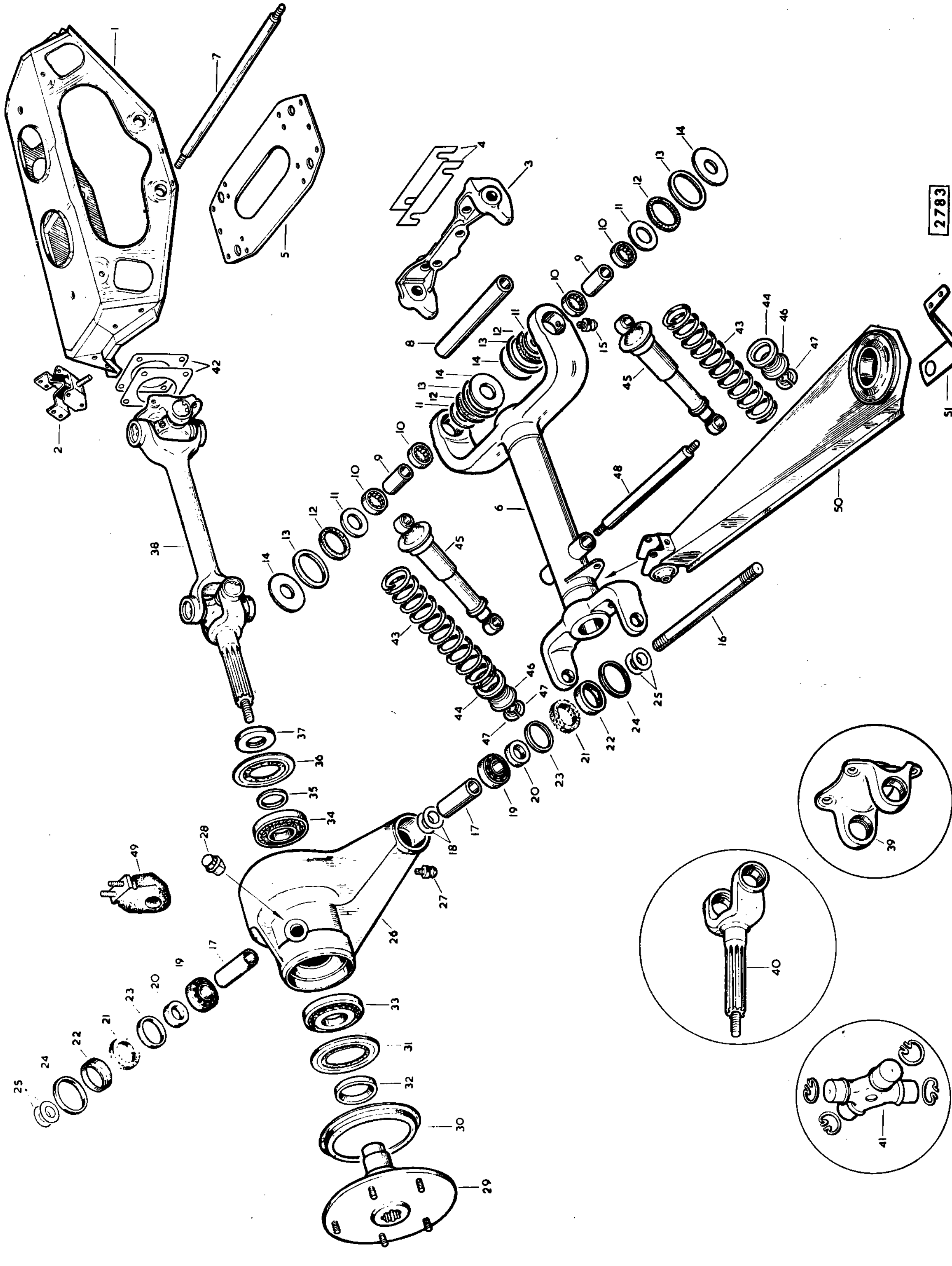


Fig. 25. Exploded view of the rear suspension.

1. Cross member
2. Rubber mounting
3. Inner fulcrum shaft mounting
4. Shim
5. Bracing plate
6. R.H. wishbone
7. Fulcrum shaft
8. Distance tube
9. Bearing tube
10. Needle bearing
11. Thrust washer (inner)
12. Sealing ring
13. Retainer
14. Thrust washer (outer)
15. Grease nipple
16. Fulcrum shaft
17. Sleeve
18. Shim
19. Bearing
20. Seating ring
21. Oil seal
22. Container
23. Spacer
24. Retaining washer
25. Shim
26. Hub carrier
27. Grease nipple
28. Grease retaining cap
29. Rear hub
30. Oil seal (outer)
31. Seating ring
32. Outer bearing
33. Inner bearing
34. Spacer
35. Oil seal (inner)
36. Seating ring
37. Half shaft
38. Flange yoke
39. Splined yoke
40. Journal assembly
41. Shim
42. Joint cover
43. Joint cover
44. Rear suspension coil spring
45. Rear shock absorber
46. Dust shield
47. Rubber bush
48. Spring seat
49. Retainer
50. Mounting shaft
51. Bump stop
52. Radius arm
53. Rubber bush
54. Rubber bush
55. Safety strap

SECTION L

BRAKES

4·2 MARK 10 MODEL

INDEX

INDEX *(continued)*

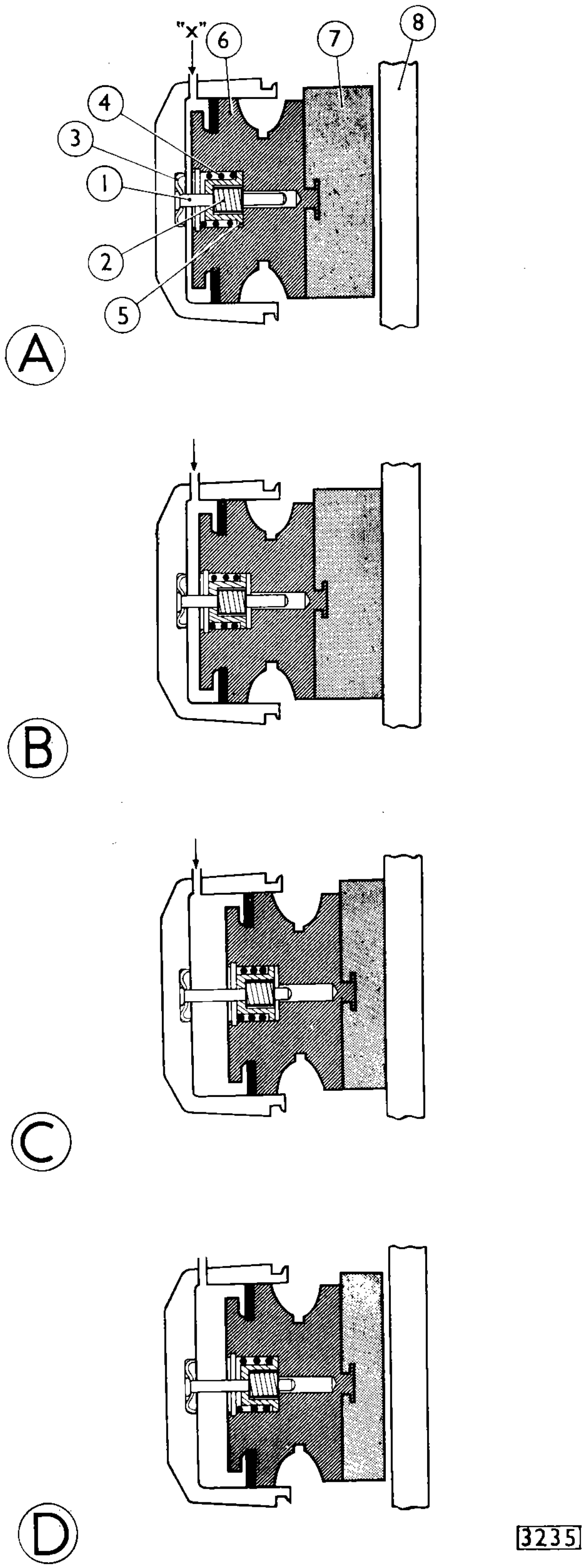


Fig.1. *Operation of the self-adjusting mechanism.*

A—BRAKE OFF ('X' indicates the fluid connection)

B—BRAKE ON—Retractor spring compressed

C—BRAKE ON—Retractor bush drawn along pin by piston as pad wears.

D—BRAKE OFF—Bush retains its new position on pin and spring returns to normal.

1. Retractor pin
2. Retractor bush
3. Washer
4. Return spring
5. Spring retainer
6. Piston
7. Friction pad.
8. Disc.

THE BRAKING SYSTEM

DESCRIPTION

Each wheel brake assembly consists of a hub mounted disc, rotating with the wheel, and a braking unit rigidly attached to the suspension member.

The braking unit consists of a caliper, straddling the disc, which houses a pair of piston-operated friction pads. The outer piston assembly is housed in a cylinder integral with the caliper while the inner cylinder is bolted to the inner face of the caliper and can be detached. A securing pin, retained by a spring clip, passes through the body of the caliper and the inner cylinder block securing the friction pads and a stop plate. The stop plate serves as a stop for the friction pads when they have reached the end of their life, and also excludes dirt from the caliper. A dust seal spigots on the outer face of each piston and a rubber seal is fitted between the piston and the cylinder. A counterbore in the piston accommodates a retractor bush which tightly grips the stem of a retractor pin. This pin forms part of an assembly which is peened into the base of the cylinder bore. The assembly consists of a retractor stop bush, a coil spring, a dished cap and the retractor pin; it functions as a return spring and maintains a "brake off" working clearance of approximately 0·008" – 0·010" (0·20 – 0·25 mm.) between the pads and the disc throughout the life of the pads.

Retractor operation (Fig. 1)

The retractor unit consists of the retractor pin (1) pressed into the cylinder block and the retractor bush (2), washer (3), return spring (4), and spring retainer (5) peened into the piston (6).

When the brakes are applied, the piston moves the friction pad (7) towards the disc (8). The retractor bush grips the pin, holding the spring retainer and the return spring against the washer. The piston, in moving the distance between the pad and disc, compresses the return spring and, when the brakes are released, the return spring expands maintaining an equal clearance between the pad and the disc.

As the pad wears, the washer will move the retractor bush down the pin until the pad contacts the disc. The retractor bush remains in this new position and, when the brakes are released, the return spring expands permitting the pads to maintain the normal "brakes off" clearance of approximately 0·008" – 0·010" (0·20 – 0·25 mm.) as before.

Handbrake operation

The self-adjusting handbrakes are attached to the rear brake caliper bodies but form an independent mechanically operated system carrying its own friction pads. The handbrakes are self-adjusting to compensate for friction pad wear and automatically provide the nearest clearance between the disc brakes and the friction pads.

DATA

Make	Dunlop	
Type	Bridge type calipers with quick change pads	
	Front	Rear
Brake friction pads:		
Face dimensions	2·811" × 2·119" (71·4 mm. × 53·82 mm.)	2·020" × 1·993" (51·31 mm. × 50·62 mm.)
Thickness	0·65" (16·5 mm.)	0·65" (16·5 mm.)
Brake disc:		
Diameter	10·91" (27·71 cm.)	10·375" (26·35 cm.)
Thickness	½" (12·7 mm.)	½" (12·7 mm.)
Master cylinder bore diameter	⅞" (22·2 mm.)	
Master cylinder stroke	1$\frac{11}{16}$" (42·86 mm.)	
Servo unit type	Dunlop Concentric Suspended Vacuum	
Main friction pad-material	Mintex M.59	
Handbrake friction pad-material	Mintex M.59	

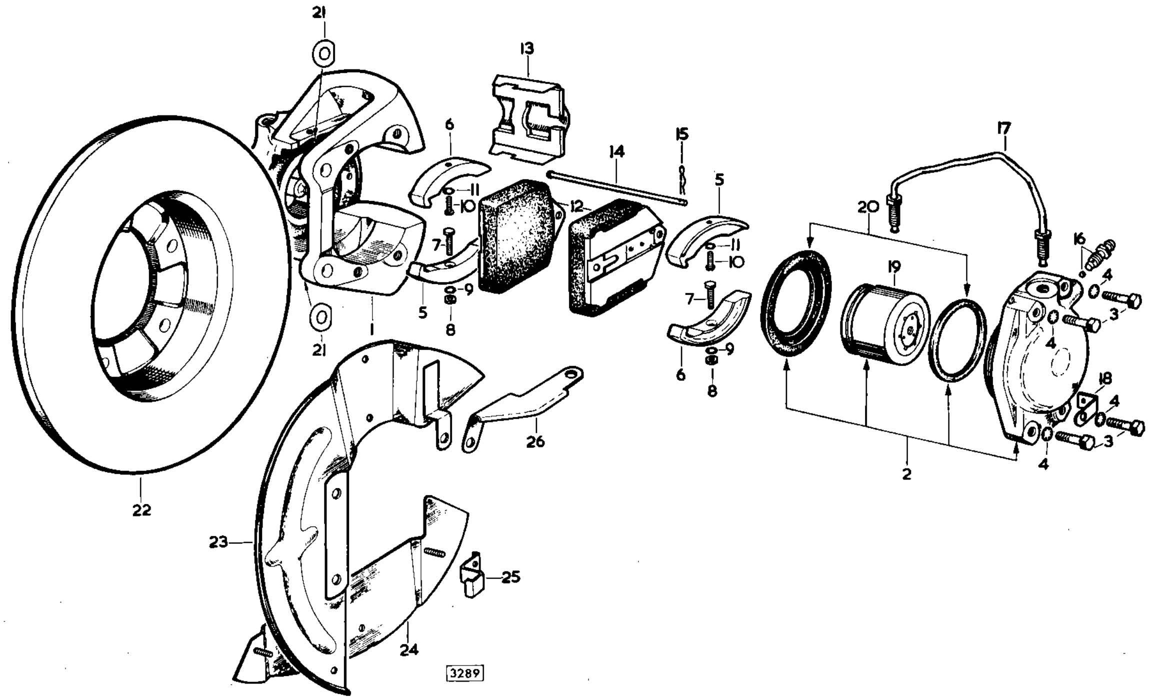


Fig.2. *Exploded view of a front brake assembly.*

1. Caliper and piston assembly
2. Piston and cylinder assembly
3. Bolt
4. Shakeproof washer
5. Pad support R.H.
6. Pad support L.H.
7. Bolt
8. Nut
9. Shakeproof washer
10. Screw
11. Shakeproof washer
12. Friction pad kit
13. Stop assembly
14. Pin
15. Clip
16. Bleed screw and ball
17. Bridge pipe
18. Bracket
19. Piston
20. Seal Kit
21. Shim
22. Disc
23. R.H. Front disc shield (upper).
24. R.H. Front disc shield (lower)
25. Clip
26. R.H. Front brake hose bracket.

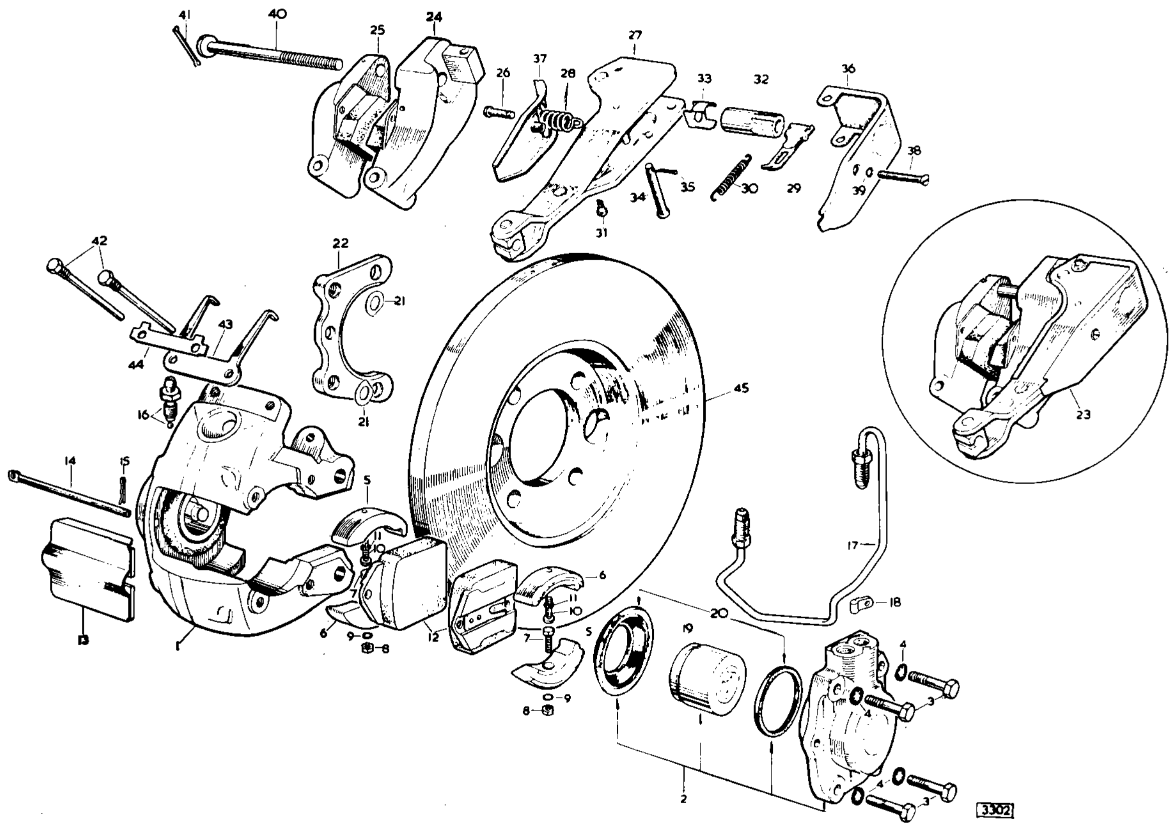


Fig.3. *Exploded view of a rear brake assembly.*

1. Caliper and piston assembly
2. Piston and cylinder assembly
3. Bolt
4. Shakeproof washer
5. Pad support R.H.
6. Pad support L.H.
7. Bolt
8. Nut
9. Shakeproof washer
10. Screw
11. Shakeproof washer
12. Friction pad kit
13. Stop plate
14. Pin
15. Clip
16. Bleed screw and ball
17. Bridge pipe
18. Clip
19. Piston
20. Seal Kit
21. Shim
22. Adaptor plate
23. Handbrake mechanism
24. Pad carrier R.H. inner
25. Pad carrier R.H. outer
26. Anchor pin
27. Operating lever
28. Return spring
29. Pawl assembly
30. Tension spring
31. Anchor pin
32. Adjusting nut
33. Friction spring
34. Hinge pin
35. Split pin
36. Protection cover (rear)
37. Protection cover (front)
38. Bolt
39. Shakeproof washer
40. Bolt
41. Split pin
42. Bolt
43. Retraction plate
44. Tab washer

ROUTINE MAINTENANCE

EVERY 3,000 MILES (5,000 KM.)

Brake Fluid Level

The two fluid reservoirs for the hydraulic brakes are attached to the engine bulkhead on the driver's side of the car.

At the recommended intervals check the level of the fluid in the reservoirs and top up if necessary to the level mark above the fixing strap marked "Fluid Level" using only the correct specification of brake fluid.

Do NOT overfill.

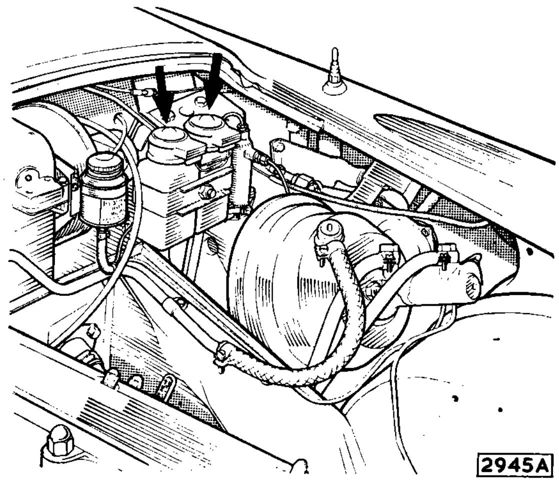


Fig.4. *Brake fluid reservoirs—left-hand drive*

Warning

When topping up the brake fluid reservoirs care must be taken to ensure that no fluid is spilled on the body of the car as this will damage the paint-work.

The level can be plainly seen through the plastic container.

Remove the plastic cap and disconnect the two electrical cables from the "snap-on" terminals. Unscrew the filler cap and top up if necessary to the recommended level. Insert the combined filler cap and float slowly into the reservoir to allow for displacement of fluid and screw down the cap. Wipe off any fluid from the top of the cap and connect the cables to either of the two terminals.

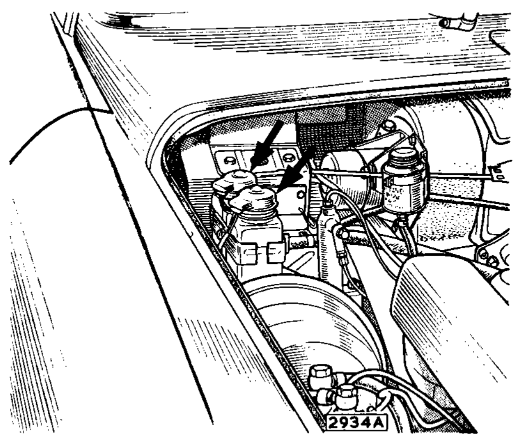


Fig.5. *Brake fluid reservoirs—right-hand drive*

Brake Fluid Level Warning Light

A warning light (marked "Brake Fluid—Hand-brake") situated on the facia behind the steering wheel, serves to indicate if the level in one or both of the brake fluid reservoirs has become low, provided the ignition is "on". As the warning light is also illuminated when the handbrake is applied, the handbrake must be fully released before it is assumed that the fluid level is low. If with the ignition "on" and the handbrake fully released the warning light is illuminated the brake fluid must be "topped-up" immediately.

As the warning light is illuminated when the handbrake is applied and the ignition is "on" a two-fold purpose is served. Firstly, to avoid the possibility of driving away with the handbrake applied. Secondly, as a check that the warning light bulb has not "blown"; if on first starting up the car with the handbrake fully applied, the warning light does not become illuminated the bulb should be changed immediately.

Note: If it is found that the fluid level falls rapidly indicating a leak from the system, the car should be taken immediately to the nearest Jaguar Dealer for examination.

Fig.6. *Brake fluid/Handbrake warning light.*

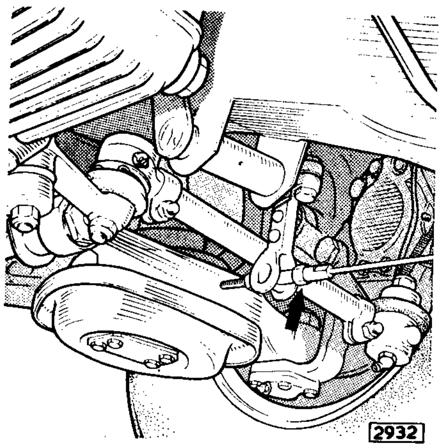


Fig.7. *Handbrake cable adjustment linkage.*

Footbrake Adjustment

Both the front wheel and rear wheel brakes are so designed that no manual adjustment to compensate for brake friction pad wear is necessary as this automatically takes place when the footbrake is applied.

Handbrakes

The self-adjusting handbrakes are attached to the rear brake caliper bodies but form an independent mechanically actuated system carrying its own friction pads. The handbrakes are self-adjusting to compensate for friction pad wear and automatically provide the necessary clearance between the brake discs and the friction pads.

Handbrake Cable Adjustment

The handbrake cable adjustment linkage (Fig.7) is situated to the rear of the front suspension assembly on the driver's side of the car.

Fully release the handbrake control in the car and slacken the locknut at the rear of the adjustment linkage. Ensure that levers at the calipers are in the "fully off" position by pressing toward the caliper and adjust the length of the cable to a point just short of where the caliper levers start to move; no attempt should be made to place the cable under tension otherwise the handbrake may bind.

EVERY 6,000 MILES (10,000 KM.)

Friction Pads—Examination for Wear

At the recommended intervals, or if a loss of braking efficiency is noticed, the brake friction pads (2 per brake) should be examined for wear; the ends of the pads can be easily observed through the apertures in the brake caliper. When the friction pads have worn down to a thickness of approximately $\frac{1}{4}''$ (7 mm.) they need renewing.

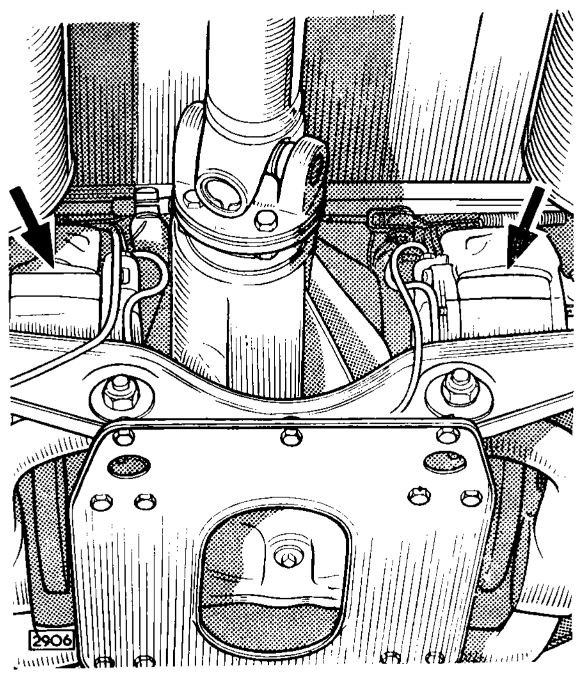


Fig.8. *The location of the rear brake calipers.*

Friction Pads—Renewal

To remove the friction pads, withdraw the spring clip and extract the pad retaining pin and stop plate.

Insert a hooked implement through the hole in the metal tag attached to the friction pad and withdraw the pad by pulling on the tag.

To enable the new friction pads to be fitted it will be necessary to force the pistons back into the cylinder blocks by means of a special tool. Before doing this, it is advisable to half empty the brake supply tank, otherwise forcing back the friction pads will eject fluid from the tank with possible damage to the paintwork.

When all the new friction pads have been fitted, top up the supply tank to the recommended level.

Insert the new friction pads into the caliper ensuring that the slot in the metal plate attached to each pad engages with the button in the centre of the piston.

Finally, refit the stop plate and secure with the retaining pin. Apply the footbrake a few times to operate the self-adjusting mechanism, so that normal travel of the pedal is obtained.

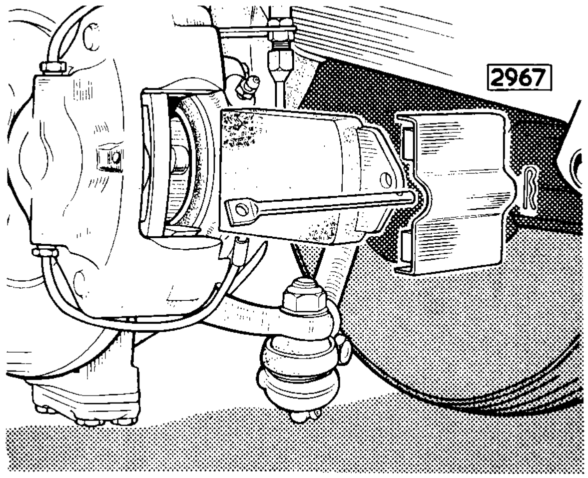


Fig.9. *Friction pad removal.*

RECOMMENDED BRAKE FLUIDS

Preferred Fluid:

Dunlop Disc Brake Fluid (SAE 70 R3).

Alternative Brake Fluids:

Recognised brands of brake fluid conforming to specification SAE 70 R3 such as:

Castrol Girling Crimson Brake Fluid.

Lockheed Super Heavy Duty Brake Fluid.

In the event of deterioration of the rubber seals and hoses due to the use of an incorrect fluid, all the seals and hoses must be replaced and the system thoroughly flushed and refilled with one of the above fluids.

BLEEDING THE BRAKE SYSTEM

"Bleeding" the brake hydraulic system (expelling the air) is not a routine maintenance operation and should only be necessary when a portion of the hydraulic system has been disconnected or if the level of the fluid has been allowed to fall. The presence of air in the hydraulic system will cause the brakes to feel ' spongy".

During the bleeding operation it is important that the level in the appropriate reservoir is kept topped up to avoid drawing air into the system.

(a) Check that all the connections are tightened and all bleed screws closed.

(b) Fill the appropriate reservoir with brake fluid of the correct specification.

(c) Attach the bleeder tube to the bleed screw on the left-hand rear brake and mmerse the open end of the tube in a small quantity of brake fluid contained in a clean glass jar. Slacken the bleed screw and operate the brake pedal slowly backwards and forwards through its full stroke until fluid pumped into the jar is reasonably free from air bubbles. Keep the pedal depressed and close the bleed screw. Release the pedal.

(d) Repeat for the right-hand rear brake. Repeat the operation for the front brakes.

(e) Repeat the complete bleeding sequence until the brake fluid pumped into the jar is completely free from bubbles.

(f) Lock all bleed screws and finally regulate the fluid level in the reservoir.

(g) Apply a normal working load on the brake pedal for a period of two or three minutes and examine the entire system for leaks.

Do not use the fluid which has been bled through the system to replenish the reservoir as it will have become aerated. Always use fresh fluid straight from the tin. Use only the recommended fluid.

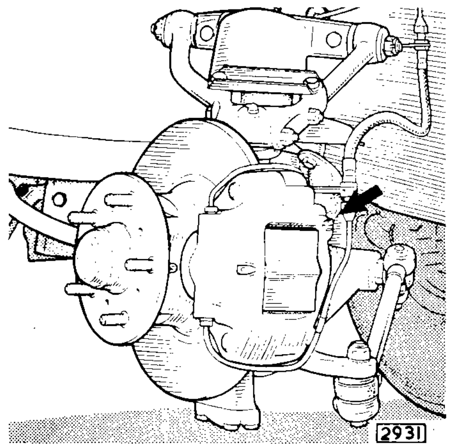


Fig.10. *The location of the brake bleed nipple.*

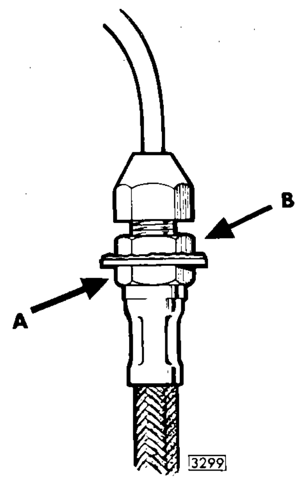


Fig.11. *Flexible hose connection. Hold hexagon "A" with a spanner when removing or refitting locknut "B".*

BRAKE OVERHAUL—PRECAUTIONS

The complete brake system is designed to require the minimum of attention providing the hydraulic fluid in the reservoir is not allowed to fall below the recommended level no defects should normally occur. Fluid loss must be supplemented by periodically topping up the reservoir with fluid of the same specification as that in the system.

The inclusion of air in a system of this type will be indicated by sluggish response of the brakes and spongy action of the brake pedal. This condition may be due to air induction at a loose joint or at a reservoir in which the fluid has been allowed to fall to a very low level. These defects must be immediately remedied and the complete system bled. Similarly, bleeding the system is equally essential following any servicing operation involving the disconnecting of part or whole of the hydraulic system.

The following instructions detail he procedure for renewal of component parts and for complete overhaul of the disc brakes, handbrakes and master cylinders. The units should be thoroughly cleaned externally before dismantling. Brake fluid should be used for cleaning internal components, and, except where otherwise stated in these notes, the use of petrol, paraffin or chemical grease solvents should be avoided as they may be detrimental to the rubber components. Throughout the dismantling and assembling operation it is essential that the work bench be maintained in a clean condition and that the components are not handled with dirty or greasy hands. The precision parts should be handled with extreme care and should be carefully placed away from tools or other equipment likely to cause damage. After cleaning, all components should be dried with lint-free rag.

When it is not the intention to renew the rubber components, they must be carefully examined for serviceability. There must be no evidence of defects such as perishing, excessive swelling, cutting or twisting, and where doubt exists comparison with new parts may prove to be of some assistance in making an assessment of their condition. The flexible pipes must show no signs of deterioration or damage and the bores should be cleaned with a jet of compressed air. No attempt should be made to clear blockage by probing as this may result in damage to the lining and serious restriction to fluid flow. Partially or totally blocked flexible pipes should always be renewed. When removing or refitting a flexible pipe, the end sleeve hexagon (A, Fig.11) should be held with the appropriate spanner to prevent the pipe from twisting. A twisted pipe will prove detrimental to efficient brake operation.

FLUSHING THE SYSTEM

If the fluid in the system becomes thick or "gummy" after long service or because the vehicle has been laid up for some time, the system should be drained off, flushed and refitted. This should be carried out at least once every three years. The system should also be flushed if it has become contaminated by the use of an unsuitable fluid.

Start the engine and permit to idle.

Pump all fluid out of the system through the bleeder screw on each of the disc brake calipers in turn.

Connect one end of a rubber tube to the bleeder screw, insert the other end into a container; slacken the bleeder screw one complete turn and pump the brake pedal by depressing it quickly and permitting it to return without assistance. Repeat, with a pause between each operation, until no more fluid can be expelled. Discard all fluid extracted from the system.

Fill the master cylinder fluid supply tanks with industrial methylated spirits and flush the system. Continue flushing with methylated spirits until at least one quart has been passed through each disc brake caliper.

Before refilling the system with Heavy Duty Brake Fluid ensure that all the methylated spirit has been bled off.

Note: If the system has become contaminated by the use of mineral oil, the above process may not prove effective, In such cases it is recommended that the various hydraulic units, including the pipe line, be dismantled and thoroughly cleaned. All rubber parts, including flexible hose, should be renewed and the contaminated fluid destroyed immediately.

THE BRAKE PEDAL SHAFT HOUSING

REMOVAL

Remove the servo vacuum pipe from the manifold assembly on the servo.

Disconnect the fluid inlet and outlet pipes from the master cylinder. Plug the pipe ends.

Pull back the trim under the pedal box in the car.

Remove the four nuts and shakeproof washers from the studs in the base of the pedal shaft housing.

Remove the brake pedal pad.

Withdraw the servo and pedal shaft housing assemblies.

REFITTING

Refitting is the reverse of the removal procedure.

THE VACUUM CONCENTRIC BOOSTER

DESCRIPTION

The vacuum concentric booster complete with the master cylinder assembly is mounted within the engine compartment and it is connected to the pedal linkage by the actuating push rod.

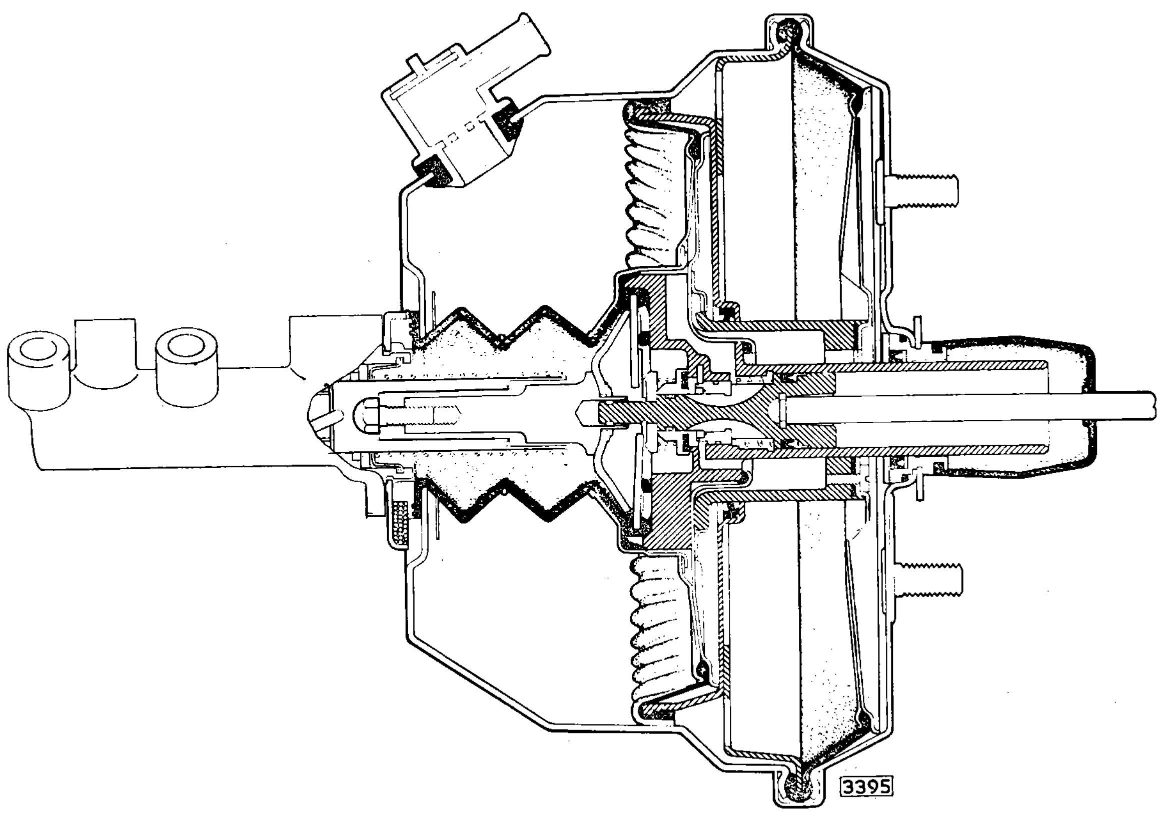


Fig.12. *The vacuum concentric booster complete with master cylinder.*

The booster unit consists, basically, of a pair of diaphragm assemblies linked together by a plastic sleeve; an actuating valve assembly and a rubber bellows, all of which are housed within pressed steel covers. The bellows assembly forms the atmospheric chamber which is protected by a filter assembly.

A manifold assembly, mounted in a rubber grommet in the front cover, is connected to a source of vacuum by means of a rubber hose.

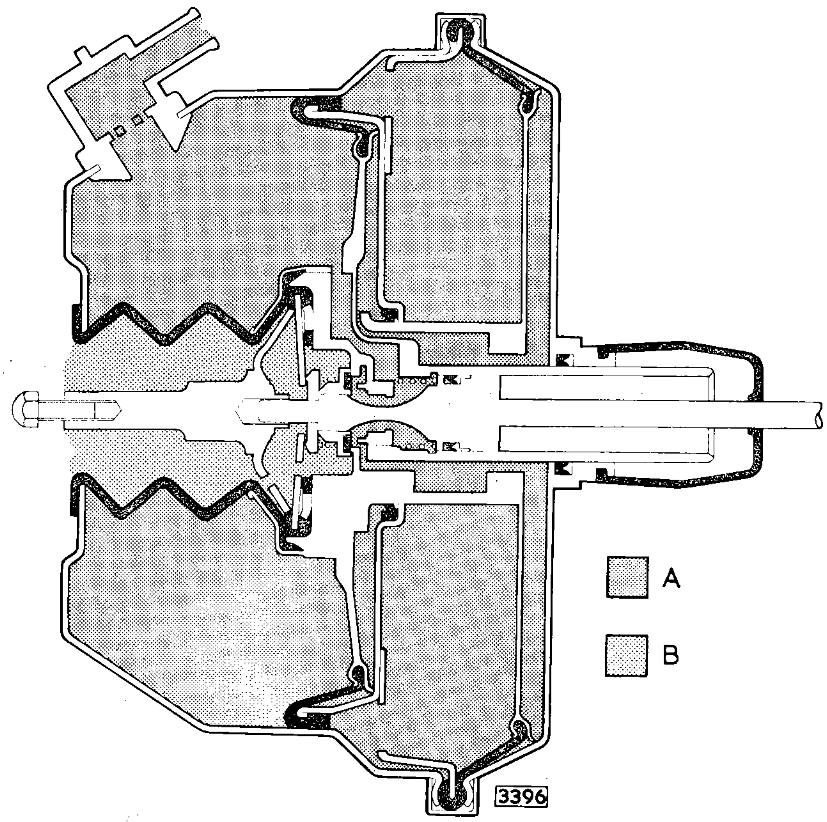


Fig.13. *Released position*
A—vacuum, B—atmospheric pressure.

OPERATION

Released Position

With the engine running and no load applied on the brake pedal, the vacuum port is in the open position and the booster unit is in complete vacuum suspension with vacuum present, equally, on both sides of the diaphragm assemblies.

Brake Application

When the brake pedal is depressed, the push rod moves the valve plunger forward.

The initial movement of the plunger closes the vacuum port and prevents further evacuation of the chambers at the rear of the diaphragm assemblies. Further movement of the actuating

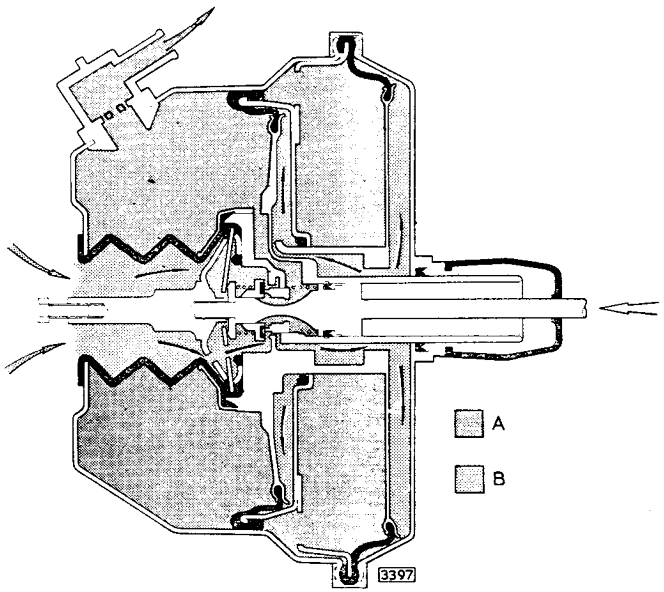


Fig.14. *Brake application.*
A—vacuum, B—atmospheric pressure.

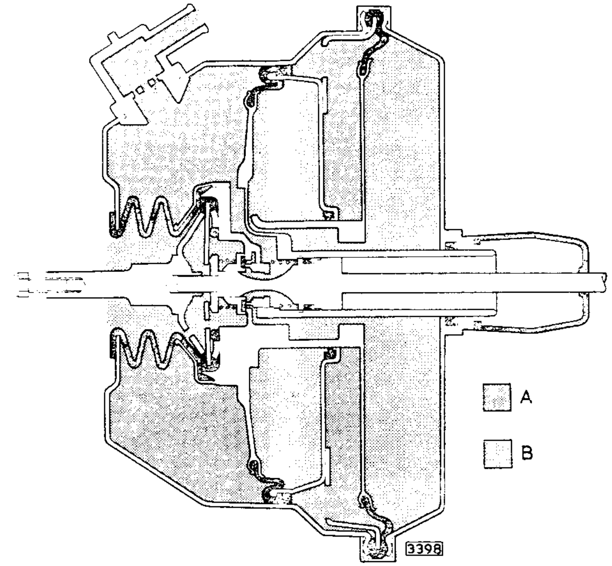


Fig.15. *Holding position.*
A—vacuum, B—atmospheric pressure.

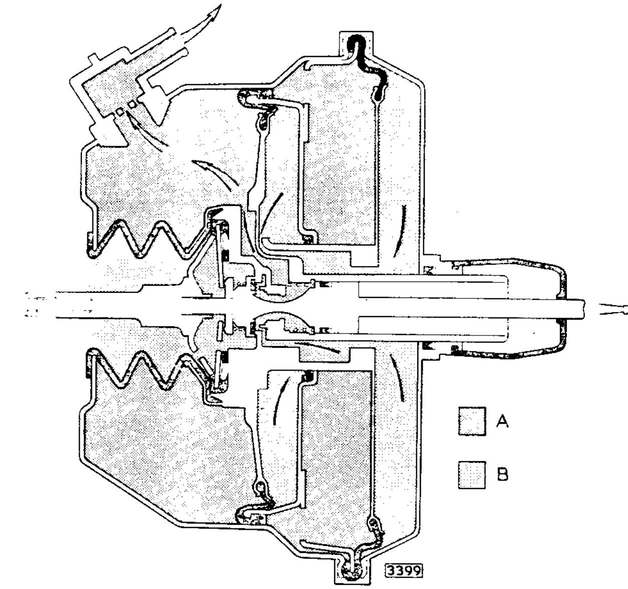


Fig.16. *Releasing position.*
A—vacuum, B—atmospheric pressure.

plunger opens the atmospheric valve and permits atmospheric pressure to enter the chambers at the rear of the diaphragm assemblies.

Vacuum on the front side and atmospheric pressure on the rear side of the diaphragm developes a force to close the recuperating ports and to force fluid under pressure to the wheel cylinders.

As hydraulic pressure is developed a reaction counter force acts against a lever and ring assembly, designed to transmit the reaction force back through the actuating control assembly to the brake pedal thus providing the operator with a resistance proportional to the hydraulic pressure applied.

Holding Position

When the forward movement of the brake pedal stops, the push rod prevents further movement of the actuating plunger. The unbalanced forces of atmospheric pressure on the rear and vacuum on the front of the diaphragm assemblies will continue to move the diaphragm assemblies forward to close the atmospheric port.

The vacuum port remains closed thus the power-assist force acting on the master cylinder piston will stabilise and the hydraulic forces applying the brakes will be maintained at a constant level.

Releasing Position

As the brake pedal load is released by the operator, the plunger return spring moves the actuating plunger rearwards opening the vacuum port to allow evacuation of atmosphere from the chambers at the back of the diaphragms. Servo assistance is eliminated and the retraction device in the brake assemblies together with the master cylinder return springs restore the complete unit to the released position.

BRAKE APPLICATION WITH NO VACUUM

Manual braking can be achieved if the vacuum system fails. In this condition the push rod and actuating plunger move forward until the shoulder at the rear of the plunger contacts the neck of the hub to form a continuous column with the output rod thereby applying the brakes.

REMOVAL

Drain the fluid reservoirs and remove the clips from the low pressure hoses on the master cylinder.

Disconnect the hydraulic pipe assemblies from the front and rear unions on the master cylinder.

Remove the trim adjacent o the brake pedal housing.

Remove the four nuts, together with the shake-proof washers, from the studs securing the brake pedal housing to the dash.

Remove the servo unit and pedal housing.

DISMANTLING AND REASSEMBLY

If the master cylinder is removed from the servo unit for any reason, the dome headed screw projecting from the front end of the push rod in the servo unit must be set to provide 0·010–0·015" (0·25–0·38 mm.) clearance with the master cylinder piston. (Churchill Tool No. J.26.)

BRAKES

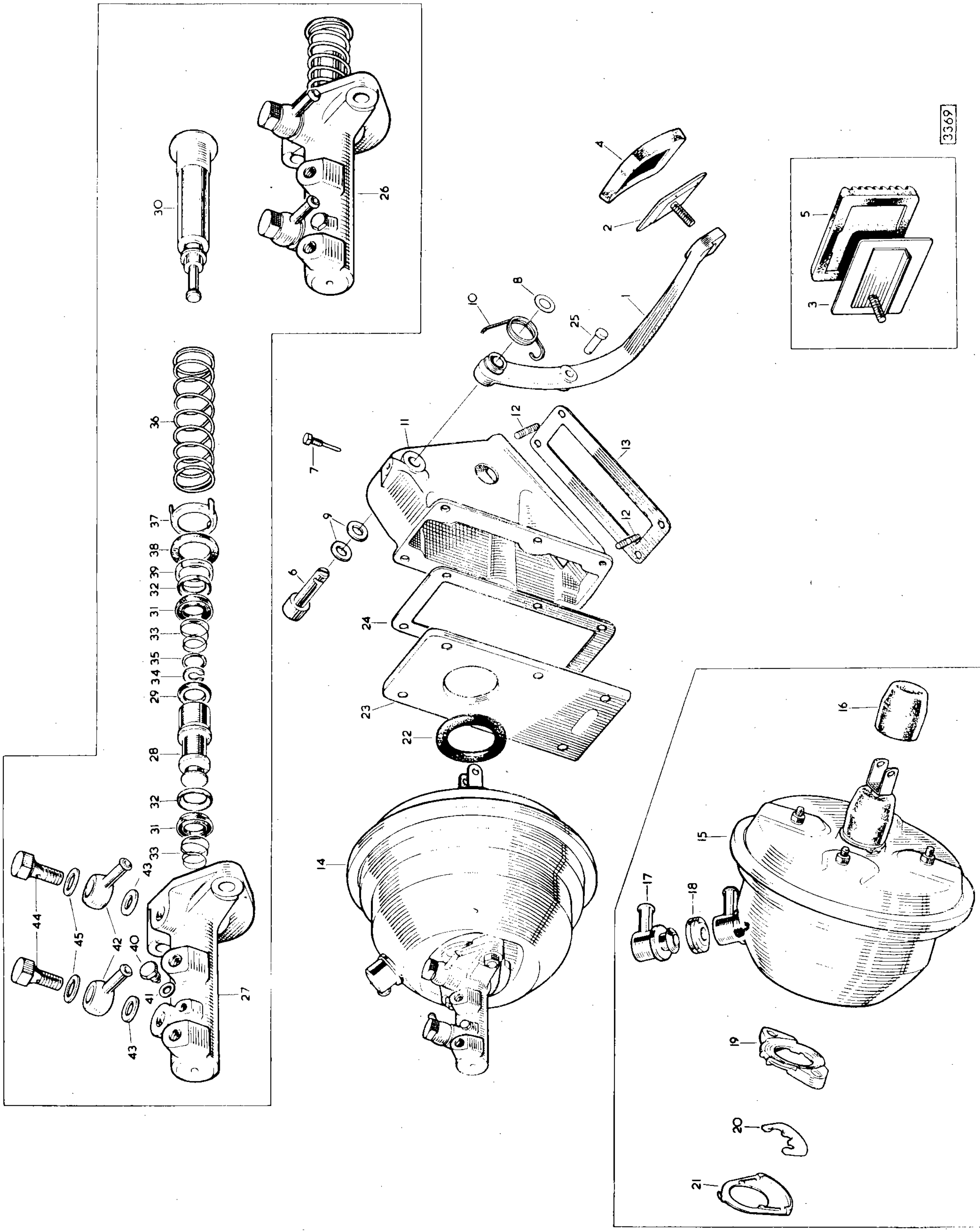

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Fig.17. *Exploded view of booster, master cylinder and pedal shaft housing.*

1. Brake pedal
2. Steel pad (overdrive)
3. Steel pad (automatic transmission)
4. Rubber pad (overdrive)
5. Rubber pad (automatic transmission)
6. Shaft
7. Locking pin
8. Fibre washer (thin)
9. Fibre washer (thick)
10. Return spring
11. Pedal shaft housing
12. Stud
13. Gasket
14. Brake servo unit and master cylinder
15. Brake servo unit
16. Boot
17. Manifold assembly
18. Grommet
19. Filter retainer
20. Filter
21. Filter cover
22. Sealing ring
23. Sealing plate
24. Gasket
25. Clevis pin
26. Brake master cylinder
27. Body
28. Rear piston
29. Static seal
30. Front piston
31. Cup seal
32. Seat
33. Recuperating spring
34. Retainer
35. Circlip
36. Return spring
37. Seat
38. Seal
39. Bearing ring
40. Stop peg
41. Gasket
42. Banjo
43. Gasket
44. Bolt
45. Gasket

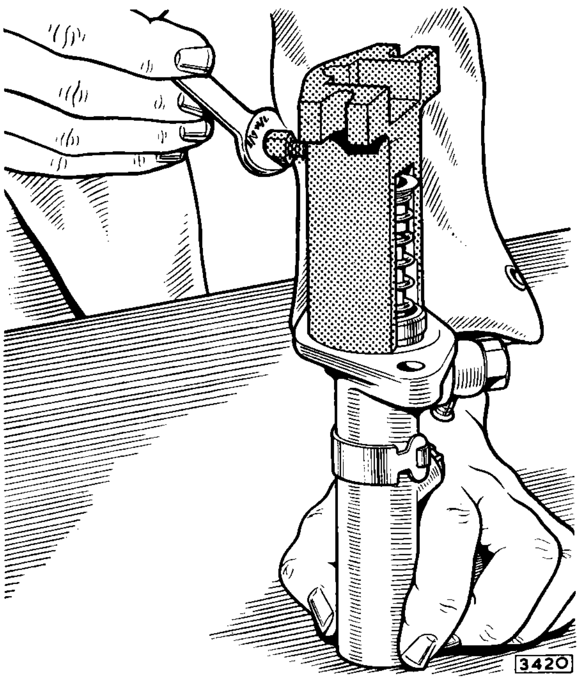

Fig.18. *Depth setting the special tool, Tool No. J.26, on the master cylinder.*

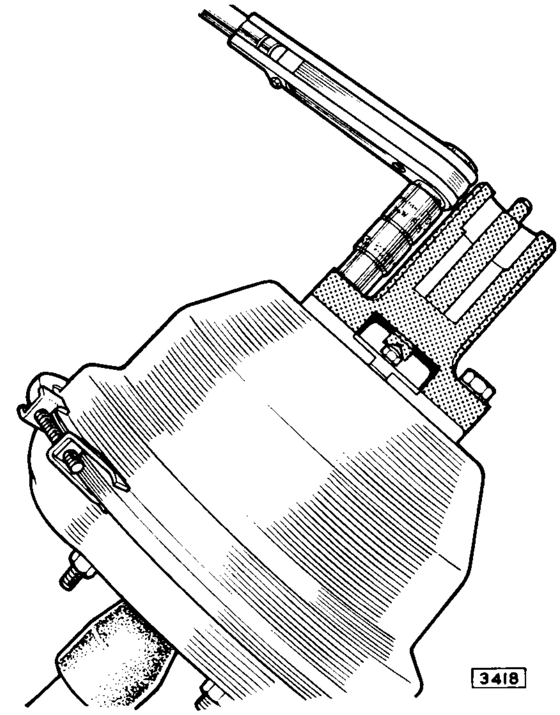

Fig.19. *Setting the clearance before refitting the master cylinder using special tool, Tool No. J.26.*

THE MASTER CYLINDER

REMOVAL (Fig.17)

Bleed the system as detailed on Page L.11.

Remove the low pressure and high pressure connections from the master cylinder.

Remove the two nuts and shakeproof washers securing the master cylinder to the servo and withdraw the master cylinder.

Unscrew and remove the stop peg (40 Fig.17) from the master cylinder body.

The outer and inner pistons together with the springs and seals can now be removed. To dismantle proceed as follows:—

(a) Remove the stop peg (40)

(b) Release the three lugs on the spring seat (37) and withdraw the front and rear piston assemblies which are locked together.

To separate the pistons, compress the spring (36) and remove the circlip (35) thus freeing the front piston. There is a hole drilled in the rear piston providing access to the circlip.

REFITTING

Refitting is the reverse of the removal procedure Churchill Tool Part No. J.29 is used to compress the return spring as shown in Fig.20.

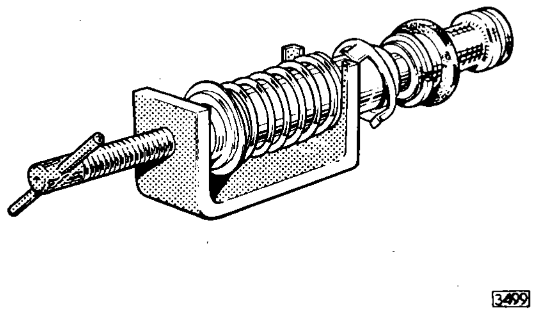

Fig.20. *Re-assembling the master cylinder using Tool Part No. J.29*

FRONT CALIPERS
(Fig.2)

REMOVAL

In order to remove a front caliper, jack up the car and remove the road wheel. Disconnect the fluid feed pipe and plug the hole in the caliper.

Discard the locking wire from the mounting bolts. Remove the caliper, noting the number of shims fitted.

REFITTING

Locate the caliper body, complete with the cylinder assemblies, in position and secure with two bolts.

Check the gap between each side of the caliper and the disc, both at the top and bottom of the caliper.

The difference should not exceed 0·010″ (0·25 mm.) and round shims may be fitted between the caliper and the mounting plate to centralise the caliper body. Lockwire the mounting bolts.

If not already fitted, fit the bridge pipe connecting the two cylinder assemblies. Connect the supply pipe to the cylinder body and ensure that it is correctly secured.

Bleed the brakes as described on page L.11.

REAR CALIPERS
(Fig. 3)

REMOVAL

The rear suspension unit must be removed in order to withdraw the rear calipers (see Section K "Rear Suspension"). Support the suspension unit under its centre.

Withdraw the split pin, remove the clevis pin joining the handbrake inner cable to the operating lever at the caliper and withdraw the outer cable from the trunnion on the other level.

Remove the operating lever return springs at each caliper.

Remove the hydraulic feed pipe at the caliper and plug the hole to prevent the ingress of dirt.

Remove the front hydraulic damper and road spring unit (as described in Section K.) and remove the four self-locking nuts from the halfshaft inner universal joint.

Withdraw the joint from the bolts and allow the hub carrier to move outwards. Support the carrier in this position.

Note the number of camber shims between the universal joint flange and the brake disc.

Knock back the locking tabs (44) and remove bolts (42) securing the pad carriers (24 and 25) to the caliper (1) and the retraction plate (43). Withdraw the pad carriers (24 and 25) from the aperture at the rear of the cross member.

Remove the stop assembly (13) from the caliper and, using a hooked implement, withdraw both brake pads.

Rotate the disc until the holes in the disc line up with the caliper mounting bolts.

Knock back the locking tabs and remove the mounting bolts.

Note the number of small circular shims fitted to the caliper mounting bolts between the caliper and the axle casing.

Remove the caliper.

REFITTING

Refitting is the reverse of the removal procedure.

The correct number of camber shims should be fitted.

When the halfshaft has been refitted check the caliper for centralisation as described in refitting the front calipers.

Fit the fluid supply pipe and the bridge pipe.

Bleed the braking system.

THE FRONT BRAKE DISCS

REMOVAL

Jack up the car and remove the road wheel. Disconnect the flexible hydraulic pipe from the frame connection and plug the connector to prevent ingress of dirt and loss of fluid.

Discard the locking wire and remove the two caliper mounting bolts noting the number of round shims fitted between the caliper and the mounting plate.

Remove the caliper.

Remove the hub (as described in Section J).

Remove the five setscrews and spring washers securing the disc to the hub and remove the disc.

REFITTING

Refitting is the reverse of the removal procedure. The hub bearing endfloat should be set (see Section J) and the caliper fitted and centralised as described previously (page L.18).

Reconnect the brakes and bleed the braking system.

THE REAR BRAKE DISCS

REMOVAL (Fig.3)

Remove the rear suspension unit (see Section K).

Invert the suspension and remove the two hydraulic damper units together with the road springs.

Remove the four steel type self-locking nuts securing the halfshaft inner universal joint and brake disc to the axle output shaft flange.

Withdraw the halfshaft from the bolts, noting the number of camber shims between the universal joint and the brake disc.

Remove the handbrake operating lever return spring at each caliper.

Knock back the locking tabs (44) and remove the bolts (42) securing the pad carriers (24 and 25) to the caliper and piston assembly (1) and the retraction plate (43). Withdraw the pad carriers from the aperture at the rear of the cross member.

Remove the stop assembly (13) from the caliper and, using a hooked implement, withdraw both brake pads.

Disconnect the brake fluid feed pipe at the caliper.

Unscrew the mounting bolts through the access holes in the brake disc.

Withdraw the bolts, noting the number and position of the caliper centralising shims.

Withdraw the caliper through the aperture at the front of the cross member.

Tap the halfshaft universal joint and brake disc securing bolts back as far as possible.

Lift the lower wishbone, hub carrier and halfshaft assembly upwards until the brake disc can be withdrawn from the mounting bolts.

REFITTING

Refitting the brake discs is the reverse of the removal procedure. The secur ng bolts must be knocked back against the drive shaft flange when the new disc has been fitted.

Care mus be taken to refit the caliper centralising shims in the same position. The centralization of the caliper should be checked (as described in "Refitting the Calipers") when the halfshaft has been refitted.

Refit the rear suspension (as described in Section K "Rear Suspension").

Bleed the brakes as described on page L.11

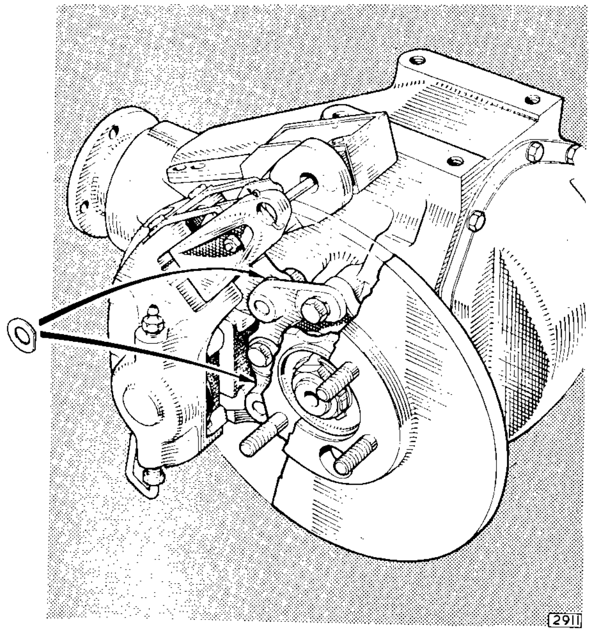

Fig.21. *Disc brake caliper adjustment shims.*

BRAKE DISC "RUN-OUT"

Check the brake discs for "run-out" by clamping a dial test indicator to the stub axle carrier for the front discs and the cross member for the rear discs. Clamp the indicator so that the button bears on the face of the disc. "Run-out" should not exceed 0·006″ (0·15 mm.) gauge reading. Manufacturing tolerances on the disc should maintain this truth and in the event of "run-out" exceeding this value, the components should be examined for damage.

Note: It is most important that the endfloat of the front hubs and the rear axle ou put shafts is within the stated limits otherwise the brakes may not function correctly.

The front hub endfloat adjustment is described in Section J ' Front Suspension." The endfloat adjustment of the rear axle output shafts is described in Section H "Rear Axle."

RENEWING THE FRICTION PADS

Brake adjustment is automatic during the wearing life of the pads. The pads should be checked for wear every 6,000 miles (10,000 km.) by visual observation and measurement; when wear has reduced the pads to the minimum permissible thickness of $\frac{1}{4}''$ (7 mm.) the pad assemblies (complete with securing plates) must be renewed. If checking is neglected the need to renew the pads will be indicated by a loss of brake efficiency. The friction pads have been selected as result of intensive development, and it is essential at all times to use only factory approved material.

To fit the new friction pad assemblies proceed as follows:—

(a) Remove the nut, washer and bolt securing the keep plate and withdraw the plate.

(b) With a suitable hooked implement engaged in the hole in the lug of the securing plate withdraw the defective pad assemblies

(c) Thoroughly clean the backing plate, dust seal and the surrounding area of the caliper.

(d) With the aid of the special tool (Part No. 10416), press in the piston assemblies to the base of the cylinder bores as shown in Fig.22.

Note: Before doing this, it is advisable to half empty the brake supply tank, otherwise forcing back the friction pads will eject fluid from tl e tank with possible damage to the paintwork. When all the new friction pads have been fitted, top up the supply tank to the recommended level.

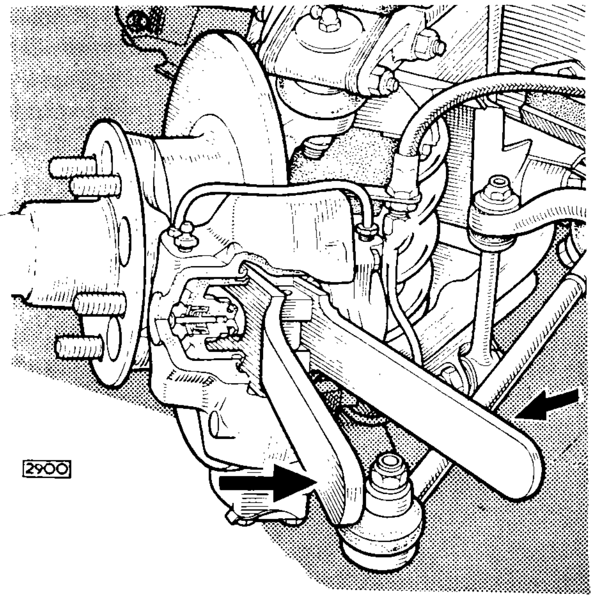

Fig.22. *Resetting the pistons with the special tool, Part No. 10416.*

Insert the forked end of the piston resetting lever into the space between the caliper bridge and one of the piston backing plates, with the fork astride the projec ing piston spigot and its convex face bearing on the piston backing plate. Locate the spigot end of the lever pin in the keep plate bolt hole in the bridge. Pivot the lever about the pin to force the piston to the base of its cylinder.

Insert the new friction pad assembly.

Replace the keep plate and secure it with the pad retaining pin.

RENEWING THE BRAKE PISTON SEALS

Remove the caliper.

Withdraw the brake pads as described under "Renewing the Friction Pads."

Disconnect and blank off the supply pipe and remove the bridge pipe.

Remove the bolts securing the cylinder blocks to the caliper and withdraw the cylinder blocks. Thoroughly clean the blocks externally before proceeding with further dismantling.

Disengage the dust seal from the groove around the cylinder block face.

Connect the cylinder block to a source of fluid supply and apply pressure to eject the piston assembly.

Using a blunt screwdriver carefully push out and remove the piston seal and the dust seal. It is impossible to strip the piston down further.

Check that the piston and cylinder bore are thoroughly clean and show no signs of damage.

When replacing the piston and dust seals, first lightly lubricate with brake fluid, hen place on the piston using the fingers only. Locate the retractor pin in the retractor bush in the piston, then with even pressure press the piston assembly into the cylinder bore. During this operation ensure the piston assembly is in correct alignment in relation to the cylinder bore and that the piston seal does not become twisted or trapped as it enters. Engage the outer rim of the dust seal in the groove around the cylinder block face. Ensure that the two support plates are in position.

Reassemble the cylinder blocks to the caliper.

Fit the bridge pipes, ensuring that they are correctly positioned. Connect the supply pipe and bleed the hydraulic system (as described on page L.11.)

THE HANDBRAKE

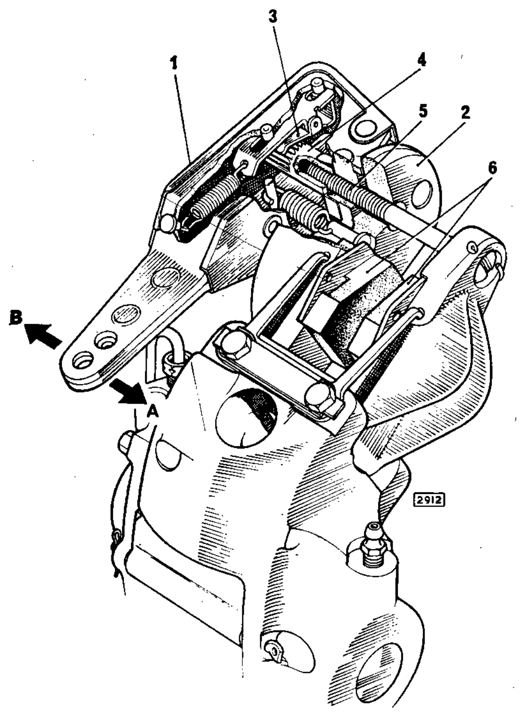

Fig.23. *Cutaway view of the handbrake mechanism.*

OPERATION (Fig.23)

The self-adjusting handbrakes are attached to the rear brake caliper bodies but form an independent mechanically actuated system carrying its own friction pads. The hand brakes are self-adjusting to compensate for friction pad wear and automatically provide the necessary clearance between the brake discs and the friction pads.

When the handbrake lever in the car is operated, the operating lever (1) is moved away from friction pad carrier (2) and draws the friction pads (6) together. Under normal conditions, when the lever is released the pawl (3) in the adjusting mechanism returns to its normal position, thus the normal running clearance between the brake disc and the friction pads is maintained.

In the event of there being increased clearance, the pawl will turn the ratchet nut (4) on the bolt thread drawing the adjuster bolt (5) inwards and bringing the friction pads closer to the brake disc until the normal running clearance is restored.

FRICTION PAD CARRIERS—REMOVAL

With the car on a ramp, disconnect the handbrake cable from the operating levers on the handbrake mechanisms as follows:—

(a) Remove the split pin, withdraw the clevis pin and disconnect the fork end on one lever and withdraw the outer cable from the trunnion of the other lever.

(b) Lift the locking tabs and remove the pivot bolts and retraction plate. Remove the friction pad carriers by moving them rearwards around the disc and withdrawing from the rear of the rear suspension assembly. Repeat for the second handbrake.

DISMANTLING

Remove the cover securing bolt, discard the split pin and withdraw he pivot clevis pin. Remove the dust cover and remove the split pin from the screw-driver slot in the adjusting bolt. Unscrew the adjusting bolt from the ratchet nut and withdraw the nut and pawl over the locating dowel. Detach the operating lever return spring and remove the operating lever and lower cover plate.

ASSEMBLING

Assembly is the reverse of the dismantling procedure.

FRICTION PAD CARRIERS—REFITTING

Refitting is the reverse of the removal procedure but the handbrake should be set as follows:—

(a) Ensure that the handbrake pivot bolts are slack.

(b) Remove the split pin from the head of the adjuster bolt and slacken the bolt until there is approximately $\frac{1}{4}''$ (6.34 mm.) free movement between the head and outer pad carrier.

(c) Pull the inner and outer pad carriers away from the disc bending the brass retraction fingers until there is $\frac{1}{16}''$ (1·6 mm.) clearance between each pad and the disc.

(d) Take up the free movement at the adjuster bolt by tightening until the bolthead is in light contact with the outer pad carrier seating.

(e) Fit a new split pin to lock adjuster bolt.

(f) Pull and release the handbrake lever repeatedly until the ratchet ceases to operate, which will indicate that the correct adjustment has been obtained.

With the handbrake applied reasonably hard, tighten the pivot bolts and secure with the tab washer.

Note: It is ESSENTIAL that the brass retraction fingers are in good condition, i.e. not badly distorted. The ends which fit into the pad carriers must be inserted fully into the holes to avoid the possibility of twisting the fingers.

Reconnect the handbrake compensator linkage to the operating levers and check the cable adjustment.

HANDBRAKE CABLE ADJUSTMENT

The handbrake cable adjustment linkage (Fig.7) is situated to the rear of the front suspension assembly on the driver's side of the car.

Fully release he handbrake control in the car and slacken the locknut at the rear of the adjustment linkage. Ensure that levers at the calipers are in the "fully off" position by pressing toward the caliper and adjust the length of the cable to a point just short of where the caliper levers start to move; no attempt should be made to place the cable under tension otherwise the handbrake may bind.

HANDBRAKE FRICTION PADS—RENEWING

With the friction pad carriers removed, withdraw the old pads by slackening the nuts in the outer face of each pad securing plate. Fit new pads, short face upwards, ensuring that each pad locates the head of the retaining bolt. Fit new retraction fingers and assemble the carrier to the main calipers, leaving the pivot bolts slack.

Pull and release the handbrake lever repeatedly until the ratchet ceases to operate, which will indicate that the correct adjustment has been obtained.

With the handbrake applied reasonably hard, tighten the pivot bolts and secure the tab washer.

Note: It is recommended that new retraction fingers are fitted when replacing the handbrake pads, but they should on no account be bent to suit the calipers.

Reconnect the handbrake compensator linkage to the operating levers and check the handbrake cable adjustment.

HANDBRAKE CABLE—REMOVAL (Fig.24)

From under the car, remove the rear end of the handbrake cable from the operating levers on the handbrake mechanism as follows. Remove the split pin, withdraw the clevis pin (29) and disconnect the fork end at one operating lever and withdraw the outer cable end from the trunnion on the other lever.

Remove the pinch bolt and withdraw the forward end of the outer cable from the trunnion adjacent to the rear suspension radius arm mounting post. Remove the two small bolts and self-locking nuts securing the top half of the nylon intermediate cable guides (27). Disconnect the front end of the cable from the cross shaft linkage on the chassis side member, adjacent to the rear of the front road wheel by removing the front brass nut.

Withdraw the main handbrake cable.

Refitting

Refitting is the reverse of the removal procedure and the cable should be adjusted as described previously.

HANDBRAKE CONTROL—REMOVAL

Remove the split pin and withdraw the clevis pin securing the primary cable fork end to the cross shaft lever, noting the three spacing washers. Remove the fork end from the cable by means of the slotted hole.

Pull back the carpet and felt on the side of the transmission tunnel at the upper end of the handbrake control. Remove the two setscrews securing the handbrake control to the transmission

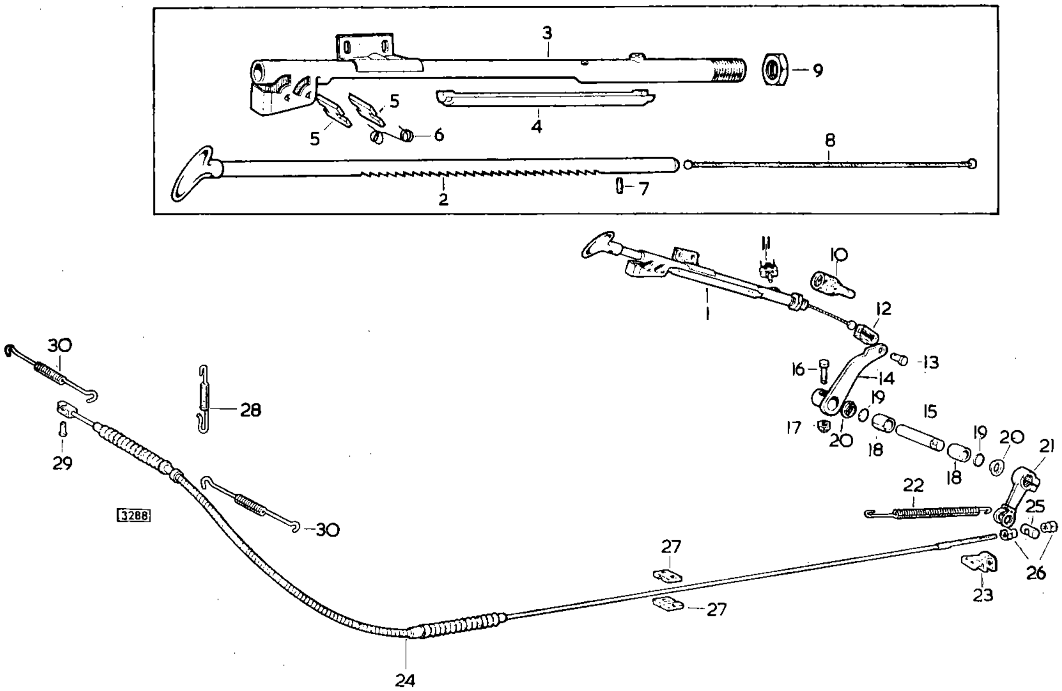

Fig. 24. *The handbrake control components.*

1. Handbrake assembly
2. Handle and rod
3. Handbrake housing
4. Protective sleeve
5. Pawl
6. Spring
7. Guide pin
8. Handbrake primary cable
9. Nut
10. Rubber sleeve
11. Warning light switch
12. Fork end
13. Clevis pin
14. Intermediate lever
15. Shaft
16. Bolt
17. Self-locking nut
18. Bush
19. Rubber seal
20. Seal retainer
21. Handbrake lever
22. Return spring
23. Handbrake cable abutment bracket
24. Handbrake main cable
25. Trunnion
26. Adjusting nut
27. Guide (nylon)
28. Spring
29. Clevis pin
30. Return spring

tunnel adjacent to the rear of the heater outlet.

Pull back the carpets at the lower end of the handbrake control and slacken the nut on the control. Remove the nut in the engine compartment securing the lower end of the handbrake control. Remove the two cables from the handbrake warning light switch and withdraw the handbrake control and primary cable from inside the car.

Refitting

Refitting is the reverse of the removal procedure.

THE BRAKE FLUID LEVEL AND HANDBRAKE WARNING LIGHT

DESCRIPTION

The brake fluid level and handbrake warning light, situated in the side facia panel, will indicate after the ignition has been switched on whether the brake fluid in the reservoir is at a low level or the handbrake has not reached the fully off position. This is effected by three switches, one in the top of each of the fluid reservoirs and a third on the handbrake control, being in circuit with a single warning lamp which is included in the ignition circuit.

When the ignition is switched on and while the handbrake remains applied, the warning light will glow but will become extinguished when the handbrake is fully released with the brake fluid in the reservoir at a high level.

Should the warning light continue to glow after the handbrake has been fully released, it indicates that the brake fluid in the reservoir is at a very low level and the cause must be immediately determined and eliminated. Should the brake fluid be at a high level, the cause of the handbrake remaining on must be investigated.

HANDBRAKE WARNING LIGHT SWITCH—SETTING

The handbrake warning light switch is situated at the lower end of the handbrake control. When the handbrake is fully released, the plunger of the switch is depressed and the handbrake warning light is extinguished.

Should it be necessary to reset the handbrake warning light switch proceed as follows:—

(a) Remove the handbrake control and primary cable (as described in "Handbrake Control—Removal").

(b) Slacken off the lock-nut and unscrew the warning light switch. Ensure that the handbrake control is in the "fully off" position and screw the switch fully in. Unscrew the switch half a turn and line up with the handbrake tube, tighten the locknut and refit the handbrake control.

THE VACUUM RESERVOIR AND CHECK VALVE

DESCRIPTION

The vacuum reservoir is incorporated in the vacuum system between the inlet manifold and the vacuum servo unit. It is located in the right-hand wing adjacent to the bulkhead. Its purpose is to provide a reserve of vacuum in the event of braking being required when the engine has stalled. For this purpose a vacuum check valve in the form of a tee-piece is fitted in the pipe system. Included in the inlet port of the check valve is a rubber spring loaded valve. When there is a depression in the inlet manifold the valve is drawn off its seat against the spring loading thus the interior of the reservoir becomes equal to that of the inlet manifold, the valve spring will then return the valve to its seat thus maintaining the highest possible degree of vacuum in the reservoir.

REMOVAL

To remove the vacuum reservoir on left-hand drive cars, it will be necessary to unscrew the two butterfly nuts securing battery clamp, remove the clamp and withdraw the battery.

Slacken the clip securing the vacuum hose to the reservoir and disconnect the hose. Remove the three nuts and bolts securing the reservoir to the wing and withdraw the reservoir.

To remove the vacuum reservoir on right-hand drive cars, it will be necessary to remove the brake vacuum servo and pedal box assembly (as described on page L.13).

REFITTING

Refitting is the reverse of the removal procedure.

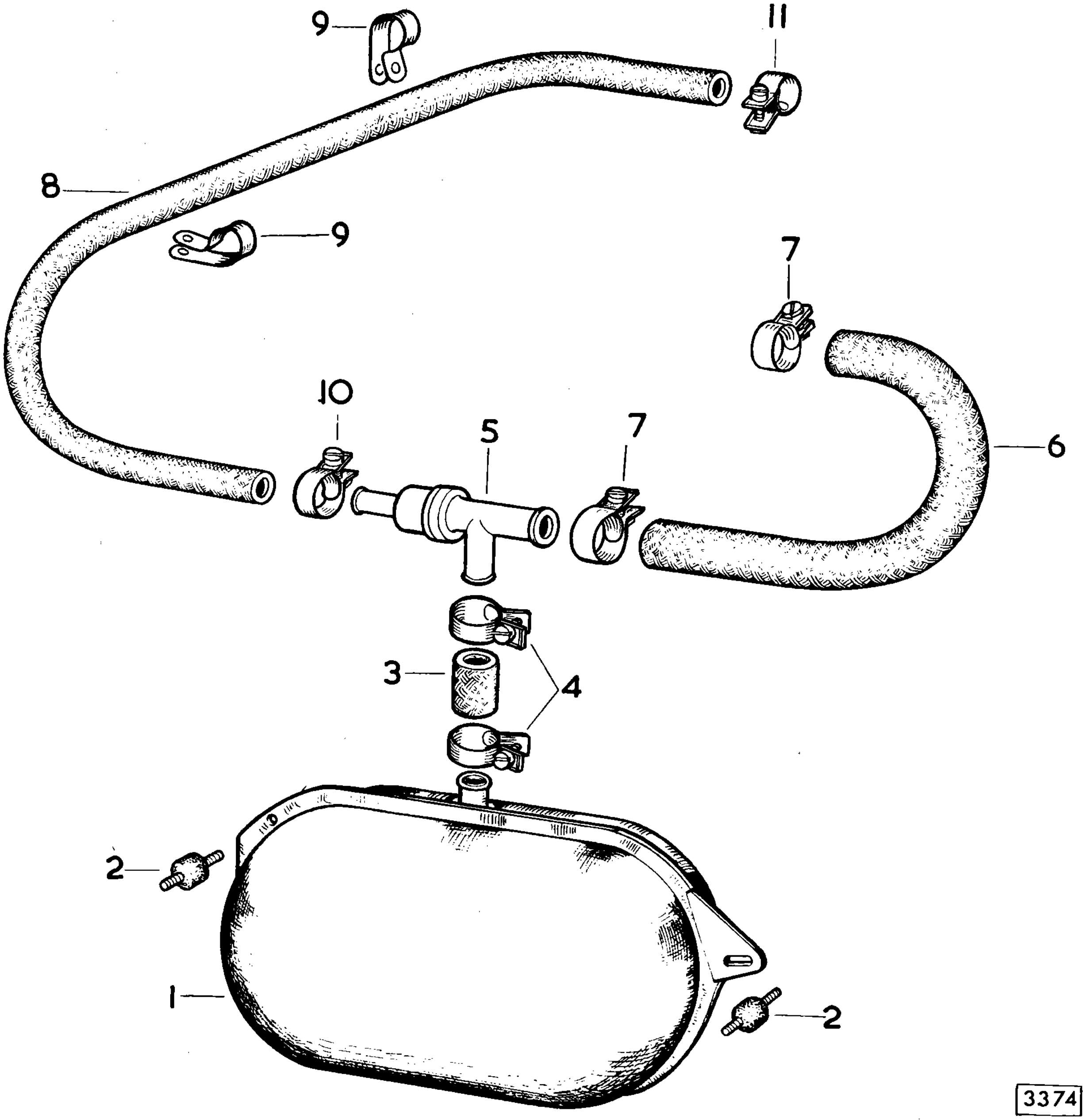

Fig. 25. *The vacuum reservoir and check valve (R.H. drive).*

1. Reservac tank
2. Rubber mounting
3. Hose
4. Clip
5. Check valve
6. Hose
7. Clip
8. Hose
9. Clip
10. Clip
11. Clip

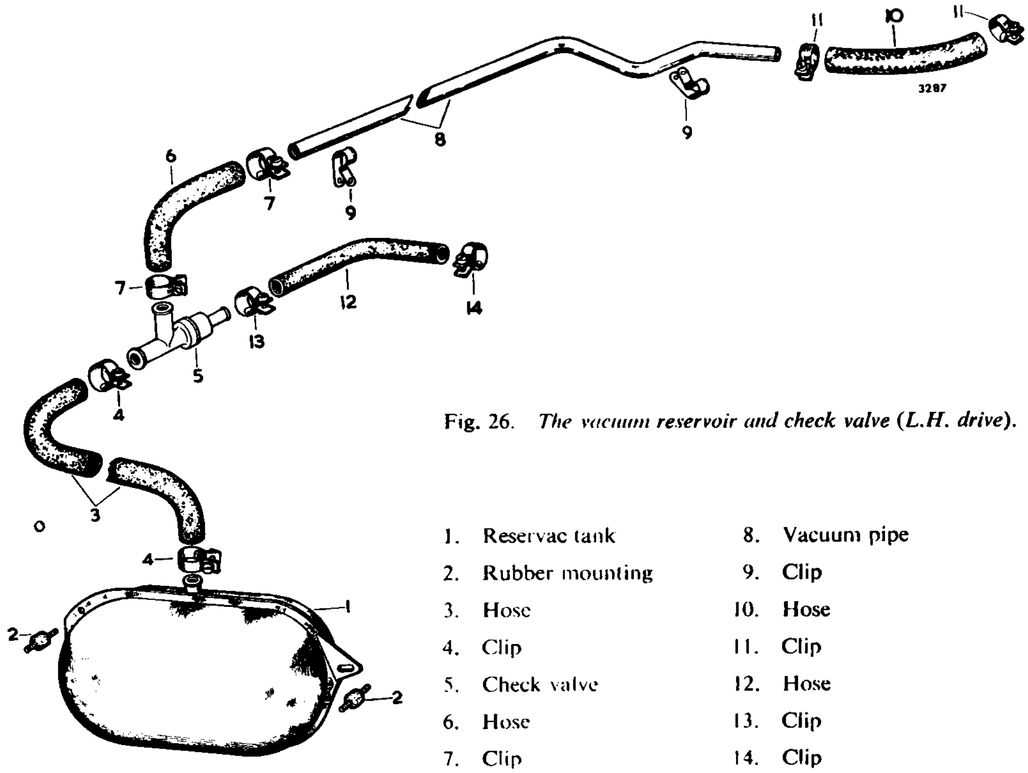

Fig. 26. *The vacuum reservoir and check valve (L.H. drive).*

1. Reservac tank
2. Rubber mounting
3. Hose
4. Clip
5. Check valve
6. Hose
7. Clip
8. Vacuum pipe
9. Clip
10. Hose
11. Clip
12. Hose
13. Clip
14. Clip

SPECIAL TOOLS

DESCRIPTION

Master cylinder clearance setting gauge (J.26)*

Master cylinder return spring compressor (J.29)*

*Churchill Tool Number.

SECTION M

WHEELS AND TYRES

4·2 MARK 10 MODEL

INDEX

WHEELS AND TYRES

DESCRIPTION

Dunlop SP. 41 radial ply tyres with special tubes are fitted as standard equipment to pressed steel disc wheels.

DATA

Road wheels	
Make	Dunlop
Type	Pressed steel disc
Fixing	Five studs and nuts
Rim section	$5\frac{1}{2}$ J
Rim diameter	14″ (345.6 mm.)
Tyres	
Make	Dunlop
Type	S.P. 41 radial ply tyre with special tubes
Size	205 - 14

INFLATION PRESSURES

In view of the high speeds of which these cars are capable, it is important that the correct tyre pressures are used for all conditions.

	Front lb./sq. in.	Rear lb./sq. in.
For conditions where maximum performance, with sustained speeds, is being used, or for touring conditions, where the car is fully laden	38 (2·67 kg./cm.^{2})	38 (2·67 kg./cm.^{2})
For normal motoring with maximum speed up to 100 m.p.h. (160 k.p.h.) ..	30 (2·11 kg./cm.^{2})	30 (2·11 kg./cm.^{2})

For two up normal motoring, to give maximum comfort, it is permissible, and may be found desirable to reduce rear tyre pressures by 3 lb./sq. in. (·21 kg./cm.^{2}).

Note: Inflation pressures should be checked when the tyres are cold, such as standing overnight, and not when they have attained normal running temperatures.

Incorrect pressures will have an adverse affect on steering, riding comfort and tyre wear. Inflation pressure increases as a tyre warms up. Pressure increases more in hot weather and as a result of high speed running. These factors are taken into account when designing the tyre and when determining recommended inflation pressures. Pressure in a warm tyre should not be reduced to standard for a cold tyre.

"Bleeding" the tyre increases its deflection and will cause its temperature to climb still higher and will result in under-inflation when the tyre has cooled.

Always ensure that the valve caps are fitted as they prevent the ingress of dirt and form a secondary seal to the valve core.

TYRES—GENERAL INFORMATION

Dunlop S.P.41 tyres are designed to give good performance characteristics and tread life, particularly on cars with the high speed range of the Jaguar Mark 10.

When replacing worn or damaged tyres and tubes it is essential that tyres with exactly the same characteristics are fitted. On no account should radial ply tyres such as S.P.41 be fitted to the front wheels when conventional cross-ply tyres such as R.S.5 or C.W.44 winter pattern are fitted to the rear.

Note: Special tubes are required for use with radial ply tyres.

CONSTRUCTION OF THE TYRE

Tyres must be flexible and responsive. They must also be strong and tough to contain the air pressure, resist damage, give long mileage, transmit driving and braking forces, and at the same time provide road grip, stability and good steering properties.

The tyre casing strength is derived from layers of cords disposed radially from bead wire to bead wire.

Tread bracing consists of layers of specially arranged textile cord material laid circumferentially under the tread with the direction of cords in each layer alternating and crossing the centre line of the tread at a low angle. These layers form an almost inextensible band around the circumference of the tyre, thus keeping the tread profile flatter at all times.

By following the inflation pressure recommendations on page M.3 the owner will obtain the best results from both tyres and car.

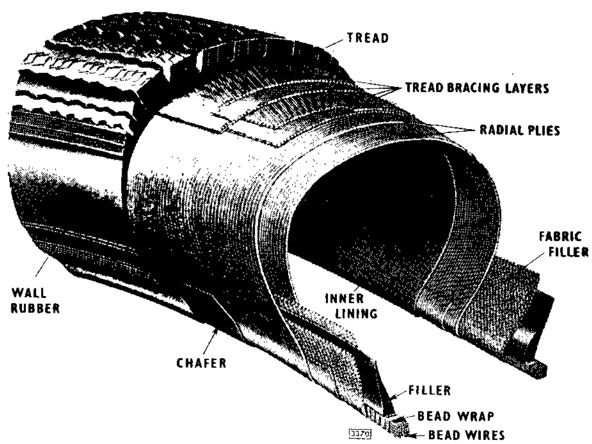

Fig. 1. Tyre construction.

REMOVAL AND FITTING OF TYRES

The wheels fitted to the Mark 10 model have rims with a "Hump" bead seat (See Fig. 2) and need special care in fitting and removing for which the correct methods are detailed below.

REMOVING

Free each bead from its taper seating in the usual way. Note that the bead on the hump side of the rim will have to be pushed away from the flange further than usual before it is free.

To facilitate lifting the beads over the rim flanges lubricate the tyre beads and levers with a thin vegetable oil solution, or Dunlop Tyre Bead Lubricant, Code TBL/1.

Lift the beads, one at a time, over the narrower bead ledge which is on the outside of the wheel rim.

FITTING

If the rim is dirty or rusty, clean both rim flanges and bead seats with emery cloth or steel wool.

Lubricate tyre beads, rim flanges, rim bead ledges and levers with a suitable solution as already mentioned in Tyre Removal.

Both beads must be fitted over the narrow ledge side or outside of the wheel rim. The narrower ledge should be facing upwards if fitting is accomplished with the wheel lying flat.

In order to achieve optimum balance and smooth running it is desirable, when fitting a tyre, to position it relative to the wheel in such a way that the tyre and wheel assembly is as round as possible, that is, minimum radial run-out. Mark the tyre relative to the wheel to facilitate refitting.

INFLATING

When inflating the tyre, be sure that the valve core is in the valve and DO NOT EXCEED 40 POUNDS AIR PRESSURE as there is a risk of breaking the bead wires. If it is found that the beads will not seat properly, deflate, lubricate and centralise tyre before re-inflating. When the tyre bead does not seat properly at the second attempt, the wheel rim circumference is suspect and should be checked with a rim gauge, if available, or replaced with a new wheel.

After the beads have seated properly, reduce pressure to the recommended operating pressure.

Note: Lock the wheel down when using the mounting machine and do not stand over the tyre when inflating it.

Check the tyre pressure frequently to be absolutely sure that the pressure never exceeds 40 pounds per sq. in. It is advisable to use an extension pressure gauge with a clip-on chuck and stand well back for maximum safety.

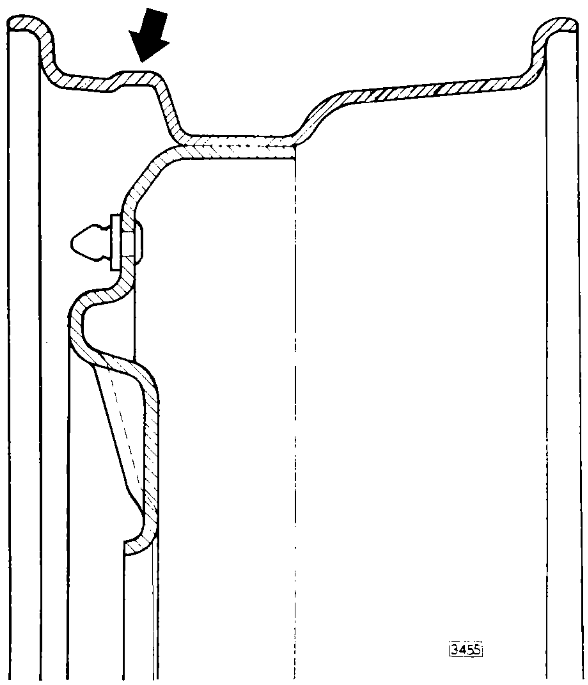

Fig. 2. Cross-section of the wheel rim showing the position of the hump.

TYRE EXAMINATION

Examine tyres periodically for flints, nails, etc., which may have become embedded in the tyre. Such foreign bodies should be removed with a blunt screwdriver or similar instrument.

Any accidental damage, such as cuts, etc. which might result in failure on the road should be repaired by a competent specialist.

WHEEL ALIGNMENT AND ITS ASSOCIATION WITH ROAD CAMBER

It is very important that correct wheel alignment should be maintained. Misalignment causes a tyre tread to be scrubbed off laterally because the natural direction of the wheel differs from that of the car.

An upstanding sharp "fin" on the edge of each pattern rib is a sure sign of misalignment and it is possible to determine from the position of the "fins" whether the wheels are toeing in or toeing out.

"Fins" on the inside edges of the pattern ribs—nearest to the car—and particularly on the near side tyre indicate toe in. "Fins" on the outside edges, particularly on the offside tyre, indicate toe out.

With minor misalignment, the evidence is less noticeable and sharp pattern edges may be caused by road camber even when wheel alignment is correct. In such cases it is better to make sure by checking with an alignment gauge.

Road camber effects the direction of the car by imposing a side thrust and if left to follow its natural course the car will drift towards the near side. This is instinctively corrected by steering towards the road centre.

As a result the car runs crab-wise, diagrammatically illustrated in an exaggerated form in Fig.3. The diagram shows why near side tyres are very sensitive to too much toe in and offside tyres to toe out. It also shows why sharp "fins" appear on one tyre but not on the other and why the direction of misalignment can be determined by noting the position of the "fins". Severe misalignment produces clear evidence on both tyres.

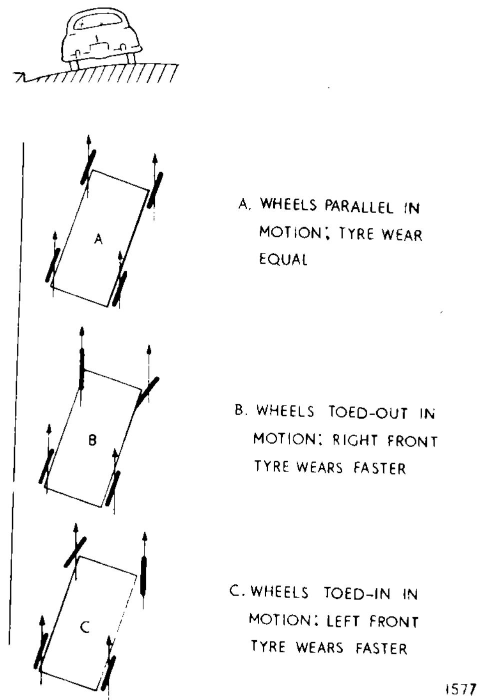

Fig. 3. Exaggerated diagram of the way in which road camber affects a car's progress (for cars driven on the left-hand side of the road).

The front wheels on a moving car should be parallel. Tyre wear can be affected noticeably by quite small variations from this condition. It will be noted from the diagram that even with parallel wheels the car is still out of line with its direction of movement, but there is less tendency for the wear to be concentrated on any one tyre.

The near side front tyre sometimes persists in wearing faster and more unevenly than the other tyres even when the mechanical condition of the car and tyre maintenance are satisfactory. The more severe the average road camber the more marked will this tendency be. This is an additional reason for the regular interchanging of tyres.

PRECAUTIONS WHEN MEASURING WHEEL ALIGNMENT

(a) The car should have come to rest from a forward movement. This ensures as far as possible that the wheels are in their natural running positions.

(b) It is preferable for alignment to be checked with the car laden.

(c) With conventional base-bar tyre alignment gauges, measurements in front of and behind the wheel centres should be taken at the same points on the tyres or rim flanges. This is achieved by marking the tyres where the first reading is taken and moving the car forwards approximately half a road wheel revolution before taking the second reading at the same points. With the Dunlop Optical Gauge, two or three readings should be taken with the car moved forwards to different positions—180° road wheel turn for two readings and 120° for three readings. An average figure should then be calculated.

Wheels and tyres vary laterally within their manufacturing tolerances, or as a result of service and alignment figures obtained without moving the car are unreliable.

TYRE AND WHEEL BALANCE

STATIC BALANCE

In the interests of smooth riding, precise steering and the avoidance of high speed "tramp" or "wheel hop" all Dunlop tyres are balance checked to predetermined limits.

As mentioned under "Tyre Fitting", it is desirable, for optimum balance and smooth running, to fit the tyre to the wheel so that the tyre and wheel assembly is as round as possible.

Due to the high speed potential of the Jaguar Mark 10, it is advisable to check both the static and dynamic balance at regular intervals.

The original degree of balance is not necessarily maintained and it may be affected by uneven tread wear, by cover and tube repairs, by tyre removal and refitting or by wheel damage and eccentricity. The car may also become more sensitive to unbalance due to normal wear of moving parts.

If roughness or high speed steering troubles develop, and mechanical investigation fails to disclose possible causes wheel and tyre balance should be suspected.

A Tyre Balancing Machine is marketed by the Dunlop Company to enable Service Stations to deal with such cases.

Warning

If balancing equipment is used which dynamically balances the road wheels on the car, the following precaution should be observed.

In the case of the rear wheels, always jack both wheels off the ground otherwise damage may be caused to the differential or the car may drive itself off the jack or stand.

DYNAMIC BALANCE

Static unbalance can be measured when the tyre and wheel assembly is stationary. There is another form known as dynamic unbalance which can be detected only when the assembly is revolving.

There may be no heavy spot, that is, there may be no natural tendency for the assembly to rotate about its centre due to gravity, but the weight may be unevenly distributed each side of the tyre centre line. Laterally eccentric wheels give the same effect. During rotation the off set weight distribution sets up a rotating couple which tends to steer the wheel to right and left alternately.

Dynamic unbalance of tyre and wheel assemblies can be measured on the Dunlop Tyre Balancing Machine and suitable corrections made when cars show sensitivity to this form of unbalance. Where it is clear that a damaged wheel is the primary cause of severe unbalance it is advisable for the wheel to be replaced.

TYRE REPLACEMENT AND WHEEL INTERCHANGING

When replacement of the rear tyres becomes necessary, fit new tyres to the existing rear wheels and, after balancing, fit these wheels to the front wheel positions on the car, fitting the existing front wheel and tyre assemblies (which should have useful tread life left) to the rear wheel positions on the car.

If at the time this operation is carried out the tyre of the spare wheel is in new condition, it can be fitted to one of the front wheel positions in preference to replacing one of the original rear tyres, which wheel and tyre can then become the spare.

Note: Due to the change in the steering characteristics which can be introduced by fitting to the front wheel positions wheels and tyres which have been used on the rear wheel positions, interchanging of part worn tyres from rear to front wheel positions is not recommended.

SECTION N

BODY AND EXHAUST SYSTEM

4.2 MARK 10 MODEL

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BODY

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EXHAUST SYSTEM

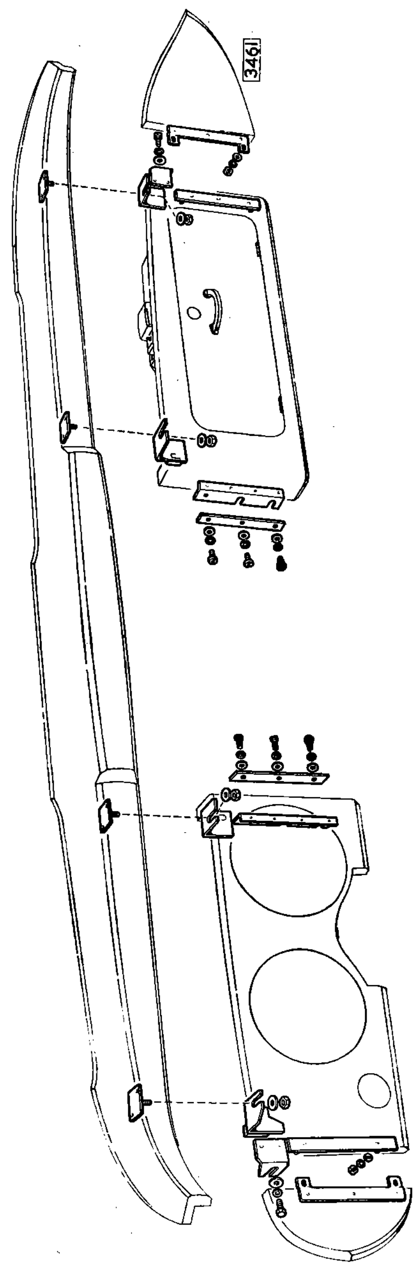

Fig. 1. The facia panel showing the fixing points.

BODY AND EXHAUST SYSTEM

BODY

SIDE FACIA PANEL

Removal

Disconnect the negative lead on the battery. Remove the two nuts and washers securing the curved side panels to the side facia panel and the glove box. Extract the two screws securing the side panels to the body at the base of the screen pillars. The screw heads are accessible after opening the door and lifting the door trim welt locally. Remove both side panels (see Fig.1).

Remove both screen pillar cappings by withdrawing the screws from the bottom fixing brackets, now exposed, inserting a thin bladed instrument between the capping and the screen pillar, pressing in the top spring clip fastener, and gently prising away the capping.

Release the four nuts securing the screen rail to the two outer and the two inner slotted attachment brackets (Fig.1).

Disconnect the two cables attached to the map light and remove the screen rail.

Withdraw the picnic tray to its full extent. Press the two spring retaining clips on the back edge inwards and complete the removal of the tray.

Hinge the centre instrument panel downwards after withdrawing the thumb screws situated in each top corner.

Release the steering wheel locknut and pull the steering wheel outwards to the full extent.

Remove he two setscrews and washers securing the top half of the flasher switch cover to the steering column and detach the cover.

Disconnect the speedometer drive cable from the rear of the speedometer.

Disconnect the flasher warning light and the automatic transmission (or overdrive) indicator panel illumination bulb cables from the snap connectors loca ed behind the facia panel above the steering column and withdraw the cables through the clip attached to the panel.

Remove the top screw of the three exposed in the instrument panel aperture and release the remaining two screws.

Note: The two lower screws locate in slotted holes and it is not necessary to remove them completely.

Remove the nut, lock washer and plain washer securing the panel outer attachment bracket to the body and detach the side facia panel (see Fig.1).

Disconnect the panel light and clock cables at the snap connector.

Withdraw the ignition and main beam warning light bulb holders.

Disconnect the "Lucar" connectors from the revolution counter and the brake fluid warning light.

Disconnect the earth wires from the speedometer and the revolution counter.

Remove the side facia panel.

Refitting

Refitting is the reverse of the removal procedure. On cars equipped with automatic transmission, ensure that the three cables connected to the flasher warning and indicator panel illumination lights do not foul the indicator pointer when the gear control is operated.

THE GLOVE BOX

Removal

Disconnect the negative lead from the battery.

Remove the curved side panels, screen pillar cappings and screen rail as detailed under "Side Facia Panel".

Withdraw the picnic tray to its fullest extent. Press the two spring retaining clips on the back edge inwards and complete removal of tray.

Hinge the centre instrument panel downwards after withdrawing the thumb screws situated in each top corner.

Remove the top screw of the three screws exposed in the instrument panel aperture and release the remaining two screws.

Note: The two lower screws locate in slotted holes and it is not necessary to remove them completely.

Remove the nut, lock washer and plain washer securing the glove box outer attachment bracket to the body and detach the glove box (see Fig.1).

Disconnect the "Lucar" connectors from the glove box illumination lamp and earth connections.

Withdraw the glove box.

Refitting

Refitting is the reverse of the removal procedure.

SCREEN RAIL

Removal

The screen rail cannot be removed until both curved side panels and screen pillar cappings have been detached as detailed under "Side Facia Panel".

Release the four nuts, serrated and plain washers securing the screen rail to the two inner and two outer attachment brackets (see Fig.1).

Disconnect the two cables attached to the map light and remove the screen rail.

Refitting

Refitting is the reverse of the removal procedure.

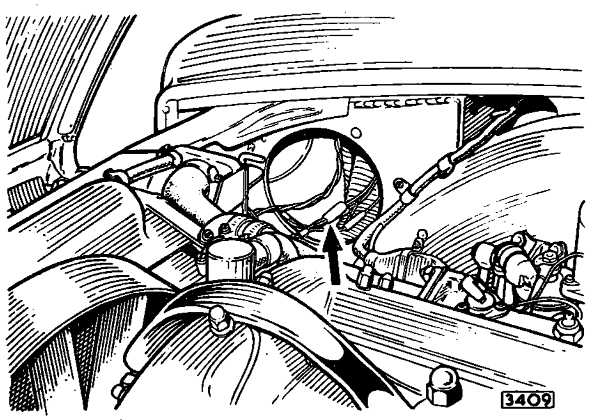

Fig. 2. The right-hand lamp connectors.

BONNET

Removal

To open the bonnet, pull the lever situated behind the facia on the right-hand side. This will release the bonnet which will now be retained by the safety catch. Insert the fingers under the rear edge of the bonnet and lift up the safety catch.

The bonnet is automatically retained in the fully open position by the action of the hinge torsion bars.

Disconnect the two inner head lamps at the snap connector junctions and withdraw the cables through the front panel grommets.

The left-hand lamp connectors are located under the wing valance; the right-hand lamp connectors being accessible after removing the air cleaner element. (Fig 2).

Detach the flexible hose connecting the cleaner to the air intake pipe.

Turn the two quick-release screws securing the air cleaner cover plate anti-clockwise through 90° and withdraw plate with the attached element.

Mark the position of the hinge brackets on the bonnet to facilitate refitting.

Remove the self-locking nuts from the two bonnet stay pivot pins, withdraw the pins and collect the double coil spring washers located between the stays and the bonnet.

Support the bonnet in the open position after the pivot pins have been removed.

Remove the two setscrews, plain and lock washers securing the bonnet to each hinge and lift off the bonnet (see Fig.3).

Refitting

Refitting is the reverse of the removal procedure.

Position the hinges to the marks made on the bonnet before removal.

BONNET HINGE ASSEMBLY

Removal

Remove the bonnet as identified under "Bonnet".

Withdraw the four setscrews, plain and lock washers securing each hinge to the body and remove the assembly. Mark the position of the hinge brackets on the body before removing.

Refitting

Refitting is the reverse of the removal procedure.

If the new hinges have been fitted it will be necessary to re-align the bonnet to the body. Elongated holes are provided in the hinge mountings to facilitate adjustment.

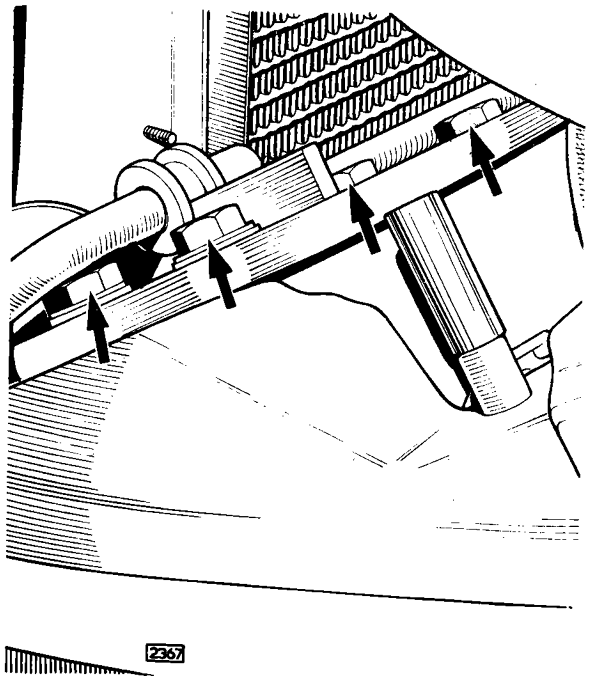

Fig. 3. The bonnet hinge and securing points.

BONNET LOCK

Two bonnet locks are provided, the left-hand being operated by a link cable connected to the right-hand lock, while the right-hand lock is connected directly by means of a rod to the bonnet release lever.

Removal of the Right-Hand Lock

Remove the self-locking nut securing the operating rod to the release lever. Pull the lever outwards clear of the rod and withdraw the rubber bush from the rod.

Disconnect the operating cable from the left-hand lock and release the outer flex from the securing clips.

Remove the two setscrews securing the right-hand lock to the lock bracket (see Fig.4).

Lower and remove the lock, withdrawing the operating rod through the grommet in the bulkhead.

Refitting the Right-Hand Lock

Refitting is the reverse of the removal procedure. Lightly grease the lock mechanism before refitting.

Adjust the right-hand lock operating rod nut to ensure that full locking movement of the catch plate is obtained.

Adjust the left-hand lock operating cable to ensure that full movement of both locks is equal.

Removal of the Left-Hand Lock

Disconnect the operating cable by releasing the inner cable locking setscrew and withdrawing the inner cable and outer flex (see Fig.5).

Remove the two setscrews securing the lock to the lock bracket and withdraw the lock.

Refitting the Left-Hand Lock

Refitting is the reverse of the removal procedure. Lightly grease the lock mechanism before fitting.

Adjust the lock operating cable to ensure that the full movement of the lock is obtained and movement is equal to the right-hand lock.

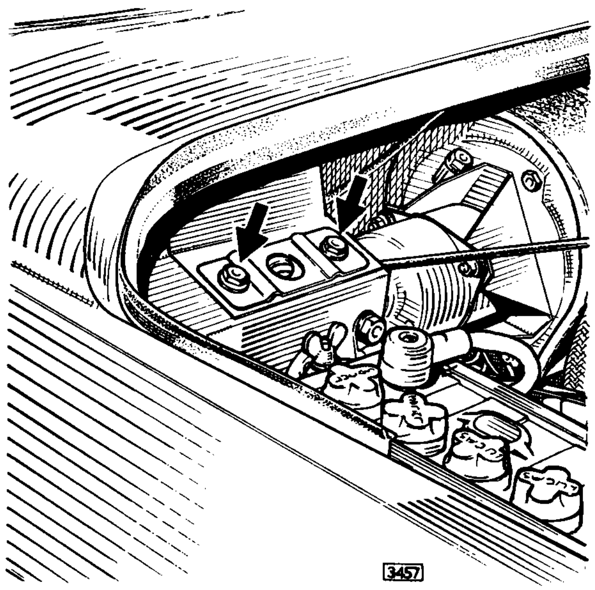

Fig. 4. The right-hand bonnet lock.

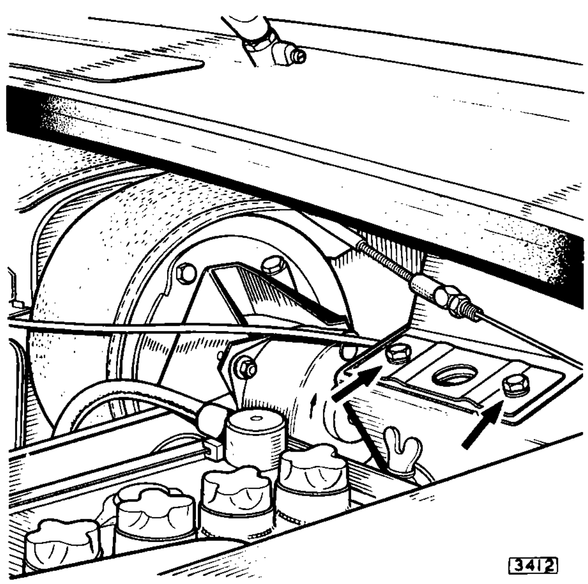

Fig. 5. The left-hand bonnet lock.

Removing the Bonnet Release Lever

Remove the self-locking nut from the operating rod. Applying a slight pressure press the pivot pin through the spring steel locking nut and withdraw from the bracket.

Remove the lever and collect the two brass shim washers.

Refitting the Bonnet Release Lever

Refitting is the reverse of the removal procedure. Lightly coat the pin with grease before refitting, and press home the spring steel nut.

Refit the nut to the operating rod and adjust to obtain full locking movement of the bonnet locks.

Removing the Bonnet Lock Striker Pegs

To remove, slacken the locknut at the top of the peg.

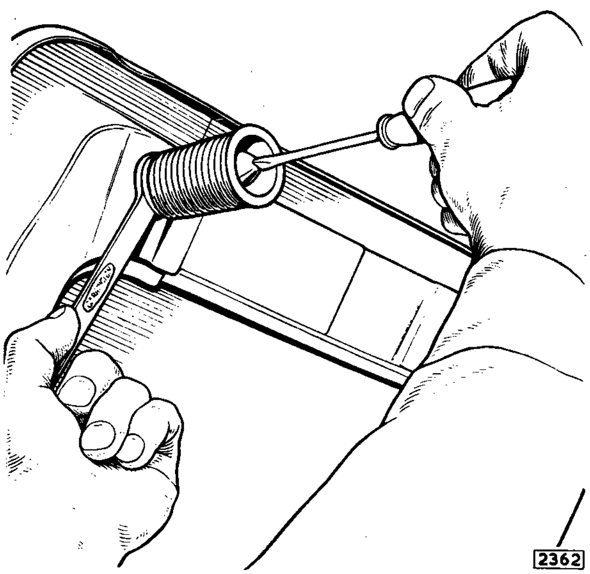

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Fig.6. The bonnet lock striker peg adjustment.

Insert a screwdriver into the slot in the peg and unscrew complete with locknut, two washers and spring. Refitting is the reverse of the removal procedure.

Adjustment of the Striker Pegs

Slacken the locknut and rotate one of the pegs with a screwdriver, until there is approximately $\frac{1}{16}$" (1·5 mm.) movement between the catch plate and the peg.

This is to ensure that the catch plate will fully engage with the peg.

Tighten the locknut and repeat the operation to the opposite peg (see Fig.6).

CHROME STRIP ON BONNET

Removal

Remove the eight nuts, plain and lock washers accessible when the bonnet is raised.

Refitting

Refitting is the reverse of the removal procedure. Adjust the strip to line up with the mascot before finally tightening the nuts.

MASCOT

Removal

Raise the bonnet and remove the two nuts, plain and lock washers securing the mascot to the bonnet. Note the cup washer fitted to the front stud fixing.

Refitting

Refitting is the reverse of the removal procedure. Adjust the mascot to line up with the centre strip and radiator grille surround before finally tightening the nuts.

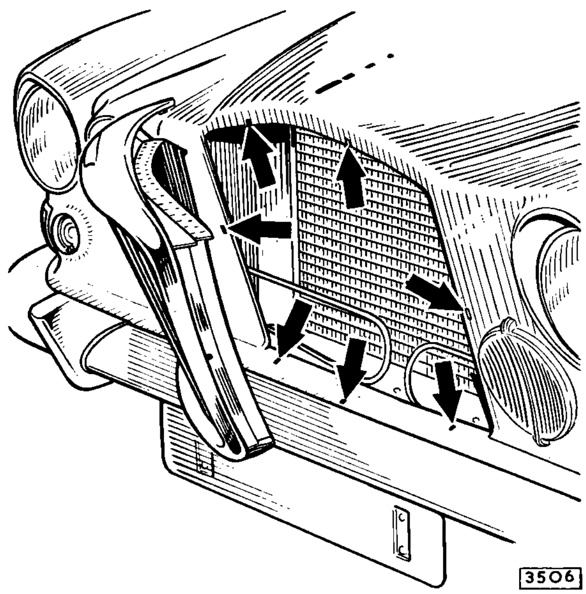

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Fig. 7. Radiator grille removal.

RADIATOR GRILLE AND SURROUND

Removal

Open the bonnet.

Remove the setscrew, cup washer and lock washer securing the radiator grille top extension to the bonnet. The setscrew is accessible through a hole in the underside of the bonnet.

Remove the two nuts, plain and lock washers from the surround top fixing, two setscrews, plain and lock washers from the side fixing and three nuts, plain and lock washers securing the surround at the bottom of the bonnet closing plate.

Remove the surround.

To detach the radiator grille, remove the four setscrews at the top and four setscrews, domed nuts and washers at the bottom mountings and detach the grille.

Refitting

Refitting is the reverse of the removal procedure. Adjust the radiator grill top extension to line up with the mascot and bonnet strip before finally tightening the setscrews and nuts.

LUGGAGE COMPARTMENT LID AND HINGES

Removal

Raise the luggage compartment lid. Remove the 28 self-tapping screws retaining the trim board casings and detach the casings. Disconnect the electrical connections to the reverse lamp and detach the earth wire.

Remove the clip and plastic strap from the left-hand hinge and withdraw the cable harness and grommet from the panel.

Mark the positions of the hinges on the lid, remove the two setscrews securing each hinge bracket and detach the luggage compartment lid.

Mark the positions of the hinges on the body.

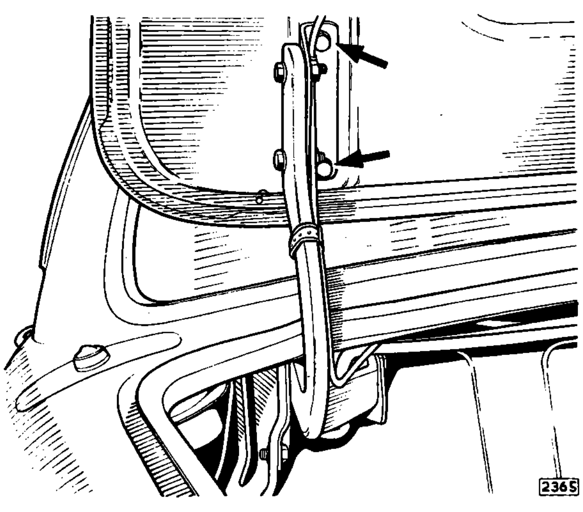


Fig. 8. The luggage compartment lid hinges.

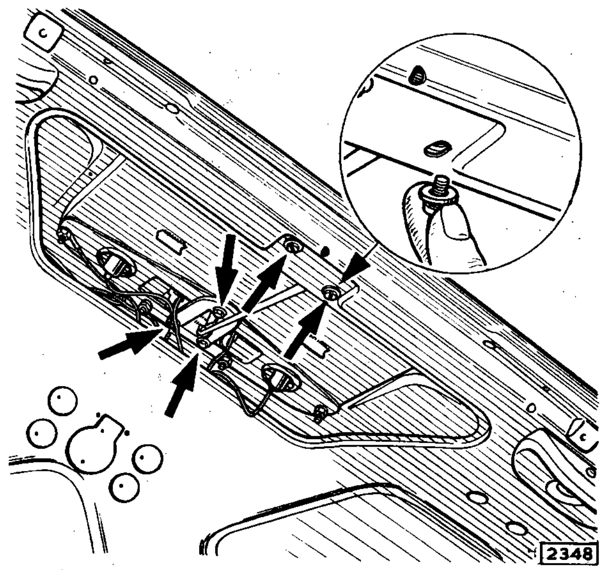


Fig. 9. The luggage compartment locks.

Remove the setscrew, nut, washer and central clip securing the right and left-hand torsion bars together. Remove the four setscrews, nuts and washers retaining each hinge to the body and detach the hinges.

Refitting

Refitting is the reverse of the removal procedure.

LUGGAGE COMPARTMENT LOCKS

Removal

Remove the two hairpin spring clips securing the right and left-hand outer links to the lock strikers and withdraw the links from the pivot pins.

Remove the hairpin spring clip securing the central link to the lock assembly and detach the link from the pivot pin.

Remove the four setscrews and washers securing the link carrier plate to the luggage compartment lid.

Feed the link assembly to the right and withdraw the left-hand link, feed the assembly to the left-hand and remove. (See Fig.9).

Remove the four setscrews, plain and lock washers and withdraw the lock assembly.

Remove the four setscrews, plain and lock washers securing each lock striker assembly to the lid and detach the strikers.

Refitting

Refitting is the reverse of the removal procedure. Do not tighten the link carrier plate setscrews until the lock strikers have been adjusted. Lightly grease all moving parts before refitting.

Adjusting the Locks

Reconnect the links to the lock assembly and the lock strikers.

Place the lock strikers in the locked position. Utilising the slotted holes on the lid mounting, adjust the link carrier plate up or down as required until the lock strikers release when the lock button is depressed. Retaining this vertical position, move the carrier plate to the right or left as necessary to equalize the release of the two lock strikers. Tighten the retaining setscrews.

Adjust the lock striker pegs until the locks operate correctly and do not rattle. Tighten the striker peg retaining screws.

PETROL FILLER LIDS

Removal

The removal sequence is identical for both right-hand and left-hand lids.

Remove the return spring. Unscrew the two setscrews and washers securing the lid and hinge to the inner wall of the petrol filler cap compartment. Remove the two setscrews securing the lid to the hinge (see Fig.10).

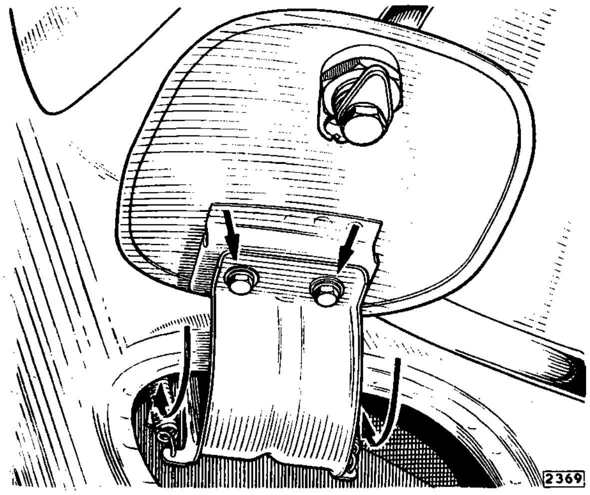


Fig. 10. Removal of the fuel filler lid.

Refitting

Refitting is the reverse of the removal procedure. When refitting the lid tighten the setscrews finger tight only in the elongated holes, then align the lid to fit into the recess of the body panel. Tighten the setscrews securely.

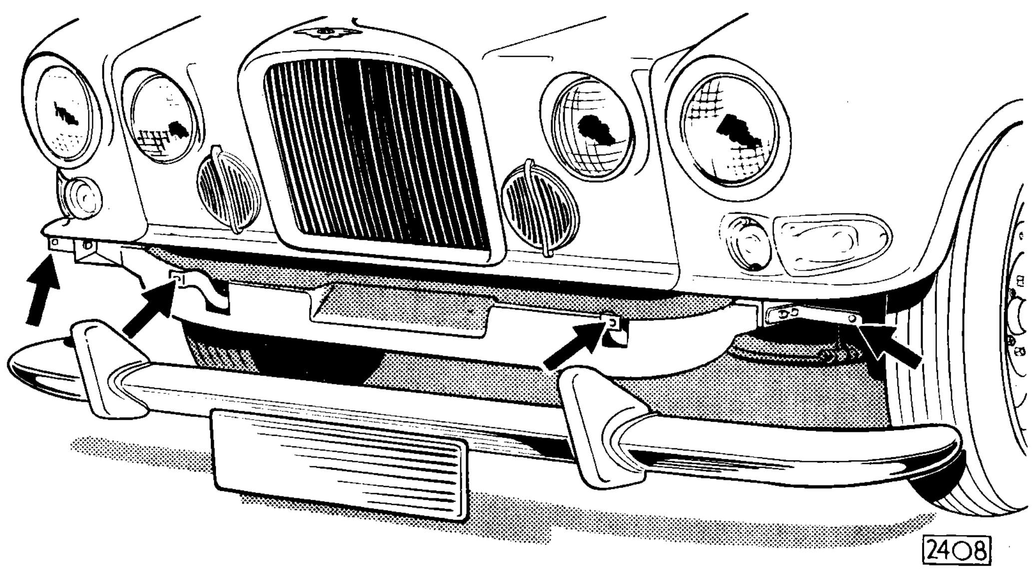


Fig. 11. Showing the mounting points for the front bumper.

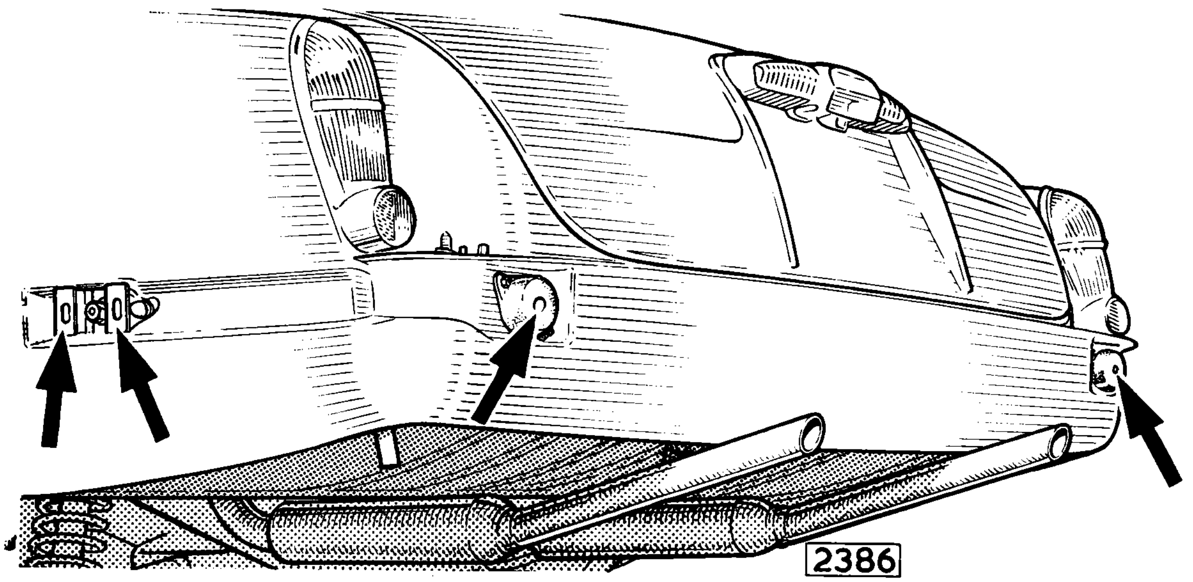


Fig. 12. The mounting points for the rear bumper.

FRONT BUMPER

Removal

Remove the two bolts, nuts, plain and lock washers securing the front bumper to the side brackets and the two bolts, nuts, plain and lock washers securing the bumper to the inner brackets.

Withdraw the bumper (see Fig.11).

Refitting

Refitting is the reverse of the removal procedure.

FRONT BUMPER OVER-RIDERS

Removal

Remove the nut, plain and lock washers and the setscrew, plain and lock washer securing each over-rider to the front bumper.

Remove the over-rider and beading.

Refitting

Refitting is the reverse of the removal procedure. Replace the beading between the over-riders and the bumper when re-assembling.

REAR BUMPER

Removal

Remove the four setscrews, plain and lock washers securing the bumper to the side mounting brackets and the four setscrews, plain and lock washers securing the bumper to the inner brackets.

Withdraw the bumper (see Fig.12).

Refitting

Refitting is the reverse of the removal procedure.

REAR BUMPER OVER-RIDERS

Removal

Remove the nut, plain and lock washers and the setscrew, plain and lock washer securing each over-rider to the rear bumper.

Remove the over-rider and beading.

Refitting

Refitting is the reverse of the removal procedure. Replace the beading between the over-riders and the bumper when re-assembling.

WINDSCREEN

Removal

Prise off the two centre chrome clips securing the ends of the chrome finisher encircling the windscreen.

Prise off the chrome finisher from the windscreen rubber. Extract one end of the rubber insert and withdraw completely.

Run a thin bladed tool around the windscreen to break the seal between the rubber and the windscreen aperture flange.

Strike the glass with the flat of the hand from inside the car, starting at one corner and working towards the bottom.

Repeat this process around the complete windscreen and withdraw the glass.

Refitting

Remove the old sealer from the windscreen flange. Examine the windscreen rubber for cuts. If the old windscreen was of the toughened glass type it is recommended that the rubber should be replaced. This is because small particles of glass may have become impregnated in the rubber and could break the screen again. If, however, the windscreen was not broken by a projectile, the windscreen aperture flange should be examined for a bump in the metal. If this is found, the bump should be filed away otherwise the glass may break again.

The rubber should be attached to the aperture with the flat side of the rubber towards the rear. Coat the glass channel in the rubber surround with a soap solution to provide lubrication between the glass and rubber when refitting.

Using the special tool (A, Fig.14) insert the screen into the rubber along the bottom edge first. It is important that the glass should be fitted equally. DO NOT fit one end and then try to fit the other. Using the special tool (B, Fig.14) insert the rubber sealing strip with the round wide edge to the outside.

Using a pressure gun filled with a sealing compound, and fitted with a copper nozzle (so that the glass will not be scratched) apply the nozzle of the gun between the metal body flange and the rubber and fill with sealing compound. Repeat the operation between the glass and the rubber. Remove any excess sealing compound with a cloth soaked in white spirit. DO NOT USE THINNERS as this will damage the paintwork.

Fit the chrome strip on top of the rubber and bend to suit contour if necessary. Coat the inside of the chrome strip with Bostik 1251 and allow to become tacky. Place the chrome strip on the rubber and with the hook (A, Fig.14) lip the rubber over the top of the finisher. Fit the two centre chrome clips and lip the rubber over the edges of the clips.

REAR GLASS

Removal

Prise off the two chrome finisher pieces securing the ends of the chrome finisher which encircle the rear window.

Prise off the chrome finisher from the back light rubber. Extract one end of the rubber insert and withdraw completely.

Run a suitable thin bladed too around the back light to break the seal between the rubber and the back light aperture flange.

Strike the glass with the flat of the hand from inside the car, starting in one corner and working towards the bottom.

Repeat this process around the complete rear light glass.

If the car is fitted with a heated back light it is necessary to disconnect the two electrical connections in the boot (black/white and black) and care should be taken when removing the back light not to break the two wires which pass through the holes in the sealing rubber.

Refitting

Remove the old sealer from the back light flange. Examine the sealing rubber for cuts. If the back light is of the toughened glass type (that is, all cars except those fitted with heated back lights) it is recommended that the back light rubber should be replaced.

This is because small particles of glass may have been impregnated into the rubber and could break the glass again. If, however, the back light was not broken by a projectile the back light aperture flange should be examined for a bump in the metal. If this is found the bump should be filed away otherwise the glass may break again.

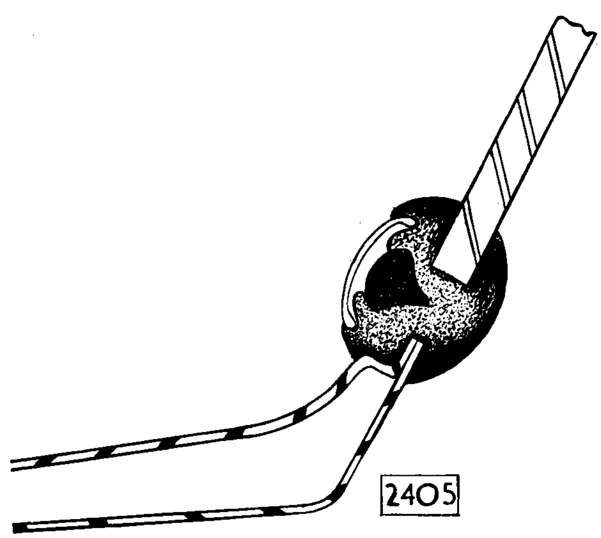


Fig. 13. Section through the rear glass.

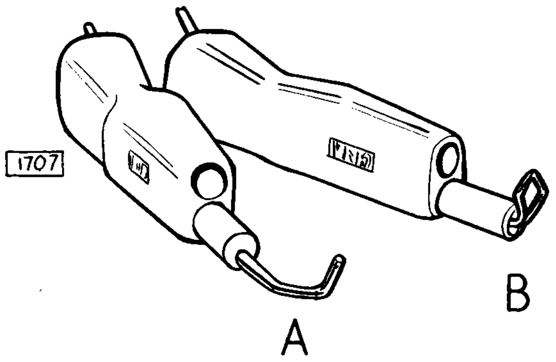


Fig. 14. The two special tools used for refitting the windscreen.

The rubber should be attached to the back light aperture with the flat side of the rubber facing the inside of the car.

If the car is fitted with a heated back light, pierce the sealing rubber in the two appropriate positions (Fig.20) to take the wires which lead to the element.

Using the special tool (A, Fig.14) insert the back light into the rubber along the bottom edge first. On cars fitted with a heated back light, feed the electrical wires through the holes in the sealing rubber first (Fig.20).

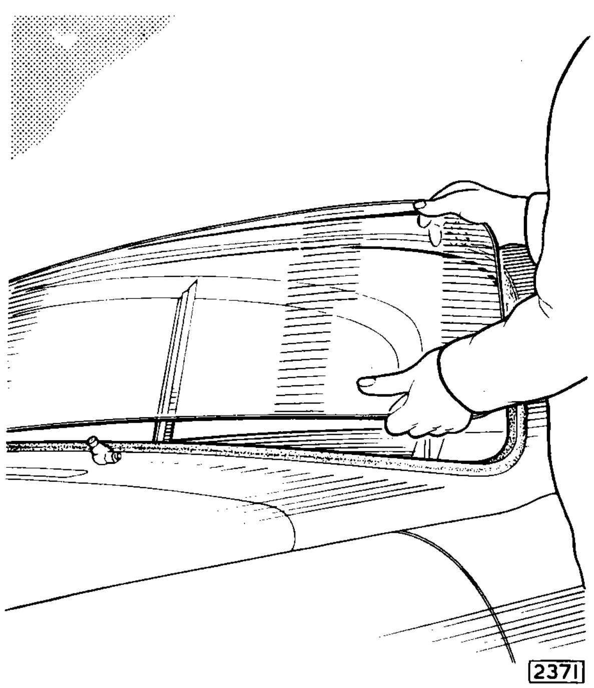


Fig. 15. Removing the windscreen.

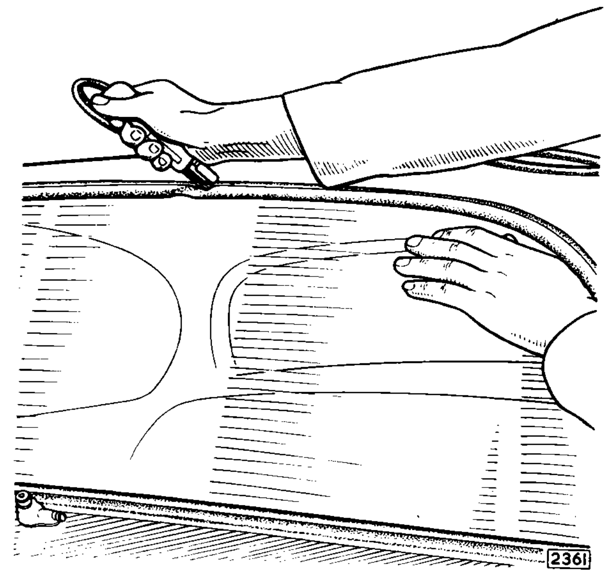


Fig. 16. Using the special tool ("B" Fig. 14) when inserting the rubber sealing strip in the windscreen rubber.

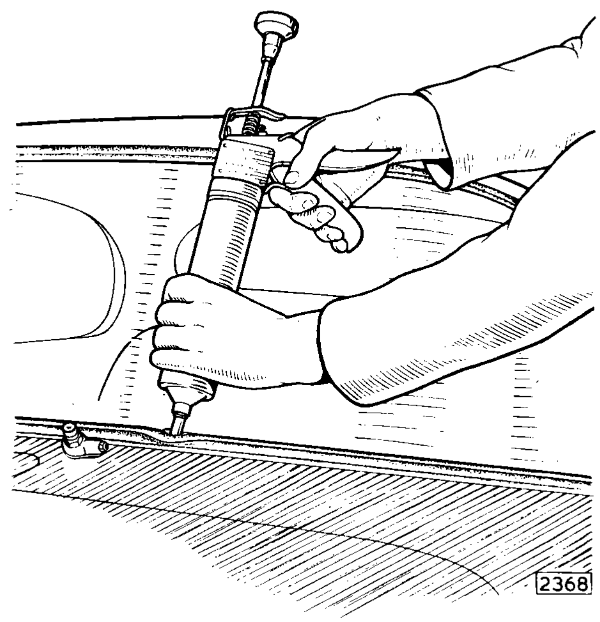


Fig. 17. Using a gun to inject sealing compound between the surround rubber and the glass.

It is important that the glass is fitted equally, DO NOT fit one end and then try to fit the other.

Usingthe special tool (B, Fig. 14) insert the rubber sealing strip with the rounded wide edge to the outside.

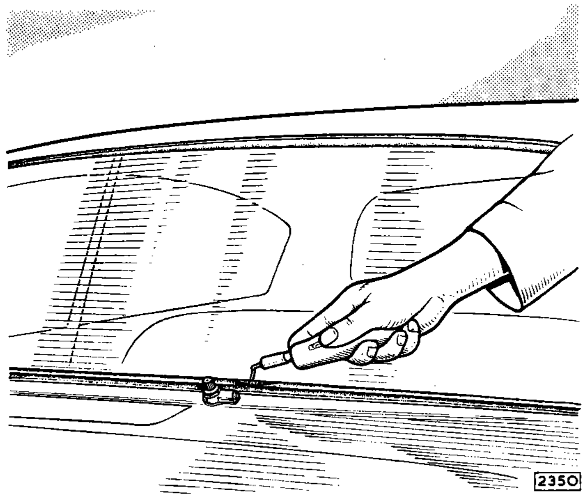


Fig. 18. Lapping the sealing rubber over the chrome strip with the special tool ("A" Fig. 14).

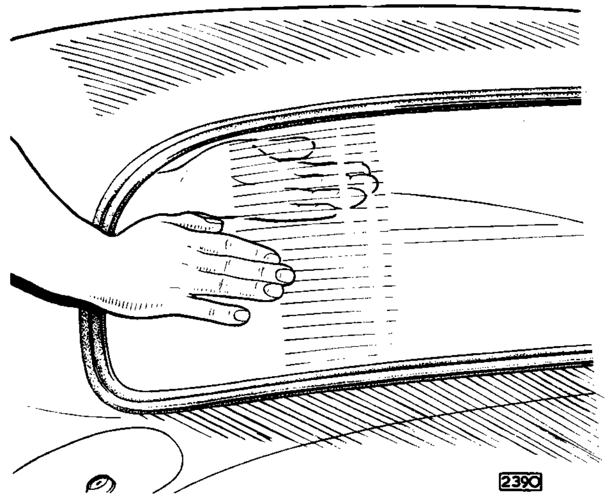


Fig. 19. Removal of the rear glass.

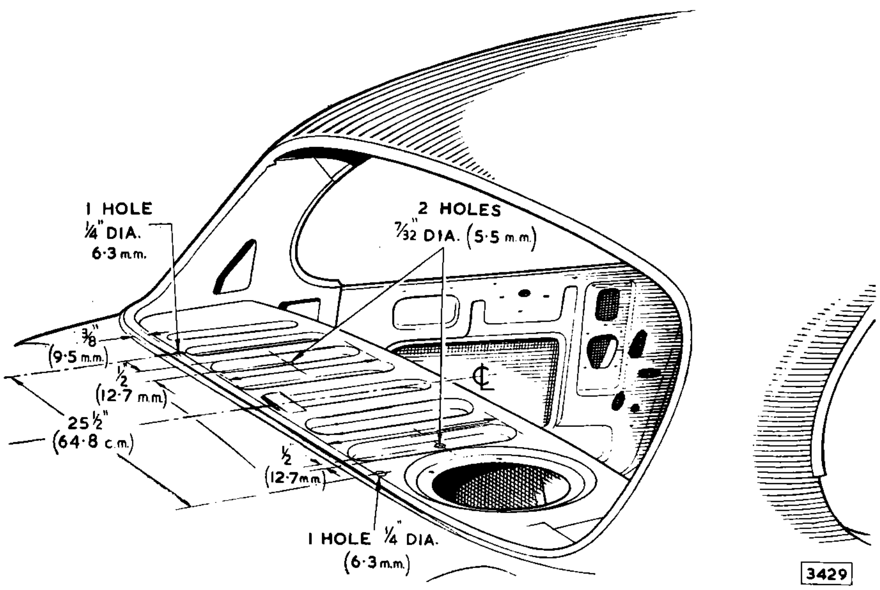


Fig. 20. Drilling dimensions for heated backlight.

Using a pressure gun filled with a sealing compound and fitted with a copper nozzle (so that it will not scratch the glass) apply the nozzle of the gun between the metal body flange and the rubber and fill with sealing compound (Fig. 17).

Remove excess sealing compound with a rag soaked in white spirit. DO NOT USE THINNERS as this will damage the paintwork.

Check that there is a small gap between the sealing rubber edge and the depression for the rear glass aperture. This is necessary to allow the chrome finishing strip to seat on the sealing rubber. If the rubber bends hard onto the depression at certain points insert a small length of stiff piping cord ⅛" (3·1 mm.) diameter at the required positions, this will facilitate the fitting of the chrome strip. Fit the chrome on top of sealing rubber and bend to suit contour if necessary. Coat the inside of the chrome strip with a layer of Bostik adhesive and allow to become tacky. Place the chrome strip onto the sealing rubber and with a hook (A, Fig. 14) lift the lip of the rubber over the chrome finisher. Fit the two centre chrome clips and lip the rubber over the edges of the clips.

Reconnect the heated back light cables if fitted.

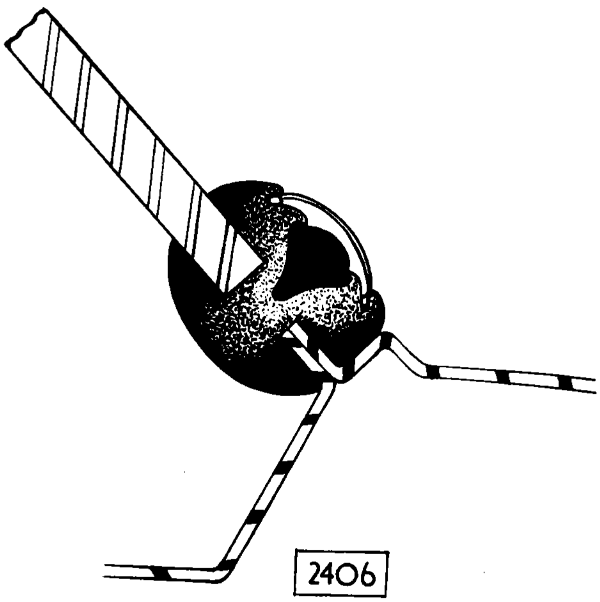


Fig. 21. Section through the windscreen glass.

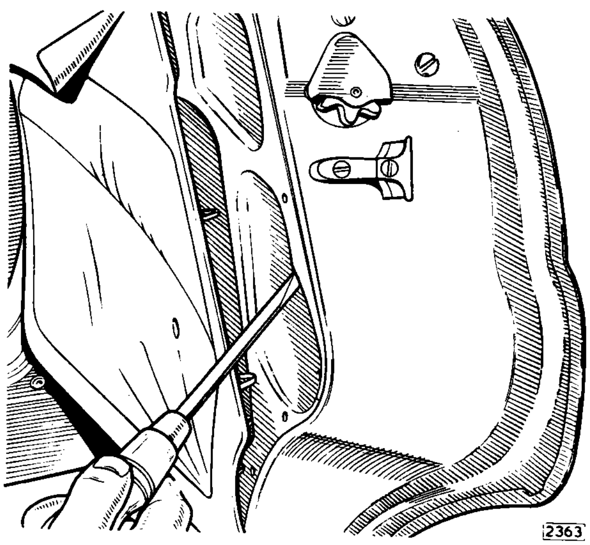


Fig. 22. Removing the front door trim casing.

FRONT DOOR AND HINGES

Removal

Remove the door trim casing as detailed under "Front and Rear Door Trim Casings", page N.19.

Remove the clear plastic sheet from the front section of the door.

Insert a thin blade screwdriver between the door frame and the small casing attached to the door upper closing panel and prise off the casing which is secured by two spring clips.

Pull the casing covering away from the door to expose the top hinge cover plate. Withdraw the five cross headed drive screws and remove the cover plate.

Remove the split pin and clevis pin from the check strap bracket.

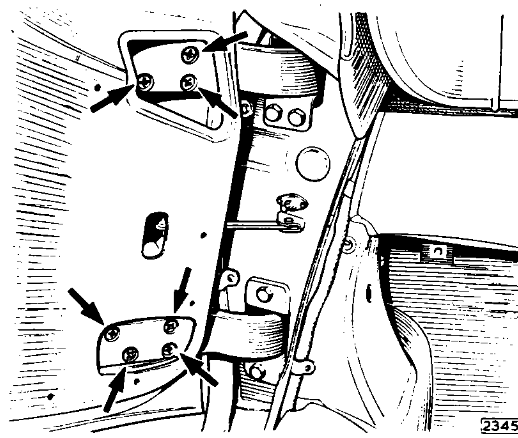


Fig. 23. The front door hinge mounting points.

Important: Care must be taken when the check strap has been disconnected to ensure that the door opening is restrained and the leading edge of the door is not allowed to contact the body panel. Failure to observe this may result in damage to the body panel paintwork.

Note: On cars equipped with electrically operated windows, it will be necessary to withdraw the motor cables as follows:—

Remove the two clips securing the cables to the door inner panel.

Disconnect the three snap connectors.

Remove the three setscrews securing the cable guide tube to the door closing panel and withdraw the cables and tube from the door.

Mark the position of the two hinges on the door.

Remove the four cross headed setscrews securing each hinge to the door and lift the door away from the hinges.

To remove the hinges from the door pillar, mark the position of the two hinges on the door pillar.

Disconnect the door opening torsion spring lever by removing the split pin and withdrawing the clevis pin from the bottom hinge. Remove the three setscrews and lock washers from the bottom hinge. Withdraw the hinges from the pillar.

Note: The hinges cannot be removed from the pillar until the door has been removed.

Refitting

Refitting is the reverse of the removal procedure.

Refit the door casing as detailed under "Front and Rear Door Trim Casings" (page N.19).

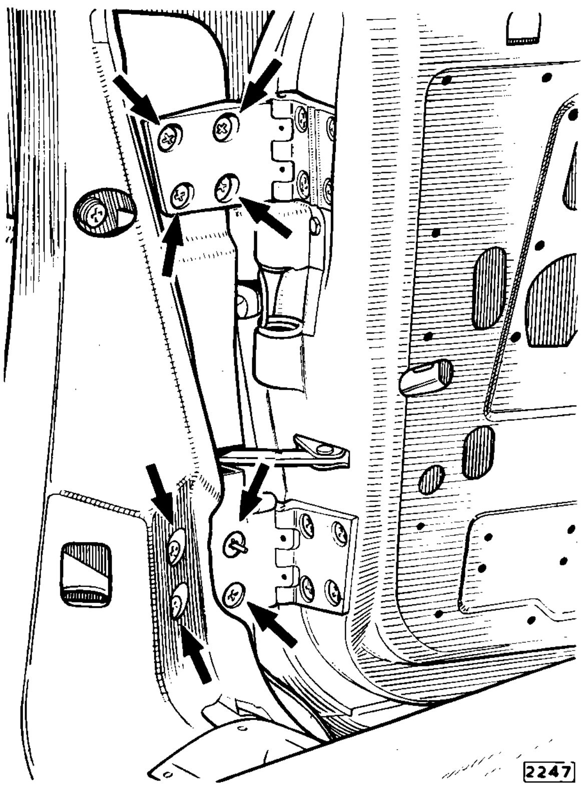


Fig. 24. The rear door hinge mounting points.

REAR DOOR AND HINGES

Removal

Remove the centre pillar capping by inserting a thin bladed screwdriver between the capping and the pillar pressing in the two spring clips fasteners and gently prising the capping away. Care must be taken not to damage the polished woodwork.

Remove the trim welts from the pillar by pulling away from the flange fixing.

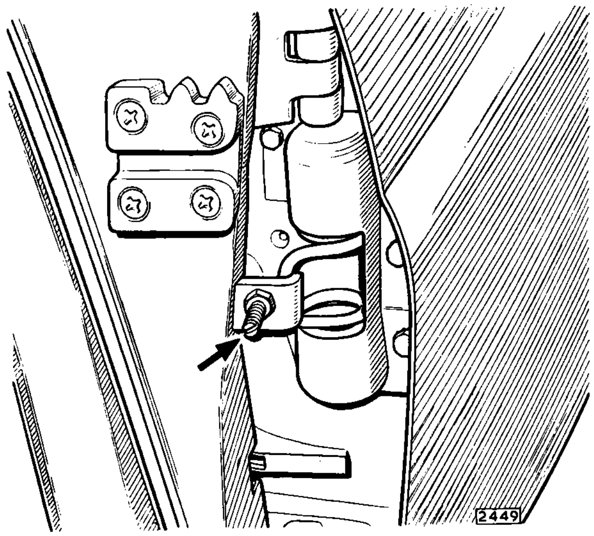


Fig. 25. The location of the rear door torsion spring adjuster screw.

Lift the centre pillar lower trim casing where stuck to the pillar, locate and remove three drive screws and detach the trim casing. Locate and disconnect the door pillar switch cable at the snap connector.

Mark the position of the top hinge on the body.

Note: On cars equipped with the electrically operated windows, it will be necessary to withdraw the motor cables as follows:—

Remove the door trim casing as detailed under "Front and Rear Door Trim Casings" page N.19.

Remove the two clips securing the cables to the door inner panel.

Disconnect the four snap connectors.

Detach the rubber door link by prising away the three plastic stud fixings from the door closing panel and withdraw the cables from the door.

Remove the split pin and clevis pin from the check strap bracket.

Important: Care must be taken when the check strap has been disconnected to ensure that the door opening is restrained and the panel of the door is not allowed to contact the rear edge of the front door. Failure to observe this may result in damage to the door panel and paintwork.

Remove the four cross headed setscrews securing each hinge to the body.

Note: The top outer screw on the bottom hinge functions as a door pillar switch.
To remove, press in the pin and extract as an ordinary screw.

Remove the door.

To remove the hinges from the door, mark the position of the two hinges on the door and extract the four cross headed screws from each hinge.

Refitting

Refitting is the reverse of the removal procedure.

Refit the door casing as detailed under "Front and Rear Door Trim Casings".

Adjusting the Door Torsion Spring

To adjust the door opening torsion spring, open the front door to gain access to the adjuster. Release the adjuster locknut, insert a screwdriver in the slot in the screw and turn clockwise to increase and anti clockwise to decrease the spring tension.

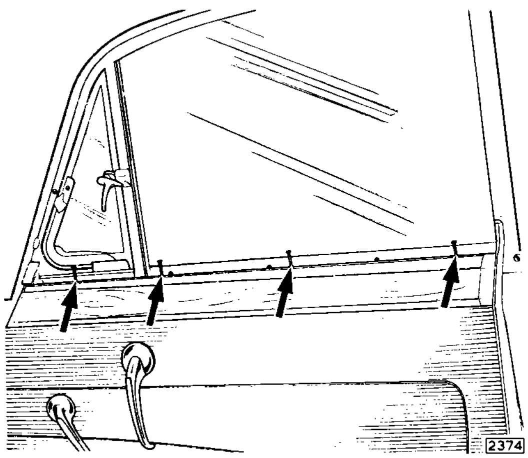


Fig. 26. The screws securing the waist rail to the door frame.

FRONT AND REAR DOOR TRIM CASINGS

Removal

Remove the four self-tapping screws and cup washers securing the wood capping to the waist rail.

Remove the four screws securing the waist rail to the door frame and detach the rail.

The covering for the door casing is attached to the door frame at the bottom of the window aperture with upholstery solution. Pull the covering away from the door frame.

Remove the five drive screws now exposed securing the door casing to the door frame.

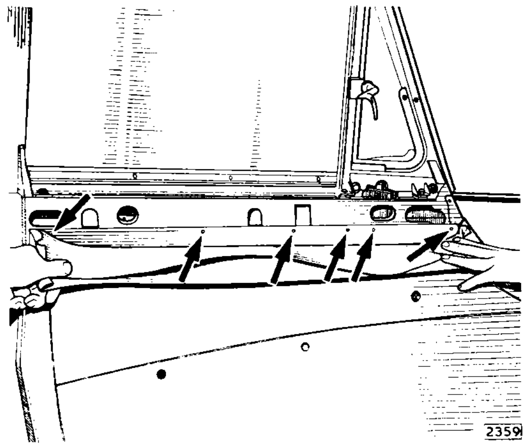


Fig. 27. The screws securing the top of the door trim casing.

Remove the two setscrews securing the arm rest to the door and detach the arm rest.

Insert a thin bladed screwdriver between the interior door lock handle and inner ring and prise apart. Insert a draw wire with a small formed hook end between the handle and the ring and locate the hook in the handle retaining spring clip loop (see Fig.28).

Withdraw the retaining spring clip.

The draw wire should be made from piano or spring steel wire with a 1″ (25·4 mm.) diameter loop formed at the opposite end to the hook for holding purposes.

Withdraw the door handle from the splined lock shaft.

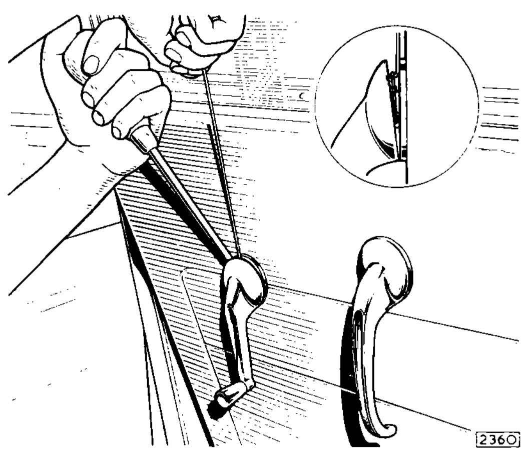


Fig. 28. Removing the window regulator handle.

As an alternative method for releasing the spring clip insert a flat strip of steel about $\frac{1}{16}''$ (1·6 mm.) thick between the handle (A) and the inner ring (B) as illustrated in Fig.29.

Press downwards sufficiently to disengage the spring clip from the groove in the splined handle spindle and retain it in this position to enable the handle to be removed.

Remove the window regulator handle, secured in the same way as the door lock handle.

Insert a thin bladed screwdriver between the door casing and the door frame.

Prise off the casing which is secured by 16 clips on the front door and 13 clips on the rear door. Remove the felt pads from the regulator shafts.

To remove the small trim casing attached to the front door upper closing panel, lift away the trim covering where stuck to the door panel and prise off the casing which is secured by two clips.

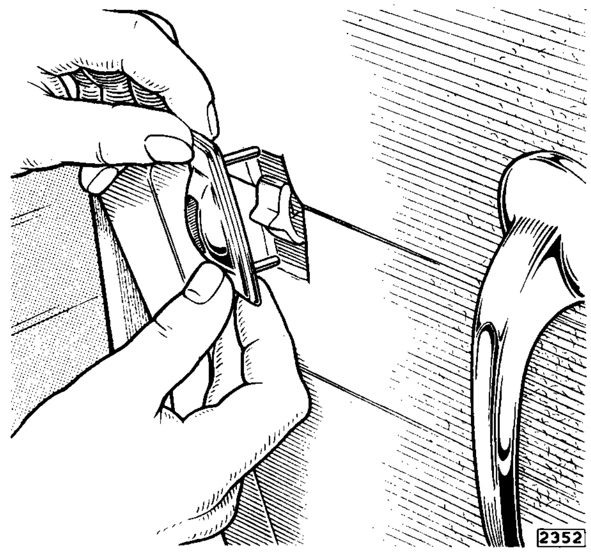


Fig. 30. Removing the rear door switch escutcheon (electrically operated windows).

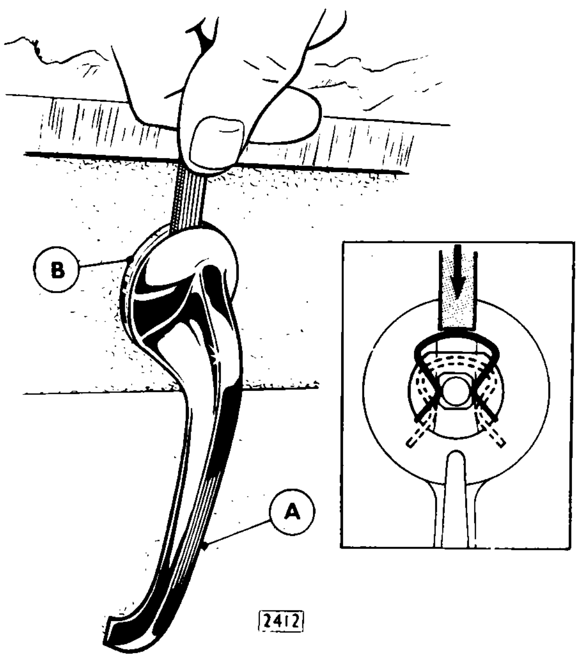


Fig. 29. An alternative method of removing the regulator handle.

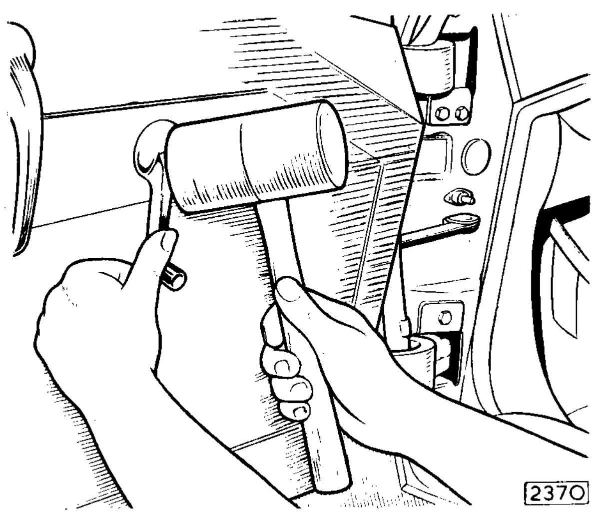


Fig. 31. Refitting the regulator handle.

Refitting

Refitting is the reverse of the removal procedure.

When refitting the window regulator and door lock handles, reassemble the spring clips to the handles with the loop uppermost before attaching to the splined shafts.

Fully close the window and fit the regulator handle with the knob vertically below the escutcheon. Feed the handle onto the correct spline and tap fully home with a soft faced hammer. Ensure that the inner ring is fitted to the handle before attaching to the shaft.

The door lock handle is fitted in a similar manner.

FRONT DOOR WINDOW FRAME AND GLASS

Removal

Remove the door trim casing as detailed under "Front and Rear Door Trim Casings" page N.19.

Pull off the clear plastic sheet found attached to the door frame with upholstery solution.

Remove the five round headed setscrews and washers securing the window frame to the top of the door frame.

Note and collect all the packing pieces under these screws. Care must be taken to replace the same number of packing pieces under their respective screws when refitting the frame.

Remove the drive screw securing the window frame to the rear top corner of the door.

Remove the two setscrews and washers securing the two legs of the window frame to the door. Collect the fibre packing washers when withdrawing the screws.

Withdraw the window frame.

Collect the small rubber sealing pad fitted to the rear of the window frame and the door top panel.

Raise the glass and withdraw from the regulator arms.

Remove the weather strip from the door frame by withdrawing six drive screws and lifting away the chrome bearing and rubber seal.

If the glass is to be renewed, remove the channel and discard the sealing compound.

Refitting

Fit the regulator arm channel to the glass, if previously removed, renewing the sealing compound.

Fit a new rubber seal to the weather strip chrome beading if damaged and refit the strip to the door securing with the six drive screws. Bed the two ends of the chrome beading in a glass sealing compound before securing to the door for a length of approximately 3" (76·2 mm.).

Place the glass into position on the regulator arms and slide the glass into position between the door frame.

Insert the window frame into the door and enter the glass into the window frame channel.

Refit all screws, bolts, nuts and packing pieces.

Tighten finger tight only and refit the small rubber sealing pad to the frame rear.

Close the door and check the clearance of the frame with the screen pillar. Adjust the window frame to a clearance of $\frac{1}{4}$" (6·4 mm.) maximum.

Fully tighten all the mounting points and check that the glass moves freely in the frame channels.

Seal the entry point of the frame rear leg into the door frame with sealing compound.

Clean off any surplus sealing compound and refit the plastic sheeting.

Refit the door casing as detailed under "Front and Rear Door Trim Casings" page N.19.

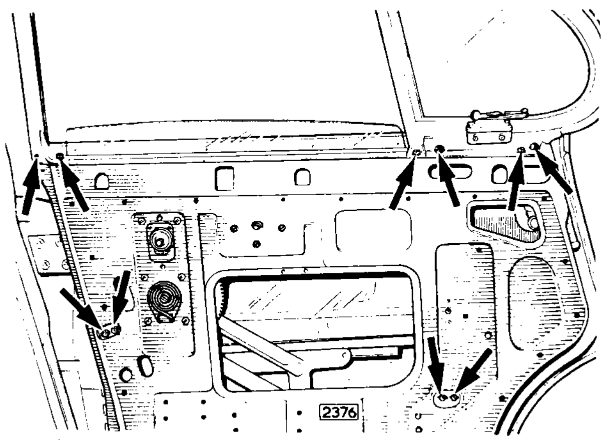


Fig. 32. The rear door window frame securing screws.

REAR DOOR WINDOW FRAME AND GLASS

Removal

Remove the door trim casing as detailed under "Front and Rear Door Casings".

Pull off the clear plastic sheet.

Remove the three round-headed setscrews and washers securing the window frame to the top of the door frame.

Remove the countersunk bolt and chrome cap nut securing the frame front to the door panel.

Release the two slotted screws accessible through holes in the door panel below the N.D.V. light.

Raise the window.

Remove the two bolts, nuts and washers securing the front and rear legs to the door frame.

Collect all packing pieces. Care must be taken to replace the same number of packing pieces under their respective screws when refitting the frame.

Withdraw the window frame. Collect the small rubber pad fitted between the front of the window frame and the door panel top.

Raise the glass and withdraw from the regulator arms.

Remove the weather strip from the door frame by withdrawing six drive screws and lifting away the chrome beading and rubber seal.

If the glass is to be removed, remove the channel and discard the sealing compound.

Refitting

Fit the regulator arm channel to the glass, if previously removed, renewing the sealing compound.

Fit a new rubber seal to the weather strip chrome beading if damaged, and refit the strip to the door securing with the six drive screws. Bed the two ends of the chrome beading in a glass sealing compound before securing to the door for a length of approximately 3" (76·2 mm.).

Place the glass into position on the regulator arms and slide the glass into position between the door frame.

Insert the window frame into the door, noting that the two screws and washers located under the N.D.V. light register correctly with the slotted holes in the window frame. Refit all screws, bolts, nuts and packing pieces. Tighten finger tight only and refit the small rubber pad to the frame front.

When the electrically operated window system is fitted to the car, the window regulator handles are omitted, being replaced on the rear window only by an electrical switch. To remove the switch escutcheon before removing the door casing, insert a thin bladed screwdriver between the escutcheon and the casing and gently prise the escutcheon away.

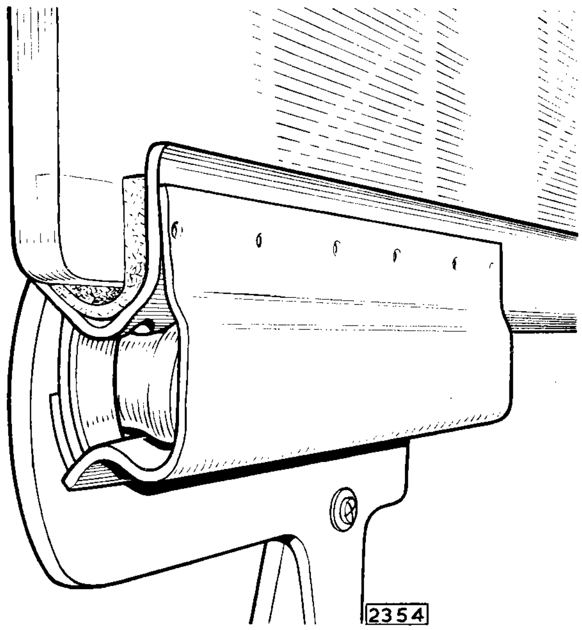


Fig. 33 The window regulator arm and channel.

Close the door and check the clearance of the frame with the centre pillar. Adjust the window frame to a clearance of $\frac{1}{4}$" (6·4 mm.) maximum. Check that the rear door frame is parallel with front door frame with both doors closed.

Fully tighten all the mounting points and check that the glass moves freely in the frame channels. Refit the plastic sheeting.

Refit the door casing as detailed under "Front and Rear Door Casings"

FRONT NO DRAUGHT VENTILATOR

Removal

Remove the trim casing from the front door as detailed under "Front and Rear Door Trim Casings"

The no draught ventilator adjustment and securing mechanism is visible through a small aperture in the door frame.

Remove the locknut, nut and washer securing the spring against the quadrant and withdraw the quadrant.

Remove the pin and segment on the N.D.V. post.

Remove the countersunk screw securing the hinge to the door frame.

Open the N.D.V. and withdraw from the window frame.

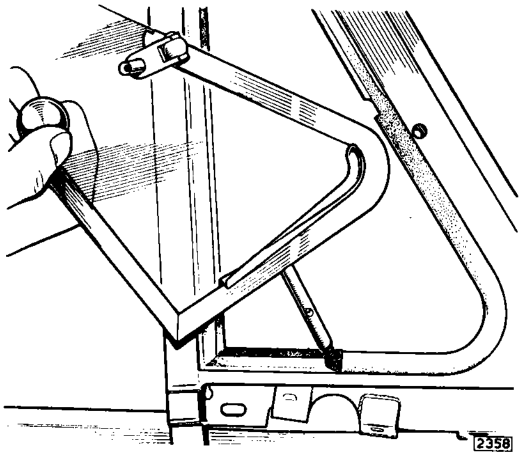


Fig. 34. Removing the front N.D.V. light from frame.

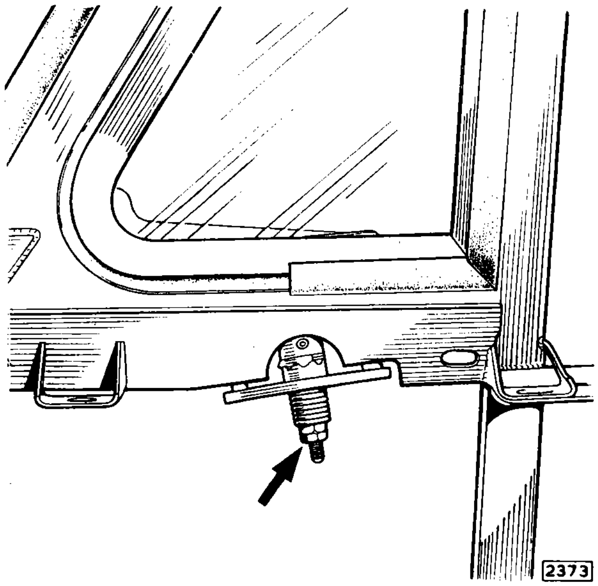


Fig. 35. The front N.D.V. light adjustment.

Refitting

Refitting is the reverse of the removal procedure.

Adjust the quadrant spring tension so that the N.D.V. light will remain in any of the open positions selected without backlash.

REAR NO DRAUGHT VENTILATOR

Removal

Remove the nut, screw and fibre washer securing the rear N.D.V. bracket to the catch arm which operates the N.D.V.

Open the ventilator, remove the five countersunk screws securing the N.D.V. hinge to the window frame and withdraw the light.

Refitting

Refitting is the reverse of the removal procedure.

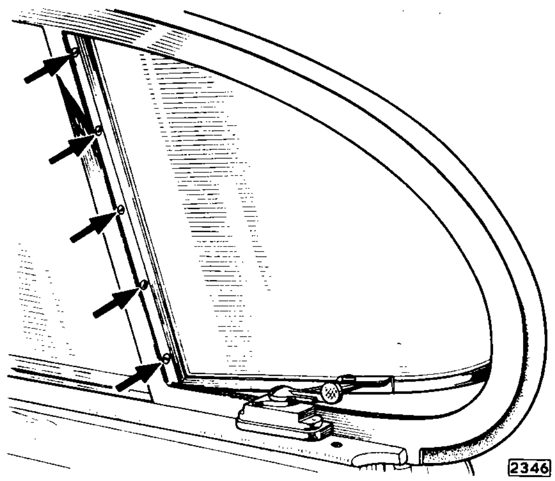


Fig. 36. Removing the rear N.D.V. light.

FRONT WINDOW REGULATOR

(Manually Operated)

Removal

Remove the door trim casing as detailed under "Front and Rear Door Trim Casings".

Pull off the clear plastic sheet and remove the felt placed over the window regulator spindle.

Remove the window frame and glass as detailed under "Front and Rear Door Window Frames" page N.21.

Remove the four screws and lock washers securing the window regulator to the door frame.

Remove the four screws and lock washers securing the window regulator spring to the door.

Withdraw the mechanism from the door frame.

Refitting

Refitting is the reverse of the removal procedure.

REAR-WINDOW REGULATOR

(Manually Operated)

Removal

Remove the door trim casing as detailed under "Front and Rear Door Trim Casings".

Remove the felt placed over the regulator spindle and pull off the clear plastic sheet.

Remove the window frame and glass as detailed under "Front and Rear Door Window Frames" page N.21.

Remove the six screws and lock washers securing the regulator mechanism to the door frame and withdraw the mechanism.

Refitting

Refitting is the reverse of the removal procedure.

FRONT WINDOW REGULATOR

(Electrically Operated)

Refer to Section P "Electrical and Instruments" for the removal and refitting procedure.

REAR WINDOW REGULATOR

(Electrically Operated)

Refer to Section P "Electrical and Instruments" for the removal and refitting procedure.

FRONT SEATS AND SEAT RUNNERS

Removal

Remove the cushion.

Slide the seat fully rearwards.

Remove the two setscrews and washer securing the front of the seat runners to the body floor and collect the two distance pieces located between the runner and the floor.

Slide the seat forwards and remove the setscrew securing the inner runner and the nut and bolt securing the outer runner to the floor. Collect the two distance pieces.

Disconnect the two slide springs and push the seat slide forward exposing the setscrews securing the rear of the seat slides to the seat.

Remove the bolts, nuts and washers.

Push the seat slides to the rear and remove the front securing bolts, nuts and washers.

Note: The outer slides are secured by setscrews and washers only.
Collect the distance piece between the slides and the seat frame.

To remove the seat back rest, extract the split pins and withdraw the four clevis pins securing the back rest to the seat frame pivots and locking mechanism. Collect the washers from the clevis pins. To remove the locking bars, turn the release handle to release the locking catch and withdraw the locking bars.

To remove the handle, insert a screwdriver between the handle and spring cap and press the cap inwards. This will expose the retaining pin which should be tapped out. The handle and spring cap can now be removed.

Refitting

Refitting the seat back rest and locking mechanism is the reverse of the removal procedure.

When refitting the seat and seat slides care must be taken to ensure that the distance pieces are replaced exactly as removed.

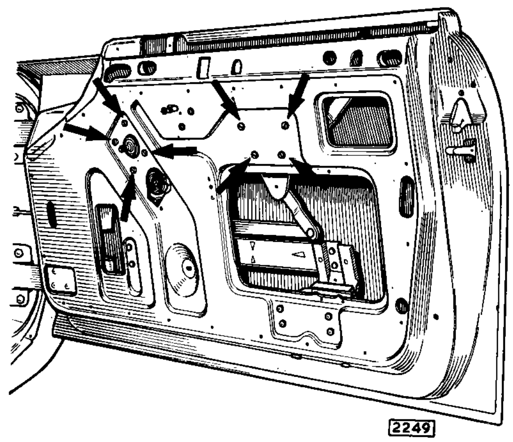


Fig. 37. The screws securing the front window winding mechanism to the door frame.

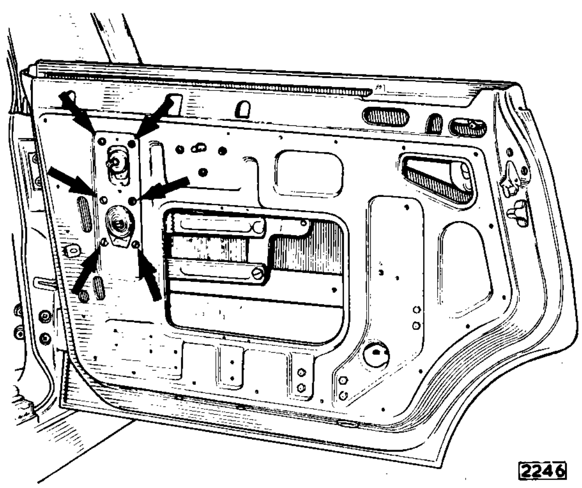


Fig. 38. The screws securing the rear window winding mechanism to the door frame.

REAR SEAT AND SQUAB

Removal

Lift the rear cushion upwards, withdraw forwards and remove.

Remove the three setscrews, nuts serrated and lock washers securing the bottom of the rear seat squabs to the back of the seat pan.

Lift the squabs to disengage the three top hook fixings and remove.

Refitting

Refitting is the reverse of the removal procedure.

POLISHED WOOD CAPPINGS

Removal of Centre Pillar Capping

Insert a thin bladed screwdriver between the trim casing and the centre door pillar. Prise off the trim casing and pull downwards to release the tongue on the casing from behind the upper capping.

Knock the wooden capping downward with the hand and remove. The wooden capping is secured by two clips.

Note: If seat belts are fitted it will be necessary to detach the anchorage plate by withdrawing the fixing bolt before removing the capping.

Refitting

Refitting is the reverse of the removal procedure.

Removal of the Capping Rail at the side of the windscreen

Release the two nuts with serrated and plain washers securing the screen rail to the body.

Remove the screw securing the bottom of the side capping rail to the body.

Pull away the sealing rubber around the top of the front door aperture. This will expose the screw securing the side capping rail.

Withdraw the side capping rail downwards to clear the cant rail joint.

Refitting

Refitting is the reverse of the removal procedure.

Removal of the Rear Cant Rail

Remove the rear quarter cant rail as described above.

Slide the rear cant rail to the rear, insert a thin bladed screwdriver between the rail and the body, press in the four spring clips and gently prise away the cant rail.

Note: On some cars the rail may also be secured by a woodscrew accessible after lifting the door aperture sealing rubber adjacent to the centre pillar.

Refitting is the reverse of the removal procedure.

Removal of the Courtesy Light and Capping

Remove the rear quarter cant rail as described above.

Remove the rear cant rail securing screw (if fitted) and slide the rail to the rear to clear the courtesy light capping.

Slide the capping to the rear, insert a screwdriver between the capping and the body, press in the two spring clips and gently prise away the capping.

Disconnect the two cables from the light unit.

To remove the courtesy light from the capping, pull off the light cover, and withdraw the two screws securing the lamp to the block.

Removal of the Front Cant Rail

Remove the rear quarter cant rail as described previously.

Remove the rear cant rail securing screw (if fitted) and slide the rail to the rear.

Slide the courtesy light capping to the rear to clear the front cant rail.

Slide the front cant rail to the rear, insert the thin bladed screwdriver between the rail and the body, press in the three spring clips, and gently prise away the cant rail.

Note: On some cars, the rail may also be secured by a wood screw accessible after lifting the door aperture sealing rubber adjacent to the centre pillar.

TRANSMISSION TUNNEL COVER AND CONSOLE

Removal

Disconnect the battery.

Remove the black plastic button from the bottom of the ash tray (or radio) surround panel and withdraw the slotted screw now exposed.

Detach the surround by pulling away the two peg fixings from the spring retainers located at the top corners of the panel.

Disconnect the cables from the radio (if fitted).

Remove the console from the gearbox tunnel after removing two thumb nuts from the rear end and two

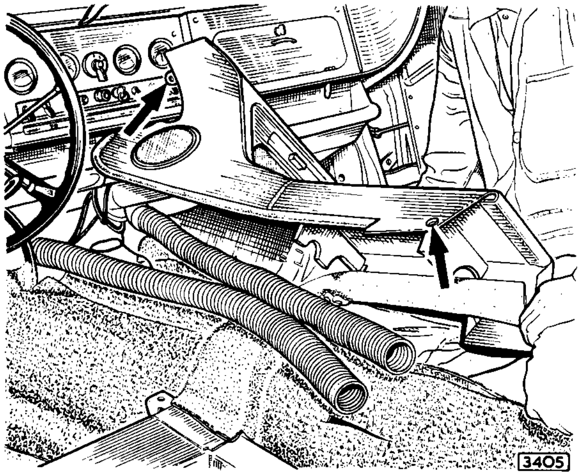


Fig. 39. The transmission tunnel cover securing points.

thumb nuts and drive screws beneath the parcel tray.

Remove the gear lever knob and lift the console over the gear lever (synchro-mesh gear boxes only).

If the car is equipped with electrically operated windows, insert a screwdriver under the four-switch panel at the rear edge and lift clear of the spring/stud mounting.

Withdraw rearwards away from the cl'p fixing and feed the panel through the aperture in the console.

Care must be taken not to damage the polished facia when removing or refitting.

Remove the picnic tray by withdrawing to the full extent and pressing the spring retaining clips on the back edge inwards.

Refitting

Refitting is the reverse of the removal procedure.

PARCEL TRAY

Removal

Remove the transmission tunnel cover and console as detailed above.

Remove the small screws retaining the four temperature control knobs to the levers and withdraw the knobs. Remove the two self-locking nuts retaining the temperature control levers to the pivots located under the parcel tray and withdraw the levers. Note the location of the pivot bushes and washers for reference when refitting.

Remove the two setscrews and nuts securing the heater control unit to the mounting brackets and withdraw the unit from the parcel tray surround.

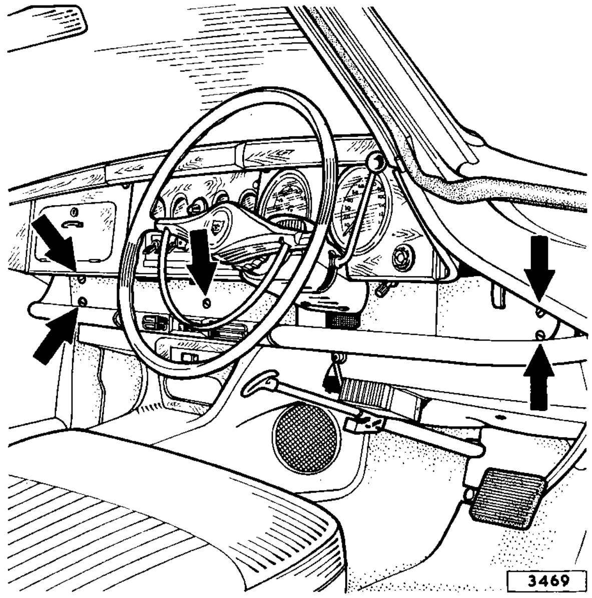


Fig. 40. The parcel tray securing points.

Remove the six drive screws securing the parcel tray to the bulkhead, two central and two at each outer edge and withdraw the parcel tray.

REAR HEATER DUCT CONTROL

Removal

Remove two drive screws and detach the cover.

Detach the two flexible pipes from the duct orifice.

Lift the carpet, where cut, below the rear duct assembly, remove the four drive screws and detach the complete duct unit.

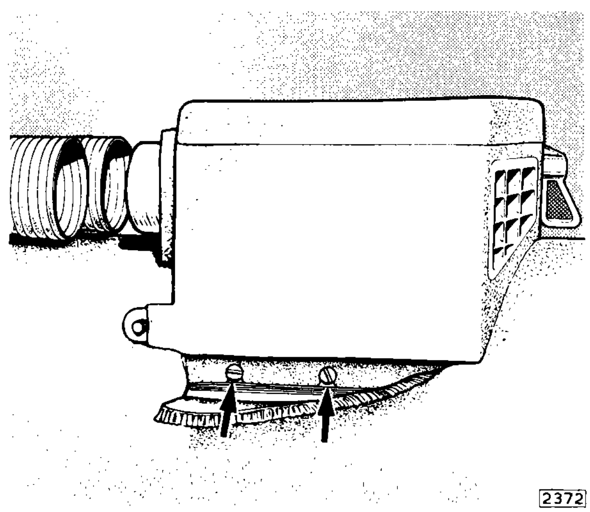


Fig. 41. The rear heater dual control securing points.

Note: On the front it is necessary to remove the lower glass channel bolt with plain and lockwashers and packing pieces to enable the control to be pressed in sufficiently to clear the spindle.

To detach the operating spring, remove the duct unit, open the shutter, turn the spring through 90° and lift the spring hooks away from the pivot holes in the shutter and the body.

Refitting

Refitting is the reverse of the removal procedure.

DOOR LOCK MECHANISM

Removal of Lock mechanism

Remove the door trim casing as detailed under "Front and Rear Door Trim Casings" page N.19.

Pull off the clear plastic sheet attached to the door frame with upholstery solution.

Raise the window to the full extent and release the spring clip holding the bottom of the outside handle connecting link (E or Ea) Fig.44 to the dowel (F) on the intermediate lever. This is accessible through an aperture in the inner door panel. Remove the spring clip (G) and the waved washer fitted between the connecting link (H) and the remote control link.

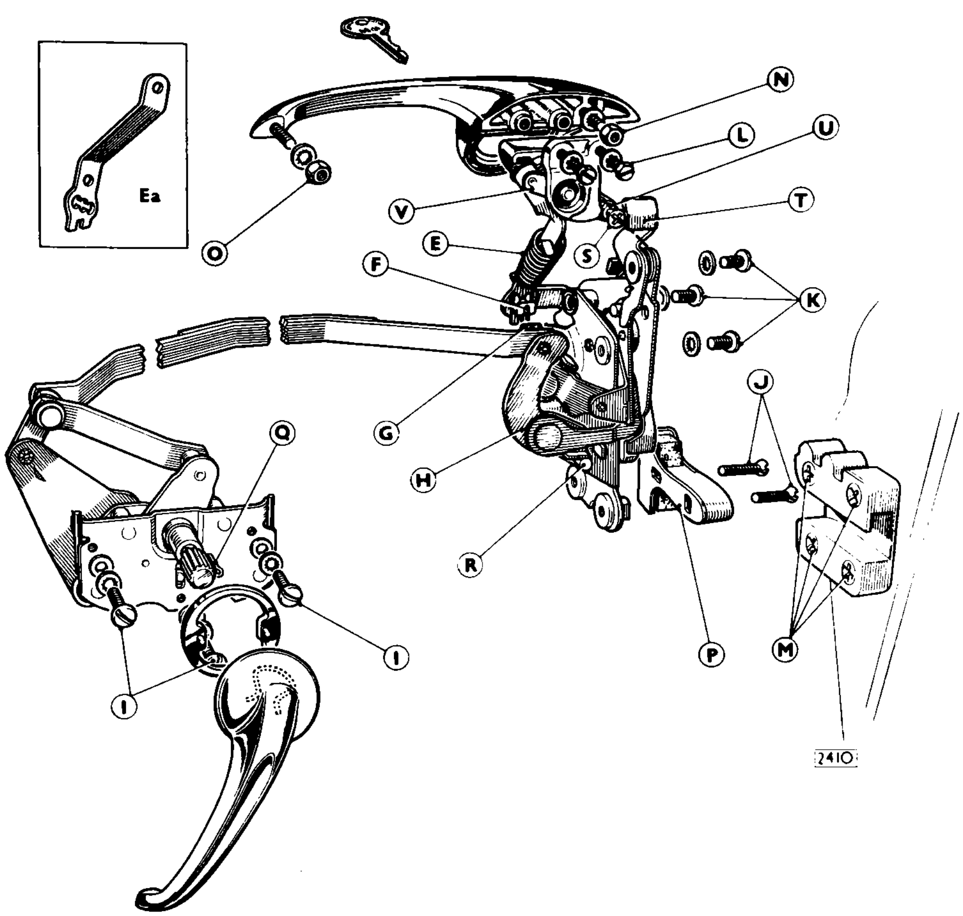


Fig. 42. Exploded view of the door lock mechanism.

Removing the Lock Unit

Remove the two countersunk screws (J) which pass through the dovetail and the three setscrews with lock and plain washers (K) (two on the rear doors) from the door shut face.

Remove the lock through the aperture in the door panel.

Removing the Outside Handle Base Plate Assembly

This is retained from inside the door by two setscrews (L) and lockwashers.

Removing the Outside Handle

This should not be removed unless it is necessary to fit a replacement handle and is retained in position by the two nuts (N) and (O) and lockwashers.

On the front doors it will be necessary to remove the window frame and glass as detailed on page N.21 but on the rear doors the window frame only should be removed as detailed on page N.21 and the glass wound down to its lowest point.

Removing the Striker Unit

Do not disturb the three fixing screws (M) unless it is necessary to make adjustments or fit a replacement.

Removing the Remote Control Unit

Remove the three setscrews (I), lock and plain washers securing the remote control unit to the door panel.

Press the control inwards to clear the spindle from the door panel and remove from the door via the large aperture.

REFITTING THE LOCK MECHANISM

Refitting the Lock Unit

The lock is inserted through the upper aperture in the inner door panel and passed between the window channel and the outer door panel, if the window channel has not been previously removed, so that the rotor and dovetail locating studs project through their respective apertures in the shut face of the door.

The dovetail (F) is then placed in position and retained with the two countersunk screws (J). The three screws (K) with lockwashers (two on the rear doors) are fitted through the shut face.

Refitting the Remote Control Unit

The remote controls must always be fitted in the locked position.

In the case of the front doors the controls are supplied pinned in the locked position as shown at (Q) ready for fitting.

Locate the remote control inside the door via the large aperture so that the spindle and the split pin on the front doors project through the door inner panel.

Fit the connecting link to the stud on the lock lever (H) with the waved washer interposed and fit the spring clip (G).

Fit the three setscrews (I) with the plain and lock washers.

Do not tighten the setscrews at this stage.

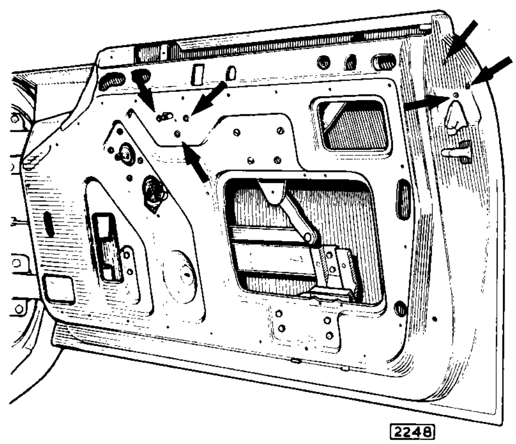


Fig. 43. Showing the front door lock mounting points.

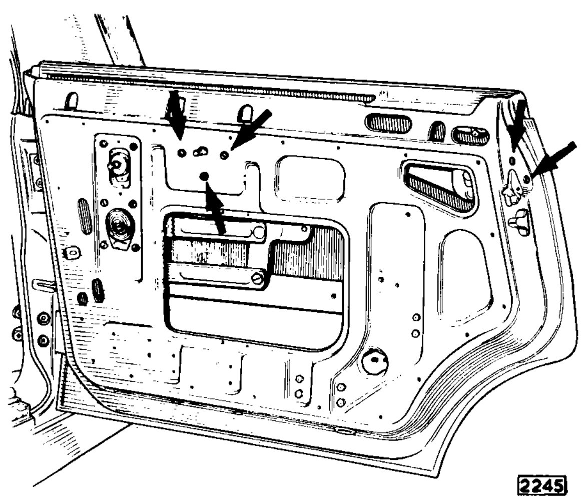


Fig. 44. The rear door lock mounting points.

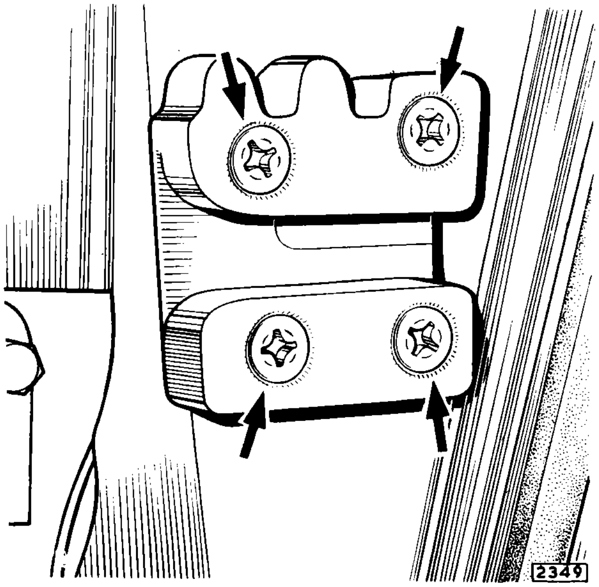


Fig. 45. Location of the door striker plate securing screws.

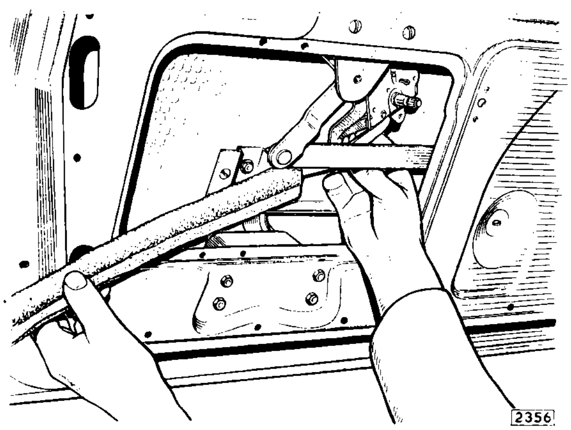


Fig. 46. Placing the front door lock in position.

Aligning the Lock Assembly

The assembly is aligned by sliding the remote control towards the lock, the holes in the inner door panel being elongated for this purpose. The lock lever (H) should then be in contact with the stop (R) on the lock as illustrated and three securing screws (I) can then be tightened.

Refitting the Outside Handle Base Plate Assembly

The base plate assemblies are stamped L.H. (left-hand) or R.H. (right-hand).

The appropriate assembly should be held in position inside the door panel and the clearance between the push button plunger (S) and the lock contractor (T) checked through the aperture in the inner door panel. The clearance should be $\frac{1}{32}$" (0·79 mm.).

To adjust release the locknut (U), screw the plunger screw (S) in or out as required and re-tighten the locknut.

Before finally fitting the assembly, the appropriate connecting link (E) (Ea on rear doors) should be attached to the dowel on the plunger operating lever (V) and retained by the spring clips.

The base plate assembly is secured from inside the door by two setscrews (L) which pass into the back of the outside handle.

Connecting the Push Button Mechanism

First ensure that the remote control is set in the locked position. On the front doors this is retained by the split pin (Q) as illustrated.

To compensate for variations in fitting, the links (E and Ea) are provided with three holes at the bottom end. It will be observed that one of these can be aligned with the dowel (F) in the intermediate lever. The link is automatically retained by a spring clip.

At this stage, remove the split pin (Q) from the remote control on the front doors in order that the locking operation can be checked as follows:—

Depress the push button; the plunger (S) should clear the lock contractor (T).

Conversely, when the remote control is set in the unlocked position, the plunger should pass squarely behind the lock contractor, coming into contact with it when the push button is operated.

Fitting and Adjusting the Striker Unit

Attach the striker loosely by means of its four screws (M) which pass through the door pillar into an adjustable tapping plate.

Positioning is carried out by trial and error until the door can be closed easily but without rattling and no lifting or dropping of the door is apparent. Ensure that the securing screws are finally tightened.

Important: The striker must be retained in the horizontal plane relative to the door axis.

Master Check for Correct Alignment

Fit an inside handle vertically downwards on the remote control spindle. This is simply pressed on, being automatically retained by the internal spring.

Front Doors

Turn the inside handle **forward.** It will automatically return to the central position when released. Close the door while holding the push button in the **fully depressed** position. The door will remain locked although the push button may be **freely depressed.**

Insert the key in the slot in the push button and turn in the appropriate direction. Push button control will then be restored and the door can be opened.

After turning the key, will automatically return to the **horizontal** position when it can be removed.

Important: The key must be removed from the locking device before closing a door in the locked position.

Rear Doors

Turn the inside handle forward into the locked position where it will be automatically retained.

Close the door; it will then be locked although the push button may be freely depressed.

To unlock, the inside handle is returned to the central position when push button control is restored.

Lubrication

Before fitting the door casing, ensure that any moving parts are adequately greased. After assembly introduce a few drops of thin machine oil around the rotor and into the private lock key slots. These items should be lubricated once a month.

Important: The private lock cylinders must not under any circumstances be lubricated with grease.

ACCIDENTAL DAMAGE

The repair of integral construction bodies varies in some degree, depending upon the extent of the damage, to that of separate body and chassis construction.

Superficial damage can be repaired in a similar manner to that employed on "all steel" bodies which is familiar to all body repairers.

Repairs to rectify extensive damage affecting the main members of the underframe must be carried out so that when the repair is completed the main mounting points for the engine, front and rear suspensions, etc., are in correct relation to each other.

When checking for, or rectifying, distortion in the main underframe members, reference should be made to the diagrams in the section headed "Checking Body Underframe Alignment" which provides the important dimensions to be observed.

Replacement Body Panels

Where the existing panels or members are badly damaged and it is not possible to effect a satisfactory repair in position, the affected panels will have to be cut out and replacement panels welded in their place.

It will frequently be found advantageous to use only a part of a given panel so that the welded joint can be made in a more accessible position. Great care must, of course, be taken when cutting the mating portions of the panel to ensure that perfect matching is obtained.

For example, if damage to a front wing is confined to the forward end a simpler and quicker repair can be effected by cutting the front wing off between the wheel aperture and the wing valance.

If the replacement front wing is then cut to match, a simple butt weld can be made and after cleaning down with a sanding disc and filling with plumber's lead the joint should be invisible.

Any unused portions of replacement panels should be retained as it will often be found that they can be used for some future repair job.

Where a replacement panel to be fitted forms part of an aperture such as for a door or the luggage boot lid, an undamaged door or lid should be temporarily hinged on position and used as a template to assist location while the replacement panel is clamped and welded in position.

Similarly, an undamaged radiator grille can be used as a template to accurately form the aperture when fitting a replacement front wing or wings.

Before any dismantling takes place after accidental damage a check of the underframe alignment should be carried out.

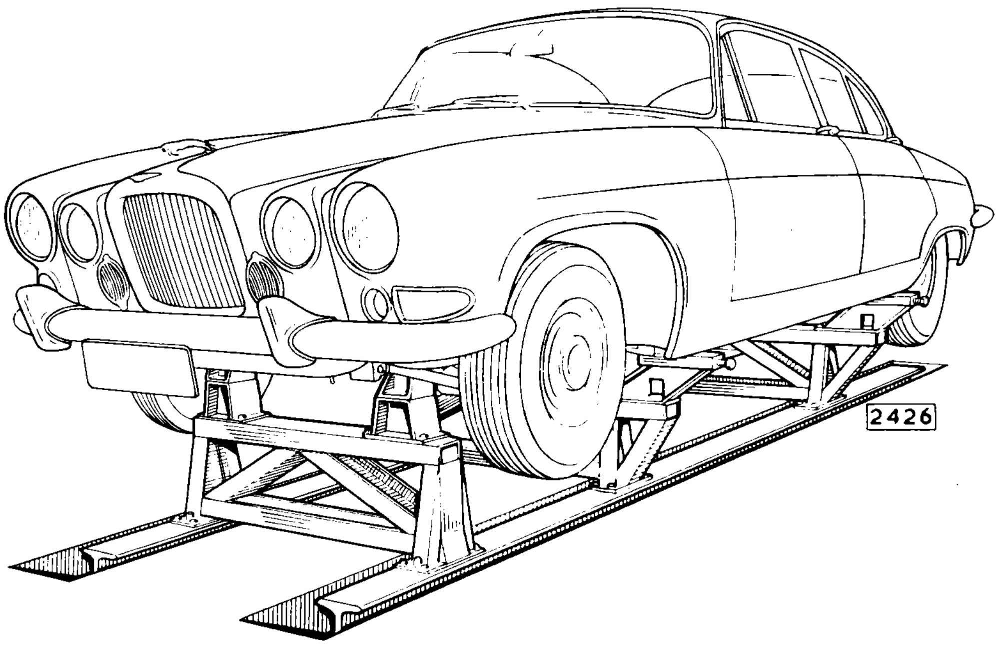


Fig. 47. The body underframe jig.

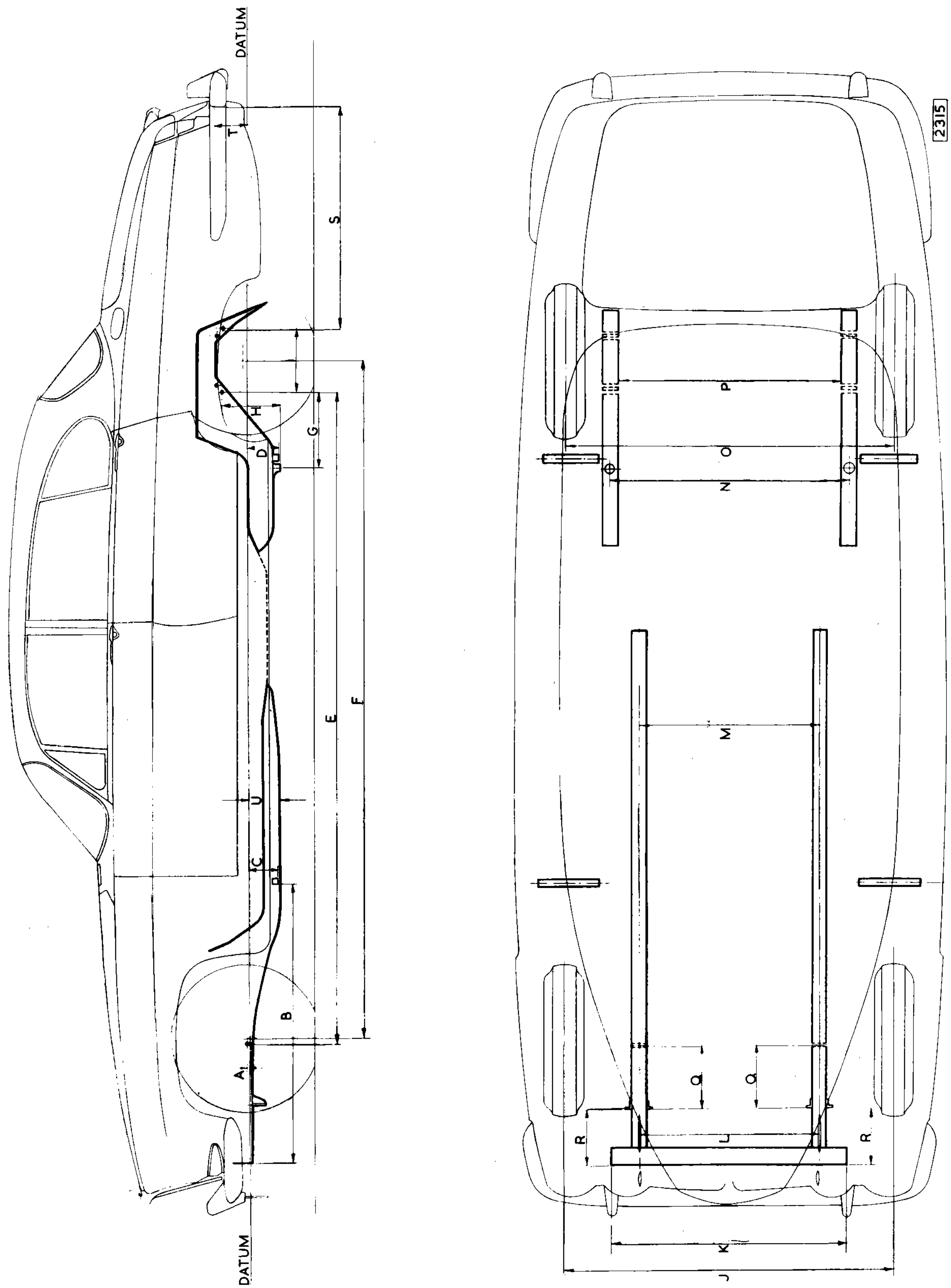


Fig. 48. The underframe alignment diagram.

KEY TO ALIGNMENT DIAGRAM

SYMBOL	MEASUREMENT TAKEN FROM	DIMENSION
A	Datum line to centre of tube in chassis side member for front suspension cross member mounting	$1\frac{1}{16}''$ (2·7 cm.)
B	Front of jacking tube to front face of sub-frame cross member	$49\frac{35}{64}''$ (124·75 cm.)
C	Datum line to bottom face of front jacking tube	$5\frac{17}{64}''$ (13·37 cm.)
D	Datum line to bottom face of rear jacking tube	$5\frac{17}{64}''$ (13·37 cm.)
E	Centre line of tube for front suspension cross member mounting to centre line of lower front tube of rear suspension frame mounting	$114\frac{5}{8}''$ (291·14 cm.)
F	Centre of front wheel to centre of rear wheel	120″ (304·8 cm.)
G	Centre line of radius arm body mounting bracket to centre line of lower front tube of rear suspension frame mounting	$12\frac{15}{64}''$ (31·1 cm.)
H	Bottom of radius arm body mounting bracket to centre line of lower front tube of rear suspension frame mounting	$10\frac{7}{64}''$ (25·68 cm.)
I	Centre line of lower front tube to lower rear tube of rear suspension frame mounting	$11\frac{1}{4}''$ (28·58 cm.)
J	Front track	$58\frac{3}{4}''$ (149·22 cm.)
K	Outer ends of front cross member	$55\frac{1}{2}''$ (140·97 cm.)
L	Centre lines of front chassis side members at front	$26\frac{5}{8}''$ (67·62 cm.)
M	Centre lines of front chassis side members at rear	$26\frac{5}{8}''$ (67·62 cm.)
N	Centre lines of radius arm body mounting	$41\frac{7}{8}''$ (106·36 cm.)
O	Rear track	$58\frac{21}{32}''$ (148·98 cm.)
P	Inner faces of rear chassis side members	$38\frac{7}{8}''$ (98·74 cm.)
Q	Forward face of front suspension cross member mounting bracket to tube in chassis side member for front suspension cross member	$11\frac{1}{4}''$ (28·58 cm.)
R	Forward face of front suspension cross member mounting bracket to front face chassis cross member	$9\frac{1}{2}''$ (24·13 cm.)
S	Lower rear tube of rear suspension frame mounting to rear bumper mounting face	$39\frac{51}{64}''$ (101·08 cm.)
T	Datum line to centre line of rear bumper mounting bolt hole	$6\frac{3}{32}''$ (15·47 cm.)
U	Datum line to underside of straight section of chassis side member	$5\frac{1}{32}''$ (12·78 cm.)

CHECKING BODY UNDERFRAME ALIGNMENT

Checking for Distortion in the Horizontal Plane

The plan view of the body on page N.30 provides the important dimensions for checking for distortion in the underframe. These dimensions can be measured actually on the underside of the body or by dropping perpendiculars from the points indicated by means of a plumb-bob on a clean and level floor. If the latter method is adopted, the area directly below each point should be chalked over and the position at which the plumb-bob touches the floor marked with a pencilled cross.

Checking for Distortion in the Vertical Plane

For checking the underframe for distortion in the vertical plane, the side elevation gives the details of the important dimensions from a datum line.

If the relative distance between two points **above** the datum line is required, one dimension should be subtracted from the other.

If the relative distance between a point above the datum line and the straight section of the chassis side member is required, add the dimension "U"—$5\frac{1}{32}$" (12·78 cm.)*— to the dimension above the datum line.

If it is required to check the dimensions from ground level, raise up the car at the front and rear, insert four blocks or stands of exactly equal height between the ground and the straight section of the chassis side members. **Do not allow the weight of the car to rest on the blocks as these are only intended as test pieces.**

The distance from the ground to any given check point will be:

Height of blocks + U* + Distance from datum line to check point.

EXHAUST SYSTEM

REMOVAL

Remove the self-locking nuts securing the tail pipe rubber mountings (26) to the underside of the luggage compartment floor. The nuts are accessible after lifting the rear edge of the floor covering.

Remove the nuts and lockwashers securing the rear intermediate pipes to the support brackets (25).

Release the clips (20) securing the rear intermediate pipes to the main silencer (13) and detach the rear silencer assembly.

Release the clips (14) and remove the main silencers.

Remove the bolts, self-locking nuts and plain washers securing the front intermediate pipes (7–8) to the rubber mountings (10) and collect the insulating washers and distance collars.

Release the clips (9) securing the pipes to the front silencers (5) and detach the pipes.

Release the clips (6) and remove the front silencers.

Remove the setscrew, nut and lockwashers securing the front down pipe (1) to the rear down pipe (2).

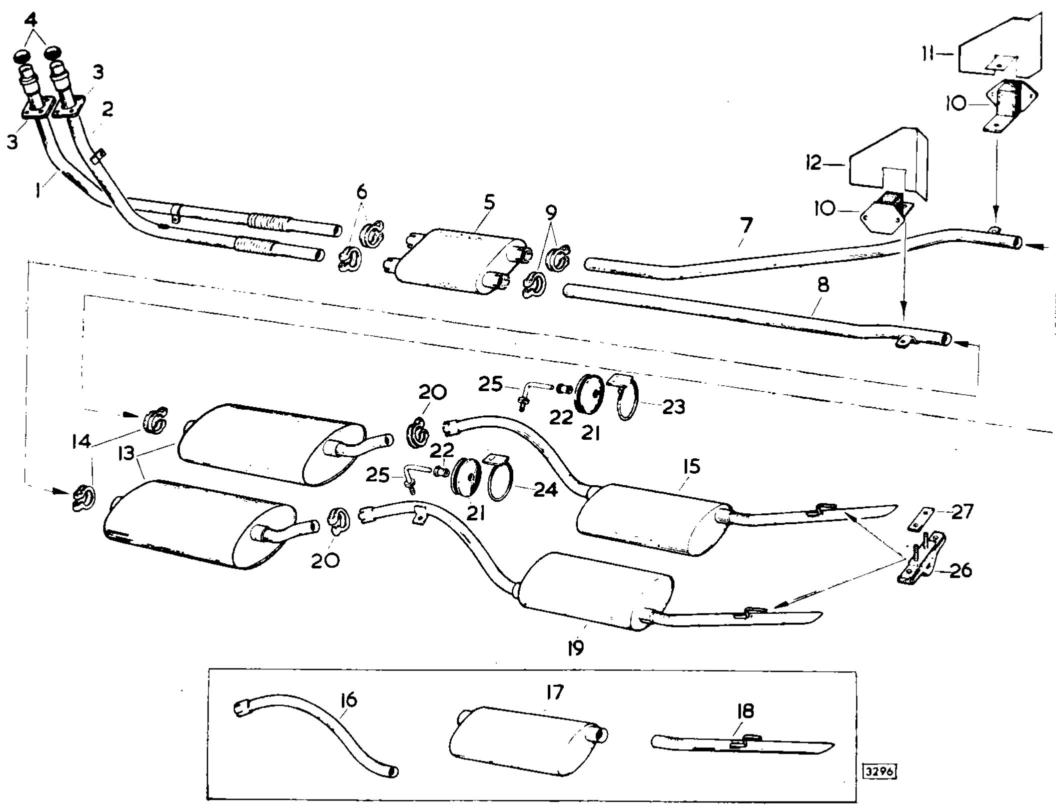
Remove the nut, lockwashers and plain washer securing the rear down pipe to the clutch housing.

Remove the four nuts together with the lockwashers securing each down pipe flange (3) to the exhaust manifold, withdraw the pipes and collect the sealing rings (4).

Check the condition of the rubber mountings and renew as necessary.

REFITTING

Renew the sealing rings (4) when refitting and reassemble in the reverse order to the removal procedure



1. Down pipe (front)
2. Down pipe (rear)
3. Flange
4. Sealing ring
5. Front silencer
6. Clip
7. Intermediate pipe
8. Intermediate pipe
9. Clip
10. Rubber mounting
11. Heat shield
12. Heat shield
13. Main silencer
14. Clip
15. Rear silencer
16. Rear Inter. pipe
17. Rear silencer
18. Tail pipe
19. Rear silencer
20. Clip
21. Rubber mounting
22. Bush
23. Ring bracket
24. Ring bracket
25. Bracket assembly
26. Rubber mounting
27. Spacer

Fig. 49. The exhaust system.

SECTION O

HEATING AND WINDSCREEN WASHING EQUIPMENT

4·2 MARK 10 MODEL

INDEX

CAR HEATING AND VENTILATING SYSTEM

WINDSCREEN WASHING EQUIPMENT

HEATING AND WINDSCREEN WASHING EQUIPMENT

CAR HEATING AND VENTILATION SYSTEM

DESCRIPTION

The car heating and ventilation system consists of a heating element and twin-speed electrically driven fans.

Both driver and front passenger have individual choice of heater outlet temperature on a fully variable basis.

The rear outlet temperature will always be the mean of the temperatures selected.

Air from the heating and ventilation system is directed as follows:

(a) To the front of the car through outlets, one on the driver's side and one on the passenger's side, below the parcel shelf.

(b) To the rear of the car through an outlet situated on the propeller shaft tunnel cover between the two front seats.

(c) To vents at the base of the windscreen to provide demisting and defrosting.

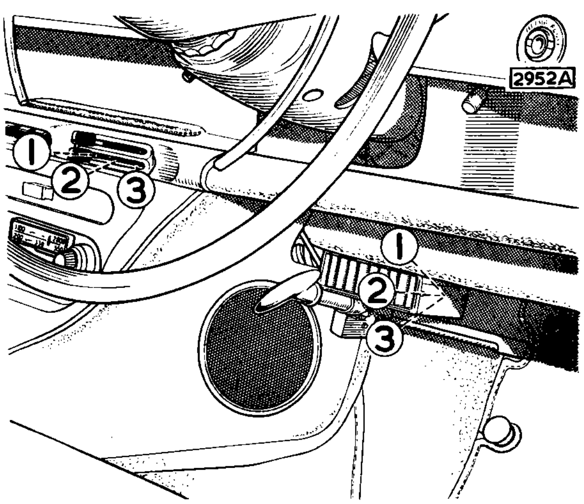


Fig. 1. The front outlet.

(1) air directed upwards.

(2) air shut off.

(3) air directed downwards.

HEATER CONTROLS

The heater control buttons marked "OFF", "HEAT" and "AIR" are situated on the main console below the parcel shelf.

These controls operate the air intake vent on the scuttle and the water valve. Operating the "OFF" button automatically cancels the "HEAT" and "AIR" buttons.

The "HEAT" button also cancels the "AIR" button. If it is desired to have the "HEAT" and "AIR" buttons in operation at the same time, the "HEAT" button must be pressed first.

In cold weather the button marked "HEAT" should, normally, be left in the depressed condition thus keeping warm water circulating through the heater matrix. When heating is required, the "AIR" button should be depressed to deliver air to the car interior.

If heating is required at the rear only, the front outlets can be put to the OFF position and the temperature controls set at suitable equal positions.

Off Button

When the "OFF" button is pressed the system is in-operative.

Heat Button

To obtain hot or warm air in the car press the "HEAT" button which will open the water valve to supply hot water to the heater element. Before operating the "AIR" button it is advisable to allow the engine to reach normal operating temperature, particularly in cold weather, to enable hot water to circulate through the heater unit prior to admitting cold air through the scuttle vent.

Adjust the heater control quadrant to gain the required temperature.

Air Button

If cold fresh air is required, press the "AIR" button which will open the scuttle vent and direct air to the outlets in the car by-passing the heating element. The fan can be switched on if it is desired to increase the circulation. Under this condition the temperature control levers are in-operative.

Temperature Controls

The individual temperature controls are adjustable from fully hot to fully cold. The slides are marked at each end with coloured spots:

Red spot – Fully hot.

Blue spot – Fully cold.

The Fan Switch

The fan for the heating and ventilating system increases the flow of air through the system and is controlled by a three-position switch (marked "FAN") on the instrument panel (B, Fig.4).

Lift the switch to the second position for slow speed and to the third position for fast speed, whichever is required.

Operation of the fan is required mainly when the car is stationary or running at a slow speed. At higher road speeds it will be found possible to dispense with the fan due to the speed of the car forcing air into the scuttle vent.

AIR DISTRIBUTION

The demisting outlets operate whenever the system is working. To obtain a maximum amount of air at the windscreen, both the front outlets and rear outlet should be closed.

The two front outlets (A, Fig. 4) are fitted with direction controls. In the centre position (2, Fig. 1) the air is completely shut off; in the "up" position (1) the air is directed to the body and in the "down" position (3) to the feet.

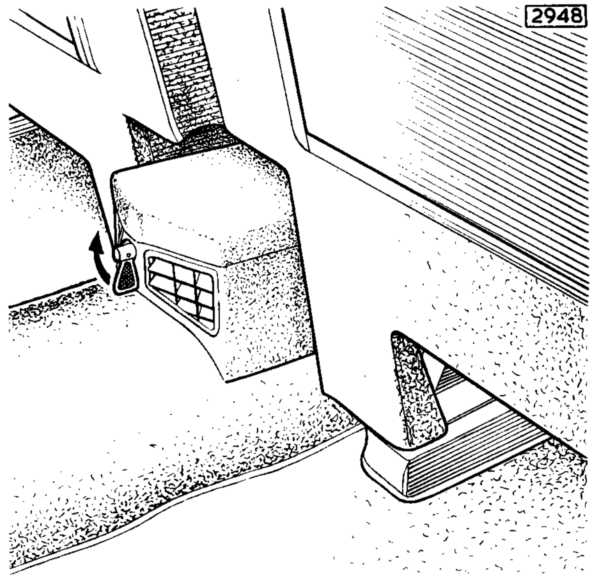


Fig. 2. Rear outlet.

The lever on the rear outlet (Fig.2) either turns the air supply "On" or "Off"; turning the lever clockwise opens the outlet.

VACUUM SYSTEM

The vacuum system which operates the heater buttons includes a vacuum supply tank which will provide approximately six complete operations after the ignition is switched off.

COLD WEATHER

To obtain heating, demisting and defrosting:

(a) Depress the button marked "HEAT" and allow a short period to elapse to permit the heater to warm up.
(b) Depress the "AIR" button.
(c) Switch the fan ON at the desired speed.
(d) Open the front and rear outlets as desired.
(e) Set the temperature controls.

To obtain rapid demisting and defrosting:

(a) Depress the button marked "HEAT" and allow a short period to elapse to permit the heater to warm up.
(b) Depress the "AIR" button.
(c) Switch the fan ON at the "FAST" position.
(d) Close the front and rear outlets.
(e) Set the temperature controls to "HOT" (red spot).

HOT WEATHER

To obtain ventilation and demisting:

(a) Depress the button marked "AIR".
(b) Switch fan ON at the desired speed.
(c) Open the front and rear outlets as desired.

To obtain rapid demisting:

(a) Depress the button marked "AIR".
(b) Switch the fan ON at the "FAST" position.
(c) Close the front and rear outlets.

HEATER MATRIX

Removal

Drain the coolant from the cooling system to below the level of the matrix, conserve the coolant if an antifreeze is in use.

Release the clip and disconnect the rubber-hose from the inlet and outlet pipes.

Carefully prise off the felt covering the front of the heater unit.

Remove the fourteen self-tapping screws securing the front cover.

Detach the cover-plate and withdraw the matrix.

Note: On left hand drive cars it will be necessary to remove the two clips securing the brake vacuum pipe before the cover plate and matrix can be withdrawn.

Refitting

Refitting is the reverse of the removal procedure.

Renew any seals that are worn or damaged.

Secure the trim material to the cover plate with a rubber solution.

VACUUM SUPPLY TANK

Removal

Pull off the small rubber tube at the vacuum supply tank non-return valve.

Slacken off the clip securing the large rubber hose to the vacuum tank.

Remove the two nuts and washers found under the right hand front wing securing the vacuum supply tank to the wing valance.

Withdraw the vacuum supply tank.

Note: If difficulty is found in reaching the clip retaining the hose to the vacuum tank, it is permissible to remove the hose from the rear end of the balance pipe.

Refitting

Refitting is the reverse of the removal procedure.

FAN MOTOR

Removal

Disconnect and remove the battery.

Remove the battery heat shield (right hand drive cars only).

Disconnect the heater flap control cable inner from the trunnion on the lever. Remove the spring clip and detach the outer flex.

Disconnect the three wires from the fan motor at the snap connectors.

Remove the three setscrews securing the fan motor and mounting bracket to the heater unit.

Withdraw the motor complete with fan and bracket.

Remove the fan by slackening off the locking nut in the centre of the fan.

Remove three setscrews to detach the motor from the mounting bracket.

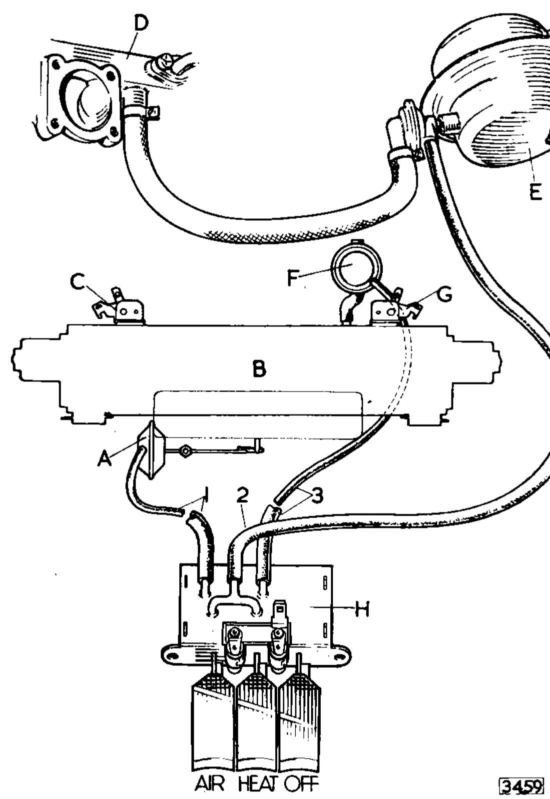


Fig. 3. The layout of the heater vacuum system.

A. Scuttle vent servo
B. Heater
C. Control box
D. Inlet manifold
E. Vacuum reservoir
F. Check valve
G. Control box
H. Heater control buttons

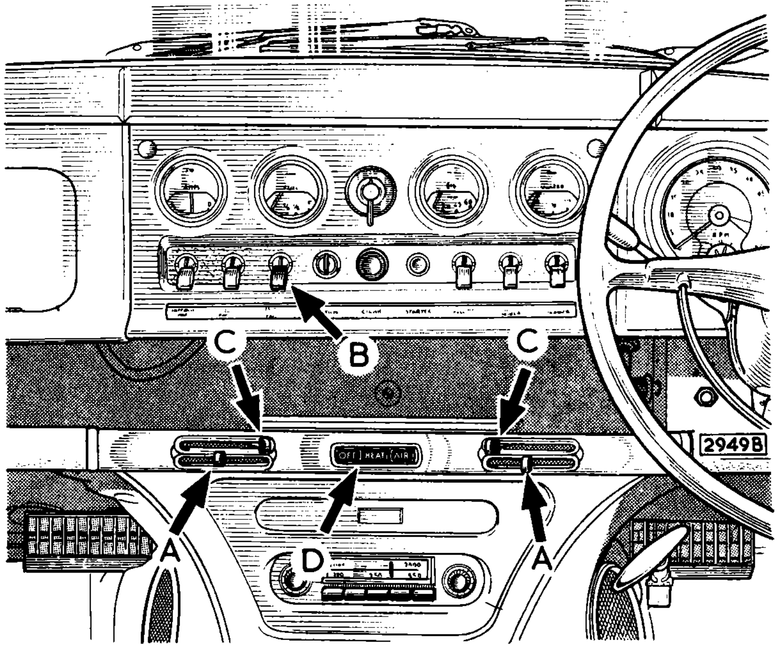


Fig. 4. Heating and ventilating controls—"A" indicates the directional controls for the front outlets. "B" indicates the fan switch. "C" indicates the temperature controls (Red spot—Hot and blue spot—cold). "D" indicates the heater control buttons.

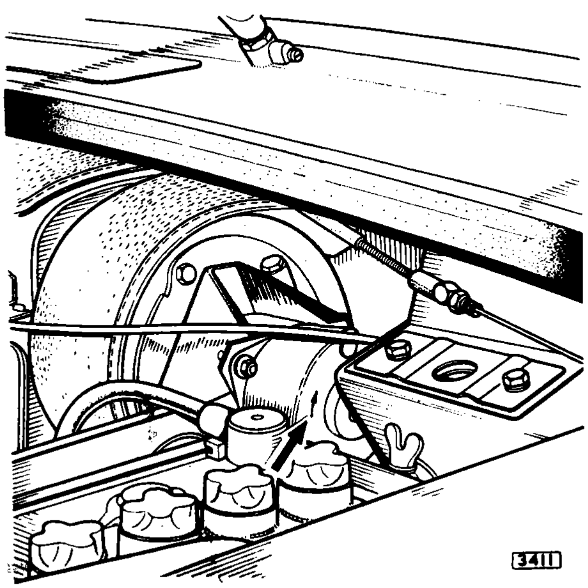


Fig. 5 View of the motor end cover showing the directional arrow.

Refitting

Refitting is the reverse of the removal procedure.

Note: The fan motors are not interchangeable and if both motors have been removed care must be taken when refitting to ensure that the correct motors are fitted to the right and left hand sides of the heater unit. The arrows painted on the end cover of the motor must point to the rear of the car, that is clockwise on the left-hand motor and anti-clockwise on the right-hand motor.

VACUUM SERVO UNIT

(Operating the Scuttle Ventilator)

The servo unit is located behind the glove box panel and is attached by two nuts and studs to the instrument panel support bracket.

Removal

Disconnect the battery.

Withdraw the picnic tray and lower the instrument panel as detailed in Section N– "Body and Exhaust System".

Remove the glovebox as detailed in Section N– "Body and Exhaust System".

Disconnect the vacuum tube from the servo unit.

Detach the spring clip retaining the servo unit pull rod to the scuttle ventilator bell crank lever.

Remove the two nuts and washers and withdraw the servo unit.

Note The servo unit is sealed during manufacture and cannot be serviced; therefore it must be replaced, if faulty, as a complete unit.

Refitting

Refitting is the reverse of the removal procedure.

HEATER WATER CONTROL VALVE

Removal

Drain the coolant from the radiator. Conserve the coolant if an anti-freeze is in use.

Disconnect the rubber suction pipe from the unit.

Slacken off the clips retaining the water hoses.

Release the nut and washer securing the unit to the bracket attached to the cylinder head and withdraw the unit.

Note: The servo unit is sealed during manufacture and cannot be serviced; therefore it must be replaced, if faulty, as a complete unit.

Refitting

Refitting is the reverse of the removal procedure.

When refitting the valve it is always advisable to replace the two small water hoses with new ones.

Check that the arrow on the valve body is pointing towards the bulkhead; this being the direction of the water flow (see Fig.6).

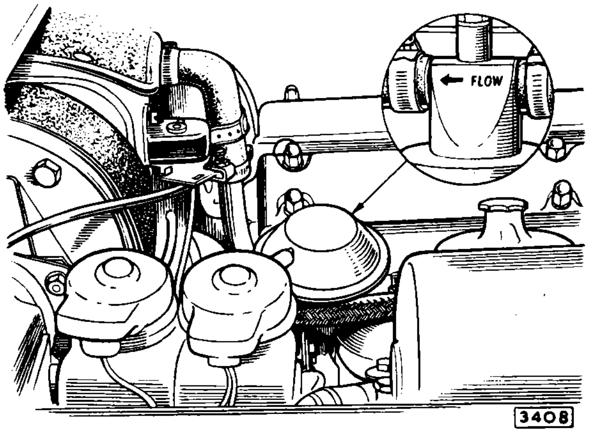


Fig. 6. Heater water control valve. The inset indicates the correct way in which to refit the valve.

HEATER UNIT

Removal

Drain the coolant from the radiator, conserve the coolant if an anti-freeze is in use.

Disconnect the battery.

Slacken off the clips and disconnect the rubber hoses from the inlet and outlet pipes.

Disconnect the heater flap control inner cables from the trunnion on the levers. Remove the spring clips and detach the outer flexes.

Disconnect the wires from the fan motors at the snap connectors. Note cable colours for reference when refitting.

Disconnect the two cables from the revolution counter generator.

Remove the three Allen screws retaining the generator to the right hand cylinder head, noting the plain and lock-washers under the screws and withdraw the generator.

Remove the eleven dome nuts and copper washers from each camshaft cover and lift off the covers. Protect the camshafts by covering with a clean cloth.

Withdraw the two bolts, one mounted either side of the heater unit passing diagonally through the fan motor mounting brackets.

Disconnect and detach the brake vacuum pipe (left-hand drive cars only).

Withdraw the heater unit complete with fan motors.

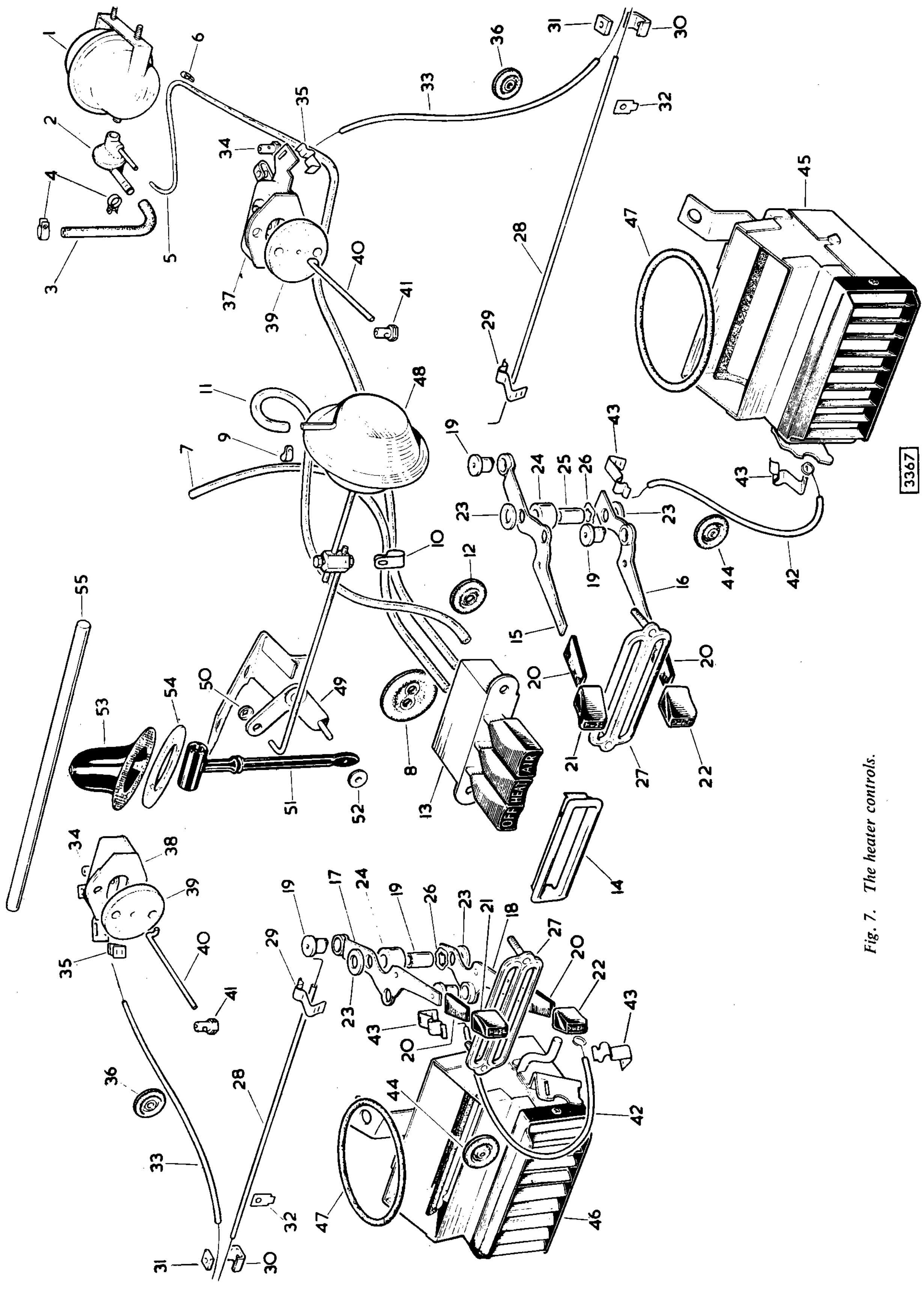


Fig. 7. The heater controls.

Key to Fig. 7

1. Reservac tank
2. Check valve
3. Vacuum hose
4. Clip
5. Vacuum hose
6. Clip
7. Vacuum hose
8. Grommet
9. Clip
10. Clip
11. Vacuum hose
12. Grommet
13. Vacuum control box
14. Escutcheon
15. R.H. upper control lever
16. R.H. lower control lever
17. L.H. upper control lever
18. L.H. lower control lever
19. Cable retainer
20. Sleeve
21. Knob
22. Knob
23. Washer
24. Spacer
25. Distance tube
26. Wave washer
27. Escutcheon
28. Rear cable
29. Clip
30. Joint clamp
31. Clamp block
32. Cable clamp
33. Front cable
34. Trunnion
35. Clip
36. Grommet
37. Control box
38. Control box
39. Seal
40. Operating rod
41. Trunnion
42. Cable
43. Clip
44. Grommet
45. R.H. air director box
46. L.H. air director box
47. Rubber seal
48. Vacuum diaphragm
49. Bell crank lever
50. Retaining washer
51. Operating rod
25. Retaining washer
53. Rubber sleeve
54. Retaining ring
55. Tie-rod

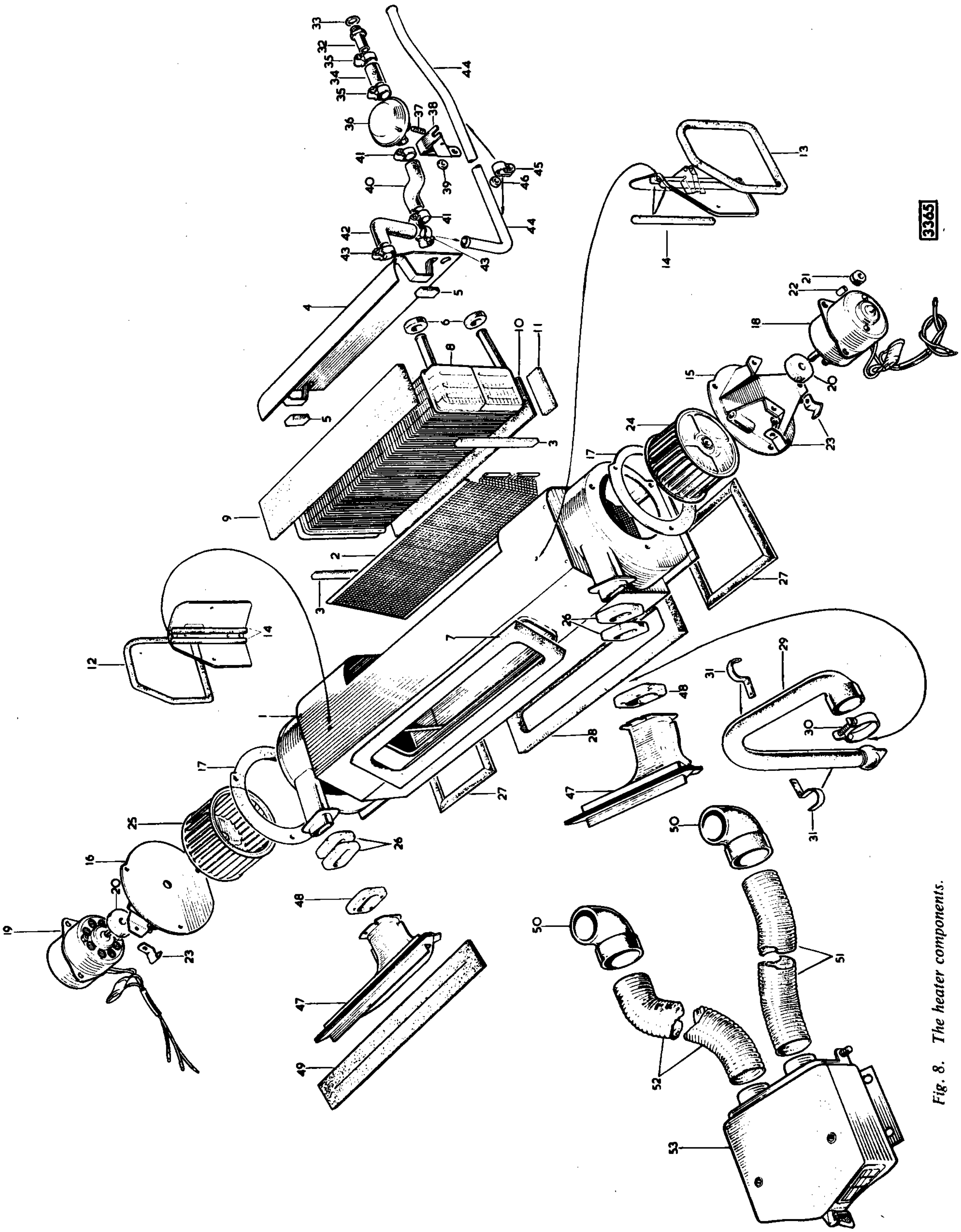


Fig. 8. The heater components.

Key to Fig. 8

1. Heater case
2. Gauze
3. Seal
4. Front cover
5. Pad
6. Seal
7. Seal
8. Heater radiator
9. Seal
10. Seal
11. Seal
12. Seal
13. Seal
14. Seal
15. Mounting plate (R.H. heater motor)
16. Mounting plate (L.H. heater motor)
17. Seal
18. Heater motor
19. Heater motor
20. Seal
21. Grommet
22. Distance tube
23. Bracket
24. Fan (R.H. heater motor)
25. Fan (L.H. heater motor)
26. Seal
27. Seal
28. Seal
29. Drain tube
30. Clip
31. Clip
32. Adaptor
33. Copper washer
34. Hose
35. Clip
36. Valve (vacuum operated)
37. Stud
38. Bracket
39. Distance piece
40. Hose
41. Clip
42. Elbow hose
43. Clip
44. Return pipe
45. Clip
46. Distance piece
47. Demister nozzle
48. Seal
49. Sealing strip
50. Rubber elbow
51. R.H. hose
52. L.H. hose
53. Air distributor box

When reassembling the fan to the motor spindle check that there is at least $\frac{1}{8}''$ (3·2 mm.) between the fan and the motor mounting bracket and the fan is running true on the spindle.

Reconnect the heater flap control cables. Ensure that the full movement of the temperature control lever and the heater flap operating lever is maintained when reconnecting.

Renew the heater motor sealing joint if worn or damaged.

Refitting

Refitting is the reverse of the removal procedure.

Care must be taken to ensure that all sealing strips are in position, renew if worn or damaged. Check that the demister spigots are properly located in the dash.

Reconnect the heater flap control cables. Ensure that the full movement of the temperature control levers and the heater flap operating levers is maintained when reconnecting.

HEATER CONTROL BUTTON PANEL

Removal

Remove the black plastic button from the bottom of the ash tray (or radio) surround panel and withdraw the slotted screw now exposed.

Detach the surround by pulling away the two peg fixings from the spring retainers located at the top corners of the panel.

Mark the position of the three vacuum pipes to each of the connector tubes of the Control Button Panel.

Remove the vacuum pipes.

Disconnect the cable from the panel illumination bulb contact.

Remove the two nuts and lock washers retaining the Control Button Panel to the support brackets and withdraw the panel.

Refitting

Refitting is the reverse of the removal procedure.

Note: The control panel has no interchangeable parts and no attempt should be made to strip the unit.

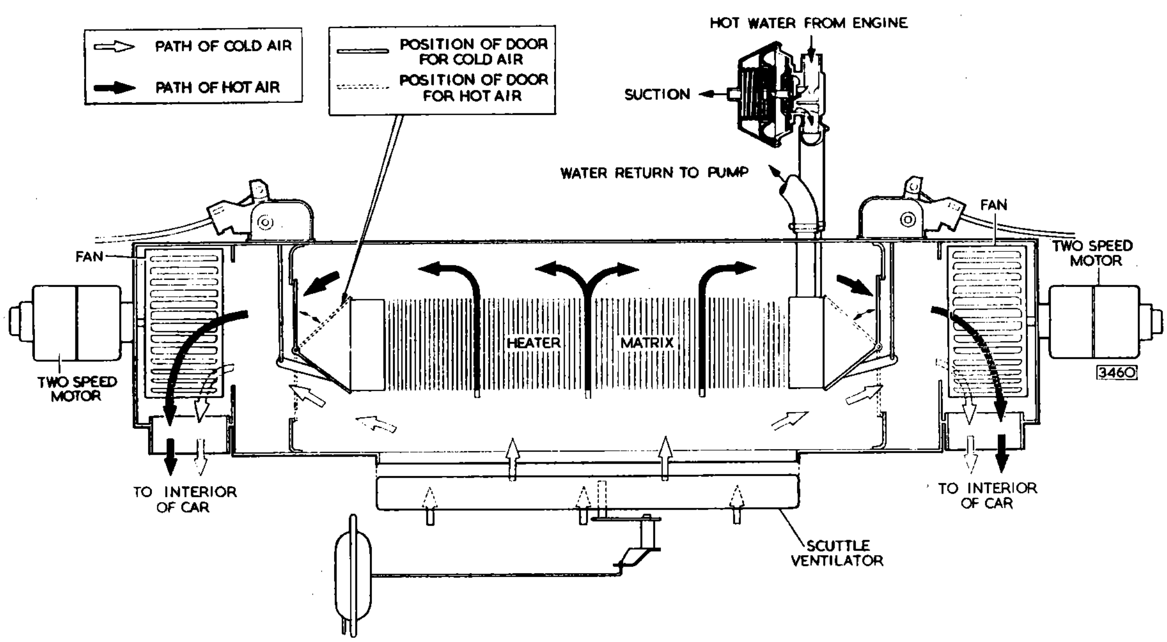


Fig. 9. Operation of the heater unit.

WINDSCREEN WASHING EQUIPMENT

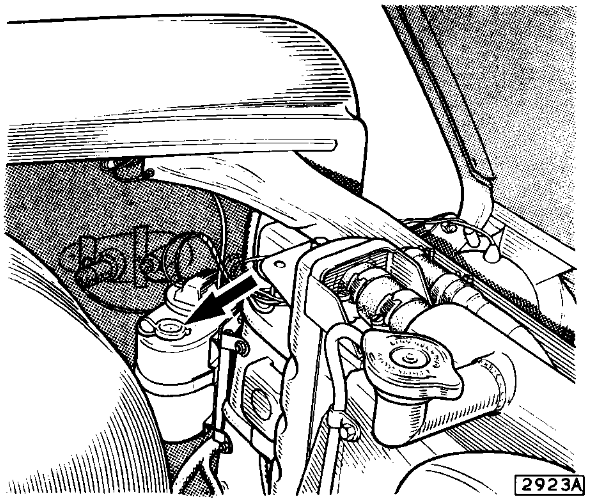


Fig. 10. The location of the windscreen washer container (non-automatic type).

AUTOMATIC MODEL (Fitted to Early Cars)

The windscreen washer is electrically operated and comprises of a glass water container mounted in the engine compartment behind the left-hand outer head light (Fig.10) and two water jets located in the windscreen wiper spindle housings.

The container is connected by tubing to the jets and water is delivered by an electrically driven pump incorporated in the water container.

OPERATION

The windscreen washer should be used in conjunction with the windscreen wipers to remove foreign matter that settles on the windscreen.

Lift the switch lever (marked "Washer" on the indicator strip) and release immediately when the washer should operate at once and continue to function for approximately seven seconds. Allow a lapse of time before operating the switch for a second time.

Warning

If the washer does not function immediately check that there is water in the container. The motor will be damaged if the switch is held closed for more than one or two seconds if the water in the container is frozen.

The washer should not be used under freezing conditions as the fine jets of water spread over the windscreen by the blades will tend to freeze up.

In the summer the washer should be used freely to remove insects before they dry and harden on the screen.

FILLING-UP

The water should be absolutely CLEAN. If possible use SOFT water for filling the container, but if this is not obtainable and hard water has to be used, frequent operation and occasional attention to the nozzle outlet holes will be amply repaid in preventing the formation of unwelcome deposits.

The correct water level is up to the bottom of the container neck. Do not overfill, or unnecessary splashing may result. Always replace the rubber filler cover correctly after filling, pressing it fully home.

It is not possible to empty the container completely with the pump. Refilling is necessary when the water level has fallen so that the top of the auxiliary reservoir is uncovered. About 30 full operations will be obtained from one filling.

When using the washer, an indication of the need to refill the container is given by the behaviour of the unit. The time taken for the auxiliary reservoir to refill increases as the water level in the container falls.

As soon as the water level has fallen to the top of the auxiliary reservoir, the amount of water delivered to the windscreen will decrease with successive operations and the time the unit runs will in proportion, become less.

If the water level is allowed to fall still further, until it is down to the bottom of the auxiliary reservoir, the automatic action will cease and water will be delivered to the windscreen only as long as the switch is operated. This will continue until the water level has fallen to the inlet orifices, when the pump will be above the water level and no water will be available for delivery to the windscreen.

Do not continue to operate the switch after the available water has been used up, otherwise damage may be caused to the unit.

Refilling the container will restore normal operation of the unit.

COLD WEATHER

To avoid damage by frost, add denatured alcohol (methylated spirits) as follows:

The underside of the rubber filler cover will be found to form a measure. Two measures of denatured alcohol should be added per container of water. USE NO OTHER ADDITIVES WHATSOEVER.

LUBRICATION

If, after lengthy service, the motor is found to be running slowly, unscrew the moulded cover from the container and apply one or two drops only of thin machine oil to the felt pad situated in the gap between the cover and the motor unit. Do not over-lubricate or excess oil may find its way into the water container when the cover is refitted, with consequent smearing of the windscreen.

To remove the container, detach the tubing, lift the container from the support bracket and disconnect the three cables

Note the location of the cable connection for reference when refitting.

ADJUSTING THE JETS

With a screwdriver turn each nozzle in the jet holder until the jets of water strike the windscreen in the area swept by the wiper blades. It may be necessary to adjust the nozzles slightly after a trial on the road due to jets of water being deflected by the airstream.

JET NOZZLES

Cleaning

To clear a blocked jet nozzle completely, unscrew the nozzle from the jet holder. Clear the small orifices with a thin piece of wire or blow out with compressed air; operate the washer with the nozzle removed. Allow the water to flush through the jet holder and then replace the nozzle.

LUBRICATION

If, after lengthy service, the motor is found to be running slowly, unscrew the moulded cover from the container and apply one or two drops only of thin machine oil to the felt pad situated in the gap between the cover and the motor unit.

Do not over-lubricate or excess oil may find its way into the water container when the cover is refitted with consequent smearing of the windscreen.

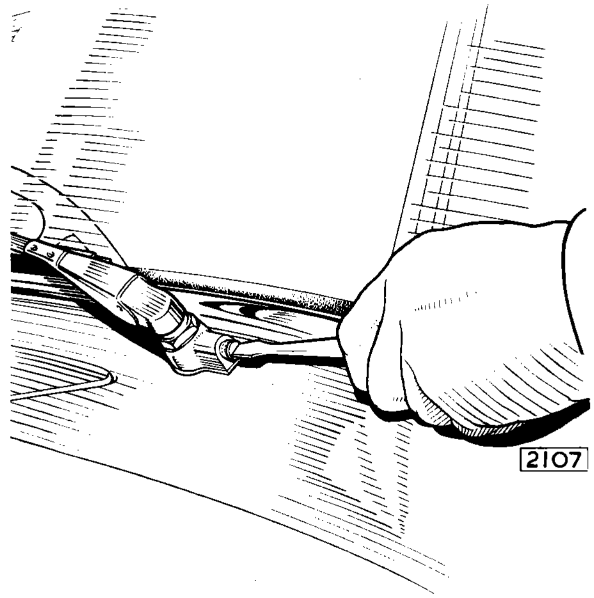


Fig. 11. Adjusting the windscreen washer jets.

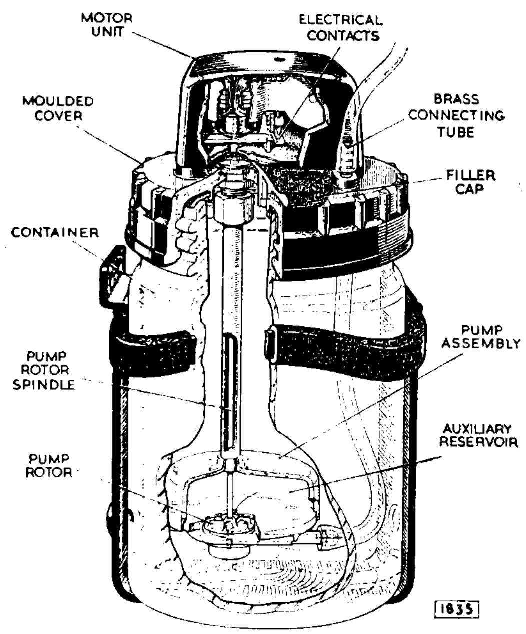


Fig. 12. The windscreen washer water container (early type).

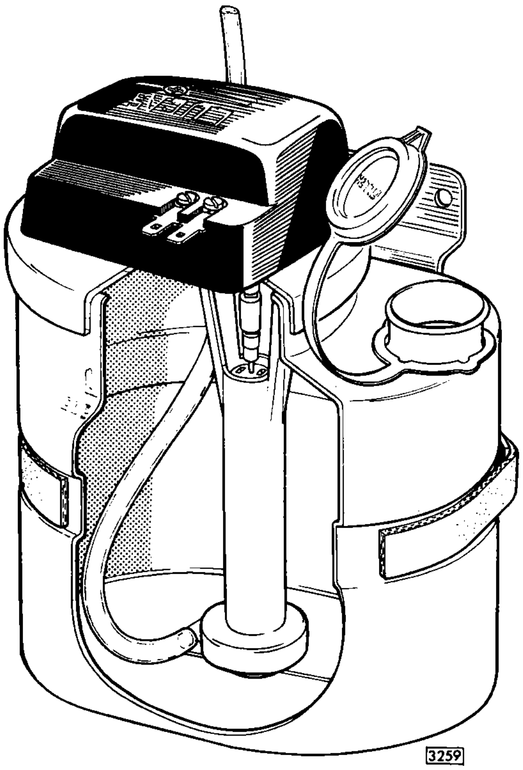


Fig. 13. Windscreen washer water container (later cars).

NON-AUTOMATIC MODEL

(Fitted to Later Cars)

The LUCAS 5SJ Screen Jet is an electrically operated unit comprising a small permanent-magnet motor driving a centrifugal pump through a 3 piece Oldham type coupling and a high density polythene water container mounted in the engine compartment behind the left-hand outer headlight (Fig.10) which is connected to two water jets located in the windscreen wiper spindle housings.

OPERATION

The windscreen washer should be used in conjunction with the windscreen wipers to remove foreign matter that settles on the windscreen.

Lift the switch lever (marked "Washer" on the indicator strip) when the washer should operate at once and continue to function until the switch is released.

Warning

If the washer does not function immediately check that there is water in the container. The motor will be damaged if the switch is held pressed for more than one or two seconds if the water in the container is frozen.

The washer should not be used under freezing conditions as the fine jets of water spread over the windscreen by the blades will tend to freeze up.

Minimum water delivery pressure	4·5 lb./sq. in. (0·32 kg./sq. cm.)
Minimum water delivery per sec.	3·5 c.c.
Container capacity	$2\frac{1}{4}$ pints (1·1 litres)
Usable quantity of water . .	2 pints (1 litre)
Diameter of nozzle orifice . .	0·25–0·28″ (6·3 to 7mm.).

SERVICING. TESTING IN POSITION

(a) Testing with a voltmeter—

Connect a suitable direct current voltmeter to the motor terminals, observing the polarity as indicated on the moulded housing. Operate the switch. If a low or zero voltage is indicated, the "A4" fuse, switch and external connections should be checked and corrected as necessary.

If the voltmeter gives a reversed reading, the connections to the motor must be transposed.

If supply voltage is registered at the motor terminals but the unit fails to function, an open-circuit winding or faulty brushgear can be suspected. Dismantle the motor, as described below.

(b) Checking the external tubes and nozzles—

If the motor operates but little or no water is delivered to the screen, the external tubes and nozzles may be blocked.

Remove the external plastic tube from the short connector on the container cover and, after checking that the connector tube is clear, operate the switch.

If a jet of water is ejected, check the external tubes and nozzles for damage or blockage.

If no water is ejected, proceed as described below.

(c) Testing with an ammeter—

Connect a suitable direct current ammeter in series with the Screen Jet motor and operate the switch. If the motor does not operate but the current reading exceeds that shown in DATA remove the motor, as described below and check that the pump impeller shaft rotates freely.

If the shaft is difficult to turn, the water pump unit must be replaced.

If the shaft turns freely, the fault lies in the motor, which must be dismantled as described below, and its component parts inspected.

DISMANTLING

(a) Disconnect the external tube and electrical connections and remove the cover from the container.

(b) Remove the self-tapping screw which secures the motor to the cover, and pull away the motor unit.

Take care not to lose the intermediate coupling which connects the armature coupling to the pump spindle coupling.

(c) Remove the armature coupling from the armature shaft as follows:—

Hold the armature shaft firmly with a pair of snipe-nosed pliers and, using a second pair of pliers, draw off the armature coupling.

(d) Remove the two self-tapping screws from the bearing plate. The bearing plate and rubber gasket can now be removed.

(e) Remove the two terminal screws.

The terminal nuts and brushes can be removed and the armature withdrawn.

Take care not to lose the bearing washer which fits loosely on to the armature shaft.

(f) The pole assembly should not normally be disturbed. If, however, its removal is necessary, make careful note of its position relative to the motor housing. The narrower pole piece is adjacent to the terminal locations.

Also, the position of the pole clamping member should be observed.

When fitted correctly, it locates on both pole pieces but, if fitted incorrectly, pressure is applied to one pole piece only.

BENCH TESTING

If the motor has been overheated, or if any part of the motor housing is damaged a replacement motor unit must be fitted.

(a) Armature—

If the armature is damaged, or if the windings are loose or badly discoloured, a replacement armature must be fitted.

The commutator must be cleaned with a fluffless, petrol-moistened cloth or, if necessary, by polishing it with a strip of very fine glass paper.

The resistance of the armature winding should be checked with an ohm meter. The resistance between commutator segments should be as shown under DATA.

(b) Brushes—

If the carbon is less than $\frac{1}{16}''$ (1·59 mm.) long, a new brush must be fitted.

Check that the brushes bear firmly against the commutator.

RE-ASSEMBLING

Re-assembly of the unit is the reversal of the dismantling procedure.

The following points should be observed:

(a) Make sure that the bearing recess in the motor housing is filled with Rocol Molypad molybdenised grease. Remove excessive grease from the face of the bearing boss.

(b) Check that the pole piece assembly does not rock and that the pole pieces are firmly located on the circular spigot. Ensure that both the pole piece assembly and the clamping member are the right way round [see sub paragraph (f)—DISMANTLING].

(c) Before replacing the motor unit on the cover, ensure that the armature coupling is pushed fully home. Also check that the intermediate coupling is in place.

PERFORMANCE TESTING

Equipment required—
DC supply of appropriate voltage
DC voltmeter, first grade, moving coil
0–3 amp DC ammeter
0–15 lb./sq. in. (0–1 kg./sq. cm.) pressure gauge
Pushbutton with normally open contacts
Two-jet nozzle (Lucas No. 295005)
On-off tap
100 cc. capacity measure
4′ 6″ (1·37 m.) length of plastic tubing

(a) Connect up the equipment as shown in Fig.14. The water level in the container must be 4″ (101·6 mm.) above the base of the pump assembly. The pressure gauge and nozzle must be 18″ (457·2 mm.) above the water level.

(b) Open the tap.

(c) Depress the pushbutton for approximately 5 seconds and check the voltmeter reading, which should be the same as the supply voltage. On releasing the switch, immediately close the tap to ensure that the plastic tubing remains charged with water.

(d) Empty the measuring cylinder.

(e) Open the tap and operate the push switch for precisely 10 seconds after which period release the switch and close the tap.

During the 10-second test the current and pressure values should be in accordance with those shown in DATA and at least 35 cc. of water should have been delivered.

ADJUSTING THE JETS

Proceed as directed on Page O.16.

JET NOZZLES

Cleaning

Proceed as directed on Page O.16.

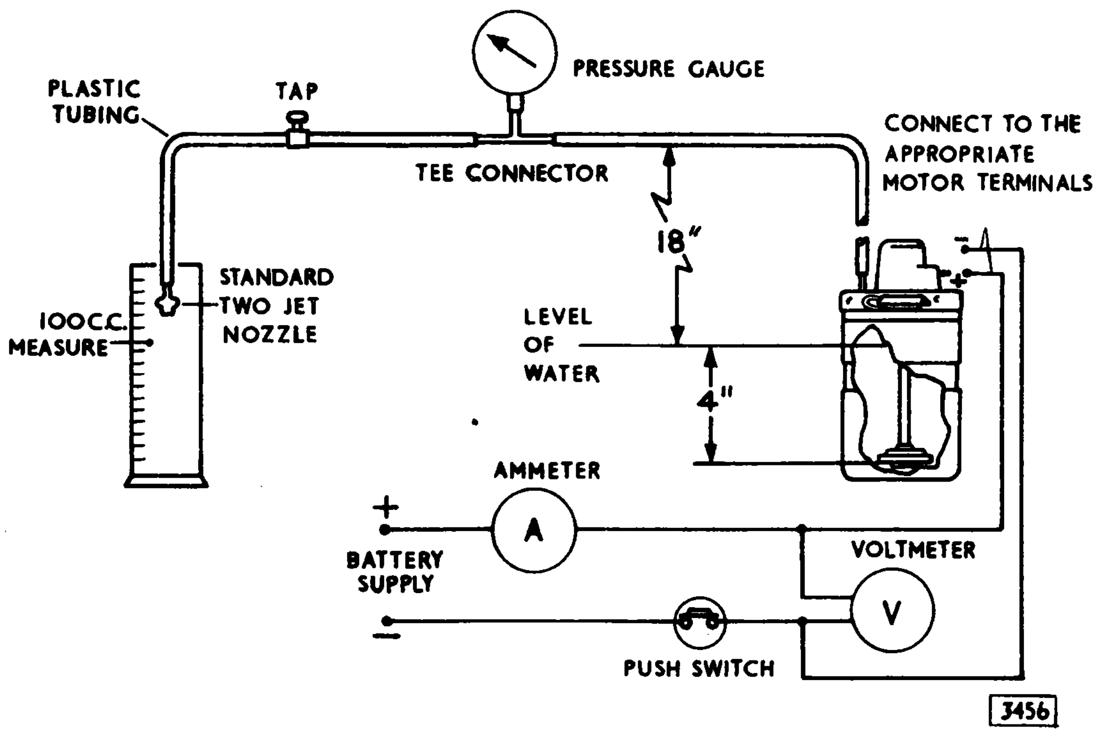


Fig. 14. Performance testing the windscreen washing equipment.

SECTION P

ELECTRICAL AND INSTRUMENTS

4·2 MARK 10 MODEL

INDEX

INDEX *(continued)*

LAMPS

HORNS

INDEX *(continued)*

WINDSCREEN WIPER

THE FACIA PANEL

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THE INSTRUMENT PANEL COMPONENTS

THE BI-METAL RESISTANCE INSTRUMENTATION

INDEX *(continued)*

OPTIONAL EXTRAS

ELECTRICAL AND INSTRUMENTS

BATTERY

The Lucas FRV11A battery is of the semi-linkless type, the short cell inter-connectors being partially exposed to enable testing of the individual cells to be carried out with a heavy discharge tester.

DATA

Battery type	FRV11A
Voltage	12
Number of plates per cell	11
Capacity at 10-hour rate	60 ampere hours
Capacity at 20-hour rate	67 ampere hours

ROUTINE MAINTENANCE

Wipe away any foreign matter or moisture from the top of the battery, and ensure that the connections and the fixings are clean and tight.

About once a month, or more frequently in hot weather, examine the level of the electrolyte in the cells. If necessary add distilled water to bring the electrolyte just level with the separator guards, which can be seen when the vent plugs are removed.

The use of a Lucas battery filler will be found helpful in this topping-up process, as it ensures that the correct electrolyte level is obtained automatically and also prevents distilled water from being spilled over the battery top.

Distilled water should always be used for topping-up. In an emergency however, clean soft rain water collected in an earthenware container may be used.

Note: Never use a naked light when examining a battery as the mixture of oxygen and hydrogen given off by the battery when on charge, and to a lesser extent when standing idle, can be dangerously explosive.

REMOVAL

Unscrew the two wing nuts retaining the battery retaining clamp; remove the fixing rods and strap. Disconnect the terminals and lift out the battery from the cradle.

REFITTING

Refitting is the reverse of the removal procedure. Before refitting the cable connectors, clean the terminals and coat with petroleum jelly.

PERSISTENT LOW STATE OF CHARGE

First consider the conditions under which the battery is used. If the battery is subjected to long periods of discharge without suitable opportunities for recharging, a low state of charge can be expected. A fault in the generator or regulator, or neglect of the battery during a period of low or zero mileage may also be responsible for the trouble.

Vent Plugs

See that the ventilating holes in each vent plug are clear.

Level of Electrolyte

The surface of the electrolyte should be just level with the tops of the separator guards. If necessary, top up with distilled water. Any loss of acid from spilling or spraying (as opposed to the normal loss of **water** by evaporation) should be made good by dilute acid of the same specific gravity as that already in the cell.

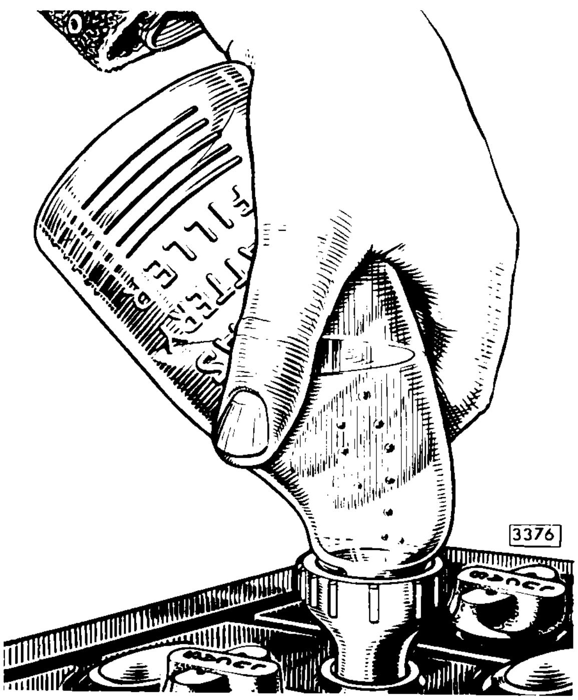

Fig. 1. Lucas battery filler.

Cleanliness

See that the top of the battery is free from dirt or moisture which might provide a discharge path. Ensure that the battery connections are clean and tight.

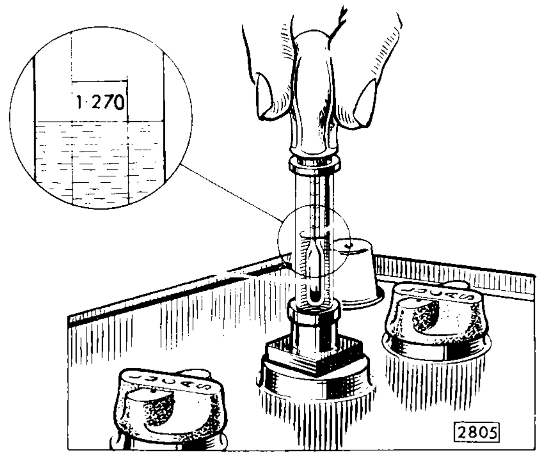

Fig. 2. Checking a battery with a hydrometer.

Hydrometer Tests

Measure the specific gravity of the acid in each cell in turn with an hydrometer. To avoid misleading readings, do not take hydrometer readings immediately after topping-up.

The readings given by each cell should be approximately the same.

If one cell differs appreciably from the others, an internal fault in the cell is indicated.

The appearance of the electrolyte drawn into the hydrometer when taking a reading gives a useful indication of the state of the plates. If the electrolyte is very dirty, or contains small particles in suspension, it is possible that the plates are in a bad condition.

The specific gravity of the electrolyte varies with the temperature, therefore, for convenience in comparing specific gravities, this is always corrected to 60°F. (16°C.), which is adopted as a reference temperature. The method of correction is as follows:

For every 5°F. (15°C.) below 60°F. (16°C.) deduct 0·002 from the observed reading to obtain the true specific gravity at 60°F.

For every 5°F. (15°C.) above 60°F. (16°C.) add 0·002 to the observed reading to obtain the true specific gravity at 60°F. (16°C.).

The temperature must be that indicated by a thermometer actually immersed in the electrolyte, and not the air temperature.

Compare the specific gravity of the electrolyte with the values given in the table and so ascertain the state of charge of the battery.

If the battery is in a discharged state, it should be recharged, either on the vehicle by a period of day-time running or on the bench from an external supply, as described under "Recharging from an External Supply".

Discharge Test

A heavy discharge tester consists of a voltmeter, 2 or 3 volts full scale, across which is connected a shunt resistance capable of carrying a current of 150–160 amperes. It is important to use only a suitably rated instrument. Pointed prongs are provided for making contact with the inter-cell connectors.

Press the contact prongs against the exposed positive and negative terminals of each cell. A good cell will maintain a reading of 1·2–1·5 volts, depending on the state of charge, for 10 seconds.

If, however, the reading rapidly falls off, the cell is probably faulty and a new plate assembly may have to be fitted.

RECHARGING FROM AN EXTERNAL SUPPLY

If the battery tests indicate that the battery is merely discharged, and is otherwise in a good condition, it should be recharged, either on the vehicle by a period of day-time running or from an external supply. Note correct battery polarity (NEGATIVE EARTH) when connecting the charging unit cables.

If the latter, the battery should be charged at 6 amperes until the specific gravity and voltage show no increase over three successive hourly readings. During the charge the electrolyte must be kept level with the tops of the separator guards by the addition of distilled water.

A battery that shows a general falling-off in efficiency common to all cells, will often respond to the process known as "cycling". This process consists of fully charging the battery as described above and then discharging it by connecting to a lamp board, or other load, taking a current of 5 amperes. The battery should be capable of providing this current for at least 7 hours before it is fully discharged, as indicated by the voltage of each cell falling to 1·8. If the battery discharges in a shorter time, repeat the "cycle" of charge and discharge.

PREPARING NEW UNFILLED, UNCHARGED BATTERIES FOR SERVICE

Preparation of Electrolyte

Batteries should not be filled with acid until required for initial charging.

Electrolyte of the specific gravity required is prepared by mixing distilled water and concentrated sulphuric acid, usually of 1·835 specific gravity. The mixing must be carried out either in a lead-lined tank or in a suitable glass or earthenware vessel. Slowly add the acid to the water, stirring with a glass rod. **Never add the water to the acid,** as the resulting chemical reaction causes violent and dangerous spurting of the concentrated acid. The correct specific gravity for the filling acid and approximate proportions of acid and water are indicated in the following table:

Heat is produced by the mixture of acid and water, and the electrolyte should be allowed to cool before taking hydrometer readings—unless a thermometer is used to measure the actual temperature, and a correction applied to the reading before pouring the electrolyte into the battery.

Filling the Battery

The temperature of the acid, battery and filling-in must not be below 32°F. (0°C.).

Carefully break the seals in the filling holes and fill each cell to the level of the separator guard with electrolyte of the appropriate specific gravity. Allow the bat ery o stand for 12 hours, in order to dissipate the heat generated by the chemical action of the acid on the plates and separators. Restore levels by adding more acid of the same specific gravity and then proceed with the initial charge.

Initial Charge Rate

Charge at a rate of 4 amps until the voltage and specific gravity readings show no increase over five successive hourly readings. This may take up to 80 hours, depending on the length of time the battery has been stored before charging.

Keep the current constant by varying the series resistance of the circuit or the generator output.

This charge should not be broken by long rest periods. If, however, the temperature of any cell rises above the permissible maximum (that is, 100°F. (38°C.) for batteries filled with 1·270 S.G acids, 120°F. (49°C.) for those with 1·210 S.G. acid .

the charge must be interrupted until the temperature has fallen at least 10°F., (—10°C.) below that figure. Throughout the charge, the electrolyte must be kept level with the top of the separator guards by the addition of acid solution of the same specific gravity as the original filling-in acid, until the specific gravity and voltage readings have remained constant for five successive hourly readings. If the charge is continued beyond that point, top up with distilled water.

At the end of the charge carefully check the specific gravity in each cell to ensure that, when corrected to 60°F. (16°C.), it lies within the specified fully-charged limits.

If any cell requires adjustment, some of the electrolyte must be siphoned off and replaced by distilled water or by acid of the strength originally used for filling-in, depending on whether the specific gravity is too high or too low. Continue the charge for an hour or so to ensure adequate mixing of the electrolyte and again check the specific gravity readings. If necessary, repeat the adjustment process until the desired reading is obtained in each cell. Finally, allow the battery to cool, and siphon off any electrolyte above the tops of the separator guards.

State	Home and climates with shade temperature ordinarily below 80°F (26·6°C). Specific gravity of electrolyte (corrected to 60°F). (16°C).	Climates with shade temperature frequently over 80°F (26·6 C). Specific gravity of electrolyte (corrected to 60°F). (16°C)
Fully charged	1·270–1·290	1·210–1·230
About half discharged	1·190–1·210	1·130–1·150
Completely discharged	1·110–1·130	1·050–1·070

Specific Gravity of Filling Acid (corrected to 60°F)	
Home and climates with shade temperature ordinarily below 80°F (26·6°C) 1·260 Add 1 part by volume of acid (1·840 S.G.) to 3·2 parts of distilled water to mix this electrolyte	Climates with shade temperaures frequently above 80°F (26·6°C) 1·210 Add 1 part by volume of acid (1·835 S.G.) to 4 parts of distilled water to mix this electrolyte
Quantity of electrolyte required per cell $1\frac{1}{4}$ pints approximately (720 cc.)	

PREPARING NEW "DRY-CHARGED" BATTERIES FOR SERVICE

Filling the Cells

Carefully break the seals in the filling holes and fill each cell with correct specific gravity acid as shown in the table on page P.10 to the top of the separator guards in one operation. The temperatures of the filling room, battery and acid should be maintained at between 60°F. (16°C.) and 100°F. (38°C.). If the battery has been stored in a cool place, it should be allowed to warm up to room temperature before filling.

Freshening Charge

Batteries filled in this way are up to 90% charged and capable of giving a starting discharge one hour after filling. When time permits, however, a short freshening charge will ensure that the battery is fully charged.

Such a freshening charge should be 5 amperes for not more than 4 hours.

During the charge the electrolyte must be kept level with the top of the separators by the addition of distilled water. Check the specific gravity of the electrolyte at the end of the charge; if 1·270 acid was used to fill the battery, the specific gravity should now be between 1·270 and 1·290; if 1·210 acid, between 1·210 and 1·230.

Maintenance in Service

After filling, a dry-charged battery needs only the attention normally given to all lead-acid type batteries.

DISTRIBUTOR

DESCRIPTION

The Lucas 22D6 distributor is fitted to all 4·2—Mk. 10 cars.

All models fitted with automatic transmission have a speed limiter incorporated in the rotor. The distributor DATA remains the same for all cars.

This device operates as a spring controlled governor plate attached to the rotor and lifts at a pre-determined maximum engine speed to earth out the H.T. circuit.

The speed limiter is necessary due to the safe maximum speed limitations of the Borg-Warner transmission unit therefore no attempt must be made to fit the standard rotor arm, which will not have the governor plate fitted, as a replacement.

Note: From Engine No. 7D51651 Automatic transmission.
Engine No. 7D50740 Overdrive transmission.
Engine No. 7D50740 Standard transmission.

A waterproof cover is incorporated in the distributor assembly and is located between the distributor cap and the body.

The cover is detachable after removing the distributor cap and disconnecting the cable from the contact breaker spring post. The distributor DATA remains the same as that stated on page P.15.

REMOVAL

Spring back the clips and remove the distributor cap. Disconnect the low tension wire from the distributor.

Disconnect the vacuum pipe by withdrawing the elbow sleeve junction.

Remove distributor clamping plate retaining setscrew and withdraw distributor.

REFITTING

If the distributor clamping plate pinch bolt has not been slackened during removal of distributor refitting will be the reverse of the removal procedure. Enter the distributor into the cylinder block with the vacuum advance unit connection facing the cylinder block.

Rotate the rotor arm until the driving dog engages with the distributor drive shaft.

If the distributor clamping plate pinch bolt has been slackened during removal of distributor it will be necessary to reset the ignition timing as follows:

Ignition Timing

Set the micrometer adjustment in the centre of the scale.

Connect the low tension wire to the terminal on the distributor body.

Enter the distributor into the cylinder block with the vacuum advance unit connection facing the cylinder block.

Rotate the rotor arm until the driving dog engages with the distributor drive shaft.

Rotate the engine until the rotor arm approaches the No. 6 (front) cylinder segment in the distributor cap.

Slowly rotate the engine until the ignition timing scale on the crankshaft damper is the appropriate number of degrees before the pointer on the sump. (See Data).

Connect a 12 volt test lamp with one lead to the distributor terminal (or the CB terminal of the ignition coil) and the other to a good earth.

Slowly rotate the distributor body until the points are just breaking, that is, when the lamp lights up.

Tighten the distributor plate pinch bolt.

A maximum of six clicks on the vernier adjustment from this setting, to either advance or retard, is allowed.

ROUTINE MAINTENANCE

Distributor Contact Breaker Points

Every 3,000 miles (5,000 km.), (first 500 miles (800 km.) with new contact set), check the gap between the contact points with feeler gauges when the points are fully opened by one of the cams on the distributor shaft. A combined screwdriver and feeler gauge is provided in the tool kit.

The correct gap is 0·014–0·016″ (0·36–0·41 mm.).

If the gap is incorrect, slacken (very slightly) the contact plate securing screw and adjust the gap by turning a screwdriver in the nick in the contact plate and the slot in the base plate, clockwise to decrease the gap and anti-clockwise to increase the gap. Tighten the securing screw and recheck the gap (Fig. 4.)

Examine the contact breaker points. If the contacts are burned or blackened, clean them with a fine carborundum stone or very fine emery cloth. Afterwards wipe away any trace of grease or metal dust with petrol moistened cloth.

Lubrication—Every 3,000 miles (5,000 km.)

Remove the moulded cover and withdraw the rotor arm. A tight rotor arm can be withdrawn by using a suitable pair of levers carefully applied at opposite points below the rotor moulding—never against the metal electrode.

Important: Do not allow oil or grease on or near the contacts when carrying out the following lubrication.

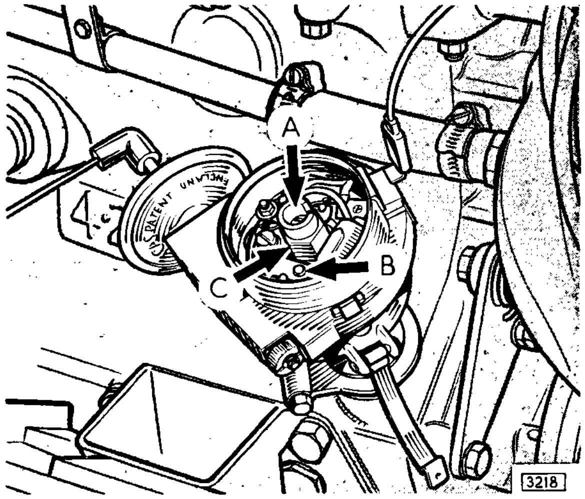

Fig. 4. Distributor lubrication points.

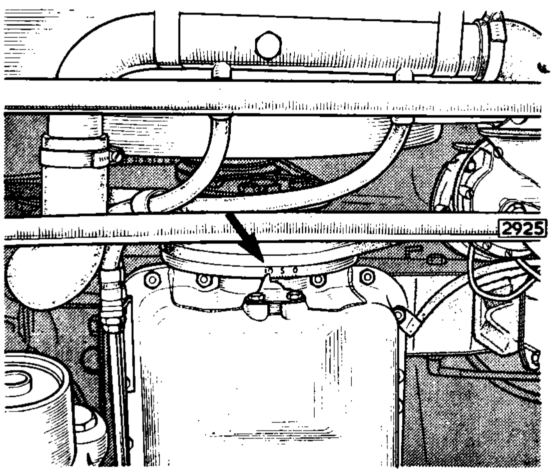

Fig. 3. Ignition timing scale on crankshaft damper.

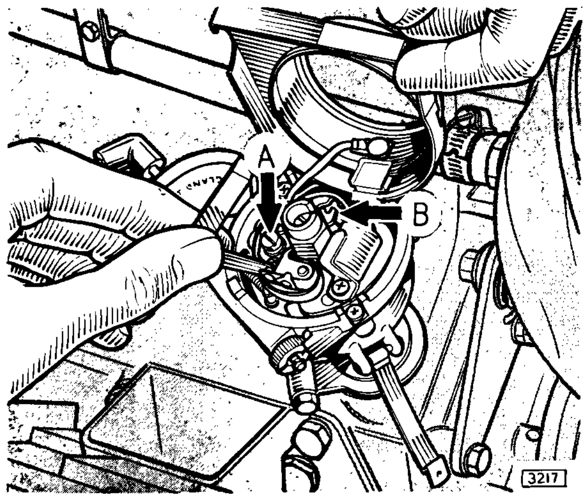

Fig. 5. Checking the gap—the screw "A" secures the fixed contact plate; the contact plate is adjusted by turning a screwdriver in slot "B".

Cam Bearing

To lubricate the cam bearing, inject a few drops of thin machine oil into the rotor arm spindle (Fig.4). Do not remove or slacken the screw located inside the spindle—a space is provided beneath the screw-head to allow the lubricant to reach the cam bearing.

Pivot Post

Place a drop of clean engine oil on the tip of the pivot post (see Fig.4).

Cam

Lightly smear the faces of the cam (Fig.4) with Mobilgrease No. 2 or with clean engine oil.

Centrifugal Timing Control

Inject a few drops of thin machine oil through a convenient aperture in the contact breaker base plate.

Cleaning

Clean the moulded cover inside and outside with a soft dry cloth. Pay particular attention to spaces between the terminals. Check that the small carbon brush inside the moulding can move freely in its holder.

Whilst the rotor arm is removed, examine the contact breaker. Rough, burned or blackened contacts can be cleaned with fine carborundum stone or emery cloth. After cleaning remove any grease or metallic dust with a petrol moistened cloth.

Contact cleaning is facilitated by removing the lever to which the moving contact is attached. To do this, remove the nut, insulating piece and electrical connections from the post to which the contact breaker spring is anchored. The contact breaker lever can then be lifted off the pivot post and the spring from the anchor post.

After cleaning and trimming the contacts, smear the pivot post (Fig.4) with Ragosine Molybdenised Noncreep Oil or with Mobilgrease No. 2. Reassemble the contact breaker and check the setting.

Refit the rotor arm, carefully locating its moulded projection in the spindle keyway and pushing it on as far as it will go.

Refit the moulded cover and spring the two side clips into position.

SERVICING

Dismantling

When dismantling, note carefully the position in which the various components are fitted in order to simplify their reassembly.

Bearing Replacement

The ball bearing at the upper end of the shank can be removed with a shouldered mandrel locating on the inner journal of the bearing.

When fitting a new ball bearing, the shouldered mandrel must locate on both inner and outer journals of the bearing.

The bearing bush at the lower end of the shank can be driven out with a suitable punch.

A bearing bush may be prepared for fitting by allowing it to stand completely immersed in medium viscosity (S.A.E. 30–40) engine oil for at least 24 hours. In cases of extreme urgency, this period of soaking may be shortened by heating the oil to 100°C. for 2 hours and then allowing to cool before removing the bush.

The bush is pressed into the shank with a shouldered mandrel. The mandrel should be hardened and polished and approximately 0·0005″ greater in diameter than the distributor shaft. To prevent subsequent withdrawal of the bush with the mandrel, a stripping washer should be fitted beween the shoulder of the mandrel and the bush.

Under no circumstances should the bush be overbored by reamering or by any other means, since this will impair the porosity and therefore the lubricating quality of the bush.

Re-assembly

When re-assembling, Ragosine molybdenised noncreep oil or (failing this) clean engine oil, should be smeared on the shaft and, more lightly, on the contact breaker bearing plate.

DISTRIBUTOR DATA

Compression Ratio	7:1–8:1–9:1
Lucas Ignition Distributor Type Model No:	22 D. 6
Lucas Service	41060A
Cam dwell angle	34°±3°
Contact breaker gap	0·014–0·016″ (0·36–0·41 mm.)
Contact breaker spring tension measured at free contact	18–24 ozs. (512–682 gms.)

IGNITION TIMING

7:1 Compression Ratio	6° BTDC
8:1 Compression Ratio	9° BTDC
9:1 Compression Ratio	10° BTDC

IGNITION DISTRIBUTOR TEST DATA

			VACUUM TIMING ADVANCE TESTS The distributor must be run immediately below the speed at which the centrifugal advance begins to function to obviate the possibility of an incorrect reading being registered.				CENTRIFUGAL TIMING ADVANCE TESTS Mount distributor in centrifugal advance test rig and set to spark at zero degrees at 100 r.p.m.				
Distributor Type	Lucas Service Number	Lucas Vacuum Unit Number	Vacuum in inches of mercury and advance in degrees Inches	Degrees	No advance in timing below-ins. of mercury	Lucas Advance Springs Number	Accelerate to-RPM and note advance in degrees RPM	Degrees	Decelerate to-RPM and note advance in degrees RPM	Degrees	No advance in timing below-RPM
22D6	41060A (standard) 41065A (auto. trans.)	54415894	20 13 9 7½ 6	7—9 6—8½ 2½—5½ 0—3 0—½	4½	55415562	2,300	8½—10½	1,800 1,250 800 650 525	82—10½ 6½—8½ 5—7 2—4 0—1½	300

Auto advance weights Lucas number 54413073. One inch of mercury = 0·0345 kg/cm².

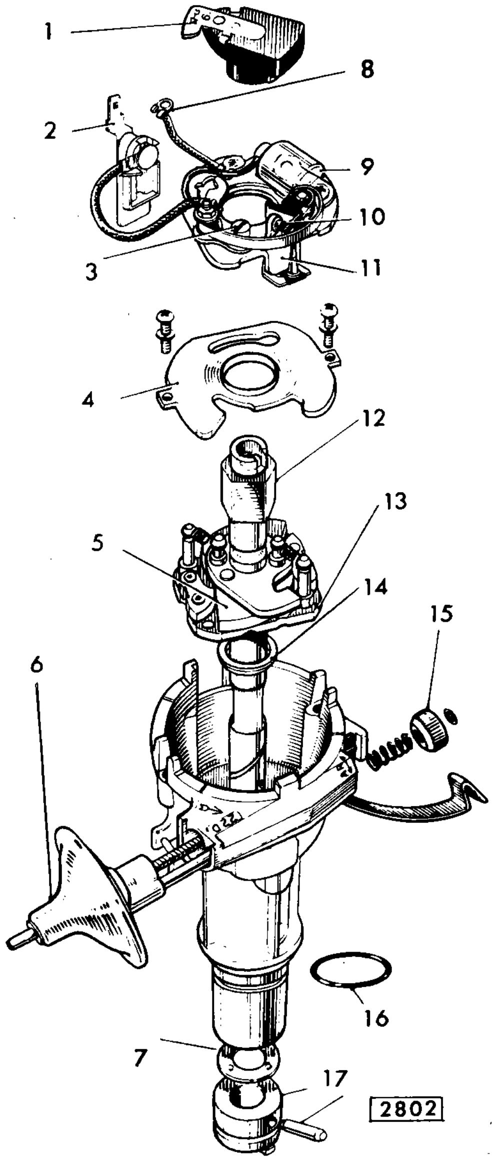

Fig. 6. The distributor components.

1. Rotor arm
2. L.T. terminal
3. Fixed contact plate securing screw
4. Contact breaker base plate
5. Centrifugal timing control weights
6. Vacuum timing control unit
7. Thrust washer
8. C.B. earth connector
9. Capacitor
10. Contacts
11. Contact breaker moving plate
12. Cam
13. Action plate
14. Distance collar
15. Micrometer adjustment nut
16. Oil seal washer
17. Dog and pin

ALTERNATOR

GENERAL

The Lucas 11 AC alternator is a lightweight machine designed to give increased output at all engine speeds.

Basically, the unit consists of a stationary output winding with built-in rectification and a rotating field winding energised from the battery through a pair of slip-rings.

The stator consists of a 24 slot, 3 phase star connected winding on a ring-shaped lamination pack, housed between the slip-ring end cover and the drive end bracket.

The rotor is of 8 pole construction and carries a field winding connected to two face type slip-rings. It is supported by a ball bearing in the drive end bracket and a needle roller bearing in the slip-ring end cover. See Fig. 7.

The brushgear for the field system is mounted on the slip-ring end cover. Two carbon brushes, one positive and the other negative, bear against a pair of concentric brass slip-rings carried on a moulded disc attached to the end of the rotor.

The positive brush is always associated with the inner slip-ring.

The slip-ring end cover also carries six silicon diodes connected in a 3 phase bridge circuit to provide rectification of the generated alternating current output. See Fig. 8. The diodes are cooled by air flow through the alternator induced by a 6″ (152·4 mm.) ventilating fan at the drive end.

The alternator is matched to an output control unit, Model 4 TR, see page P.23 for full details of the unit.

This unit controls the alternator field current and hence the alternator terminal voltage.

A cut-out is not included in the control unit as the diodes in the alternator prevent reverse currents from flowing through the stator when the machine is stationary or is generating less than the battery voltage.

No separate current-limiting device is incorporated; the inherent self-regulating properties of the alternator effectively limit the output current to a safe value.

The output control unit and the alternator field windings are isolated from the battery when the engine is stationary by a separate pair of contacts in the ignition switch.

On cars fitted with a steering column lock the field windings are isolated by means of a relay replacing the ignition switch control.

PERFORMANCE DATA

Cutting-in speed ..	500 engine r.p.m. at 13·0 alternator volts
Maximum D.C. output..	45 amp. at 3,000 engine r.p.m. (6,000 alternator r.p.m.) 13·5 volts
Stator phases .. .. Phase connection .. Resistance/phase at 68°F (20°C) ±5%	3 Star 0·107 ohms
Resistance of field coil at 68°F (20°C) ±5% ..	3·770 ohms

ROUTINE MAINTENANCE

No routine maintenance is necessary with the alternator or control unit.

Occasionally wipe away any dirt or oil which may collect around the slip-ring end cover.

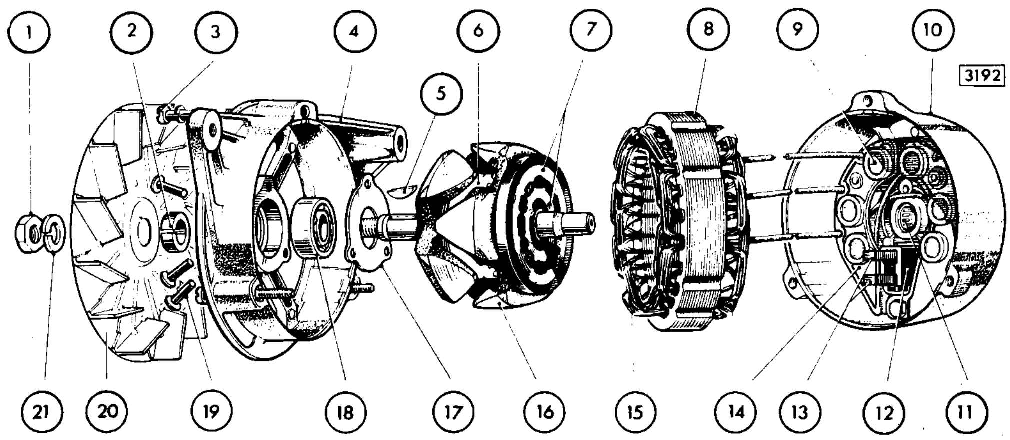

Fig. 7. Exploded view of the Lucas 11 AC Alternator.

1.	Shaft nut	12.	Brush box moulding
2.	Bearing collar	13.	Brushes
3.	Through fixing bolts (3)	14.	Diode heat sink
4.	Drive end bracket	15.	Stator windings
5.	Key	16.	Rotor
6.	Rotor (field) winding	17.	Bearing retaining plate
7.	Slip rings	18.	Ball bearing
8.	Stator laminations	19.	Bearing retaining plate rivets
9.	Silicon diodes (6)	20.	Fan
10.	Slip ring end bracket	21.	Spring washer
11.	Needle roller bearing		

REMOVAL

Disconnect the cables from the three terminals on the slip ring end cover. Note the colour and location of the two cables with "Lucar" termination for reference when refitting.

Note: A fourth terminal is located on the slip-ring end cover. This terminal is not used and no cables must be connected to it when refitting the alternator.

Remove the drive belt by pushing the spring loaded jockey pulley inwards and lifting the belt over the alternator pulley.

Remove the two bolts securing the alternator to the mounting bracket and adjuster link and withdraw the alternator.

REFITTING

Refitting is the reverse of the removal procedure.

When replacing the alternator belt, hold the spring loaded jockey pulley in towards the block and only release when the belt is sitting securely in the "vee" tracks.

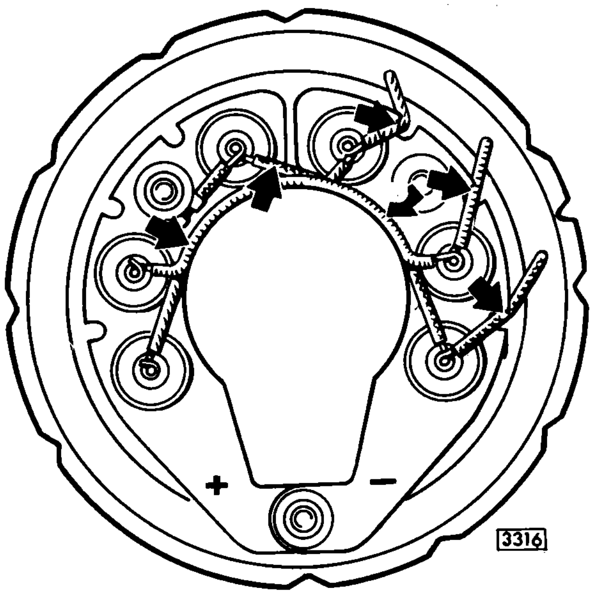

Fig. 8. Showing the silicon diodes and connections in the slip ring and cover.

SERVICE PRECAUTIONS

Important: Mk. 10 4·2 cars are equipped with transistors in the control box unit and diode rectifiers in the alternator. The car electrical system must NOT be checked with an ohm meter incorporating a hand driven generator until these components have been isolated.

REVERSED battery connections will damage the diode rectifiers.

Battery polarity must be checked before connections are made to ensure that the connections to the car battery are NEGATIVE earth. This is most important when using a slave battery to start the engine.

NEVER earth the brown/green cable if it is disconnected at the alternator. If this cable is earthed, with the ignition switched ON, the control unit and wiring may be damaged.

NEVER earth the alternator main output cable or terminal. Earthing at this point will damage the alternator or circuit.

NEVER run the alternator on open circuit with the field windings energised, that is with the main lead disconnected, or the rectifier diodes are likely to be damaged due to peak-inverse voltages.

SERVICING

Testing the Alternator in position

In the event of a fault developing in the charging circuit check by the following procedure to locate the cause of the trouble.

(a) Disconnect the battery earth cable.

(b) Lower the instrument panel and disconnect the brown and brown/white cables from the ammeter. Connect the two cables to a good quality moving-coil ammeter registering at least 75 amperes.

(c) Detach the terminal connector block from the base of the control unit and connect the black and brown/green cables together by means of a short length of cable with two "Lucar" terminals attached. This operation connects the alternator field winding across the battery terminals and by-passes the output control unit (Fig. 9).

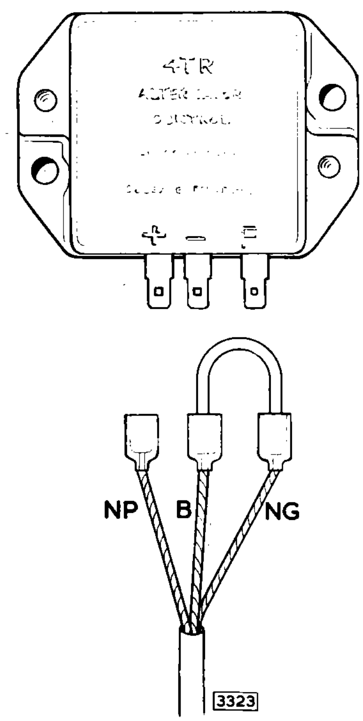

Fig. 9. Detach the terminal connectors from the base of the control unit.

(d) Reconnect the battery earth lead. Switch on the ignition, and start the engine. Slowly increase the engine speed until the alternator is running at approximately 4,000 R.P.M. (2,000 engine R.P.M.)

Check the reading on the ammeter which should be approximately 40 amperes with the machine at ambient temperature.

A low current reading will indicate either a faulty alternator or poor circuit wiring connections.

If after checking the latter (especially the earth connections) a low reading persists on repeating the test, proceed to Paragraph (5).

If, however, a zero reading results, switch on the ignition and check that battery voltage is being applied to the rotor windings by connecting a voltmeter between the two cable ends normally attached to the alternator field in the field isolating contacts in the ignition switch or the wiring associated with this circuit.

Check each item in turn and rectify as necessary.

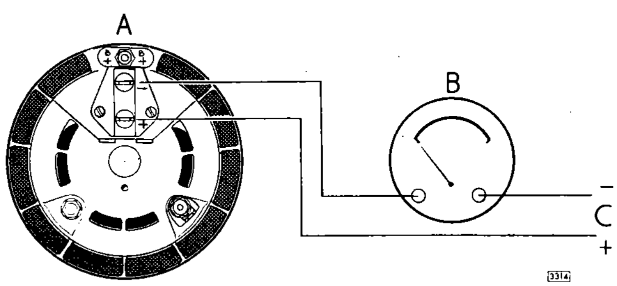

Fig. 10. Testing the alternator with an ammeter. A—Alternator, B—Ammeter, C—Battery.

(e) If a low output has resulted from the test described in paragraph (4) and the circuit wiring is in order measure the resistance of the rotor coil (field) by means of an ohmmeter connected between the field terminal blades with the external wiring disconnected. The resistance must approximate to 3·77 ohms.

If an ohmmeter is not available, connect a 12 volt D.C. supply between the field terminals with an ammeter in series. The ammeter reading should be approximately 3·2 amperes. Fig. 10.

A zero reading on the ammeter, or an "Infinity" reading on the ohmmeter indicates an open circuit in the field system, that is, brushgear, sliprings, or winding. Conversely if the current reading is much above, or, the ohmmeter is much below the values given above, it is an indication of a short-circuit in the rotor-winding, in which case the rotor/slipring assembly must be changed.

DISMANTLING THE ALTERNATOR

Disconnect the battery and remove the alternator as detailed on page P.18.

Remove the shaft nut and spring washer and withdraw the pulley and fan.

Unscrew the nuts and remove the three through bolts.

Note: The nuts are staked to the through bolts and the staking must be removed before the nuts are unscrewed. If the threads of the nuts or bolts are damaged, new bolts must be fitted re-assembling.

Mark the drive end bracket, lamination pack and slip ring end cover so that they may be re-assembled in correct angular relation to each other. Care must be taken not to damage the 'amination pack when marking.

Withdraw the drive end bracket and rotor from the stator. The drive end bracket and rotor need not be separated unless the bearing requires examination or the rotor is to be replaced in which case the rotor should be removed from the drive end bracket by means of a hand press having first removed the shaft key and bearing collar.

Remove the terminal nuts, washers, insulating pieces brush box screws and the 2BA hexagon headed setscrews and withdraw the stator and heat sink assemblies from the slip ring end cover.

Close up the retaining tongue at the root of each field terminal blade and withdraw the brush spring and terminal assemblies from the moulded brushbox.

REASSEMBLY

Reassembly of the alternator is the reverse of the dismantling procedure. Care must be taken to align the drive end bracket, lamination pack and slip ring end bracket correctly.

Tighten the three "through" bolts evenly to a maximum torque of 45·500 lb. ins. (0·518–0·576 kgm.). Restake the nuts after tightening.

Tighten the brush box fixing screws to a maximum torque of 10 lb.ins. (0·115 kg/m.).

INSPECTION OF BRUSH GEAR

Measure brush length. A new brush is $\frac{5}{8}''$ (15·88 mm.) long; a fully worn brush is $\frac{5}{32}''$ (3·97 mm.) long and must be replaced at, or approaching this length. The new brush is supplied complete with brush spring and "Lucar" terminal blade and has merely to be pushed in until the tongue registers.

To ensure that the terminal is properly retained, carefully lever up the retaining tongue with a fine screwdriver blade, so that the tongue makes an angle of about 30° with the terminal blade.

The normal brush spring pressures are 4–5 oz. (113–142 gms.) with the spring compressed to $\frac{25}{32}''$ (19·84 mm.) in length and $7\frac{1}{2}$–$8\frac{1}{2}$ oz. (212–242 gms.) with the spring compressed to $\frac{13}{32}''$ (10·31 mm.) in length. These pressures should be measured if the necessary equipment is available.

Check that the brushes move freely in their holders. If at all sluggish, clean the brush sides with a petrol-moistened cloth or, if this fails to effect a cure, lightly polish the brush sides on a smooth file. Remove all traces of brush dust before re-housing the brushes in their holders.

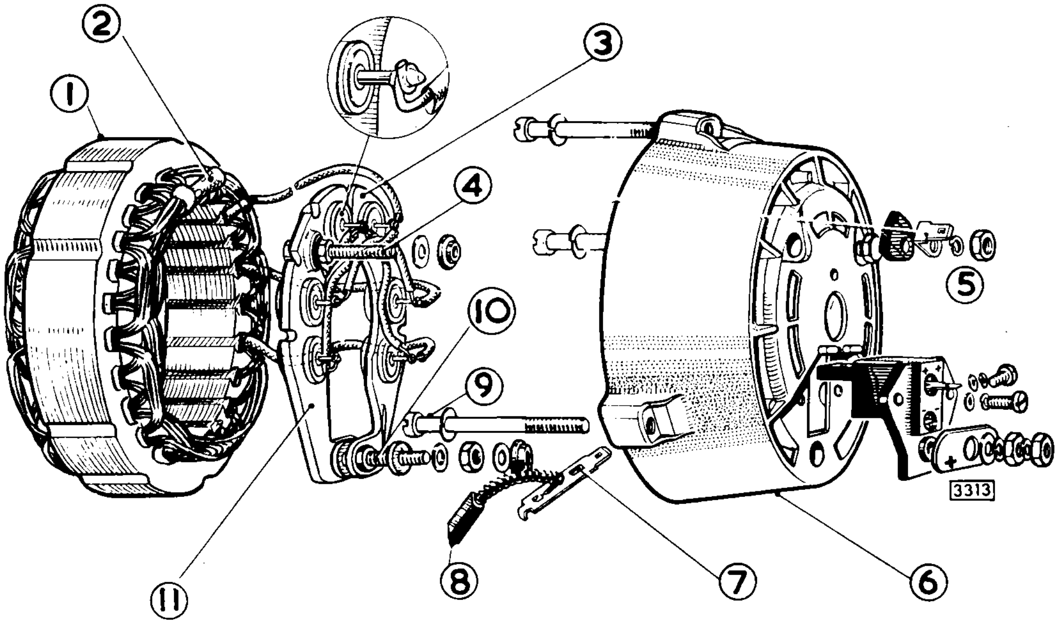

Fig. 11. Exploded view of slip ring end cover.

1. Stator
2. Star point
3. Negative heat sink and anode base diodes (black)
4. Warning light terminal "AL"
5. Field terminal (2 off)
6. Slip ring end cover
7. Terminal blade retaining tongue
8. Rotor slip ring brush (2 off)
9. "Through" bolts (3 off)
10. Output terminals (+)
11. Positive heat sink and cathode base diode (red)

INSPECTION OF SLIP-RINGS

The surfaces of the slip-rings should be smooth and uncontaminated by oil or other foreign matter. Clean the surfaces using a petrol-moistened cloth, or if there is any evidence of burning, very fine glasspaper. On no account must emery cloth or similar abrasives be used. No attempt should be made to machine the slip-rings, as any eccentricity in the machining may adversely affect the high-speed performance of the alternator. The small current carried by the rotor winding, and the unbroken surface of the slip-rings means that the likelihood of scored or pitted slip-rings is almost negligible.

ROTOR

Test the rotor winding by connecting an ohmmeter or 12-volt D.C. supply between the slip-rings (as described on page P.20 where this test was made with the brushgear in circuit). The readings of resistance or current should be as given in para. e, page P.20.

Test for defective insulation between each of the slip-rings and one of the rotor poles using a mains low-wattage test lamp for the purpose. If the lamp lights, the coil is earthing and a replacement rotor/slip-ring assembly must be fitted.

No attempt should be made to machine the rotor poles or to true a distorted shaft.

STATOR

Unsolder the three stator cables from the heat sink assembly taking care not to overheat the diodes. By lettering these cables A, B and C, three "pairs" of cables—AB, BC and AC—are available for testing the stator windings. Measure the volt drop across each of these "pairs" in turn while passing 20 amp between the cable ends. The volt drop should be approximately 4·3 volts in each of the three measurements. If any, or all, of the readings are other than these, a replacement stator must be fitted.

Test for defective insulation between stator coils and lamination pack with a mains test lamp. Connect the test probes between any one of the three cable ends and the lamination pack. If the lamp lights, the stator coils are earthing and a replacement stator must be fitted.

Before re-soldering the stator cable ends to the diode pins carry out the following test.

DIODES

Each diode can be checked by connecting it in series with a 1·5 watt test bulb (Lucas No. 280) across a 12-volt D.C. supply and then reversing the connections.

Current should flow, and the bulb light, in one direction only. Should the bulb light up in both tests or not light up in either, the diode is defective and the appropriate heat sink assembly must be replaced.

The above procedure is adequate for service purposes. Any accurate measurement of diode resistance requires factory equipment.

Since the forward resistance of a diode varies with the voltage applied, no realistic readings can be obtained with battery-powered ohmmeters. However, should a battery-ohmmeter be used, a good diode will yield "Infinity" in one direction, and some indefinite but much lower, reading in the other.

Warning: OHMMETERS OF THE TYPE INCORPORATING A HAND-DRIVEN GENERATOR MUST NEVER BE USED FOR CHECKING DIODES.

ALTERNATOR DIODE HEAT SINK REPLACEMENT

The alternator heat sink assembly comprises two mutually-insulated portions, one of positive polarity and the other negative. The diodes are not individually replaceable, but, for service purposes, are supplied already pressed into the appropriate heat sink portion. The positive portion carries three cathode base diodes marked red, and the negative portion three anode base diodes marked black.

When soldering the interconnections, "M" grade 45-55 tin-lead solder should be used.

Great care must be taken to avoid overheating the diodes or bending the diode pins. The diode pins should be lightly gripped with a pair of suitable long-nosed pliers (which act as a thermal shunt) and the operation of soldering carried out as quickly as possible.

After soldering, the connections must be neatly arranged around the heat sinks, to ensure adequate clearance of the rotor, and be tacked down with "MM" EC1022 adhesive where indicated in Fig. 8. The stator connections must pass through the appropriate notches at the edge of the heat sink.

BEARINGS

Bearings which are worn to the extent that they allow excessive side movement of the rotor shaft must be renewed.

The needle-roller bearing in the slip-ring end cover is supplied complete with the end cover.

To renew the drive end ball-bearing (following withdrawal of the rotor shaft from the drive-end bracket) proceed as follows:—

File away the roll-over on each of the three bearing retaining plate rivets and punch out the rivets.

Press the bearing out of the bracket.

Before fitting the replacement bearing see that it is clean and, if necessary, pack it with high-melting point grease such as Shell Alvania No. 3 or an equivalent lubricant.

Locate the bearing in the housing and press it home. Refit the bearing retaining plate using new rivets.

ALTERNATOR OUTPUT CONTROL UNIT MODEL 4TR

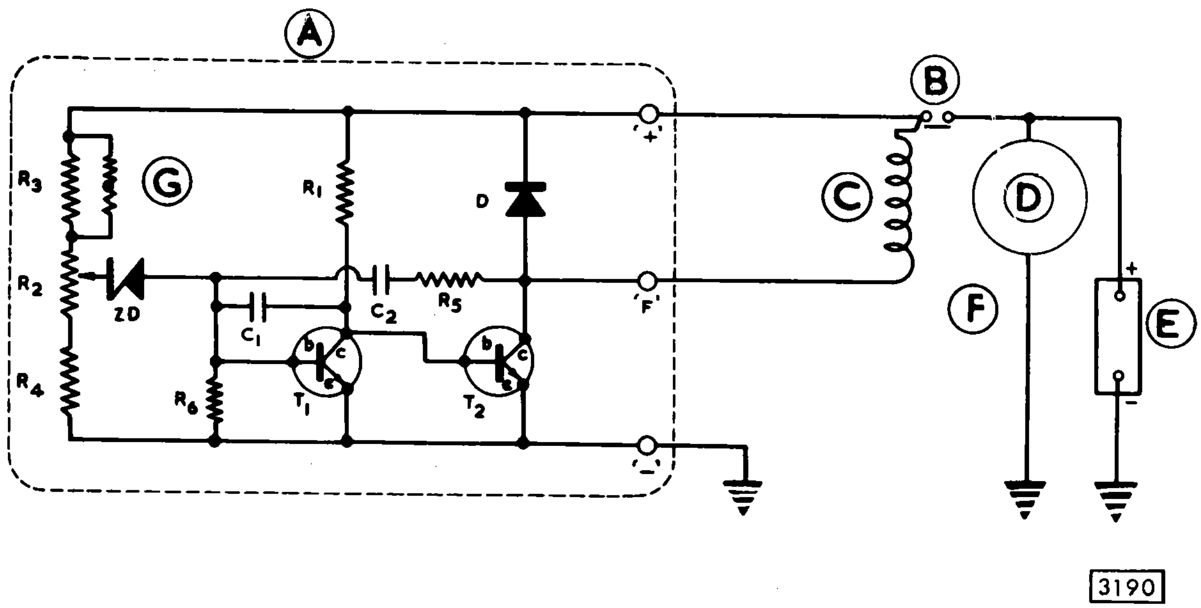

Fig. 12. Alternator output control unit circuit diagram.

A—Control unit. B—Field isolating device.
C—Rotor field winding. D—Alternator. E—12 volt Battery.
F—Stator winding (rectified) output. G—Thermistor.

DESCRIPTION

Model 4TR is an electronic control unit. In effect its action is similar to that of the vibrating contact type of voltage control unit, but switching is achieved by transistors instead of vibrating contacts, while a Zener diode provides the voltage reference in place of the voltage coil and tension spring system. No cut-out is required since the diodes incorporated in the alternator prevent reverse currents flowing. No current regulator is required as the inherent self-regulating properties of the alternator effectively limit the output current to a safe value.

The control unit and the alternator field windings are isolated from the battery when the engine is stationary, by a special double-pole ignition switch. On cars fitted with a steering column lock the field windings are isolated by means of a relay replacing the ignition switch control.

Care must be taken at all times to ensure that the battery, alternator and control unit are correctly connected. Reversed connections will damage the semiconductor devices employed in the alternator and control unit.

OPERATION

When the ignition is switched on, the control unit is connected to the battery through the field isolating switch or relay. By virtue of the connection through R1 (see Fig. 12), the base circuit of the power transistor T2 is conducting so that, by normal transistor action, current also flows in the collector-emitter portion of T2 which thus acts as a closed switch to complete the field circuit and battery voltage is applied to the field winding.

As the alternator rotor speed increases, the rising voltage generated across the stator winding is applied to the potential divider consisting of R3, R2 and R4. According to the position of the tapping point on R2, a proportion of this potential is applied to the Zener diode (ZD). This latter is a device which opposes the passage of current through itself until a certain voltage is reached, above which it conducts comparatively freely. The Zener diode can thus be considered as a voltage-conscious switch which closes when the voltage across it reaches its "breakdown" voltage (about 10 volts) and, since this is a known proportion of the alternator output voltage as determined by the position of the tapping point of R2, the breakdown point therefore reflects the value of the output voltage. Thus at "breakdown" voltage the Zener diode conducts and current flows in he base-emitter circuit of the driver transistor T1. Again, by transistor action, current will now flow in the collector-emitter portion of T1 so that some of the current which previously passed through R1 and the base circuit of T2 is diverted through T1. Thus the base current of T2 is reduced and, as a result, so also is the alternator field excitation. Consequently, the alternator output voltage will tend to fall—and this in turn will tend to reduce the base current in T1, allowing increased field current to flow in T2. By this means, the field current is continuously varied to keep the output voltage substantially constant at the value determined by the setting of R2.

To prevent overheating of T2 (due to power dissipation) this transistor is operated only either in the fully-on or fully-off condition. This is achieved by the incorporation of the positive feed-back circuit comprising R5 and C2. As the field current in transistor T2 starts to fall, the voltage at "F" rises and current flows through resistor R5 and capacitor C2 thus adding to the Zener diode current in the base circuit of transistor T1. This has the effect of increasing the current through T1 and decreasing still further through T2 so that the circuit quickly reaches the condition where T1 is fully-on and T2 fully-off. As C2 charges, the feed-back current falls to a degree at which the combination of Zener diode current and feed-back current in the base circuit of T1 is no longer sufficient to keep T1 fully-on. Current then begins to flow again in the base circuit of T2. The voltage at "F" now commences to fall, reducing the feed-back current eventually to zero. As T2 becomes yet more conductive and the voltage at "F" falls further, current in the feed-back circuit reverses in direction, in effect reducing still further the base current in T1. This effect also is cumulative and the circuit reverts to the condition where T1 is fully-off and T2 fully-on.

This condition is only momentary since C2 quickly charges to the opposite polarity, when feed-back current is reduced and current again flows in the base circuit of T1. The circuit thus oscillates, switching the voltage across the alternator field winding rapidly on and off.

Transistor T2 is protected from the high induced voltage surge which results from the collapse of the field current, by the surge quench diode D connect across the field windings. This diode also provides a measure of field current smoothing since current continues to flow in the diode after the excitation voltage is removed from the field. The elimination of radio interference is achieved by connecting condenser C1 between the base and collector terminals of T1 to provide negative feed-back. At high temperatures, a small leakage current may flow through the Zener diode even though the latter is in the nominally nonconductive state. Resistor R6 provides a path for this leakage current which otherwise would flow through T1 base circuit and adversely affect the regulator action.

A thermistor is connected in parallel with resistor R3. The thermistor is a device whose resistance increases as the temperature falls and vice versa. Any alteration in its ohmic value will modify the voltage distribution across the potential divider and thus affect the voltage value at which the Zener diode begins to conduct, so matching the changes which take place in battery terminal voltage as the temperature rises.

CHECKING AND ADJUSTING THE CONTROL UNITS

Important: the following voltage checking and setting procedure must be carried out only:

(a) providing the alternator and associated wiring circuits have first been tested and found satisfactory, and

(b) in conjunction with a well-charged battery, i.e. with the charging current not exceeding 10 amperes.

(c) Run the alternator at charging speed for eight minutes. This operation applies when bench testing or testing on the car.

VOLTAGE CHECKING

Leave the existing connections to the alternator and control unit undisturbed. Connect a high-quality voltmeter between control unit terminals "+" and "—". If available, use a voltmeter of the suppressed-zero type, reading 12–15 volts. Switch on an electrical load of approximately 2 amperes, e.g. side and tail lighting. Start the engine and run the alternator at 3,000 r.p.m. until conditions (b) and (c) above obtains.

The voltmeter should now show a reading of 13·9–14·3 volts at 68–78°F. (20–26°F.C.) ambient temperature volts. If not, but providing the reading obtained has risen to some degree above battery terminal voltage before finally reaching a steady value; the unit can be adjusted to control at the correct voltage (see "ADJUSTING").

If however the voltmeter reading remains unchanged (at battery terminal voltage) or, conversely, increases in an uncontrolled manner, then the control unit is faulty and as its component parts are not serviced individually, a replacement unit must be fitted.

ADJUSTING

Stop the engine and withdraw the control unit mounting screws. Invert the unit and chip away the sealing compound which conceals the potentiometer adjuster, (see Fig.13). Check that the voltmeter is still firmly connected between terminals "+" and "—". Start the engine and, while running the alternator at 3,000 r.p.m., turn the potentiometer adjuster slot—clockwise to increase the setting or anti-clockwise to decrease it—until the required setting is obtained. Use care in making this adjustment—a small amount of adjuster movement causes an appreciable difference in the voltage reading. Recheck the setting by first stopping the engine then again running the alternator at 3,000 r.p.m.

Remount the control unit and disconnect the voltmeter.

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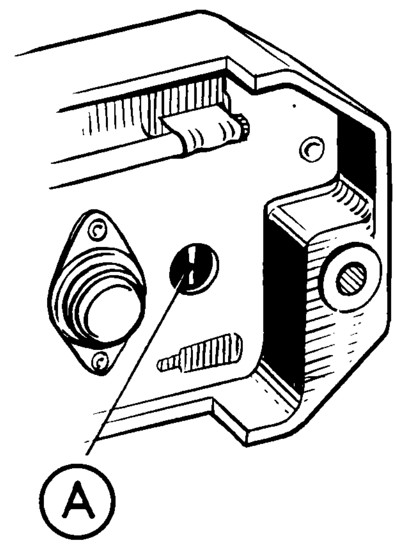


Fig. 13. 4 TR Alternator control. "A" indicates the potentiometer adjuster.

THE STARTER MOTOR

DESCRIPTION

The purpose of the pre-engaged (or "positive engagement") starter motor is to prevent premature pinion ejection.

Except on occasions of tooth-to-tooth abutment, for which special provision is made, the starter motor is connected to the battery only after the pinion has been meshed with the flywheel ring gear, through the medium of an electro-magnetically operated linkage mechanism. After the engine has started, the current is automatically switched off before the pinion is retracted. On reaching the out-of-mesh position, the spinning armature is brought rapidly to rest by a braking device. This device takes the form of a pair of moulded shoes driven by a cross peg in the armature shaft and spring loaded (and centrifuged) against a steel ring insert in the commutator end bracket. Thus, with the supply switched off and the armature subjected to a braking force, the possibility is minimised of damaged teeth resulting from attempts being made to re-engage a rotating pinion.

A bridge-shaped bracket is secured to the front end of the machine by the through bolts. This bracket carries the main battery input and solenoid winding terminals, short extension cables being connected between these and the corresponding solenoid terminals.

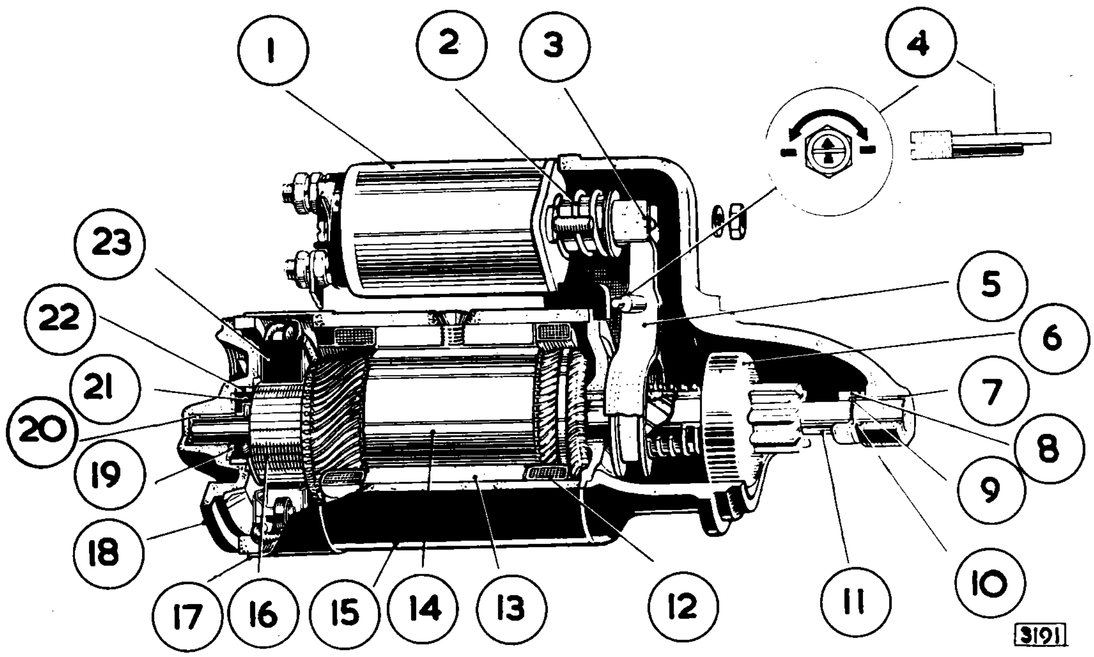


Fig. 14. The Pre-engaged Starter Motor, Model M 45 G.

1. Actuating solenoid
2. Return spring
3. Clevis pin
4. Eccentric pivot pin
5. Engaging lever
6. Roller clutch
7. Porous bronze bush
8. Thrust collar
9. Jump ring
10. Thrust washer
11. Armature shaft extension
12. Field coils
13. Pole shoe
14. Armature
15. Yoke
16. Commutator
17. Band cover
18. C.E. bracket
19. Thrust washer
20. Porous bronze bush
21. Brake shoes and cross peg
22. Brake ring
23. Brushes

TOOTH-TO-TOOTH ABUTMENT

The electro-magnetically actuated linkage mechanism consists essentially of a pivoted engaging lever having two hardened steel pegs (or trunnion blocks) which locate with and control the drive through the medium of a groove in an operating bush. This bush is carried, together with the clutch and pinion assembly, on an internally splined outboard driving sleeve—the whole mechanism being housed in a cut-away flange-mounting snout-shaped end bracket. The operating bush is spring loaded against a jump ring in the driving sleeve by an engagement spring located between the bush and the clutch outer cover. The system return or drive de-meshing spring is located round the solenoid plunger.

On occasions of tooth-to-tooth abutment (between the ends of the starter pinion teeth and those of the flywheel ring gear), the pegs or trunnion blocks at the "lower" end of the engaging lever can move forward by causing the operating bush to compress the engagement spring, thus allowing the "upper" end of the lever to move sufficiently rearwards to close the starter switch contacts. The armature then rotates and the pinion slips into mesh with the flywheel ring gear under pressure of the compressed engagement spring.

THE "LOST MOTION" (SWITCH-OFF) DEVICE

As it is desirable that the starter switch contacts shall not close until the pinion has meshed with the flywheel ring gear so it is important that these same contacts should always re-open before the pinion has been retracted—or can be opened in the event of a starter pinion remaining for some reason enmeshed with the flywheel ring gear. To ensure this, a measure of "lost motion" is designed into some part of the engagement mechanism, its effect being to allow the starter switch or solenoid contacts (which are always spring-loaded to the open position) to open before pinion retraction begins.

Several methods of obtaining "lost motion" have been adopted, but each depends upon the yielding of a weaker spring to the stronger system return (drive de-meshing or disengagement) spring of the solenoid plunger.

This initial yielding results in the switch contacts being fully-opened within the first $\frac{1}{8}''$ (3·18 mm.) of plunger return travel—this action being followed by normal drive retraction.

Solenoid model 10S has a weaker ("lost motion") spring located inside the solenoid plunger. Here, enclosed at the outer end by a retaining cup, it forms a plunger-within-a-plunger and is spring-loaded against the tip of the engaging lever inside the plunger clevis link.

THE ROLLER CLUTCH

Torque developed by the starting motor armature must be transmitted to the pinion and flywheel through an over-running or free-wheeling device which will prevent the armature from being rotated at an excessively high speed in the event of the engaged position being held after the engine has been started. The roller clutch performs this function.

The operating principle of the roller clutch is the wedging of several plain cylindrical rollers between converging surfaces. The convergent form is obtained by matching cam tracks, to a perfectly circular bore. The rollers. of which there are three, are spring-loaded and, according to the direction of drive, are either free or wedgelocked between the driving and driven members. The clutches are sealed in a rolled over steel outer cover and cannot be dismantled for subsequent re-assembly.

THE STARTER SOLENOID

The starter solenoid is an electro-magnetic actuator mounted pick-a-back fashion on the yoke of the pre-engaged starting motor. It contains a soft iron plunger (linked to the engaging lever), the starter switch contacts and a coil consisting of two windings, i.e., a heavy-gauge pull-in or series winding and a lighter-gauge hold-on or shunt winding.

Initially, both windings are energised in parallel when the starter device is operated, but the pull-in winding is shorted out by the starter switch contacts at the instant of closure—its duty having been effected.

Magnetically, the windings are mutually assisting.

Like the roller clutch assembly, the starter solenoid is sealed in a rolled-over steel outer case or body and cannot be dismantled for subsequent re-assembly.

PERFORMANCE DATA

STARTER MOTOR

Model	M 45 G Pre-engaged.
Lock Torque	22·6 lb.ft. (3·13 kgm.) with 465 amperes at 7·6 terminal volts.
Torque at 1000 r.p.m.	9·6 lb.ft. (1·33 kgm.) with 240 amperes at 9·7 terminal volts.
Light running current	70 amperes at 5,800–6,500 r.p.m.

SOLENOID SWITCH

Model	
Closing coil resistance (measured between terminal "STA", copper link removed and "Lucar" terminal)	0·36–0·42 ohms.
Hold on coil resistance (measured between "Lucar" terminal and solenoid outer case)	1·49–1·71 ohms.

ROUTINE MAINTENANCE

EVERY 24,000 MILES (38,400 KM.)

Checking the Brushgear and Commutator

Remove the starter motor (see page P.29) from the engine.

Release the screw and remove the metal band cover and check that the brushes move freely in the brush boxes by holding back the spring and pulling gently on the flexible connection. If a brush is inclined to stick, remove it from its holder and clean its sides with a petrol moistened cloth. Replace the brushes in their original position in order to retain "bedding". Brushes which will not bed properly or have worn to $\frac{5}{16}''$ (7·94 mm.) in length must be renewed. See page P.31 for method of procedure.

Check the tension of the brush springs with a spring balance. The correct tension should be 52 ozs. (1·47 kg.) on a new brush.

Replace each existing brush in turn with a new brush to enable the tension of the brush springs to be tested accurately.

Check that the commutator is clean and free from oil or dirt. If necessary, clean with a petrol moistened cloth. If this is ineffective, rotate the armature and polish the commutator with fine glass paper. DO NOT use emery cloth. Blow out all abrasive dust with a dry air blast.

A badly worn commutator can be re-skimmed by first rough turning, followed by diamond finishing. DO NOT undercut the insulators.

Armatures must NOT be skimmed below a minimum diameter of 1·531″ (38·90 mm.).

Replace the armature if below this limit.

REMOVAL

Disconnect the battery earth lead.

Remove the oil filter unit from the engine, catch any escaping oil in a container.

Disconnect the battery cable and solenoid switch cable from the starter motor.

Remove the two setscrews and lockwashers securing the motor to the housing, gently bend away the carburetter drain pipes and remove the starter motor through the chassis frame.

The two setscrews are accessible from beneath the car.

The best method of removing the setscrews is to use a socket spanner with extensions of approximately 30″ (76 cms.) in length and enter the spanner from behind the transmission unit. A second operator will be needed to guide the socket spanner on to the setscrews from inside the engine compartment.

REFITTING

Refitting is the reverse of the removal procedure.

Care must be taken when refitting the two setscrews, which have a fine thread, that they are not cross-threaded.

Renew the oil filter joint when refitting the unit.

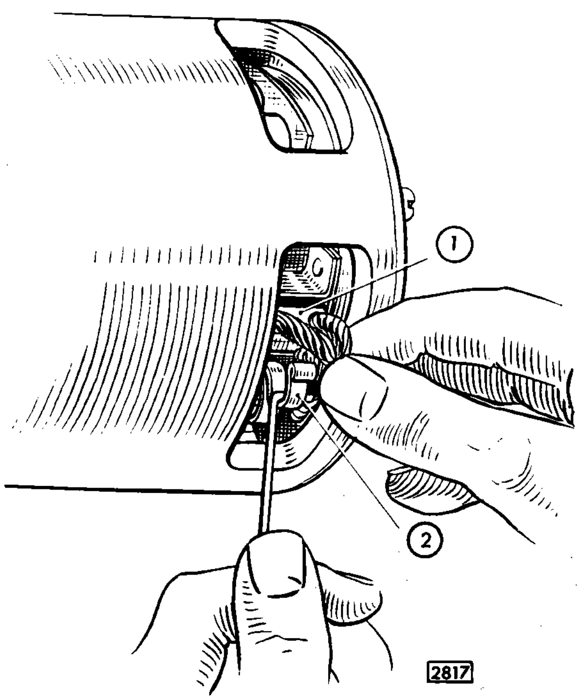


Fig. 15. Checking the brush gear.

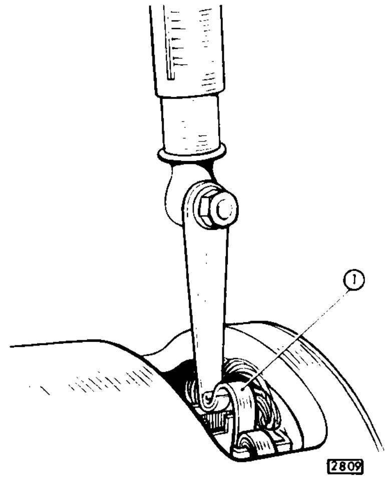


Fig. 16. Testing the brush spring tension. Brush spring indicated.

SERVICING

Testing in Position

Check that the battery is fully charged and the terminals are clean and tight. Recharge if necessary.

Switch on the lamps and ignition and operate the starter control. If the lights go dim, but, the starter does not crank the engine an indication is given that the current is flowing through the starter motor winding, but, the armature is not rotating for some reason.

The fault is possibly due to high resistance in brush gear, or, open circuit in armature or field coils.

Remove the starter motor for examination.

If the lights retain their full brilliance when the starter control is operated check:

(a) the starter motor circuit for continuity.

(b) the solenoid unit for continuity.

If the supply voltage is found to be applied to the starter motor when the control is operated the unit must be removed from the engine and checked for an internal fault.

Sluggish or slow action of the starting motor is usually due to a loose connection causing a high resistance in the motor circuit. Check as described above.

If the motor is heard to operate, but does not crank the engine, indication is given of damage to the drive.

BENCH TESTING

Removing the Starting Motor from the Engine

Disconnect the battery. Disconnect and remove the starter motor from the engine. See page P.29 for removal procedure.

MEASURING THE LIGHT RUNNING CURRENT

With the starter motor securely clamped in a vice and using a 12-volt battery, check the light running current and compare with the value given on page P.28. If there appears to be excessive sparking at the commutator, check that the brushes are clean and free to move in their boxes and the spring pressure is correct. See symptoms 7 and 8 page P.28.

MEASURING LOCK TORQUE AND LOCK CURRENT

Carry out a torque test and compare with the values given on page P.28.

If a constant voltage supply is used, it is important to adjust this to be 7·6 volts at the starter terminal when testing.

FAULT DIAGNOSIS

An indication of the nature of the fault, or faults, may be deduced from the results of the no-load and lock torque tests.

Symptom	Probable Fault
1. Speed, torque and current consumption correct.	Assume motor to be in normal operating condition
2. Speed, torque and current consumption low.	High resistance in brush gear e.g., faulty connections, dirty or burned commutator causing poor brush contact.
3. Speed and torque low, current consumption high.	Tight or worn bearings, bent shaft, insufficient end play, armature fouling a pole shoe, or cracked spigot on drive end bracket. Short-circuited armature earthed armature or field coils.
4. Speed and current consumption high, torque low.	Short-circuited windings in field coils.
5. Armature does not rotate, high current consumption.	Open-circuited armature, field coils, or solenoid unit. If the commutator is badly burned, there may be poor contact between brushes and commutator.
6. Armature does not rotate, high current consumption.	Earthed field winding or short-circuited solenoid unit. Armature physically prevented from rotating
7. Excessive brush movement causing arcing at commutator.	Low brush spring tension, worn or out-of-round commutator. "Thrown" or high segment on commutator.
8. Excessive arcing at the commutator.	Defective armature windings, sticking brushes or dirty commutator.

DISMANTLING

Disconnect the copper link between the lower solenoid terminal and the starter motor yoke.

Remove the two solenoid unit securing nuts. Detach the extension cable and withdraw the solenoid from the drive end bracket casting, carefully disengaging the solenoid plunger from the starter drive engagement lever.

Remove the cover band and lift the brushes from their holders.

Unscrew and withdraw the two through bolts from the commutator end bracket. The commutator end bracket and yoke can now be removed from the intermediate and drive end brackets.

Extract the rubber seal from the drive end bracket.

Slacken the nut securing the eccentric pin on which the starter drive engagement lever pivots and unscrew and withdraw the pin.

Separate the drive end bracket from the armature and intermediate bracket assembly.

Remove the thrust washer from the end of the armature shaft extension using a mild steel tube of suitable bore. Prise the jump ring from its groove and slide the drive assembly and intermediate bracket from the shaft.

To dismantle the drive further prise off the jump ring retaining the operating bush and engagement spring.

BENCH INSPECTION

After dismantling the motor, examine individual items.

Replacement of Brushes

The flexible connectors are soldered to terminal tags; two are connected to brush boxes and two are connected to free ends of the field coils. Unsolder these flexible connectors and solder the connectors of the new brush set in their place.

The brushes are pre-formed so that "bedding" to the commutator is unnecessary. Check that the new brushes can move freely in their boxes.

Commutator

A commutator in good condition will be burnished and free from pits or burned spots. Clean the commutator with a petrol-moistened cloth. Should this be ineffective, spin the armature and polish the commutator with fine glass paper; remove all abrasive dust with a dry air blast. If the commutator is badly worn, mount the armature between centres in a lathe, rotate at high speed and take a light cut with a very sharp tool. Do not remove more metal than is necessary. Finally polish with very fine glass paper. The INSULATORS between the commutator segments MUST NOT BE UNDERCUT.

Armatures must NOT be skimmed below a minimum diameter of 1·531" (38·90 mm.). Replace the armature if below this limit.

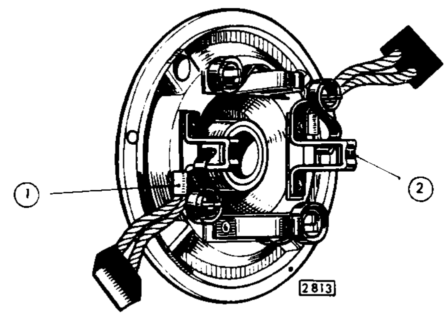


Fig. 17. Commutator and bracket brush connections.

Armature

Lifted conductors:

If the armature conductors are found to be lifted from the commutator risers, overspeeding is indicated. In this event, check that the clutch assembly is operating correctly.

Fouling of armature core against the pole faces:

This indicates worn bearings or a distorted shaft. A damaged armature must in all cases be replaced and no attempt should be made to machine the armature core or to true a distorted armature shaft.

Insulation test:

To check armature insulation, use a 110-volt A.C. test lamp.

The test lamp must not light when connected between any commutator segment and the armature shaft.

If a short circuit is suspected, check the armature on a "growler". Overheating can cause blobs of solder to short circuit the commutator segments.

If the cause of an armature fault cannot be located or remedied, fit a replacement armature.

Field Coils

Continuity Test:

Connect a 12-volt test lamp and battery between the terminal on the yoke and each individual brush (with the armature removed from the yoke). Ensure that both brushes and their flexible connectors are clear of the yoke. If the lamp does not light, an open circuit in the field coils is indicated.

Replace the defective coils.

Insulation test:

Connect a 110-volt A.C. test lamp between the terminal post and a clean part of the yoke. The test lamp lighting indicates that the field coils are earthed to the yoke and must be replaced.

When carrying out this test, check also the insulated pair of brush boxes on the commutator end bracket. Clean off all traces of brush deposit before testing. Connect the 110-volt test lamp between each insulated brush box and the bracket.

If the lamp lights this indicates faulty insulation and the end bracket must be replaced.

Replacing the field coils:

Unscrew the four pole-shoe retaining screws, using a wheel-operated screwdriver. Remove the insulation piece which is fitted to prevent the inter-coil connectors from contacting with the yoke.

Draw the pole shoes and coils out of the yoke and lift off the coils. Fit the new field coils over the pole shoes and place them in position inside the yoke. Ensure that the taping of the field coils is not trapped between the mating surfaces of the pole shoes and the yoke.

Locate the pole shoes and field coils by lightly tightening the retaining screws.

Replace the insulation piece between the field coil connections and the yoke.

Finally, tighten the screws by means of the wheel-operated screwdriver while the pole pieces are held in position by a pole shoe expander or a mandrel of suitable size.

Bearings and Bearing Replacement

The commutator and drive end brackets are each fitted with a porous bronze bush and the intermediate bracket is fitted with an indented bronze bearing.

Replace bearings which are worn to such an extent that they will allow excessive side play of the armature shaft.

The bushes in the intermediate and drive end brackets can be pressed out, whilst that in the commutator end bracket is best removed by inserting a $\frac{9}{16}''$ tap squarely into the bearing and withdrawing the bush with the tap.

Before fitting a new porous bronze bearing bush, immerse it for 24 hours in clean engine oil (SAE 30-40). In cases of extreme urgency, this period may be shortened by heating the oil to 100°C., for two hours and then **allowing the oil to cool before removing the bush.** Fit new brushes by using a shouldered, highly polished mandrel approximately 0·0005″ greater in diameter than the shaft which is to fit in the bearing. **Porous bronze bushes must not be reamed out after fitting,** as the porosity of the bush will be impaired.

After fitting a new intermediate bearing bush, lubricate the bearing surface with Rocol "Molypad" molybdenised non-creep, or similar oil.

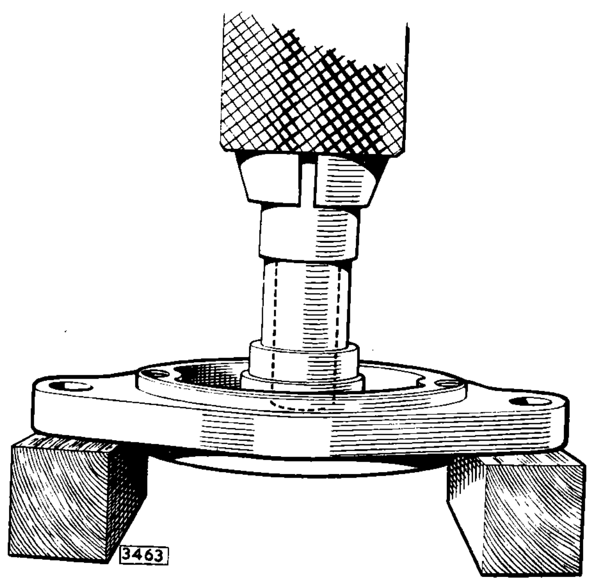


Fig. 18. Method of fitting the porous bronze bush.

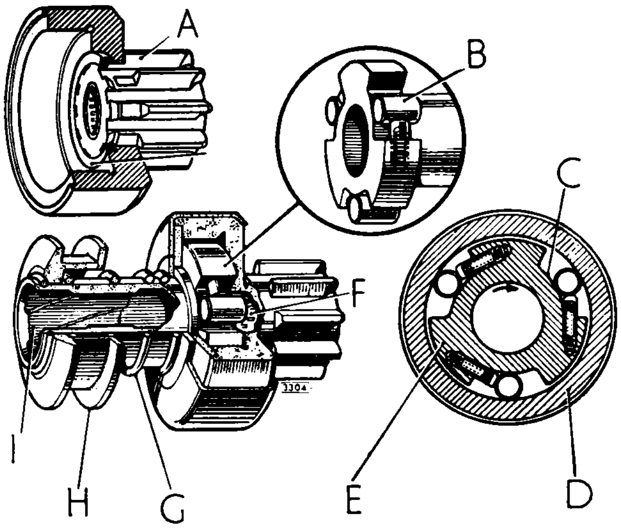


Fig. 19. The roller clutch drive components.

A—Alternative construction (pinion pressed and clear-ringed into driven member).

B—Spring loaded rollers.

C—Cam tracks.

D—Driven member (with pinion).

E—Driving member.

F—Bush.

G—Engagement spring.

H—Operating bush.

I—Driving sleeve.

CHECKING THE ROLLER CLUTCH DRIVE

A roller clutch drive assembly in good condition will:

Provide instantaneous take-up of the drive in the one direction.

Rotate easily and smoothly in the other.

Be free to move round or along the shaft splines without roughness or tendency to bind.

Similarly, the operating bush must be free to slide smoothly along the driving sleeve when the engagement spring is compressed.

Trunnion blocks must pivot freely on the pegs of the engaging lever.

All moving parts should be smeared liberally with Shell Retinax "A" grease, or an equivalent alternative.

REASSEMBLY

After cleaning all parts, reassembly of the starting motor is a reversal of the dismantling procedure given in para. 4 (c), but the following special points should be noted.

The following parts should be tightened to the maximum torques indicated:

Nuts on solenoid copper terminals:	20 lb.in. (0·23 kg.m.)
Solenoid fixing bolts:	4·5 lb.ft. (0·62 kg.m.)
Starting motor through bolts:	8·0 lb.ft. (0·83 kg.m.)

When refitting the C.E. bracket, see that the moulded brake shoes seat squarely and then turn them so that the ends of the cross peg in the armature shaft engage correctly with the slots in the shoes.

SETTING PINION MOVEMENT

After complete assembly of the starting motor connect the "Lucar" solenoid terminal by way of a switch to a 6-volt supply.

Connect the other side of the supply to the starting motor yoke.

Close the switch (this throws the drive assembly forward into the engage position) and measure the distance between the pinion and the thrust washer on the armature shaft extension. Make this measurement with the **pinion pressed lightly towards the armature** to take up any slack in the engagement linkage. For correct setting this distance should be 0·005"–0·015" (0·127–0·381 mm.). To adjust the setting, slacken the eccentric pivot pin securing nut and turn the pin until the correct setting is obtained. Note that the arc of the adjustment is 180° and the head of the arrow marked on the pivot pin should be set only between the arrows on the arc described on the drive end bracket casting.

After setting, tighten the securing nut to retain the pin position.

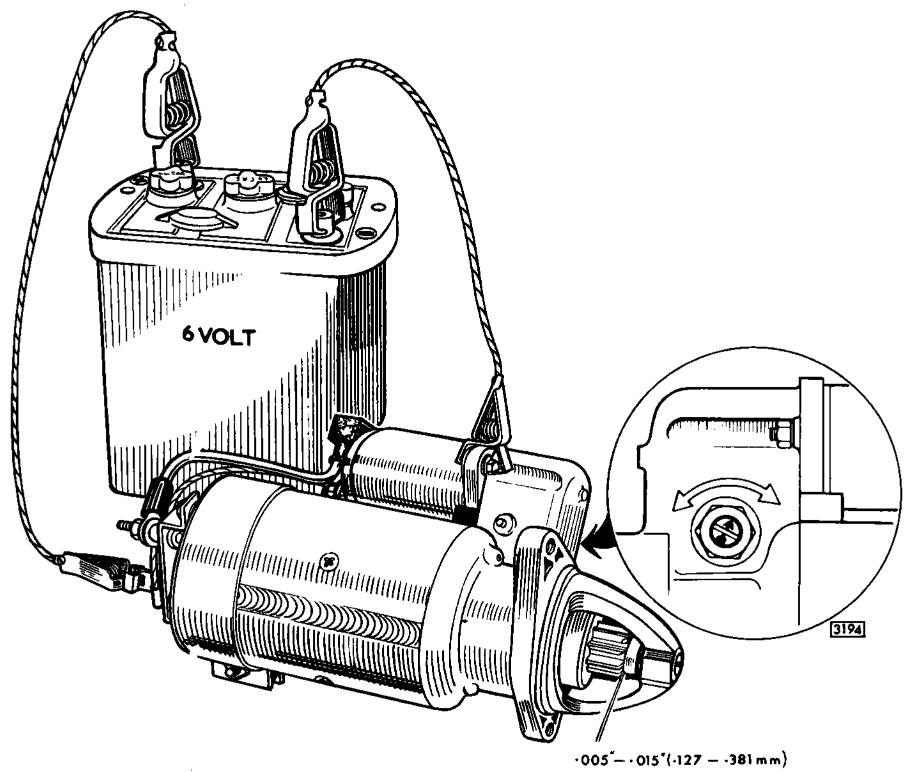


Fig. 20. Setting pinion movement.

CHECKING OPENING AND CLOSING OF STARTER SWITCH CONTACTS

The following checks assume that pinion travel has been correctly set. Remove the copper link connecting solenoid terminal "STA" with the starting motor terminal.

Connect, through a switch, a supply of 10-volts D.C., to the series winding, i.e., connecting between the solenoid "Lucar" terminal and large terminal "STA". DO NOT CLOSE THE SWITCH AT THIS STAGE.

Connect a separately energised test lamp circuit across the solenoid main terminals.

Insert a stop in the drive end bracket to restrict the pinion travel to that of out-of-mesh clearance—normally, a nominal $\frac{1}{8}''$ (3·17 mm.). An open-ended spanner of appropriate size and thickness can often be utilised for this purpose—its jaws embracing the armature shaft extension.

Energise the shunt winding with a 10-volt D.C. supply and then close the switch in the series winding circuit.

The solenoid contacts should close fully and remain closed, as indicated by the test lamp being switched on and emitting a steady light.

Switch off and remove the stop.

Switch on again and hold the pinion assembly in the fully engaged position.

Switch off and observe the test lamp.

The solenoid contacts should open, as indicated by the test lamp being switched off.

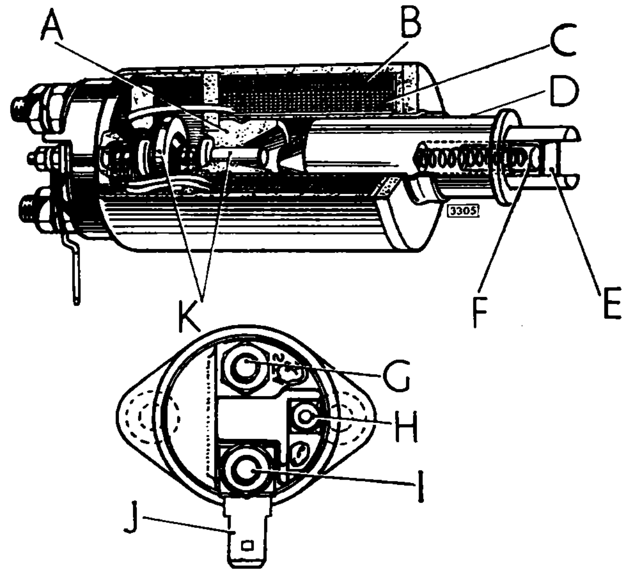


Fig. 21. Checking the opening and closing of the starter switch contacts.

A—Core.
B—Shunt winding.
C—Series winding.
D—Plunger.
E—Clevis pin.
F—"Lost motion" devices.
G—Sta inal.
H—Sol minal.
I—Ba inal.
J—Ac terminal.
K—Spi moving
cor mbly.

LAMPS

LIGHT BULBS

LIGHT	LUCAS BULB No.	VOLTS	WATTS	APPLICATION
Outer Headlight (Main and dip beams)	Sealed Beam Unit 410 411	12 12 12 12 12	60/45 50/40 37·5/50 45/40 45/40 (Yellow)	Home and R.H.D. Export S. America and Middle East. U.S.A. Belgium, Holland, Sweden, Austria, Italy and Germany. France.
Inner Headlight (Main beam only) ..	Sealed Beam Unit 410	12 12 12	37·5 37·5 (Yellow) 45	Home and R.H.D. Export, Austria, U.S.A. and Germany. France. Italy.
Side light	989	12	6	
Front and Rear Flashing indicators	382	12	21	
Rear/Brake	380	12	6/21	
Number Plate	989	12	6	
Reversing lights	382	12	21	
Interior Lights—pillar/rear	254	12	6	
Glovebox illumination	254	12	6	
Map light	989	12	6	
Luggage Compartment illumination ..	989	12	6	
Instrument illumination, Headlight Warning, Ignition Warning, Handbrake/Fluid Warning .. .. Sidelamp Warning light	987	12	2·2	 Italy only.
Switch indicator strip, Flasher Warning Overdrive indicator .. .. .. Automatic Transmission indicator ..	281	12	2	
Heater Control panel	286	24	3	

HEADLIGHTS

DESCRIPTION

The 4·2 Mk. 10 Model is fitted with the four headlight system, the standard light units fitted are of the sealed beam type having aiming pads mounted into the lenses. These pads are of use with an approved mechanical aimer (such as the Lucas Lev-L-Lite).

To obtain the best possible results from the headlights, it is essential that they are correctly adjusted. The alignment of the headlight beam is set correctly before the car leaves the factory but, if for any reason adjustment becomes necessary and an approved beam setter is not available, the following procedure should be carried out.

HEADLIGHT BEAM SETTING

Place the car on a level surface in front of a wall or board. Mark out the vertical and horizontal centre lines of both inner and outer headlight units on the wall or board and position the car 25 feet (7·6 m.) away from, and square to, the surface.

Inner headlight beam setting (all cars)

Switch the headlights on in the full beam position and blank off the outer headlights. Set the inner headlights to the position shown in Fig.22.

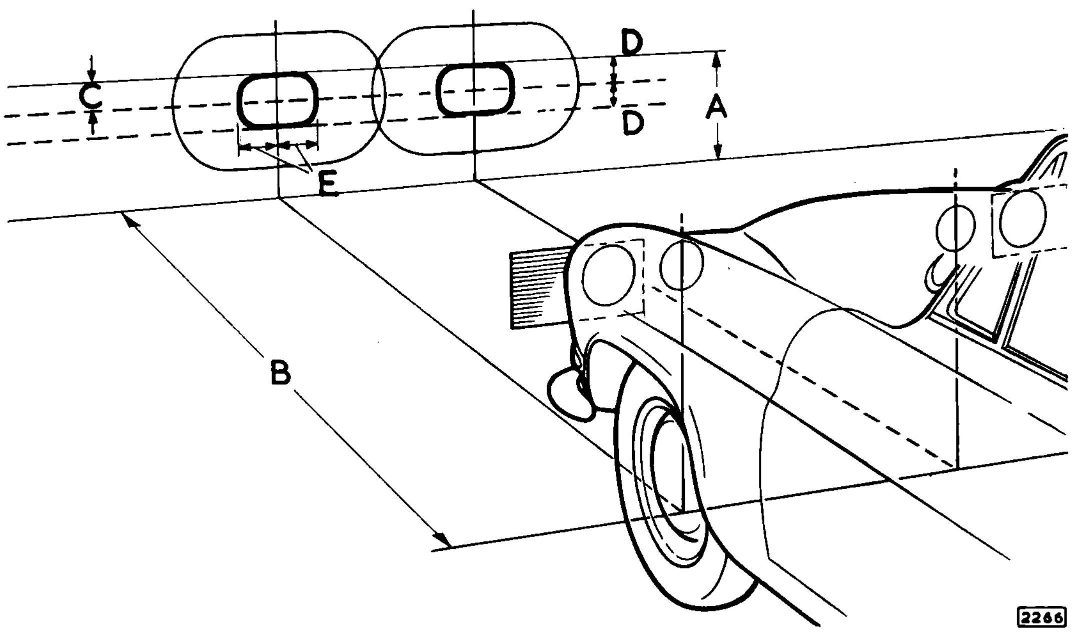


Fig. 22. Inner headlight beam setting.

"A" Height of horizontal centre line of lamps from the ground.
"B" Setting distance of car from wall—25 feet (7·6 m.).
"C" Centre of "Hot Spot" below horizontal centre line—2″ (50·78 mm.).
"D" Vertical drift limits ±2″ (50·78 mm.).
"E" Horizontal drift limits ±6″ (15·24 cm.).

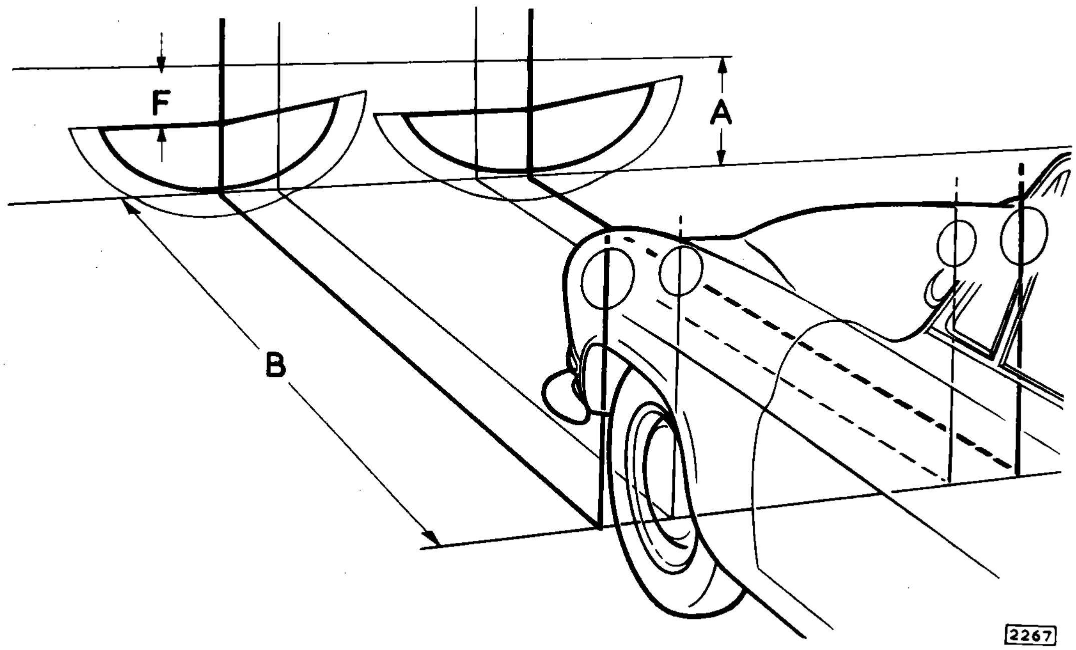


Fig. 23. Outer headlight beam setting—vertical dip.

"A" Height of horizontal centre line of lamp from ground.
"B" Setting distance of car from wall—25 feet (7·6 m.).
"F" 3″ (76·2 mm.).

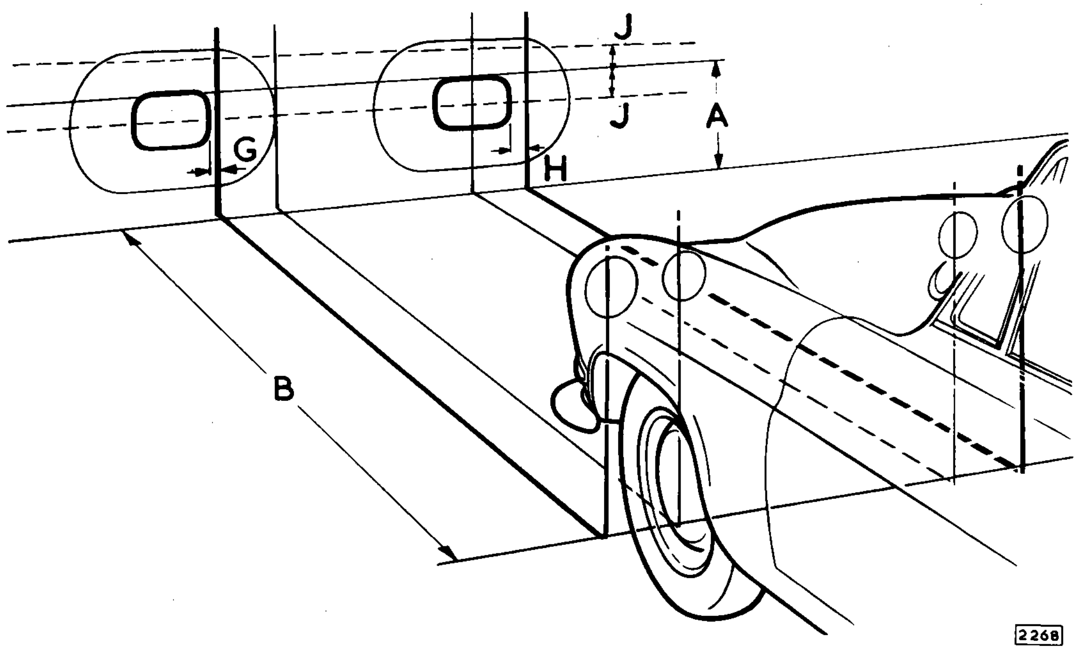


Fig. 24. Outer headlight beam setting (right-hand drive cars).

"A" Height of horizontal centre line of lamp from the ground.
"B" Setting distance of car from wall—25 feet (7·6 m.).
"G" Lateral aim of high intensity zone—2″ (50·78 mm.).
"H" Horizontal drift limits—centre line of lamp to 6″ (15·24 cm.) left.
"J-J" Vertical drift limits ±2″ (50·78 mm.).

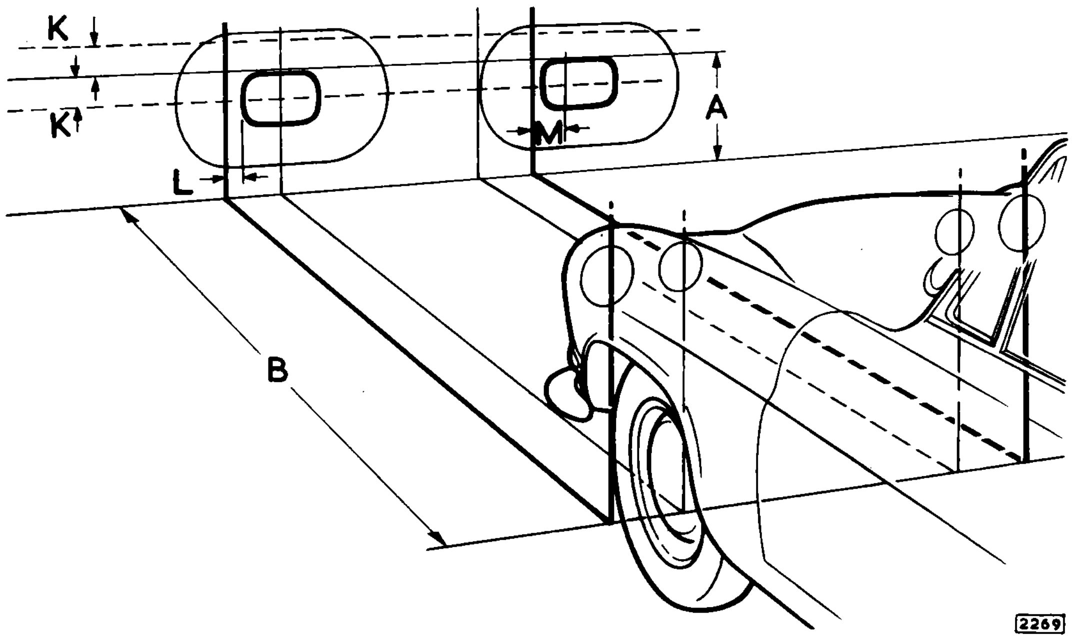


Fig. 25. Outer headlight beam setting (left-hand drive cars).
"A" Height of horizontal centre line of lamp from the ground.
"B" Setting distance of car from wall—25 feet (7·6 m.).
"K-K" Vertical drift limits ±2" (50·78 mm.).
"L" Lateral aim of high intensity zone—2" (50·78 mm.).
"M" Horizontal drift limits—centre line of lamp to 6" (15·24 cm.)—right.

Outer headlight beam setting (vertical dip units)

With the headlights switched on in the dip position, set the outer headlight beams to the position shown in Fig. 23.

Outer headlight beam setting (right-hand drive cars excluding vertical dip units)

With the headlights switched on in the dip position, set the outer headlight beams to the position shown in Fig. 24.

Adjusting the Headlight Beam

Remove the headlight surround by unscrewing the retaining screw and springing the surround away from the bottom clip fixings.

The setting of the outer beams is adjusted by two screws, one being located at the top centre and the other at the centre left-hand side. The top screw is for vertical adjustment, that is, to raise or lower the beam; turn the screw anti-clockwise to lower the beam and clockwise to raise the beam. The side screw is for lateral adjustment, that is, to turn the beam to left or right. To move the beam to the right turn the screw clockwise and to move the beam to the left, turn the screw anti-clockwise.

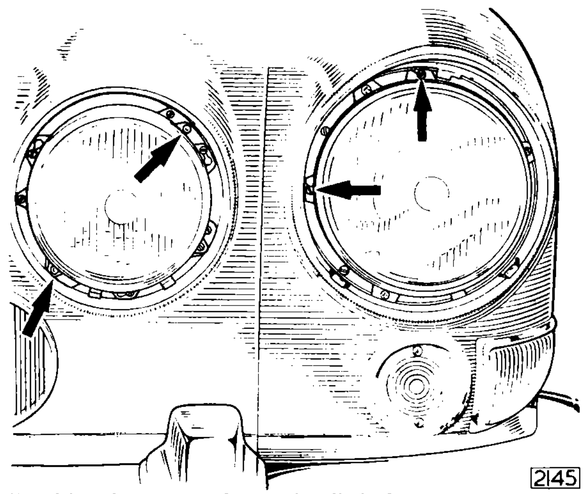


Fig. 26. The inner and outer headlight beam setting screws.

The setting of the two inner beams is adjusted by two screws diagonally opposite each other. The upper screw is for vertical adjustment, turn the screw clockwise to move the beam to the right and anti-clockwise to move the beam to the left.

Note: Cars for some countries are fitted with similar light units in the inner and outer positions. The adjustment of the beam on these outer lights is the same as that described above for the inner headlights.

LIGHT BULB REPLACEMENT

OUTER HEADLIGHT REPLACEMENT

Remove the top retainer screw and withdraw the headlight embellisher noting the two retaining lugs at the lower edge. Remove the three cross headed screws and the headlight unit retaining rim. Withdraw the headlight unit and detach the socket from the rear of the unit. The headlight may now be replaced with a unit of the correct type.

On cars fitted with non-sealed beam headlights proceed as described above until the headlight unit is withdrawn, release the bulb retaining spring clips and withdraw the bulb. Replace with a bulb of the correct type (see Page P.36). When reassembling note that a groove in the bulb plate must register with a raised portion of the bulb retainer.

Note: Do not turn the two slotted screws or the setting of the headlights will be upset.

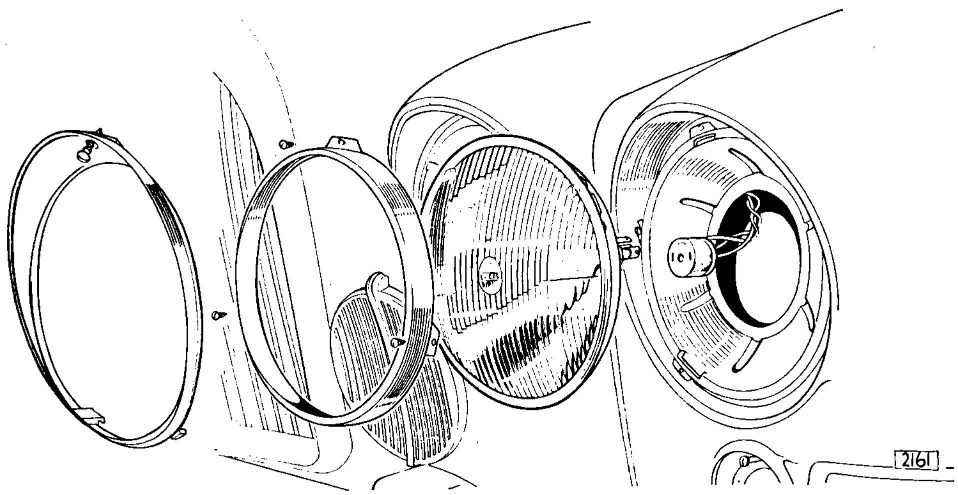


Fig. 27. The outer headlight unit removal.

INNER HEADLIGHT—REPLACEMENT

The procedure for replacing the inner headlight unit or bulb is the same as that described in "Outer Headlight—Replacement". However, when removing the headlight unit retaining rim, it is not

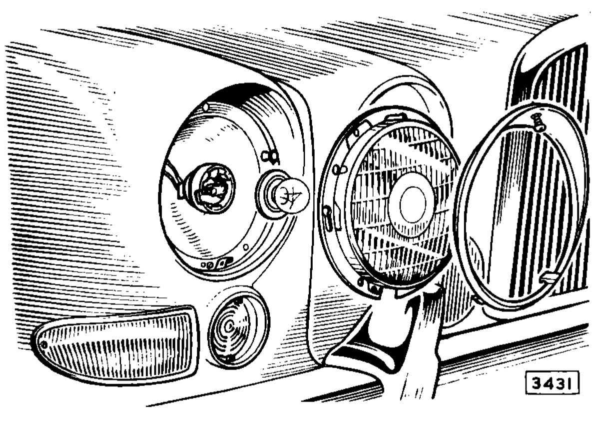


Fig. 28. The outer headlight bulb removal (non-sealed beam unit).

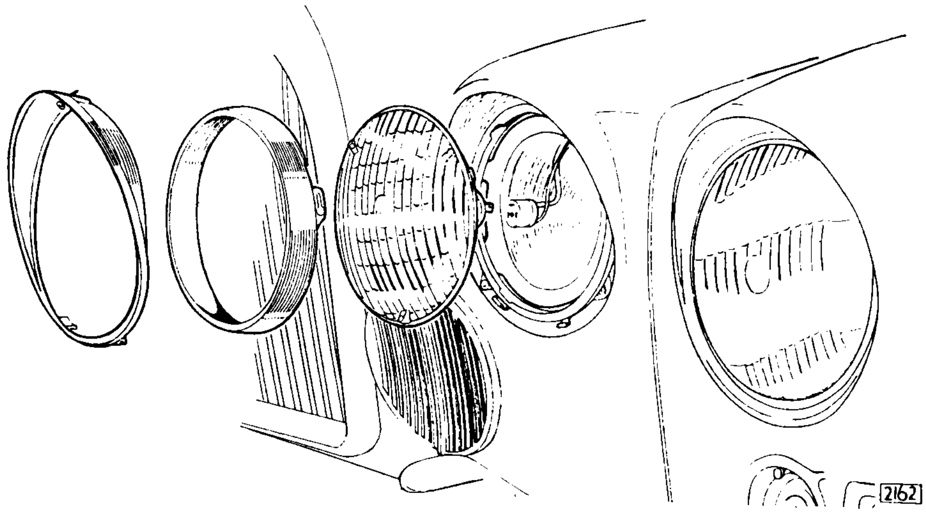


Fig. 29. The inner headlight unit removal.

necessary to remove the three cross headed screws, these should be slackened and the rim turned anti-clockwise until it can be withdrawn.

Note: Do not turn the two slotted screws or the setting of the headlight will be upset.

SIDELIGHT BULB—REPLACEMENT

Remove the two screws retaining the light embellisher. Withdraw the embellisher and light unit, remove the bulb holder from the rear of the unit. The bulb may then be removed by pressing in and turning anti-clockwise.

FRONT FLASHER—REPLACEMENT

Remove the screw retaining the light glass and disconnect the glass at the three tags under the chrome surround. The bulb may then be removed by pressing in and turning anti-clockwise.

REAR FLASHER BULB—REPLACEMENT

Remove the screws securing the appropriate luggage compartment casing and withdraw the upper bulb holder from the rear of the light assembly. The bulb may then be removed by pressing in and turning anti-clockwise.

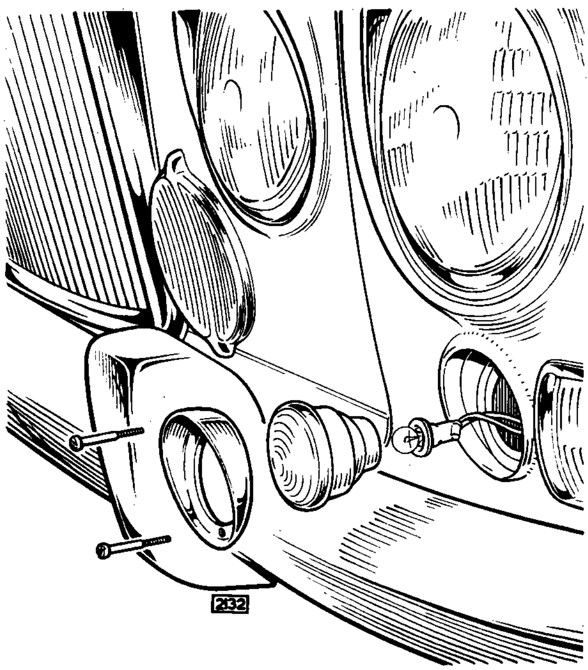


Fig. 30. Side light bulb removal.

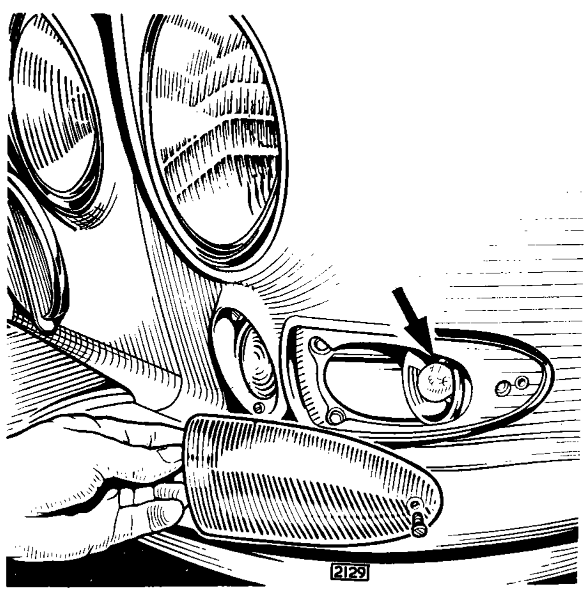


Fig. 31. Front flasher bulb removal.

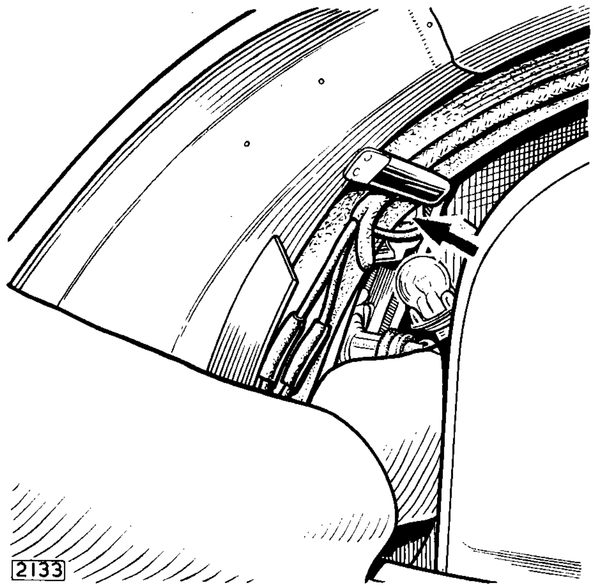


Fig. 32. Rear flasher bulb removal.

REAR/BRAKE LIGHT BULB—REPLACEMENT

Proceed as for Rear Flasher Bulb but withdraw the lower bulb holder. When fitting a replacement bulb note that the pins are offset.

LUGGAGE COMPARTMENT LIGHT BULB—REPLACEMENT

The bulb is accessible through an aperture in the luggage compartment lid casing. Remove the bulb by pressing in and turning anti-clockwise.

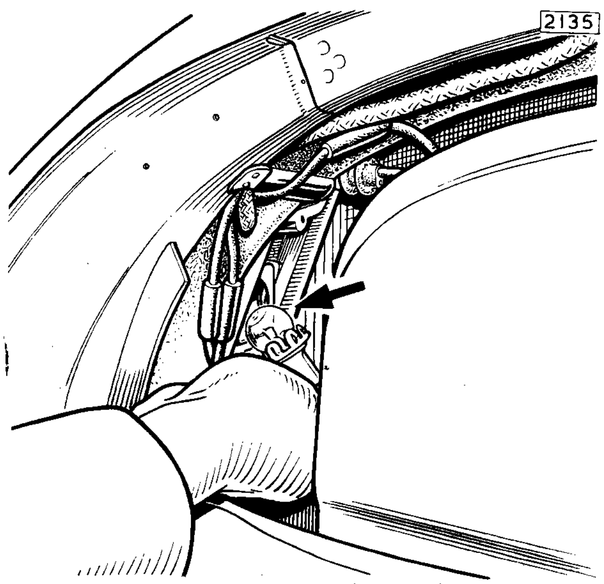


Fig. 33. Rear/brake bulb removal.

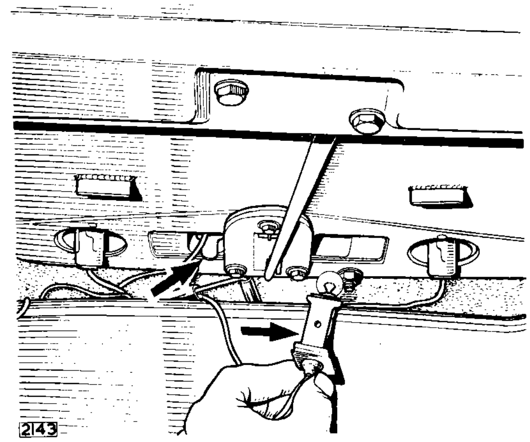


Fig. 34. Number plate bulb removal.

NUMBER PLATE LIGHT BULB—REPLACEMENT

Remove sufficient screws securing the luggage compartment lid casing to allow access to the bulb holders. The number plate bulb holders are the two in the centre of the group. Press the tag in, lift and withdraw the holder. The bulb may then be removed by pressing in and turning anti-clockwise.

REVERSING LIGHT BULB—REPLACEMENT

Proceed as for the number plate light bulb. The reversing light bulb holders are those on the outside of the group.

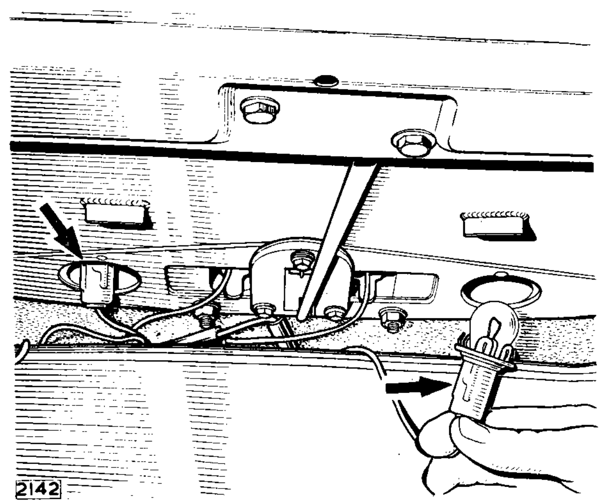


Fig. 35. Reverse lamp bulb removal.

HEATER CONTROL PANEL LIGHT BULB—REPLACEMENT

Remove the black plastic button from the bottom of the ash tray (or radio) surround panel and withdraw the slotted screw now exposed.

Detach the surround panel by pulling away the two peg fixings from the spring retainers located at the top corners of the panel.

Insert the hand in the panel aperture and locate the two bulb carriers on the underside of the heater control unit.

Swivel the contact terminal through 90° away from the faulty bulb and withdraw the bulb downwards through the carrier.

Refit the surround panel by pressing the two peg fixings into the spring retainers and fitting the bottom screw. Refit the plastic button.

INTERIOR LIGHT BULBS—REPLACEMENT

Using care to avoid breakages, prise the cover from the appropriate interior light noting the stud fixings. Remove the bulb by pressing in and turning through 90°. Replace the bulb with one of the correct value by pressing the bulb into the holder and turning until the notches inside the holder are located. Replace the cover by pressing onto the securing studs.

GLOVEBOX LIGHT BULB—REPLACEMENT

Open the glove box lid and remove the mauve glass from its holder. Care should be taken when removing this glass to avoid breakages. Remove the bulb from between the two contacts and replace with a bulb of the correct value. Replace the glass.

SIDELAMP WARNING LIGHT BULB—REPLACEMENT (ITALIAN MARKET ONLY)

Withdraw the bulb carrier unit only from the holder (accessible from the rear face of the side facia panel). Unscrew the bulb and replace with one of the correct value, that is, 12-volt, 2·2 watts screw cap.

BRAKE FLUID AND HANDBRAKE WARNING LIGHT BULB—REPLACEMENT

Unscrew the bezel of the lamp, exercising care to control the run of the spring loaded bulb beneath. Feed the bulb into the spring-loaded bulb holder, ensure that the red transparent window is retained in the bezel by a small circlip, position the designation plate on the bulb holder and screw on the bezel.

FLASHING INDICATOR BULB—REPLACEMENT

Disconnect the earth lead at the battery.

Detach the switch cover from above the steering column by withdrawing the two most sunken screws from below. Withdraw one or both flasher indicator warning light bulb holders from the outer sockets of the upper switch cover. Remove the bulb from the holder by applying inward pressure and rotating through 90° in either direction.

The bulb is replaced by inserting into the bulb holder and rotating through 90° until the notches inside the bulb holder are located. Replacing the bulb holder and upper switch cover is the reverse of the removal procedure.

AUTOMATIC SELECTOR BULB—REPLACEMENT

Disconnect the earth cable at the battery. Detach the upper switch cover from the steering column by removing the two most sunken screws from below. Remove the bulb holder from the centre socket in the switch cover. Remove the bulb from the holder by pressing in and turning through 90° in either direction. The bulb is replaced by inserting into the bulb holder and turning until the notches inside the bulb holder are located. Replacing the bulb holder and upper switch cover is the reverse of the removal procedure.

MAP LIGHT BULB—REPLACEMENT

Remove the bulb which is situated under the centre of the screen rail in front of the instrument panel. Removal is effected by pressing the bulb inwards, rotating slightly and withdrawing outwards.

Replace the bulb by a reversal of the above procedure.

INDICATOR STRIP BULBS—REPLACEMENT

Three bulbs are provided along the bottom rear edge of the instrument panel. Withdraw the bulbs by pulling out from the sockets provided in the rear panel.

Replace the appropriate bulb with one of the correct value.

FLASHER UNIT

The flasher unit is housed in a small cylindrical container located behind the instrument panel and is accessible after removing the picnic tray and lowering the panel (see Page P.54).

The automatic operation of the flasher lamps is controlled by means of a switch, contained in the flasher unit, being operated automatically by the alternative heating and cooling of an actuating wire: also incorporated is a small relay to flash the indicator warning lights when the system is functioning correctly. Failure of either of these lights to flash will indicate a fault.

In the event of trouble occurring the following procedure should be followed:

(a) Check bulbs for broken filaments.

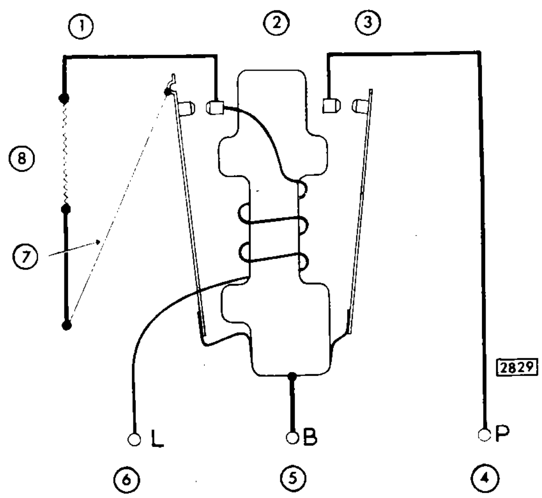


Fig. 36. Flasher unit circuit diagram.

1. Main armature/contacts
2. Steel core and coil
3. Secondary armature and pilot contacts
4. To pilot lamp(s)
5. From battery
6. To lamps via switch
7. Actuating wire
8. Ballast resistor

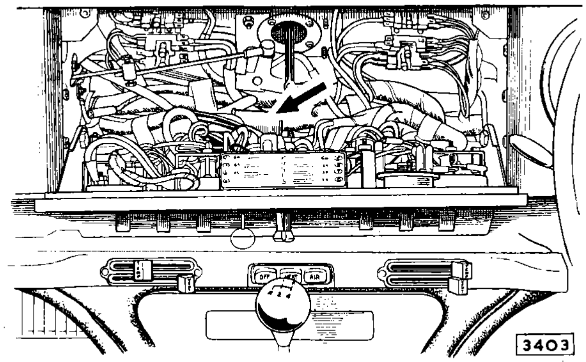


Fig. 37. The location of the flasher unit behind the instrument panel.

(b) Refer to the wiring diagram and check all flasher circuit connections.

(c) Switch on the ignition and check with a voltmeter that flasher unit terminal "B" is at 12 volts, with respect to earth.

(d) Connect together flasher unit terminals "B" and "L" and operate the direction indicator switch. If the flasher lamps now light the flasher unit is defective and must be replaced

(e) If after the above checks the bulb still does not light a fault is indicated in the manual flasher switch on the steering column which is best checked by substitution.

Note: It is important that only bulbs of the correct wattage rating (that is, 21 watts) are used in the flasher lamps.

FUSE UNITS

Four Lucas Model 4 FJ fuse units, each carrying two live glass cartridge type fuses and two spares are incorporated in the electrical system and are located behind the instrument panel.

Access to the fuses is obtained by removing the two instrument panel retaining screws (top left-hand and top right-hand corners.) Withdraw the picnic tray to the full extent and locate the two spring steel retaining clips attached to the tray at the back edge. Press both clips inwards to the centre of the car and complete the withdrawal of the tray. The instrument panel will then hinge downwards exposing the fuses and the fuse indicator panel. The circuits controlled by individual fuses are shown on the indicator panel and it is essential that the blown fuse is replaced by one of the correct value.

Only one of the spare fuses is visible and they are retained in position by a small spring clip. Always replace the spare fuse as soon as possible.

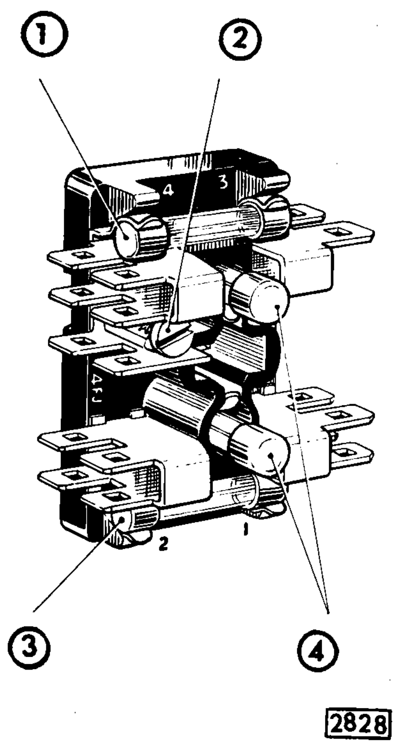


Fig. 38. *The 4 J fuse unit.*

On cars exported to Germany the tail lamps and number plate lamps are not fused.

The heated back light fuse (when fitted) is contained in a plastic fuse holder retained in a clip below the right-hand fuse block.

The Overdrive Solenoid fuse (when fitted) is contained in a plastic fuse holder retained in a clip behind the curved side facia panel on the steering wheel side.

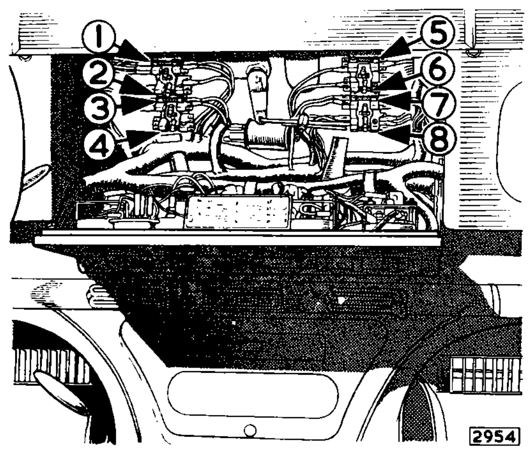


Fig. 39. *Location of fuses.*

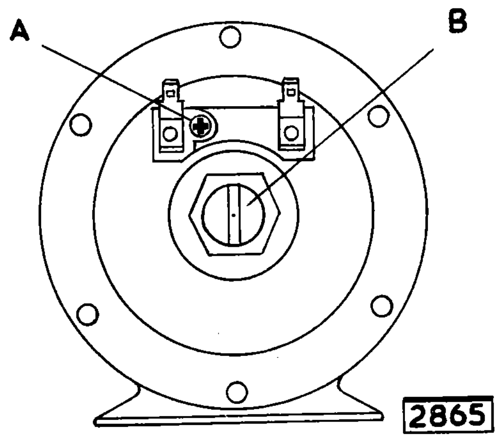
CIRCUITS

Fuse No.		Amps.
1	Headlamp main beam	50
2	Headlamp dip beam	35
3	Flashers, wipers, washers, horn relay, heater	35
4	Spare	
5	Horns	50
6	Side, tail, panel, number plate, boot lights	35
7	Cigar lighter, headlamp flasher, interior and map lights, clock	35
8	Reverse lights, choke, petrol, oil and water gauges, brake lights	35
	Heated backlight (optional extra)	15
	Overdrive solenoid (when fitted)	8
	Radio line fuse (when fitted)	5

HORNS
(MODEL 9H)

DESCRIPTION

The Lucas 9H horns are mounted on a common bracket behind the radiator on the left hand side of the car.



A—Contact breaker adjustment screw.
B—Slotted centre core (do not disturb).

Fig. 40. Lucas 9 H horn.

The horn circuit operates through a Lucas 6RA relay, the contacts C1 and C2 closing when the relay coil is energised by depressing the semi-circular horn ring attached to the steering wheel, or by pressing the centre button.

MAINTENANCE—CIRCUIT CHECKING

In the event of the horn(s) failing to sound or performance becoming uncertain, check that the fault is not due to external causes before any adjustments are made.

Check as follows and rectify as necessary.

(a) Battery condition.
(b) Loose or broken connections in the horn circuit. Test with voltmeter at cable terminals.
(c) Loose fixing bolts. It is important to keep the horn mountings tight and to maintain rigid the mountings of any units fitted near the horns.
(d) Faulty relay. Check by substitution after verifying that current is available at terminal C2 (cable colour brown and blue) and terminal W1 (green).
(e) Check that fuse 3 (35 amp.) and fuse 5 (50 amp.) have not blown.

Note: Horns will not operate until the ignition is switched on.

ADJUSTMENT

The horns cannot be conveniently adjusted in position, remove and mount securely on the test fixture.

A small serrated adjustment screw is provided to take wear of moving parts only in the horn and is located adjacent to the horn terminals. Turning this screw does not alter the pitch of the note.

Connect a 0–25 moving coil ammeter in series with the horn supply feed. The ammeter should be protected from overload by connecting an ON-OFF switch in parallel with its terminals.

Keep this switch ON except while taking readings, that is when the horn is sounding.

Turn the adjustment screw anti-clockwise until the horn just fails to sound.

Turn the screw clockwise until the horn operates within the specified current limits of 6·5–7·0 amps.

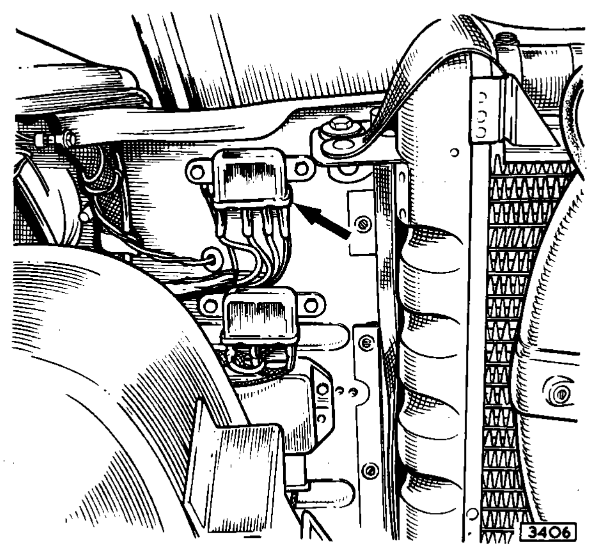


Fig. 41. The location of the 6 RA relay.

SERVICE REPLACEMENTS

When fitting replacement horns it is essential that the following procedure be carried out.

(a) Refit the lockwashers in their correct positions, one on each side of the mounting bracket centre fixing.

(b) Ensure after positioning the horn, that the $\frac{5}{16}''$ centre fixing bolt is secure but not overtightened. Overtightening of this bolt will damage the horn.

(c) Ensure that when a centre fixing bolt or washers other than the original are used that the bolt is not screwed into the horn to a depth greater than $\frac{11}{16}''$ (17·5 mm.).

HORN RELAY—CHECKING

If the horn relay is suspected check for the fault by substitution or by the following method:

(a) Check that fuses No. 3 and No. 5 have not blown. Replace if necessary.

(b) Check with a test lamp that current is present at relay terminals W1 (green) and C2 (brown and purple). Switch on ignition before checking terminal W1.

(c) Remove cable from terminal W2 (purple and black) and earth the terminal to a clean part of the frame. Relay coil should now operate and close contacts. Reconnect cable.

(d) Remove cables from terminal C1 (purple and yellow). Check for continuity by means of an earthed test lamp when horn button or ring is depressed with the ignition "ON". Replace relay if faulty.

WINDSCREEN WIPER

DATA

Wiping Speed	
Normal	45–50 cycles per minute
High	60–70 cycles per minute
Light Running Current	
Normal Speed	2·7–3·4 amperes
High Speed	2·6 (or ess) amperes
Stall Current	10–11 amperes
Pressure of Blades against Windscreen	5·5–7·5 ounces (156–212 gms.)
Maximum permissible force to move cable rack in protective tubing with motor, arms and blades disconnected	6·0 lb. (2.72 kilograms)

DESCRIPTION

The windscreen wiper assembly consists of a two-speed, thermostatically protected motor coupled by a cable rack drive to two scuttle mounted wheel boxes. The cable rack comprises a flexible inner core of steel wire wound with a wire helix. A reciprocating motion is imparted to the rack by a connection rod in the motor gearbox and transmitted to the wiper arm spindles by engagement of the rack with a gear in each wheelbox.

The wipers are self parking and are controlled by a switch on the instrument panel, giving Park, Slow, and Fast speed operation. The fast speed is intended for use when driving fast through heavy rain or light snow. It should NOT be used with heavy snow or a drying windscreen.

If overloaded, the motor windings will overheat and cause the thermostat to trip and isolate the motor from the supply. Possible causes include: Packed snow or ice on the screen, over-frictional or oil-contaminated blades, damaged drive mechanism or spindle units. Provided the obstruction or other cause of excessive heating is removed, normal working resumes automatically when the temperature falls to a safe level.

MAINTENANCE

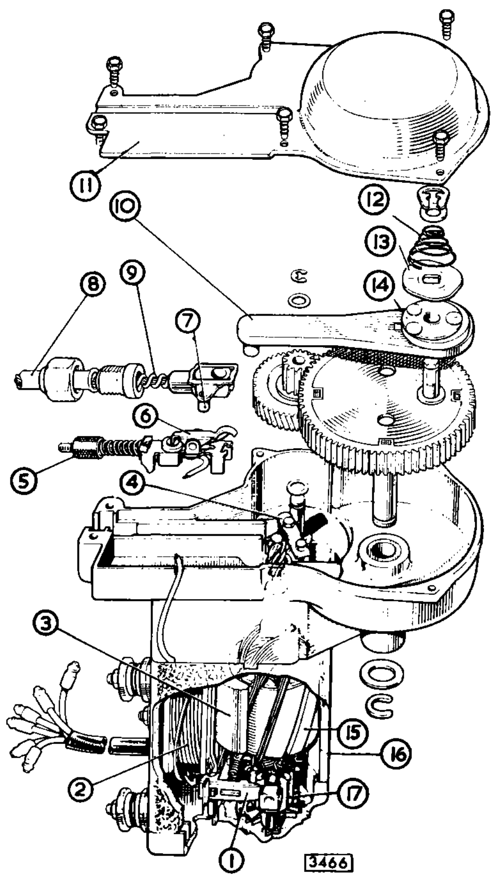
Efficient wiping is dependent upon having a clean windscreen and wiper blades in good condition.

Use methylated spirits (denatured alcohol) to remove oil, tar spots and other stains from the windscreen.

Silicone and wax polishes should not be used for this purpose.

Worn or perished wiper blades are readily removed for replacement.

When necessary, adjustment to the self-parking mechanism can be made by turning the knurled nut located near the cable rack outlet on the wiper motor. Turn the nut only one or two serrations at a time, and test the effect of each setting before proceeding.



1. Brush gear
2. Field coil
3. Pole piece
4. Armature end play stop plate
5. Parking adjuster
6. Crosshead—actuated limit switch
7. Switch striker pin
8. Protective tubing
9. Cable rack
10. Connecting rod
11. Gearbox cover
12. Conical spring
13. Friction plate
14. Pivoted coupling (eccentric)
15. Armature
16. Yoke
17. Commutator

Fig. 42. The DR 3 wiper motor components.

Disconnect the cable harness attached to the motor at the snap connectors noting the cable colours.

Remove the four nuts and washers securing the motor to the mounting bracket attached to the bulkhead adjacent to the left-hand front wing.

Detach the motor and withdraw the rack from the wheel boxes.

Note: On right-hand drive cars it will be necessary to remove the battery to gain access to the wiper motor.

Disconnecting the Cable

Remove the six small set bolts from the wiper motor gearbox cover.

Lift off the cover, remove the circlip from the post in the gearwheel.

Remove the washer, conical spring, friction plate and connecting rod from the crosshead.

Lift out the cable ferrule from the gear casing.

REFITTING

Refitting is the reverse of the removal procedure.

Refit the wiper arms and blades as follows:

(a) Switch on the ignition.

(b) Switch on the windscreen wipers to slow speed and note the arc of rotation of the wheelbox spindles.

1. Blade
2. Entry slot
3. Arm

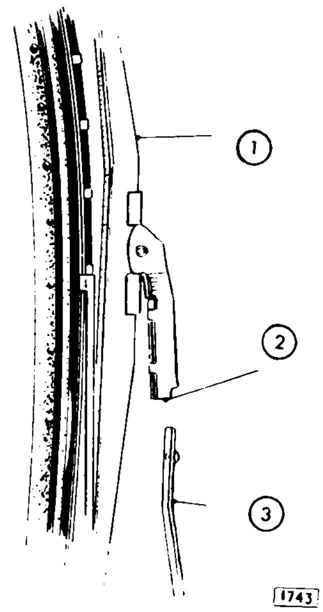


Fig. 43. The attachment of the wiper blade to the arm.

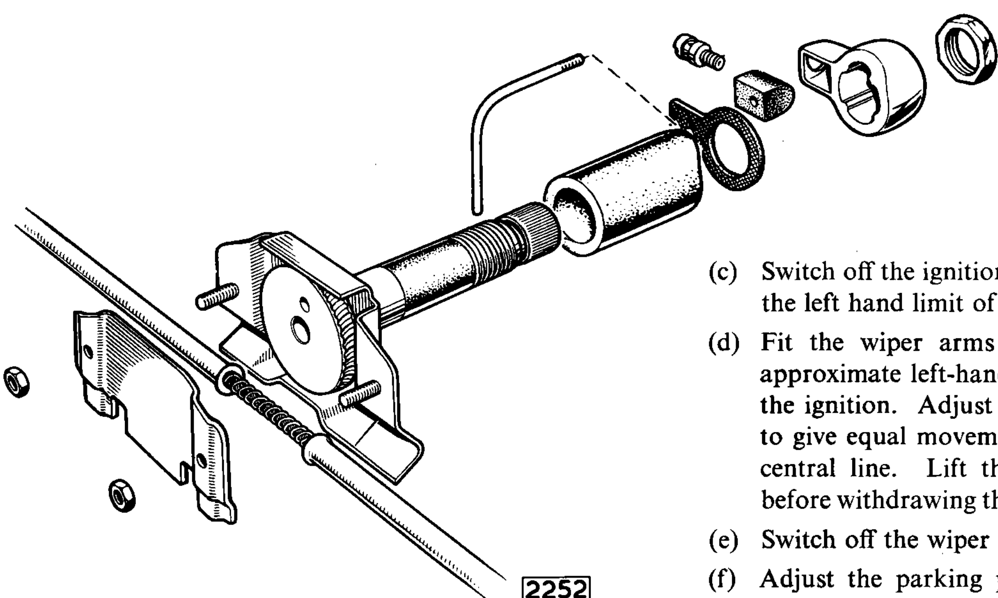


Fig. 44. Exploded view of the wheelbox.

(c) Switch off the ignition when the spindles reach the left hand limit of travel.

(d) Fit the wiper arms to the spindles in the approximate left-hand position and switch on the ignition. Adjust the position of the arms to give equal movement either side of the arc central line. Lift the spindle locking catch before withdrawing the arms from the spindles.

(e) Switch off the wiper switch.

(f) Adjust the parking position of the arms by turning the knurled adjuster nut anti-clockwise to lower the arms (Right-hand drive cars) and clockwise to lower the arm (Left-hand drive cars).

REMOVAL OF WHEELBOXES

Remove picnic tray and lower the instrument panel as described on page P.54.

Remove the side facia panel as described on page P.54.

Remove the glove box as described on page P.54.

Withdraw both wiper arms from the spindles.

From outside the car, unscrew the large nuts securing the wheelboxes to the scuttle.

Detach the clear plastic screen washer tubing from the tube connections inside the car. Remove the chrome distance pieces with attached tube connection and the rubber seals.

Detach the demister ducts by removing the four nuts and washers from each unit.

Remove the backplates from the wheelboxes by removing the four nuts and shakeproof washers.

Pull the cable from the worm wheels and slide off the spacer tubing.

From inside the car withdraw the wheelboxes and spacers.

REFITTING

Refitting is the reverse of the removal procedure. When refitting, ensure that the flared end of the tube from the wiper motor to the left-hand wheelbox is securely held in the wheelbox and registers in the slot provided in the backplate.

REMOVAL OF WIPER MOTOR AND CABLE

Withdraw the wiper arms from the spindles. Disconnect the earth cable at the battery.

Unscrew the large nut connecting the cable guide to the wiper motor.

Remove the setscrew and nut securing the earth wire to the motor mounting bracket.

FAULT DIAGNOSIS

Poor performance can be electrical or mechanical in origin and not necessarily due to a faulty motor, for example:

Low voltage at the motor due to poor connections or to a discharged battery.

Cable rack binding in protective tubing;

Excessive loading on the wiper blades;

Wheelboxes loose, out of alignment or spindles binding in the bearing housing.

TESTING

Unless the origin of the fault is apparent, proceed as follows to determine the cause of failure.

Measuring Supply Voltage

Using a first grade moving coil voltmeter, measure the voltage between the motor supply terminal (to which the green cable is connected) and a good earthing point. This should be 11·5 volts with wiper working normally. If the reading is low, check the battery, switch (by substitution), cabling and connections.

To check the "Fast" Speed Current

Using a fully charged 12-volt battery and two test leads, connect the "GREEN" cable on the wiper motor to the "Positive" battery terminal. Join the "YELLOW" and "RED" cables together and connect to the "Negative" battery terminal. Connect the "BLUE" and "WHITE" cables together. Check the cycles per minute of the wiper spindle.

To Check the "Slow" Speed Current

Connect the "GREEN" cable to the "Positive" battery terminal. Join the "BROWNS" and "RED" cables together and connect to the "Negative" battery terminal. Connect the "BLUE" and "WHITE" cables together. Check the cycles per minute of the wiper spindle.

Measuring the Light Running Current

The light running current must not exceed 3·4 amperes at normal speed of 45–50 r.p.m./or t.p.m. of the output motor shaft; also 2·6 amperes at fast speed 60–70 c.p.m./or r.p.m. of output motor shaft.

If the current is in excess of these figures, change the wiper motor. See DATA chart for other information.

Checking Cable Rack and Tubing

The maximum permissible force to move the cable rack in its protective tubing is 6 pounds with the wiper arms, blades and motor disconnected. The measurement can be made by hooking a spring balance in the hole in the cross-head (into which a pin on the connecting rod is normally located) and withdrawing the rack with the balance.

Binding of the rack can be due to kinked or flattened tubing or to faulty installation. Minor faults can be cleared with a suitable tested mandrel sold specifically for checking wiper installations. Badly kinked or flattened tubing must be renewed. Any bends of less than 9″ radius must be reformed.

It is ESSENTIAL that all the flared ends of the tubing are registered in the slots provided in the wheel box plates before tightening the wheel box cover plate securing nuts.

The cable rack should be well lubricated with Duckham's HBB grease.

Checking Wheelboxes

Check the wheelboxes for misalignment or looseness and rectify as required.

Renew seized wheelboxes.

Checking the Wiper Motor Brush Gear

Remove the motor (see page P.50).

Withdraw the two through bolts and detach the end cover.

Expand the retaining spring and lift off the two brush carriers as an assembly.

Note: The two brushes are loose in the carriers and care must be taken that they are not misplaced when removed.

Refitting

Refitting is the reverse of the removal procedure. Ensure that the brushes are refitted in the same way as originally fitted.

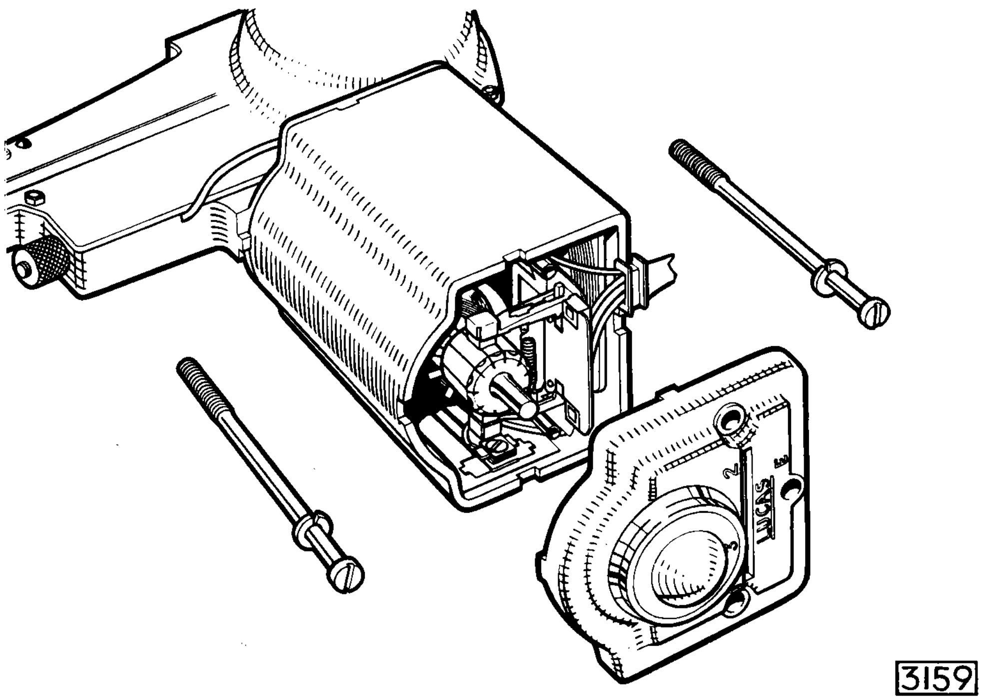


Fig. 45. Checking the wiper motor brush gear.

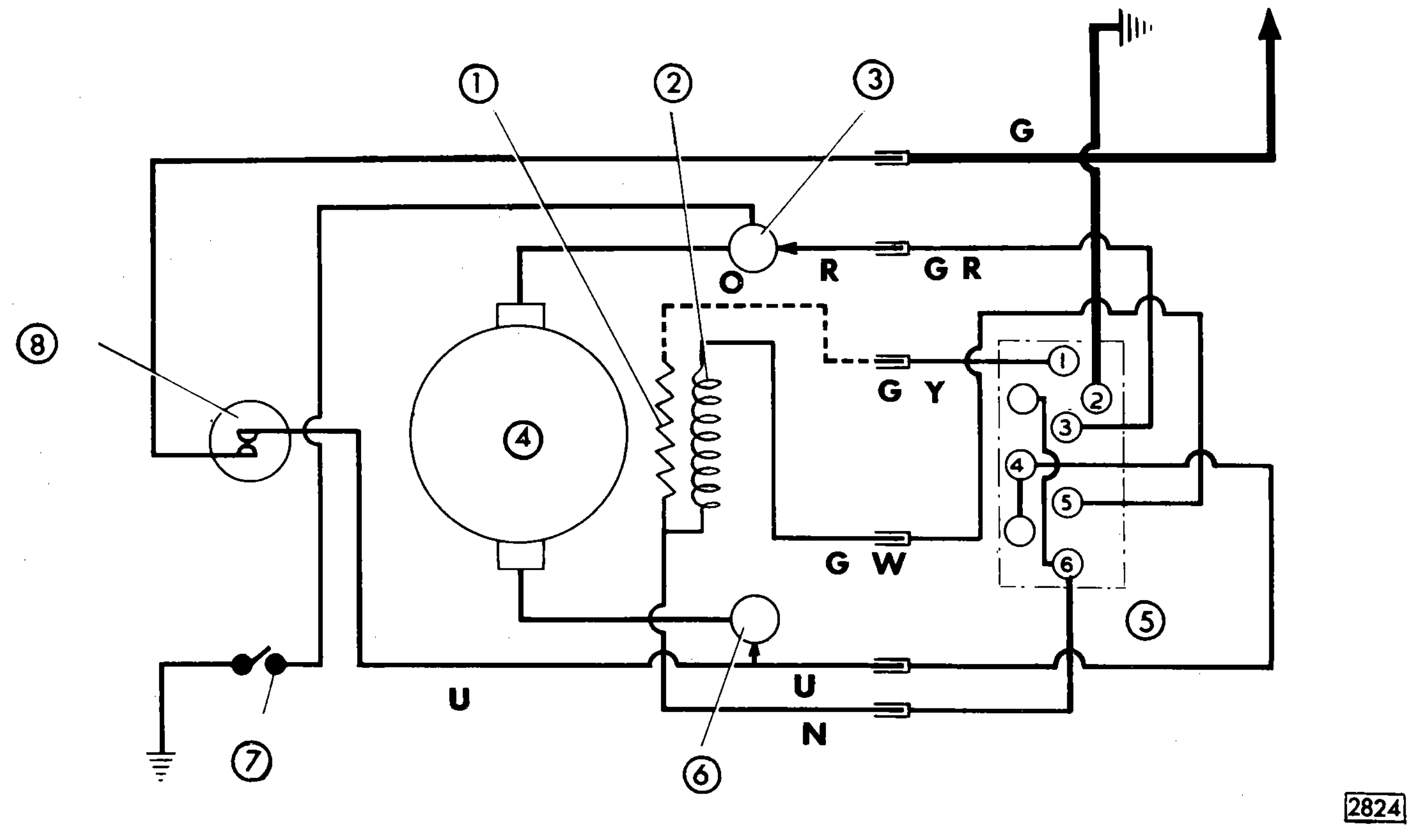


Fig. 46. Wiring connections—switch to wiper.

1.	Resistor	G.	Green
2.	Field coil	GR.	Green with Red
3.	R.H. terminal	GY.	Green with Yellow
4.	Armature	GW.	Green with White
5.	79 SA switch	N.	Brown
6.	L.H. terminal	O.	Orange
7.	Parking switch	R.	Red
8.	Thermostatic circuit breaker	U.	Blue

WIRING HARNESS REPLACEMENT

The wiring harness consists of four main items, namely, the forward, the panel and right and left-hand body harness.

The junctions between the forward and body harnesses are behind the side facia panel and the glove box adjacent to the screen pillars.

When replacing harness, all items must be secured in the clips provided and all grommets must be renewed if worn or damaged.

The body harnesses are routed over the door sills beneath a protective cover. To gain access to the body harness, carefully lift off the door sill trimming, drill out the rivets and remove the covers.

The engine harness is connected to the forward harness by means of a multi-pin plug and socket. The plug has a register to prevent incorrect connection.

Refer to the wiring diagram when making any connections (see page P.87).

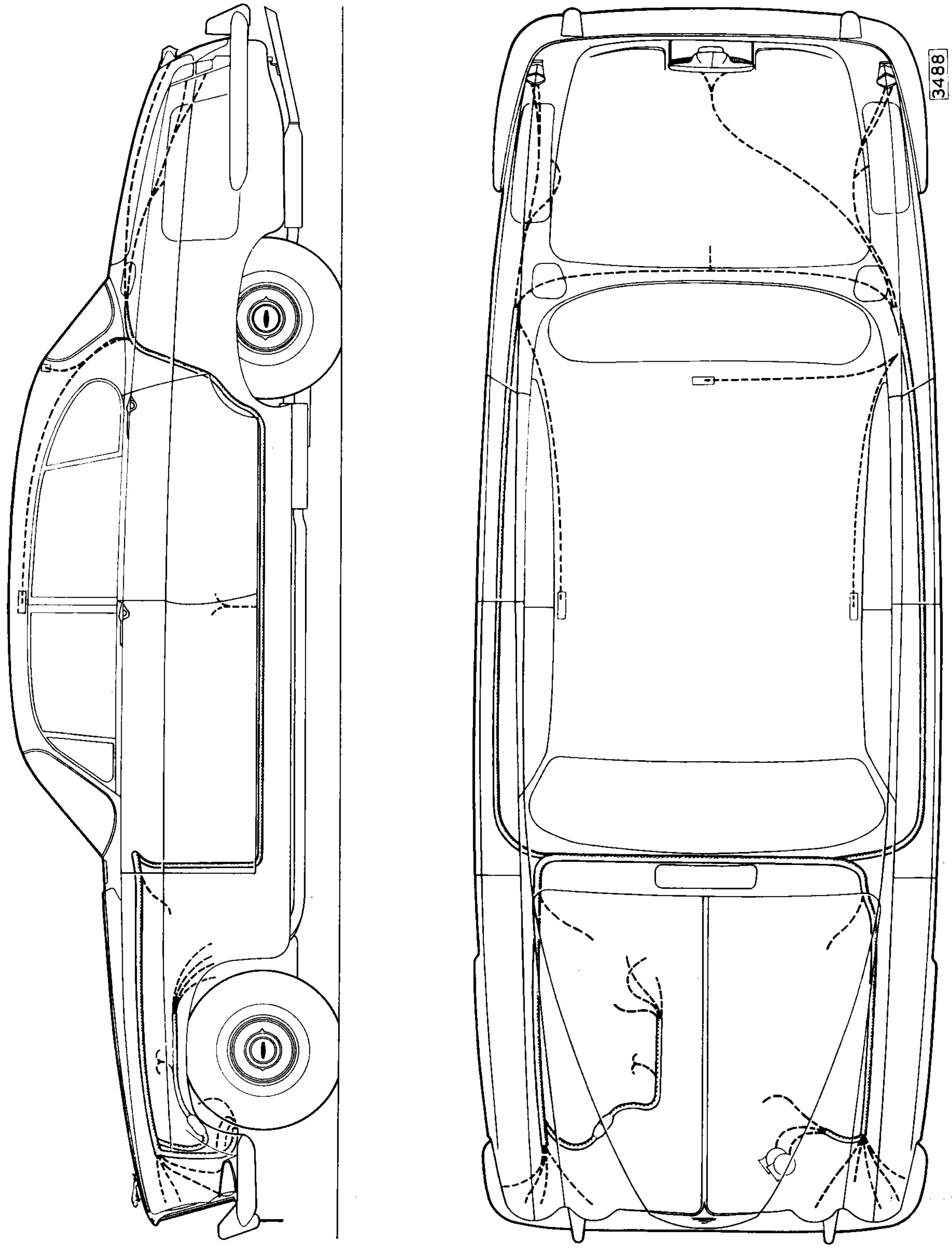


Fig. 47. Layout of the wiring harness.

THE FACIA PANEL

SCREEN RAIL

Removal

The screen rail cannot be removed until both curved side panels and screen pillar cappings have been detached as detailed under "Side Facia Panel".

Release the four nuts, serrated and plain washers securing the screen rail to the two inner and two outer attachment brackets (see Fig.48).

Disconnect the two cables attached to the map light and remove the screen rail.

Refitting

Refitting is the reverse of the removal procedure.

THE INSTRUMENT PANEL

Opening

Detach the earth lead from the battery.

Remove the ignition key and cigar lighter for safe keeping.

Withdraw the picnic tray to its full extent. Press the two spring retaining clips on the back edge inwards and complete removal of tray.

Hinge the centre instrument panel downwards on its bottom edge, after withdrawing the thumb screws situated in each top corner.

Removal

The instrument panel can be removed completely by detaching the earth lead from the battery, identifying and removing the leads from the instruments, cigar lighter and switches, removing the electrical harness and clips from the instrument panel and withdrawing the two hinge pivot bolts from the instrument panel support brackets.

Refitting

Refitting is the reverse of the removal procedure.

Re-connect the leads in accordance with their colour coding, utilizing the wiring diagram as a reference.

Closing

Closing is the reverse of the opening procedure. Check that the clips securing the main harness to the instrument panel will in no way foul any of the switch or instrument terminals, otherwise a direct short will occur when the battery is connected.

THE GLOVE BOX

Removal

Disconnect the earth lead from the battery.

Remove the curved side panels, screen pillar cappings and screen rail as detailed under "Side Facia Panel".

Withdraw the picnic tray to its full extent. Press the two spring retaining clips on the back edge inwards and complete removal of tray.

Hinge the centre instrument panel downwards after withdrawing the thumb screws situated in each top corner.

Remove the top screw of the three exposed in the instrument panel aperture and release the remaining two.

Note: The two lower screws are located in slotted holes and it is not necessary to remove them completely.

Remove the nut, lock washer and plain washer securing the glove box outer attachment bracket to the body and detach the glove box (see Fig.48).

Disconnect the "Lucar" connectors from the glove box illumination lamp and earth connections.

Withdraw the glove box.

SIDE FACIA PANEL

Removal

Disconnect the negative lead on the battery. Remove the two nuts and washers securing the curved side panels to the side facia panel and the glove box. Extract the two screws securing the side panels to the body at the base of the screen pillars. The screw heads are accessible after opening the door and lifting the door trim welt locally.

Remove both curved side panels (see Fig.48).

Remove both screen pillar cappings by withdrawing the screws from the bottom fixing brackets, now exposed, inserting a thin bladed instrument between the capping and the screen pillar, pressing in the top spring clip fastener, and gently prising away the capping.

Release the four nuts securing the screen rail to the two outer and the two inner slotted attachment brackets (Fig.48).

Disconnect the two cables attached to the map light and remove the screen rail.

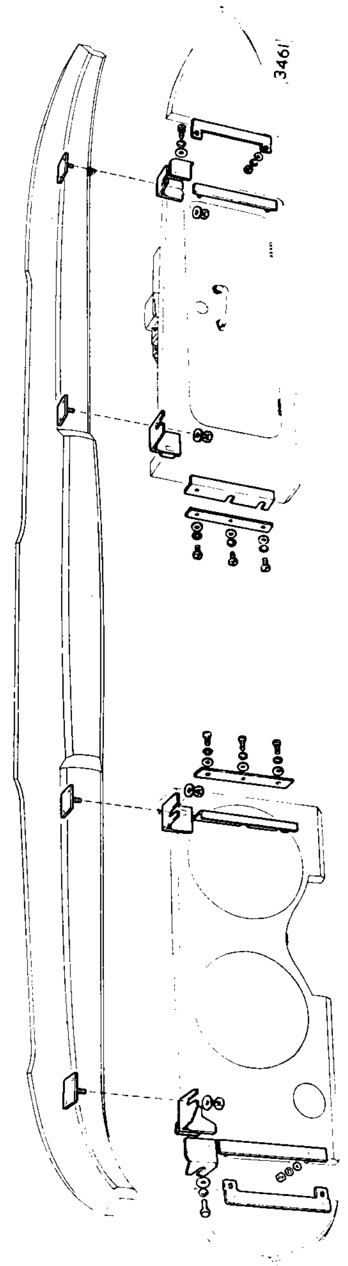


Fig. 48. The facia panel.

Withdraw the picnic tray to its full extent. Press the two spring retaining clips on the back edge inwards and complete the removal of the tray.

Hinge the centre instrument panel downwards after withdrawing the thumb screws situated in each top corner.

Release the steering wheel locknut and pull the steering wheel outwards to the full extent.

Remove the two setscrews and washers securing the top half of the flasher switch cover to the steering column and detach the cover.

Disconnect the speedometer drive cable from the rear of the speedometer.

Disconnect the flasher warning light and the automatic transmission (or overdrive) indicator panel illumination bulb cables from the snap connectors located behind the facia panel above the steering column and withdraw the cables through the clip attached to the panel.

Remove the top screw of the three exposed in the instrument panel aperture and release the remaining two.

Note: The two lower screws locate in slotted holes and it is not necessary to remove them completely.

Remove the nut, lock washer and plain washer securing the panel outer attachment bracket to the body and detach the side facia panel (see Fig.48).

Disconnect the panel light and clock cables at the snap connector.

Withdraw the ignition and main beam warning light bulb holders.

Disconnect the "Lucar" connectors from the revolution counter and the brake fluid warning light.

Disconnect the earth wires from the speedometer and the revolution counter.

Remove the side facia panel.

Refitting

Refitting is the reverse of the removal procedure. On cars equipped with automatic transmission, ensure that the three cables connected to the flasher warning and indicator panel illumination lights do not foul the indicator pointer when the gear control is operated.

THE INSTRUMENTS

SPEEDOMETER

Removal

Detach the earth lead from the battery and raise the steering wheel to the highest position.

Remove the upper half of the steering column nacelle.

Detach the speedometer from the facia board by removing the two knurled nuts, earth lead and two retaining pieces, then withdraw the flexible drive from the centre of the instrument by slackening the knurled sleeve. Withdraw the speedometer from facia board, identifying and removing the two warning lights and two instrument illumination lights from the hidden face of the instrument. Remove the flexible trip odometer setting drive from the rear of the speedometer by slackening the knurled sleeve.

Refitting

Refitting is the reverse of the removal procedure. Replace the headlamp warning light in the right-hand aperture at the back of the instrument. Replace the ignition warning light in the left-hand aperture.

THE SPEEDOMETER DRIVE CABLE

Removal

Disconnect the flexible drive cable and remove the speedometer from the side instrument facia as previously detailed. Detach the flexible drive cable from the right-angle drive attachment on the gearbox and release it from the retaining clips.

Refitting

Refitting is the reverse of the removal procedure but particular attention must be given to the following points:—

(i) That the run of the flexible drive cable is without any sharp bends.

(ii) That the securing clips are so shaped that they only hold the cable in position without crushing it.

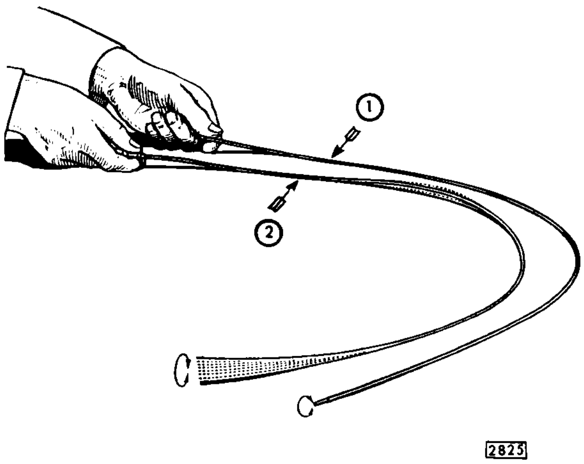


Fig. 49. Checking the inner flex for kinks.

SPEEDOMETER CABLE

General Instructions

Flexible cable condition to a great extent affects performance of speedometers. Poor installation or damage to the flexible drive will show up as apparent faults. It is most important that the flexible drive should be correctly fitted and maintained as illustrated in the following diagrams.

(a) Smooth Run

Run of flexible drive must be smooth. Minimum bend radius 6″. No bend within 2″ of connections.

(b) Securing

Avoid sharp bends at clips. If necessary change their positions. Do not allow flexible drive to flap freely. Clip at suitable points.

(c) Securing

Avoid crushing flexible drive by over-tightening clip.

(d) Connection

Ensure tightness of outer flex connections. They should be finger tight only. It may be necessary to clean thoroughly the point of drive before the connection can be screwed completely home.

(e) Connection of Inner Flexible Shaft

Where possible slightly withdraw inner flex and connect outer first. Then slide inner into engagement.

(f) Removal of Inner Shaft

Most inner flexes can be removed by disconnecting instrument end and pulling out flex. Broken inner flex will have to be withdrawn from both ends.

(g) Examination of Inner Flexible Shaft

Check for kinked inner flexible shaft by rolling on clean flat surface. Kinks will be seen and felt.

(h) Lubrication Every 10,000 Miles

Withdraw inner flexible drive (see paragraph (f).) Place blob of grease on end of outer cable. and insert flex through it, carrying grease inside Use Esso T.S.D. 119 or equivalent. Do NOT use oil.

(i) Excessive Lubrication

Avoid excessive lubrication. If oil appears in flexible drive, suspect faulty oil-seal at point of drive.

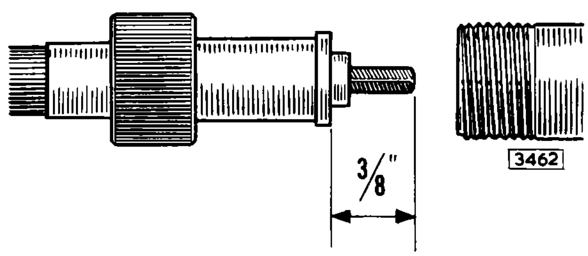


Fig. 50. The amount the inner flex must protrude.

(j) Inner Shaft Projection

Check $\frac{3}{8}$″ projection of inner flex beyond outer casing at instrument end. This ensures correct engagement in instrument and point of drive.

(k) Concentric Rotation

Check that inner flex rotates in centre of outer cable.

(l) Damaged Inner Shaft

Examine inner flex ends for wear or other damage. Before fitting new flex ensure instrument main spindle is free.

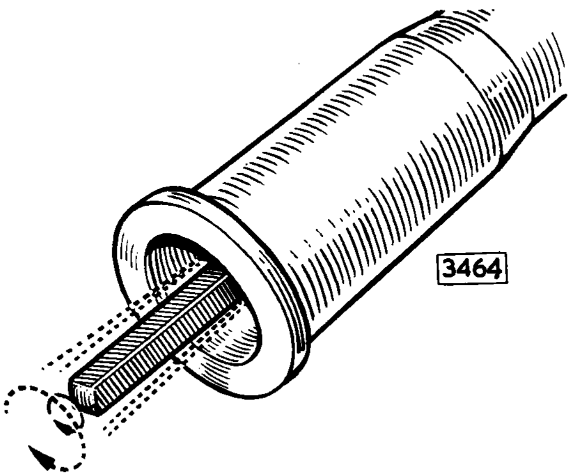


Fig. 51. Checking the inner flex for "run-out".

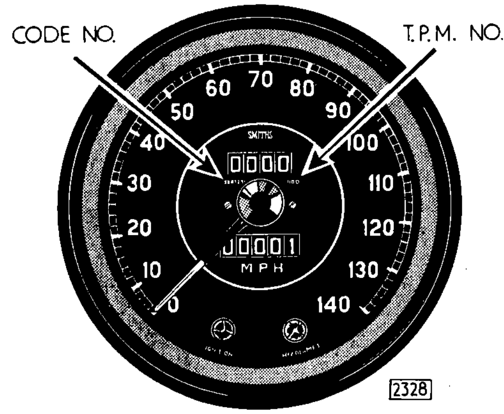


Fig. 52. The code number and turns per mile on the speedometer instruments.

(m) Damaged Drive End Connections

Examine point of drive for damage or slip on gears in gearbox.

(n) Ensuring Correct Drive Fitted

When ordering, state Make, Year and Model of vehicle. State also length of drive required when alternatives are shown.

SPEEDOMETERS—GENERAL INSTRUCTIONS

Speedometer performance is dependent on the flexible drive, and apparent faults in the instrument may be due to some failure of the drive. Before returning a speedometer for service, the flexible drive should be checked, as described in the previous paragraphs. The following diagrams indicate how to check the instrument performance.

(o) Instrument Not Operating

Flexible drive not properly connected (see paragraph (e)).

Broken or damaged inner flexible shaft or fault at point of drive (see paragraphs (l) and (m)), in which case remove and replace flex (see paragraphs (f) and (h)) or rectify point of drive fault. Insufficient engagement of inner shaft (see paragraph (j)). Defective instrument—return for service.

(p) Instrument Inaccurate

Incorrect speedometer fitted. Check code number.

(q) Speedometer Inaccurate

Check tyre pressures. Inaccuracy can be caused by badly worn tyres. Non-standard tyres fitted, apply to Smiths for specially calibrated instrument.

(r) Speedometer Inaccurate

Rear axle non-standard. Drive ratio in vehicle gearbox non-standard. A rapid and simple check is obtained by entering in the formula the figures found in the test (see paragraph 19).

$$\frac{1680\ N}{R} = \text{T.P.M. No.}$$

Where N = Number of turns made by the inner shaft for 6 turns of rear wheel and R = Radius of rear wheel in inches measured from centre of hub to ground.

Example

Cardboard pointer on inner shaft (see (s)) rotates $9\frac{1}{8}$ times as vehicle is pushed forward 6 turns of rear wheel. Rear wheel radius $12\frac{1}{4}$".

Flex turns per mile:

$$\frac{1680 \times 9\frac{1}{8}}{12\frac{1}{4}} = \frac{15330}{12\frac{1}{4}} = 1251 = \text{T.P.M. No.}$$

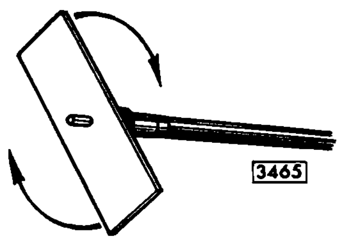


Fig. 53. Cardboard counter on the inner flex for checking the number of turns.

(s) Gearing Test

Disconnect flexible drive from speedometer. With the gears in neutral, count the number of turns of the inner shaft for six turns of the rear wheels when the vehicle is pushed forward in a straight line. Measure rolling radius of rear wheels—centre of hub to ground. Apply figures in formula (see sub-paragraph (r)).

(t) Correct Speedometer

Number illustrated should correspond within 25 either way with the number obtained from paragraphs (r) and (s). If it does not, apply to Smiths for specially calibrated instrument, giving details of test and vehicle.

(u) Pointer Waver

Oiled up instrument. Replace oil seal if necessary, clean and lubricate flexible drive (see paragraph (h)). Return instrument for replacement.

(v) Pointer Waver

Inner flexible shaft not engaging fully. Check (j), then try (d). Also check (l).

(w) Pointer Waver

Kinked or crushed flexible drive. Check ((g) and (c). For withdrawal of inner shaft see paragraph (f). Bends of too small a radius in flexible drive, check (a).

(x) Pointer Waver

If (u), (v) and (w) show no sign of trouble, instrument is probably defective. Return for replacement.

(y) Noisy Installation

Tapping noises. Check (e) and (b). Flexible drive damaged. Check (g) and (l) (also see paragraph (f)), check lubrication is sufficient. Check (j) and (k).

(za) Noisy Installation

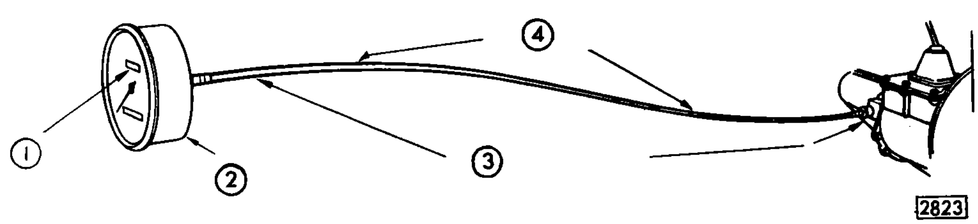
General high noise level. Withdraw inner shaft (see paragraph (f)) and reconnect outer flex. If noise continues at lower level then source of noise is in vehicle point of drive. Fitting new P.V.C. covered flexible drive with nylon bush on inner shaft and instrument with rubber mounted movement should overcome this trouble.

(zb) Noisy Installation

Regular ticking in time with speedometer decimal distance counter. Return speedometer for replacement.

(zc) Noisy Installation

Loud screeching noise more prevalent in cold weather, return instrument for replacement.



1. Regular ticking
2. Screeching noise
3. General high noise level
4. Tapping noises

Fig. 54. Diagram showing the apparent source and type of noise.

REVOLUTION COUNTER AND CLOCK

The revolution counter and clock are of the electrical type and the electrical leads to both are included in the car harness. The clock is mounted in the bottom of the revolution counter indicator head and to effect its removal, it is necessary to remove both speedometer and revolution counter from the side facia panel. The revolution counter consists of an A.C. generator fitted to the rear end of the camshaft with an indicator head mounted in the side facia panel, both units have Lucar tags of equal size.

Removal

Remove the speedometer from the side facia panel as previously detailed, this will give the necessary working clearance. Detach the revolution counter from the facia board by removing two knurled nuts, earth lead and retaining pieces, then withdraw the revolution counter by removing the two centre and two instrument illumination bulbs from the hidden face of the instrument and from the clock at the snap connector. Detach the flexible clock setting drive by slackening the knurled sleeve and remove the clock from the revolution counter by removing two nuts.

Refitting

Refitting is the reverse of the removal procedure.

Refit the leads, utilizing the wiring diagram as a reference.

Testing operation of Revolution Counter

Utilizing an A.C. voltmeter check the current across the terminals of the generator at the rear of the right hand camshaft while the engine is running; as a rough guide it can be assumed that there is one volt output per 100 r.p.m. When electrical current is evident, check the continuity of the two leads by attaching the terminals to the generator and connecting the voltmeter to the opposite ends of the cables after removal from revolution counter. If when running engine continuity is evident, it can be assumed that the instrument is unserviceable and must be exchanged.

THE REVOLUTION COUNTER DRIVE

The revolution counter drive takes the form of a small A.C. electrical generator fitted at the rear R.H. end of the cylinder head where its tongued driving spindle engages a slotted adaptor screwed in the rear end of the inlet camshaft. Leads included in the electrical harness of the car connect with the Lucar tabs pointing upward in the body of the generator and with similar tabs at the rear of the instrument lead in the side facia panel. The Lucar tabs are of the same size and the leads can be fitted either way round.

Removal

Open the engine compartment and detach the earth lead from the battery.

Remove the electrical harness from the two Lucar tabs on the A.C. generator on the rear R.H. end of the cylinder head. Detach the A.C. generator from the rear R.H. end of the cylinder head by withdrawing three Allen screws and a plate washer, remove the generator in a rearward direction and note the position of the tongued driving spindle.

Refitting

Refitting is the reverse of the removal procedure.

Check with the aid of a mirror, that the tongued driving spindle is in line with the slot in the camshaft before fitting the generator.

ELECTRIC CLOCK

Removal

Detach the earth lead from the battery. Remove the revolution counter from the instrument panel as detailed under "Revolution Counter and Clock Removal". Detach the clock from the rear face of the revolution counter by removing the two nuts. The flexible setting drive can be removed by slackening the knurled nut. Disconnect the cable at the snap connector.

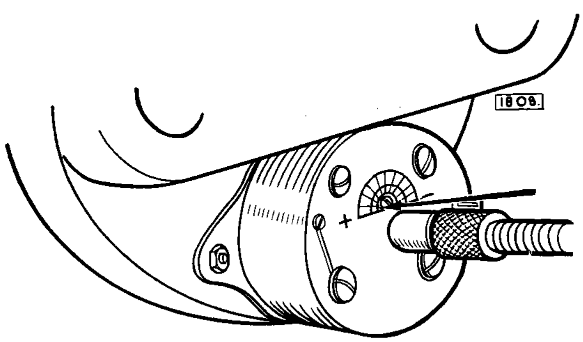


Fig. 55. The adjustment screw for the clock.

Refitting

Refitting is the reverse of the removal procedure.

Adjustment

Adjustment is effected by means of a small screw surrounded by a semi-circular scale located at the back of the instrument.

FLASHING INDICATOR CONTROL

Removal

Disconnect the earth lead at the battery. Detach the upper and lower switch covers from around the steering column by removing the two sunken screws and three screws from below. Disconnect the seven cable harness at the snap connectors at the left-hand side of the steering column. Detach the flasher indicator control from the left-hand side of the steering column by withdrawing two horizontally positioned screws from the right-hand side.

Refitting

Refitting is the reverse of the removal procedure. Insert the wires into the connectors so that similar coloured wires are opposite each other.

Cars from chassis No: 1D51137 R.H.D. and 1D75679 L.H.D. including chassis No's: 1D51052 -1D51103 R.H.D. and 1D75628–1D75671 L.H.D. will have an adjustable upper steering column top bearing.

When refitting the switch to these cars re-adjust the upper bearing as detailed in Section I—STEERING—Page I.29.

OVERDRIVE SWITCH

Removal

Disconnect the earth cable at the battery. Detach the upper switch cover from the steering column by removing the two most sunken screws from below. Disconnect the two cables at the snap connectors, release the nut securing the switch to the mounting bracket and withdraw the switch.

Refitting

Refitting is the reverse of the removal procedure but ensure that the switch lever is horizontal in the "out" position when tightening the securing nut.

INHIBITOR SWITCH AND RELAY (AUTOMATIC TRANSMISSION ONLY)

On cars equipped with automatic transmission an inhibitor switch, mounted on the steering column and connected to the gear selector lever, by a link, is provided to prevent the starter motor solenoid operation unless the gear lever is in the "N" or "P" positions.

A relay is incorporated in the inhibitor switch/starter solenoid circuit to obviate over loading the inhibitor switch contacts when the starter motor is engaged.

In operation the closing of the inhibitor switch contacts by movement of the gear selector lever to the "N" or "P" positions energises the relay coil windings when the starter button is depressed with the ignition "ON".

Current is then supplied to the starter solenoid through the relay main contacts (C1 and C2).

The inhibitor switch also incorporates the reverse lamp switch.

THE INHIBITOR SWITCH

Removal

Remove the console and parcel tray as detailed in Section N—"Body and Exhaust System".

Disconnect the cables from the switch, located on a bracket attached to the steering column. Note the location of the wires on the switch for reference when refitting.

Detach the control link from the switch by withdrawing from the rubber bush, release the clamp ring setscrew and remove the switch.

Refitting

Insert the switch in the clamp ring, but, do not tighten the setscrew. Reconnect the control link.

Select neutral ("N") on the gear selector quadrant and hold in this position.

Rotate the switch in the clamp ring, until the small hole in the lever registers with the indent in the back of the switch.

A small mirror held at the back of the switch will enable the indent to be located correctly.

Tighten the clamp ring setscrew and reconnect the cables.

Refit the parcel tray, heater controls and console by reversing the removal procecure.

THE INHIBITOR SWITCH RELAY

Removal

The relay is mounted behind the curved side facia at the base of the screen pillar on the left-hand side of the car.

To remove, withdraw the two securing screws, lower the relay and disconnect the cables. Note the location of the cables for reference when refitting.

Refitting

Refitting is the reverse of the removal procedure.

THE INSTRUMENT PANEL COMPONENTS

REMOVAL

Detach the earth lead from the battery.

Remove the ignition key and cigar lighter for safe keeping.

Withdraw the picnic tray and hinge the centre instrument panel downward after withdrawing the thumb screws situated in each top cover.

Ignition Switch

Identify and remove the ignition switch cables. Withdraw the ignition switch from the rear of the instrument panel by removing the chrome ring and fibre washer.

Note the locating washer fitted to the threaded portion of the switch.

The lock barrel can be withdrawn by inserting a thin rod through a hole in the body of the switch and depressing the plunger in the lock. Insert the key and turn to the "ON" position to gain access to the plunger.

Refitting is the reverse of the removal procedure. When refitting a new lock barrel check that the number of the key is the same as that stamped on the lock barrel.

Insert the key in the lock and turn the switch to the "ON" position before inserting the lock barrel. Refit the locating washer over the threaded portion of the switch before inserting in the panel and locate the tag with the cut-out portion in the panel hole.

Note: On cars not fitted with a steering column lock the ignition switch also functions as an alternator field isolation switch.
Care must be taken when reconnecting the switch that the cables are connected as shown in the wiring diagram. Use the diagram as a reference.

Cigar Lighter Element

Withdraw the cigar lighter and ensure that it is cold. Place the unit in the palm of the hand, knob first, and hold the sleeve downward against the pressure of the spring. Unscrew the lighter element and fit a replacement. It is important **not** to omit the spring as it ejects the lighter unit when it attains the correct temperature.

Cigar Lighter Unit

Detach the earth lead from the battery. Withdraw the cigar lighter. Identify and remove the cables from the cigar lighter housing. Unscrew the outer casing at the rear of the panel and withdraw the inner section of the cigar lighter unit.

Refitting is the reverse of the removal procedure.

Starter Push Button

Remove the cables from the push button. Withdraw the push button through the face of the instrument panel by removing the nut, washer and spring washer at the rear of the instrument panel.

Refitting is the reverse of the removal procedure.

Head and Side Light Switch

Detach the earth lead from the battery.

Remove the light switch control lever from the face of the instrument panel by depressing the plunger in the right-hand side.

Identify and remove the leads from the light switch.

Remove the three nuts, shakeproof washers, washers and blade terminal from the switch mounting posts. Withdraw the light switch. The designation plate can be removed from the instrument panel face by detaching the nut on the rear of the panel.

Refitting is the reverse of the removal procedure. Re-position the designation plate on the instrument panel by allowing a flat on the threaded barrel to locate a flat in the panel.

The light switch control lever is pressed onto the light switch so that the plunger locates with a drilling in the hub of the control lever.

Tumbler Switches

Detach the earth lead from the battery.

Identify and remove the leads from the Lucar tags on the switch body. Withdraw the tumbler switch from the rear of the instrument panel by holding the switch lever in a horizontal position and removing the screwed chromium ring from the face of the instrument panel.

Refitting is the reverse of the removal procedure. The flat face of the switch lever should be facing downwards.

Ammeter and Oil Pressure Gauges

Detach the earth lead from the battery.

Withdraw the illumination bulb holder from the rear of the gauge. Remove the cables from the terminal posts. Remove the two knurled nuts and "U" clamp. Withdraw the gauge through the front face of the instrument panel.

When refitting the gauges, check that the "U" clamp does not foul any terminals or the bulb holder.

Fuel and Water Temperature Gauges

Removal and refitting of these gauges is similar to the ammeter and oil pressure gauges. But in this case, the "U" clamp is retained by one knurled nut.

The removal and replacement of the fuel gauge tank unit and water temperature transmitter unit are detailed in the "Fuel System" and "Cooling System" sections respectively.

Voltage Regulator (Fuel and Water Temperature Gauges)

Remove the cables (noting their respective positions) from the voltage regulator situated in the left-hand corner of the instrument panel. Withdraw the voltage regulator by removing one nut, shakeproof washer and blade terminal.

When refitting the voltage regulator, ensure that a good earth is made between the regulator and panel.

Switch Indicator Strip

Remove the indicator strip, chrome finisher and light filter from the bottom edge of the instrument panel by withdrawing the four screws.

REFITTING

Refitting is the reverse of the removal procedure.

THE BI-METAL RESISTANCE INSTRUMENTATION

Engine Temperature, Fuel Tank and Oil Pressure Gauge:

DESCRIPTION

The Bi-metal Resistance Instrumentation for engine temperature, petrol tank contents and engine oil pressure consists of a gauge unit fitted in the instrument panel, a transmitter unit fitted in the engine unit or petrol tanks and connected together to the battery, the oil pressure gauge being an exception, through a common voltage regulator.

The purpose of the latter is to ensure a constant supply at a predetermined voltage thus avoiding errors due to a low battery voltage. In the instance of the oil pressure gauge this is not quite so critical to supply voltage.

In all systems the gauge unit operates on the thermal principle utilizing a heater winding wound on a bimetal strip, while the transmitter units of the engine temperature and petrol tank contents gauge are of the resistance type but in both instances the system is voltage sensitive. The transmitter unit of the oil pressure gauge is of the thermal pressure principle utilizing a heater winding wound on a bi-metal strip having contact at one end with the second contact mounted on a diaphragm which is sensitive to engine oil pressure.

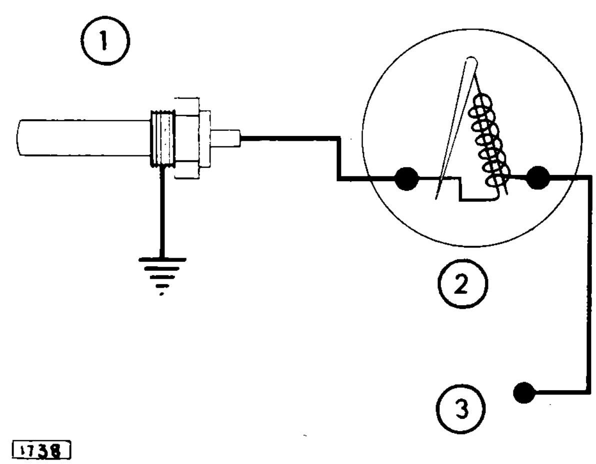
OPERATION OF THE ENGINE TEMPERATURE GAUGE

The transmitter unit of the engine temperature gauge is fitted in the water outlet pipe of the engine unit and is a variable resistance and consists of a temperature sensitive resistance element contained in a brass bulb. The resistance element is a semi-conductor which has a high negative temperature co-efficient of resistance and its electrical resistance decreases rapidly with an increase in its temperature. As the temperature of the engine unit rises the resistance of the semi-conductor decreases and increases the flow of current through the transmitter similarly a decrease in engine temperature reduces the flow of current.

The gauge unit fitted in the instrument panel consists of a heater winding, connected at one end to the transmitter unit and at the second end to the "I" terminal of the voltage regulator, wound on a bi-metal strip which is linked to the indicator needle. The heater winding and bi-metal strip assembly is sensitive to the changes in voltage received from the transmitter unit causing the heater winding to heat or cool in the bi-metal strip, resulting in the deflection of the indicator needle over the scale provided. The calibration of the scale is such that the movement of the indicator needle over it is relative to the temperature of the transmitter unit bulb and therefore the temperature of the engine unit.

OPERATION OF THE FUEL TANK GAUGE

The transmitter units of the petrol gauge are fitted in the petrol tanks and each is a variable resistance actuated by a float, the arm of which carries a contact travelling across a resistance housed in the transmitter body. The float arm takes up a position relative to the level of petrol in the tank being used and thus varies the amount of current passing through the indicator unit.



1. Temperature transmitter
2. Rear of indicator
3. Voltage regulator terminal "I"

Fig. 56. The engine temperature gauge circuit.

The gauge unit in the instrument panel consists of a heater winding, connected at one end to the transmitter units and at the other to the "I" terminal of the voltage regulator, wound on a bi-metal strip which is linked to the indicator needle. The heater winding and bi-metal strip assembly is sensitive to the changes in voltage received from the position of the transmitter float, causing the heater winding to heat or cool the bi-metal strip, resulting in the deflection of the indicator needle over the scale provided. The calibration of the scale is such that the movement of the indicator needle over it is relative to the position of the transmitter float actuated by the level of the contents in the petrol tank.

Exaggerated indicator needle movement due to petrol swirl in either tank is considerably reduced as there is a delay before current changes from the transmitter unit can heat or cool the bi-metal and heater winding assembly in the indicator unit, which causes the deflection of the needle.

Similarly the indicator needle will take a few moments to register the contents of the petrol tank being used when the ignition is first switched on.

OPERATION OF THE OIL PRESSURE GAUGE

The transmitter unit of the oil pressure gauge, fitted in the head of the engine oil filter, is a voltage compensated pressure unit and consists of a diaphragm, a bi-metal strip with a heater winding wound thereon, a resistance and a pair of contacts. One contact is attached to the diaphragm while the second is mounted on one cnd of the bi-metal strip, the second end of which is connected through the resistance and the gauge unit to the battery supply; the heater winding is also connected to the battery supply but not through the resistance. Engine oil pressure will close the contacts causing current to flow through the gauge unit, bi-metal strip and contacts to earth resulting in the heating of the heater winding which will, after a time, open the contacts.

The gauge unit fitted in the instrument panel consists of a winding, connected at one end to the battery supply and at the second to the transmitter unit wound on to a bi-metal strip which is linked to an indicating needle. The heater winding and bi-metal strip assembly is sensitive to the continuity changes received from the thermal pressure unit, fitted in the engine oil filter, causing the heater

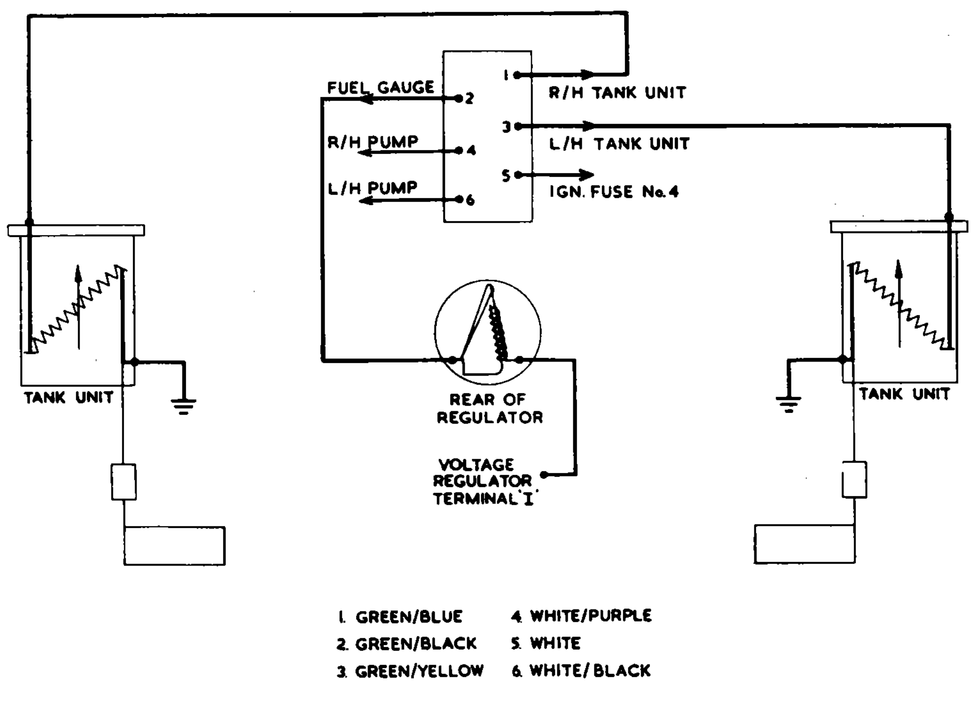


Fig. 57. The fuel tank contents gauge circuit.

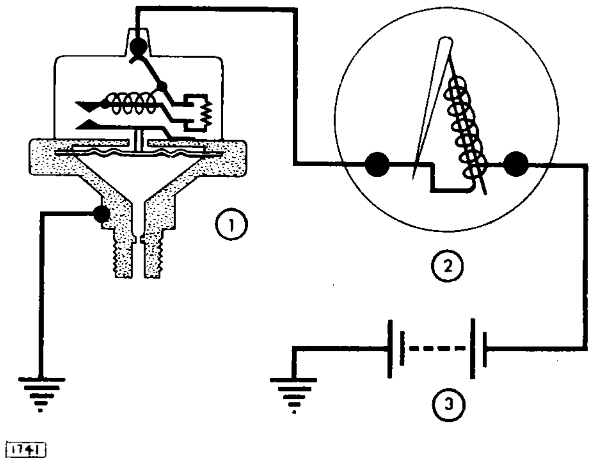


Fig. 58. The engine oil pressure gauge circuit.

1. Thermal pressure transmitter
2. Rear of indicator
3. Battery

winding to heat or cool the bi-metal strip resulting in the deflection of the indicating needle over the scale provided.

The changes in continuity of current from the transmitter unit will vary according to the amount of oil pressure, for as the latter rises, the outward moving diaphragm contact limits the return travel of the bi-metal strip contact thus allowing a longer continuity period.

This results in a greater heating of the heater winding in the gauge unit and increased deflection of the indicating needle over the scale showing a greater oil pressure.

The opening and closing of the transmitter unit contacts is continuous thus the temperature of the heater winding in the gauge unit is kept within close limits and the calibration of the scale is such that the movement of the indicating needle over it is relative to the opening of the transmitter unit contacts and therefore the oil pressure of the engine is recorded.

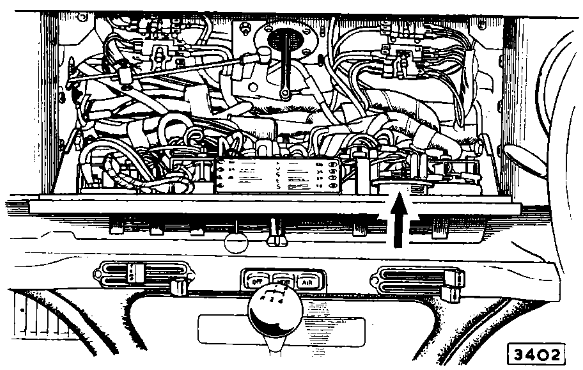


Fig. 59. The location of the voltage regulator

ANALYSIS OF THE ENGINE TEMPERATURE AND PETROL TANK GAUGE FAULTS

NOTE: THE INSTRUMENT PANEL GAUGES MUST NEVER BE CHECKED BY SHORT-CIRCUITING THE TRANSMITTER UNITS TO EARTH

Symptom	Unit Possibly at Fault	Action
nstrument panel gauge showing a "zero" reading	Voltage regulator	Check that output voltage at terminal "I" is 10 volts
	Instrument panel gauge	Check for continuity between the gauge terminals with the leads disconnected.
	Transmitter unit in petrol tank or engine unit.	Check for continuity between the terminal and the case with lead disconnected.
	Wiring	Check for continuity between the gauge, ιhe transmitter and the voltage regulator, also that the transmitter unit is earthed.
Instrument panel gauge showing a high/low reading when ignition switched on	Voltage regulator	Check output voltage at terminal "I" is 10 volts.
	Instrument panel gauge Transmitter unit in petrol tank or engine	Check by substituting another instrument panel gauge. Check by substituting another transmit er unit in petrol tank or engine unit.
	Wiring	Check for leak to earth.
Instrument panel gauge showing a high reading and overheating	Voltage regulator	Check output voltage at terminal "I" is 10 volts.
	Wiring	Check for short circuit; on wiring to each transmitter unit.
Instrument panel gauge showing an intermittent reading	Voltage regulator	Check by substituting another voltage regulator.
	Instrument panel gauge	Check by substituting another instrument panel gauge.
	Transmitter unit in petrol tank or engine unit	Check by substituting another transmitter unit in petrol tank or engine unit.
	Wiring	Check terminals for security, earthing and wiring continuity.

ANALYSIS OF THE OIL PRESSURE GAUGE FAULTS

Symptom	Unit Possibly at Fault	Action
Instrument panel gauge showing a "zero" reading	Wiring	Check for continuity between the gauge and the transmitter unit and that the latter is earthed.
	Instrument panel gauge	Check for continuity between the gauge terminals with leads disconnected. If satisfactory replace the transmitter unit.
Instrument panel gauge showing a reading with ignition switched on but engine not running	Transmitter unit on oil filter head	Check by substituting another transmitter unit.
Instrument panel gauge showing a high reading and overheating	Transmitter unit on oil filter head	Check by substituting another transmitter unit.
Instrument panel gauge showing a below "z ro" reading with ignition switched off	Instrument panel gauge	Check by substituting another instrument panel gauge.

OPTIONAL EXTRAS

This section covers the installation of the equipment available as optional extras for the 4·2 Mk. 10

ELECTRICALLY OPERATED WINDOWS

GENERAL

This system (fitted as an optional extra) enables the window regulators to be operated by means of pushbutton switches which control reversible electric motors mounted in each door panel and actuate the lifting and lowering mechanism.

Six control switches are employed, two for the use of passengers in the rear of the car controlling the rear windows, and four for the driver's use, giving control over all four windows and overriding the rear passengers' switches. The driver's control switches each incorporate two switching sequences; the first is a normally-closed on-off switch isolating the power supply to the rear window switches, and this operates fractionally ahead of a single-pole changeover switch controlling the direction of motor rotation.

The system is operative only when the ignition is switched on, when the closing of a heavy-duty relay (Model 9RA) connects the window lift circuit direct to the battery (via the solenoid starter switch).

A thermostatic circuit breaker protects the motor windings from damage should the motors be stalled with the current on, as for example with the control switch not released although the window is fully open or fully closed, or if the regulating mechanism is out of adjustment or requires lubrication. It also protects the wiring should fault current be flowing for any reason in any part of the circuit.

A single circuit breaker is employed in conjunction with a second relay (Model 6RA) having normally closed contacts. In the event of stall or fault current flowing in the circumstances described above, the circuit breaker will operate. Current will then flow through the relay winding (rated at 65 milliamps) thus opening the relay contacts. So long as the switch remains closed or the fault exists, the relay will be energised, preventing further operation of the motors. When the switch is released, or the fault rectified, the relay is de-energised and the contacts re-closed, so restoring the system to normal. It should be noted, however, that since by operating the driver's window control switch the remainder of the circuit is isolated, the driver may still use the system to control his own window provided that the cause of the trouble is in one or all of the passengers' windows.

Note: In the event of a window not closing when the switch is operated, it can be wound up with the aid of a special screwbrace which is retained in the luggage compartment next to the wheel brace.

The screwbrace should be inserted in an aperture provided in the bottom edge of the door and engaged with a slot in the regulator mechanism. The window can now be wound up to the closed position.

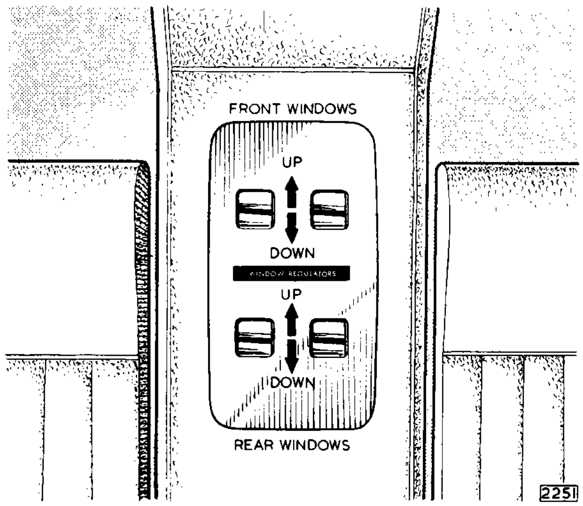


Fig. 60. The driver's control switches.

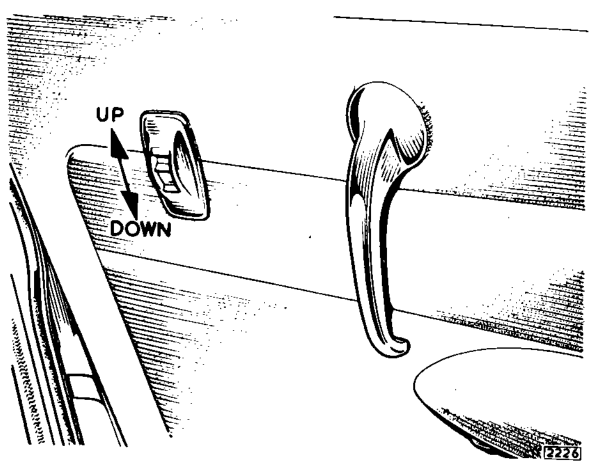


Fig. 61. Rear passenger's window regulator switch.

DATA

Motor (Model 4GM)

Current consumption 12·5 amps. approximately at armature speed of 3,500±200 r.p.m. with torque of 25 oz. in. Cold stall current 32–37 amps. at 12 volts (not to be allowed to flow for longer than 5 seconds without circuit breaker in use). Light running current not to exceed 4¼ amps. at 13·5 volts. Brush pressure 160 grams.

Relay (Model 9RA)

Cut-in voltage 6·0–9·0 volts. Drop-off voltage 2·0 volts (min.). Coil resistance 130±10 ohms.

Relay (Model 6RA)

Cut-in voltage 8·5–10 volts. Drop-off voltage 6·0 volts (max.). Coil resistance 76±5 ohms.

Circuit Breaker (Models 3CB)

Under stall conditions the circuit breaker must operate in less than 5 seconds, and reset in less than 10 seconds. These figures apply to the first operation of the circuit breaker and with an ambient temperature of 20°C. For subsequent operations, and with the circuit breaker in situ on the car and therefore at a higher ambient temperature, the circuit breaker will operate sooner and take longer to reset.

DRIVER'S CONTROL SWITCHES

Removal

Disconnect the battery.

Prise up the switch panel from the rear with a wide, blunt instrument taking care not to mark the wood veneer.

Lift out the panel and remove seven self-tapping screws retaining the wood capping to the switch panel.

Remove the two screws and wires and remove the required switch.

Refitting

Refitting is the reverse of the removal procedure.

REAR PASSENGER'S CONTROL SWITCHES

Removal

Remove the rear door casing as detailed in the Body-Section N.

Remove the switch from the door panel and disconnect the wires.

Refitting

Refitting is the reverse of the removal procedure.

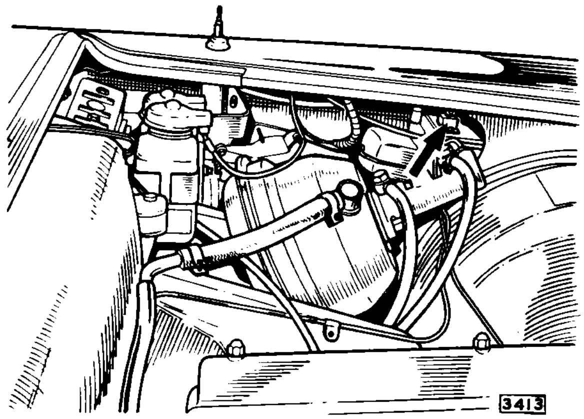


Fig. 62. Location of the electric window mechanism relay.

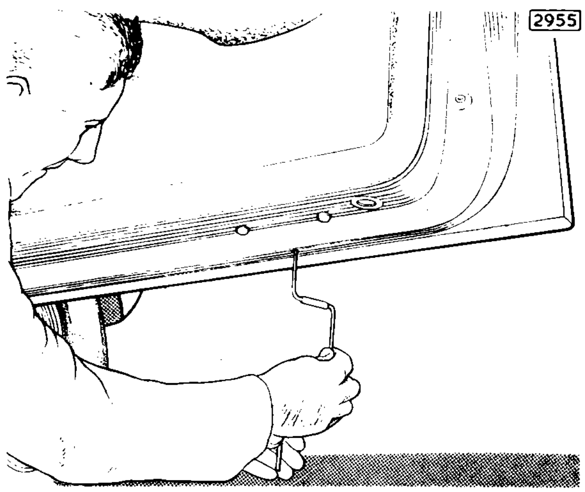


Fig. 63. Winding up the front windows using the special screwbrace.

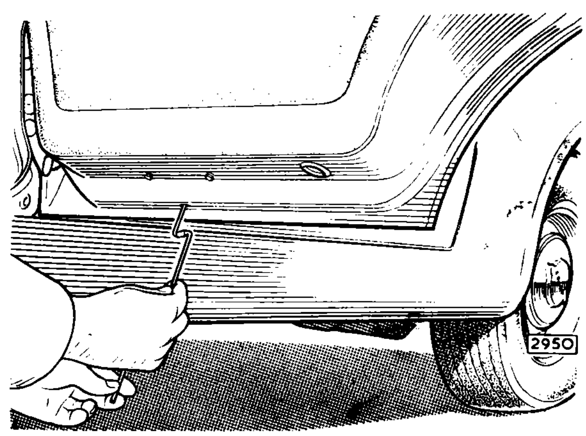


Fig. 64. Winding up the rear windows using the special screwdriver.

REMOVING AND REFITTING THE WINDOW REGULATORS

Removal of Door Casing

Remove the four screws from the wood capping at the top of the door panel.

Remove the four screws revealed securing the wood facia rail on the door panel (note the amount of packing strips underneath the facia rail brackets).

Lift up the leather cloth which is affixed to the top of the door frame.

Remove the self-tapping screws revealed in the top of the casing.

Remove the interior door handle by pushing the escutcheon inwards and extracting the spring retainer clip.

Remove the two screws securing the arm rest.

Remove the door casing by pulling away the door frame and releasing the spring clips.

Remove the polythene sheet covering the inner door frame.

Removal of Window Regulator

If it becomes necessary to remove the motor or any other part of the regulator mechanism for maintenance or replacement, the complete regulator must be taken out of the door first as follows:—

Disconnect the battery

Lower the window to the fully open position and remove the self-tapping screw (1) Fig.65, securing the regulator motor support bracket (2) to the window sill fold in the outer door panel.

Important: Raise the window to approximately one inch from the closed position.

Remove three of the four bolts and nuts (3) with their plain and shakeproof washers retaining the arm rest support bracket to the inner door panel and swing the bracket downwards out of the way as illustrated.

Disconnect the three cables (4) at the snap connectors situated in the aperture of the door frame and remove the three clips and screws (6) securing the cables to the door frame as illustrated.

Note: Before attempting to release the regulator the glass must be retained in the raised position by inserting a small screwdriver or similar tool through one of the upper door casing clip holes in the door frame as shown in (7).

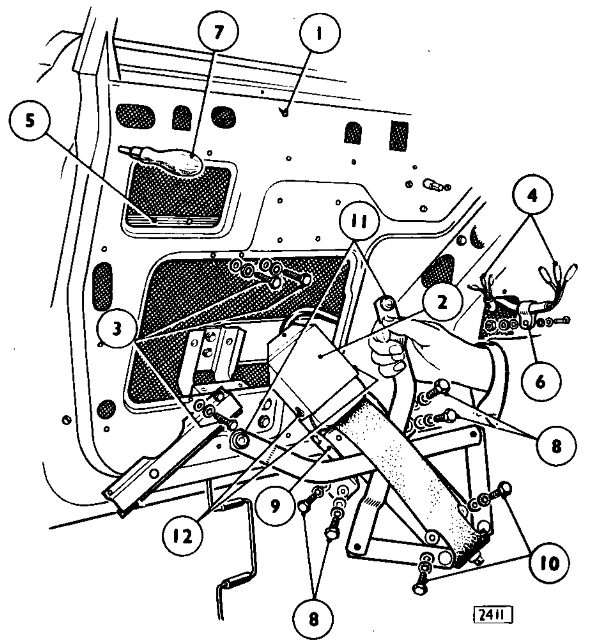


Fig. 65. Removing the regulator.

Remove the four setscrews (8) plain and lock-washers securing the upper regulator bracket (9) to the top mounting rail (5) inside the door.

Remove the two setscrews (10) plain and lock-washers securing the regulator backplate to the bottom mounting bracket.

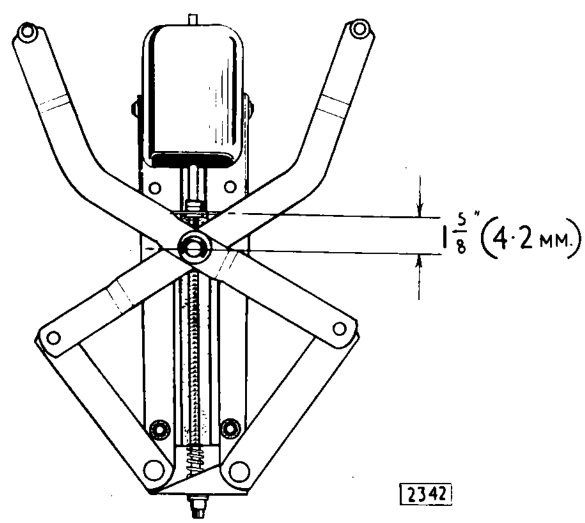


Fig. 66. Showing the setting dimension for the regulator arm

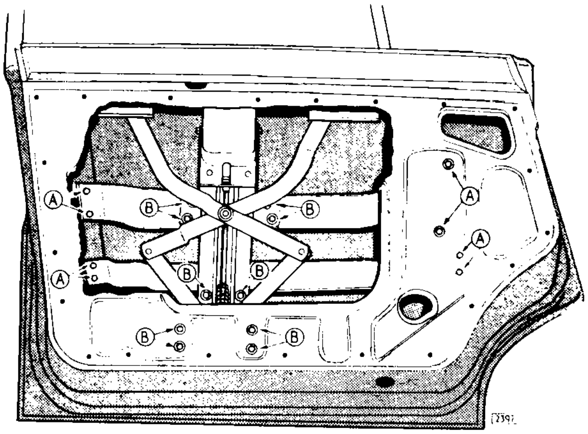


Fig. 67. Refitting the regulator.

Important: To ensure that the slotted bottom of the lifting screw (25), Fig.68, clears the outer door panel and is parallel with the glass, spacing washers are fitted on some doors between the regulator back-plate and the bottom mounting bracket. The position of these must be noted for reassembly.

Allow the regulator to find its natural position and tighten the bolts or fit packing between the lower bracket and inner face of door as necessary.

Raise the window and check the current used.

With the engine running the regulator must not use more than 17 amps. when closing the window. It is desirable to use as little current as possible.

If more than 17 amps. is used when operating the window it may be necessary to elongate the holes in the lower regulator mounting bracket so that the motor spindle can be positioned exactly at right angles to the bottom edge of the window glass.

Removing the Motor

Remove the two setscrews (12) Fig.68 and plain washers securing the motor to the support brackets. Detach the motor support and raise the motor sufficiently to release the driving shaft (14) from the end coupling (15) and the dowels from the locating holes (16). This will also release the top of the paper oil shield (17) which should be bent downwards out of the way.

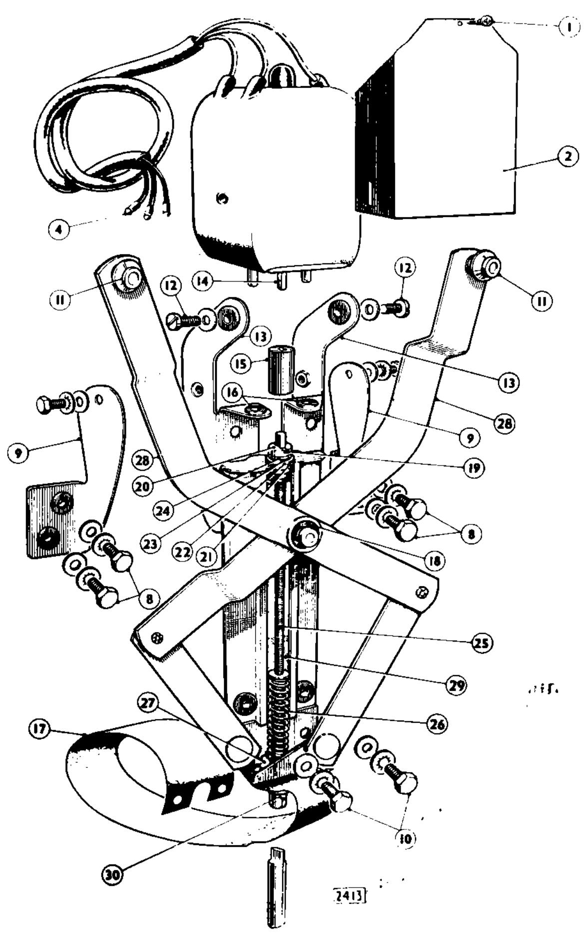


Fig. 68. Exploded view of the window regulator.

If the rubber coupling is removed collect the driving peg attached to the driven shaft below the coupling.

Refitting the Motor

Fit the driving peg onto the "D" shaped driven shaft, then place the rubber coupling with the lug facing the bottom of the regulator in position over the driving peg. The coupling should be free to rotate on the driven shaft.

Place the paper oil shield in position and engage the two motor dowels in the rubber bushed locating holes in the bottom motor support brackets.

The driving shaft (14), coupling (15) and the lifting screw (25) are "D" shaped to ensure instant and positive engagement.

Place the support (2) over motor and secure with two screws (12) and washers

Note: To enable the motor support to be positioned inside the door the screws should not be tightened at this stage.

Replacing the Lifting Screw

Release the circlip (18) and washer. Collect the three plastic washers (when fitted) one immediately above, one between and one below the lifting arms.

Knock the cross pin (19) out of the top thrust collar (20). Note the sequence of assembly for refitting the flexible bush (21), the bearing bush (22), hardened washer (23), thrust bearing (24) and finally the collar and thrust pin.

The lifting screw (25) is unscrewed from the bottom until the lifting nut is released. The screw and bottom bearing assembly can then be removed.

Important: If the bottom bearing assembly is replaced a single washer, plastic coated on one side, is used in place of the hardened washer (23) and the thrust washer (24) used on the top bearing. The washer must be assembled so that its coated side is in contact with the bottom thrust collar.

Note: If a new lifting screw is to be fitted the hole for the bottom cross pin must be drilled in position. End float should be between 0·005" (0·127 mm.) and 0·015" (0·381 mm.).

Replacing the Lifting Nut

To remove the nut the buffer spring (26) with its nylon top bush, must be taken off first to allow the nut to slide to the bottom of its channel when it can be removed. The spring is held in position at the bottom by a retaining clip (27) riveted to the regulator backplate.

FAULT LOCATION

In the event of the system not operating satisfactorily it will be necessary—because of the interdependability of the mechanisms associated with each window—to note the symptoms and locate the source of the trouble by a process of elimination with the aid of the wiring diagram.

The following notes are given for guidance:—

It is important that the supply voltage for testing must be a minimum of 12 volts. If, for some reason, the engine cannot be running at above generator cut-in speed during testing, an external battery supply must be used.

Complete Failure of System

This will usually indicate that the battery supply is not connected to the system. Check by means of a voltmeter connected between 9RA relay terminal C2 and earth; with the ignition switched on, the meter should register battery voltage. If not, check wiring from ignition switch to relay terminal W2 and from terminal W1 to earth. Also from feed on starter solenoid switch to relay terminal C1. If wiring is in order, check relay by substitution. If voltage is indicated as far as terminal C2 on 6RA relay, disconnect the cables at the circuit breaker to driver's window control switch and to relay terminal W1, and check at terminal C3. No reading indicates relay contacts permanantly open, and a new relay should be fitted. (The functioning of the relay winding can be checked by disconnecting external connections from relay terminals C3, C2 and W1).

There should now be direct continuity between C3 and C2. With 12 volts applied between C2 and W1, the relay should operate to open the contacts and break the continuity between C2 and C3,. If reading is shown at C3, next check at circuit breaker terminal normally connected to driver's window control switch. No reading indicates circuit breaker permanently open circuit, and it should be replaced. Reconnect cables from control switch and relay terminal W1 and C3 at circuit breaker.

If normal supply voltage is available at the circuit breaker, check for loose, broken or earth-fault cable connection from circuit breaker to driver's window control switch. If normal supply voltage is available, the only other fault which could produce this symptom is a faulty switch not disconnecting the driver's window motor, which consequently passes stall current and causes the protective circuit described under "General Description" to operate. Check switch operation.

Driver's Window Operates Normally, but None or One of the Remainder Operates

If operation of the driver's control switch causes the driver's window to operate normally, but none or one only of the remainder do so, the cause of the trouble may be due to a sticking switch or an earth fault in the rest of the circuit causing the protective circuit to function. Operation of the driver's window control switch has the effect of isolating the remainder of the system, allowing the driver's window motor to operate individually.

Depending upon the situation of the fault, however, it might be possible to localise it more closely. With the driver's window control switch off, operate the rear window master control switch on the same side. By doing so, the corresponding rear passenger control switch will be isolated, and if the rear window now operates normally, a faulty rear passenger switch or feed wire can be suspected.

Such a fault will also prevent both windows on the opposite side from operating.

If no operation results, next operate the switch controlling the front window on the opposite side. If this window now operates, an indication is given that the fault is associated with the rear window circuit on that side which has now been isolated by the front control switch. Release the front control switch and operate the rear window master control switch, thereby isolating the rear passenger control switch. If the rear window operates normally, a faulty rear passenger switch or feed wire can be suspected. Such a fault will prevent the front window and the rear window on the opposite side from operating.

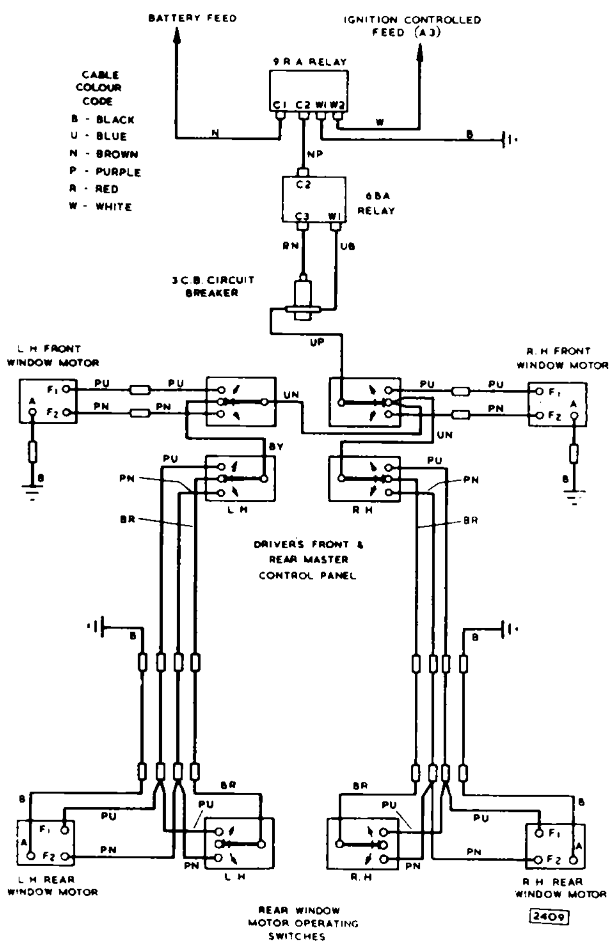


Fig. 69. The electric window circuit.

Failure of One Window Only

Check if voltage appears at the switch terminal connection to the motor when the switch is operated. If not, make point-to-point check with voltmeter along circuit to non-operative mechanism, paying particular attention to snap connectors. If voltage is present at switch terminal, check wiring from switch to motor and motor to earth. Provided that the window mechanism is free to operate, an open circuit in the motor itself is indicated in these circumstances and a replacement unit should be fitted.

If voltage is present at the switch input terminal but not at the appropriate switch output terminal when the switch is operated, check switch by substitution.

If voltage is present at the motor switch terminal when the ignition is first switched on, but fails to zero after a few seconds, and the window does not move, this indicates that stall current is being drawn by the motor causing the circuit breaker to open. Check window mechanism for freeness in operation.

Failure due to Sticking Windows

Failure of window operation may be due to sticking windows causing the circuit breaker to operate and opening the 6RA relay contacts.

The following details give the cause and remedy of possible source.

(i) **Sticking in the Up Position**

(a) **Cause:** Fouling between regulator arms and top bush plate.
Remedy: Raise complete regulator by elongating mounting holes.

(b) **Cause:** Binding of regulator arm bobbins in glazing channels.
Remedy: Re-align glazing channels.

(ii) **Sticking in the Down Position**

(a) **Cause:** Rubber bush at bottom of lifting screw misplaced.
Remedy: Re-position bush.

(b) **Cause:** Retaining clip for spring at the bottom of the lifting screw misplaced.
Remedy: Re-position the clip.

(c) **Cause:** Lack of end float (should be 0·010–0·015" (0·25–0·37 mm.) between lower bush and collar at bottom of lifting screw.
Remedy: Replace regulator.

(d) **Cause:** Fouling of cut-away in inner regulator arm on nylon bush at the bottom of the lifting screw.
Remedy: Clear the metal from the end of the cut-away at the point of foul.

ELECTRICALLY-HEATED BACKLIGHT

DESCRIPTION

An electrically-heated back light to provide demisting or defrosting is fitted as an optional extra.

OPERATION

The heating element, consisting of a fine wire mesh between the laminations of the glass, is connected to the main wiring harness.

The element comes into operation when the ignition is switched on, no separate switch being provided.

The current consumption is approximately 5 amperes.

A 15 ampere fuse contained in a plastic holder, located in a clip behind the instrument is provided in the circuit as a safety precaution.

FITTING INSTRUCTIONS

Remove the fitted back light as detailed in Section N—Page N.14 (Body and Exhaust System).

Remove the rear seat and squab as detailed in Section N—Page N.25.

Lift up the rear parcel tray trimming where secured by solution to the rear squab panel and remove the two drive screws now exposed securing the trim board. Pull the board away from the retaining clips at the rear edge.

Drill two ¼" (6·4 mm.) holes in the parcel tray 12¾" (32·4 cm.) from either side of the centre line of the tray and ⅜" (9·5 mm.) from the rear edge. (See Fig.70) and fit the two small grommets. Drill two 7/32" (5·6 mm.) holes as also shown in Fig.70.

Fit the heated back light as detailed in Section N-Page N.15.

Feed the two cables attached to the back light through the grommets, ensure that the cables pass through the felt on the underside of the parcel tray panel.

Pull away the luggage compartment bulkhead trimming locally at the centre top edge and locate the two cables, black and black/white, incorporated in the harness and temporarily secured in a harness clip on the bulkhead.

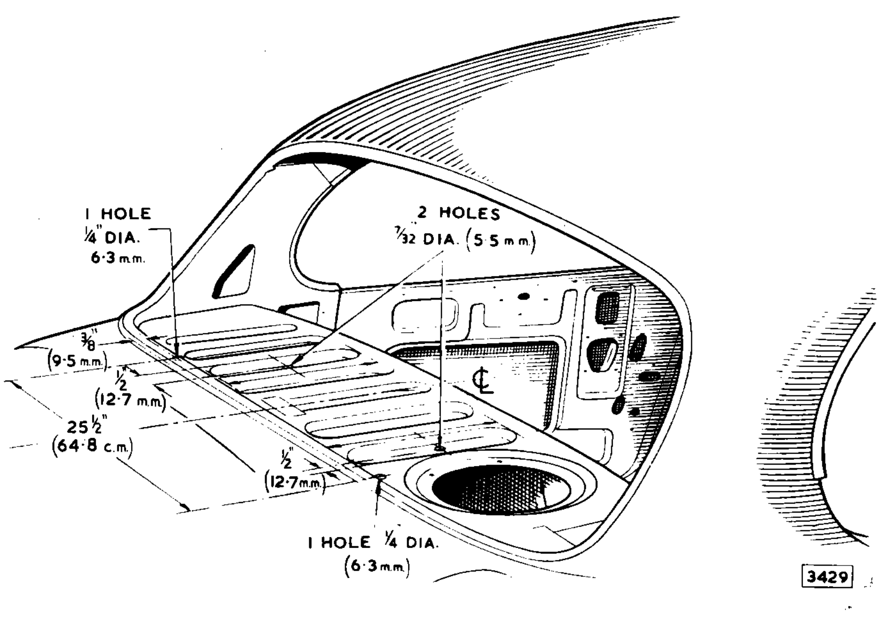


Fig. 70. Drilling instructions for the electrically-heated backlight.

Connect the two cables to the leads from the back light, noting the cable colours.

Clip the cables to the underside of the parcel tray with the two clips provided utilizing the $\frac{7}{32}''$ (5·6 mm.) holes previously drilled.

Refit the parcel tray trim board, squab and seat cushion.

Disconnect the battery.

Remove the picnic tray (see page P.54) and lower the centre instrument panel.

Withdraw the two screws retaining the left-hand fuse blocks in position, insert the fuse carrier clip plate, with attached clip behind the fuse blocks and refit the screws.

Clip in the fuse holder.

Connect the white cable to the vacant A3 terminal on the fuse block along with the existing white cables.

Connect the black/white cable from the fuse holder to the equivalent cable already situated in the existing body harness.

Refit the instrument panel and picnic tray.

Reconnect the battery, switch on the ignition and test through.

FAULT DIAGNOSIS

Check that the fuse has not blown. Replace if necessary by one of the correct value.

Check the back-light element by disconnecting the cable connectors in luggage compartment and reconnecting the back-light cables to a 12 volt battery with a 0–20 moving coil ammeter in series.

If no reading is apparent on the meter replace the back-light glass as detailed in Section N Page N.15 (Body and Exhaust System).

If a reading is shown on the meter check the feed cable connections in the luggage compartment for continuity with a voltmeter. Insert the fuse and switch on the ignition before checking.

RADIO

DESCRIPTION

SMITHS "Radiomobile" radio sets are available in the following models to suit the broadcasting requirements of different countries. Rear extension speakers are also available if required.

920T – Long and Medium wave band

922T – Medium wave band

530TB – Medium and Short wave band

This instruction covers both left and right hand drive cars.

Warning: Before connection to the battery supply is made, it is essential to ensure that the polarity of the receiver is made for "NEGATIVE GROUND".
DAMAGE TO THE TRANSISTORS IS INEVITABLE IF POLARITY IS INCORRECT

The receiver and front loudspeaker are fitted in the console situated centrally below the parcel tray.

The rear loudspeaker is fitted on the right-hand side of the parcel tray.

The aerial is fitted on the **drive side** wing.

AERIAL MOUNTING (AW458/72) (MANUAL DRIVE)

Warning: Where the trimming is retained in position by adhesive, extreme care must be exercised when breaking the adhesive bond.

Disconnect battery.

Place front seats in extreme rear position and remove seat cushions.

Remove 3 PK screws securing the drive side scuttle casing. Ensuring not to break the adhesive bond securing the casing to the "A" post, position casing to allow access to the inner scuttle panel.

With extreme care, break the adhesive bond securing hardura trim to the inner scuttle panel. Locate pre-pierced cut-out in felt on inner scuttle panel and remove, exposing the metal cover plate. Remove cover plate secured by one 10 UNF and two PK screws.

Remove the 10 UNF screw at rear of exposed aperture in inner scuttle.

Mark and drill $\frac{7}{8}''$ dia. hole to dimensions, as shown in Fig. 71.

Dismantle aerial, as shown in Figs. 72 and 73.

Note: Care must be taken to avoid damage to the nylon drive cable or allow it to become coated with foreign matter.

Pass aerial through shaped hole in inner scuttle panel. See Fig.73. Assemble aerial to aerial mounting plate as shown in Fig.73.

Secure aerial assembly to inner scuttle using the two 10 UNF screws previously removed.

Note: When securing the aerial assembly into car, it is important to ensure that the seal washer is positioned as shown in Fig.73 and also that the top of the aerial screen tube passes through the aperture in the screening plate at the top of the wing valance, as shown in Fig.71. It is also necessary to keep all car electrical wiring as far away as possible from the area of this screening plate.

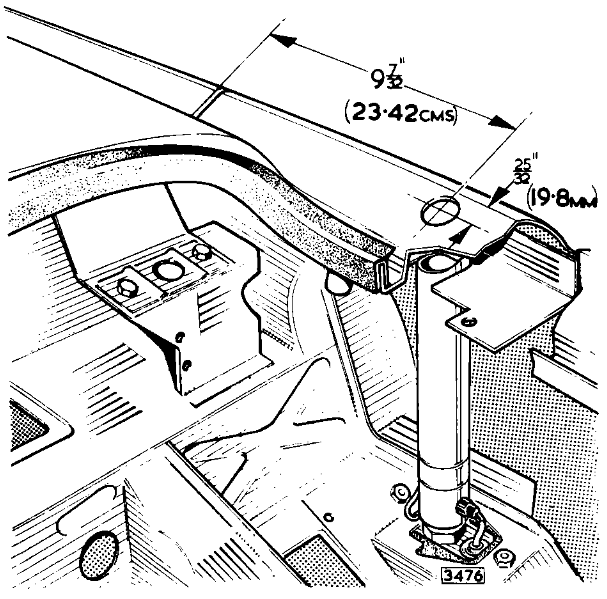


Fig. 71. Drilling instructions for aerial.

Secure winder box mechanism to inner scuttle panel with PK screws provided, as shown in Fig.74.

Note: It will be found necessary to remove the felt in the area of the winder mechanism and to channel the felt on the under side of the inner scuttle to obtain a maximum circular sweep for the drive cable. Sharp bends must be avoided.

Secure drive and reservoir cables at the rear of the inner scuttle panel with clip provided and route cables as shown in Fig.74. It is important to ensure hat the cables do not foul the car controls.

Route aerials lead to receiver location. Replace all trim, cutting a suitable hole in the hardura to accept the boss of the aerial winder mechanism.

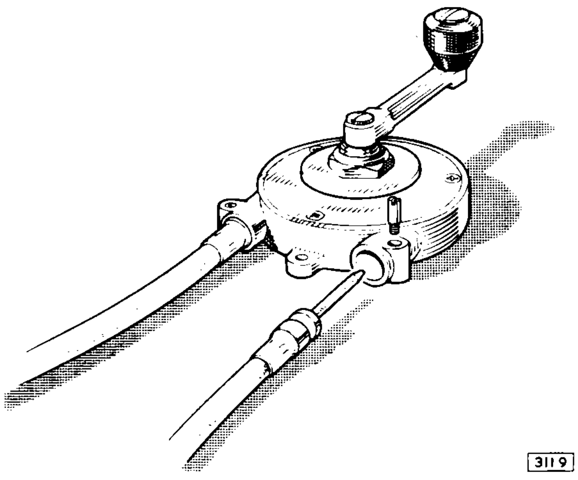


Fig. 72. Aerial winder mechanism—showing the cable sleeve and drive withdrawn.

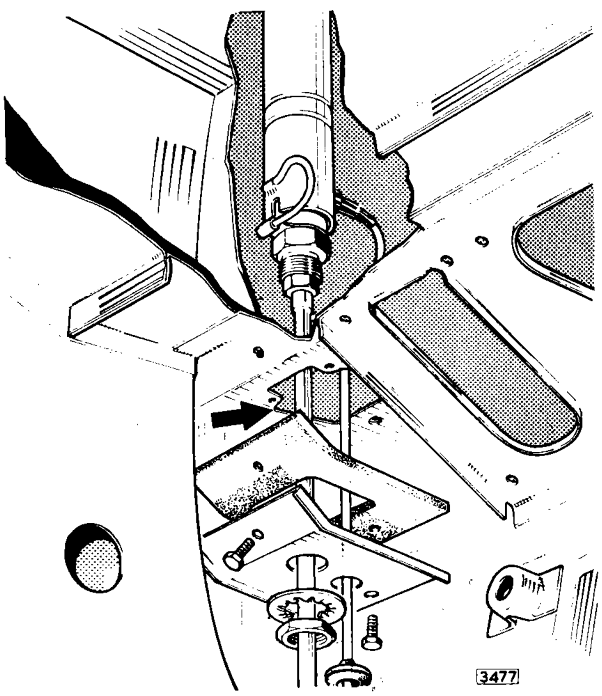


Fig. 73. Fitting the aerial—the arrow indicates the shaped hole in the inner scuttle panel.

AERIAL MOUNTING (AW475/72) (MOTOR DRIVE)

Proceed as aerial mounting procedure for AW458/72.

Drill three $\frac{7}{8}$" dia. holes in floor cross member on **drive side,** as shown in Fig.75, taking care not to damage the trim. Insert grommets provided in the positions shown.

Assemble screws to motor mounting bracket as shown in Fig.76 and 77. Secure mounting bracket to floor of car and door sill using fixings provided.

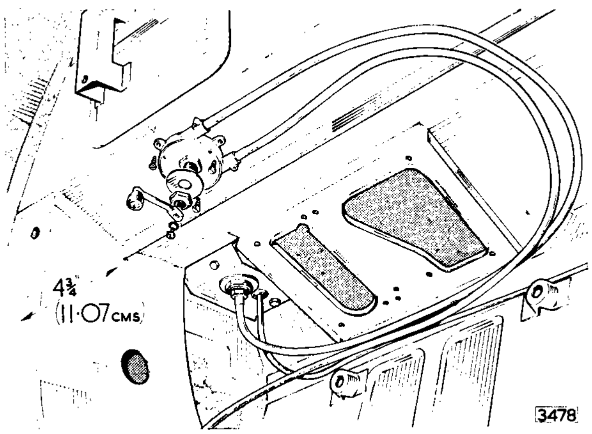


Fig. 74. Mounting position and cable run for hand operated aerial.

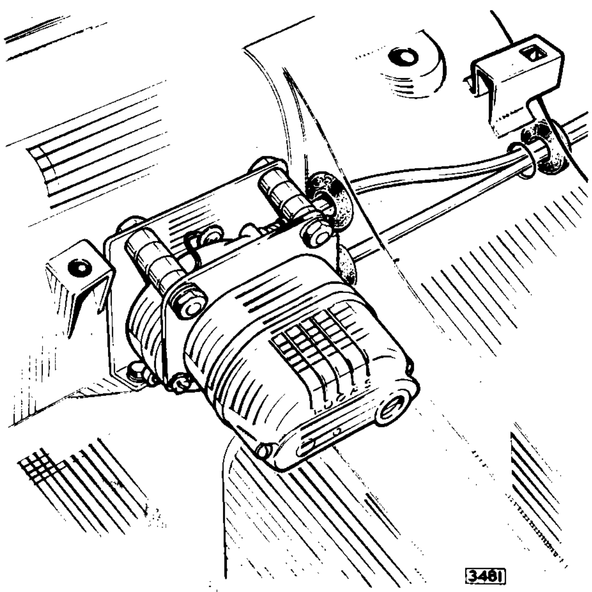


Fig. 75. Mounting position and cable run for the electrically operated aerial (L.H. Drive).

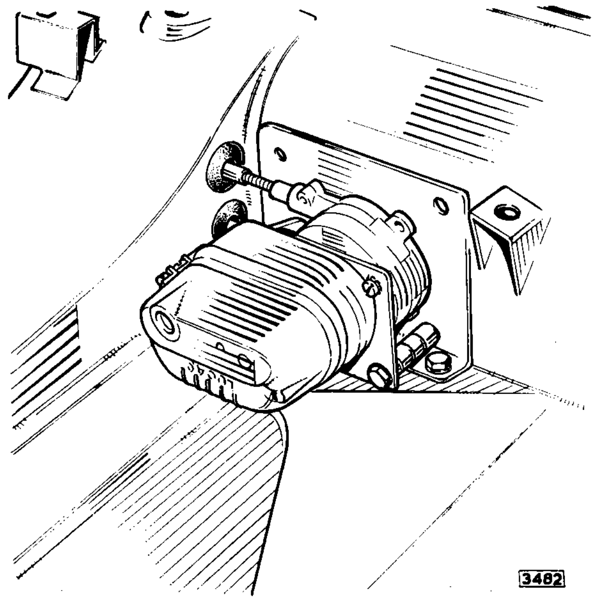


Fig. 76. Mounting position of the electrically operated aerial (R.H. Drive).

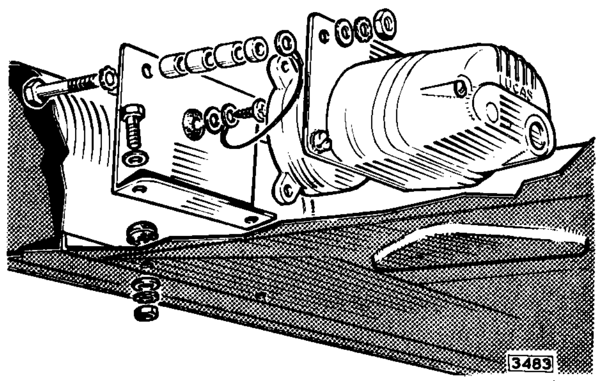


Fig. 77. Mounting bracket (R.H. Drive).

Note: All felt must be removed under the aerial motor mounting bracket and aerial motor, to allow the motor to be as low as possible under the drive side front seat.

Route drive and reservoir cables under the felt and carpet. Connect motor loom assembly to motor and re-connect the drive cable to aerial motor drive box. Secure motor to the mounting bracket, as shown in Figs. 76 and 77.

Route loom assembly to cover plate under steering column. Mount aerial motor switch in convenient position on cover plate.

Connect fused lead of supply loom to A2 on fuse box behind central instrument panel.

Route aerial lead to receiver location and replace the trim with suitable adhesive.

RADIO UNIT AND FRONT LOUDSPEAKER MOUNTING

Disconnect the battery.

Remove the transmission tunnel cover and console as detailed in Section N—Body and Exhaust System—Page N.25.

Fit short loudspeaker lead to $6\frac{1}{2}''$ round loudspeaker.

Secure loudspeaker to console as shown in Fig.77, positioning card ring provided between inside face of console and the loudspeaker.

Note: Excess studding securing the loudspeaker bezel and grille must be cut flush with the securing nuts, otherwise the excess studding will penetrate the loudspeaker cone.

Remove blanking panel covering left-hand side loudspeaker bezel and grille.

Note: The removal of this blanking plate ensures maximum venting for the front loudspeaker.

Remove trimmed escutcheon secured by wood screws behind wooden facia. Discard grille and remove excess material covering scale aperture and holes in escutcheon. Replace escutcheon.

On some early model radio sets replace the escutcheon with the one supplied in the kit.

Attach the radio steady brackets to the two studs on the console adjacent to the ashtray carrier.

Withdraw the two control knobs and assemble the radio unit to the panel as shown.

Connect fuse lead to spare blade on ammeter. Connect one end of the short suppressed battery lead provided in the suppression parts group, to the battery fly lead from the receiver. Connect other end of the short suppressed battery lead to the fuse lead.

Failure to insert this short suppressed battery lead between the fuse and receiver will possibly give rise to battery lead borne interference.

Note: Access to ammeter is gained by withdrawing the picnic tray and removing two knurled screws at top of the centre instrument panel and lowering it to its fullest extent. The fuse holder is intended to be situated in this area.

Connect loudspeaker lead to loudspeaker socket of receiver.

Connect insulated bond to receiver using rear fixings on underside of receiver.

Connect aerial lead to receiver.

Locate rear loudspeaker lead already provided in car and identified by white clear plastic covering, and connect loudspeaker leads for "balance control condition" to three way terminal block, as shown on label attached to balance control. (When rear speaker is fitted).

Re-connect battery ensuring that there is no electrical short circuit.

Switch on receiver and tune to a weak signal on 1200 Kc./s. (approx. 250 metres) and adjust aerial trimmer for maximum volume.

Replace console unit, securing insulated bond provided under one of the front thumb nut fixings.

Drill $\frac{3}{8}''$ dia. hole in convenient position in cover plate under steering column in glove tray. Secure the balance control to cover plate, route the leads to receiver location (Rear speaker installation only).

Note: It is important that the area underneath and behind the heat sink is well ventilated. Sufficient felt should be removed in the area to achieve this condition.

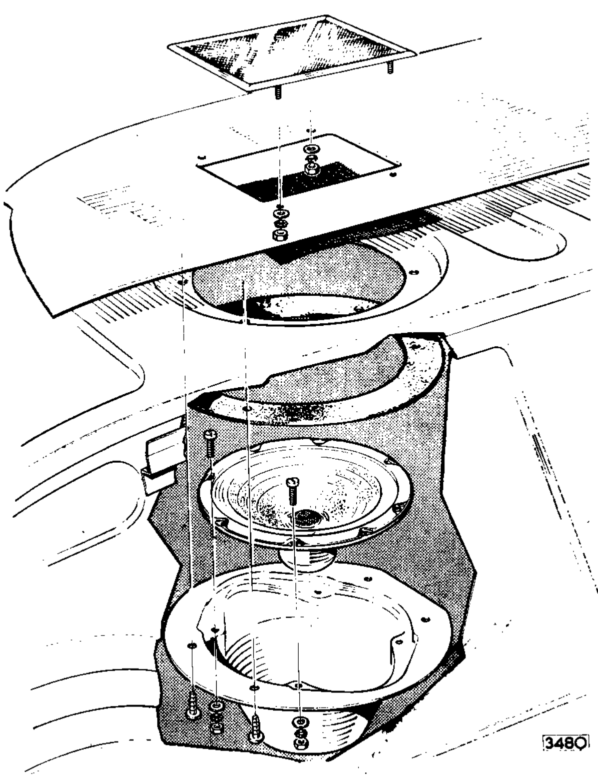


Fig. 78. Fitting the front speaker.

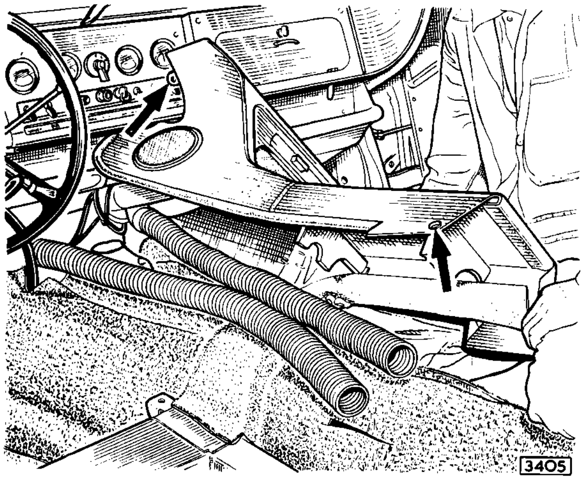


Fig. 79. The removal of the console.

SUPPRESSION

It is important to scrape to bare metal all points at which an earth connection is made.

Connect a 1 mfd. suppressor capacitor to the "SW" terminal on the coil. Secure capacitor mounting clip under coil bracket mounting bolt.

Connect a 1 mfd. suppressor capacitor to the output terminal of the alternator. Secure capacitor mounting clip under alternator fixing bolt.

Connect a 0·25 mfd. suppressor capacitor to the oil gauge transmitter. Secure capacitor mounting clip under suitable sump bolt ensuring that the bolt is re-tightened securely.

Connect a 1 mfd. suppressor capacitor to the battery feed connection of each petrol pump. Secure capacitor mounting clip to boot lid hinge support bracket using fixings provided.

Note: It will be necessary to drill a $\frac{7}{32}$" (5·5 mm.) dia. hole in each boot lid hinge support bracket below the grommet routing battery feed leads to the petrol pumps for the suppressor fixing screws.

Connect a 1 mfd. suppressor capacitor to the purple lead connections on No. 7 fuse situated at the rear of the centre instrument panel compartment Secure capacitor mounting clip under adjacent bolt in facia support bracket.

ADDITIONAL SUPPRESSOR (For 530 T MODEL)

It is important to scrape to bare metal all points at which an earth connection is made.

Connect a 1 mfd. suppressor capacitor to the "D" terminal on the voltage regulator. Secure mounting clip of capacitor under regulator fixing bolt.

Connect a 1 mfd. capacitor to battery feed at clock using two-way connector provided. Earth the capacitor mounting clip under the top screw securing side facia to centre instrument panel bracket. Access to this screw is obtained by lowering the centre instrument panel. The capacitor is installed with fly lead uppermost to ensure that clearance exists between the instrument panel and capacitor when the panel is in the closed position.

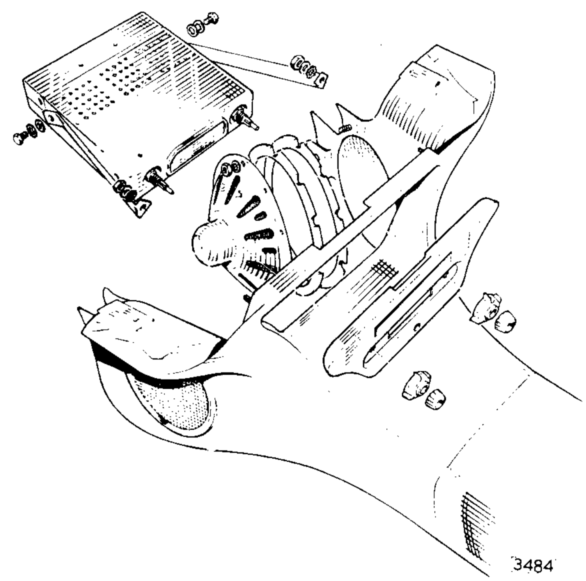


Fig. 80. Fitting the radio and speaker.

REAR SPEAKER MOUNTING

Disconnect the battery.

Remove rear seat cushion.

Remove two screws retaining the attached brackets at the bottom of the rear seat squab.

Remove the squab in an upward and forward direction disengaging from the retaining clips attached to the front edge of the parcel shelf.

Lift the rear parcel tray trimming where secured by solution to the rear squab panel and remove the two drive screws now exposed securing the trim board. Pull the board away from the retaining clips at the rear edge.

Remove the semi-pierced portion in the trim board, carefully slit the trimming and fold back around the square hole.

Refit trim board, rear squab and cushion.

From inside the luggage compartment remove the housing and seal washer secured to underside of parcel tray.

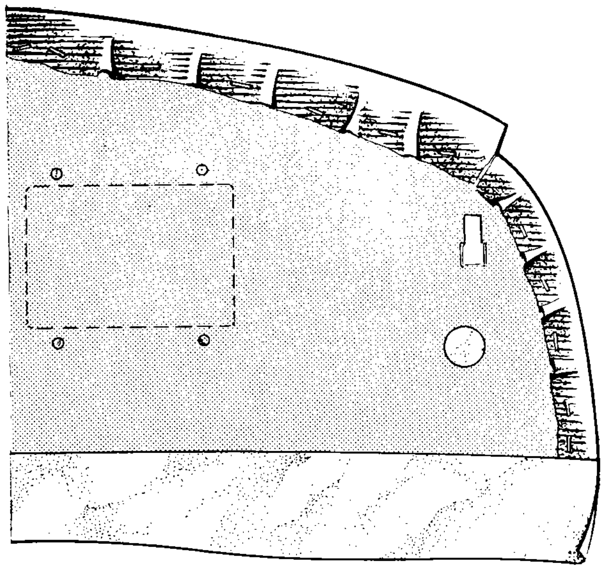


Fig. 81. The rear speaker aperture in the rear parcel tray

Connect the loudspeaker lead to the loudspeaker and secure the speaker to the housing with the screws provided.

Refit the bezel to the parcel tray.

Refit the speaker housing.

Locate the clear plastic covered flex in the loom in the luggage compartment and connect to the speaker lead with the two-way terminal block provided.

Connect balance control as follows:—

Remove existing lead from receiver to front loudspeaker and connect new lead terminated with two-pin plug to appropriate socket in receiver.

Connect the twin clear plastic lead from rear speaker, located behind facia panel, and connect to points "B" and "C" on the terminal block of the balance control assembly

Connect the front loudspeaker lead to points "A" and "B" on the terminal block of the balance control.

Connect the speaker lead from receiver to points "A" and "C" on the terminal block.

Fix the balance control as detailed on page P.81.
Re-connect battery.

THE STEERING COLUMN LOCK

DESCRIPTION

A "WASO-WERKEN" combined ignition switch/steering column lock is available as an optional extra for the 4·2 Mark 10 model and replaces the normal ignition switch in the instrument panel.

The switch/lock unit is mounted on an extension arm attached to the steering column, below the steering wheel and has three operative positions—Drive, Garage and Stop as listed below; the fourth position "Start" not being used.

The normal ignition, which becomes inoperative, is retained in the instrument panel.

OPERATION OF SWITCH

(1) Drive

This is the normal driving position. The key cannot be withdrawn in this position and the ignition is "ON".

(2) Garage

This is the normal stop position. The key can be withdrawn leaving the car capable of being steered with the ignition "OFF".

(3) Stop

This is the locked stop position. The key can be removed leaving the steering locked and the ignition "OFF"

To unlock the steering, insert the key in the lock and turn to Garage or Drive position.

FITTING THE STEERING COLUMN LOCK

The normal ignition switch, which becomes inoperative also functions as a field isolation switch. Modifications are therefore necesssary to the wiring system to the alternator and the 4TR control unit and includes the fitting of a Lucas 6RA relay.

(a) Disconnect the battery.
(b) Remove the console from the gearbox tunnel.
(c) Remove the picnic tray and lower the instrument panel. Detach the flasher unit from the tray mounting.
(d) Remove the small screws retaining the four temperature control knobs to the levers and withdraw the knobs.

Remove the two self-locking nuts retaining the temperature control levers to the pivots located under the parcel tray and withdraw the levers. Note the location of the pivot bushes and washers for reference when refitting.
Remove the two setscrews and nuts securing the heater control unit to the mounting brackets and withdraw the unit from the parcel tray surround.
Remove the six drive screws securing the parcel tray to the bulkhead, two central and two at each outer edge and withdraw the parcel tray.

(e) **(Automatic Transmission Cars Only)**
Disconnect the cables from the flashing indicator switch, illuminated indicator nacelle and the inhibitor switch. Note the location of the cables on the inhibitor switch for reference when refitting.
Remove the steering wheel and upper column.
Remove the selector control rod and mechanism from the upper column to facilitate fitting the lock.
Do **NOT** disturb the position of the inhibitor switch in the clamp ring.

(f) **Standard and Overdrive Transmission Cars**
Do not remove the steering cloumn. The lock can be fitted after the removal of the parcel tray.
(g) Fit the lock to the steering column, but do not tighten the clamp bolts.
Check that the switch/lock assembly is correctly aligned in the lower cover cut-out. Insert the key and turn to the Stop position. Remove the key and check that the lock bolt is entering the register holes in the outer and inner columns and the steering is locked.
Tighten the clamp bolts evenly until the heads shear off.

Note the location of the terminals on the lock switch before fitting for reference when connecting the cables.

Important: IT IS IMPORTANT THAT THE CORRECT OPERATION OF THE LOCK IS ENSURED BEFORE THE CLAMP BOLTS ARE FULLY TIGHTENED.
AFTER THE HEADS OF THE BOLTS HAVE BEEN SHEARED OFF THE LOCK CANNOT BE REMOVED.

(h) Refit the steering wheel and upper column (Automatic Transmission cars only).

Modify the wiring as follows:
Disconnect the brown/purple, brown/white and brown/red cables from the ignition switch and tape into the harness.
Disconnect the brown/red and brown/white cables, feeding the ignition switch, from the ammeter and tape into the harness.
Disconnect the brown/purple cable from the alternator and tape into the harness.
Detach the plug socket from the 4TR control unit and withdraw the brown and purple cable in the harness.

(i) Remove the two small rubber plugs from the radiator left-hand closing panel and fit the 6RA relay (C24158). Mount the relay on the two distance pieces with the terminals at the bottom.

(j) Tape the steering lock connector harness (C24160) into the panel harness. Connect the single white cable to the A3 (white) side of the ignition controlled fuse (No.3).
Connect the single brown/white cable to the ammeter.

Connect the white and brown/white cables at the junction to the steering column lock switch. Connect the white cable to terminal No. 15 and the brown/white cable to terminal No. 30.
(k) Tape the relay harness (C25621) into the forward harness over the left-hand wing valance.

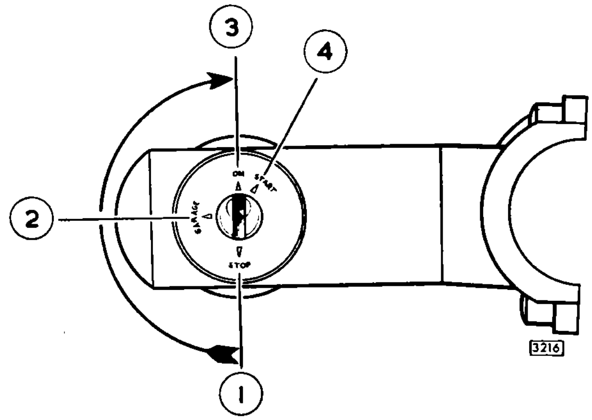
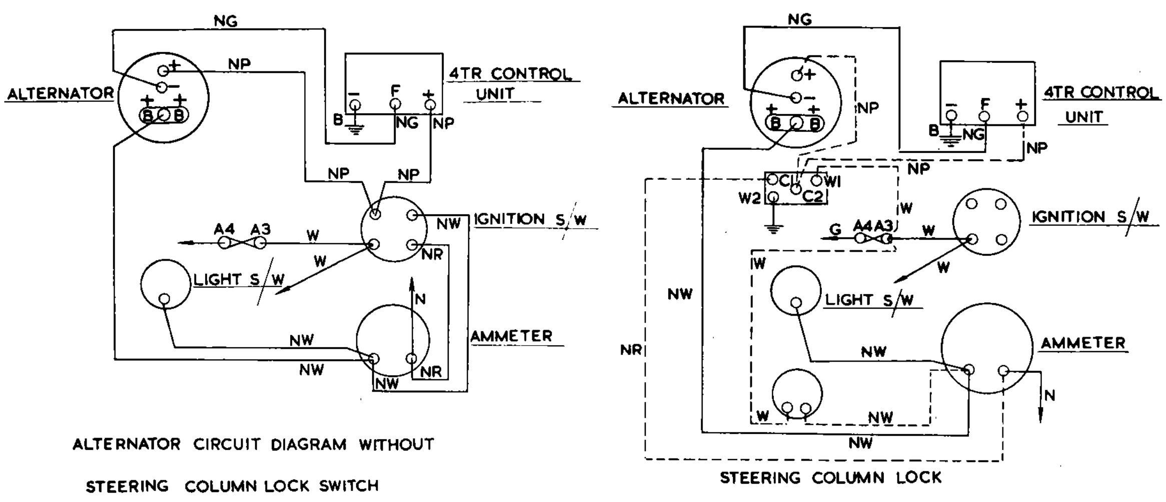


Fig. 82. The switch positions (steering column lock).

1. Stop
2. Garage
3. On
4. Start



CABLE	COLOUR CHART
N	BROWN
R	RED
G	GREEN
W	WHITE
P	PURPLE
B	BLACK

Fig. 83. The circuit diagrams (steering column lock).

(l) Feed the white and brown/red harness junction through the main harness grommet and connect the white cable to the ignition controlled fuse (3).

(m) Connect the brown/red cable with eyelet to the ammeter in conjunction with the brown cable.

(n) Connect the long brown/purple cable to the vacant terminal marked (+) on the alternator.

(o) Insert the short brown/purple cable into the control unit plug socket, replacing the cable previously removed and reconnect the socket.

(p) Connect the cables to the relay as follows:—

Brown/red to terminal	— C.1
Brown/purple to terminal	— C.2
White to terminal	— W.1
Black to terminal	— W.2

Black with eyelet to earth

Refit instrument panel, reconnect battery and test through.

(q) Refit parcel tray, temperature controls, heater control unit and flasher unit by reversing the removal procedure.

Before refitting the parcel tray modify as follows:—

Left-hand drive cars

Remove and discard the small square trimmed panel attached by three drive screws to the left-hand side of the steering column aperture cover.

Right-hand drive cars

Remove and discard the small curved trimmed panel attached by three drive screws to the left-hand side of the steering column aperture cover.

(r) Refit the console to the gearbox tunnel by reversing the removal procedure.

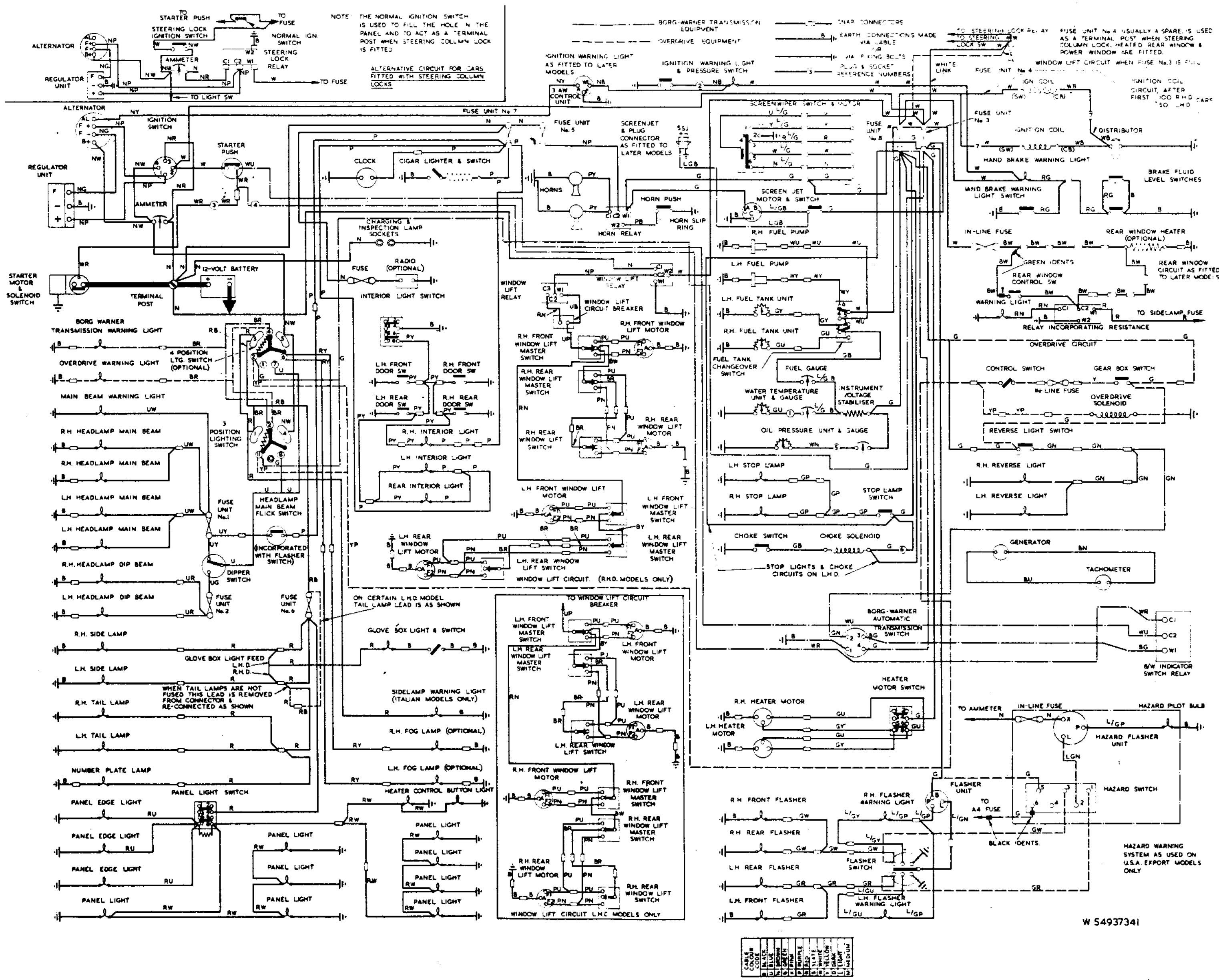


Fig. 84. Wiring diagram.

SUPPLEMENTARY INFORMATION

FOR

420 G CARS

This supplement covers the principal variations between 4·2 Litre Mark 10 and 420 G cars and includes main modifications introduced since the inception of the 420 G. Introductory chassis or engine numbers are quoted where applicable. The supplement should be inserted at the back of the 4·2 Mark 10 Service Manual (Publication E.136).

ISSUED BY

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Publication No. E.136A/1

The engine fitted to the JAGUAR 420G differs from its counterpart in the 4·2 Mark 10 in the following respects:

Revolution Counter

The revolution counter generator and drive is deleted from the R.H. side of the cylinder head and the generator is replaced by a blanking plate retained by two hexagon-headed setscrews.

Camshaft Covers

The camshaft covers have been re-designed and are now of a fluted pattern. Removal and refitting details remain the same.

Engine Mountings

From chassis numbers G1D.54614 (R. H. drive) and G1D.77410 (L. H. drive), the front engine mountings are attached to the front suspension cross member in order to isolate the body from any possible engine vibration.

The mountings are fixed to the cross member via brackets on the steering unit mounting bolts on one side and the idler unit mounting bolts on the other. The brackets which support the engine on the mountings are attached to the cylinder block by three bolts each side.

The introduction of the revised engine mounting alters the engine removal sequence in the following manner.

Proceed as detailed in the 4.2 Mark 10 Service Manual "Engine Removal" section until the engine is ready to be withdrawn from the chassis. On the steering box side of the car, remove the engine bracket completely. This procedure will enable the engine to be moved forward to clear the steering box when the nut securing the engine bracket to the rubber mounting on the idler unit side is removed.

Sump Removal

On cars with the engine mountings attached to the front suspension cross member, sump removal is as detailed in the 4·2 Mark 10 Service Manual. However, it must be noted that to withdraw the front suspension from the car, the bonnet must be removed and the engine slung on lifting tackle.

Inlet Valve Guides

Commencing at engine number 7D.55850, oil seals are fitted in a groove machined in the top of the inlet valve guide. These seals are effective in reducing the amount of oil which can be drawn down the guide into the combustion chamber.

Removing and replacing inlet valve guides remains unchanged from the details given in the 4·2 Mark 10 Service Manual.

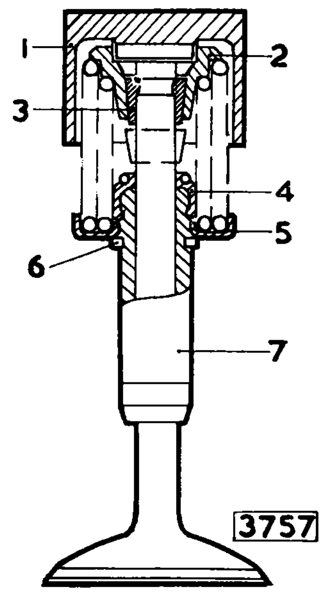


Fig. 1. 1 *Tappet* 2 *Valve collar* 3 *Cotters* 4 *Oil seal* 5 *Spring seat* 6 *Circlip* 7 *Inlet valve guide*

Main Bearing Cap Bolts

From engine number 7D.56172, plain washers replace the lockwashers previously fitted to main bearing cap bolts. The washers are fully interchangeable with their predecessors and the tightening torque remains unchanged at 83 lb. ft. (11·5 kg.m.).

Camshaft Sprocket Adjusting Plates

From engine number 7D.56496, an improved type of camshaft adjusting plate is employed. The new condition incorporates the guide pin, clamping plate and adjusting plate as a complete assembly and is fully interchangeable with the previous type.

Valve timing procedure remains unchanged from that detailed in the 4·2 Mark 10 Service Manual.

Connecting Rod Bearings

Commencing at engine number 7D.56780, the connecting rods are fitted with "eccentric wall" bearings. The **vertical** running clearance should be ·0005"–·0021" (·0127–·0533 mm.).

Petrol Filter

Commencing at chassis number G1D.54614 (R. H. drive) and G1D.77398 (L. H. drive), the petrol feed line filter unit, mounted in the engine compartment, incorporates a renewable fibre filter element in place of the filter gauze previously fitted.

The new type of element must not be cleaned but must be renewed at the Routine Maintenance period stated below.

ROUTINE MAINTENANCE

Every 6,000 Miles (10,000 Km.)

Remove the filter bowl; wash in petrol and refit.

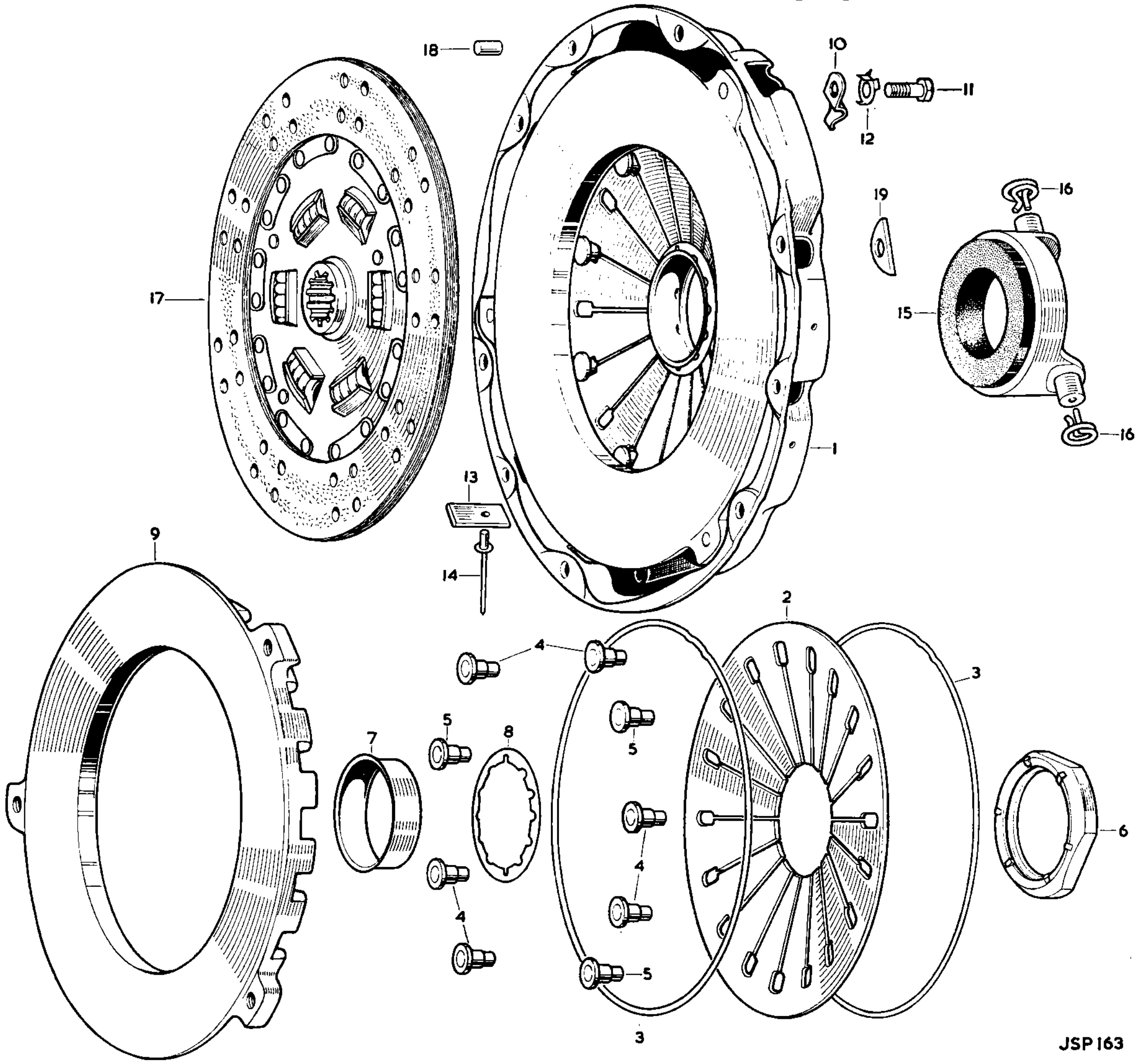
Examine the sealing washer and, if necessary, renew.

Every 12,000 Miles (20,000 Km.)

Remove the filter bowl; withdraw and discard the element. Check the condition of element and filter sealing washers and renew if necessary, fit new element, and reassemble.

Note: The filter element should be changed more frequently and the bowl washed out if sediment build-up is excessive due to poor petrol storage conditions.

Commencing at engine number 7D.56496, a Borg and Beck diaphragm spring clutch is fitted to 420 G cars.



1	Clutch cover	**8**	Belleville washer	**14**	Pop rivet
2	Diaphragm spring	**9**	Pressure plate	**15**	Release bearing
3	Fulcrum ring	**10**	Clip	**16**	Retainer
4	Rivet	**11**	Bolt	**17**	Driven plate
5	Rivet	**12**	Tab washer	**18**	Dowel
6	Release plate	**13**	Balance weight	**19**	Balance weight
7	Sleeve				

Fig. 1. *Exploded view of the diaphragm spring clutch*

SERVICING

The Borg and Beck diaphragm spring clutch is serviced in the U.K. ONLY by fitting an exchange unit which is available from the Works, Spares Division, Coventry. Individual parts are available from the same source for the repair of this clutch in Overseas Markets where exchange units may not be readily available. IT IS ESSENTIAL when overhauling the diaphragm spring clutch, to rigidly observe the service instructions detailed below and particular attention is drawn to the necessary special tools required.

GENERAL INSTRUCTIONS

To enable the balance of the assembly to be preserved after dismantling, there are corresponding paint marks on the cover plate and driving plate. In addition, there are corresponding reference numbers stamped in the flanges of the cover and driving plate.

When reassembling ensure that the markings coincide, and that, when refitting the clutch to the flywheel, the letter "B" stamped adjacent to one of the dowel holes coincides with the "B" stamped on the edge of the flywheel.

The clutch is balanced in conjunction with the flywheel by means of loose balance pieces which are fitted under the appropriate securing bolt. Each balance piece must be refitted in its original position, the number stamped on the balance weight corresponding to the number stamped on the cover plate. There are three balance weights stamped 1, 2 and 3, the weight stamped 3 being the heaviest.

If the graphite release bearing ring is badly worn it should be replaced by a complete bearing assembly.

CLUTCH REMOVAL

In order to remove the clutch, the engine and gearbox must first be removed.

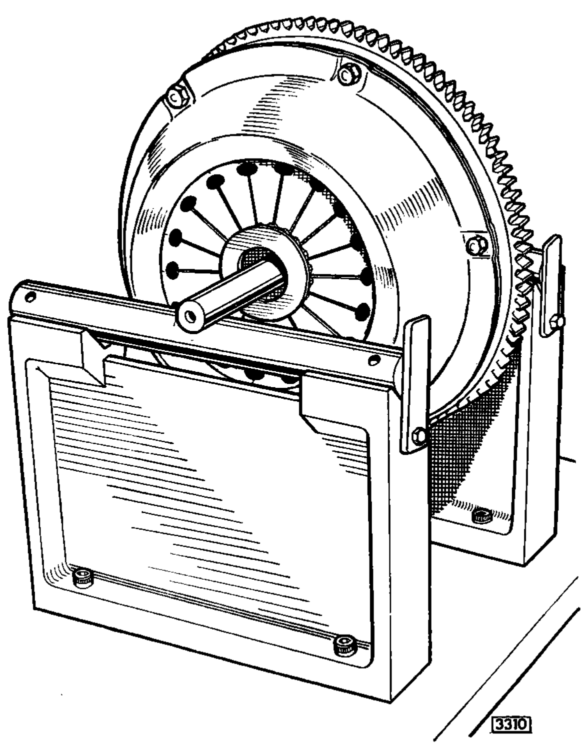


Fig. 2. *Clutch and flywheel balancing*

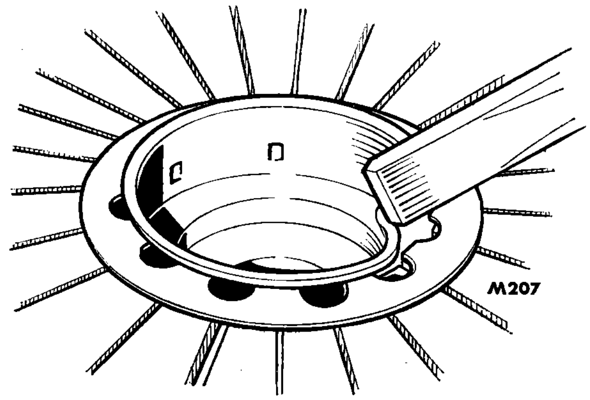


Fig. 3. *Collapsing the centre sleeve with a hammer and chisel*

Remove gearbox and clutch housing from engine.

Remove the bolts securing the clutch to the flywheel and withdraw the clutch assembly.

Retain any balance weight fitted.

DISMANTLING

Removing Release Plate

The centrally mounted release plate is held in position by a small centre sleeve which passes through the diaphragm spring and belleville washer into the release plate.

To free the plate, collapse the centre sleeve with a hammer and chisel. To avoid any possible damage whilst carrying out this operation, support the release plate in the locating boss of the special tool which should be held firmly in a vice.

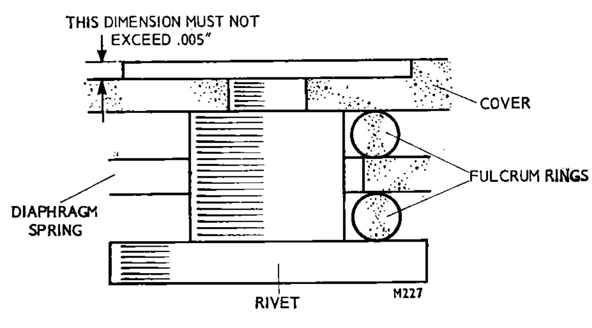


Fig. 4. *Do not reduce the thickness of the cover pressing in excess of ·005" (·127 mm.).*

Separating the Pressure Plate from Cover Pressing

Knock back the locking tabs and remove the three setscrews securing the pressure plate to the straps riveted to the cover pressing. These straps within the cover pressing must NOT be detached as this is an assembly reduced to its minimum as a spare part.

Dismantling the Cover Assembly

Remove the rivets securing the diaphragm spring and fulcrum rings by machining the shank of the rivets using a spot face cutter.

IT IS ESSENTIAL that the thickness of the cover is not reduced in excess of ·005″ (·127 mm.) at any point. The remaining portions of the rivets may be removed with a standard pin punch.

REBUILDING

The Cover Assembly

Prior to rebuilding, check the cover pressing for distortion. Bolt the cover firmly to a **flat** surface plate and check that a measurement taken at

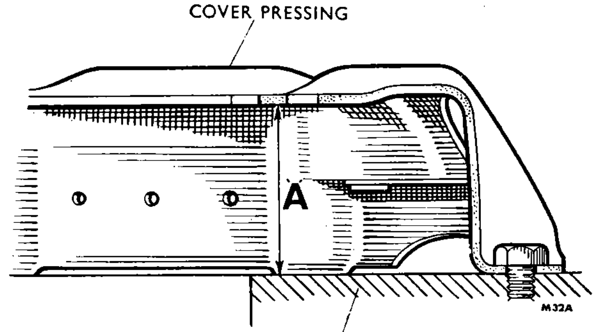
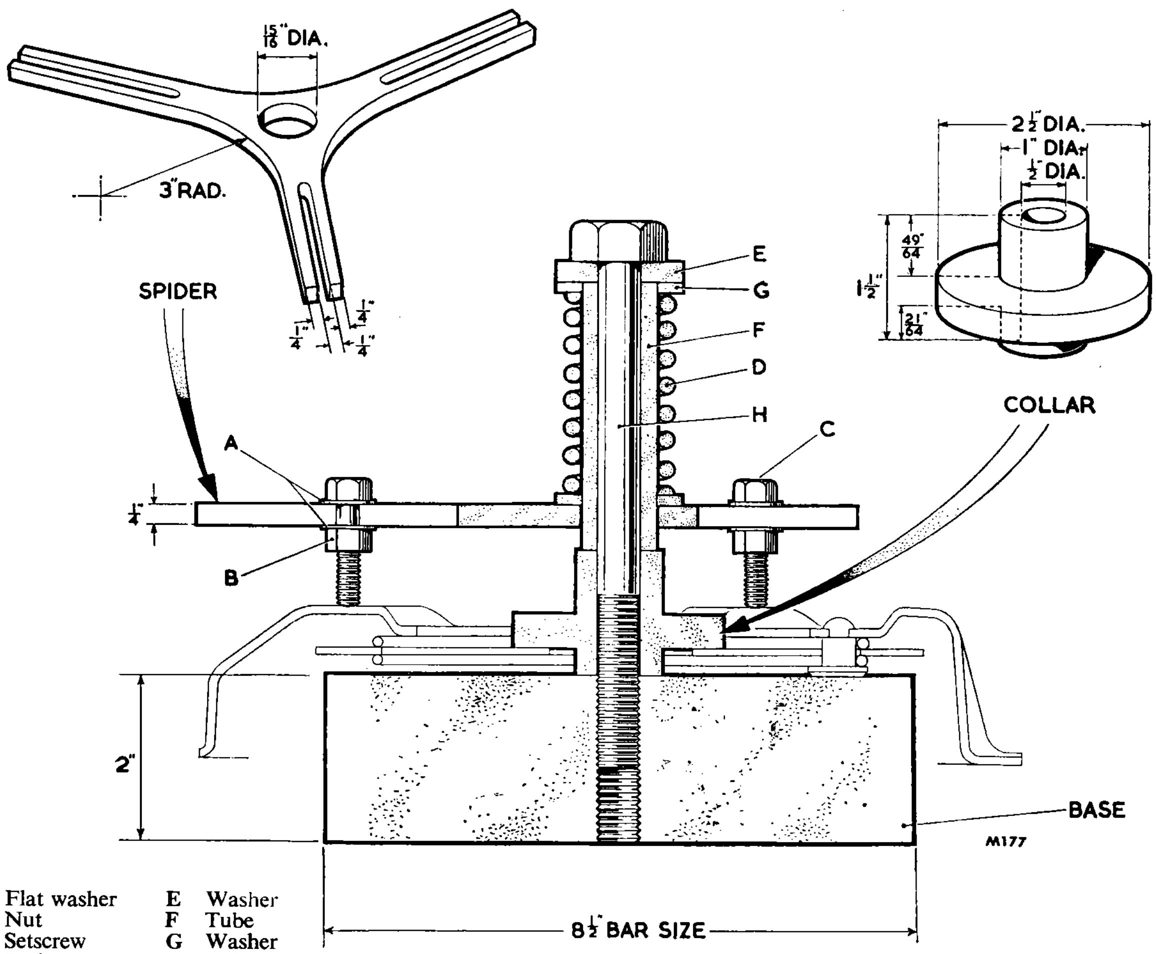


Fig. 5. *The measurement "A" must not vary by more than ·007″ (·2 mm.).*



A	Flat washer	**E**	Washer
B	Nut	**F**	Tube
C	Setscrew	**G**	Washer
D	Spring	**H**	Bolt

Fig. 6. *Dimension of special tool for compressing the diaphragm spring when rivetting the spring to cover pressing.*

various points from the cover flange to the machined land inside the cover pressing do not vary by more than ·007″ (·2 mm.). If the measurement exceeds this figure the cover must be replaced.

To achieve a satisfactory result when riveting the diaphragm spring into the cover pressing, a special tool must be fabricated to the specifications given in Fig. 6.

All parts except the spring can be made from mild steel. Position the fulcrum ring inside the cover pressing so that the location notches in the fulcrum ring engage a depression between two of the larger diameter holes in the cover pressing.

Place the diaphragm spring on the fulcrum ring inside the cover and line the long slots in the spring with the small holes in the cover pressing. Locate a further fulcrum ring on the diaphragm spring so that the location notches are diametrically opposite the location notches in the first ring. Fit new shouldered rivets, ensuring that the shouldered portion of each seats on the machined land inside the cover.

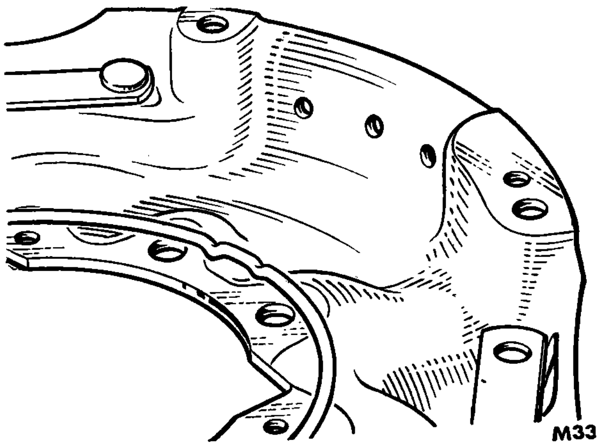


Fig. 7. *Assembly of cover pressing and fulcrum ring*

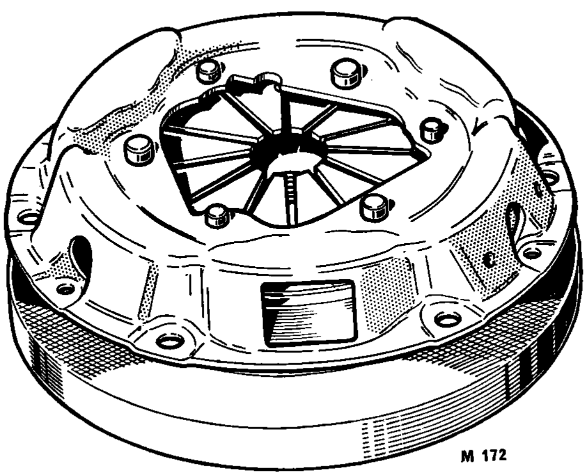


Fig. 8. *Clutch and base plate inverted*

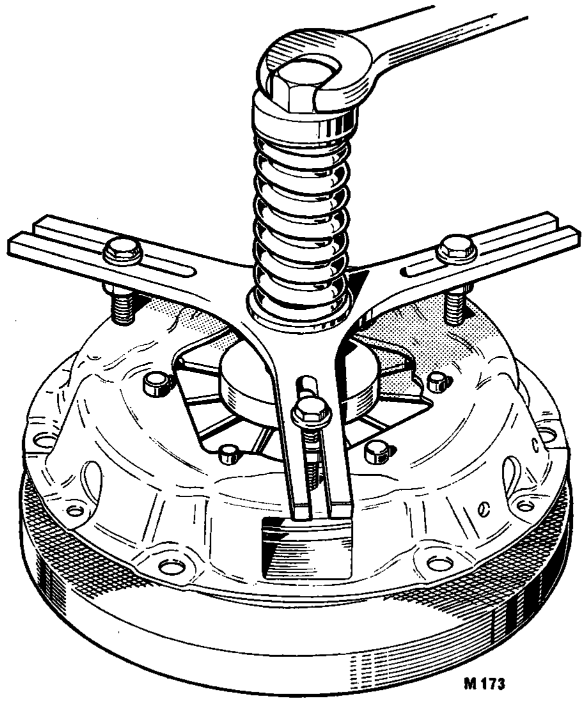


Fig. 9. *Tighten down the large nut so that the diaphragm spring is compressed flat*

Place the base of the special tool on to the rivet heads. Invert the clutch and base plate.

Fit the collar to the large bolt and fit the large bolt complete with spring, spider and collar into the

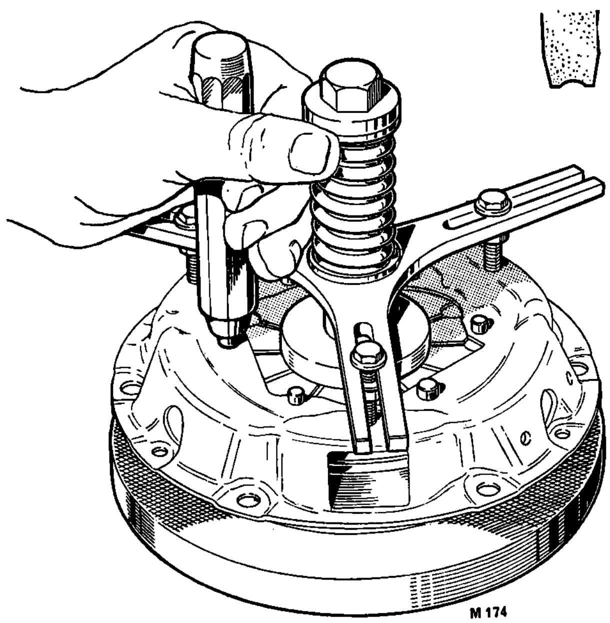


Fig. 10. *Rivetting with a hand punch*

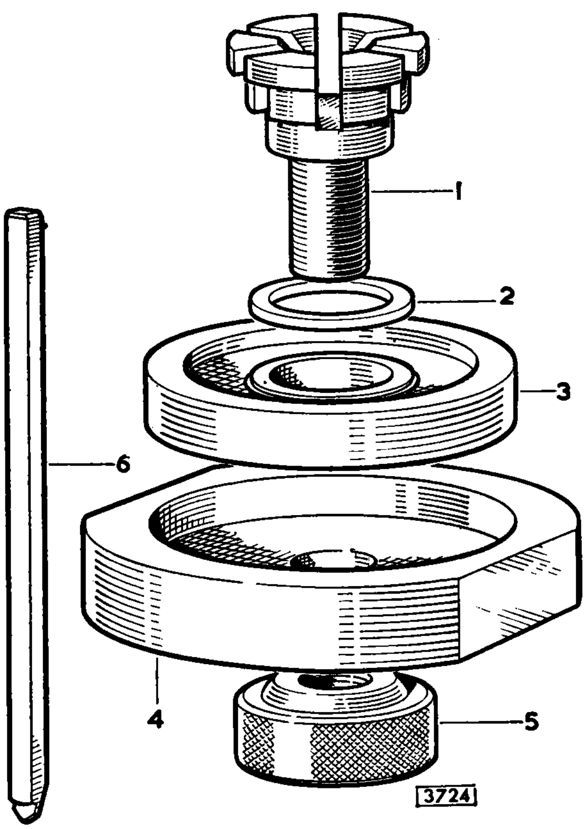
tapped hole in the base. Position the three setscrews on the spider so that they contact the cover pressing. Tighten down the centre bolt until the diaphragm spring becomes flat and the cover pressing is held firmly by the setscrews.

Rivet securely with a hand punch.

Assembling the Pressure Plate to Cover Pressing

Before assembling the pressure plate to the cover pressing, examine the plate for any signs of wear. Should it have been damaged or have excessive scoring, it is strongly recommended that a new plate is fitted. If, however, renewal of the pressure plate is not possible, grinding of the original unit may be undertaken by a competent machinist, bearing in mind that incorrect grinding of the plate may seriously affect the operation of the clutch. IN NO CIRCUMSTANCES MUST THE PRESSURE PLATE BE GROUND TO A THICKNESS OF LESS THAN 1·070" (27·178 mm.).

Position the pressure plate inside the cover assembly so that the lugs on the plate engage the slots in the cover pressing. Insert the three setscrews through the straps which are rivetted to the cover pressing and lock with the tab washers.



1 Staking guide
2 Washer
3 Locating base
4 Base plate
5 Knurled nut
6 Punch

Fig. 11. *Special Tool (SSC805)*

Fitting a New Release Plate

A special tool (Part number SSC.805) is available from Automotive Products Ltd., Service and Spares Division, Banbury, England, for completion of this operation. Ensure that all parts of the clutch and special tool are clean.

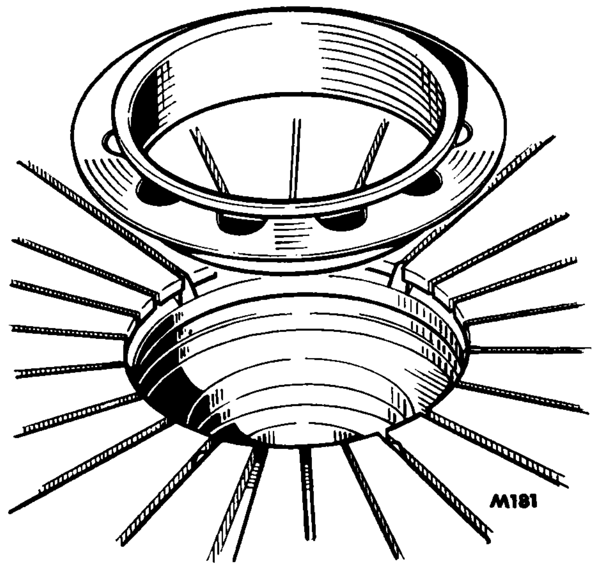


Fig. 12. *Fitting the sleeve and belleville washer*

Grip the base of the tool in a vice and place the locating boss into the counterbore of the base plate. Place the release plate, face downwards, into the counterbore of the locating boss.

Apply a little high melting point grease to the tips of the diaphragm spring fingers and position the clutch, pressure plate friction face upwards, on to the release plate.

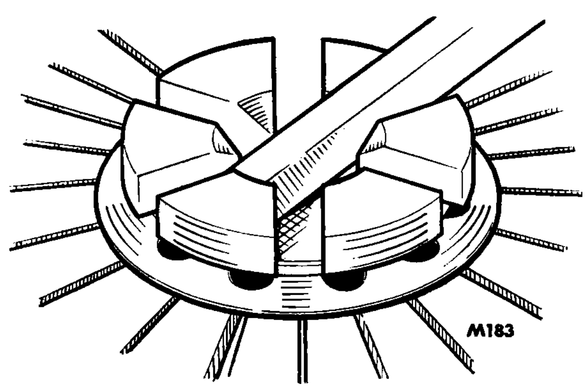


Fig. 13. *Staking the sleeve to the release plate*

Place the belleville washer, concave surface towards the spring, on to the centre of the diaphragm spring and then push the centre sleeve through the spring into the release plate.

Drop the special washer into the sleeve and insert the staking guide into the centre of the assembly. Fit the knurled nut to the thread on the staking guide, tighten down until the whole assembly is solid. Using the special punch, stake the centre sleeve in six places into the groove in the release plate.

REFITTING

Place the driven plate on the flywheel, taking care that the larger part of the splined hub faces the gearbox. Centralize the plate on the flywheel by means of the dummy shaft (a constant pinion shaft may be used for this purpose). Secure the cover assembly with the six setscrews and spring washers, tightening the screws a turn at a time by diagonal selection. Ensure that the "B" stamped adjacent to one of the dowel holes coincides with the "B" stamped on the periphery of the flywheel.

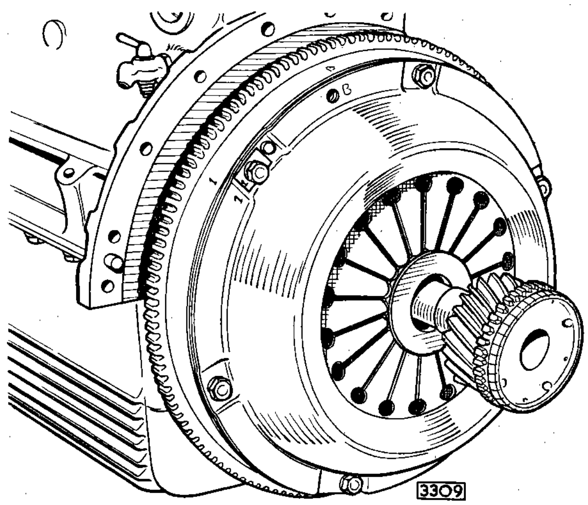


Fig. 14. *Centralising the driven plate on the flywheel by means of a dummy shaft.*

CONDITION OF CLUTCH FACINGS

The possibility of further use of the friction facings of the clutch is sometimes raised, because they have a polished appearance after considerable service. It is natural to assume that a rough surface will give higher frictional value against slipping, but this is not correct. Since the introduction of non-metallic facings of the moulded asbestos type, in service a polished surface is a common experience, but it must not be confused with a glazed surface which is sometimes encountered due to the conditions discussed below.

The ideal smooth or polished condition will provide a normal contact, but a glazed surface may be due to a film or a condition introduced, which entirely alters the frictional value of the facings. These two conditions might be simply illustrated by the comparison between a polished wood and a varnished surface. In the former the contact is still made by the original material whereas, in the latter instance, a film of dried varnish is interposed between the contact surfaces.

The following notes are issued with a view to giving useful information on this subject:—

(a) After the clutch has been in use for some little time under perfect conditions (that is, with the clutch facings working on true and polished or ground surfaces of correct material, without the presence of oil, and with only that amount of slip which the clutch provides for under normal conditions) then the surface of the facings assumes a high polish, through which the grain of the material can be clearly seen. This polished facing is of mid-brown colour and is then in a perfect condition.

(b) Should oil in small quantities gain access to the clutch in such a manner as to come into contact with the facings, it will burn off due to the heat generated by slip which occurs under normal starting conditions. The burning off of the small amount of lubricant has the effect of gradually darkening the facings, but provided the polish on the facings remains such that the grain of the material can be clearly distinguished, it has very little effect on clutch performance.

(c) Should increased quantities of oil or grease obtain access to the facing, one or two conditions, or a combination of the two, may arise, depending upon the nature of oil, etc.
   (i) The oil may burn off and leave on the surface a carbon deposit which assumes a high glaze and causes slip. This is a very definite, though very thin deposit, and in general it hides the grain of the material.
   (ii) The oil may partially burn and leave a resinous deposit on the facings, which frequently produces a fierce clutch, and may also cause a "spinning" clutch due to a tendency of the facings to adhere to the flywheel or pressure plate face.

(iii) There may be a combination of (i) and (ii) conditions which is likely to produce a judder during clutch engagement.

(d) Still greater quantities of oil produces a black soaked appearance to the facings, and the effect may be slip, fierceness, or judder in engagement, etc., according to the conditions. If the conditions under (c) or (d) are experienced, the clutch driven plate should be replaced by one fitted with new facings, the cause of the presence of oil removed and the clutch and flywheel face thoroughly cleaned.

FAULT FINDING

SYMPTOM	CAUSE	REMEDY
Drag or Spin	(a) Oil or grease on the driven plate facings.	Fit new facings or replace plate.
	(b) Misalignment between the engine and splined clutch shaft.	Check over and correct the alignment.
	(c) Air in clutch system.	"Bleed" system. Check all unions and pipes.
	(d) Bad external leak between the clutch master cylinder and the slave cylinder.	Renew pipe and unions.
	(e) Warped or damaged pressure plate or clutch cover.	Renew defective part.
	(f) Driven plate hub binding on splined shaft.	Clean up splines and lubricate with small quantity of high melting point grease.
	(g) Distorted driven plate due to the weight of the gearbox being allowed to hang on clutch plate during assembly.	Fit new driven plate assembly using a jack to take overhanging weight of the gearbox.
	(h) Broken facings of driven plate.	Fit new facings, or replace plate.
	(i) Dirt or foreign matter in the clutch.	Dismantle clutch from flywheel and clean the unit; see that all working parts are free. **Caution:** Never use petrol or paraffin for cleaning out clutch.
Fierceness or Snatch	(a) Oil or grease on driven plate facings.	Fit new facings and ensure isolation of clutch from possible ingress of oil or grease.
	(b) Misalignment.	Check over and correct alignment.
	(c) Worn out driven plate facings.	Fit new facings or replace plate.
Slip	(a) Oil or grease on driven plate facings.	Fit new facings and eliminate cause.
	(b) Seized piston in clutch slave cylinder.	Renew parts as necessary.
	(c) Master cylinder piston sticking.	Free off piston.
Judder	(a) Oil, grease or foreign matter on driven plate facings.	Fit new facings or driven plate.
	(b) Misalignment.	Check over and correct alignment.
	(c) Bent splined shaft or buckled driven plate.	Fit new shaft or driven plate assembly.
Rattle	(a) Damaged driven plate.	
	(b) Excessive backlash in transmission.	
	(c) Wear in transmission bearings.	Fit new parts as necessary.
	(d) Bent or worn splined shaft.	
	(e) Release bearing loose on throw out fork.	

FAULT FINDING—*continued*

SYMPTOM	CAUSE	REMEDY
Tick or Knock	Hub splines worn due to misalignment.	Check and correct alignment then fit new driven plate.
Fracture of Driven Plate	(a) Misalignment distorts the plate and causes it to break or tear round the hub or at segment necks.	Check and correct alignment and fit new driven plate.
	(b) If the gearbox during assembly be allowed to hang with the shaft in the hub, the driven plate may be distorted, leading to drag, metal fatigue and breakage.	Fit new driven plate assembly and ensure satisfactory re-assembly.
Abnormal Facing Wear	Usually produced by over-loading and by excessive clutch slip when starting.	In the hands of the operator.

Half Shafts

From chassis numbers G1D.54447 (R.H. Drive) and G1D.77353 (L. H. Drive), grease nipples are fitted to the universal joints of the final drive half shafts. Access to these nipples is gained by removing the plastic sealing plug located in each joint cover.

ROUTINE MAINTENANCE

Every 3,000 Miles (5,000 Km.)

Lubricate the half shaft universal joints (4 per car) with the recommended grade of lubricant as shown in the 4·2 Mark 10 Service Manual.

"Powr-Lok" Differential

From chassis numbers G1D.54476 (R. H. Drive) and G1D.77358 (L. H. Drive), the limited slip "Powr-Lok" differential is deleted from the final drive unit of 420G cars in favour of a conventional differential.

Conventional Differential

Routine maintenance, removal, service adjustments and refitting procedures for the final drive with conventional differential are the same as detailed for the unit having the "Powr-Lok" differential. Dismantling and assembling procedures differ and are detailed below.

Dismantling

Bend down the locking tabs of the lock straps and remove the drive gear screws. Withdraw the drive gear from the differential casing by tapping with a rawhide mallet.

Using a small punch, drive out the pinion mate shaft locking pin which is secured by peening over the case, and remove the pinion mate shaft. Fig.1 indicates the direction in which the pin must be driven out: it is not possible to drift out the pin in the opposite direction.

Rotate the side gears by hand until the pinions are opposite the openings in the differential casing; remove the differential gears taking care not to lose the thrust washers fitted behind them.

Assembling

Assemble the side gears with the thrust washers in position. Insert the differential pinions through openings in the casing and mesh them with the side gears. Hold the pinion thrust washers on the spherical faces of the pinions whilst rotating the differential gear assembly into its operating position by hand.

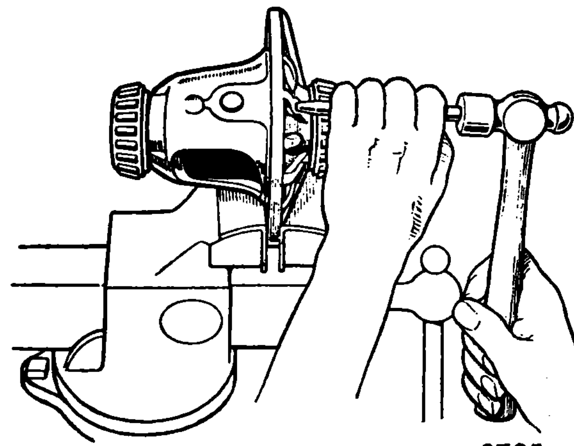


Fig. 1. *Removal of the pinion mate shaft locking pin*

Line up the pinions and thrust washers and install the pinion shaft in position. Line up the cross hole in the shaft with the hole in the differential case and fit the pinion mate shaft locking pin. Using a punch, peen over the metal of the differential casing to prevent the locking pin working loose and causing extensive damage to the assembly.

Clean the drive gear and differential case contacting surfaces and check for burrs. Align the tapped holes in the drive gear with those in the casing and gently tap the gear home with a lead hammer.

Insert the drive gear bolts using new locking straps and tighten the bolts to a torque of 70—80 lb. ft. (9·7—11·1 Kg.m.). Lock with the locking straps.

Steering Box and Idler Assembly

On cars with engine mountings attached to the front suspension cross member, the engine *must* be supported on lifting tackle prior to removal of either the steering box or the idler assembly.

It is important to note any shims at the mountings of the steering idler and to ensure that these are placed in their original position when refitting the idler. Check visually that the centre track rod is parallel to the front suspension cross beam. If the centre track rod is low on the idler side, shim at the **bottom** mounting bolt of the idler to correct this condition.

Steering Box – Centralisation

A centralising washer is fitted to the steering box input shaft, eliminating the need to use a special tool for this operation.

Adjust the position of the steering wheel until the cut-out in the centralising washer aligns with the hole in the steering box. Set the steering wheel to the straight-ahead position. Check by inserting a $\frac{1}{4}''$ (6·4 mm) rod.

NOTE: After completion of the front wheel alignment adjustment, remember to withdraw the centralising rod.

The electrical equipment installed in the JAGUAR 420G differs from that fitted to the 4·2 MARK 10 in the following repsects:

1 — Inclusion of a Lucas 3 AW warning light unit in the alternator circuit.
2 — Addition of two repeater flasher lamps, located on the front wings, in the flashing (turn) indicator circuits.
3 — Transistorised electric clock.
4 — Impulse revolution counter (Tachometer).
5 — Inner Headlamp (sealed beam unit) increased to 50 watts (Home market only).

THE LUCAS WARNING LIGHT CONTROL UNIT
(Model 3 AW)

DESCRIPTION

The Model 3 AW warning light unit is connected to the centre point of one of the pairs of diodes in the alternator and operates in conjunction with the ignition warning light to indicate that the alternator is charging.

The unit is mounted on the radiator closing panel adjacent to the control box, and is similar in appearance to the flasher unit, but has different internal components consisting of an electrolytic (polarised) capacitor, a resistor, and a silicon diode mounted on an insulated base with three "Lucar" terminals.

The unit is sealed, therefore servicing and adjustment is not possible. Faulty units must be replaced.

Note: Due to the external similarity of the 3 AW warning light unit to the flasher unit, a distinctive green label is attached to the aluminium case of the unit.

Checking

Check by substitution after ensuring that the remainder of the charging circuit (including the alternator drive belt) is functioning satisfactorily.

Warning: A faulty diode in the alternator or an intermittent open-circuit in the alternator-to-battery circuit can cause excessive voltage to be applied to the warning light unit. Therefore, to prevent possible damage to a replacement unit, it is important first to check the voltage between the alternator "AL" terminal and earth. With the engine running at 1,500 r.p.m., the voltage should be 7 – 7·5 volts measured on a good quality voltmeter.

If a higher voltage is registered, check that the charging circuit connections are clean and tight, and if necessary check the rectifier diodes before fitting a replacement unit.

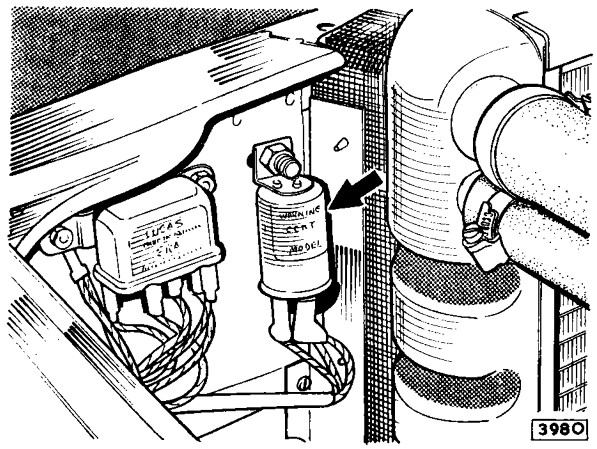


Fig. 1. *Location of 3AW control unit*

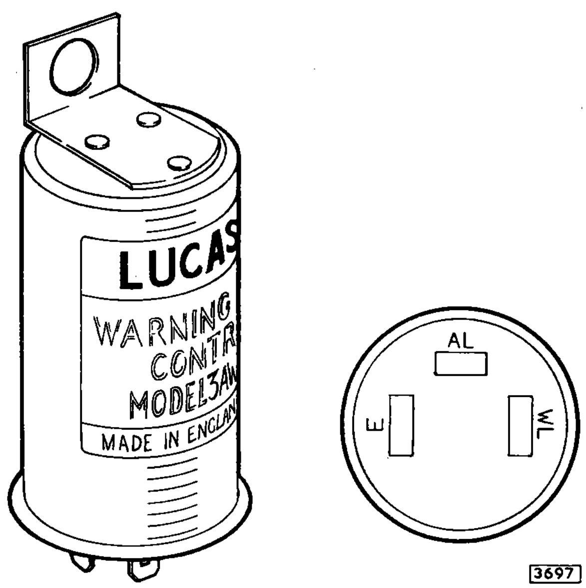


Fig. 2. *The 3AW control unit*

SIDE (REPEATER) FLASHER LAMPS

DESCRIPTION

Two repeater flasher lamps, located on the front wings, are included in the flashing (turn) indicator lamp circuits. The repeater lamps are wired in the flasher warning light system.

BULB—DATA

Lucas No. 501 (12 volt 5 watt) Capless.

BULB REPLACEMENT

Remove the retaining screw and detach the lens from the front clip fixing. Pull the bulb from the base block.

Note: As no cap is fitted to the bulb, no turning or screwing action is necessary when removing or refitting the bulb. Care must be taken when re-inserting the bulb in the block that the filament wires are not displaced.

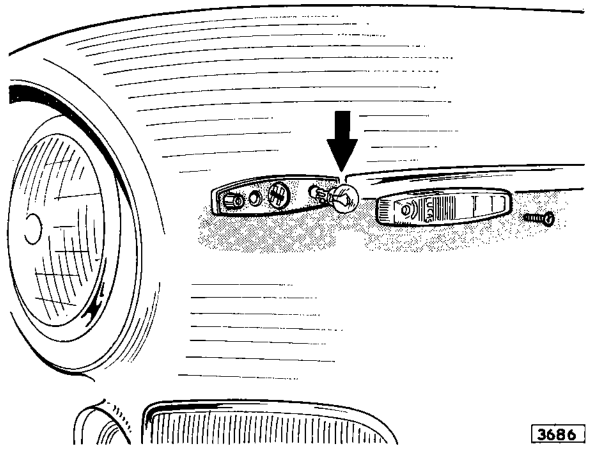


Fig. 3. *Side (repeater) flasher bulb removal*

THE ELECTRIC CLOCK

DESCRIPTION

The electric clock is a fully transistorised instrument powered by a small dry battery.

The battery is contained in a plastic holder attached to the back of the screen rail adjacent to the clock.

Frontal adjustment is provided by means of small knurled knob for setting the hands and a slotted screw for time-keeping regulation.

To set the hands, pull the knurled knob out, rotate and push in. To regulate the time-keeping, turn the slotted screw with a small screwdriver towards the positive (+) sign if gaining, and towards the minus (—) sign if losing.

Moving the indicator through one scale division will alter the time-keeping by 5 minutes per week. The action of resetting the hands automatically restarts the movement.

The window of the electric clock is a plastic moulding and should only be cleaned with a cloth or chamois leather slightly dampened with water. Oil, petrol and other fluids generally associated with cleaning, are harmful and must not be used.

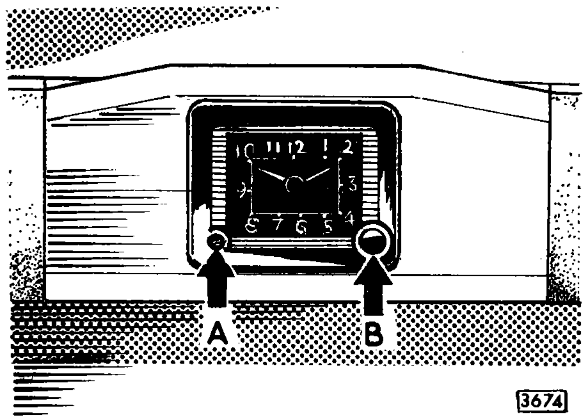


Fig. 4. *Clock controls*
A—*Time regulator* B—*Hand setting*

ROUTINE MAINTENANCE

Renew the battery every 18 months to maintain perfect time-keeping.

BATTERY REPLACEMENT

Remove the instrument panel retaining screws and lower the panel.

Lever the battery out of the holder and discard.

Press the new battery into the holder and refit the panel.

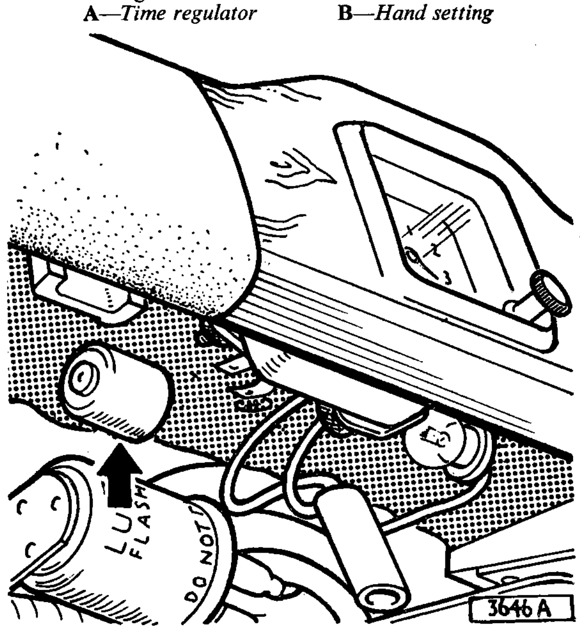


Fig. 5. *Electric clock—battery removal*

THE REVOLUTION COUNTER (TACHOMETER)

DESCRIPTION

The revolution counter is an impulse tachometer instrument incorporating transistors and a printed circuit, the pulse lead (coloured white) being wired in circuit with the S/W terminal on the ignition coil and the ignition switch.

Mechanical drive cables or an engine driven generator are not required with this type of instrument.

The performance of the instrument is not affected by distributor contact setting, by corrosion of the sparking plug points, or by differences in the gap settings.

Connection to the back of the tachometer is by means of a locked plug and socket, the contacts being offset to prevent incorrect coupling.

Removal

Disconnect the battery.

Remove the two knurled nuts, earth lead, and instrument retaining pieces.

Withdraw the instrument from the facia panel and remove the illumination bulb holders.

Disconnect the plug and socket as follows:—

Pinch the prongs of the plastic retainer clip together and withdraw from the plug and socket assembly (Fig. 6).

Detach the plug from the socket and complete the removal of the tachometer.

Note: On right-hand drive cars, remove the lower switch cover from the steering column to gain access to the two knurled nuts.

IMPORTANT: Do not detach the green and white cables connected to the plug and the instrument.

The instrument is pre-wired, the white cable being to a fixed length.

Refitting

Refitting is the reverse of the removal procedure. Reconnect the plug and socket and lock with the retaining clip.

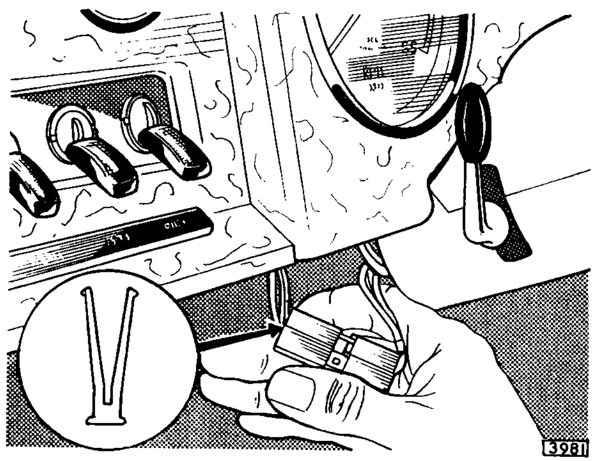
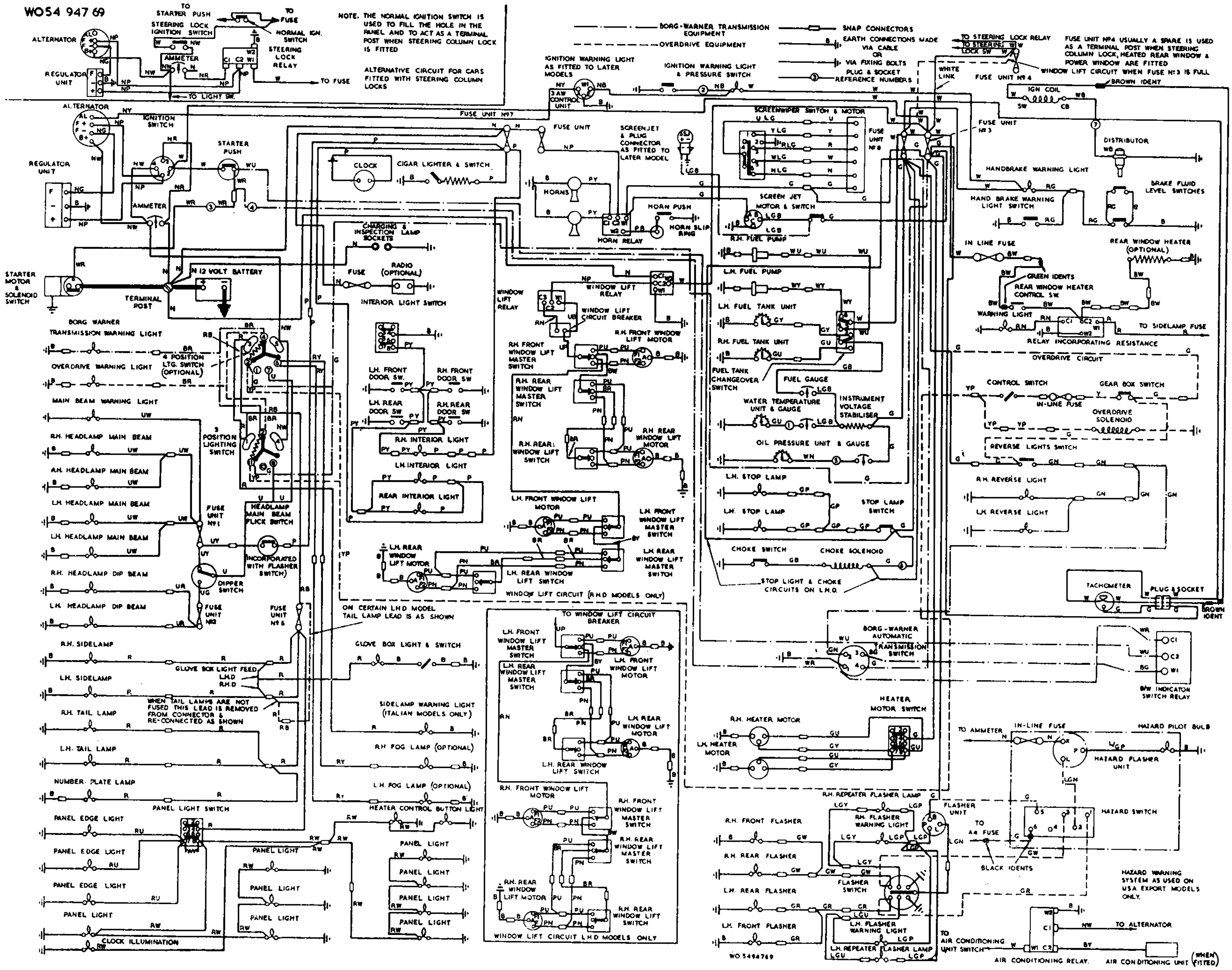


Fig. 6. *Tachometer plug and socket assembly*



CABLE COLOUR CODE

B	BLACK	U	BLUE	N	BROWN	G	GREEN
P	PURPLE	R	RED	S	SLATE	W	WHITE
Y	YELLOW	D	DARK	L	LIGHT	M	MEDIUM