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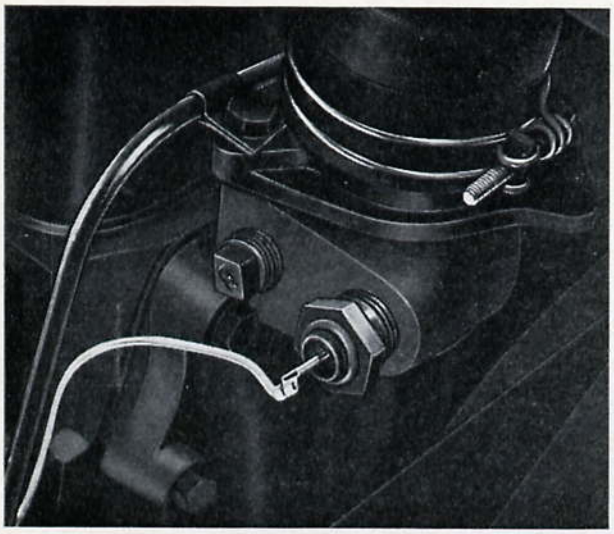

Fig. T.2. Water temperature gauge engine unit — gasoline engine shown

driven gear located in the transmission rear cover. An instrument lamp and a main beam indicator lamp are incorporated.

Water Temperature Gauge

The electrically-operated temperature gauge is controlled by an engine unit which is screwed into the thermostat housing (Fig. T.2). The gauge incorporates two coils, which, in conjunction with an armature, operates a pointer (Fig. T.3). The

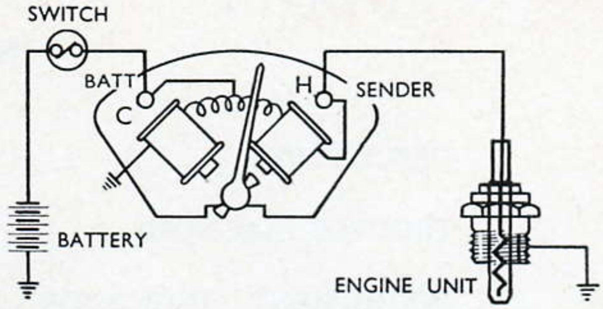

Fig. T.3. Water temperature gauge circuit diagram

engine unit contains a pellet of material the resistance of which decreases when the temperature increases.

Fuel Gauge

The electric fuel gauge is similar to the water temperature gauge and is controlled by a float-operated rheostat unit in the fuel tank (Fig. T.4).

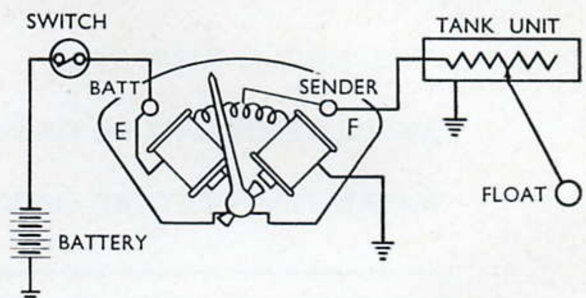

Fig. T.4. Fuel gauge circuit diagram

TROUBLE DIAGNOSIS

Water Temperature Gauge

A fault in the operation of the water temperature gauge may be due to an open circuit between the gauge and engine unit, a blown line fuse or faulty units. If the engine unit is suspect, test by substituting a new unit.

Fuel Gauge

Test the gauge as described on page T-5. If the fuel gauge shows full under all conditions, check for an open circuit in the wiring harness between the gauge and the tank unit. If the gauge shows empty under all conditions, check for a blown line fuse, reversed connections on the gauge, or faulty earthing on the gauge or tank unit.

Speedometer

If the speedometer registers neither speed nor mileage, check for a broken cable. Failure of the speedometer can also be attributed to excessive lubrication of the cable. Only the lower two-thirds of the cable should be lubricated and only the specified grease must be used.

Noisy operation of the speedometer may be due to a dry cable or a kinked casing. Lubricate the cable or remove sharp bends or kinks in the casing. If the noise originates in the speedometer head, renew the unit.

If the accuracy of the speed and mileage readings is questioned, check for correct number of teeth on the speedometer driven gear relative to tyre size and axle ratio (see Section G), before renewing. If correct, renew the speedometer unit.

INSTRUMENT, INDICATOR AND WARNING LAMP BULBS

Access to the bulbs can be gained by pulling out the bulb holders from behind the instrument cluster panel.

To withdraw the panel, disconnect the battery, remove the four attaching screws, and disconnect the speedometer cable.

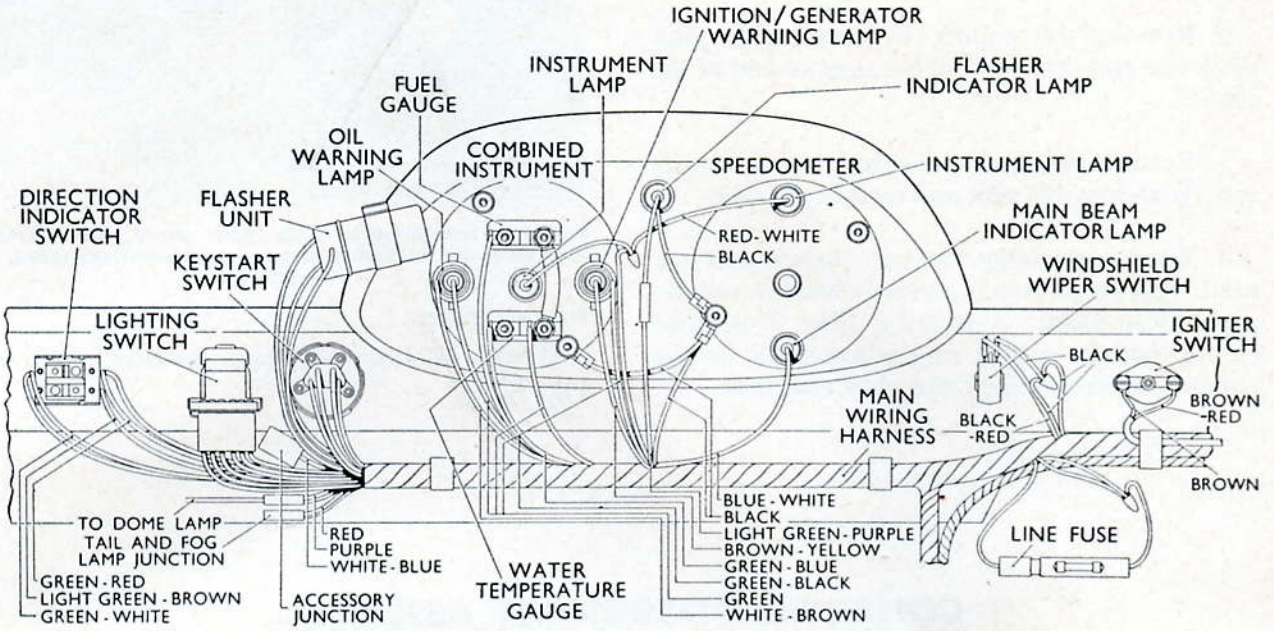

Fig. T.5. Colour coding of instruments and switch wires

SPEEDOMETER CABLE AND CASING

Removal

1. Disconnect the battery.

2. Remove the four screws securing the instrument cluster panel, withdraw the panel and disconnect the cable from the speedometer.

3. Release the cable where clipped to the footwell panel.

4. Disconnect the cable from the driven gear housing on the transmission and withdraw the cable.

Installation

Note the following:

1. Lubricate the lower two-thirds of the cable with recommended grease before assembling to the casing.

2. Fit the end of the cable incorporating a collar to the speedometer.

3. Check that bends in the cable assembly are not less than 5·00 in. radius, and that it is securely clipped to the footwell panel.

SPEEDOMETER

If major repairs are necessary, a replacement unit should be installed as specialized equipment and instruments are essential for correct calibration.

Removal

1. Disconnect the battery.

2. Remove the four screws securing the instrument cluster panel, withdraw the panel and disconnect the cable from the speedometer.

3. Withdraw the instrument and main beam bulb holders.

4. Remove the two securing nuts and lockwashers and withdraw the speedometer.

Bezel, Glass, Retainer and Dial Renewal

1. Straighten the crimped edges of the bezel whilst holding the assembly against a flat surface to avoid distortion. Lift out the bezel, glass, sealing ring and retainer.

2. Remove the pointer by rotating it anti-clockwise and pulling it off the tapered end of the shaft.

3. Remove two screws securing the unit to the case. Withdraw the unit and remove the dial.

4. When assembling the unit ensure that the head lamp beam tube is correctly located and the paper dust washer is installed (Fig. T.6). Also ensure that the sealing ring is assembled to the retainer before installing the glass and bezel.

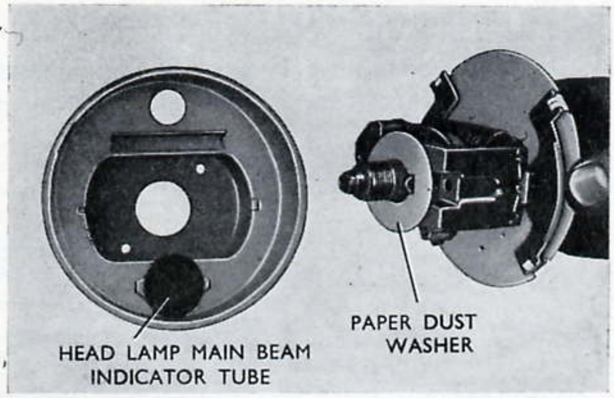

Fig. T.6. Speedometer unit, with paper dust washer located at the back of the frame, ready for installation in the case

Installation

When installing the bulb holders, refer to Fig. T.5.

COMBINED INSTRUMENT ASSEMBLY

Removal

1. Disconnect the battery.

2. Remove the four screws securing the instrument cluster panel. Withdraw the panel and disconnect the cable from the speedometer (Fig. T.7).

Fig. T.7. View showing instrument cluster panel detached and cable disconnected from speedometer

3. Disconnect the wires and bulb holders from the instrument, remove the securing nuts and lockwashers and withdraw the assembly.

Bezel, Glass, Retainer and Mask Renewal

1. Straighten the crimped edges of the bezel whilst holding the assembly on a flat surface to avoid distortion. Lift out the bezel, glass, sealing ring and retainer.

2. Remove the mask.

3. Before installing a new mask, ensure that the ignition/generator and oil warning lamp masks are correctly located (Fig. T.8).

4. Ensure that the sealing ring is installed in the retainer before assembling the glass and bezel.

5. Crimp the ends of the bezel segments securely.

Installation

When reconnecting the wires and installing the bulb holders, refer to Fig. T.5.

FUEL GAUGE

Testing

1. Withdraw the instrument cluster assembly, see under previous heading.

2. Disconnect the wire from the gauge 'SENDER' terminal.

3. Temporarily reconnect the battery and switch on the key start switch. The gauge pointer should move to the 'F' (full) position on the dial.

4. Short the 'SENDER' terminal to earth when the pointer should return to the 'E' (empty) position if the gauge is operating correctly.

Removal

1. Remove the combined instrument and disassemble the bezel, glass, retainer and mask (page T-4).

2. Remove the nuts, washers, terminals and insulators and withdraw the gauge.

Reassembly

Note the following:

1. Make sure the pips in the gauge insulators engage the slots in the case.

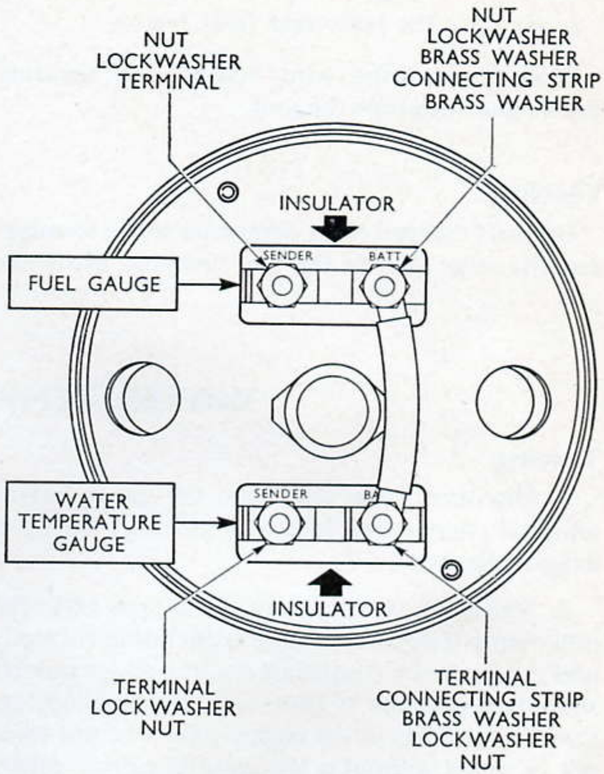

Fig. T.9. Rear view of combined instrument assembly, showing assembly sequence of gauge attaching parts

2. Assemble the gauge attaching parts in the order shown in Fig. T.9. The connecting strip couples the 'BATT' terminals on the gauges.

3. Ensure that the warning lamp masks are correctly located in the case (Fig. T.8), before installing the main mask.

4. Ensure that the sealing ring is installed in the retainer before assembling the glass and bezel.

5. Crimp the ends of the bezel segments securely.

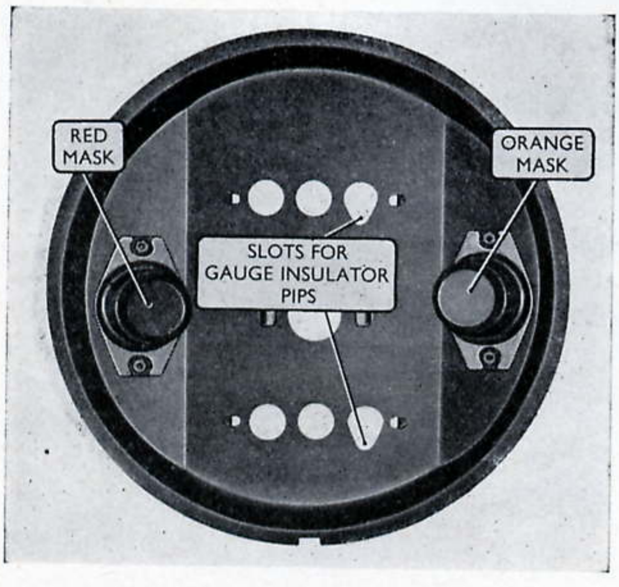

Fig. T.8. View of combined instrument case showing location of ignition/generator warning lamp mask on left, and oil warning lamp mask on right

Installation

When reconnecting the wires to the fuel and water temperature gauges and installing the bulb holders, refer to Fig. T.5.

FUEL GAUGE TANK UNIT

Removal

1. Remove the body rear floor board.

2. Disconnect the wire, remove the securing screws and withdraw the unit.

Testing

Connect the lead of an ohmmeter to the terminal and the other lead to the unit housing. Move the float arm up and down, when a reading of between 1 and 30 ohms should be obtained.

Installation

Note the following:

1. Fit a new gasket between the unit and tank.

2. Install the unit so that the terminal is towards the front of the tank.

WATER TEMPERATURE GAUGE

Testing

1. Disconnect the wire from the gauge engine unit and connect one lead of a 12 volt 6 watt test lamp to the wire.

2. Switch on the key start switch and earth the other lamp lead. If the gauge is operating correctly and the feed wire is satisfactory, the gauge pointer should move to the 'H' (hot) side. This will indicate that the fault lies in the engine unit. The test must not be made without a test lamp in circuit, otherwise the gauge coils will be damaged.

3. If the gauge does not register, carry out the following check:

(*a*) Withdraw the instrument cluster panel; see operations 1 and 2 under 'Combined Instrument Assembly' on page T-4.

(*b*) Disconnect the wire from the gauge 'SENDER' terminal and connect a lead of the test lamp to the terminal.

(*c*) Temporarily reconnect the battery and switch on the key start switch. Earth the other lamp lead when the gauge pointer should move to the 'H' (hot) side. This indicates that the field wire has an open circuit.

Removal and Installation

Proceed as described under 'Fuel Gauge' on page T-5.

WATER TEMPERATURE GAUGE ENGINE UNIT

Removal

1. Drain the cooling system.
2. Disconnect the wire from the connector on the engine unit (see Fig. T.2) and unscrew the unit.

Installation

Before installing the unit, smear the threads with sealing compound.

SECTION U—WINDSHIELD WIPERS

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Have you read the General Notes on page vii?

DESCRIPTION

The windshield wipers are operated by a single-speed electric motor of the compound wound two-pole type, driving a crank through a worm integral with an armature shaft and a nylon gear mounted on a cross-shaft. The crank is attached to the outer end of the cross-shaft by means of a left-hand thread.

A self-parking switch is incorporated and is adjustable for controlling the parking position of the wiper blades.

The armature is supported by a bush in the housing and a spherical bearing in the commutator end frame. The bearings are of the oil-impregnated sintered-bronze type. End float adjustment is controlled by a thrust screw and locknut in the gear case.

The field coil assembly is located in the housing by through bolts, and a brush plate carrying two brushes is assembled against spacers on the bolts and secured by nuts and lockwashers.

The motor, links and pivot housings are assembled to a mounting frame attached to the scuttle panel by the pivot housing nuts. An additional support is provided by a bracket extending downwards from the mounting frame and bolted to the scuttle drain channel.

TROUBLE DIAGNOSIS

Wipers will not Operate

First check for an open circuit in the wiring or a blown line fuse. If satisfactory, remove the windshield wiper mounting unit assembly, detach the links from the motor crank and switch on the motor. Should the motor now operate, check the linkage and pivot spindles for binding. If the motor fails to operate after detaching the links, check that current is passing through the switch to the motor. If so, the motor should be removed and disassembled for examination.

Wiper Operation Noisy

This will be due to wear of the linkage, wear of the arm pivot spindles or loose motor attaching bolts. If the motor itself is noisy it should be removed for examination.

WINDSHIELD WIPER ARMS AND BLADES

NOTE: *Alternative makes of windshield wiper arms and blades are interchangeable only as assemblies. The blades only are not interchangeable and these are identified by TEX and AERAMIC stamped on the blade.*

The pressure applied by the wiper arm spring should be 12 to 15 oz., checked by applying a spring balance to the centre of the blade (Fig. U.1).

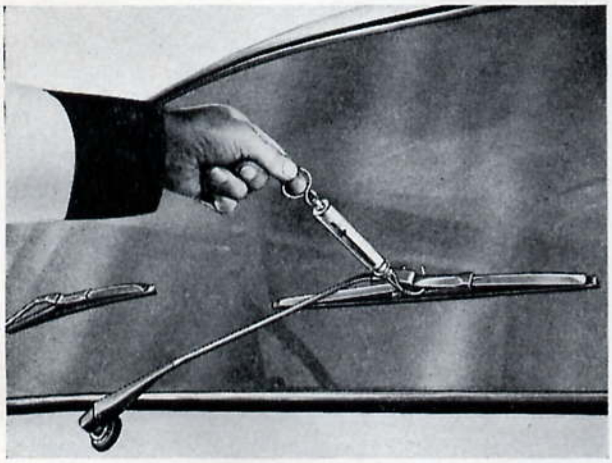

Fig. U.1. Checking the tension of a wiper arm spring

Removal

1. Ensure that the wiper arms are in the parked position.

2. Remove the blade by inserting a thin screwdriver between the spring and the arm. Depress the spring to release the arm from the spring; on Aeramic assemblies, it is necessary to tilt the blade slightly to disengage it from the pip on the arm.

3. Spring pressure retains the Aeramic arm on the pivot spindle sleeve splines. To remove, ease the arm off the sleeve with a screwdriver.

4. The Tex arm is secured by a tapered wedge which grips the pivot spindle splines. Loosen the wedge screw and gently tap inwards to loosen the wedge. Withdraw the arm from the spindle.

Installation

Install the wiper arms and blades so that the approximate measurement from the centre of the blade to the bottom of the glass is 2·80 in. on the driver's side and 3·50 in. on the opposite side.

WINDSHIELD WIPER SWITCH

Removal

1. Disconnect the battery.

2. Remove the four screws securing the instrument cluster panel, withdraw the panel and disconnect the speedometer cable.

3. Remove the switch securing nut, withdraw the switch and disconnect the wires.

WINDSHIELD WIPER UNIT

Removal

1. Remove the wiper arms and blades.

2. Remove the bolt securing the motor support bracket to the scuttle drain channel.

3. Remove the engine cowl centre panel. Remove the air cleaner.

4. Disconnect the wires from the wiper motor.

5. Remove the pivot housing nuts (Fig. U.2), escutcheons and seals.

6. Move the unit across the scuttle to the passenger's side of the vehicle and withdraw the assembly through the engine cowl aperture.

Fig. U.2. Removing the nut from a wiper pivot housing

Disassembly

1. Remove the circlips and withdraw the links and washers from the pins.
2. Remove the motor from the frame.

Reconditioning

To renew a pivot, drill out the securing rivets with an $\frac{1}{8}$ in. diameter drill and rivet a new assembly to the flanged side of the mounting bracket.

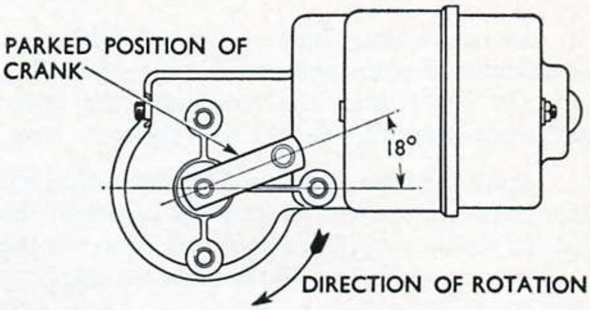

Fig. U.3. Wiper motor with crank in parked position—right drive

Reassembly

Note the following:

1. Rotate the motor to the parked position (Figs. U.3 and U.4) and install the mounting frame so that the earth strip is between the motor lower mounting boss and the frame.

2. When reassembling the links, note the location of the washers and arrangement of the bushes shown in Fig. U.5.

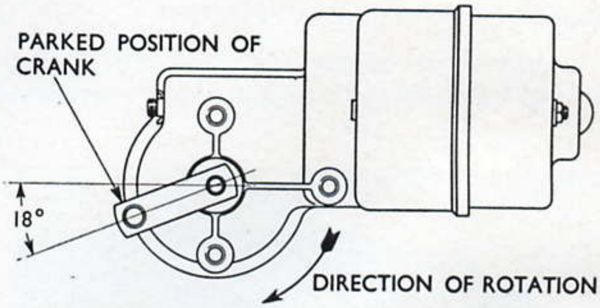

Fig. U.4. Wiper motor with crank in parked position—left drive

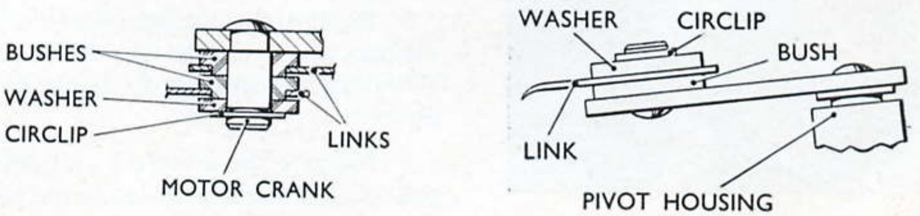

Fig. U.5. Details of link attachment to motor and pivot cranks

Installation

Note the following:

1. Use new sealing rings for the pivot housings and assemble a plate against the inner seals (Fig. U.6). Do not tighten the nuts until the lower attachment is secure, together with the earth strip.

2. Install the wiper arms and blades so that the approximate measurement from the centre of the blade to the bottom of the glass is 2·80 in. on the driver's side and 3·50 in. on the opposite side.

3. Connect the green wire to the 'BAT' terminal, and the black-red wire to the 'SW' terminal. Switch on the motor and check the parked position of the blades with the windshield in a wet condition.

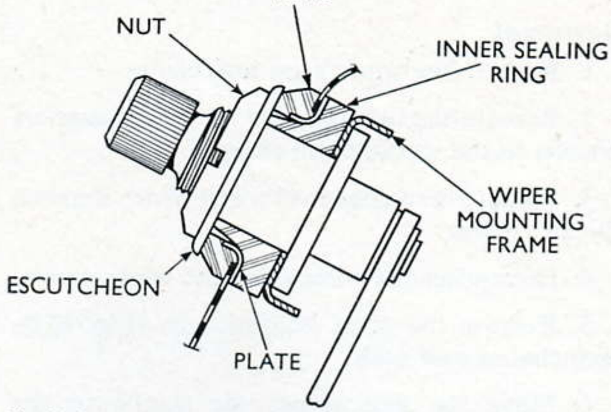

Fig. U.6. Sectioned view of wiper pivot housing attachment to scuttle

WINDSHIELD WIPER MOTOR

Self-Parking Switch Adjustment

1. With the windshield in a wet condition, operate the wiper motor and then switch off. Note whether the wiper blades come to rest before or after the parked position, when the approximate measurement between the centre of the blade and the bottom of the windshield glass should be 2·80 in. on the driver's side and 3·50 in. on the opposite side.

2. Rotate the hexagon-head pin in the centre of the switch plate as required (Fig. U.7).

3. Operate the motor and check for correct parking. Carry out further adjustment if necessary.

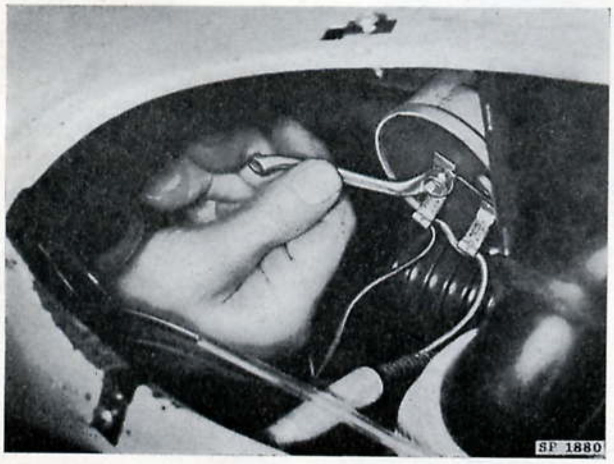

Fig. U.7. Adjusting the wiper motor self-parking switch pin

Removal

1. Remove the windshield wiper unit as detailed under the previous heading.

2. Remove the circlips and withdraw the links and washers from the crank pins.

3. Remove the motor from the frame.

Disassembly

1. Thoroughly clean the exterior of the motor prior to disassembly; *use cleaning fluids sparingly to prevent contamination of the interior.*

2. Remove the switch plate securing screw and move the plate to one side.

3. Remove the nuts and lockwashers from the through bolts and withdraw the commutator end frame and insulator.

4. Remove the shim washer and insulating washer from the armature shaft.

5. Unsoleer the brush wires, and withdraw wires from the brush holders. Discard the brush springs.

6. Remove the through bolt inner nuts and lock-washers and withdraw the brush plate assembly. Withdraw the brushes from the brush plate and discard.

7. Remove the armature and detach the thrust ball located in a depression at the inner end of the shaft.

Inspection and Reconditioning

Clean the interior of the motor with a moderate pressure dry air blast. *No liquid should be used for internal cleaning.*

Armature

1. Examine the armature thrust screw for wear.

2. Examine the shaft worm for wear or damage.

3. Examine the commutator for pitting or wear. To refinish, clean and polish the surface of the commutator using very fine glass paper. *Do not use emery cloth.* Clean out loose deposits from the commutator slots.

4. Check the fit of the armature shaft in the bush in the body and the spherical bearing in the commutator end frame. The spherical bearing is serviced with the end frame as an assembly.

To renew the bush, drive out the old bush then install a new bush so that the end is level with the housing face.

5. Test the armature for open circuit and earthed windings. Visually examine soldered connections.

Cross-shaft and Gear

1. Examine the gear for wear or damage. The gear is renewable as an assembly with the shaft.

2. Check the cross-shaft for end float and clearance in the bushes. If end float exists, renew the thrust washer and spring washer. The procedure for renewing the bushes is as follows:

(*a*) Remove the crank by unscrewing it *clockwise* from the cross-shaft and withdraw the cross-shaft, gear thrust washer and spring washer.

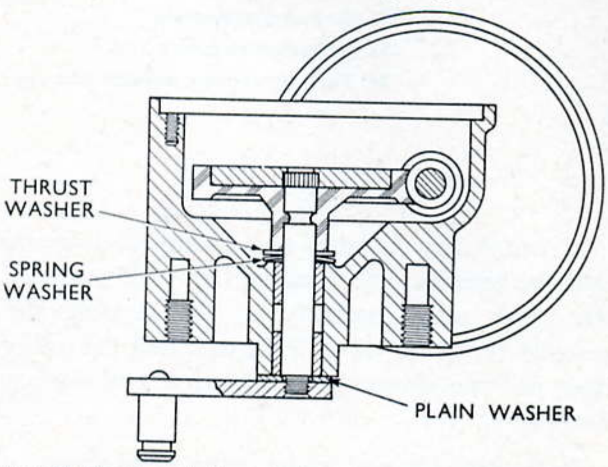

Fig. U.8. Sectioned view of wiper motor showing location of washers on cross-shaft

(*b*) Drive the bushes out of the housing and install the new bushes so that the end of each bush is level with the housing face.

(*c*) Lubricate the bushes with engine oil, and assemble the thrust washer to the cross-shaft adjacent to the gear, followed by the spring washer (Fig. U.8).

(*d*) Install the gear into the housing and assemble the plain washer to the end of the shaft. Screw the crank on to the shaft and tighten to the specified torque.

Field Coils

Test the field coils for continuity or short circuits. Ensure that the taping is not displaced or worn and that the coils are not loose on the pole pieces. Install a new field coil assembly as follows:

(*a*) Unsolder the wires on the switch plate, and remove the field coil assembly from its housing by carefully levering on the laminations with two screwdrivers (Fig. U.9).

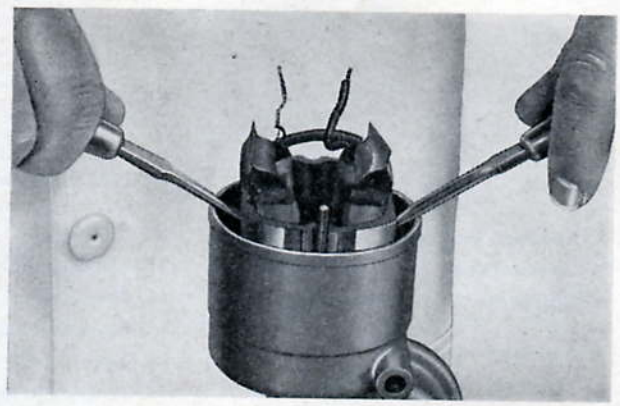

Fig. U.9. Removing the field coil assembly

(*b*) Ensure that the through bolt adjacent to the crank is in position before inserting the field coil assembly in the housing.

(*c*) Position the field coil assembly in the housing so that the green and black wires will pass through the hole in the housing.

(*d*) Solder black field wire to the 'sw' (central) wire connector and green wire to the 'BAT' connector.

Parking Switch

Examine the parking switch contact, at the end of the U-shaped spring on the switch plate, for wear or pitting. If necessary, clean up the contact with fine emery paper. If the contact does not clean up satisfactory, install a new one.

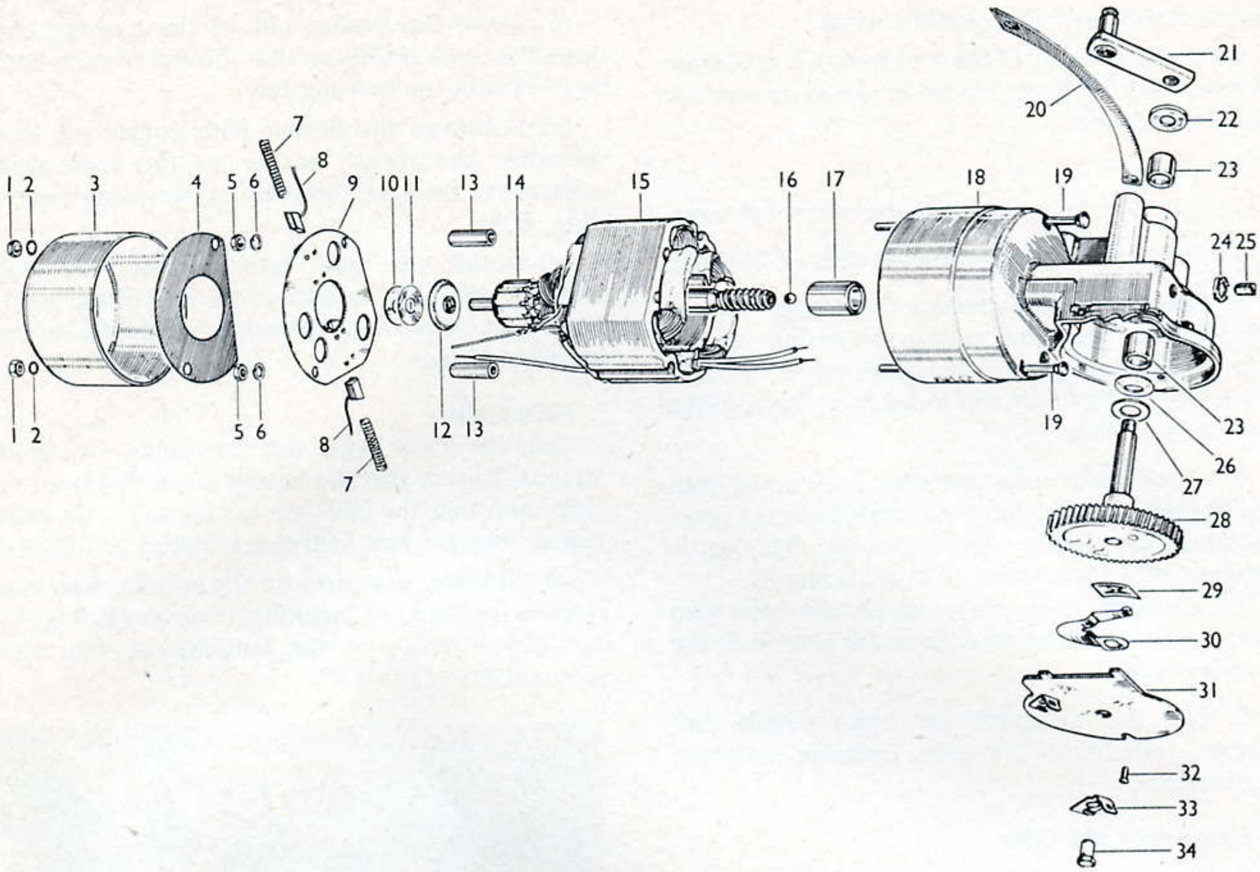

Fig. U.10. Exploded view of wiper motor

1. Through bolt nuts
2. Lockwashers
3. Commutator end frame and spherical bearing
4. End frame insulator
5. Through bolt inner nuts
6. Lockwashers
7. Brush springs
8. Brushes
9. Brush plate
10. Armature shim washer
11. Insulating washer
12. Oil slinger
13. Through bolt spacers
14. Armature
15. Field coil assembly
16. Thrust ball
17. Armature shaft bush
18. Housing
19. Through bolts
20. Earth strip
21. Crank
22. Plain washer
23. Cross-shaft bushes
24. Locknut
25. Thrust screw
26. Cross-shaft spring washer
27. Cross-shaft thrust washer
28. Cross-shaft and gear
29. Adjustment pin retainer
30. Parking contact
31. Switch plate
32. Switch plate screw
33. Switch wire connector
34. Parking contact adjustment pin

Reassembly

Note the following:

1. Before inserting the armature, lubricate the bushes with engine oil and slacken off the thrust screw two or three turns. Make sure that the thrust ball is correctly located in the depression in the end of the shaft; it can be retained in position by a small quantity of grease.

2. Install new brushes and springs and ensure that the brushes slide freely in the holders. Install the brush plate assembly on the housing and resolder the brush wires. Take care that the solder does not run down the brush wires and destroy flexibility.

3. Position the end frame insulator as shown in Fig. U.11.

4. Tighten the armature shaft thrust screw lock-nut to the specified torque.

5. Adjust the armature shaft end float setting as follows:

(*a*) Run the motor with an ammeter in the circuit. Lightly tap the motor end frame with a hide mallet to align the spherical bearing thus reducing the current consumption to a minimum.

(*b*) Tighten the armature shaft thrust screw to produce maximum current consumption, then slacken off the screw to give minimum consumption.

(*c*) Finally, re-tighten the screw to produce a current consumption of ·1 to ·2 ampere.

6. Re-pack the gear casing with recommended grease to approximately one-third of its capacity.

7. Test the motor as follows:

(*a*) Connect the negative of a 14 volt test supply to the 'BAT' connector and the positive to the earth strip. Earth the 'SW' connector to the motor body. The motor should develop the specified stall torque.

(*b*) Check the current consumption after running light for 30 minutes. Consumption should be as specified.

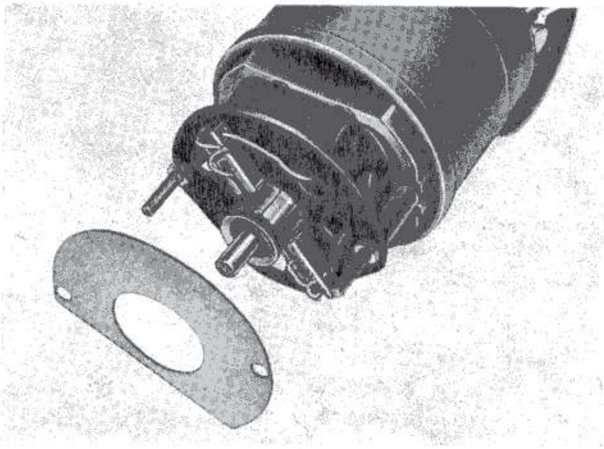

Fig. U.11. View showing arrangement of brush wires and position for flat side of end frame insulator

Installation

1. Rotate the motor to the parked position (Figs. U.3 and U.4 on page U-3). Install the motor on the mounting frame.

2. Assemble the link bushes with the flanges towards the motor and pivot cranks (Fig. U.5 on page U-3). Secure with circlips.

3. Install the assembly as detailed under 'Windshield Wiper Unit—Installation' on page U-4.

SPECIFICATIONS

WINDSHIELD WIPER MOTOR

Make and Type	Delco 258
Voltage	12
Armature Shaft End Float	See above
Test Data	
Stall torque at crank—minimum	4¾ lb.ft. on a 14 volt supply
Total light running current consumption	2·5 amps. (warm)

WINDSHIELD WIPER ARMS

Wiper Arm Spring Tension	12 to 15 oz.

TORQUE WRENCH DATA

Armature Shaft Thrust Screw Locknut	12 lb.in.
Drive Crank to Motor Cross-shaft	4¾ lb.ft.

SECTION V—WIRING

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WIRING DIAGRAMS	V - 2

Have you read the General Notes on page vii ?

DESCRIPTION

All models are equipped with a 12 volt positive earth return system with single-pole wiring comprising a main harness with subsidiary harnesses for the engine and front and rear lamps. The wires of each harness are protected by a wrapping of P.V.C. tape.

All wires are colour coded for identification and a key, together with wire specifications are given in the wiring diagrams (pages V-2 and V-3).

A cartridge-type line fuse is incorporated in the main harness for protection of the ignition/generator, and oil warning lamps, flasher lamps, stop lamps, fuel and temperature gauges and windshield wiper motor. The fuse is clipped to the underside of the instrument panel adjacent to the instrument cluster panel (Fig. T.5 on page T-3). The remainder of the lighting system is protected by the thermal circuit breaker in the lighting switch.

WIRING HARNESS

Removal

1. Before removing a harness, disconnect the battery.

2. When removing the main harness, withdraw the instrument cluster panel as described under 'Combined Instrument Assembly' on page T-4.

Installation

Note the following:

1. Clip the harness loosely in position and place the extensions to their respective components.

2. Ensure a slight amount of slack is provided at all connecting points. Wires must not pull on the connections.

3. Clean earth connections and smear with petroleum jelly. Wires must be clear of sharp edges.

4. Check all circuits for correct operation.

SPARK PLUGS

Removal

Disconnect the H.T. leads and unscrew the spark plugs with a close fitting tube wrench.

Inspection

1. Check the plugs for correct type. These are of integral construction and cannot be disassembled for cleaning.

2. Examine the insulators for cracks and the electrodes for excessive burning.

3. Clean and pressure test the plugs. Set the gap to the specified limits by bending the side electrode only.

Installation

Use new gaskets when installing the plugs.

CONDENSER

NOTE: *The condenser can be checked while in position if desired (page R-4).*

Removal

1. Detach the distributor cap and rotor.

2. Slacken the outer nut from the contact stud and detach the condenser lead.

3. Remove the condenser mounting bracket screw and lift away condenser.

Inspection

1. Check the security of the terminal tag.

2. Test the condenser (page R-4).

Installation

Install the condenser so that the holes in the bracket locate on the pips in the plate.

CIRCUIT BREAKER CONTACTS

Removal

1. Remove the distributor cap and rotor.

2. Check the tension of the circuit breaker moving contact spring with a small spring balance (Fig. R.11). The reading must be taken just as the contacts separate and should be within the specified limits. Decrease excessive tension by contracting the arc of the spring. To increase the tension, open the spring slightly whilst the contacts are removed.

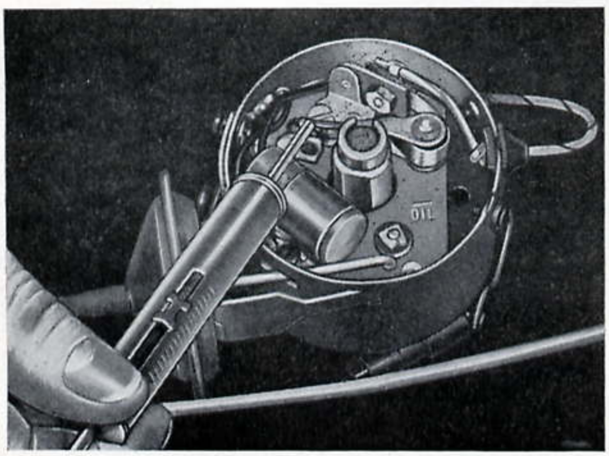


Fig. R.11. Checking the tension of the circuit breaker moving contact spring

3. Disconnect the L.T. wire from the coil.

4. Remove the condenser mounting bracket screw and the circuit breaker locking screw. Withdraw the contacts, condenser and L.T. wire as an assembly.

5. Remove the contact stud nut from the inside of the insulating pad, withdraw the stud with the condenser and L.T. wires attached, and remove the moving contact.

Cleaning the Contacts

Clean the contacts with a fine grade oil stone. Take care that the faces of the contacts are maintained flat and square to one another so that when reassembled, full contact is obtained. Clean the contacts thoroughly. If badly worn or pitted they should be renewed.

Installation

1. Locate the moving contact spring on the contact stud (which has the condenser and L.T. wires attached), insert the stud in the insulating pad and loosely assemble the nut.

2. Apply a spot of oil to the moving contact pivot on the circuit breaker plate and place the contact set and condenser in position. Install the condenser with the holes in the bracket locating on the pips in the plate.

3. Loosely install the fixed contact locking screw, then tighten the contact stud nut securely.

4. Secure the L.T. wire in position with the clip on the distributor housing, and connect the wire to the '+' terminal on the coil.

5. Set the gap of the circuit breaker contacts as detailed under the following heading.

Circuit Breaker Gap Adjustment

1. The correct gap for contacts which have been in service is ·019 to ·021 in.

2. When installing new contacts the initial setting should be ·021 to ·023 in. to allow for bedding down of the moving contact rubbing block on the distributor cam.

3. Using cam dwell equipment, check the cam dwell angle and adjust the circuit breaker gap as necessary.

4. If cam dwell equipment is not available, proceed as follows:

(*a*) Rotate the engine until a cam peak is centralized on the moving contact rubbing block. *Do not attempt to turn the engine with the fan.*

(*b*) With the fixed contact locking screw slackened, insert a screwdriver into the slot at the end of the plate carrying the fixed contact and turn the plate until the required gap (checked with a feeler gauge) is obtained, then tighten the locking screw and re-check the gap.

NOTE: *After adjusting the contacts, always check the ignition timing (page R-5).*

CIRCUIT BREAKER PLATE ASSEMBLY

Removal

1. Remove the distributor.

2. Remove the vacuum control and circuit breaker plate assembly.

Disassembly

Remove the contacts and condenser as detailed on page R-8.

NOTE: *Do not attempt to disassemble the circuit breaker plate assembly. This must be serviced by replacement only.*

Inspection

Check that the circuit breaker upper plate rotates smoothly on the lower plate, and check the tension between the two plates by attaching a spring balance to the vacuum control post (Fig. R.12).

Reassembly

Reassemble the contacts and condenser to the circuit breaker upper plate.

Installation

Note the following:

1. Check and adjust the circuit breaker gap (see above).

2. Install the distributor as detailed under 'Ignition Timing' on page R-5).

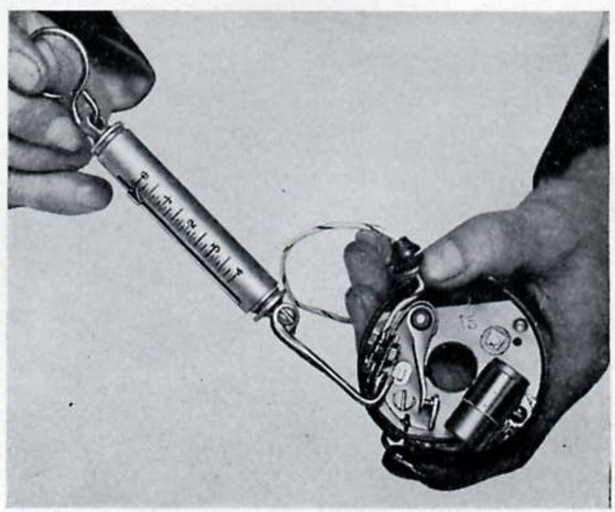


Fig. R.12. Checking the frictional resistance between the circuit breaker upper and lower plates

CENTRIFUGAL ADVANCE TEST

A synchroscope test enables the performance and behaviour of the distributor to be checked. It will indicate faulty operation of the centrifugal advance mechanism or mechanical faults such as excessive wear of the shaft, bushes, or cam spindle. Poor spark phasing due to worn cam lobes or a bent shaft can be checked and the centrifugal advance curve plotted. Figures obtained should be checked against those specified.

The centrifugal advance can also be checked with the distributor installed in the engine, using special equipment. When checking, disconnect the suction pipe from the vacuum advance unit.

Testing

If the figures obtained during the test are outside the specified limits the cause should be investigated. It may happen that while the upper part of the advance curve is within limits, the intermediate part shows over-advance. This is usually due to weak springs or badly worn centrifugal advance mechanism. Should the advance curve exceed the limit at the upper end (where it should flatten out) this indicates a fault with the centrifugal weight stop pin.

Synchroscope Test Diagnosis

Mechanical faults indicated by spark phasing are as follows:

SPARK OBTAINED	INDICATION
Regular and evenly spaced	Mechanically sound
Unevenly spaced	Worn shaft or bushes. Cam slack on shaft. Shaft bent or cam peaks worn
Multiple sparks	Contact bounce—usually occurs at certain fixed speeds and is associated with a weak circuit breaker spring
Intermittent sparking at all firing points	Dirty or pitted contacts. Gap incorrect
One spark unevenly placed	Worn or damaged cam peak

DISTRIBUTOR

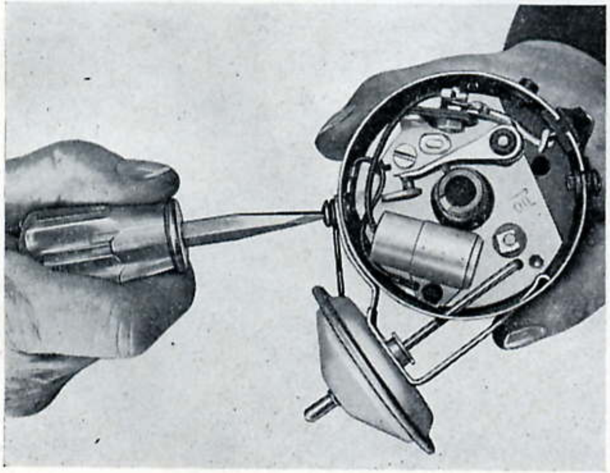


Fig. R.13. Removing the vacuum control unit attaching screw

Removal

1. Disconnect the L.T. wire from the coil.

2. Disconnect the suction pipe from the vacuum control.

3. Disconnect the leads from the spark plugs and remove the distributor cap.

4. Remove the bolt securing the distributor clamp plate to the crankcase and withdraw the distributor.

Disassembly

1. Remove the rotor and the vacuum control (Fig. R.13).

2. Remove the circuit breaker plate assembly and remove the contacts and condenser.

3. Drill away one end of the driving sleeve rivet, and punch out the rivet.

4. Mark the sleeve in relation to the mainshaft and drive the shaft from the sleeve just sufficiently to engage an extractor. Remove the sleeve and thrust washer.

NOTE: *Do not drive the shaft completely out of the sleeve as any burrs on the shaft may damage the bushes in the housing.*

5. Withdraw the mainshaft and upper thrust washer.

6. Remove the oil seal ring and the clamp plate from the housing shank.

7. Remove and discard the advance weight springs.

Inspection

1. Wipe the distributor cap inside and out with a clean dry cloth, and examine the carbon button for wear and the segments for burning.

2. Check the rotor contact spring for distortion. The set of the spring is important to ensure adequate contact pressure (Fig. R.14).

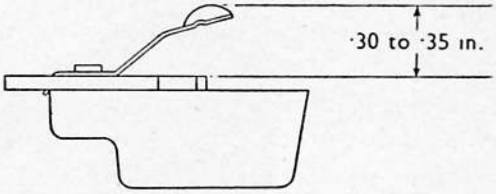


Fig. R.14. Rotor spring contact setting

3. Test the distributor cap, rotor, H.T. leads and condenser as described on page R-5.

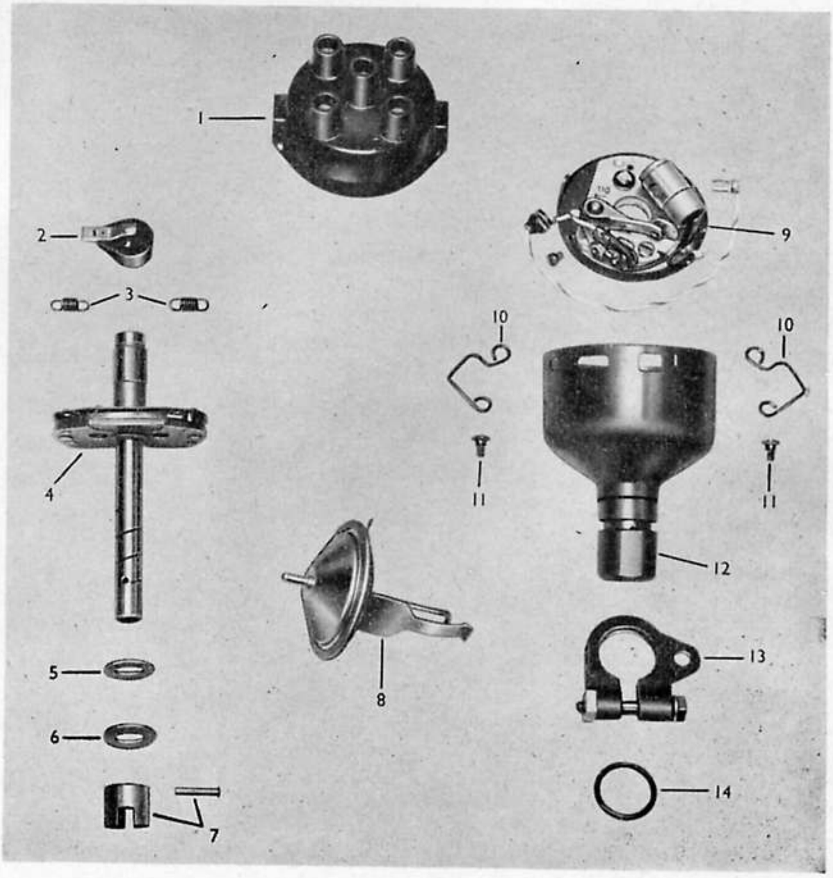
4. Examine, and clean or renew the contacts as described on page R-8.

5. Check the fit of the mainshaft in the housing bushes, and the advance weights, pins and cam for wear. Wear in the bushes necessitates renewal of the housing.

6. Check the action of the vacuum control by operating the arm. Test with vacuum equipment where available. Full movement of the diaphragm should be obtained with a vacuum reading of 20 inHg.

Fig. R.15. Exploded view of distributor

1. Cap
2. Rotor
3. Advance weight springs
4. Mainshaft and cam
5. Upper thrust washer
6. Lower thrust washer
7. Driving sleeve and rivet
8. Vacuum control unit
9. Circuit breaker assembly
10. Cap clips
11. Retaining screws
12. Housing
13. Housing clamp
14. Oil seal ring



depressing the horn push a reading of 12 volts should be obtained. If a reading is not obtained the relay is defective and should be renewed.

Removal

1. Disconnect the battery.
2. Disconnect the wires from the relay.
3. Remove the relay, secured by two screws.

Installation

Note the following:

1. Secure the earth wire under the appropriate attaching screw.

2. Attach the wires as follows: the purple wire to the horn, to terminal 'C1', the purple wire from the main harness, to terminal 'C2' and the purple-black wire to terminal 'W1'.

SECTION T—INSTRUMENTS

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Have you read the General Notes on page vii ?

DESCRIPTION

Fig. T.1. General view of instrument cluster panel

The instruments are mounted in the form of a cluster panel and consists of two separate assemblies, a combined instrument assembly and a speedometer, attached to the facing of the panel (Fig. T.1). A flasher indicator lamp is mounted above the instruments and in the centre of the panel. The combined instrument assembly incorporates a water temperature gauge, fuel gauge, oil and ignition/generator warning lamps and an instrument lamp.

Speedometer

The speedometer operates on the magnetic principle by which a permanent magnet reacts on a metal speed cup attached to the shaft carrying the speed indicator. The drive cable engages a

Horns Operate Continuously

Check by disconnecting the purple-black terminal connection on the horn or relay. If the horn stops sounding, the horn push or wiring is faulty. If the horn continues to sound, this indicates a short to earth inside the horn.

Horn Tone Weak

If either operates intermittently or weak, check all connections and adjust the horn.

SEALED BEAM HEAD LAMPS

Light Unit Renewal

1. Remove the head lamp rim.

2. Remove the three screws securing the light unit clamp ring. Do not disturb the lamp beam trim screws (Fig. S.3) otherwise the alignment of the lamp beams will be altered.

3. Withdraw the unit from the lamp body and disconnect the wiring adaptor.

4. Install the new light unit and rim.

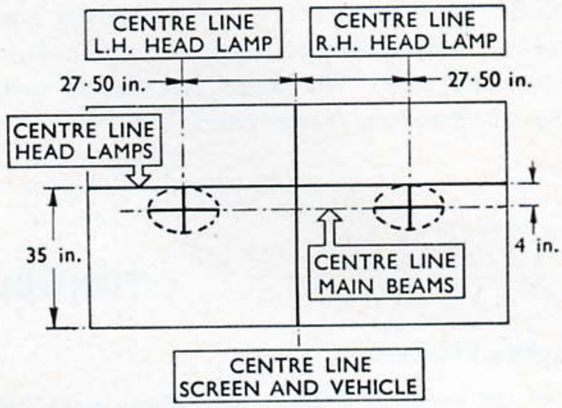


Fig. S.4. Head lamp beam alignment screen details

Beam Alignment

1. Remove the head lamp rim to expose the lamp beam trim screws (Fig. S.3).

2. Adjust the trim screws as necessary to align the lamp beams using head lamp beam aligning equipment or a screen, details of which are shown in Fig. S.4.

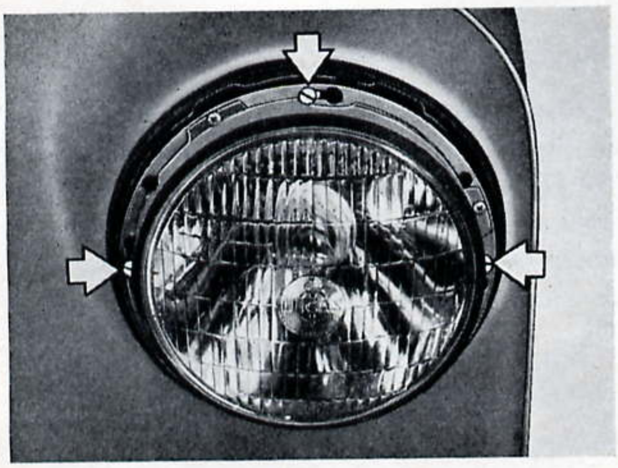


Fig. S.3. The arrows indicate the lamp beam trim screws

Before commencing adjustment, the trim screws must be screwed right in. When using a screen the following must be observed:

(*a*) The vehicle must be unladen.

(*b*) Tyres must be inflated to correct pressure.

(*c*) The vehicle and screen must stand on a level floor.

(*b*) The front of the vehicle must be 25 feet from the screen and square with it, with the centre line of the vehicle in line with the centre of the screen.

Removal

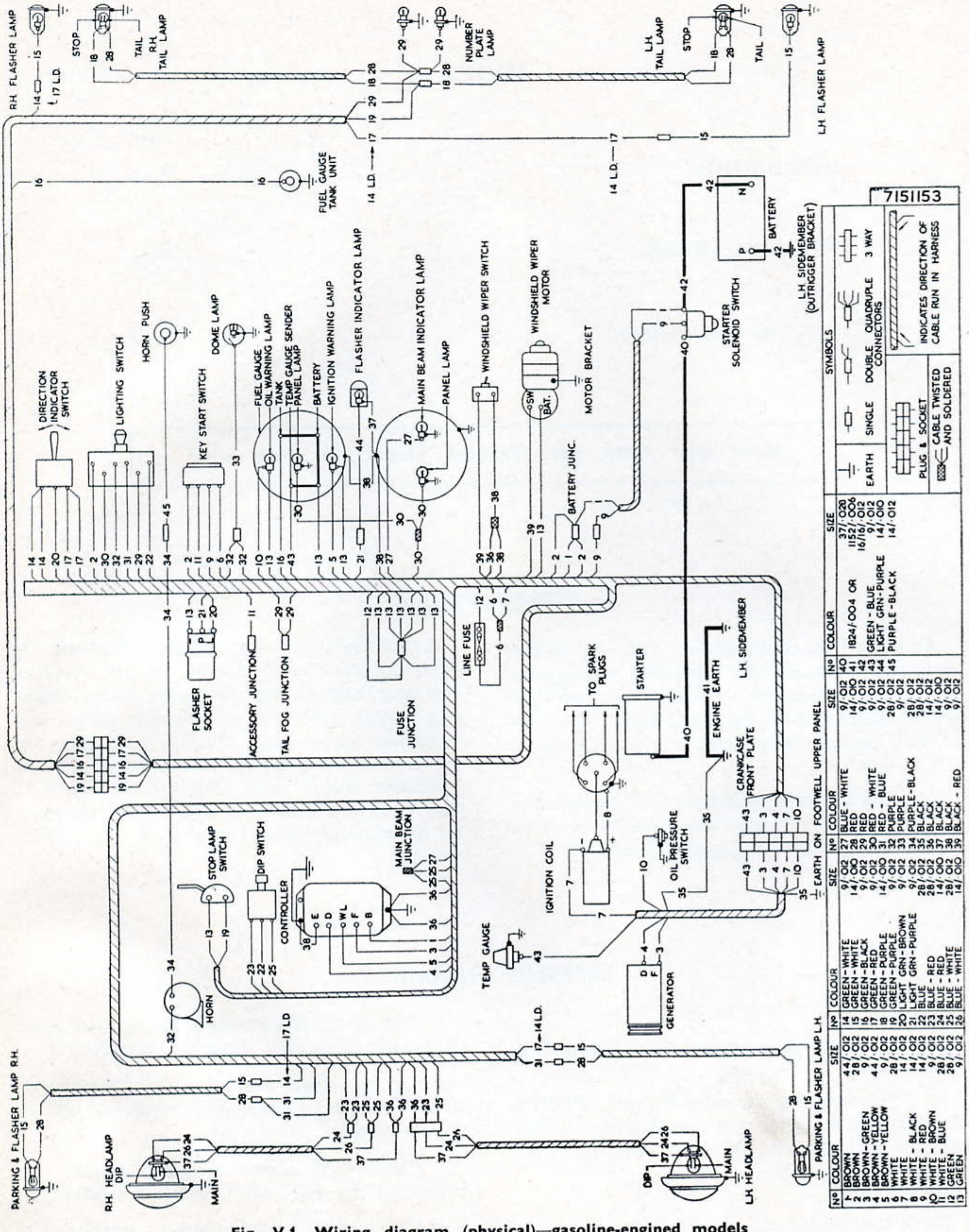
1. Disconnect the lamp wires at the plug-in connectors adjacent to the top of the radiator and pull the wires through the wing splashguard.

2. Remove the lamp rim.

3. Remove the four attaching screws and withdraw the lamp and wiring, together with the rubber gasket. Do not lose the mud seals on the beam trim screw bosses.

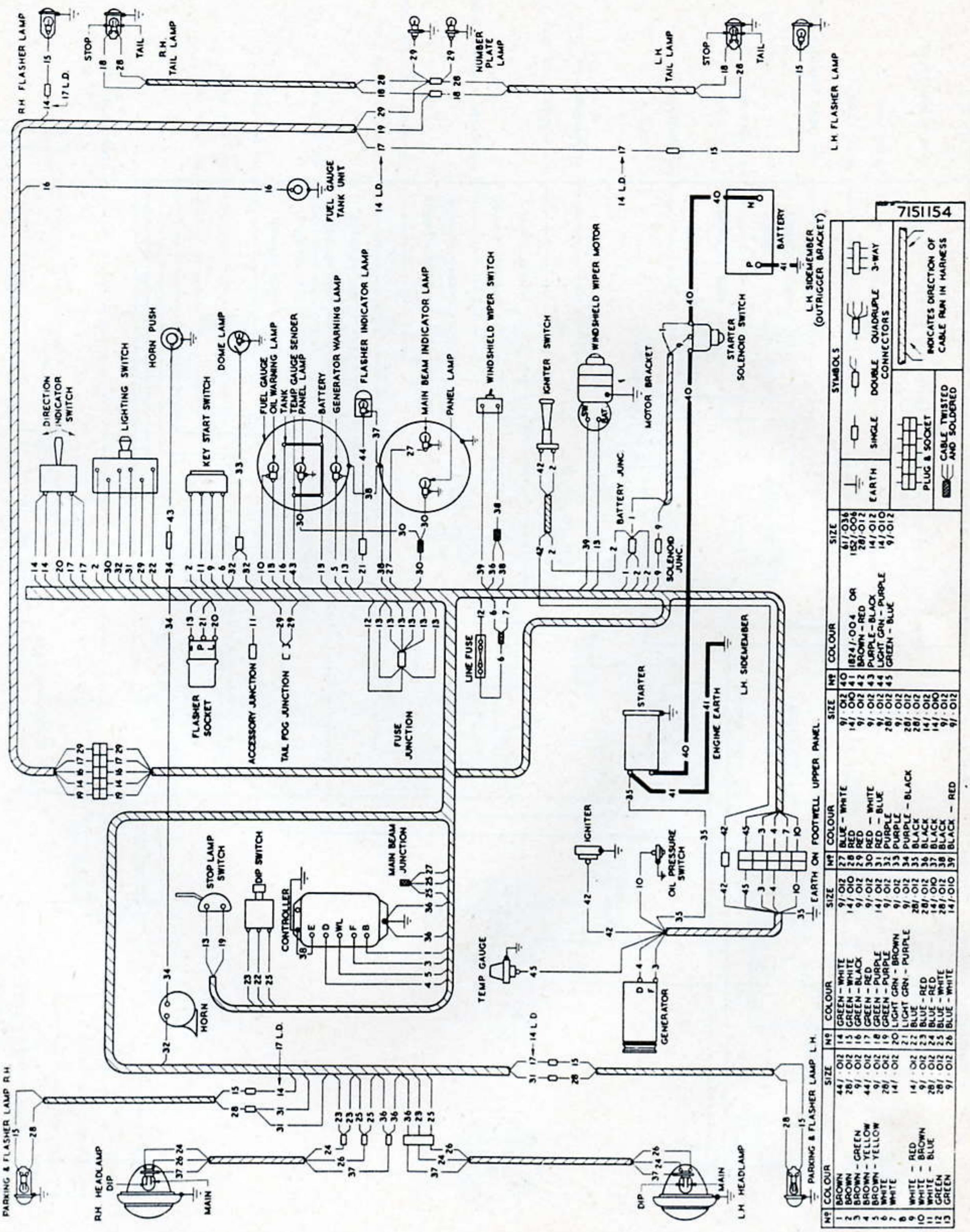
Installation

Before installing the lamp rim, align the lamp beam.



Nº	COLOUR	SIZE	Nº	COLOUR	SIZE	Nº	COLOUR	SIZE	Nº	COLOUR	SIZE
1	BROWN	44/·012	14	GREEN - WHITE	9/·012	27	BLUE - WHITE	9/·012	40		37/·020
2	BROWN	28/·012	15	GREEN - WHITE	14/·010	28	RED	14/·010	41	1824/·004 OR	1152/·006
3	BROWN - GREEN	9/·012	16	GREEN - BLACK	9/·012	29	RED	9/·012	42		16/16/·012
4	BROWN - YELLOW	44/·012	17	GREEN - RED	9/·012	30	RED - WHITE	9/·012	43	GREEN - BLUE	9/·012
5	BROWN - YELLOW	9/·012	18	GREEN - PURPLE	14/·010	31	RED - BLUE	9/·012	44	LIGHT GRN - PURPLE	14/·010
6	WHITE	28/·012	19	GREEN - PURPLE	9/·012	32	PURPLE	28/·012	45	PURPLE - BLACK	14/·012
7	WHITE	14/·012	20	LIGHT GRN - BROWN	9/·012	33	PURPLE	9/·012			
8	WHITE - BLACK	14/·012	21	LIGHT GRN - PURPLE	9/·012	34	PURPLE - BLACK	28/·012			
9	WHITE - RED	14/·012	22	BLUE	28/·012	35	BLACK	28/·012			
10	WHITE - BROWN	9/·012	23	BLUE - RED	28/·012	36	BLACK	14/·012			
11	WHITE - BLUE	28/·012	24	BLUE - RED	14/·010	37	BLACK	14/·010			
12	GREEN	28/·012	25	BLUE - WHITE	28/·012	38	BLACK	9/·012			
13	GREEN	9/·012	26	BLUE - WHITE	14/·010	39	BLACK - RED	9/·012			

Fig. V.1. Wiring diagram (physical)—gasoline-engined models



Nº	COLOUR	SIZE	Nº	COLOUR	SIZE	Nº	COLOUR	SIZE	Nº	COLOUR	SIZE
1	BROWN	44/·012	14	GREEN - WHITE	9/·012	27	BLUE - WHITE	9/·012	40		61/·036
2	BROWN	28/·012	15	GREEN - WHITE	14/·010	28	RED	14/·010	41	1824/·004 OR	1152/·006
3	BROWN - GREEN	9/·012	16	GREEN - BLACK	9/·012	29	RED	9/·012	42	BROWN - RED	28/·012
4	BROWN - YELLOW	44/·012	17	GREEN - RED	9/·012	30	RED - WHITE	9/·012	43	PURPLE - BLACK	14/·012
5	BROWN - YELLOW	9/·012	18	GREEN - PURPLE	14/·012	31	RED - BLUE	9/·012	44	LIGHT GRN - PURPLE	14/·010
6	WHITE	28/·012	19	GREEN - PURPLE	9/·012	32	PURPLE	28/·012	45	GREEN - BLUE	9/·012
7	WHITE	14/·012	20	LIGHT GRN - BROWN	9/·012	33	PURPLE	9/·012			
8			21	LIGHT GRN - PURPLE	9/·012	34	PURPLE - BLACK	28/·012			
9	WHITE - RED	14/·012	22	BLUE	28/·012	35	BLACK	28/·012			
10	WHITE - BROWN	9/·012	23	BLUE - RED	28/·012	36	BLACK	14/·012			
11	WHITE - BLUE	28/·012	24	BLUE - RED	14/·010	37	BLACK	14/·010			
12	GREEN	28/·012	25	BLUE - WHITE	28/·012	38	BLACK	9/·012			
13	GREEN	9/·012	26	BLUE - WHITE	14/·010	39	BLACK - RED	9/·012			

Fig. V.2. Wiring diagram (physical)—diesel-engined models

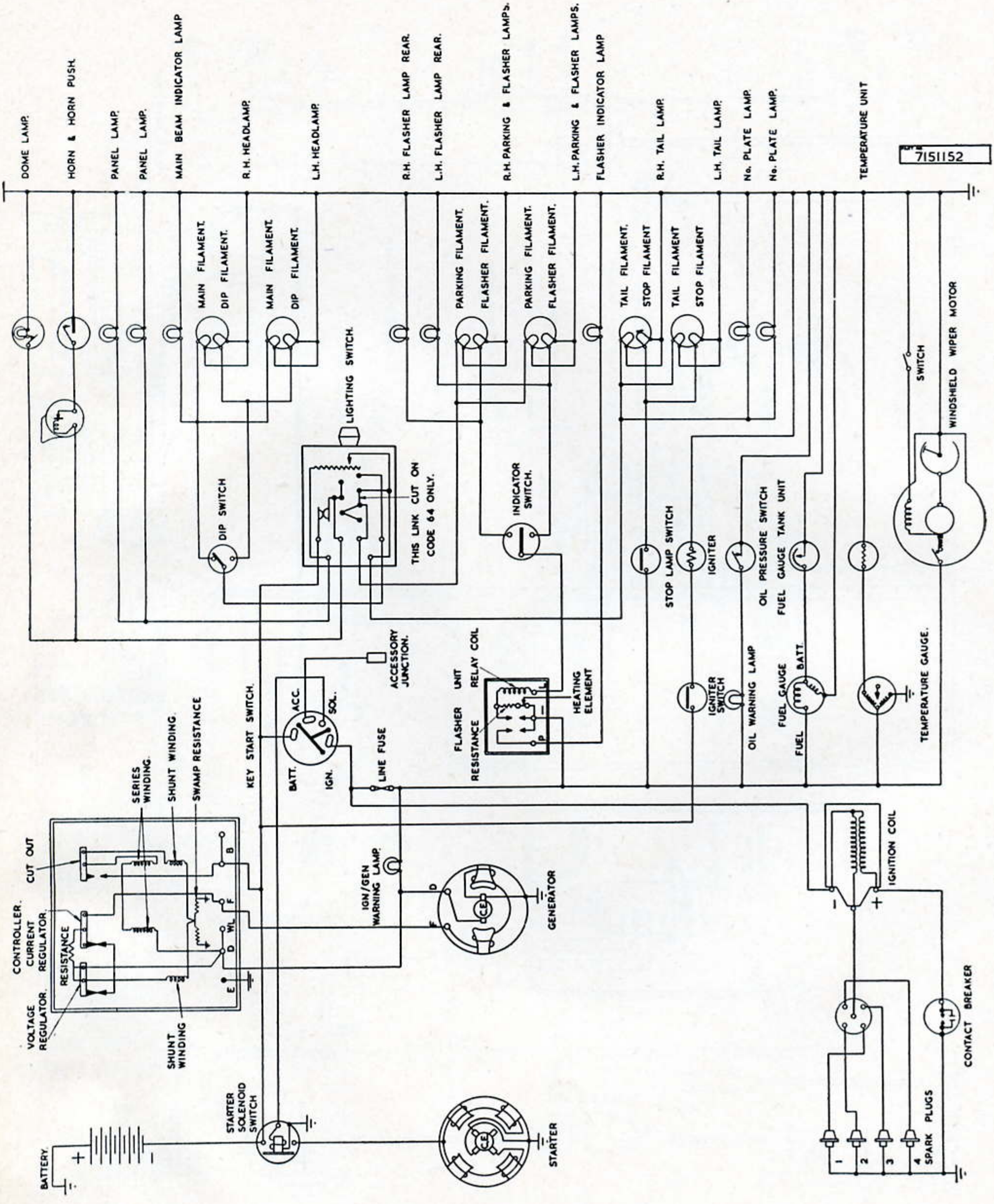


Fig. V.3. Wiring diagram (theoretical)—all models

SECTION W—BODY AND CHASSIS FRAME

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BODY REPAIRS	W - 9
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Have you read the General Notes on page vii ?

DESCRIPTION

Body

The body is of all-steel construction except for a detachable plywood floor. The roof is a one-piece steel pressing supported on pressed steel hoops. The body sides are one-piece steel pressings strengthened by inner steel panels which extend upwards to the waist.

The front doors are carried on rollers, top and bottom, and slide on the outside of the body. Each door contains one fixed and one sliding glass window mounted in a metal frame. The door on the driver's side is locked by the ignition key whereas the opposite door is locked from the inside by a turn-button. The front doors and door apertures on CAL are wider than those on CAS, and the CAL body floor is extended a corresponding amount at the front by means of a metal panel.

Each rear door is fitted with a glass window mounted in a rubber glazing channel. The doors are carried on self-aligning hinges and are locked by the ignition key.

The body is fitted with a one-piece windshield carried in a rubber weatherstrip incorporating a chrome-faced insert.

Chassis Frame

The chassis frame is of the cruciform type (see Fig. W.10 on page W-10) incorporating three crossmembers in addition to the cruciform member. The front crossmember is detachable.

GUARDIAN MAINTENANCE

Door Lock Barrels

Lubricate the lock barrels with an oil specially developed for the purpose, such as 'Slip' lock oil. This lubricant has the added advantage of an anti-freeze property which prevents freezing of the barrels down to $-40°$.

Door Hinges and Rollers

Lubricate the hinges of the back doors and front centre panel, and the front door rollers, with engine oil. Access to the lower rollers is from underneath the vehicle.

Door Catches and Check Links

Lightly coat the working surfaces of the door and front centre panel catches, and the back door check links and locking rods, with high melting point grease.

BUMPERS AND BRACKETS

Removal

Front Bumper

1. Remove the nuts and bolts securing the bumper brackets to the chassis frame.

2. Remove the nut and bolt securing one of the brackets to the bumper, withdraw the bumper and lift away the remaining bracket.

Rear Bumper

1. Remove the nuts and bolts securing the support to the bumper bracket and chassis frame.

2. Remove the nuts and bolts securing the bumper brackets to the frame, and withdraw the bumper.

Installation

Note the following:

1. Check the condition of the grommets before installing the bumpers.

2. Assemble the front bumper brackets to the chassis frame before installing the bumper.

3. Do not tighten the bolts until all of them are installed.

RADIATOR GRILLE AND MOULDINGS

Removal

1. Remove the eight securing screws and lift away the grille.

2. Remove the nut and washer securing each side moulding. Remove the mouldings. If a side moulding only is to be removed, slacken the grille bottom side attaching screw to release the inner end of the moulding.

Installation

Do not tighten the side moulding nuts until the grille is located.

FRONT LOWER PANEL

Removal

1. Disconnect the head lamp, parking lamp and horn wires at the connectors, and detach the wires from the clips. Pull the wires through the grommets in the splashguard panels.

2. Remove the front bumper.

3. Remove the following nuts, bolts and plain washers securing the front lower panel: six each side attaching the panel to the front side panels, one each side at the top and four at the front attaching the panel to the radiator support frame. The two lower bolts at the front are obscured by the bottom moulding.

4. Lift away the panel.

Disassembly

1. Remove the head lamps and parking lamps.

2. Remove the radiator grille and mouldings.

Reassembly

Note the following:

1. Refer to page S-4 when installing the head lamps.

2. When installing the radiator grille and mouldings, refer above.

Installation

Note the following:

1. Smear all sealing strips with rubber adhesive before installing.

2. Install all panel securing bolts before tightening.

3. Secure all wires with the appropriate clips and check the connections with wiring diagrams in Section V.

4. Check the operation of the lamps and horns.

FRONT SIDE PANELS

Removal

1. Remove the front lower panel.

2. Remove the three nuts, bolts and plain washers securing the side panel to the centre hinged panel land.

3. Remove the screw at the bottom rear corner securing the panel to the door front pillar.

4. Ease the panel outwards and towards the rear to disengage it from the door pillar.

Installation

Note the points under 'Front Lower Panel—Installation'.

WINDSHIELD

The safety glass windshield is either toughened or laminated plate. Each glass can be identified by the manufacturers marks etched in the centre at the bottom of the glass.

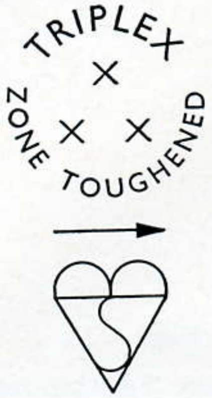

Fig. W.1. Toughened glass windshields can be identified by this symbol etched in the centre at the bottom of the glass. The arrow points to the side of the glass containing the modified zone

Removal

1. Remove the windshield wiper arms and blades.

2. Remove the glass weatherstrip insert. The ends of the insert should be in the centre at the top of the glass.

3. Where a toughened glass windshield is used, remove the glass by bumping with the palm of the hand from inside the vehicle. Leather or thick cloth gloves should be worn as a precaution in the event of the glass breaking. Where moderate bumping with the hand fails to free the glass and weatherstrip, a steady foot pressure may be applied, using thick felt pads between the feet and glass to distribute the pressure evenly.

Before removing a shattered toughened glass, protect the surrounding paint and cover air ducts.

4. When removing a *laminated* glass, cut away the lip of the weatherstrip on the outer side and as close to the edge of the glass as possible. Then carefully push the glass outwards. *Do not bump the glass out as this may cause it to fracture.*

5. Remove the weatherstrip from the glass or aperture.

Inspection

1. If the glass or weatherstrip is to be used again, clean off the old sealing compound.

2. Check the glass for chipped edges; these are potential sources of cracking.

3. Where the glass is removed in order to correct water leaks or for replacement due to breakage, it is important to check the windshield aperture for distortion or damage. For this purpose, the glass can be used as a template as follows:

(*a*) Support the glass in the aperture with four checking blocks located as shown in Fig. W.2 and check that the spacing between the edge of the glass and the aperture flange is uniform and the contour of the flange compares favourably with that of the glass.

(*b*) Mark any areas of the aperture requiring correction, then remove the glass and checking

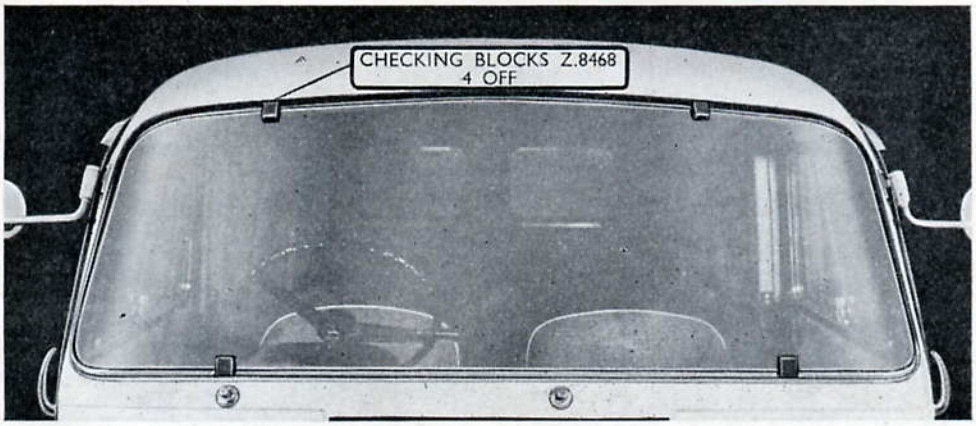

Fig. W.2. Windshield glass supported in body aperture by blocks when checking aperture for distortion or damage

blocks, re-form the aperture and rebate as necessary and re-check with the glass.

NOTE: *Care should be taken to avoid scratching the glass or chipping the edges when using the glass as a template.*

Installation

1. Before installing a toughened glass, check that the modified zone is on the driver's side (Fig. W.1).

2. Fit the weatherstrip to the glass so that the corners are correctly positioned.

3. Run a length of cord around the groove of the weatherstrip, arranging a crossed loop at the top and crossed ends at the bottom.

4. Apply sealing compound all round the aperture flange. Sealers suitable for the operation are: Bostik No. 6, Seelastik, Glasticon 234, or 3M Brand Weatherstrip Adhesive.

5. Place the windshield into the aperture so that the cords are on the inside. With pressure applied from the outside, lift the lip of the weatherstrip over the aperture flange by pulling the cords in opposite directions (Fig. W.3).

6. Inject sealing compound between the glass and the weatherstrip.

7. Clean off any surplus sealer with white spirit.

8. Smear the insert groove in the weatherstrip with soft soap and install the insert, using a wooden spike as shown on Fig. W.4. The ends of the insert should meet in the centre of the top of the glass.

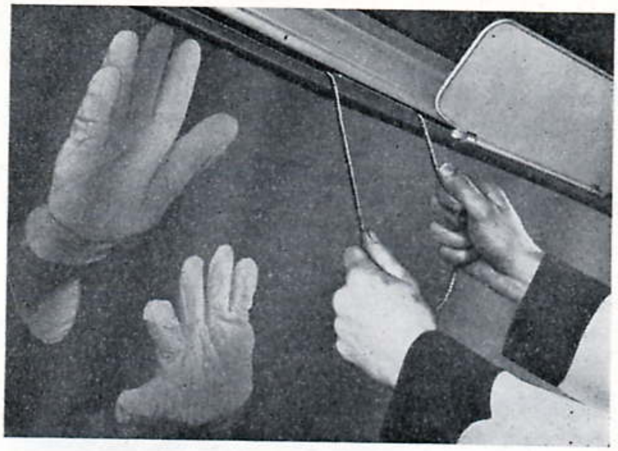

Fig. W.3. Installing the windshield glass. With pressure applied to the outside, a cord is used to lift the weatherstrip lip over the body aperture flange

9. Check the sealing of the windshield by spraying with water.

10. Install the windshield wiper arms and blades (page U-2).

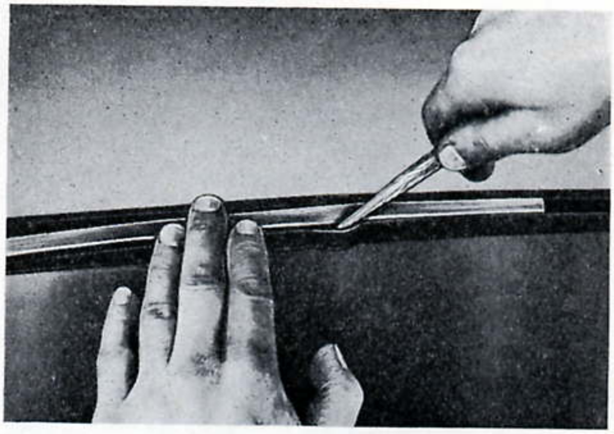

Fig. W.4. Installing the windshield weatherstrip insert, using a wooden spike

FRONT DOOR HANDLES

Removal

1. Press back the door inside handle escutcheon, and tap out the handle retaining pin.

2. Withdraw the handle, escutcheon and spring.

3. Remove the screws securing the outside handle and withdraw the handle, retaining plate and gasket.

Installation

Apply recommended lubricant to the rubbing surfaces before installing the handles.

FRONT DOOR LOCK

Removal

1. Remove the door handles.

2. Remove the lock securing screws and cover plate, and withdraw the lock.

Installation

Apply recommended lubricant to the lock and rubbing surfaces of the handles before installing.

FRONT DOOR GLASSES

Removal

1. Using a flat-ended tool, drive out the wedges (Fig. W.5) securing the window frame to the door. If a wedge is difficult to remove, apply pressure to the outside of the frame and opposite the wedge to be removed.

2. Ease the window frame outwards from the aperture.

3. Remove the weatherstrip from the window aperture flanges.

Glass Renewal

Remove the screw at each end of the frame and separate the two halves. Remove the existing glasses, install the new and reassemble the frame. Do not over-tighten the securing screws.

Installation

1. Clean the flanges of the window aperture and check for burrs or distortion.

2. With the joint at the top, install the weatherstrip on to the aperture flanges.

3. Smear the outer faces of the weatherstrip with soft soap, place the window assembly into the aperture and push the frame inwards to fully locate on the weatherstrip. Care is necessary to avoid displacing the weatherstrip.

4. With pressure applied to the outside edge of the window frame, insert each wedge into a slot in the frame so that the step in the wedge (Fig. W.6) is facing the interior of the vehicle.

5. Tap each wedge into position so that it locates over the inside flange of the weatherstrip. Each wedge should be driven in carefully to avoid tearing the weatherstrip.

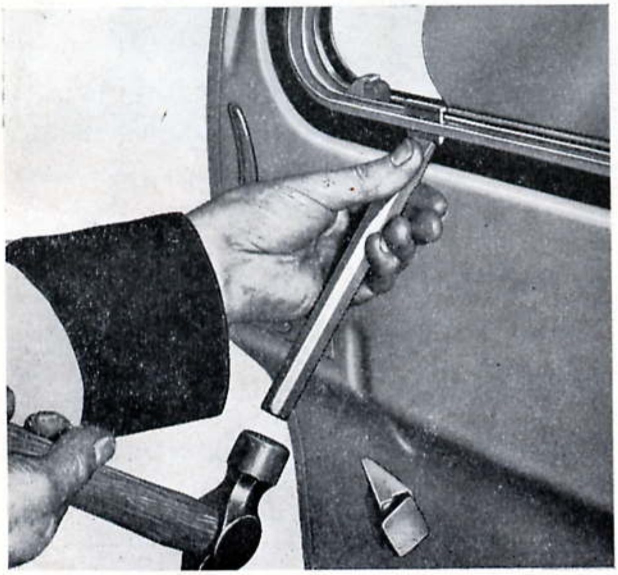

Fig. W.5. Removing one of the wedges securing a front door window frame

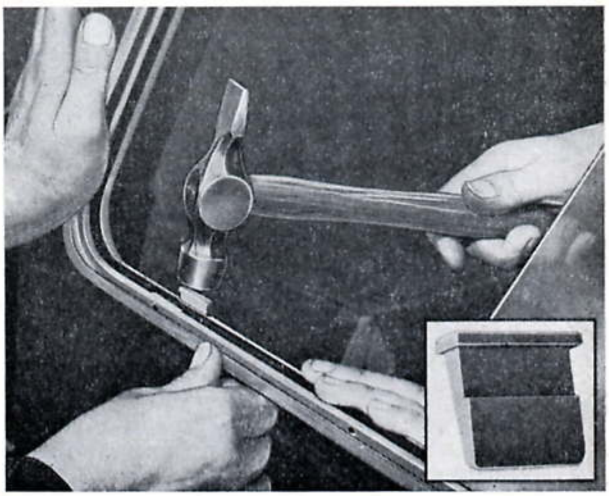

Fig. W.6. View from outside of vehicle showing installation of one of the wedges securing the window frame to the front door. Inset shows wedge step which must face towards *interior* of vehicle

DOME LAMP

Bulb Renewal

To gain access to the bulb, rotate the lamp lens and at the same time pull downwards. When installing the lens make sure that the lips of the retaining springs engage the slots in the lens.

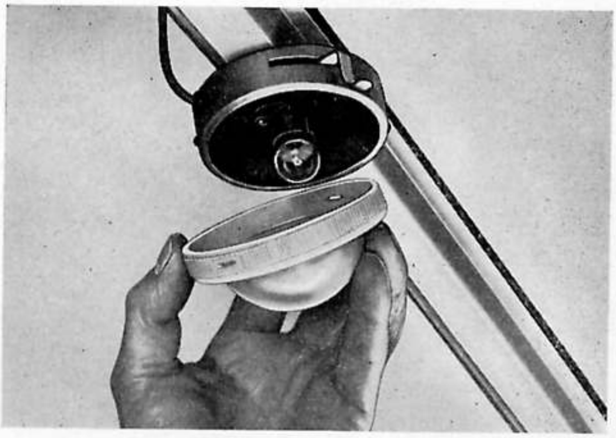

Fig. S.9. Dome lamp details

Removal

1. Disconnect the battery.

2. Rotate the lamp lens and at the same time pull downwards. Detach the feed wire.

3. Remove the securing screws and lift away the lamp.

Installation

Note the following:

1. Install the lamp so that the switch lever is towards the front of the vehicle.

2. When installing the lens, make sure the lips of the retaining spring engage the slots in the lens.

THERMAL CIRCUIT BREAKER

The circuit breaker is incorporated in the lighting switch which must be removed if the circuit breaker requires testing.

Testing

Connect the junction and battery terminals of the lighting switch (Fig. S.10) to a 12 volt battery, with a variable resistance and a 0–40 ammeter inserted in series in one of the leads (Fig. S.11). The contacts should remain closed when subjected to a current of 22 amperes but should open within 30 to 180 seconds at 21°C (70°F) with a current of 33 amperes.

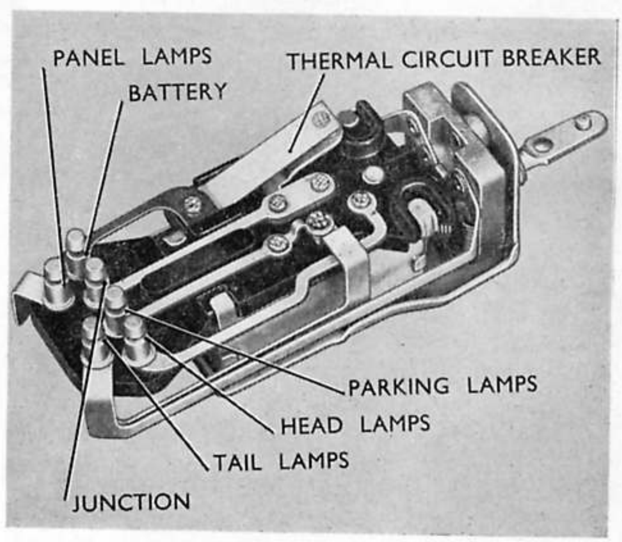

Fig. S.10. Lighting switch details

FRONT DOORS

Removal

1. Remove the two screws securing the door stop to the inside of the door panel.

2. Close the door and remove the two screws and roller retaining plate from the top slide channel adjacent to the rear edge of the door.

3. Slide the door rearwards until the top rollers are opposite the cut-away in the slide channel.

4. Lift the door up and outwards at the top allowing the top rollers to pass through the cut-away, then lower the door to release the bottom rollers from the slide channel.

Installation

Lubricate the door rollers and slide channels with recommended grease.

BACK DOOR GLASSES

Removal

1. Using a blunt awl, ease the inner lip of the glazing channel over the side and top edges of the door panel.

2. With the glass supported, apply outward pressure at the top and lift the bottom lip of the channel over the panel. Withdraw the glass and glazing channel.

3. Remove the glazing channel from the glass.

Installation

Note the following:

1. After assembling the glazing channel to the glass, run a length of cord around the groove in the channel and cross the ends about half-way along the bottom.

2. Assemble the glass so that the bottom lip of the glazing channel locates over the flange of the door panel. Press downwards and inwards and pull the cord ends to lift the lip of the channel over the flange (Fig. W.7).

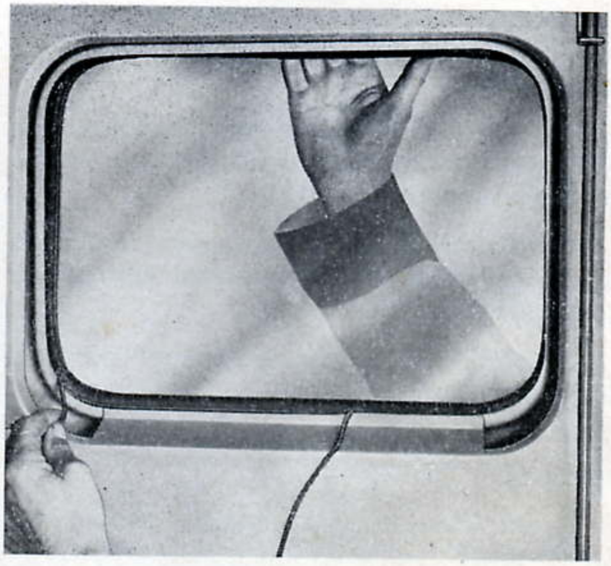

Fig. W.7. Installing the back door glass and glazing channel

BACK DOORS AND HINGES

Removal

1. Remove the rivet securing the door check link to the door pillar.

2. Remove the bolts securing the hinges to the door.

3. Remove the cover panel inside the body and behind the door bottom hinge.

4. Remove the hinge securing nuts and bolts.

Installation

Note the following:

1. Lubricate the hinge pins, check links and door locking rods with recommended grease.

2. Adjust the door locking rod guides so that when shut the door does not rattle.

BODY ASSEMBLY

Removal

1. Disconnect the battery.

2. Drain the radiator.

3. Remove the radiator grille and front bumper.

4. Remove the following nuts, bolts and plain washers: six each side securing the front lower panel to the side panels, and five each side securing the radiator support frame to the wing splash-guards.

5. Detach the head lamp, parking lamp and horn wires at the connectors and release the harness where clipped to the radiator support panel.

6. Disconnect the radiator and heater hoses.

7. Remove the two nuts, bolts and retainers securing the radiator support to the chassis frame crossmember.

8. Lift away the front lower panel complete with radiator, and remove the insulators and ferrules from the support frame.

9. Withdraw the steering drop arm (see Section M) and remove the bolts securing the steering gear to the chassis frame.

10. Disconnect the gear shift control rods from the selector levers.

11. Disconnect the wire from the water temperature gauge engine unit.

12. On diesel-engined models, remove the igniter supply tank from its support bracket.

13. Remove the nuts and lockwashers and withdraw the clutch and brake pedals.

14. Remove the air cleaner.

15. Disconnect the main and engine wiring harness at the connectors on the side of the foot-well panels, and remove the screw securing the earth wire. Detach the harness where clipped to the body.

16. Disconnect the throttle control rods from the cross-shaft levers and the controls from the carburetter or fuel injection pump.

17. Remove the body floor boards.

18. Disconnect the cables from the starter and the wires from the stop lamp switch.

19. Disconnect the speedometer cable from the transmission.

20. Disconnect the parking brake lever link from the bell crank lever.

21. Disconnect all rear lamp wires at the connectors, and detach the wires where clipped to the chassis frame.

22. Slacken the clips securing the fuel tank filler pipe hose, and slide the filler pipe and vent pipe hoses clear of the tank pipes.

23. Remove the twelve bolts securing the body to the chassis frame. The two bolts each side at the front have larger heads than those adjacent.

24. Lift off the body, ensuring that wiring harness and controls are free from obstruction.

Installation

Note the following:

1. Before installing the body, position all mounting pads and the two mounting strips, at the body attachment points on the chassis frame. In addition, place two sealing strips along each side-member, one in line with the battery the other above the rear axle.

2. Do not tighten any body securing bolts until all have been fitted.

3. Check that the wiring harness is not trapped or will become chafed.

4. Tighten the steering gear attaching bolts to the specified torque (see Section M).

5. Adjust the gear shift control rods (see Section F).

6. Refer to Section D when assembling diesel engine controls.

7. When installing the front lower panel, refer to page W-3.

8. Refer to the wiring diagrams in Section V when reconnecting the wiring harness.

9. Check the operation of all lights and controls.

BODY REPAIRS

Minor body damage can be corrected in the normal way with hydraulic body repair equipment. Consideration must, however, be given to probable distortion sustained by other body members in addition to the obviously damaged parts. For example, an impact involving a side panel may also have caused the less apparent distortion of the underbody crossmembers and the body mounting brackets on the chassis frame sidemembers, also the floor panel wheelarch reinforcement.

Where extensive buckling and tearing of the body is encountered, the most economical and satisfactory repair may be to cut away the damaged parts and weld in new panels or members.

In those cases of major damage to the vehicle, the body assembly must be removed to enable an alignment check to be carried out on the chassis frame. The principal dimensions shown in Figs. W.8 and W.9 will assist in determining body distortion.

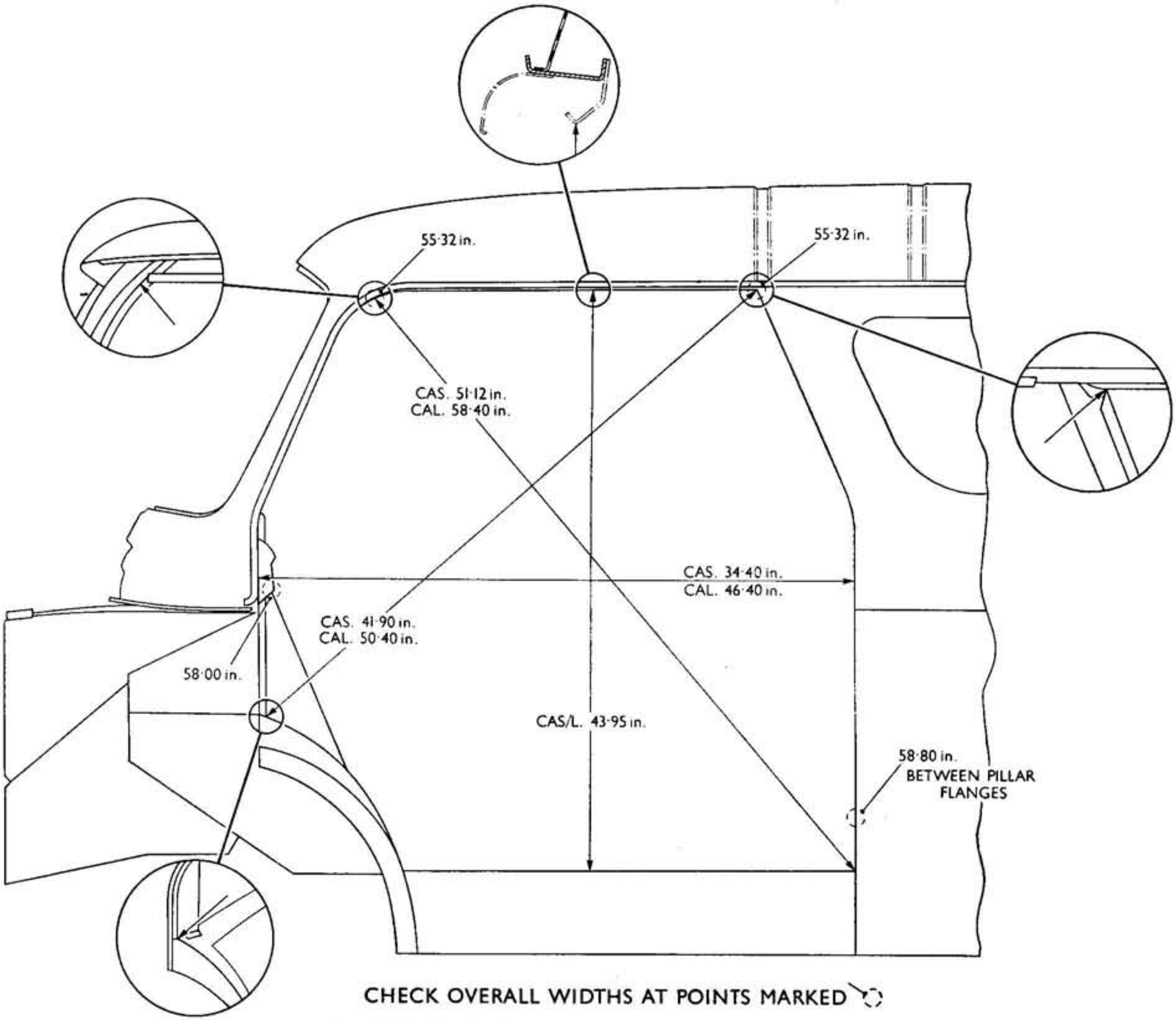

Fig. W.8. Body front door aperture dimensions

CHASSIS FRAME

Checking Alignment

Reference should be made to Fig. W.10 when checking the alignment of a chassis frame which has sustained accidental damage. A check of the dimensions between the datum points shown and making a cross check at the dotted lines will reveal where the distortion exists.

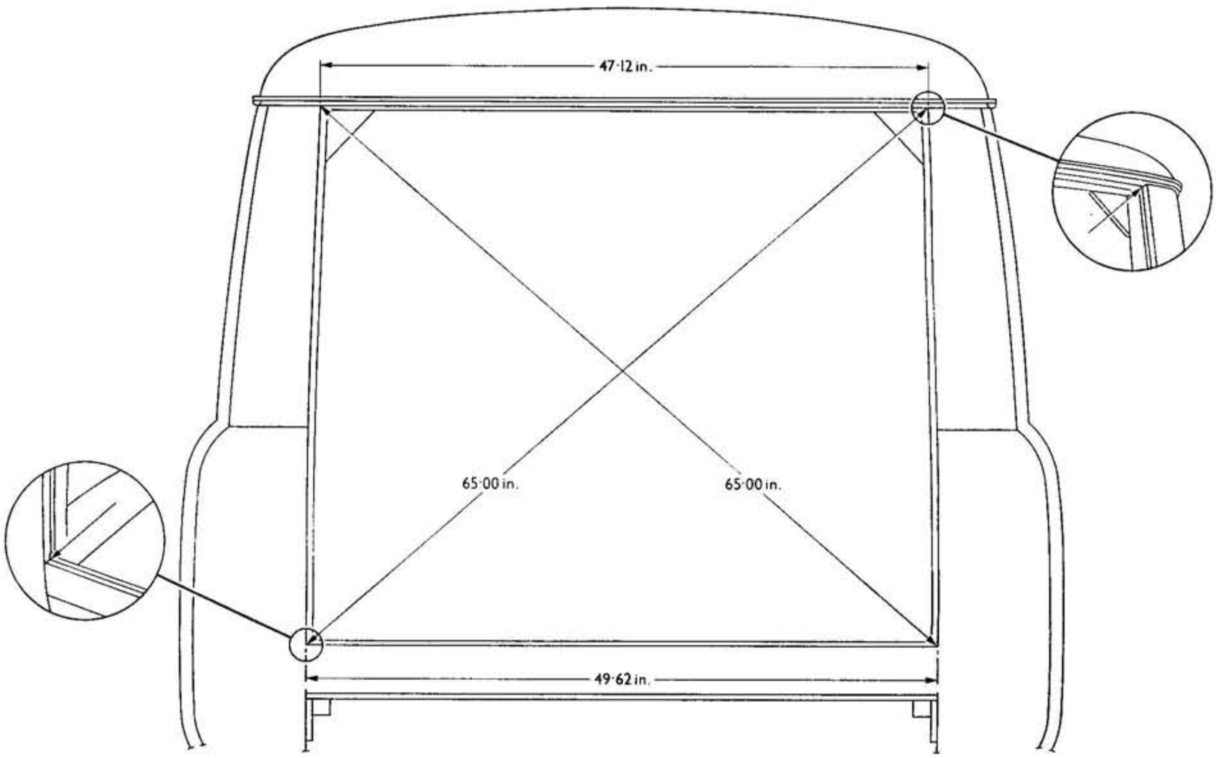

Fig. W.9. Body back door aperture dimensions

Frame Straightening

It is permissible to straighten the frame if the damage is not excessive. Whenever possible the frame should be straightened cold. If, however, it is necessary to heat the frame to rectify damage, the following precautions should be taken:

The damaged area should be heated to full cherry red as rapidly as possible before attempting to straighten the members. The member should be re-heated to full cherry red as necessary during the straightening operation and finally allowed to cool slowly.

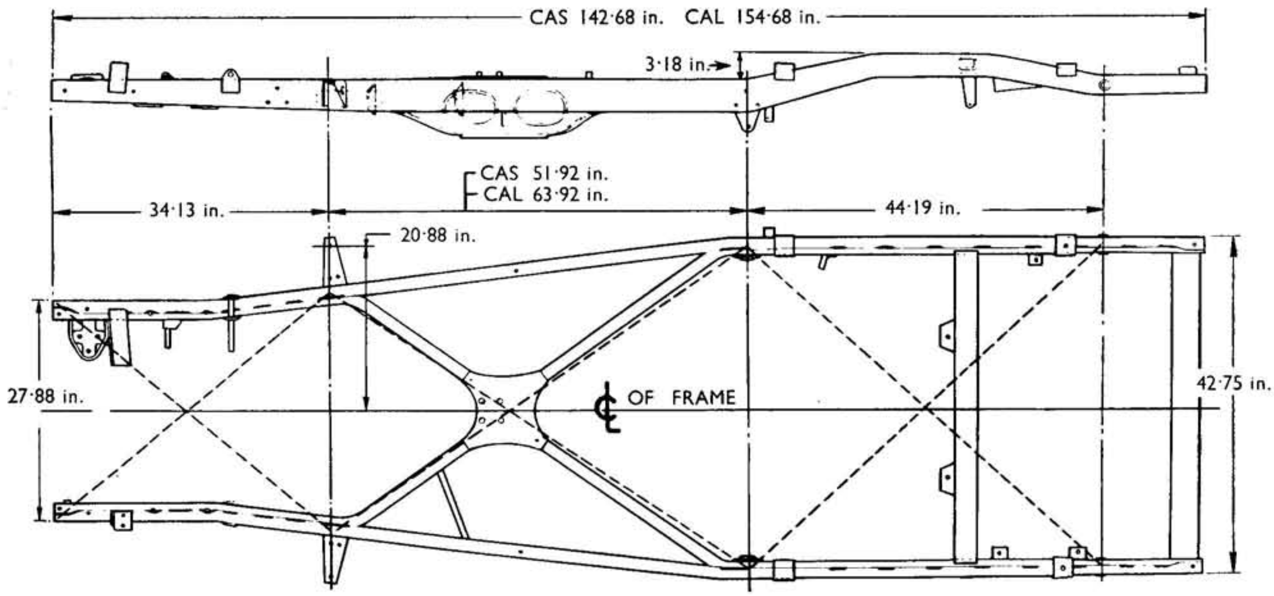

Fig. W.10. Chassis frame dimensions

SECTION X—VENTILATION AND HEATING

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Have you read the General Notes on page vii ?

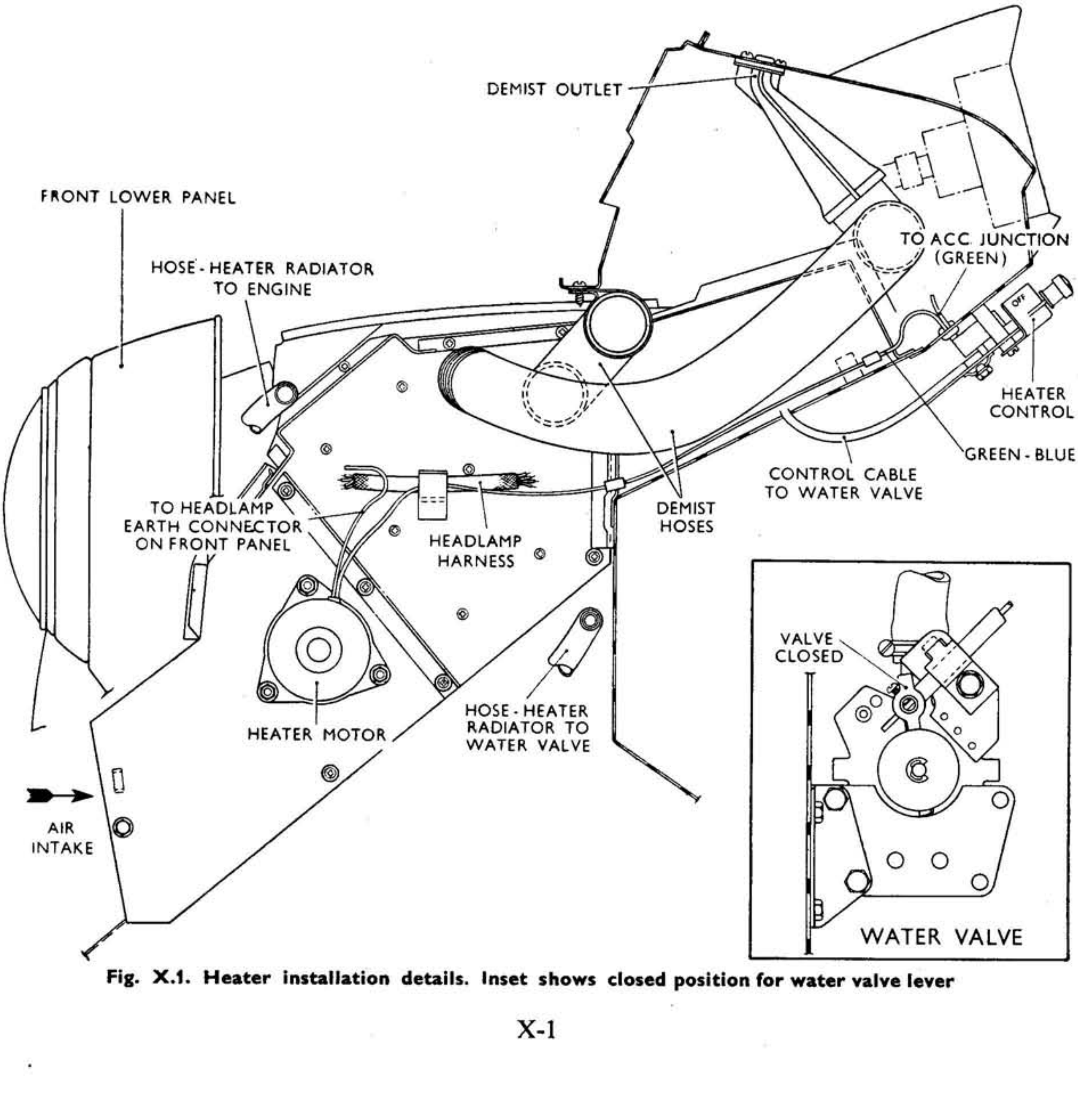

Fig. X.1. Heater installation details. Inset shows closed position for water valve lever

DESCRIPTION

Controlled interior ventilation is provided by an air duct attached to each front splashguard panel. The front end of the ducts are screened and connect with an aperture in the body front lower panel. A spring-loaded flap at the rear of each duct and mounted on the scuttle panel, controls entry of air from the duct to the interior of the vehicle. Each flap is operated by a rod located below the instrument panel.

When a heater is installed (Fig. X.1), the heater radiator and motor is mounted in place of the air duct panel and demist hoses are connected to the outlets in the top of the instrument panel and adjacent to the windshield. The heater control, mounted on the driver's side below the instrument panel is connected by cable to a water valve in the heater hose circuit and also incorporates a switch connected to the heater motor.

With the control in the 'HEAT' or 'MAX' positions, warm air is directed through the demist hoses and on to the windshield. At the same time, the flow of warm air into the vehicle below the instrument panel can be regulated by means of the ventilator flaps.

To boost the air flow the heater motor can be switched on by pulling out the knob on the control lever. The switch circuit is operative only when the key start switch is in the on position.

TROUBLE DIAGNOSIS

Insufficient or No Heat from Heater

Control Cable Incorrectly Adjusted. Check the operation of the water valve lever, and if necessary, re-adjust the cable (page X-4).

Water Valve Faulty. Failure of the water valve, causing obstruction to water flow to the heater radiator, will restrict output from the heater. Renew the water valve.

Engine Cooling System Thermostat Faulty. If the thermostat is defective, the temperature of the water in the engine cooling system and heater radiator may not rise sufficiently for satisfactory heating of the vehicle interior, even after prolonged running of the engine. Check, and if necessary, renew the thermostat.

Heater Runner (Fan) Loose on Motor Spindle. If the nut securing the runner to the motor spindle is loose the motor will rotate without turning the runner. Where necessary remove the heater, and re-locate and secure the runner.

Water Hoses or Heater Radiator Obstructed. Kinked or perished hoses, or sediment build-up in these or the heater radiator, will affect the efficiency of the heater. Reverse flush the heater radiator. If water flow is still inadequate, remove the heater radiator and clear the water passages with a chemical cleaner, or install a new radiator.

Heater Motor Inoperative

Intermittent or complete failure may be due to a blown line fuse or a fault in the wiring connecting the heater motor to the switch.

A fault in the internal wiring of the motor can be determined by connecting a jumper lead from a known source direct to the motor feed wire. If the motor still fails to operate, it should be renewed.

HEATER RADIATOR AND MOTOR

Removal

1. Drain the cooling system.

2. Detach the heater motor wires at the connectors.

3. Disconnect the demist hoses from the heater.

4. Disconnect the water hoses from the heater radiator. Note the positions of the hoses so that they can be reassembled correctly.

5. Remove the thirteen screws securing the heater radiator and motor covers to the splashguard and volute housing, also the nut and bolt at the front, securing the heater inlet panel.

6. Remove the radiator cover, lift out the radiator and remove the bottom cup from the splashguard panel.

7. Lift out the motor and cover assembly.

SECTION Q—STARTING SYSTEM

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Have you read the General Notes on page vii?

DESCRIPTION

The components incorporated in the starting system are the starter, solenoid starter switch, battery, and key start switch. A cold starting aid is also incorporated on diesel-engined models.

Starter

An M35G type starter is used on the gasoline engine and an M45G type on the diesel engine. Both types of starter are very similar in construction.

The starter, secured to the clutch housing by two bolts, is a series-parallel wound four-pole motor incorporating an inertia-operated pinion designed to crank the engine and automatically disengage when the engine starts.

The principle features are a field system mounted in a cylindrical yoke, brush gear integral with the commutator end bracket, an armature carrying the drive mechanism and a drive end bracket. The yoke and end brackets are secured together by two through bolts.

The field coil windings on the M35G starter are of aluminium strip, and of copper strip on the M45G starter. Four copper-carbon brushes are spaced at 90°. Two opposite brushes and the holders are earthed to the commutator end bracket whilst the other pair have insulated holders and are connected to the field coil system. Each end bracket incorporates a sintered-bronze bush in which the armature is supported.

Starter Drive

Incorporated in the in-board type drive is a thrust spring so arranged to counteract shock

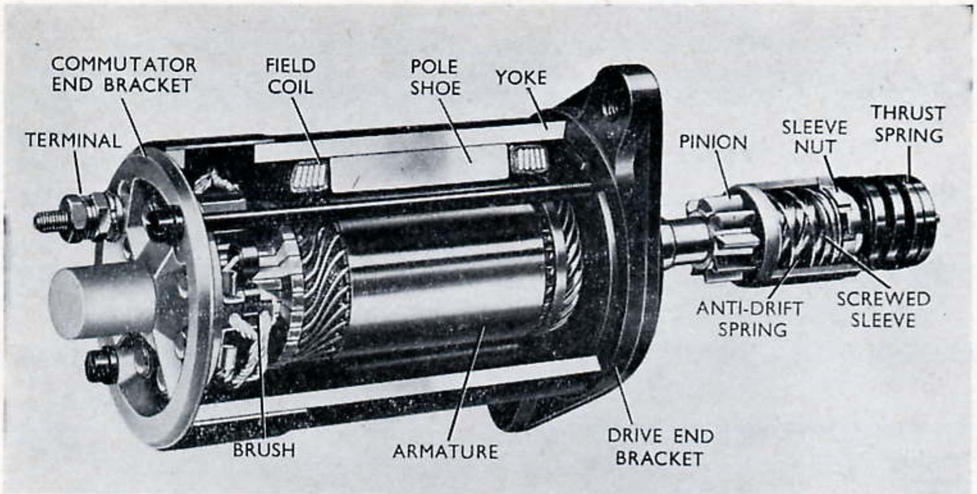

Fig. Q.1. Cut-away view of starter

loading upon engagement of the pinion with the flywheel ring gear. A pinion anti-drift spring is provided to prevent the pinion vibrating into mesh with the ring gear whilst the engine is running.

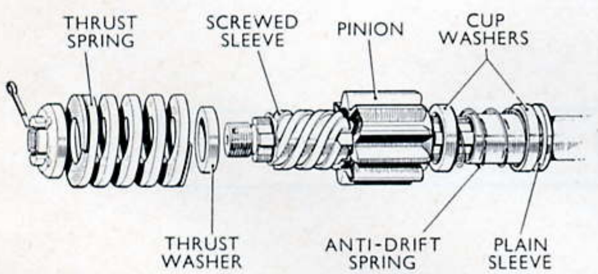

Fig. Q.2. Details of the starter run-off helix drive used on diesel-engined models

To prevent overstressing the armature, the M45G starter incorporates a run-off helix drive as shown in Fig. Q.2.

Key Start Switch

The same type of switch is used on both the gasoline and diesel-engined models, and is described on page R-3.

Solenoid Starter Switch

The solenoid starter switch is a sealed unit. It is attached to the body mounting bracket adjacent to the battery by two nuts and bolts. At the inner end of the switch, a rubber cap masks the end of the solenoid plunger by which the switch can be manually operated.

Cold Starting Aid

This is standard equipment on diesel-engined models and comprises a supply tank and igniter.

The supply tank (Fig. Q.4) is mounted on the engine cowl right-hand side panel. The igniter (Fig. Q.3), comprises a tubular valve body secured to a holder screwed into the intake manifold, and surrounded by a heater coil, an extension of which forms an igniter coil. The valve body houses a needle, the stem of which retains a ball valve in position against its seating. The valve body and the heater igniter coil is enclosed by a perforated shield which projects into the manifold. The igniter is connected to the supply tank by a flexible pipe.

The igniter switch is of the push type mounted on the instrument panel.

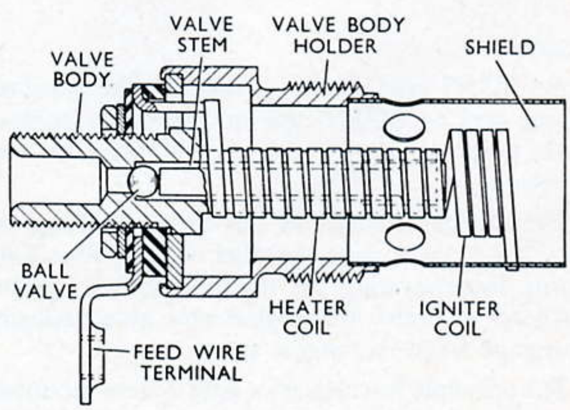

Fig. Q.3. Sectioned view of igniter for diesel engine

OPERATION

Starter

When the key start is operated the starter solenoid switch is energized thus completing the starter circuit. Rotation of the armature causes the pinion to move along the screwed sleeve and engage with the flywheel ring gear. When fully in mesh, further forward movement of the pinion is prevented by the pinion contacting a shoulder on the shaft (or plain sleeve on the M45G starter), and the pinion drive is taken via the screwed sleeve and the splines on the armature shaft. As the screwed sleeve is a sliding fit on the shaft, the sleeve can move towards the rear of the shaft against the resistance of the thrust spring, and in this manner the shock loading of initial pinion engagement is absorbed.

On the M45G starter the pinion can become disengaged from the screwed sleeve under conditions of engine backfire, and allowed to run free. When this occurs the screwed sleeve moves along the armature shaft, against the pressure of the thrust spring and out of engagement with the pinion. Immediately the loading on the thrust spring is relieved the screwed sleeve re-engages the pinion which resumes its normal position.

Cold Starting Aid

When the igniter is switched on, the heat from the coil expands the valve body, thus opening the ball valve and allowing fuel to flow on to the coils. The fuel is vaporized and mixes with air drawn into the manifold when the engine is cranked, to form a combustible mixture which is ignited by the heater coil extension. The flame, protected by the shield, heats the air drawn into the cylinder.

When the unit is switched off, the valve body cools and the valve closes.

TROUBLE DIAGNOSIS

Starter will not Operate

Loose Connections or Broken Cable. Tighten loose terminal connections or renew the broken cable.

Key Start Switch or Solenoid Starter Switch Faulty. See under 'Starter Operation Sluggish'.

Fault in Starter. If no defect is found during the foregoing checks it will be necessary to remove the starter from the vehicle and bench test.

Starter Pinion will not Engage

This condition is usually caused by dirt or excessive wear which prevents the pinion sleeve nut running along the screwed sleeve.

Starter Pinion will not Disengage

If the starter pinion is jammed in mesh with the flywheel ring gear, a click will be heard from the solenoid starter switch when the key start switch is operated. The pinion can be freed from the flywheel ring gear by rotating the squared external front end of the armature shaft after removing the cover. The cause can be attributed to dirt on the screwed sleeve of the starter drive or damaged pinion and/or flywheel ring gear teeth.

Starter Rough or Noisy

If the starter is not loose on its mounting it can be assumed that the starter pinion and flywheel ring gear teeth are worn or damaged, or the starter bearings worn excessively. Remove the starter and check the condition of the engaging teeth. If satisfactory, disassemble and examine the unit.

Starter Operation Sluggish

Loose Connections or Partly Broken Cable. Either of these faults will reduce the flow of current and eventually lead to a complete breakdown with the possible danger of short circuit. Check and tighten all connections. Renew frayed cables.

Solenoid Starter Switch Faulty. This switch is a sealed unit located adjacent to the battery. Test the switch as described on page Q-4.

Key Start Switch Faulty. Before renewing the unit make sure that current is reaching the switch. Examine the multi-socket connector to ensure that the pins are making contact.

Starter Brushes Worn or Sticking. If the brushes are worn below the minimum permissible length they should be renewed, otherwise loss of brush spring tension will result in poor brush to commutator contact. Brushes sticking in their holders, or broken springs, will cause a similar condition.

SOLENOID STARTER SWITCH

Testing Switch on Vehicle

Operate the key start switch, when a click should be heard from the solenoid. This indicates that the solenoid contact bridge is moving. If a click cannot be heard, proceed with the following tests:

1. Connect a 0–20 range voltmeter across the switch small terminal and earth. Operate the key start switch when a reading of 12 volts should be obtained. If no reading is obtained, current is not reaching the solenoid due to a faulty key start switch or wiring.

2. If a reading of 12 volts is obtained in the first test, disconnect the voltmeter and insert an 0–10 range ammeter in the switch wire, and operate the key start switch. A reading of 4 to 6 amperes should be recorded if the solenoid winding is in good condition. If a reading is not obtained, renew the solenoid switch.

3. Connect the 0–20 range voltmeter across the terminals; a reading of 12 volts should be obtained. Operate the key start switch and if the solenoid contacts are closing, the voltmeter reading should drop to zero. If the reading fails to drop to zero, renew the switch.

Removal

1. Disconnect the battery.

2. Disconnect the cables and wires from the switch.

3. Remove the nuts, lockwashers and bolts securing the switch to the body mounting bracket.

Installation

Connect the cables and wires to the switch as follows:

1. The battery positive cable to earth by the switch lower attaching bolt.

2. The starter cable to the front main terminal.

3. The white-red wire to the small terminal.

4. The battery negative cable and the brown wire to the rear main terminal.

IGNITER SUPPLY TANK

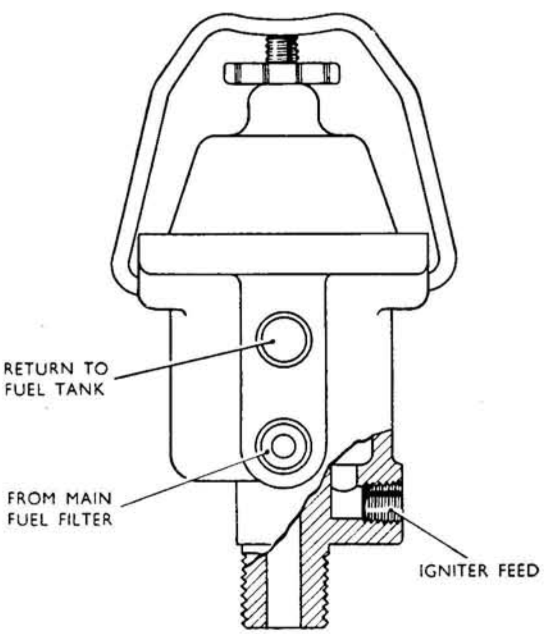

Fig. Q.4. Part-sectioned view of igniter supply tank

Removal

1. Disconnect the three fuel pipes.

2. Remove the nut and lockwasher from the adaptor and remove the supply tank and adaptor from its bracket.

Installation

Note the following:

1. Ensure the adaptor is tight on the supply tank.

2. Refer to Fig. Q.4 when connecting the fuel pipes.

IGNITER

Servicing of the igniter is confined to periodic cleaning of the flame shield by brushing off carbon deposit and ensuring all perforations are clear.

STARTER

Checking Starter Circuit

When dealing with complaints of faulty starter operation, the following points should be checked prior to removing the starter for bench test.

(*a*) Condition of the battery.

(*b*) Battery terminal connections.

(*c*) Starter circuit cables and connections.

(*d*) Operation of the solenoid starter switch (page Q-4).

Removal

Gasoline-engined Models

1. Remove the engine cowl centre and lower centre panels.

2. Remove the starter upper securing bolt.

3. Raise and support the vehicle and on left drive vehicles, disconnect the gear shift upper rod from the transmission selector lever. Remove the starter lower securing bolt.

4. On right drive vehicles, remove the bolts securing the engine front mountings to the support brackets, and raise the engine about ·50 in.

5. Move the starter forward, detach the cable and withdraw the unit forwards and downwards.

Diesel-engined Models

1. Remove the engine cowl centre and lower centre panels.

2. Disconnect the cable and earth wire from the starter.

3. Remove Nos. 1 and 2 injector pipes and No. 2 banjo connector from the fuel injection pump. *Seal the delivery ports and protect the pipes and connector against the entry of dirt.*

NOTE: *Before disconnecting the pipes, clean the area around the pipe unions and banjo. A small particle of dirt is sufficient to cause a malfunction of the fuel injection equipment.*

4. Remove the attaching bolts and withdraw the starter upwards.

Disassembly

1. Remove the commutator cover band.

2. Remove the through bolts.

3. Tap the drive end bracket off the yoke and withdraw the armature and drive end bracket assembly (Fig. Q.5).

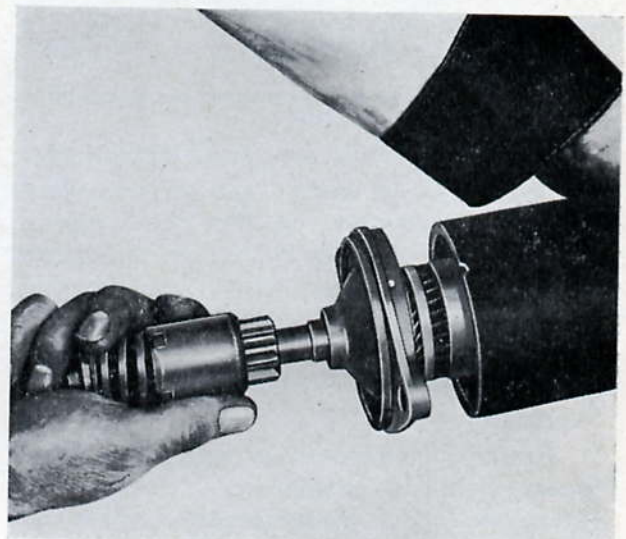

Fig. Q.5. Withdrawing the armature complete with starter drive from the yoke

4. Remove the two insulated brushes from the holders.

5. Remove the terminal nut, and the plain and insulating washers from the terminal post. Remove the spacer from the post insulating sleeve.

6. Remove the commutator end bracket and withdraw the terminal post insulating sleeve.

7. Remove the starter drive and drive end bracket from the armature as follows:

(*a*) On the M35G starter, compress the thrust spring and remove the circlip (Fig. Q.6) and collar.

On the M45G starter, remove the split pin from the shaft nut (Fig. Q.2), secure the squared end of the shaft in a vice and unscrew the nut anti-clockwise.

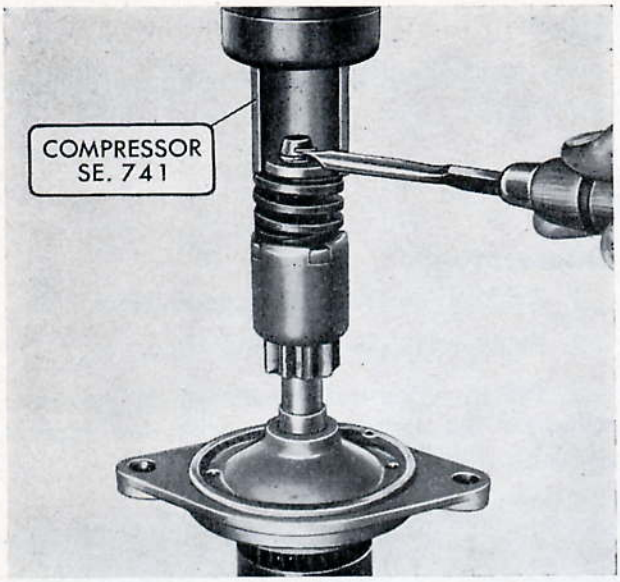

Fig. Q.6. Removing the circlip retaining the starter drive collar

(*b*) Remove the thrust spring and thrust washer.

(*c*) Withdraw the pinion and screwed sleeve assembly. If necessary, on the M35G starter, rotate the pinion slightly to line up the splined washer inside the pinion barrel with the shaft splines.

Inspection and Reconditioning

Armature

1. Examine the commutator for pitting or wear. If necessary refinish as follows:

Clean and polish the commutator, using very fine glass paper, or if necessary, skim very lightly provided the diameter is not reduced below the specified limit, and finish by polishing with very fine glass paper. *Do not undercut the mica segments.*

2. Check the armature for short circuits, open circuits and earthed windings as described for the generator on page P-9, noting that the growler switch in this case must be turned to the 'STARTER' position.

Bearings

The procedure for bush renewal is as follows:

(*a*) Drive the bush out of the bracket.

(*b*) Saturate the new bush with engine oil in the manner described for the generator bush on page P-8. As the bore of the drive end bush is larger, two pieces of rubber can be used to seal the ends of the bush.

(*c*) Press home the new bush.

Brush Gear

1. Check for sticking brushes in their holders and for excessive brush wear.

2. To free sticking brushes, clean off all deposits from the brushes and holders. If necessary, ease the brushes by polishing the sides of the brush with a fine cut file.

3. To renew the earthed brushes, and the insulated brushes of the M45G starter, unsolder the leads at the tags under the brush holders or field coils, and solder the new brush leads in position.

4. To renew the insulated brushes of the M35G starter, proceed as follows:

(*a*) Remove the field coils from the yoke using a pole shoe screwdriver.

(*b*) Cut off the original brush leads approximately ·30 in. from the coil connecting point. New brush leads cannot be soldered direct to the aluminium field coils.

(*c*) Clean up and tin the remaining parts of the original brush leads which are resistance-brazed to the coils (Fig. Q.7).

(*d*) Cut the leads of the replacement brushes to the required length, flatten the ends and tin (Fig. Q.7).

Brush ready for installation

◀ Brush leads on field coils cut back, cleaned and tinned

Brushes joined to field coils, longer lead at right-angles ▶

Fig. Q.7. Operations for renewing insulated brushes on the M35G starter (*e*) Locate one flex of the brush lead each side of remaining part of original lead, clinch round with pliers then solder in position. The brush with the longer lead should be soldered so that the lead is at right angles to the field connecting point, as shown in Fig. Q.7, to ensure adequate clearance with adjacent brush holder.

(*f*) Cut the insulating braid to the required length and secure with the braid clip.

(*g*) When installing the field coils, refer to operation 2 under 'Field Coils'.

5. Test the brush holder mountings as detailed on page P-11).

Field Coils

Proceed as for the generator (page P-11), noting the following:

1. If a defect in the field coils is indicated during either of the tests, there is no need to trace the fault to the individual coil, as separate coils are not serviced, and the complete set must be renewed.

2. Position the field coils in the yoke with the field terminal post to the right of the dowel recess (Fig. Q.8).

3. Locate the insulating band between the field coils and the yoke to insulate the bare field connections.

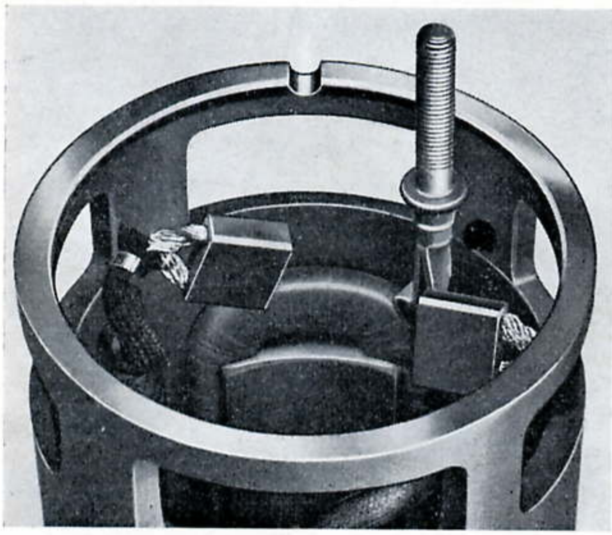

Fig. Q.8. When the field coils are installed the terminal post should be located as shown

Starter Drive Components

1. Examine the pinion and screwed sleeve for wear or damage and check that the sleeve will spin freely through the pinion.

2. Examine the thrust spring. If necessary, compare with a new spring.

3. Check that the pinion anti-drift spring is not damaged or broken.

Reassembly

1. Assemble the drive end bracket to the armature shaft, followed by the drive assembly in the order shown in Figs. Q.2 and Q.9. On the M45G starter, ensure that the slots in the pinion sleeve are towards the drive end bracket.

2. On the M35G starter, compress the thrust spring and assemble the circlip to the groove in the shaft. On the M45G starter, tighten the shaft nut and install a new split pin.

3. Assemble the insulating sleeve to the terminal post (Fig. Q.9) and on the M45G starter the insulating bush to the end bracket. The flange of the bush must be on the inside.

4. Install the commutator end bracket, ensuring that the dowel in the bracket engages the recess in the yoke and that the brush leads are not trapped.

5. Lift the earthed brushes and secure in the raised position by deflecting each spring to one side.

6. Assemble the thrust washer (M35G starter) against the end of the commutator and install the armature so that the dowel in the drive end bracket engages the recess in the yoke.

7. Release the two earthed brushes so that the springs are correctly located, lift the springs of the insulated brush holders and install the brushes. Check that the brush leads do not foul the armature.

8. Check the tension of the brush springs (Fig. Q.10). To install new springs, withdraw the armature and end brackets.

9. With the lockwashers assembled, install and tighten the through bolts. Check that the armature rotates freely.

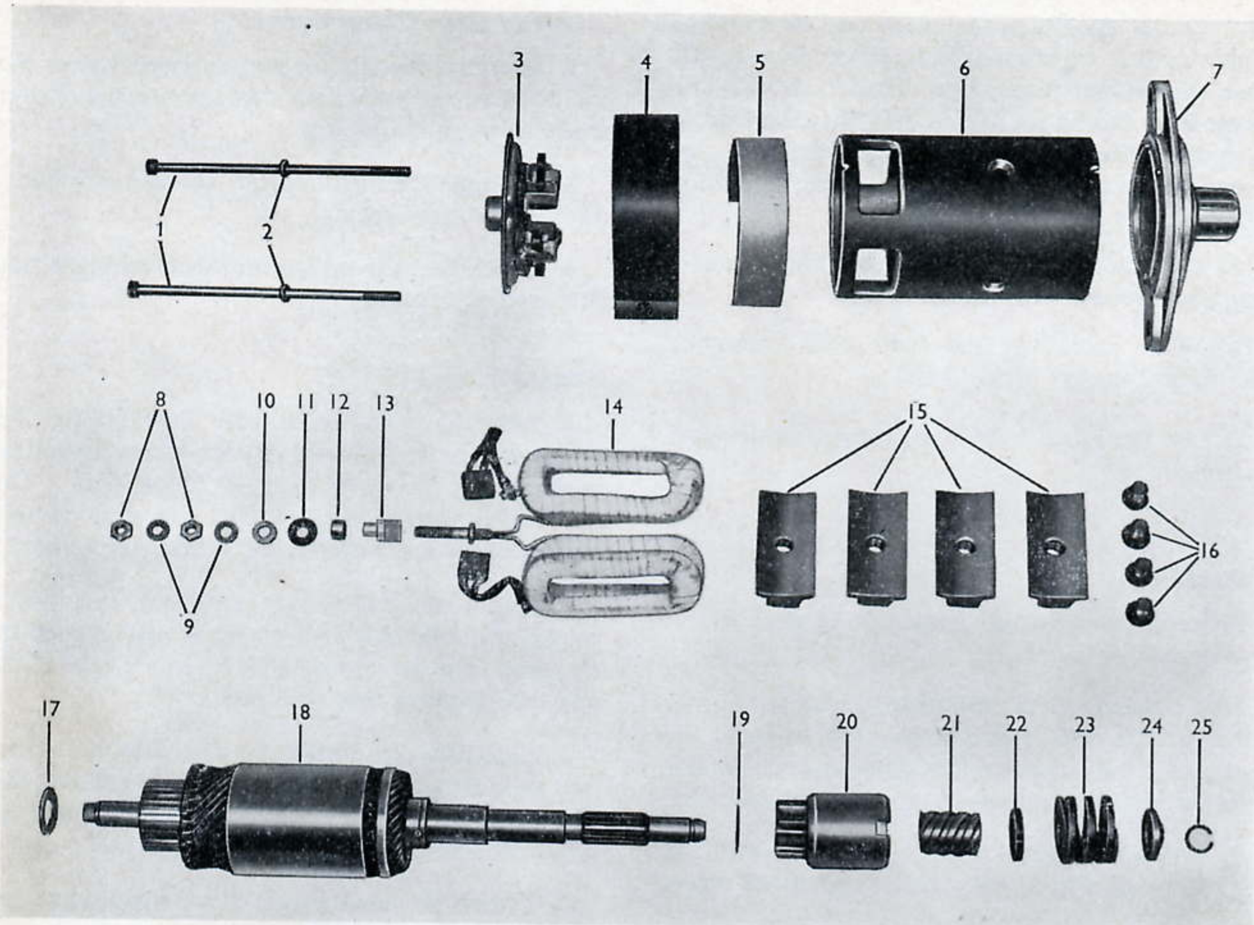

Fig. Q.9. Exploded view of starter

1. Through bolts
2. Lockwashers
3. Commutator end bracket and brush gear
4. Commutator cover band
5. Insulator
6. Yoke
7. Drive end bracket
8. Terminal nuts
9. Lockwashers
10. Plain washer
11. Insulating washer
12. Spacer
13. Insulating sleeve
14. Field coils
15. Pole shoes
16. Pole shoe screws
17. Thrust washer
18. Armature
19. Thrust washer
20. Pinion
21. Screwed sleeve
22. Thrust washer
23. Thrust spring
24. Spring collar
25. Circlip

10. Assemble the terminal washers and nuts. Do not overtighten the terminal post nut.

11. Bench test the starter. To check the run-off torque of the M45G starter, grip the pinion in a vice between soft jaws. Turn the armature shaft in the direction of normal rotation by means of a torque wrench applied to the squared end.

12. Replace the commutator cover band.

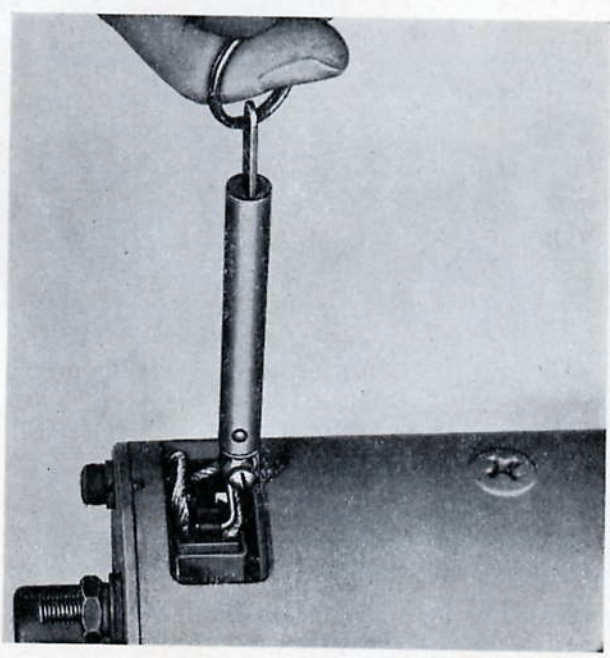

Fig. Q.10. Checking starter brush spring tension

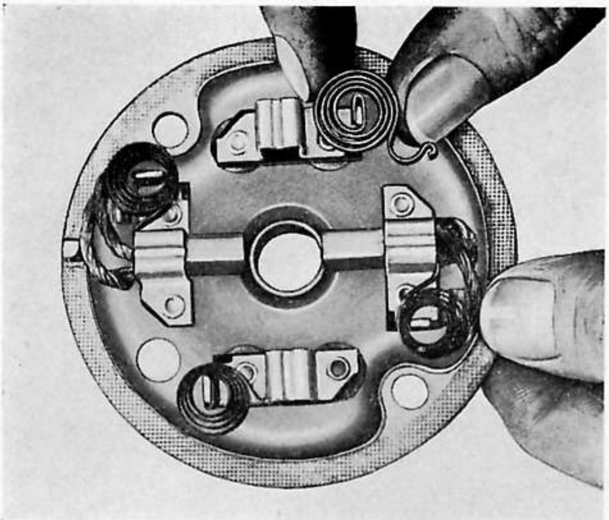

Fig. Q.11. Installing a new brush spring

Installation

Note the following on diesel-engined models:

1. Install the starter so that the larger (earth) terminal is towards the engine.

2. In addition to the earth cable, connect the black earth wire to the larger terminal.

3. When installing the injector pipes, refer to Perkins Engine Manual, Ref. 7292.

SPECIFICATIONS

SOLENOID STARTER SWITCH

Make and Type	Lucas 2ST

STARTER

	GASOLINE	DIESEL
Make and Model	Lucas M.35 G/1	Lucas M.45 G-RF17
Voltage	12	12
Brush Gear		
Spring tension	34 to 46 oz. with new brush. 25 oz. with brush worn to ·32 in.	40 to 52 oz. with new brush. 30 oz. with brush worn to ·32 in.
Brush length—minimum	·32 in.	·32 in.
Armature Commutator		
Minimum diameter after skimming	1·251 in.	1·531 in.
Test Data		
Free running	45 amps. at 9500 to 11 000 r.p.m.	45 amps. at 5800 to 6800 r.p.m.
Lock torque	10 lb. ft. at 420 to 440 amps.	22 lb. ft. at 430 to 450 amps.
Pinion run-off	—	36 lb. ft. minimum

IGNITER

Make and Type	C.A.V. 357
Current Consumption	18 amps. at 12 volts

SECTION R—IGNITION SYSTEM

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CIRCUIT BREAKER CONTACTS	R - 8
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Have you read the General Notes on page vii ?

DESCRIPTION

Distributor

The distributor (Fig. R.1), incorporates a moving circuit breaker plate which rotates on a stationary plate attached to the housing. The mainshaft carries a rotor, cam assembly and centrifugal advance mechanism. The upper bush is lubricated by felt pads in the housing and the lower bush by oil mist from the engine. The lower end of the shaft carries a thrust washer and a driving sleeve which engages dogs on the oil pump drive gear.

A vacuum control unit containing a spring-loaded diaphragm is linked by an arm to the circuit breaker moving plate; the vacuum side of the unit is connected to the carburetter on the intake manifold side of the throttle flap. Under part throttle conditions the depression in the manifold actuates the circuit breaker plate to advance the ignition timing. During acceleration, when the engine is under load, the depression is not sufficient to actuate the circuit breaker plate against the tension of the diaphragm spring so that the plate is held in the retarded position.

The centrifugal advance mechanism consists of a cam actuated by two spring-loaded weights. As the speed of the engine increases, the weights swing outwards against the pull of the springs. This moves the cam in an anti-clockwise direction, causing the circuit breaker points to open earlier and advance the ignition timing.

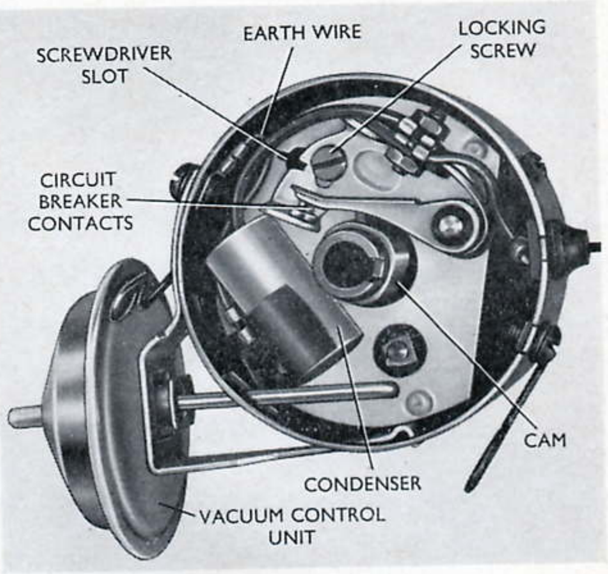

Fig. R.2. Circuit breaker and vacuum control arrangement

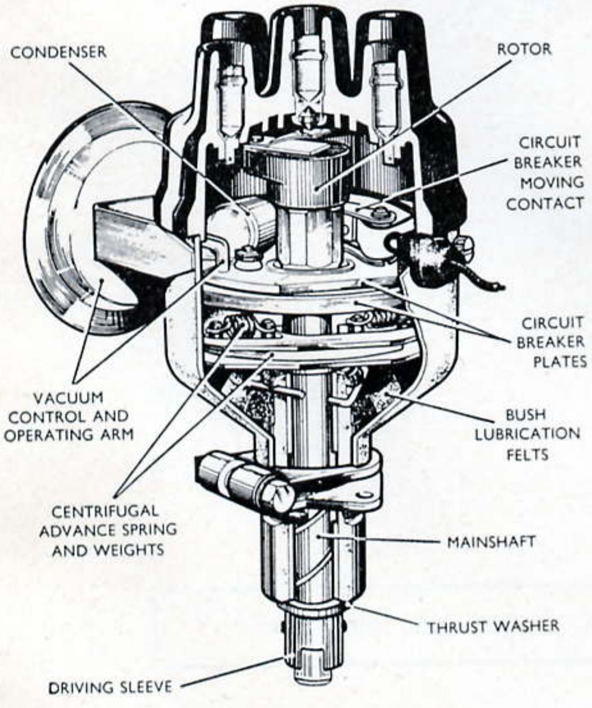

Fig. R.1. Cut-away view of distributor

Coil

The coil is an oil-filled hermetically sealed unit. In territories where low temperature conditions are experienced, the ignition system incorporates an ignition coil with a resistor (Fig. R.3), which is

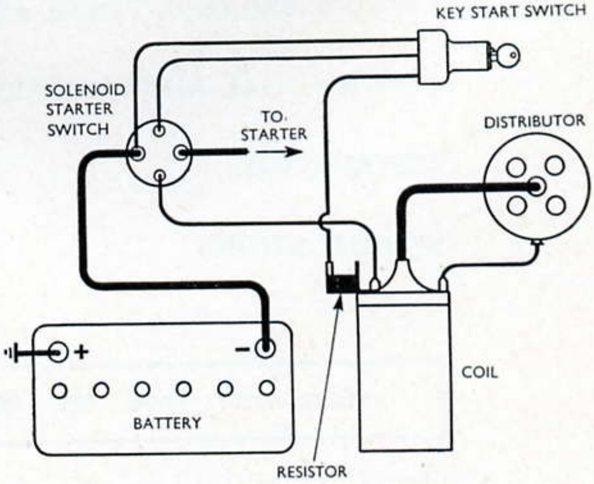

Fig. R.3. Cold start coil circuit

in circuit when the engine is running. When starting, the resistor is by-passed by a feed from the solenoid starter switch, the coil thus providing increased voltage at the spark plugs.

Key Start Switch

This is a four-position rotary type switch controlling the ignition, accessory and starter circuits. The lock barrel is renewable, being secured by a spring-loaded plunger.

GUARDIAN MAINTENANCE

Distributor

To lubricate the distributor, remove the cap and lift out the rotor. Apply a few drops of engine oil to the felt pad in the end of the cam, and inject oil through the hole marked 'OIL' in the circuit breaker plate to replenish the reservoir. Any surplus oil will drain away through a hole in the base of the distributor housing.

Lightly smear the cam with petroleum jelly. This must be done carefully to prevent any lubricant reaching the circuit breaker contacts.

When replacing the rotor, do not press down on the spring contact.

TROUBLE DIAGNOSIS

Whilst the most satisfactory method of diagnosing ignition defects is by carrying out checks using an Engine Analyser, there may be an occasion where a simple check on the operation of the ignition system is required without the aid of special equipment.

Quick Check of Ignition System

Check the condition of the battery and connections. There should be sufficient current to enable the starter to operate at normal speed.

Disconnect the coil high tension lead from the distributor cap and hold the lead about ·20 in. from a clean earth point on the engine. Operate the starter. If a good spark occurs as the engine is rotated, the ignition circuit is satisfactory to this point.

Check the condition of the plug leads and ensure leads are fitting correctly in their locating sockets. Check the condition of the distributor cap and rotor.

If no spark is obtained remove the distributor cap and operate the starter and observe whether sparking can be seen between the contacts. If the contacts open but produce no sparking, a more comprehensive test should be carried out as described under 'Ignition Circuit Tests'.

Spark Plugs Fouling and Overheating

The AC spark plugs fitted as standard equipment are satisfactory for all average operating conditions. It is only when unusual operating or engine conditions lead to persistent fouling or overheating of spark plugs that an appropriate alternative AC plug type should be fitted (see 'Specifications' on page R-14).

IGNITION CIRCUIT TESTS

The equipment required for carrying out the following series of tests for tracing faults in the ignition circuits is a variable range voltmeter and a 500 volt megger tester.

Before commencing the tests, check to ensure the battery is in a satisfactory state of charge. On cold start coils complete the checks as quickly as possible and switch off the ignition otherwise the resistor will overheat.

Low Tension Circuit Tests—Standard and Cold Start Coils

VOLTMETER CONNECTIONS	CIRCUIT BREAKER CONTACTS	VOLTAGE READING	READING INDICATION
Standard Coil Coil negative terminal and earth	Closed	11·5 to 12	Satisfactory
		No reading	If line fuse and ignition multi-socket connector O.K., switch or feed wire is defective
Cold Start Coil Coil resistor terminal and earth	Closed		
Cold Start Coil Coil negative terminal and earth	Closed	5 to 6	Satisfactory
		No reading	Resistor open-circuited
All Coils Coil positive terminal and earth	Open	11·5 to 12	Satisfactory on standard coil
		5 to 6	Satisfactory on cold start coil
		No reading	Coil primary winding open-circuited or short in circuit breaker connections or shorting condenser
All Coils Coil positive terminal and earth (voltmeter set to 0–1 volt range)	Closed	Zero to ·2	Satisfactory
		Over ·2	Dirty contacts, poor circuit breaker base plate and/or distributor housing earth, or L.T. wire open-circuited

Condenser Test (high voltage)

The condenser can be tested in position for insulation and open circuit, using a condenser tester. If a megger (500 volt) is used to test the insulation, the circuit breaker contacts must be open and the L.T. wire disconnected from the coil '+' terminal. Earth one megger lead to the distributor body and connect the other lead to the condenser terminal lead (Fig. R.4). A leakage reading of not less than 3 megohms should be obtained if the condenser is in good order.

A check on capacity will necessitate removal of the condenser and circuit breaker contacts (page R-8). Disconnect the condenser lead from the contacts and check with a test bridge.

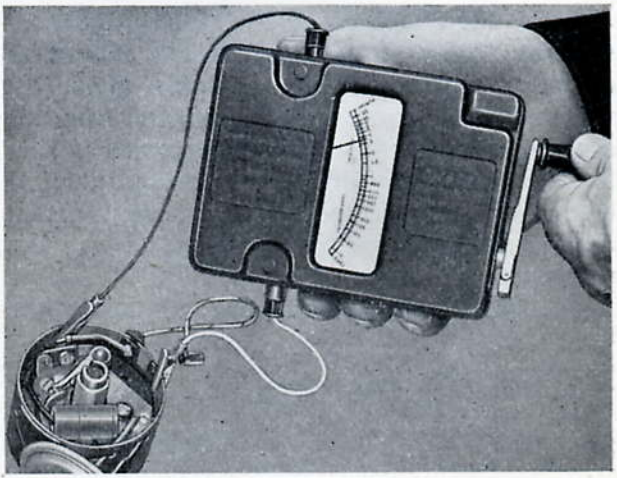

Fig. R.4. Testing the condenser for insulation and open circuit

Coil Test

Assuming that the primary circuit is operating satisfactorily, test the coil secondary winding using a coil tester. Alternatively a simple test can be applied to the secondary windings as follows:

1. Disconnect the coil H.T. lead from the distributor cap and remove the cap.

2. With the ignition switched on, hold the end of the lead about ·20 in. from a clean earth point on the engine.

3. Snap open the circuit breaker contacts a few times; each time the contacts are separated, a strong spark should jump the gap. If no sparking occurs, the secondary winding of the coil should be suspected and the coil removed for test (page R-7).

Distributor Cap and Rotor Inspection and Test

1. Detach the cap from the distributor and wipe the inside and outside with a clean dry cloth.

2. Examine the carbon button for wear and the segments for burning.

3. Inspect the cap for cracks and tracking burns. Tracking will be indicated by a thin black line between the segments. If necessary, test for this condition as follows:

Detach two alternate spark plug H.T. leads from the cap, insert the coil H.T. lead into each of the vacated sockets in turn and flick open the circuit breaker contacts (Fig. R.5); sparking will take place inside the cap if there has been any tracking.

4. Check the rotor for insulation breakdown by placing the end of the coil H.T. lead approximately ·06 in. from the edge of the rotor contact spring,

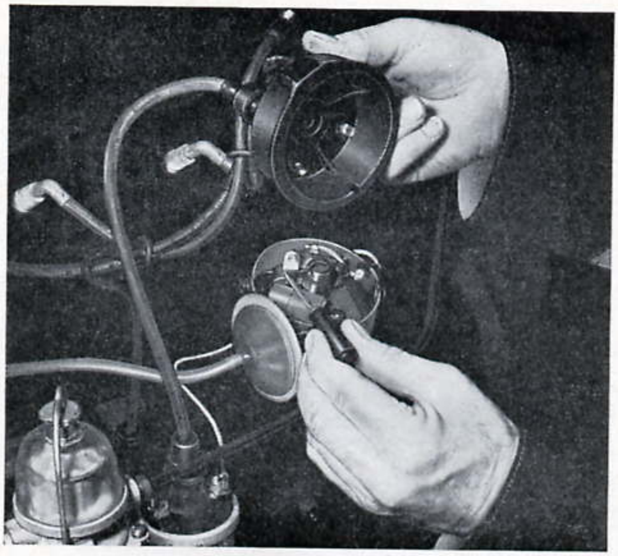

Fig. R.5. Checking the distributor cap for cracks. The coil H.T. lead is inserted in a spark plug lead socket

and flicking open the circuit breaker contacts. If the insulation is faulty a spark will jump across the gap.

Check the contact spring and button for distortion.

High Tension Leads

Use an ohmmeter to check suppressor-type leads for continuity. The resistance should be within the specified limits.

IGNITION TIMING

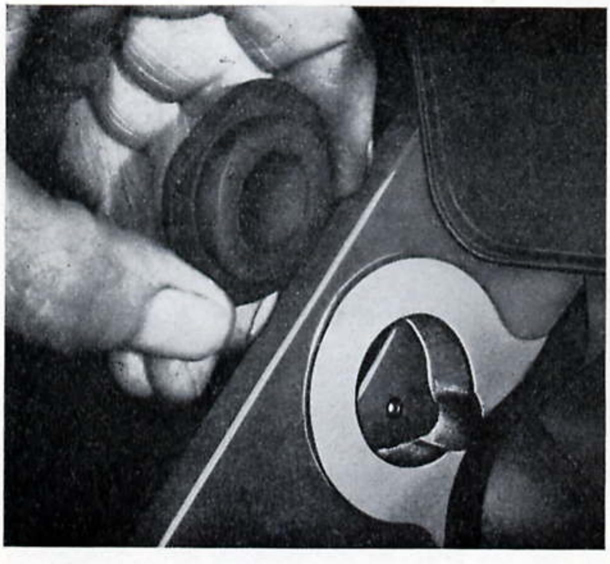

Fig. R.6. The steel ball in the flywheel is shown aligned with the centre of the ignition timing aperture

IMPORTANT: *The steel ball in the flywheel is located to provide an ignition setting of 9° before T.D.C. (U/C mark on flywheel), and on no account should the timing be advanced in excess of this figure. With the use of premium grade fuels, over-advance of the ignition timing may not be indicated by detonation (pinking), but will however be harmful to the engine and will adversely affect economy.*

Initial Setting

When an engine has been rotated after the distributor has been removed, the timing should be set as follows:

1. Remove the timing aperture plug (Fig. R.6).

2. Rotate the engine, until the steel ball in the flywheel is aligned with the centre of the timing notch (Fig. R.6). Check that the oil pump gear

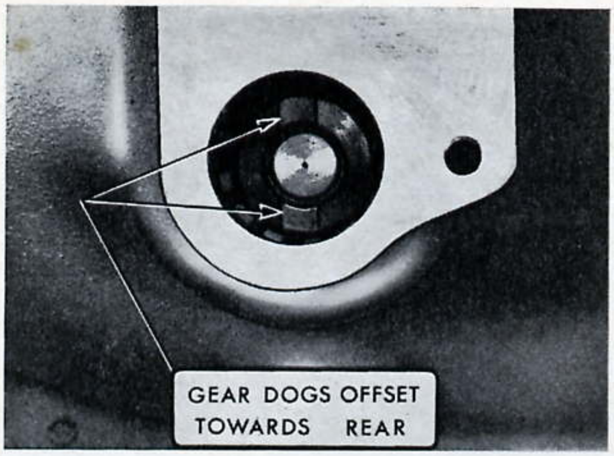

Fig. R.7. Location of oil pump drive gear dogs when installing the distributor. The dogs are at right-angles to the camshaft and offset as shown

dogs are at right angles to the camshaft and offset to the rear (Fig. R.7).

NOTE: *Do not attempt to turn the engine with the fan.*

3. Line up the distributor sleeve slots with the dogs on the oil pump drive gear and install the distributor.

4. With the distributor clamp plate bolt slackened off, bolt the plate to the crankcase.

5. Turn the distributor clockwise until the contacts are just on the point of opening, then tighten the clamp plate nut and bolt.

6. Check, and finally set the ignition timing as described under the following heading.

Checking and Adjusting

1. Check the circuit breaker contact gap (page R-9).

2. Remove the timing aperture plug (Fig. R.6).

3. Connect a timing lamp lead to No. 1 spark plug.

4. With the engine running at idling speed, direct the light from the lamp into the timing aperture, and check the alignment of the steel ball in the flywheel with the centre of the timing notch (Fig. R.6). To correct the setting, loosen the distributor clamp bolt and turn the distributor slowly, clockwise to advance the timing, or anti-clockwise to retard the timing.

5. Tighten the distributor clamp bolt and re-check the timing.

6. Switch off the engine and disconnect the timing lamp. Install the timing aperture plug.

VACUUM ADVANCE CONTROL

Checking

1. Start the engine and gradually increase speed from idling whilst observing the movement of the vacuum unit operating arm (Fig. R.8). If the control is operating satisfactorily the flange on the arm will contact the vacuum unit.

2. If the control does not operate, disconnect the suction pipe from the diaphragm unit and check if air is being drawn through the pipe when the engine speed is increased from idling. If there is no evidence of blockage or leakage and the circuit breaker upper plate can be moved freely, the diaphragm unit is faulty and the control assembly should be renewed.

3. Should the circuit breaker upper plate not move freely or not return to the retard position by pressure of the diaphragm spring, renew the plate assembly (page R-9).

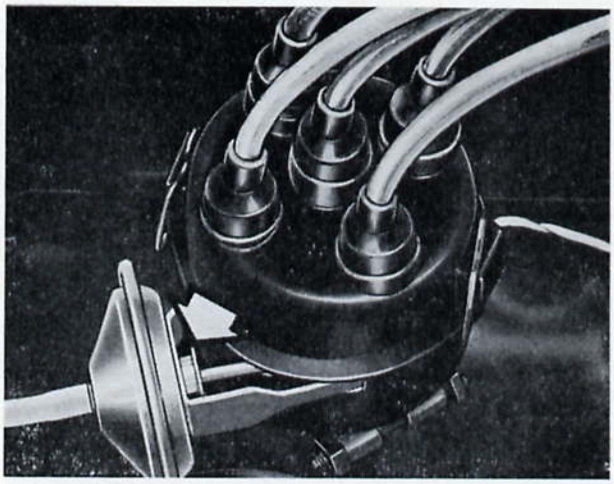

Fig. R.8. The flange on the operating arm, indicated by arrow, will contact the unit if the vacuum control is operating satisfactorily

KEY START SWITCH

Removal

1. Disconnect the battery.

2. Remove the four screws securing the instrument cluster panel, withdraw the panel and disconnect the cable from the speedometer.

3. Unscrew the switch locking ring (Fig. R.9), withdraw the switch and washer and detach the multi-socket connector.

Disassembly

With the switch in the locked position, insert a piece of stout wire through the small hole in the switch body, depress the lock barrel spring plunger and withdraw the barrel (Fig. R.10).

Reassembly

Align the lock barrel spring plunger with the hole in the switch body and insert the barrel so that the plunger engages its locking hole.

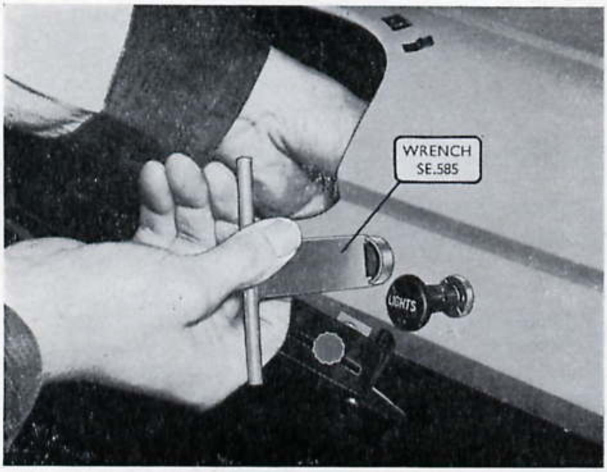

Fig. R.9. Removing the key start switch locking ring

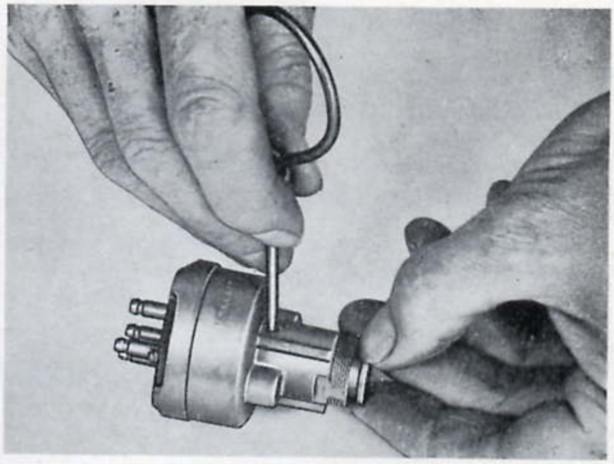

Fig. R.10. Withdrawing the starter switch barrel whilst depressing the spring plunger with a tapered-off piece of $\frac{1}{8}$in. diameter wire

COIL

Removal

Disconnect the wires and remove the attaching screws.

Testing

Test the coil for continuity of windings, earthing, and spark efficiency. The tests should be carried out with the coil at normal operating temperature, as internal faults do not always become apparent when the coil is cold.

Installation

Note the following:

Attach the distributor L.T. wire to the coil '+' terminal and the white wire to the '—' terminal. On coils with a resistor, attach the white wire to the resistor terminal and the white-blue wire from the solenoid starter switch to the coil '—' terminal.

INTRODUCTION

This Supplement provides information on changes in design and servicing procedure introduced since publication of Training Manual TS 674.

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PARKING BRAKE LEVER	4
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RITEWAY SERVICE TOOLS

Tools which carry a 'Z', 'D' or 'VR' prefix to the tool number are available from the following sources:

All territories except Continental Europe, Kent-Moore Tools Ltd, Bow Street, Birmingham 1, England.

Continental Europe, Kent-Moore International AG, Altgasse 6340, Baar-Zug, Switzerland.

Drawings of 'SE' tools are still obtainable from Service Department, Vauxhall Motors Ltd.

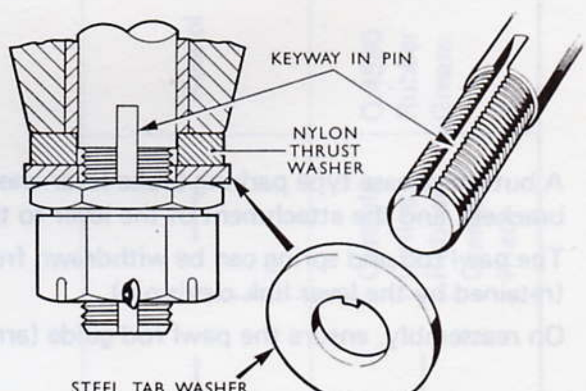
STEERING GEOMETRY

Revisions were made to the castor angle and front wheel toe-in on later models. The revised figures are:

Castor Angle – Unladen	1^{o} to 2^{o}
Toe-in – Measured on wheel rims at height of wheel centres . .	0.16/0.28 in.

STEERING KNUCKLE PIVOT PIN

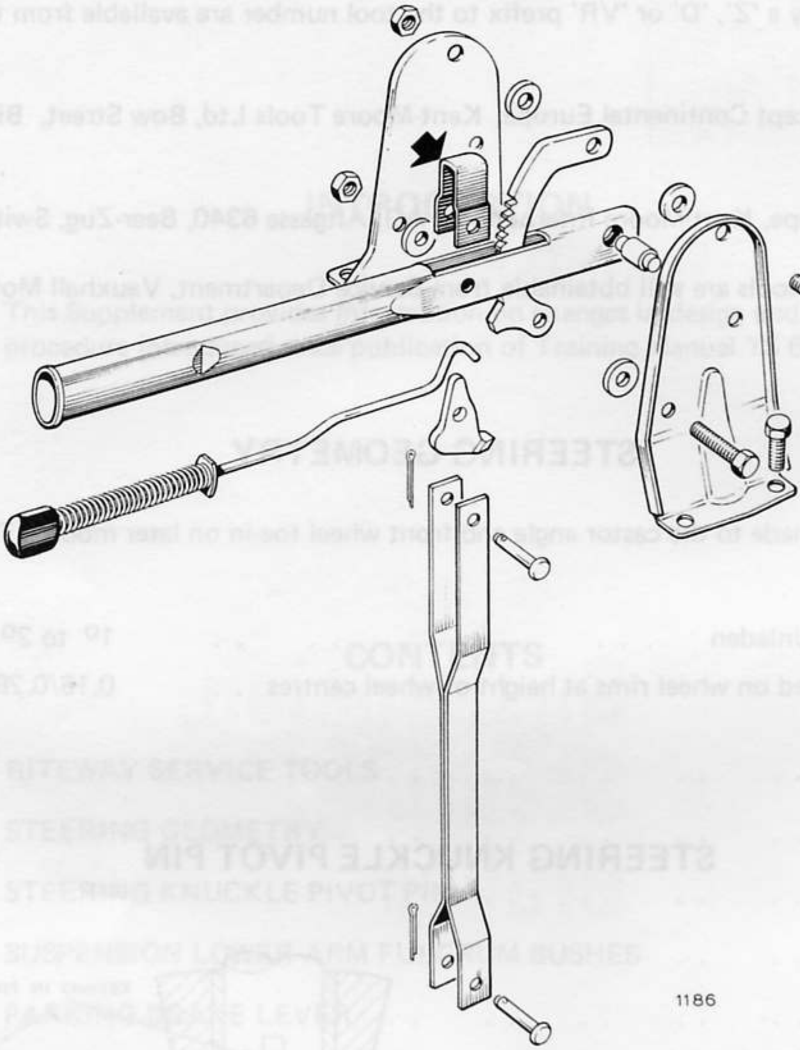
On later models, a steering knuckle with a longer pivot pin incorporating a keyway for locating a tab washer, was introduced to prevent shearing of the split pin under operating conditions.



SUSPENSION LOWER ARM FULCHRUM BUSHES

When assembling the front suspension it is important that the bushes with the longer hexagon should not be used at the rear of the lower suspension arms as they may foul the steering relay levers.

PARKING BRAKE LEVER



A button-release type parking brake lever was introduced on later models. The sector and fulcrum brackets, and the attachment of the lever to the brackets, are unchanged.

The pawl rod and spring can be withdrawn from the front of the lever after removing the pawl (retained by the lever link clevis pin).

On reassembly, ensure the pawl rod guide (arrowed) is positioned inside the fork of the lever link.

RECOMMENDED LUBRICANTS – OVERSEAS

The list of lubricants recommended for use overseas is amended as follows:

High Pressure Nipples	GM4733-M
Hub Bearings	GM4750-M
Steering Gear	GM4655-M

RECOMMENDED LUBRICANTS – UNITED KINGDOM

Usage	BP	Castrol	Duckhams	Esso	Gulf	Mobil	Petrofina	Regent	Shell
High Pressure Nipples Hub Bearings Steering Shaft Bearings	Energrease L.2	Castrolease LM	LB.10 Grease	Esso Multi-purpose Grease H	Gulflex A	Mobilgrease MP	Fina Marson HTL 2	Marfak Multi-purpose 2	Retinax A
Steering Gear	BP Gear Oil SAE 90 EP	Castrol Hypoy	Hypoid 90	Esso Gear Oil GP90/140	Multi-purpose Gear Oil 90	Mobilube GX 90	Pontonic MP SAE 90	Multigear Lubricant 90	Shell Spirax 90 EP
Brake Hydraulic System	Castrol Girling Brake and Clutch Fluid – Crimson or Lockheed Super 105 Brake Fluid								
Brake Pedal Shaft Brake Shoe Flange Plate Contact Points Parking Brake Linkage	—	—	Keenol	—	—	—	—	—	—
Hydraulic Brake Cylinders	—	Castrol/Girling Rubber Grease (Red)	Q.4590 Rubber Grease	TSD 803	—	—	—	—	—

SERVICE TRAINING MANUAL

for

ELECTRICAL EQUIPMENT
BODY
CHASSIS FRAME

BEDFORD CA
Mark 2

SERVICE

VAUXHALL MOTORS LTD

LUTON · BEDFORDSHIRE · ENGLAND

TS. 675

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GENERAL INDEX... xiii

FOREWORD

This group of the manual provides comprehensive information on the Electrical Equipment, Body and Chassis Frame of the Bedford CA, Mark 2.

Contents. The main subjects dealt with are listed on page iii. An individual index is provided on the first page of each section, and a general index is included at the end of this group.

General Notes. Recommendations on important general items which must be observed whenever service work is undertaken are collated under 'General Notes' on page vii. It is important that servicemen should become familiar with all of these points.

Recommended Lubricants. Lubricants approved and recommended for use in the United Kingdom and Overseas are listed at the end of this group.

Guardian Maintenance. The notes included under this heading in appropriate sections are confined to service procedure. For further information, reference should be made to the Guardian Maintenance booklet supplied with the vehicle.

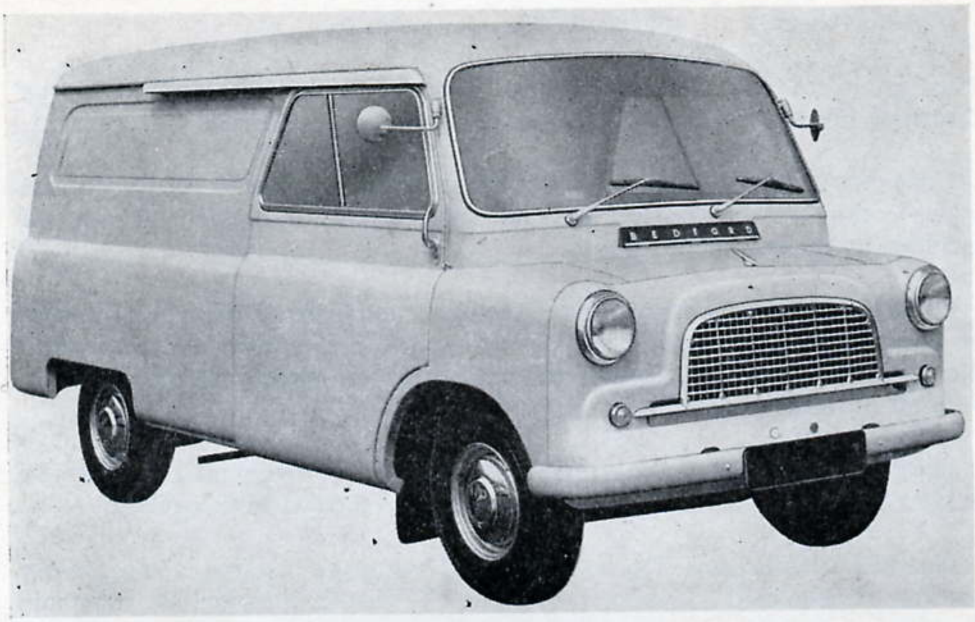
Riteway Service Tools. Reference is made throughout the manual to tools designed to facilitate service operations. All of these tools are illustrated in use.

Tools which carry a prefix 'Z' to the tool number are available to Authorized Dealers from the Parts and Accessories Department, Vauxhall Motors Limited, Dunstable, Beds.

Tools prefixed 'D' are supplied by various Factors and orders should be addressed to the Service Department, Route 2494, Vauxhall Motors Limited, Luton, Beds.

An 'SE' prefix to the number indicates that the tool must be manufactured locally. Detail drawings of 'SE' tools may be obtained from the Service Department, Route 2494.

MODEL DESIGNATIONS



CAS	...	90 in. wheelbase	Chassis No.	10/12 and 15/17 cwt.
CAL	...	102 in. wheelbase	350000 onwards	Chassis and Van

LOCATION OF MODEL IDENTIFICATION PLATE AND ENGINE NUMBERS

A plate on which is stamped the model identification letters and numbers, is attached to the footwell panel, inside the body, adjacent to the steering column.

The engine number is stamped in the following locations. On diesel-engined vehicles: on the top edge of the facing on the cylinder block to which the fuel injection pump is attached. On gasoline-engined vehicles: on a pad on the crankcase adjacent to the fuel pump.

GENERAL NOTES

Safety Precautions

Isolation of Battery. Always disconnect the battery before commencing operations where there is the slightest possibility of accidental engagement of the starter or the danger of a short circuit. Neglect to take this precaution may result in personal injury and the risk of fire.

Jacking. To prevent damage, the following precautions should be taken when jacking up and supporting the vehicle on stands.

1. When jacking up the front of the vehicle on the front axle crossmember, a block of wood should be interposed between the jack and the crossmember.

2. When jacking up the rear of the vehicle, ensure that the jack pad is in the centre of the axle housing and that any projections on the pad are not fouling the housing rear cover and taking the weight.

3. Support the vehicle on stands located below the chassis frame sidemembers.

Expendable Items

Whenever a unit is disassembled, renew all gaskets, oil seals, split pins, circlips, lockwashers and tab washers where applicable. Not all nuts and bolts are equipped with lockwashers. When in doubt on usage, refer to the Parts Catalogue.

Specifications

Refer to 'Specifications' at the end of a section for dimensional and other data for use when assessing component wear and when making adjustments. Unless otherwise stated, the dimensions given are the manufacturing limits for new parts.

Recommended Lubricants

The references to lubricants in the manual text are in general terms only. In all cases the list of 'Recommended Lubricants' at the end of the manual should be consulted for grades and specifications. This list includes particulars of lubricants to be used during initial assembly.

Screw Threads

The nuts, bolts and studs used on units of Vauxhall manufacture have threads of the Unified Thread Form. These threads closely resemble our previous usage of the American National Form thread and for practical purposes are interchangeable. Nuts or bolts with any other form of thread cannot be interchanged.

The wrenches for use on Unified-threaded nuts and bolts are listed below.

Wrench Sizes for Unified Nuts and Bolts

Bolt diameter in inches		$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$ *	$\frac{1}{2}$	$\frac{9}{16}$ *	$\frac{5}{8}$	$\frac{3}{4}$
Wrench sizes in inches across flats	Nut	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{11}{16}$	$\frac{3}{4}$	$\frac{7}{8}$	$\frac{15}{16}$	$1\frac{1}{8}$
	Bolt	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{13}{16}$	$\frac{15}{16}$	$1\frac{1}{8}$

NOTE: *For bolt diameters indicated (*) the hexagon size is greater for the nut than for the bolt.*

SECTION P—GENERATING SYSTEM

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Have you read the General Notes on page vii ?

DESCRIPTION

The 12-volt generating system comprises the generator, current-voltage controller, battery and warning lamp.

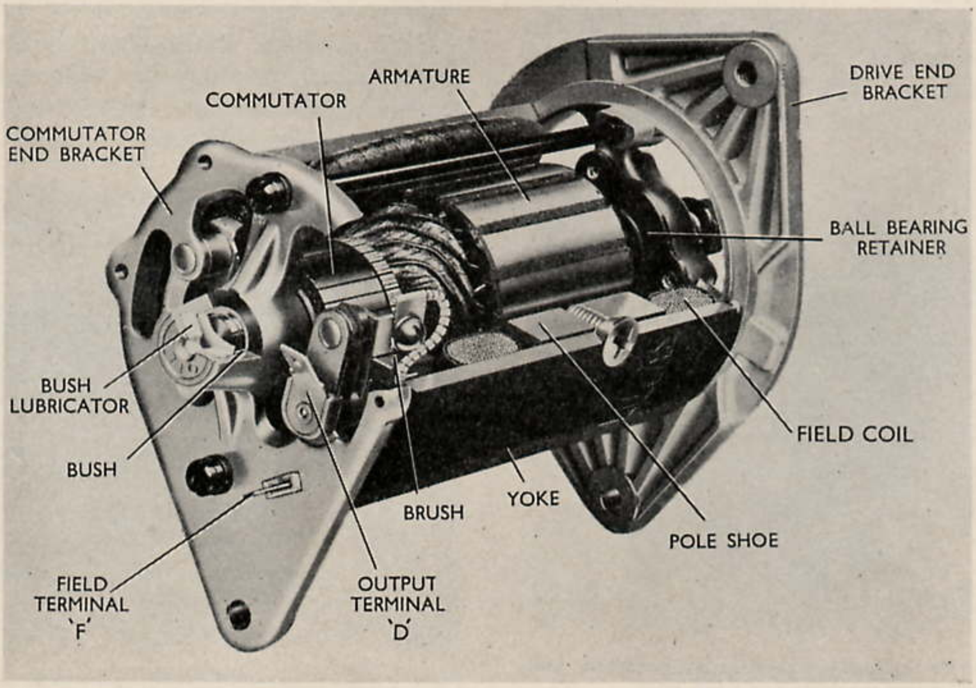


Fig. P.1. Cut-away view of generator

Generator

The generator (Fig. P.1) is a two-brush, two-pole, shunt type comprising an armature, field magnet system and brush gear, housed in a cylindrical yoke with two end brackets. The brackets are clamped to the yoke by two through bolts. Some yokes have stepped outside diameters.

The armature shaft is supported in a ball bearing located in the drive end bracket, and a sintered-bronze bush in the commutator end bracket.

One of the two carbon brushes is earthed by copper flex to the commutator end bracket which carries the brush gear; the other is insulated and connected to the generator output (D) terminal. One end of the field winding is connected to the yoke and the other end to the earthed generator field (F) terminal.

Ventilation apertures are provided in both end brackets through which air is circulated by fan blades incorporated in the generator pulley. The pulley is driven by a vee section belt from the crankshaft pulley.

Current-Voltage Controller

The current-voltage controller (Fig. P.2) comprises an insulated metal base on which is mounted a cut-out relay, current regulator and voltage regulator. These three units are enclosed by a plastic cover. Bridged between the current and voltage regulator frames is a wire-wound type field resistor (Fig. P.3).

The cut-out moving contact is located at the end of a copper strip spot-welded to the cut-out armature extension. The cut-out fixed contact consists of a copper strip which forms an integral

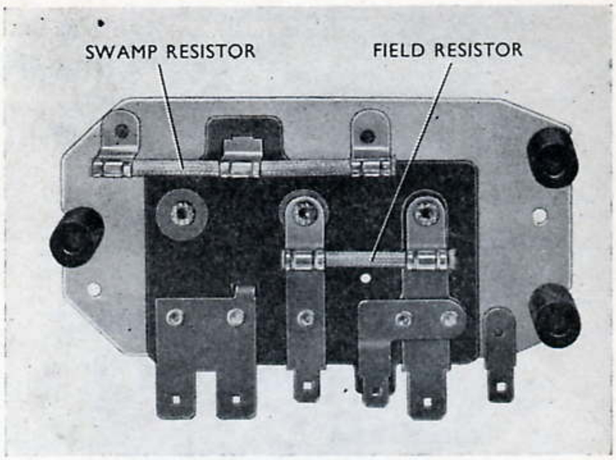


Fig. P.3. Location of swamp and field resistors

part of terminal 'B'. The armature is provided with a back stop welded to the U-frame (Fig. P.2).

The current regulator moving contact is located at the end of the armature extension. The adjustable fixed contact is located on a metal strip riveted to the U-frame and insulated from it by means of a plastic strip (Fig. P.4). The arrangement of the contacts for the voltage regulator is similar.

The current regulator core incorporates a single low-resistance series coil. The voltage regulator incorporates a high resistance shunt coil. The cut-out core carries a shunt coil, and a series coil through which all charging current flows.

Each armature hinge spring is riveted to the upper face of the armature. Adjustment of spring tension is provided by a flat steel (control) spring riveted to the armature bearing against an

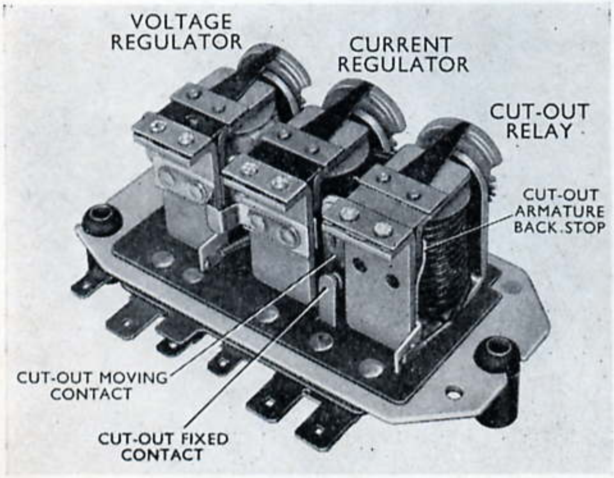


Fig. P.2. Controller showing regulator locations and cut-out relay contacts and back stop

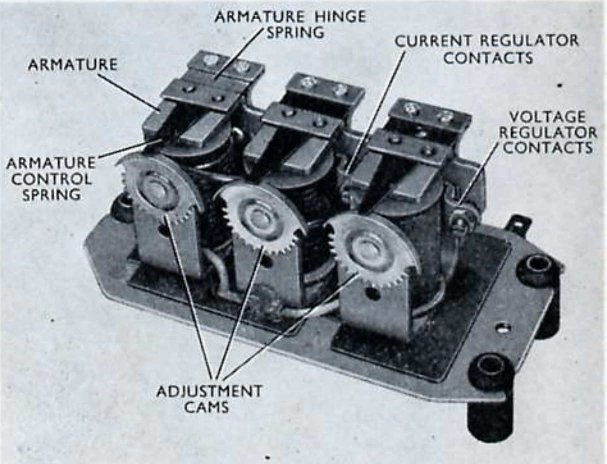


Fig. P.4. Controller adjustment cams and contact locations

adjusting cam mounted on the face of the U-frame (Fig. P.4). In addition to the bi-metal hinge springs the effects of temperature on the resistance of the cut-out and voltage regulator is minimised by a swamp resistor connected in series with the shunt coils (Fig. P.3).

Warning Lamp

A red (ignition or generator) warning lamp is incorporated in the combined instrument assembly and is connected between the controller 'D' terminal and the 'IGN' terminal of the key start switch through the line fuse.

OPERATION

Current-Voltage Controller

As the voltage regulator is shunt wound and connected across the generator terminals it is responsive only to variation in the generator voltage, whilst the current regulator, being connected in series with the load, is affected only by changes in current.

Under normal conditions when the battery is not discharged, after the generator output reaches the required value and the cut-out relay contacts close, a further increase in generator speed causes a rise in terminal voltage and subsequently the operating voltage setting of the voltage regulator is attained. When this occurs, the magnetic pull of the voltage regulator core attracts the armature and the voltage regulator contacts open, causing the field resistance located underneath the base to be inserted into the generator field circuit. The effect of inserting this resistance in the field circuit is to reduce the generator output. Consequently, the magnetic pull on the armature is reduced and the contacts close and short out the resistance again. This sequence is repeated and starts the regulator armature vibrating, the effect being to limit the generator voltage to a predetermined value.

If the battery is discharged or heavy electrical loads are imposed on the system, the generator voltage will not rise to the value at which the voltage regulator operates. Therefore another method of controlling the generator output to a safe limit is necessary and this is provided by the current regulator. When the current output of the generator reaches its maximum rated value, the electro-magnetic effect of the current flowing through the current regulator coil attracts the armature and opens the contacts, thus inserting the resistance in the field circuit. Consequently the current regulator armature is set into vibration and a safe limit is imposed on the generator output.

When commencing to charge a flat battery, the current regulator allows the maximum safe generator output to pass to the battery and this continues until the battery approaches a charged condition. At this stage the voltage available is sufficient to bring the voltage regulator into operation, the current value falls and the current regulator ceases to operate. During the change-over period, which exists for half a minute, both regulators are in operation.

After the voltage regulator has been brought into operation, the generator output tapers off until trickle charge conditions are reached.

Temperature compensation is provided on the voltage regulator and cut-out relay units by the

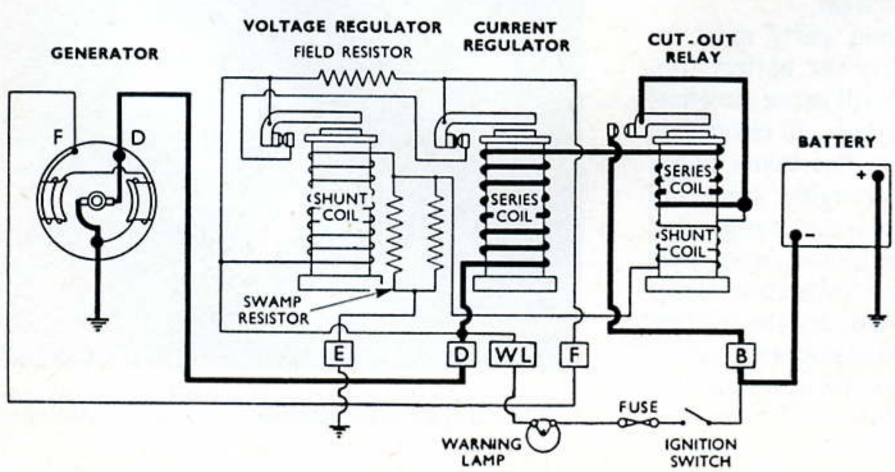


Fig. P.5. Controller circuit diagram; heavier lines indicate main charging circuit

bi-metal armature tension springs. The spring tension increases with a fall in temperature and decreases with a rise in temperature. This feature on the voltage regulator automatically permits a higher charging rate required during cold weather and a lower charge required in warm weather. The springs also compensate for the effect of temperature on the voltage regulator and cut-out relay shunt coils. As the shunt coils warm up, their resistance increases which weakens the magnetic pull on the armature; this reduction in magnetic pull is compensated by corresponding weakening of the bi-metal springs. In addition to the bi-metal springs the effects of temperature are still further minimised by the double swamp resistor.

Warning Lamp

The warning lamp functions primarily to indicate that the generator is charging. The lamp lights when the key start switch is switched on. When the engine is started and its speed increased the generator voltage will rise until the controller cut-out relay contacts close. The lamp is then extinguished.

GUARDIAN MAINTENANCE

Battery

Remove the vent plugs or cover from the battery and check the electrolyte level in each of the six cells. *Do not place the vent plugs on any part of the vehicle, as they will be wet with acid.* Distilled water should be added as required to bring the level of the liquid to the top edge of the separators or splash guard, and no more. *Do not overfill*, as the electrolyte may be sprayed out during charging. Never add acid when topping up the battery. Only water evaporates as a result of charging and discharging and if this is not replaced, sections of the plates will become exposed to the air, causing the plates to sulphate and consequently impair the efficiency of the battery. Abnormal evaporation is an indication that the battery is being overcharged. If excessive topping up is necessary to keep the electrolyte at the correct level, the current-voltage controller settings should be checked and if necessary, adjusted.

When replacing the vent plugs on Exide batteries, make sure that a rubber washer is fitted under each plug, otherwise leakage of electrolyte will occur. Plugs must be kept tight.

The battery and surrounding parts must be kept dry and clean, particularly the battery top. Accumulation of dirt and acid will cause electrical leakage between the terminal lugs. If electrolyte has spilled over and corrosion has taken place, remove the battery and thoroughly clean all affected parts of the battery terminals, hanger and clamp with a brush dipped in ammonia or soda solution. Flush off the solution with clean water after it has stopped foaming, then dry the affected areas of the battery hanger and clamp and repaint with acid-resisting paint. Renew the wood packing piece where fitted.

Before reconnecting the battery cables, apply a coating or petroleum jelly over the terminals and terminal lugs.

Generator

The generator armature shaft is supported in a ball bearing, packed with lubricant during manufacture, at the forward or drive end, and in a plain sintered bronze bush at the rear end. The bush is lubricated by a felt ring, oil charged through a hole in the centre of the end bracket (Fig. P.6). Apply only a few drops of oil; over-oiling the generator may cause the commutator to become sticky.

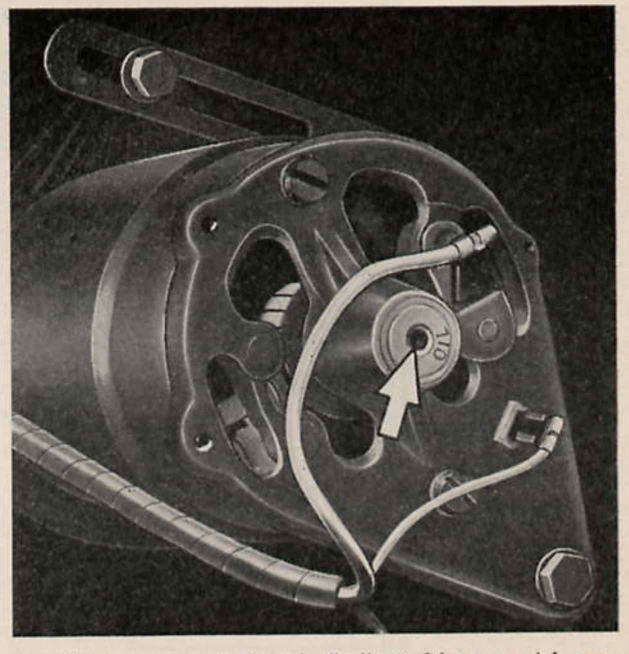


Fig. P.6. Location of oil hole (indicated by arrow) in generator end bracket for lubricating armature rear end bush

TROUBLE DIAGNOSIS

Battery in Low State of Charge

Internal Fault. The internal condition of the battery may be such that it cannot hold a charge satisfactorily. Where failure of the electrical system is due to battery condition, check the specific gravity of the battery electrolyte and carry out a high-rate discharge test to determine breakdown of cells.

Fault in Generating System. Check for loose connections in the charging circuit. If satisfactory, check the generator output and current-voltage controller settings.

Severe Operating Conditions. Very low climatic temperatures or frequent starting combined with short journeys and night driving will cause a heavy drain on the battery. Where the vehicle is operating under these conditions, it may be possible to maintain the battery in a satisfactory state of charge by adjusting the current-voltage to the upper limit of the specified voltages.

Battery Overcharged

An indication that the battery is being overcharged will be given by the need for frequent addition of distilled water in order to maintain the correct level of the electrolyte. When this is evident the setting of the current-voltage controller should be checked.

Generator Not Charging

Drive Belt Slack or Broken. The belt should be adjusted to the correct tension. If the belt is allowed to remain slack it may slip on the generator pulley.

Broken or Loose Connections. Check the connections within the charging circuit and clean and tighten any loose connections.

Fault in Generator. To establish that the generator is operating satisfactorily, check the output.

Fault in Current-Voltage Controller. If the generator is proved satisfactory, check the setting of the controller.

BATTERY

Removal

1. Disconnect the battery.

2. Remove the securing clamp and lift out the battery, and packing piece where fitted.

Inspection

1. Check the level of the electrolyte and the condition of the battery.

2. Examine the container for cracks or damage.

3. Check for cracks in the sealing compound. These cracks may cause surface leaks and can sometimes be remedied by cleaning out the old compound around the crack and refilling with hot new compound.

4. Thoroughly clean the terminal posts and wipe the battery clean and dry.

Installation

Note the following:

1. Install the battery. Refit the packing piece behind the battery. Some models have rubber buffers attached to the chassis frame. Tighten the wing nuts just enough to prevent movement of the battery in its hanger. *Avoid overtightening the nuts.*

2. Before reconnecting the battery cables, apply petroleum jelly to the contact faces of the terminals and cable connections.

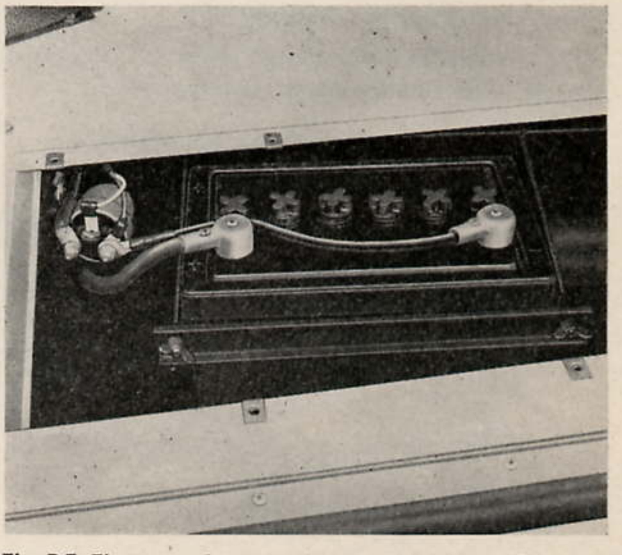
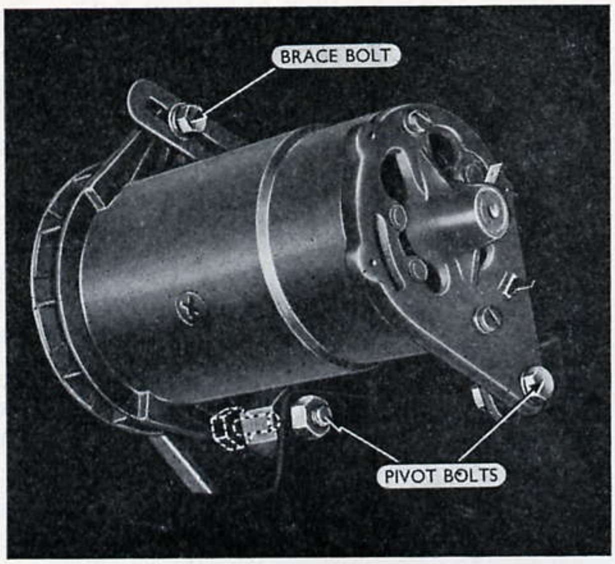


Fig. P.7. Floor panel removed to show location of battery and solenoid starter switch

GENERATOR



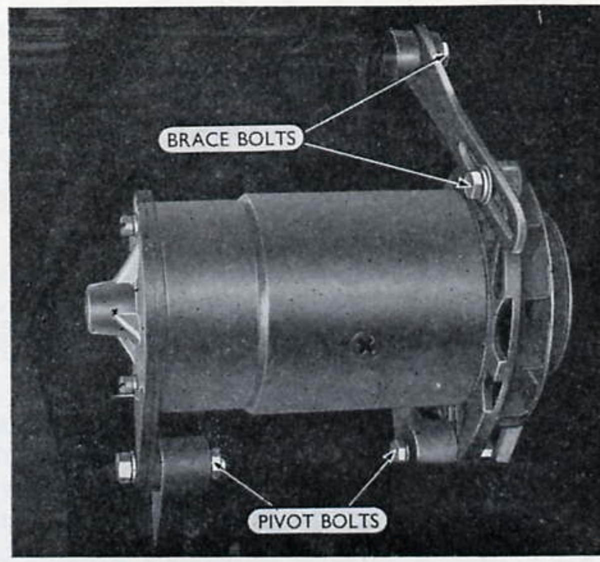


Fig. P.8. Generator mounting details. The pivot bolts and brace bolts are indicated. Left—gasoline engine; right—diesel engine

Drive Belt Adjustment

1. Slacken the generator pivot bolts (Fig. P.8), also the bolts securing the slotted brace.

2. Pivot the generator in the required direction to correct the belt tension. Check point is midway between fan and generator pulleys.

CAUTION: *The adjustment requires care. A tight belt will overload the generator bearings and also result in early belt failure. A slack belt will slip and wear and affect the charging rate.*

3. When the belt tension is correct, tighten the pivot bolts and the brace securing bolts.

Generator Output Test on Vehicle

1. Check the drive belt for correct tension.

2. The following test should be made with the generator cold:

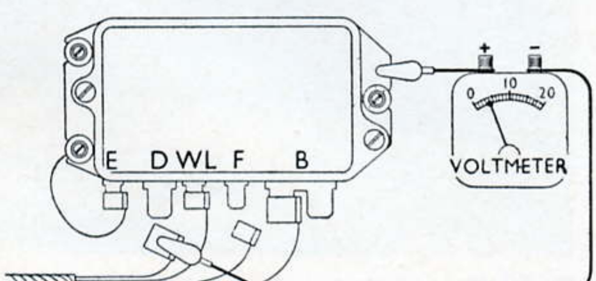


Fig. P.9. Testing generator output—stage 1

(*a*) Disconnect the wires from the controller 'D' and 'F' terminals.

(*b*) Connect the negative lead of a 0–20 range voltmeter to the wire removed from the 'D' terminal, and connect the positive lead to earth (Fig. P.9).

(*c*) Start the engine; increase the engine speed to 1500 r.p.m. and note the voltmeter reading. This should be from 2 to 4 volts.

(*d*) If no recording is obtained, the fault may be due to loss of residual magnetism. To restore this magnetism, flash the generator 'F' wire on to the

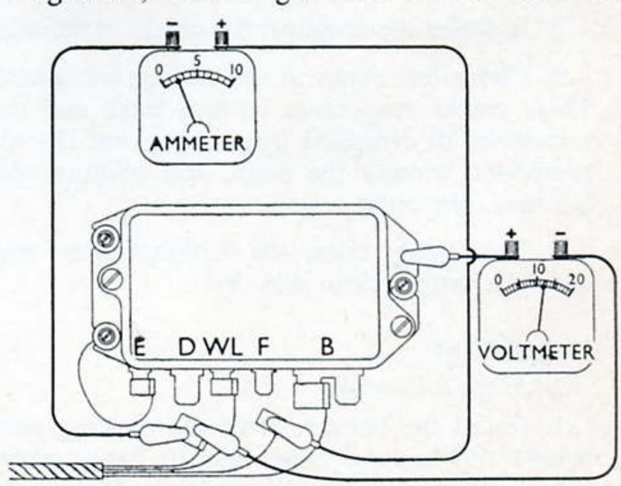


Fig. P.10. Testing generator output—stage 2

controller 'B' terminal. If there is still no reading, check the generator 'F' wire for continuity. If the wire is satisfactory, remove and disassemble the generator for examination. Where the reading is satisfactory, proceed with operation 3.

3. With the voltmeter still connected as in operation 2, check the generator field circuit as follows:

(*a*) Connect the negative lead of an 0–10 range ammeter to the 'D' wire, and the positive lead to the 'F' wire (Fig. P.10).

(*b*) Start the engine; slowly increase the engine speed until the voltmeter reading is 12 volts; the ammeter reading should then read approximately 2 amperes.

(*c*) If no reading is obtained, and the generator 'F' wire is satisfactory, remove and disassemble the generator for examination.

NOTE: *If the generator output is satisfactory when cold and no fault is evident in the controller or wiring to account for a failure to hold battery charge, run the engine for 10 to 15 minutes, at approximately 1500 r.p.m. to warm up the generator, and make a further check on the output.*

Removal

1. Disconnect the wires from the generator connectors.

2. Slacken the pivot and brace bolts.

3. Remove the brace bolt and disengage the drive belt from the pulley.

4. Remove the pivot bolts and lift away the generator.

Disassembly

1. Remove the pulley nut and lockwasher and withdraw the pulley.

2. Remove the through bolts securing the drive and commutator end brackets to the yoke.

3. Withdraw the commutator end bracket from the yoke, if necessary tapping the bracket with a hide or wooden mallet.

4. Withdraw the drive end bracket and armature assembly from the yoke and retain the fibre washer at the commutator end of the armature shaft.

NOTE: *It is not necessary to remove the drive end bracket and ball bearing assembly from the armature shaft unless the armature or bearing requires renewing. All armature tests can be carried out with the end bracket assembled to the armature.*

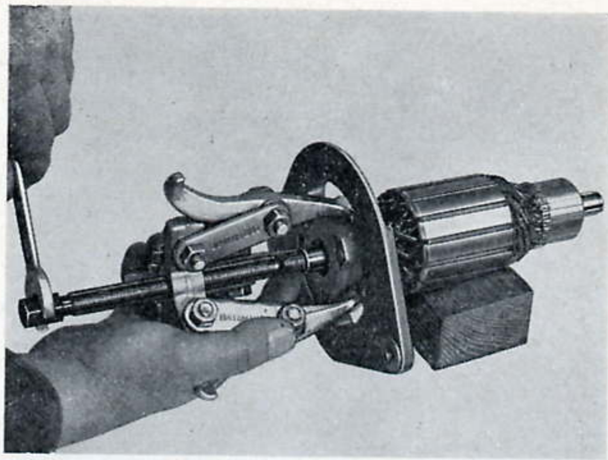


Fig. P.11. Withdrawing the drive end bracket from the armature

Inspection and Reconditioning

Clean all parts before inspection but use cleaning fluid sparingly, to avoid damage to the insulation of the armature and field coils. Do not allow cleaning fluid to enter the ball bearing.

Bearings

1. Check the armature drive end bearing for roughness or play between the inner and outer races.

2. To renew the drive end bearing:

(*a*) Remove the key and pulley spacer from the armature shaft.

(*b*) Withdraw the drive end bracket from the armature shaft with a suitable drag (Fig. P.11).

(*c*) Remove the bearing retainer by punching out the rivets.

(*d*) Push the bearing out and remove the corrugated washer and felt ring.

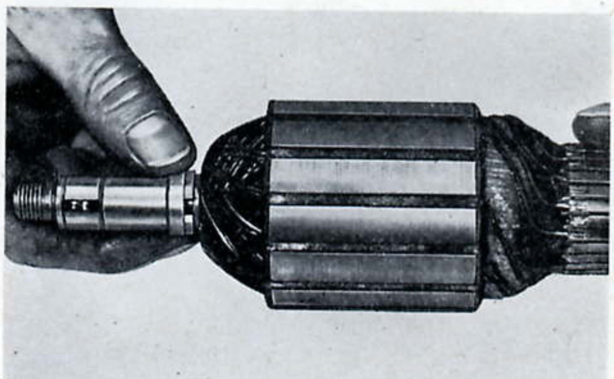


Fig. P.12. Locating the shaft collar retaining cup on the drive end of the armature shaft

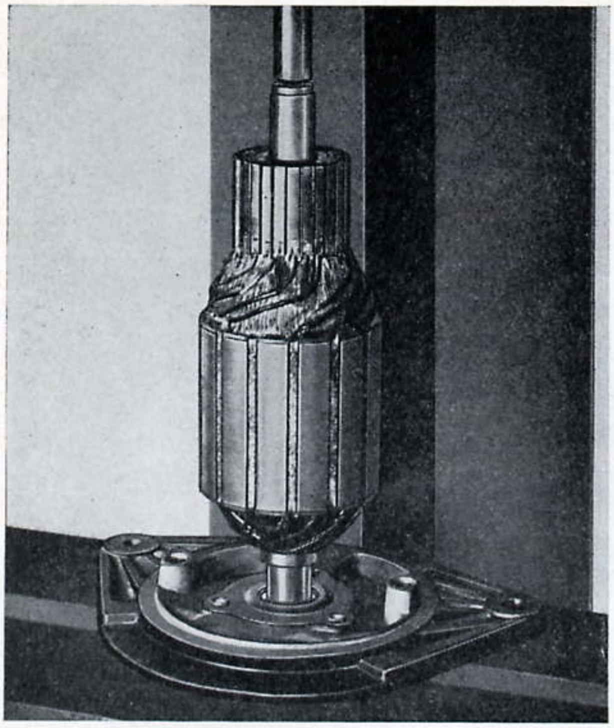


Fig. P.13. Pressing the armature into the drive end bearing. The bearing inner race must be supported

(*e*) Before installing the new bearing, pack it with recommended grease.

(*f*) Assemble a new felt ring and the corrugated washer to the end bracket, followed by the bearing.

(*g*) Place the bearing retainer in position and secure with new rivets.

(*h*) Make sure that the retaining cup is located over the shaft collar on the shaft (Fig. P.12) and press the armature into the drive end bearing (Fig. P.13). Support the inner race of the bearing

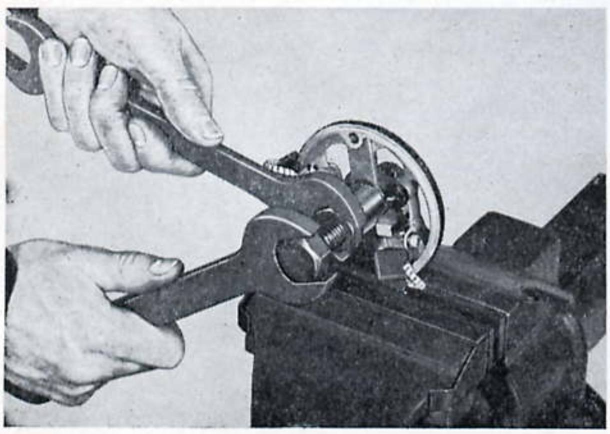


Fig. P.14. Withdrawing the commutator end bracket bush using a bolt, nut and distance piece

on the bed of the press, otherwise the corrugated washer in the bearing housing will be damaged.

3. To renew the commutator end bracket bush:

(*a*) Tap a thread in the bush with a $\frac{5}{8}$ in. diameter tap.

(*b*) Locate a distance piece, 1·00 in. long, ·75 in. diameter bore with an outside diameter of approximately 1·25 in., over the end of the bush.

(*c*) Screw a nut on a bolt of similar thread to the tap, and thread the bolt into the bush.

(*d*) Tighten the nut against the distance piece and withdraw the bush (Fig. P.14).

(*e*) Withdraw the felt ring retainer and felt ring and thoroughly clean out the bush housing.

(*f*) Soak a new felt ring in clean engine oil and install in the bush housing followed by the retainer.

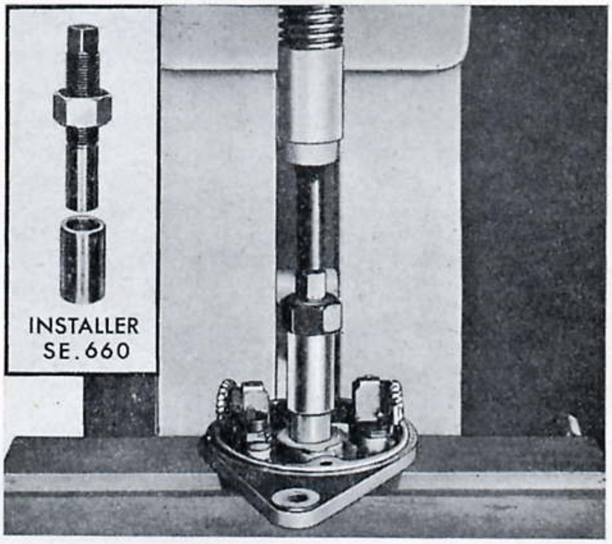


Fig. P.15. Pressing a new bush into the commutator end bracket

(*g*) Saturate the new bush with engine oil as follows:

Place a forefinger over one end of the bush and fill the bush with oil. Place the thumb over the open end of the bush and apply pressure until the oil is observed seeping through the wall of the bush. Refill the bush with oil and repeat the operation to ensure that the bush is completely saturated.

(*h*) Press the bush into the commutator end bracket, using a special installer (Fig. P.15) in conjunction with a press as follows:

Adjust the nut on the installer so that the pilot protrudes from the sleeve a distance slightly greater

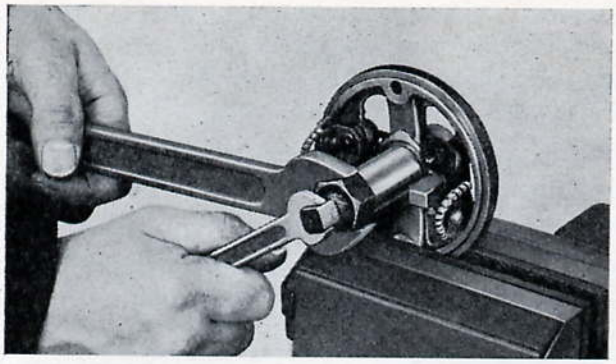


Fig. P.16. Withdrawing the installer pilot after installing the bush in the commutator end bracket

than the length of the bush. Press the bush into the bracket. Withdraw the pilot from the bush by holding the squared end and screwing down the nut (Fig. P.16).

NOTE: *It is important that the installer is used as it incorporates an accurately dimensioned pilot, which ensures correct sizing of the bush bore after installation.*

Armature

1. Examine the commutator for pitting or wear. If necessary, refinish, after carrying out operations 2, 3, and 4, as follows:

(*a*) Clean and polish the surface of the commutator, using very fine glass paper. *Do not use emery cloth.* Clean out between segments.

(*b*) The fabricated-type commutator (Fig. P.17) can be lightly skimmed and the insulators undercut between the segments to a maximum depth of ·030 in. *for the full width.*

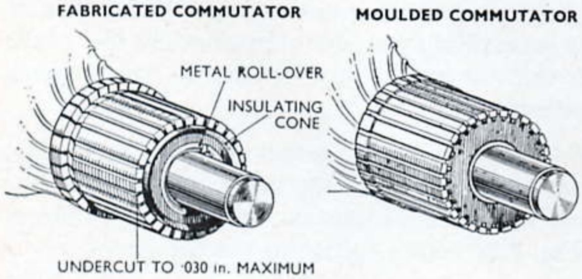


Fig. P.17. Showing the difference between the fabricated and moulded commutators

(*c*) The moulded-type commutator (Fig. P.17), can be skimmed, provided the diameter is not reduced below 1·450 in. A commutator which cannot be cleaned up without reducing its diameter below this figure must be scrapped. On these commutators the initial undercutting is sufficient to last the life of the armature.

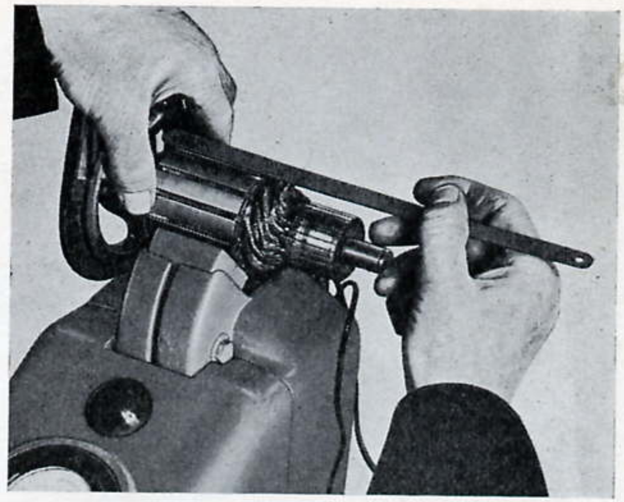


Fig. P.18. Testing armature windings for short circuits

(*d*) Finish off by polishing the commutator with glass paper.

2. Test the armature for short circuits as follows:

(*a*) Place the armature on a growler and move the switch to the 'SERIES' position.

(*b*) Hold a hacksaw blade or steel rule over, and in line with, the armature core (Fig. P.18) and slowly rotate the armature a complete revolution.

(*c*) Provided the saw blade does not vibrate, the condition of the armature is satisfactory. If the saw blade vibrates, a short circuit exists. To determine whether the short is in the armature or the commutator, switch off the growler and examine the commutator, clearing any segments which may have burred together, then retest. If the saw blade continues to vibrate, the armature is short-circuited and should be renewed. Make sure that the armature-to-commutator leads are securely soldered to the commutator segments.

3. Test the armature for open circuits as follows:

(*a*) Mount the armature on a growler, and move switch to the 'SERIES' position.

(*b*) Place the dual test fingers on adjacent commutator segments as shown in Fig. P.19. Adjust the growler rheostat to obtain a mid-scale reading on the ammeter and note the reading. Rotate the armature to bring the next gap on the commutator into the checking position. Repeat the test on all segments in turn, maintaining the same point of checking. If from any pair of adjacent segments a very low or zero reading is recorded on

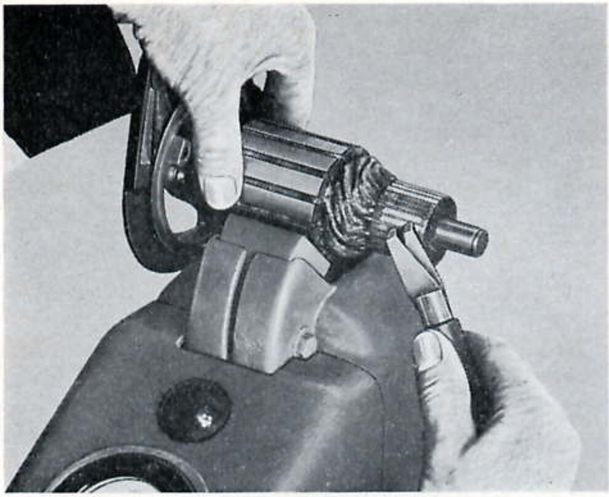


Fig. P.19. Testing armature windings for open circuits

the ammeter, an open circuit in the winding is indicated. Before proceeding further make sure that the inter-segment insulation is clear otherwise a short circuit between segments may occur.

(*c*) Re-test; if the low reading persists, an open-circuit coil is indicated, which should be rectified or the armature renewed.

4. Test the armature windings for earth, using test prods carrying mains voltage in conjunction with the continuity test lamp as follows:

(*a*) Insulate the armature from the growler by placing a strip of insulating material between the mounted armature and growler. Switch on the mains current. Place one test prod on the armature core and the other on each of the commutator segments in turn, as shown in Fig. P.20.

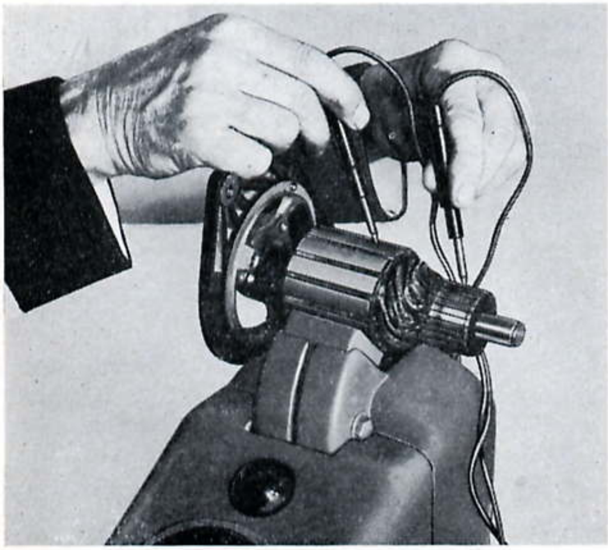


Fig. P.20. Testing armature windings for earth. An insulating strip is interposed between the armature and the growler

(*b*) If the test lamp lights, an earth on the armature is indicated and should be rectified by repair or renewal of the armature.

(*c*) If the test lamp remains unlit the condition of the armature for earth is satisfactory.

Brush Gear

1. Check for sticking of the brushes in their holders and for excessive brush wear.

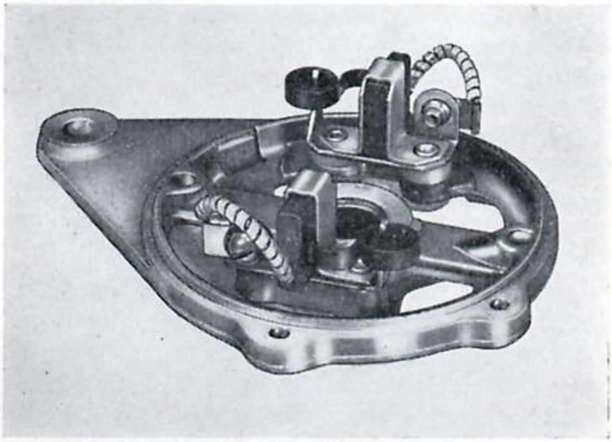


Fig. P.21. Correct location of brush lead and tag. The brushes are wedged in the retracted position by the springs, prior to installing the end bracket

(*a*) To free sticking brushes, clean all carbon deposit away and if necessary ease the brushes by lightly polishing the sides with a fine cut file. Make sure that the brushes are replaced in their original positions.

(*b*) When renewing brushes, place the shake-proof washer between the brush lead tag and the brush holder, and locate the lead and tag as shown in Fig. P.21 before tightening the tag screw.

New brushes must be bedded-in by placing a strip of fine grade glass paper around the commutator and rotating the commutator and glass paper by hand as shown in Fig. P.22.

2. Mount the drive end bracket and armature assembly in a vice, and assemble the commutator end bracket to the armature with the brushes and spring correctly located. Check the tension of the brush springs as shown in Fig. P.23.

Fig. P.22. Bedding-in new brushes with fine grade glass paper wound round the commutator, which is then rotated

3. Test the insulation of the brush holder mountings, using test prods carrying a mains voltage of 200 to 250 and having a lamp wired in series. The procedure is as follows:

Place one of the prods on the brush holder and the other on the commutator end bracket (Fig. P.24).

When the prods are applied to the positive brush holder, the series lamp should light up, but when testing the negative holder, the lamp will remain unlit if the insulation is satisfactory. Check for tightness of the rivets securing the brush holders to the end bracket.

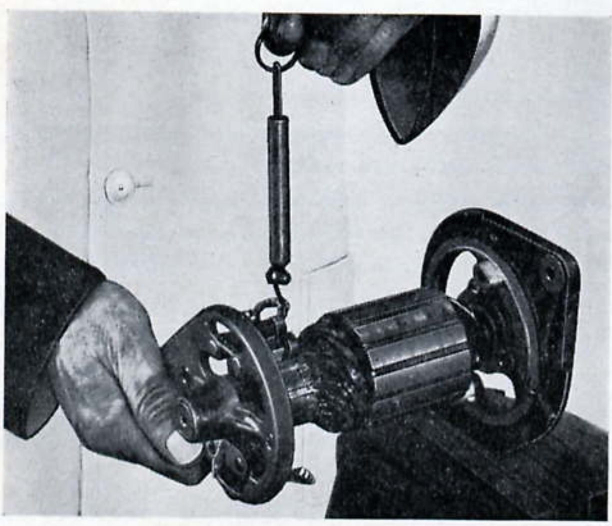


Fig. P.23. Checking generator brush spring tension

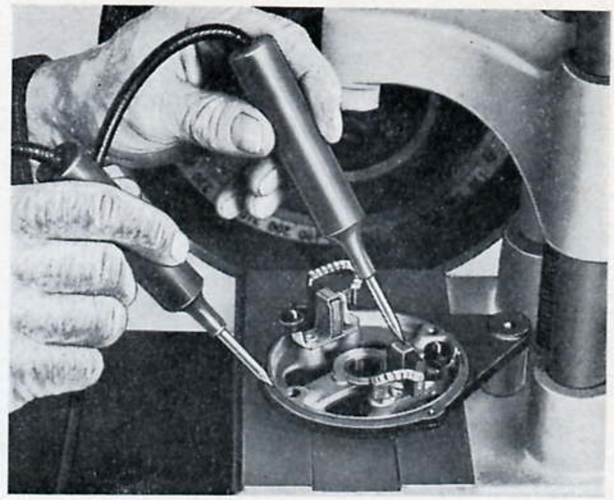


Fig. P.24. Testing brush holder insulation

Field Coils

It is essential that the field coils are in position in the generator yoke when testing for earth, therefore complete all the following tests without removing the coils. Examine the condition of the coil insulation as re-taping may be necessary even though the coil tests may prove satisfactory.

1. Test the field coils for earthed windings. Before starting the test, make sure that the terminal tags on the coil leads are not touching the yoke. Use mains supply test leads with a 40 or 60 watt lamp in series.

(*a*) Punch out the rivet securing the terminal to the yoke (Fig. P.25).

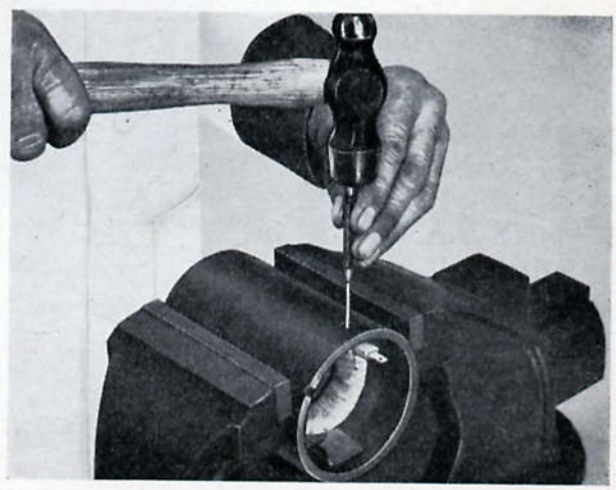


Fig. P.25. Punching out the field coil terminal rivet

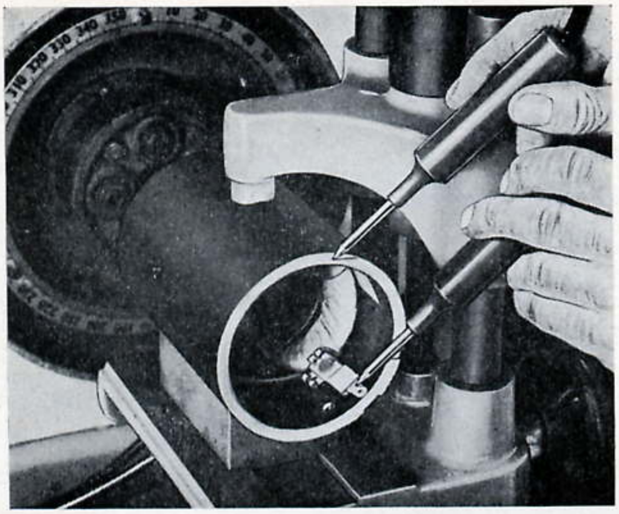


Fig. P.26. Testing field coils for earthed windings

(*b*) Place one of the test prods on the coil negative terminal and the other on the generator yoke (Fig. P.26). The lamp should remain unlit. If the lamp does light, this indicates a short to earth and the coils should be renewed or re-insulated.

2. Test the field coils for voltage drop by connecting a 12 volt supply across the coils, the negative to the field terminal and the positive to the yoke.

(*a*) Re-rivet the terminal to the yoke.

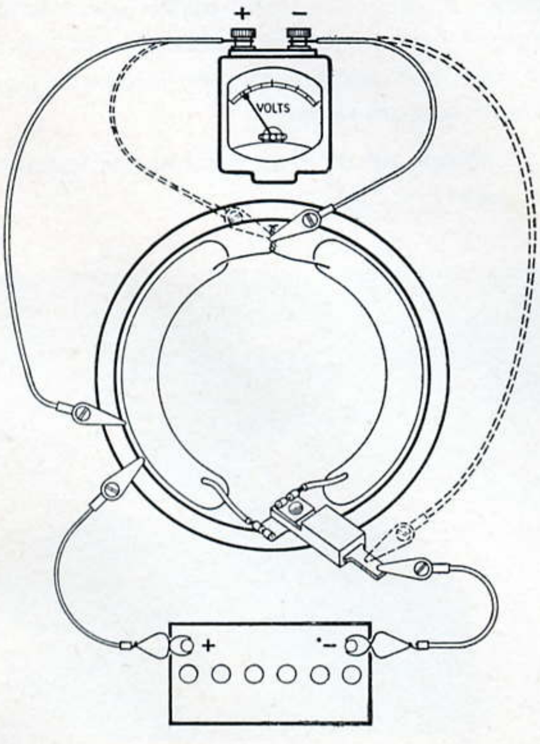


Fig. P.27. Testing field coils for voltage drop; dotted lines show voltmeter connections when testing the earthed coil

(*b*) Connect a voltmeter across each coil in turn (Fig. P.27) and note the readings obtained. A reading of 6 volts should be obtained from each coil. A reading of less than 6 volts will indicate a short in the winding on the coil undergoing test. A high reading indicates a high resistance due to a dry-soldered joint at the wire terminals or poor connection between the earth terminal and the yoke.

3. To renew the field coils or re-insulate, proceed as follows:

(*a*) Mark the yoke and pole shoes, in order that the shoes may be installed in their original positions.

(*b*) Remove the pole shoe securing screws, using a pole shoe screwdriver.

(*c*) Withdraw the field coils and pole shoes as an assembly from the yoke, also the insulating strip installed between the coils and the yoke.

(*d*) Where necessary, re-insulate the original coils using ½ in. wide linen tape. After carefully binding the tape, coat the tape with shellac and stove until completely dry.

(*e*) Locate the coils and pole shoes in the yoke in their correct relative positions and insert the pole shoe screws.

(*f*) Locate the insulating strip between the coils and generator yoke at the commutator end to prevent the coil series connection from shorting on the yoke.

(*g*) Place an expander in position to fully locate the shoes, and tighten the screws with the pole shoe screwdriver.

(*h*) Locate the field coil terminal so that the coil earth (red) wire is earthed to the generator yoke, and secure the field terminal with a new rivet.

Reassembly

1. Install the pulley spacer and key at the drive end of the armature shaft.

2. Assemble the generator pulley to the armature shaft with fan blades towards the drive end bracket and secure with the lockwasher and nut.

3. Install the armature in the yoke and place the fibre washer on the commutator end of the shaft.

4. Pull back the brush springs and raise the brushes, wedging them in the retracted position by deflecting the springs to one side of each brush (Fig. P.21 on page P-10).

5. Assemble the commutator end bracket to the armature shaft sufficiently to bring a part of the

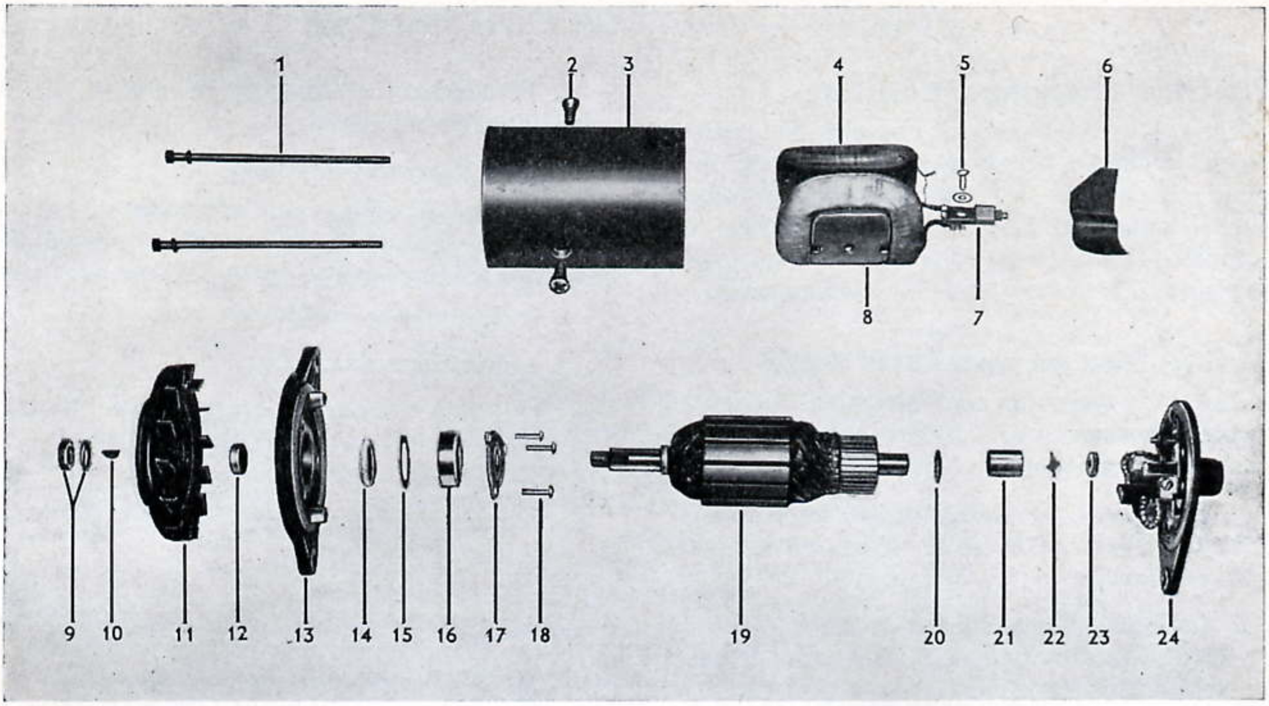


Fig. P.28. Exploded view of generator

1. Through bolt and lockwasher
2. Pole shoe screw
3. Yoke
4. Field coils
5. Field coil terminal rivet
6. Insulator
7. Field coil terminal
8. Pole shoe
9. Pulley nut and lockwasher
10. Key
11. Pulley
12. Pulley spacer
13. Drive end bracket
14. Felt ring
15. Corrugated washer
16. Ball bearing
17. Ball bearing retainer
18. Retainer rivet
19. Armature
20. Fibre thrust washer
21. Commutator end bush
22. Felt ring retainer
23. Felt ring
24. Commutator end bracket and brush gear

Fig. P.29. Raising a brush spring to release the brush when assembling the commutator end bracket to the yoke

brushes over the commutator. Release the brushes (Fig. P.29), then push the end bracket fully home.

6. Line up the dowel in each end bracket with the recesses in the yoke, then insert and tighten the through bolts. Check the armature for free rotation.

7. Before installing the generator it should be bench tested, reproducing vehicle running conditions as closely as possible.

Installation

1. Assemble the generator to its mounting bracket. Do not fully tighten the bolts.

2. Assemble the bolt to the slotted brace and adjust the drive belt tension (page P-6).

3. Reconnect the wires to the generator terminals.

CURRENT—VOLTAGE CONTROLLER

Electrical Checking and Setting

The voltage regulator, cut-out relay and current regulator should be checked and adjusted in a complete sequence. The setting of one unit only is not recommended. Use a high grade moving coil voltmeter—scale 0–20 volts and a high grade moving coil ammeter—scale 40–0–40 amperes.

Voltage Regulator Open Circuit Setting

CAUTION: Checking and adjusting should be completed *as rapidly as possible* to avoid inaccurate readings due to heating of the regulator coil.

1. Disconnect the wire from the controller 'B' terminal. Protect the wire from earthing on adjacent panels.

2. Connect the negative lead of the voltmeter to the controller 'D' terminal. A convenient method of making this connection is to clip the lead to terminal 'WL' which is common with terminal 'D'. This necessitates withdrawing the ignition/generator warning lamp feed wire. Connect the positive lead to earth (Fig. P.30).

3. Start the engine and increase engine speed gradually until the voltmeter flicks and steadies. This should occur at the readings specified.

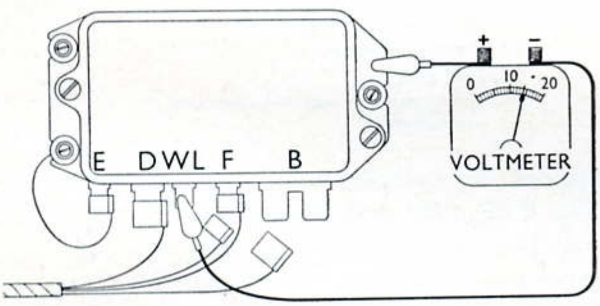


Fig. P.30. Voltage regulator, open circuit setting

4. An unsteady voltmeter reading (fluctuating more than plus or minus ·3 volt) may be due to dirty points. If the reading is steady but outside the required limits, rotate the adjustment cam to obtain the correct setting, using the tool shown in Fig. P.32. To increase the voltage, increase the cam lift.

5. Check the setting by stopping the engine, then re-starting and running the engine again up to the test speed.

6. Re-connect the wire to the 'B' terminal. Leave the voltmeter connected.

Cut-out Relay Cut-in Voltage

CAUTION: Checking and adjusting should be completed *as rapidly as possible* to avoid inaccurate readings due to heating of the relay coil.

1. Switch on the head lamps.

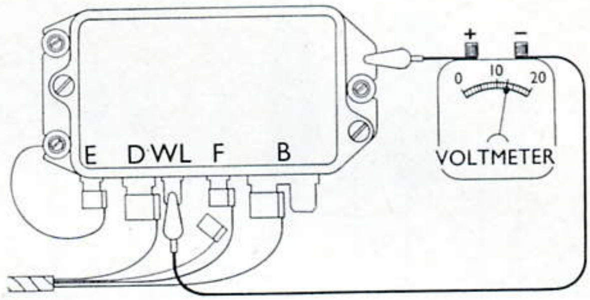


Fig. P.31. Cut-out relay, cut-in voltage setting

2. Start the engine and increase engine speed from idling. Check the voltage at the point of contact closure (Fig. P.31); this should be between 12·6 and 13·4 volts. Closure of the contacts is indicated by the voltmeter needle flicking back.

3. If necessary adjust the cut-in voltage as follows:

(*a*) Reduce the engine speed to below the cut-in speed.

(*b*) Rotate the adjustment cam (Fig. P.32), until the correct voltage is obtained. To increase the voltage, increase the cam lift.

(*c*) Re-check the voltage as previously outlined.

Fig. P.32. Adjusting the controller cut-out relay

4. Stop the engine and switch off the head lamps.

5. Disconnect the voltmeter and reconnect the ignition/generator warning lamp wire to the 'WL' terminal.

Cut-out Relay Reverse Current

1. Disconnect the wire from the controller 'B' terminal; protect the wire from earthing on adjacent panels.

2. Connect the ammeter between the terminal and the wire (Fig. P.33).

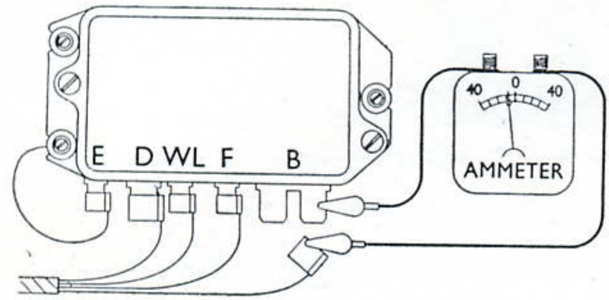


Fig. P.33. Cut-out relay, reverse current setting

3. Switch on the head lamps.

4. Start the engine and run up to charging speed, then gradually decrease the speed and note the ammeter reading. The discharge before the cut-out points open should not exceed 8 amperes.

5. Adjust the current to within the limit by bending the relay fixed contact (see Fig. P.2 on page P-2). Close the contact gap to reduce the current and open the gap to increase it.

6. Switch off the head lamps.

Current Regulator On-load Setting

1. Remove the controller cover.

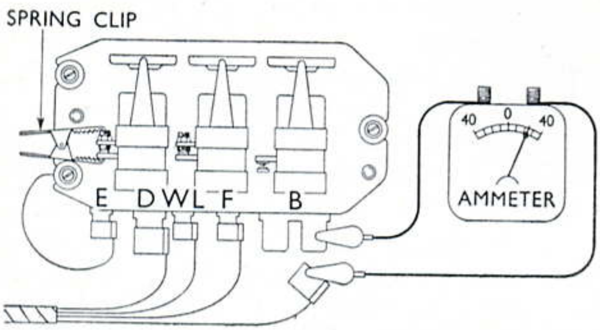


Fig. P.34. Current regulator, load setting. The voltage regulator is shorted by a clip

2. With the ammeter connected between terminal 'B' and the wire removed from the terminal, short circuit the voltage regulator contacts by means of a spring clip across the adjustable contact and the armature limb (Fig. P.34).

3. Run the engine at half throttle and note the ammeter reading. A steady reading of 22 amperes should be obtained.

4. If necessary adjust current by rotating the adjustment cam to obtain the correct setting. To increase the current, increase the cam lift.

5. Switch off the engine, remove the spring clip from the voltage regulator contacts, disconnect the ammeter and reconnect the wire to terminal 'B'.

6. Replace the controller cover.

Removal

1. Disconnect the battery.

2. Disconnect the wires and remove the controller.

Field Resistor Test

1. Examine the resistor for visual damage.

2. Connect an ohmmeter between terminals 'D' and 'F'.

3. Depress one of the regulator armatures to open the contacts (Fig. P.35). A reading of 55 to 65 ohms should be obtained.

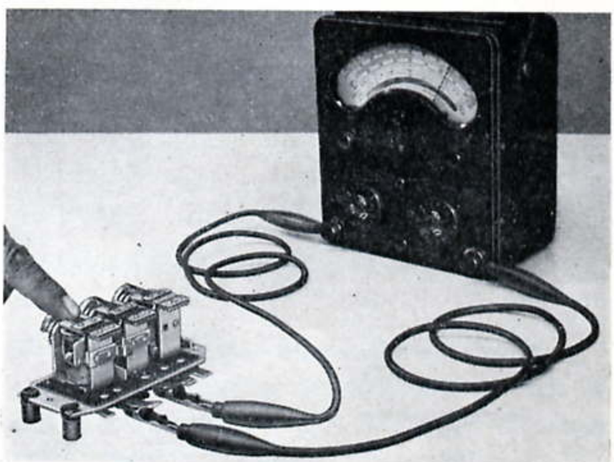


Fig. P.35. Testing the controller field resistor

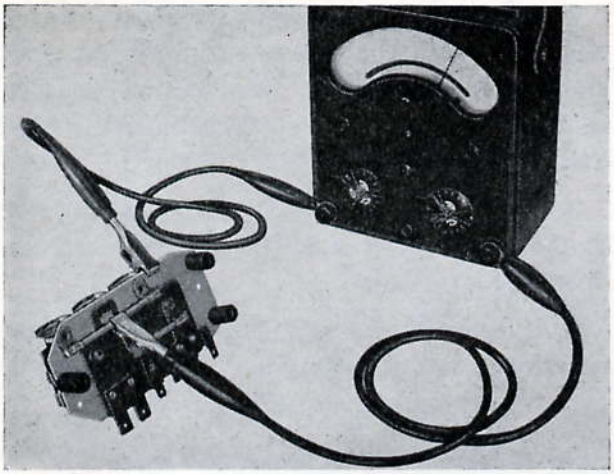


Fig. P.36. Testing the controller swamp resistor

Swamp Resistor Test

1. Examine the resistor for visual damage.

2. Connect an ohmmeter between the centre tag of the resistor and the controller base (Fig. P.36), when a reading of 13·25 to 14·25 ohms should be obtained.

Cleaning the Contacts

1. Remove the regulator stationary contacts.

2. Clean the regulator contacts with a fine carborundum stone or paper and wipe over with a cloth moistened with methylated spirits.

3. The cut-out contacts should be cleaned with a strip of fine glass paper. *On no account use carborundum stone or paper, or emery cloth on these contacts.*

4. Reassemble the regulator stationary contacts and re-set them as described under the following heading.

Mechanical Settings

Current and Voltage Regulators

Dealing with each regulator in turn, proceed as follows:

1. Rotate the adjustment cam to reduce the lift on the armature control spring, using the tool shown in Fig. P.32. Allow clearance for a tube wrench on the current regulator stationary contact locknut.

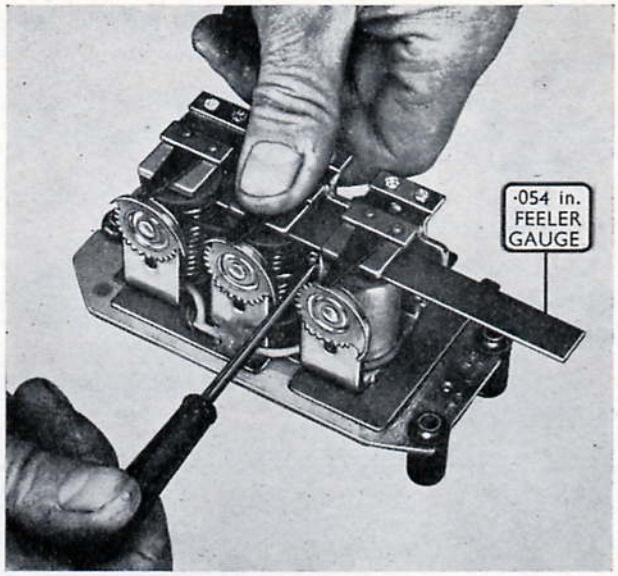


Fig. P.37. Setting the current regulator armature

2. Slacken the stationary contact locknut on both regulators.

3. Insert a ·054 in. feeler gauge between the current regulator armature and the core face (Fig. P.37). Position the feeler gauge over the core as far as the rivet heads will allow, then press the armature firmly downwards.

4. Whilst holding the armature down, screw the stationary contact inwards (Fig. P.37) until it just touches the moving contact and secure by tightening the locknut.

5. Release the armature and check armature to core air gap which should be within the specified limits.

6. Adjust the core air gap on the voltage regulator in a similar manner.

Cut-out Relay

The cut-out armature to core gap should be ·035 to ·045 in. measured by a feeler gauge inserted as far as the rivet heads will allow (Fig. P.38). If necessary, bend the back stop (Fig. P.2 on page P-2), as required.

Press the armature down until the contacts close and check the clearance between the armature and the core; this should be from ·010 to ·035 in. Adjust the fixed contact bracket as necessary to give this clearance.

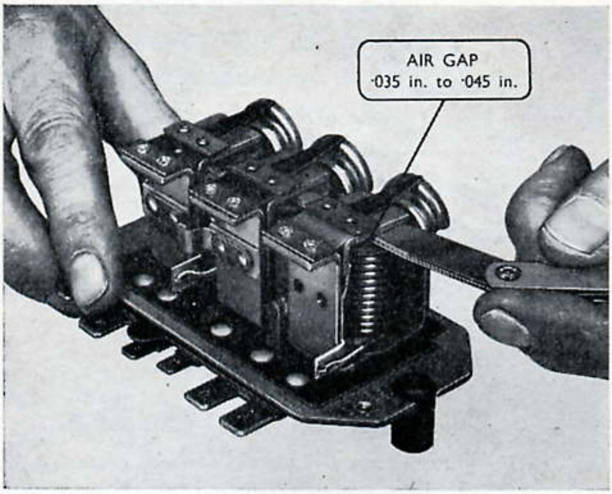


Fig. P.38. Checking the cut-out relay armature to core air gap

Installation

1. Install the controller on the footwell upper panel. Secure the black wires from the harness and the black wire from the controller terminal 'E', to the panel with the controller attaching screws.

2. Connect the wires to the terminals as follows:

(*a*) The brown-yellow wire to terminal 'D'.

(*b*) The brown-green wire to terminal 'F'.

(*c*) The brown wire to terminal 'B'.

(*d*) The brown-yellow wire (small terminal) to terminal 'WL'.

3. Reconnect the battery.

4. Re-check the electrical settings as detailed on page P-18 to ensure they are within the specified limits under vehicle operating conditions.

SPECIFICATIONS

BATTERY

	GASOLINE	DIESEL
Standard		
Make and type	Lucas BT 7A/1 or Exide 6-XNA7ZR	Exide 6-TXMZ 15L
Capacity: At 20 hour rate	43 amp. hours	87 amp. hours
Heavy-duty		
Make and type	Exide 6-XNMZ9R	—
Capacity: At 20 hour rate	57 amp. hours	—

GENERATOR

Make and Model	Lucas C40 or *C40/1
Voltage	12
Cutting-in Speed	1450 r.p.m. at 13 volts
Output	22 amps., 2250 r.p.m. at 13·5 volts
Field Resistance	6 ohms
Brush Gear	
Brush length (minimum)	·28 in.
Brush spring tension	30 oz. maximum with a new brush: 13 oz. minimum with a brush worn to ·28 in. length

* *This unit has a stepped yoke*

Belt Tension	·50 in. depression midway between the fan and generator pulleys with an applied load of 8 to 10 lb. (gasoline) and 5 to 6 lb. (diesel)
Armature Commutator	
Moulded commutator minimum diameter after skimming	1·450 in.
Fabricated commutator undercut depth	·030 in. maximum

CURRENT-VOLTAGE CONTROLLER

Make and Model	Lucas RB340, 12 volt
Resistors	
Swamp	53 to 57 ohms between tag ends before fitting, 13·25 to 14·25 ohms between centre tag and controller base after fitting
Shunt Winding Resistances	
Cut-out	9·1 to 9·9 ohms
Voltage regulator	11·2 to 12·4 ohms

ELECTRICAL SETTINGS

Current Regulator		
Load setting	21 to 23 amps.	
Field resistance	55 to 65 ohms	
Cut-out Relay		
Cut-in voltage	12·6 to 13·4 volts	
Reverse current	8 amps. maximum	
Voltage Regulator		
Open circuit setting	AIR TEMPERATURE	VOLTS
	10°C (50°F)	14·4 to 15·0
	20°C (68°F)	14·2 to 14·8
	30°C (86°F)	14·0 to 14·6
	40°C (104°F)	13·8 to 14·4

MECHANICAL SETTINGS

Current Regulator	
Armature to core air gap	·052 to ·056 in.
Cut-out Relay	
Armature to core air gap	·035 to ·045 in.
Follow-through of moving contact	·010 to ·035 in.
Voltage Regulator	
Armature to core air gap	·052 to ·056 in.

BEARINGS, SHIMS AND CIRCLIPS

Main Drive Pinion Bearing

Fit on pinion shaft	·0003 in. clearance to ·0006 in. interference	Bearing bore 1·1807 to 1·1811 in. Shaft dia. 1·1808 to 1·1813 in.
Fit in front cover	·0009 in. clearance to ·0002 in. interference	Cover bore 2·4407 to 2·4413 in. Bearing dia. 2·4404 to 2·4409 in.

Mainshaft Bearing

Fit on mainshaft	Zero to ·001 in. interference	Bearing bore ·9997 to 1·0002 in. Mainshaft dia. 1·0002 in to 1·0007 in.
Fit in rear cover	·0002 to ·0014 in. interference	Cover bore 2·4395 to 2·4401 in. Bearing dia. 2·4403 to 2·4409 in.

Mainshaft Shim

Thicknesses .. .. ·003, ·005 and ·010 in.

Mainshaft Circlips

Thicknesses .. .. ·059 to ·061 in.
·062 to ·064 in.
·065 to ·067 in.
·068 to ·070 in.
·071 to ·073 in.
·074 to ·076 in.
·077 to ·079 in.

FRONT AND REAR COVERS

Front Cover

Sleeve diameter.. .. .. 1·255 to 1·256 in.

Rear Cover

Fit of propeller shaft sliding sleeve in bush	·002 to ·005 in. clearance	Bush bore 1·3770 to 1·3785 in. Sleeve dia. 1·3735 to 1·3750 in.

Rear bush housing bore diameter .. .. 1·503 to 1·504 in.

SHAFTS AND GEARS

Mainshaft

Front bearing spigot diameter .. .. ·7992 to ·7997 in.

Front bearing needle rollers—number .. 24

First Speed Gear and Sleeve—Four-speed transmission

Fit of sleeve on mainshaft ..	Zero to ·001 in. interference	Sleeve bore 1·0620 to 1·0625 in. Mainshaft dia. 1·0625 to 1·0630 in.
Fit of gear on sleeve	·0020 to ·0041 in. clearance	Gear bore 1·3510 to 1·3525 in. Sleeve dia. 1·3484 to 1·3490 in.

Mainshaft Gears

Fit on mainshaft	·0016 to ·0032 in. clearance	Gear bore 1·4760 to 1·4770 in. Mainshaft dia. 1·4738 to 1·4744 in.

Layshaft Gear

Thrust washer thickness	·0615 to ·0635 in.
End float in casing	·0048 to ·0177 in.

Layshaft

Fit in front end of casing ..	·0004 to ·0017 in. interference	Casing bore ·7035 to ·7041 in. Shaft dia. ·7045 to ·7052 in.
Fit in rear end of casing ..	·0002 to ·0015 in. interference	Casing bore ·6693 to ·6699 in. Shaft dia. ·6701 to ·6708 in.

Bearing journal diameters:

Front	·7007 to ·7014 in.
Rear	·6701 to ·6708 in.

Bearing needle rollers—number:

Front	26
Rear	25

Reverse Pinion

End float in casing—three speed	·0040 to ·0139 in.	
Fit on shaft	·0025 to ·0040 in. clearance	Bush bore ·7820 to ·7830 in. Shaft dia. ·7790 to ·7795 in.

Reverse Pinion Shaft

Fit in rear end of casing ..	·0002 to ·0015 in. interference	Casing bore ·7995 to ·8004 in. Shaft dia. ·8006 to ·8010 in.
Fit in casing inner boss ..	Zero to ·0013 in. clearance	Boss bore ·7795 to ·7803 in. Shaft dia. ·7790 to ·7795 in.

Main Drive Pinion

Spigot diameter	·5895 to ·5902 in.
Needle roller counterbore dia.	1·0361 to 1·0366 in.

STRIKING FORKS, RODS AND LEVER SHAFT

Striking Forks

Thickness of pads	·252 to ·256 in.
Side clearance of pads in clutch groove ..	·008 to ·016 in.

Striking Fork Rods

Fit in front end of casing ..	·0019 to ·0037 in. clearance	Casing bore ·6019 to ·6029 in. Rod dia. ·5992 to ·6000 in.
Fit in rear end of casing ..	·0019 to ·0037 in. clearance	Casing bore ·5919 to ·5929 in. Rod dia. ·5892 to ·5900 in.

Striking Lever Shaft

Fit in casing .. .. .. ·0008 to ·0026 in. clearance { Casing bore ·5118 to ·5129 in. / Shaft dia. ·5103 to ·5110 in.

Reverse Striking Fork Rod—Four-speed transmission

Fit in front end of bottom cover ·002 to ·004 in. clearance { Cover bore ·5645 to ·5655 in. / Shaft dia. ·5615 to ·5625 in.

Fit in rear end of bottom cover ·002 to ·004 in. clearance { Cover bore ·5545 to ·5555 in. / Shaft dia. ·5515 to ·5525 in.

SPEEDOMETER GEARS

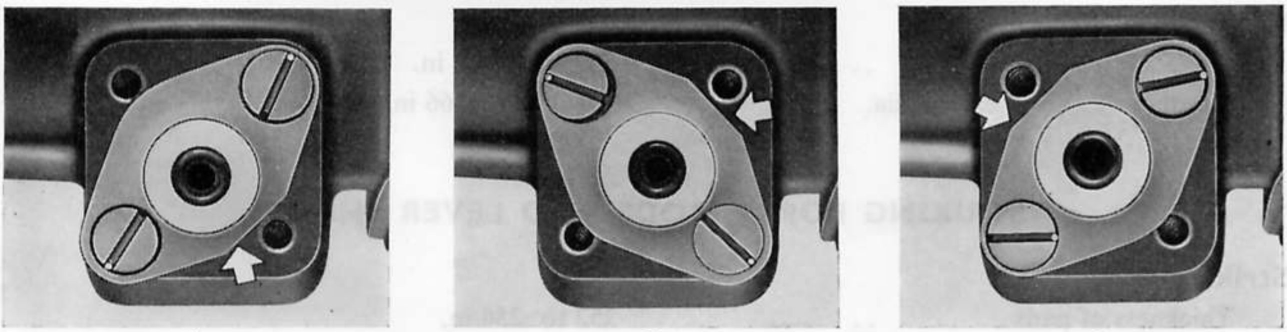
Driving Gear

Number of teeth 5

Fit on mainshaft .. .. Zero to ·0035 in. clearance { Gear bore ·9990 to 1·002 in. / Shaft dia. ·9985 to ·9990 in.

Driver Gear and Housing

REAR AXLE RATIO	REAR TYRE SIZE	NUMBER OF TEETH ON DRIVEN GEAR	HOUSING IDENTIFICATION	HOUSING FLAT LOCATION (FIG. G-43)
7/37 (5·286 to 1)	6·40–13 6·70–13	22 21	Grooved Grooved	A A
8/37 (4·625 to 1)	6·40–13 6·70–13	19 18	Plain Plain	A B
9/37 (4·111 to 1)	6·40–13 6·70–13	17 16	Plain Plain	B C



A B C

Fig. G.43. Speedometer driven gear housing flat locations

TORQUE WRENCH DATA

Striking Lever Setscrews .. .. .. *22 lb. ft.

**Clean dry threads*

SECTION H— PROPELLER SHAFT

INDEX

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DESCRIPTION	H-1
GUARDIAN MAINTENANCE	H-2
PROPELLER SHAFT	H-2
UNIVERSAL JOINTS	H-2
SPECIFICATIONS	H-3

Have you read the General Notes on page vii ?

DESCRIPTION

The tubular shaft incorporates two universal joints of the trunnion and needle roller bearing type (Fig. H.1). The sleeve of the front universal joint is splined internally to engage the rear end of the transmission mainshaft and is supported in the transmission rear cover bush. The sleeve is free to move longitudinally on the mainshaft and in the bush to compensate for movement of the rear axle. An oil seal in the transmission rear cover operates directly on the sliding sleeve.

Each needle roller bearing is retained in the yoke eye by a snap ring and sealed at its inner end by a cork oil seal located in a retainer assembled to the trunnion.

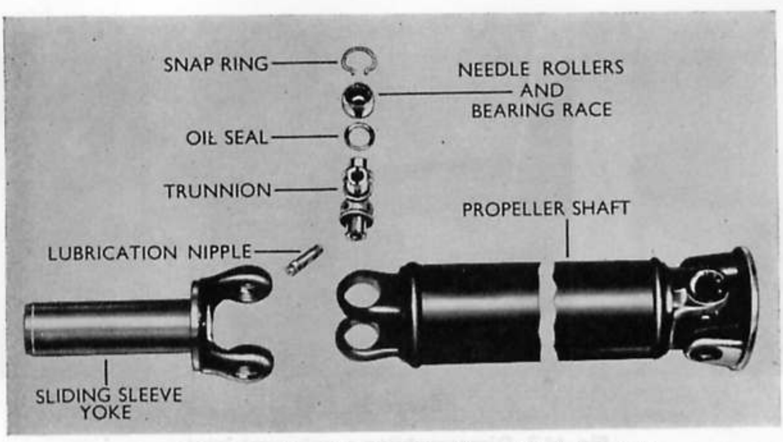

Fig. H.I. Propeller shaft and universal joint details

SPECIFICATIONS

BRAKE PEDAL

Free Travel — Measured at pedal pad ..	·26 to ·32 in.

BRAKE DRUMS

Internal Diameter	9·000 to 9·005 in.
Maximum Permissible Diameter After Service Machining	9·060 in.
Maximum Run-out of Braking Surface ..	·002 in.

RECOMMENDED LUBRICANTS

OVERSEAS

USAGE	S.A.E. VISCOSITY NO.	G.M. SPECIFICATION NO.
Front Suspension and Steering Suspension Arm Bushes Steering Knuckle King Pins Steering Joints Steering Relay Lever Bushes	—	4591–M or 4733–M
Front Hub Bearings Steering Shaft Bearing	—	4733–M
Steering Gear	90	4519–M or 4598–M
Brakes Master Cylinder Reservoir	—	4653–M
Brake Pedal Shaft Brake Shoe Abutments Parking Brake Lever Pivots Parking Brake Cable, Bridle, Guides and Clevises	—	4550–M
Hydraulic Cylinders	Castor oil base grease, harmless to rubber	

RECOMMENDED LUBRICANTS

UNITED KINGDOM

USAGE	BP	CASTROL	DUCKHAM'S	ESSO	GULF	MOBIL	REGENT	SHELL
Front Suspension and Steering Suspension Arm Bushes Steering Knuckle King Pins Steering Joints Steering Relay Lever Bushes	Energol SAE 140 or Energrease L.2	Castrol D or Castrolease LM	N.2 Oil or LB.10 Grease	Esso Gear Oil ST.140 or Esso Multi-purpose Grease H	Gulflex A or Trans-mission Oil 140	Mobilube C.140 or Mobil-grease MP	Thuban 140 or Marfax Multi-purpose 2	Dentax 140 or Retinax A
Front Hub Bearings Steering Shaft Bearing	Energrease L.2	Castrolease LM	LBM.10 Grease	Esso Multi-purpose Grease H	Gulflex A	Mobil-grease MP	Marfax Multi-purpose 2	Retinax A
Steering Gear	Energol EP SAE.90	Castrol Thio-Hypoy 90 or Hypoy 90	SG.90 Gear Oil	Esso Gear Oil GP.90	Multi-purpose Gear Lubricant 90	Mobilube GX.90	Universal Thuban 90	Spirax 90 EP
Brakes Master Cylinder Reservoir	Castrol/Girling Crimson Brake Fluid							
Brake Pedal Shaft Brake Shoe Abutments Parking Brake Lever Pivots Parking Brake Cable, Bridle, Guides and Clevises	Duckham's KG.20 Keenol Grease							
Hydraulic Cylinder	—	Castrol No. 3 Rubber Grease or Castrol/Girling Red Rubber Grease	Q.4590 Rubber Grease	Esso TSD.803	—	—	—	Shell Rubber-proof Grease

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SUPPLEMENT

Suspension, Steering, Brakes

VAUXHALL MOTORS LTD

LUTON – ENGLAND

6. On the four-speed transmission, with the gear shift lever in reverse, check that clearance exists between the change speed lever boss and the lever bracket (Fig. F.8).

Removal

1. Disconnect the control rods from the relay levers. Detach the rods from the levers on the transmission and remove the striking lever bracket.

2. Remove the relay levers from the mounting bracket.

3. Remove the steering wheel (see Section M).

4. Remove the spring from the bottom of the selector rod and the cotter securing the change speed lever to the rod.

5. Remove the selector rod lever from the support bracket and withdraw the change speed lever.

6. Remove the gear shift lever by compressing the spring-loaded pivots. Remove the pivots and springs.

7. Withdraw the selector rod.

8. Disconnect the control rods from the change speed and selector rod levers.

Disassembly

On vehicles with a four-speed transmission, remove the split pin and withdraw the bush, spring and washers from the upper end of the selector rod.

Reassembly

When reassembling the bush, spring and washers to the selector rod on four-speed transmission vehicles, assemble the bush with the shoulder against the washer (Fig. F.9).

Installation

Note the following:

1. Lubricate pivots, fulcrum pins and control rod ends with recommended grease.

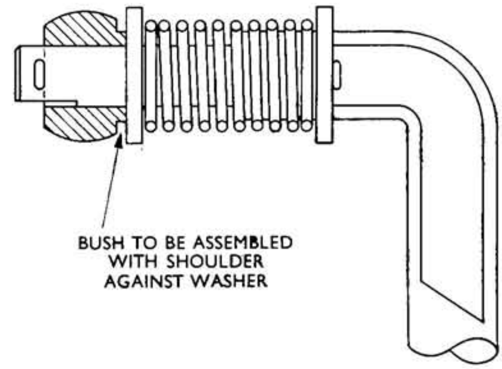

Fig. F.9. Assembly of bush to four-speed gear shift selector rod

2. Fit the thackray washers to the control rods before inserting the rods in the levers.

3. Before installing the selector rod, check the height of the gear shift lever jaw (page F-4).

4. Tighten the steering wheel nut to the specified torque.

5. Adjust the gear shift linkage (page F-4).

SPECIFICATIONS

Gear Shift Lever Pivot Jaw Adjustment (See Fig. F.6.)

Dimension, centre of jaw pivot holes to top face of steering bearing housing

Three-speed transmission	·50 to ·54 in.
Four-speed transmission	·58 to ·62 in.

TORQUE WRENCH DATA

Steering Wheel Attaching Nut	52 lb. ft.

SECTION G— TRANSMISSION

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Have you read the General Notes on page vii?

DESCRIPTION

The three-speed and four-speed transmissions are similar in basic design and incorporate synchromesh engagement on all forward speeds. All gears except those in the reverse train, which are straight spur type, are of helical tooth formation.

Main Drive Pinion

The rear end of the main drive pinion is supported by a ball bearing in the front cover, and a spigot at the front end engages a bearing installed in the rear of the crankshaft.

Mainshaft Assembly

The mainshaft is supported at the front end by needle rollers in the main drive pinion and by a ball bearing located in the rear cover. Shims are used to provide correct longitudinal location of the bearing. With the exception of the first speed gear on four-speed transmissions the mainshaft gears operate direct on the shaft journals which are copper plated.

The first speed gear, on four-speed transmissions, is bushed and operates on a sleeve pressed on the rear of the mainshaft.

The synchromesh mechanism on four-speed transmissions incorporates two clutch and clutch hub assemblies (Fig. G.1). Both assemblies are splined to the mainshaft, one located at the front end of the shaft between the main drive pinion and the third speed gear and the other at the rear end of the shaft between the first and the second speed gear. The first and second speed clutch has external teeth for engagement with the reverse pinion. The clutch hub has external splines which engage internal splines in the clutch. Three equally spaced slots in the hub periphery accommodate sliding keys which are under tension from two circular springs located in the clutch hub bore. A pip formed on the outer face of each key engages a detent groove in the clutch bore. Two synchronizing rings with threaded taper bores, located one at each end of the clutch and hub assembly, engage the synchronizing cone on the adjacent mainshaft gear. Both rings are slotted to engage the sliding keys and incorporate circumferential teeth for engagement with the clutch splines.

On three-speed transmissions, the second and third speed clutch and clutch hub is identical to the third and fourth speed clutch hub on four-speed

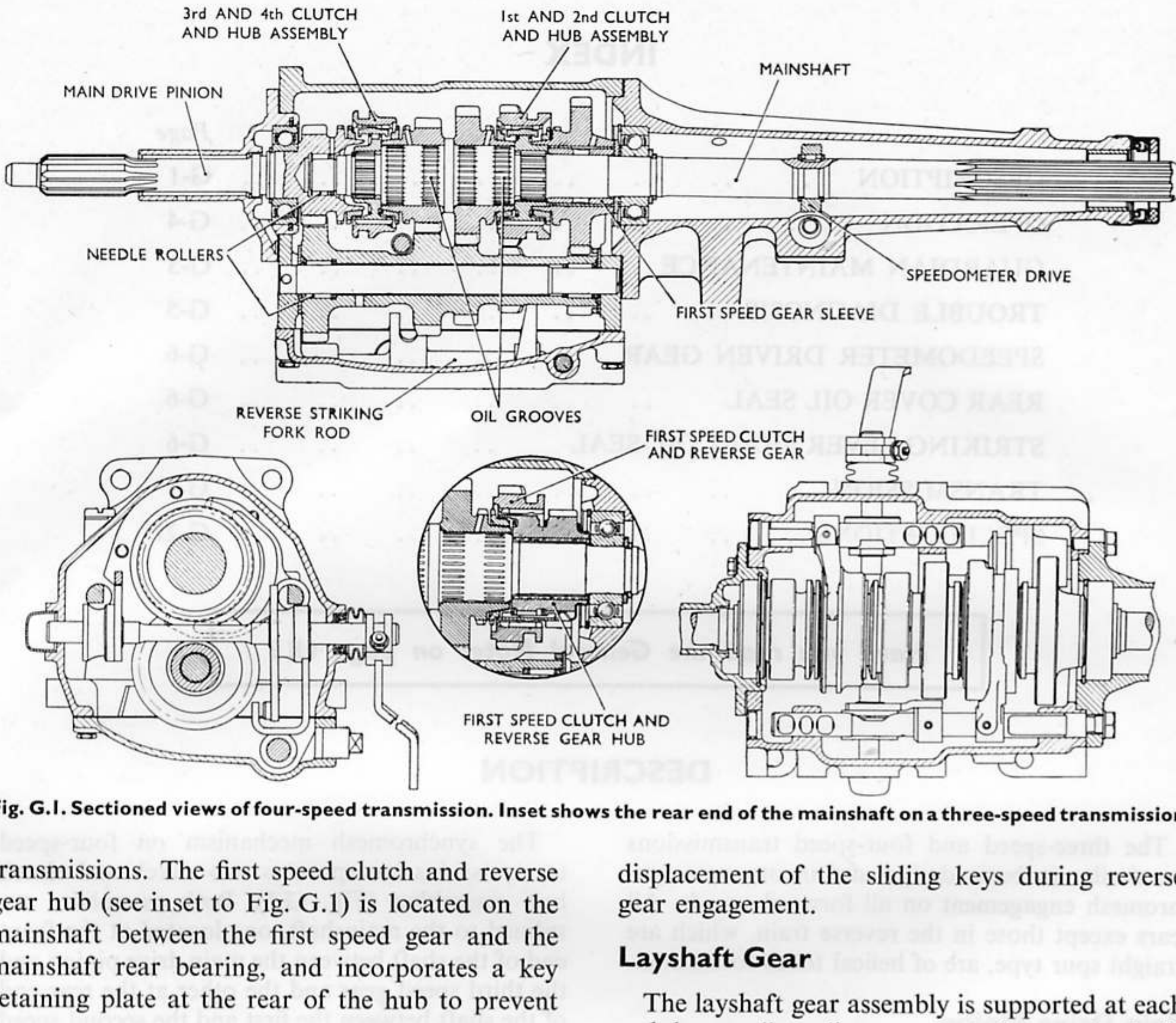


Fig. G.1. Sectioned views of four-speed transmission. Inset shows the rear end of the mainshaft on a three-speed transmission

transmissions. The first speed clutch and reverse gear hub (see inset to Fig. G.1) is located on the mainshaft between the first speed gear and the mainshaft rear bearing, and incorporates a key retaining plate at the rear of the hub to prevent displacement of the sliding keys during reverse gear engagement.

Layshaft Gear

The layshaft gear assembly is supported at each end by needle rollers on a stationary layshaft. Steel spacers are provided at each end of the needle

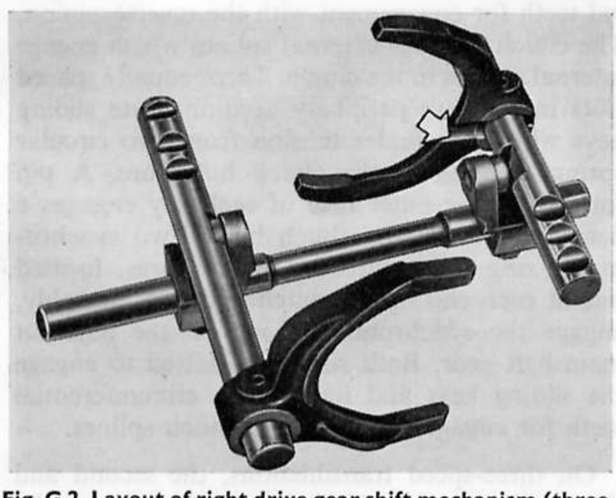


Fig. G.2. Layout of right drive gear shift mechanism (three-speed). The second and third speed striking fork is identified by a recess (indicated by arrow) provided to clear striking lever

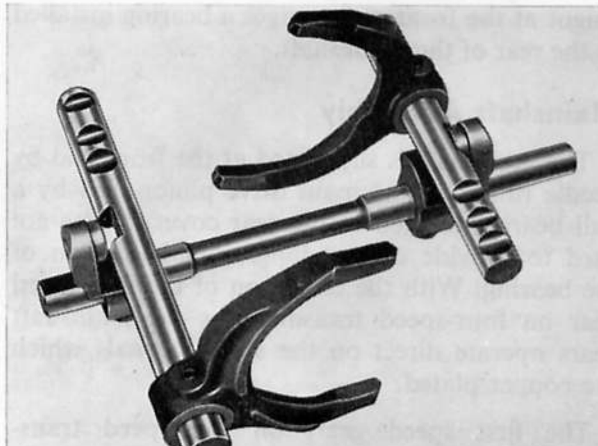


Fig. G.3. Layout of left drive gear shift mechanism (three-speed)

rollers and a steel thrust ring is splined on the rear end of the gear assembly. A phosphor-bronze thrust washer is installed at each end of the layshaft gear. The washer incorporates a tag on the periphery, which engages a slot in the casing and prevents the washer rotating. On four-speed transmissions, the layshaft is longer and incorporates an additional gear.

Reverse Pinion

The reverse pinion incorporates two bushes and rotates on a fixed shaft. On three-speed transmissions endwise location of the pinion is controlled by the transmission casing. On four-speed transmissions, the reverse pinion is a sliding gear

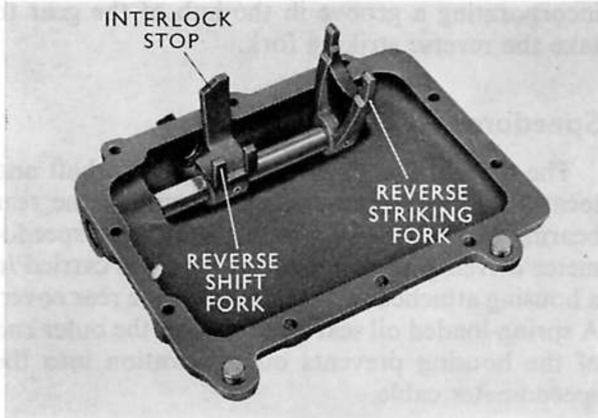
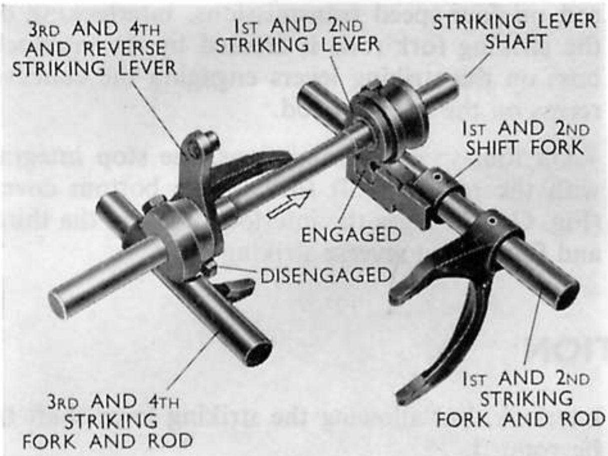
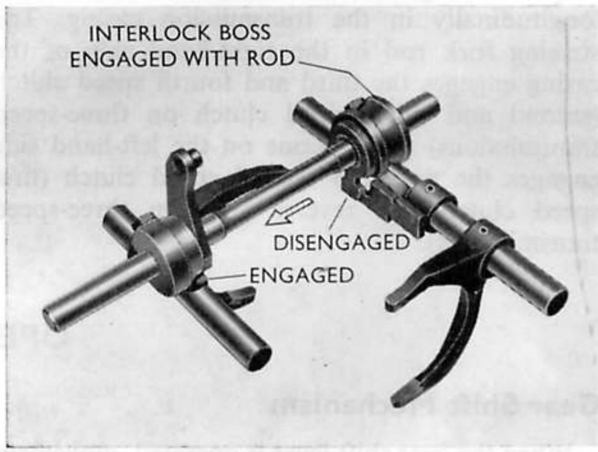


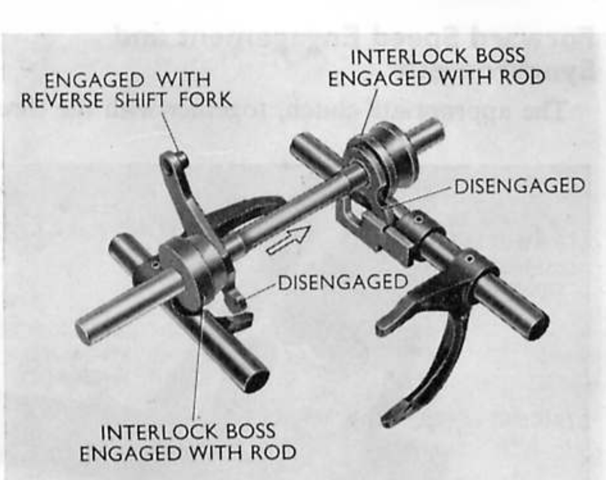
Fig. G.4. Four-speed transmission bottom cover, showing location of reverse shift fork and striking fork



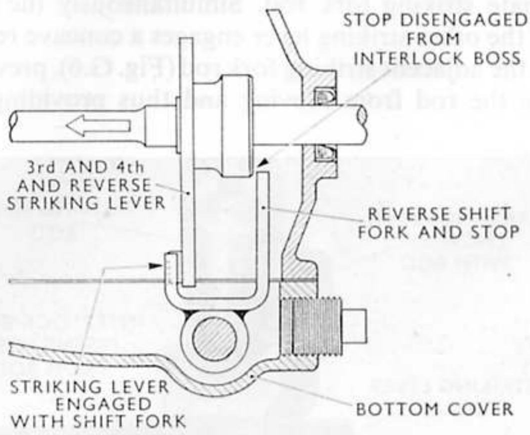
Neutral position in first and second speed plane. Striking lever shaft moved in direction of arrow, until first and second speed striking lever engages first and second speed shift fork



Neutral position in third and fourth speed plane. Striking lever shaft moved in direction of arrow until third and fourth and reverse striking lever engages third and fourth striking fork rod



Reverse engaged position. Striking lever shaft moved in direction of arrow until both striking levers are disengaged from the slots in the striking fork rods



In the reverse engaged position, the long end of the third and fourth and reverse striking lever engages with the reverse shift fork in the bottom cover. The shift fork stop prevents movement of the reverse gear when engaging third or fourth speed

Fig. G.5. Striking lever engagement details (four-speed). Shaft mechanism viewed from below

incorporating a groove in the hub of the gear to take the reverse striking fork.

Speedometer Gears

The driving gear is keyed to the mainshaft and located by two circlips midway between the rear bearing and the rear end of the shaft. The speedometer driven gear and shaft assembly is carried in a housing attached by two screws to the rear cover. A spring-loaded oil seal assembled to the outer end of the housing prevents oil penetration into the speedometer cable.

Gear Shift Mechanism

Two striking forks are secured to rods mounted longitudinally in the transmission casing. The striking fork rod in the right-hand side of the casing engages the third and fourth speed clutch (second and third speed clutch on three-speed transmissions) and the one on the left-hand side engages the first and second speed clutch (first speed clutch and reverse gear on three-speed transmissions).

Mounted transversely below the striking fork rods is the striking lever shaft. Two striking levers, which engage a slot provided in each striking fork rod, are secured to the shaft by setscrews.

On three-speed transmissions the slot in the striking fork rods is on the inside of the rods on right drive models and on the outside on left drive models (Figs. G.2 and G.3).

On four-speed transmissions, the first and second speed striking lever engages a slotted shift fork secured to the striking fork rod, and the lower end of the third and fourth striking lever engages a shift fork on the reverse striking fork rod located in the transmission bottom cover (Fig. G.4).

With the exception of the reverse striking fork rod on four-speed transmissions, interlocking of the striking fork rods is created by the interlock boss on the striking levers engaging the concave recess on the adjacent rod.

On four-speed transmissions, the stop integral with the reverse shift fork in the bottom cover (Fig. G.5) engages the interlock boss on the third and fourth and reverse striking lever.

OPERATION

Gear Shift Mechanism

When the gear shift lever is operated, movement is conveyed via the linkage to the striking lever shaft. The shaft is moved transversely and one of the striking levers engages the slot in the appropriate striking fork rod. Simultaneously the hub of the other striking lever engages a concave recess in the adjacent striking fork rod (Fig. G.6), preventing the rod from moving and thus providing an interlock, but allowing the striking lever shaft to be rotated.

When the striking lever shaft is rotated the striking fork and rod together with the appropriate clutch moves towards the selected gear.

Forward Speed Engagement and Synchromesh

The appropriate clutch, together with the three

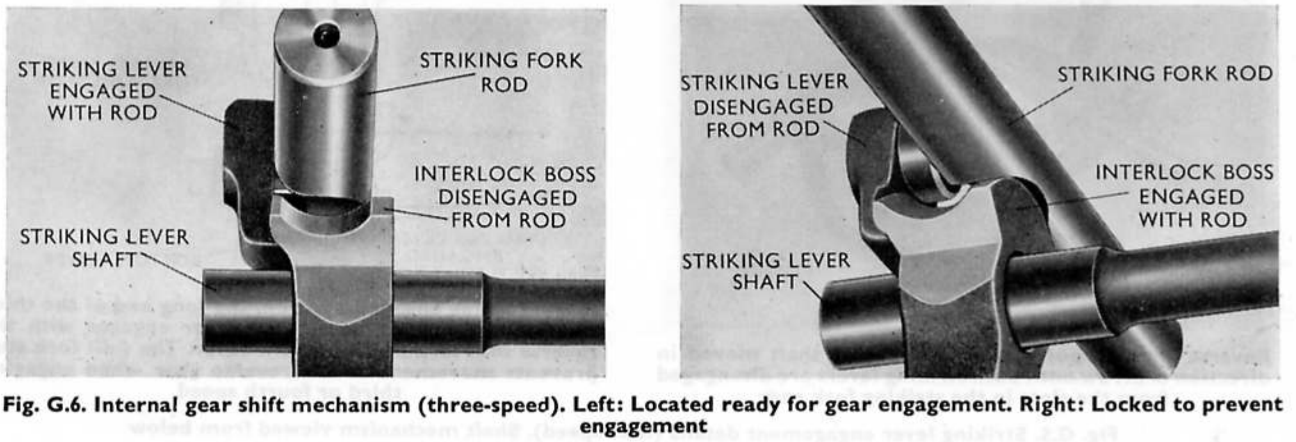


Fig. G.6. Internal gear shift mechanism (three-speed). Left: Located ready for gear engagement. Right: Locked to prevent engagement

sliding keys are moved along the hub until the keys contact the bottom of the slots in the synchronizing ring, which is then moved into contact with the synchronizing cone on the appropriate gear. This commences pre-synchronization and the friction between the ring and cone causes the ring to rotate, relative to the hub, to the extent of the clearance between the sliding keys and the slots in the ring.

At this point gear engagement is prevented as long as there is a difference in the speeds between the mating cones. As the speeds between the appropriate gear and clutch are synchronized the ring moves radially and the ring teeth line up with the internal splines of the clutch, allowing the clutch to ride past the ring and silently engage the engagement teeth on the appropriate mainshaft gear.

Reverse Gear Engagement

On three-speed transmissions, engagement of reverse is effected by the selector fork moving the combined first speed clutch and reverse gear rearwards on the hub, thus engaging the gear with the reverse pinion.

On four-speed transmissions, reverse is engaged by moving the striking lever shaft transversely in the casing, beyond the first and second speed position until the lower end of the third and fourth striking lever engages the reverse shift fork in the transmission bottom cover (Fig. G.5). Simultaneously the interlock boss moves out of engagement with the interlock stop. Rotary movement of the striking lever shaft moves the reverse pinion into engagement with the mainshaft first and second speed clutch gear and the layshaft gear.

GUARDIAN MAINTENANCE

The combined oil level and filler plug is located on the left-hand side of the transmission casing and is accessible from beneath the vehicle. Periodic draining and refilling is not required.

When checking the oil level, clean away all dirt from around the filler plug before removing it. The oil should be level with the bottom of the filler plug hole.

TROUBLE DIAGNOSIS

Difficulty in Engaging Gears

First ensure that the clutch pedal is correctly adjusted and the clutch operation satisfactory. If in order, check the gear shift control.

The trouble may be due to worn, damaged or incorrectly adjusted gear shift linkage which can restrict the full movements of the striking lever shaft in the transmission. After checking for wear or damage, adjust the linkage (see Section F).

Faulty Synchromesh Action

Faulty synchronizing action resulting in clash on engagement can be the result of any of the following:

(*a*) Lack of frictional grip between the synchronizing ring and cone due to wear or damage of either part.

(*b*) Weak, broken or displaced sliding key springs in the respective clutch hub.

(*c*) Worn or damaged teeth on the synchronizing ring. In all cases the transmission must be disassembled for rectification.

Gear Hop-out

This complaint could be due to incorrectly adjusted gear shift linkage, thus preventing full engagement of the affected gear, and resulting in hop-out.

In the case of top speed hop-out this may be due to slackness of the bolts securing the transmission to the clutch housing, foreign matter between the transmission front face and clutch housing, or slackness in the main drive pinion bearing.

Other points which can cause hop-out of any forward speed or reverse are as follows:

(*a*) Weak or broken locking ball springs.

(*b*) Excessive slackness between a clutch and hub.

(*c*) Wear or damage at the ends of the clutch internal splines and on the engagement teeth of the appropriate mainshaft gear or main drive pinion; this condition will prevent satisfactory operation of the anti-jump-out characteristics normally provided by the 'keystone' contour on the splines and engagement teeth. This will also apply to reverse on three-speed transmissions if the stepped section of the first speed clutch and reverse gear hub is worn.

(*d*) Slackness in bearings resulting in undue float of the mainshaft.

SPEEDOMETER DRIVEN GEAR

Removal and Disassembly

1. Raise and support the vehicle.

2. Detach the cable from the driven gear housing.

3. Place a tray below the housing to catch the oil from the rear cover, remove the two screws securing the housing and withdraw the housing, driven gear and oil seal as an assembly.

4. Detach the oil seal from the housing and withdraw the gear and shaft assembly.

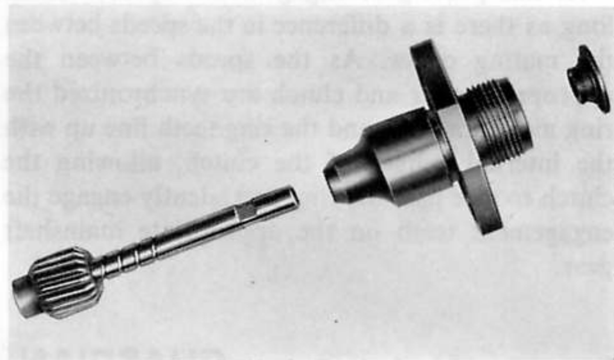


Fig. G.7. Speedometer driven gear, housing and oil seal

Installation

Note the following:

1. Lubricate the driven gear teeth, shaft and oil seal before installing.

2. Before installing the oil seal ensure that the circular spring is correctly located over the inner end of the seal.

3. Ensure that the housing is correctly positioned in the rear cover as shown in Fig. G.43.

4. After tightening, lock each screw by staking.

5. Finally run the engine for a few minutes to circulate oil from the transmission casing into the rear cover. Stop the engine and top up the transmission with recommended oil.

REAR COVER OIL SEAL

Renewal

1. Raise and support the vehicle.

2. Position a tray to catch the oil from the rear cover and remove the propeller shaft.

3. Drive off the oil seal using a sharp pointed drift applied alternately each side of the seal outer casing.

4. Soak the new seal in oil, then drive it home on the end of the rear cover, using a tubular drift.

5. Install the propeller shaft.

6. Run the engine for a few minutes to circulate oil from the transmission casing into the rear cover. Stop the engine and top up the transmission with recommended oil.

STRIKING LEVER SHAFT OIL SEAL

Renewal

1. Raise and support the vehicle.

2. Drain the oil from the transmission.

3. Detach the selector striking lever from its bracket on the transmission.

4. Remove the cotter securing the change speed striking lever to the shaft and withdraw the lever.

5. Remove the transmission bottom cover and the two striking lever setscrews.

6. Withdraw the striking lever shaft from the striking levers and the transmission casing.

7. Drive out the oil seal with a suitable drift (Fig. G.8).

8. Using a drift, install the new seal with the lip of the seal towards the inside of the transmission casing.

9. Smear the seal and striking lever shaft with oil and insert the shaft carefully to avoid damaging the seal.

10. Tighten the striking lever setscrews to the specified torque.

11. When installing the bottom cover on four-speed transmissions, renew the gasket and ensure the reverse striking fork engages the groove in the reverse pinion.

12. Refill the transmission with recommended oil up to the filler plug orifice.

Fig. G.8. Driving out the striking lever shaft oil seal

TRANSMISSION

Removal

1. Remove the detachable floor panel above the transmission.

2. Raise and support the vehicle.

3. Drain the oil from the transmission.

4. Remove the propeller shaft.

5. Disconnect the speedometer cable.

6. Disconnect the stay rod bracket from the clutch housing.

7. Support the engine under the rear of the oil pan using a block of wood against the pan to avoid damage.

8. Remove the nuts securing the engine rear mounting to the support crossmember, and remove the crossmember. Remove the mounting from the transmission rear cover.

9. Remove the clutch housing bottom cover.

10. Remove the bolts securing the transmission to the clutch housing and withdraw the transmission.

Disassembly

1. Secure a suitable support plate to the transmission and mount the assembly in a vice as shown in Fig. G.9.

2. Remove the speedometer driven gear housing and gear.

3. Remove the transmission bottom cover.

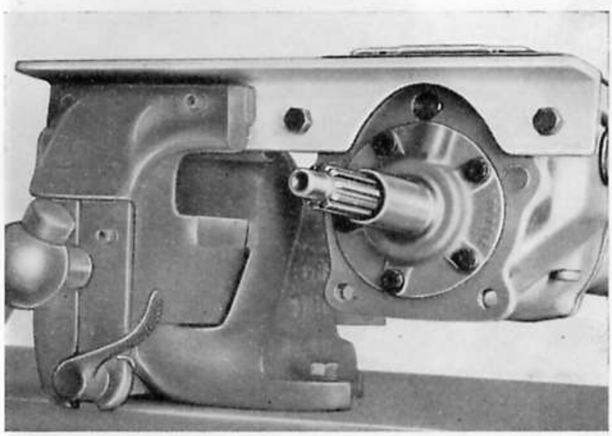


Fig. G.9. The transmission can be completely disassembled and reassembled mounted on a shaped piece of angle iron secured in a vice

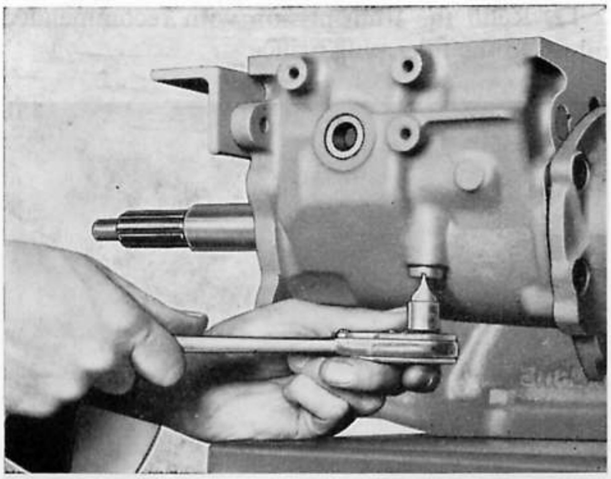


Fig. G.10. Removing a screw retaining a striking fork rod locking ball and spring

4. Remove the bolts securing the rear cover to the casing and rotate the cover to expose the rear end of the layshaft.

5. Using a brass drift, drive out the layshaft from rear to front and retain the locking ball at the front end of the shaft.

6. Lift out the layshaft gear, discard the needle rollers and the two thrust washers.

7. Remove the setscrews securing the striking levers to the striking lever shaft, and withdraw the shaft and the levers.

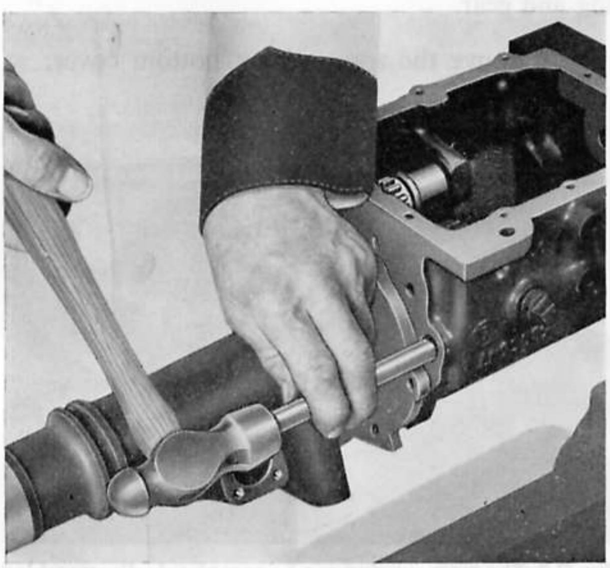


Fig. G.11. Driving out the first and second speed striking fork rod on a four-speed transmission

8. Remove the retaining screws (Fig. G.10) and withdraw the striking fork rod locking balls and springs.

9. Drive the striking fork retaining pins through the forks sufficiently to release the forks on the rods. On three-speed transmissions, engage reverse to support the rear of the rod when driving out the first and reverse fork retaining pin. Do not drive the pins out completely as they will jam on the casing.

10. Using a brass drift, drive out the striking fork rods from rear to front (Fig. G.11). The end covers will be driven out by the fork rods.

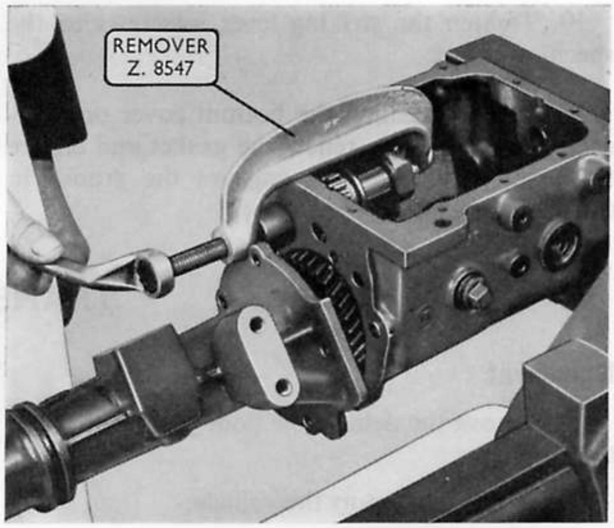


Fig. G.12. Withdrawing the reverse pinion shaft

11. Remove the striking forks.

12. Withdraw the reverse pinion shaft (Fig. G.12), and lift away the pinion.

13. Withdraw the mainshaft assembly and rear cover.

14. Remove the bolts securing the front cover, and withdraw the main drive pinion, bearing and cover assembly.

15. Drive the striking lever shaft oil seal out of the transmission casing.

Main Drive Pinion

1. Remove the needle rollers from the main drive pinion counterbore.

2. Expand the pinion bearing circlip in the front cover (Fig. G.13) and withdraw the pinion and bearing assembly from the cover by tapping the end of the shaft on a lead block.

3. Remove the circlip from the main drive pinion.

4. Remove the circlip from the front cover and assemble it to the groove in the bearing outer race.

5. With the bearing supported by the circlip on a suitable tube, press out the pinion. Remove the circlip.

Mainshaft Assembly and Rear Cover

1. Remove the mainshaft bearing circlip from the rear cover (Fig. G.14) and press the mainshaft assembly out of the cover.

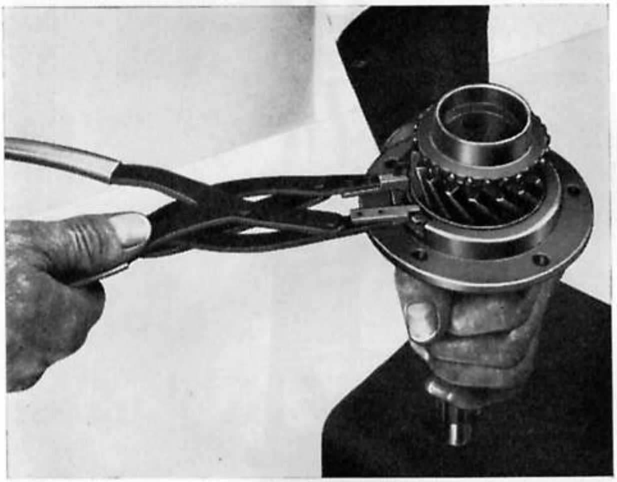


Fig. G.13. Releasing the main drive pinion and bearing from the front cover

NOTE: *The mainshaft rear bearing is an interference fit in the aluminium cover, and it may be necessary to warm the cover before removing the mainshaft and bearing assembly.*

2. On four-speed transmissions, mark with a spot of paint the first and second speed clutch hub. This will assist in identifying the hub on reassembly.

3. Remove the rear of the two circlips locating the speedometer driving gear on the mainshaft. Press off the gear and retain the key. Remove the remaining circlip.

4. Remove the mainshaft rear bearing circlip and the thrust washer.

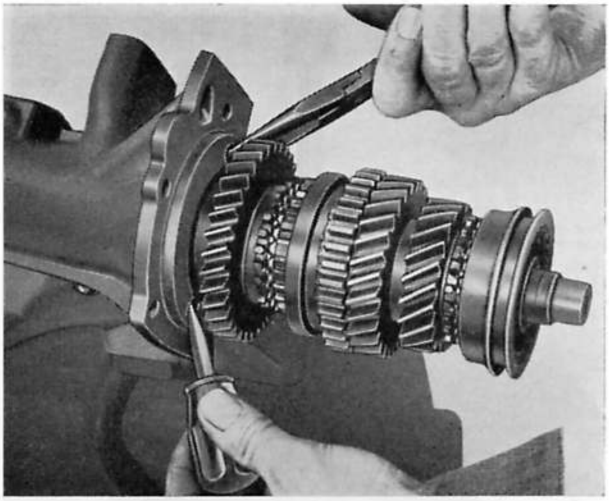


Fig. G.14. Removing the mainshaft bearing circlip from the rear cover

5. On three-speed transmissions, disassemble the mainshaft gear assembly as follows:

(*a*) Support the front face of the mainshaft first speed gear on the bed of a press and press the mainshaft out of the first speed clutch and reverse gear hub and mainshaft rear bearing.

Withdraw the first speed clutch and reverse gear from the clutch hub and remove the keys and springs from the hub.

(*b*) Remove the second and third speed hub circlip from the front end of the mainshaft.

(*c*) Support the rear face of the mainshaft second speed gear on the bed of a press and press the mainshaft out of the second and third speed hub.

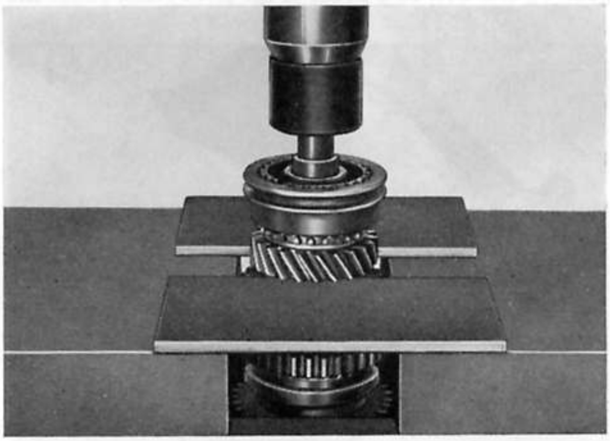


Fig. G.15. Pressing the third and fourth speed clutch hub off the mainshaft

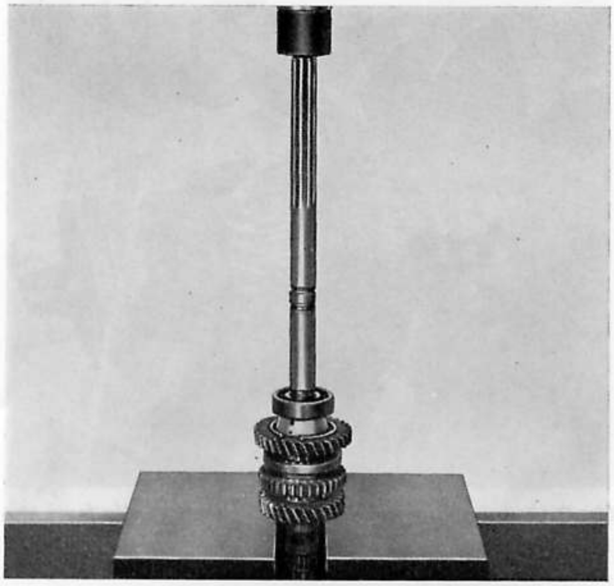


Fig. G.16. Pressing the first and second speed clutch hub off the mainshaft

Withdraw the second and third speed clutch from the hub and remove the keys and springs from the hub.

6. On four-speed transmissions, disassemble the mainshaft gear assembly as follows:

(*a*) Remove the third and fourth speed hub circlip from the front end of the mainshaft.

(*b*) Support the rear face of the third speed gear on the bed of a press as shown in Fig. G.15 and press out the mainshaft. Withdraw the clutch from the clutch hub and remove the keys and springs.

(*c*) Support the front face of the second speed gear on the bed of a press (Fig. G.16) and press the mainshaft out of the clutch hub, first speed gear sleeve and mainshaft rear bearing. Withdraw the clutch from the clutch hub and remove the keys and springs.

Fig. G.17. Driving out the reverse shift fork retaining pin

Bottom Cover—Four-Speed Transmission

1. Remove the retaining screw, and withdraw the striking fork rod locking ball and spring.

2. Remove the expansion plug from each end of the striking fork rod bore.

3. Move the striking fork rod forward until the shift fork retaining pin is in line with the drain plug hole and drive out the pin (Fig. G.17).

4. Move the rod forward until the striking fork retaining pin is in line with the drain plug hole.

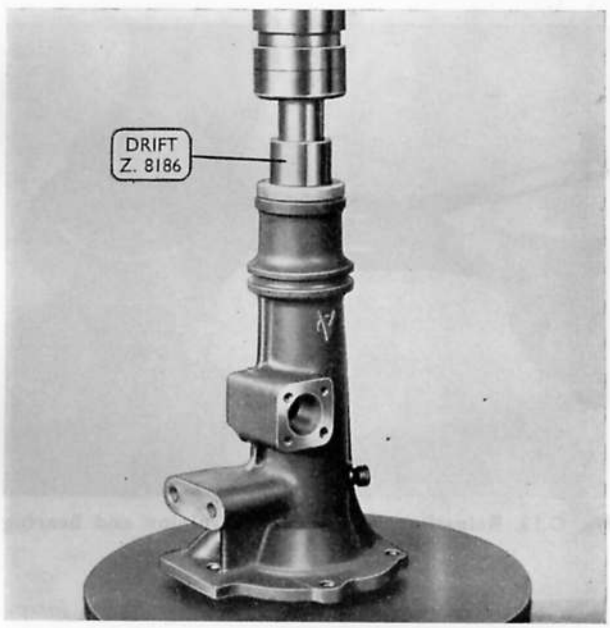


Fig. G.18. Pressing the bush out of the rear cover

Support the rear end of the rod by wedging a piece of wood between the rod and the depression in the casing. Drive out the pin and remove the rod and forks.

Inspection and Reconditioning

Ball Bearings

Clean and inspect both ball bearings (page vii).

Transmission Casing and Covers

1. Check that the striking lever shaft end cover is secure in the casing.

3. To renew the king pin proceed as follows:

(*a*) Remove the circlip or locknuts from the upper end of the king pin.

(*b*) Press out the king pin (Fig. K.18).

(*c*) Remove the two locknuts from the special service king pin, support the steering knuckle lower boss on a suitable sleeve as shown in Fig. K.19. Press in the new pin, smaller end first, until the dimension from the lower end of the pin to the bottom face of the knuckle lower boss is 2·38 in.

(*d*) Fit one of the locknuts and tighten it to the bottom end of the thread on the pin, then fit the remaining locknut and tighten it against the first locknut.

NOTE: *It is not intended that the bottom locknut should lock against the knuckle boss.*

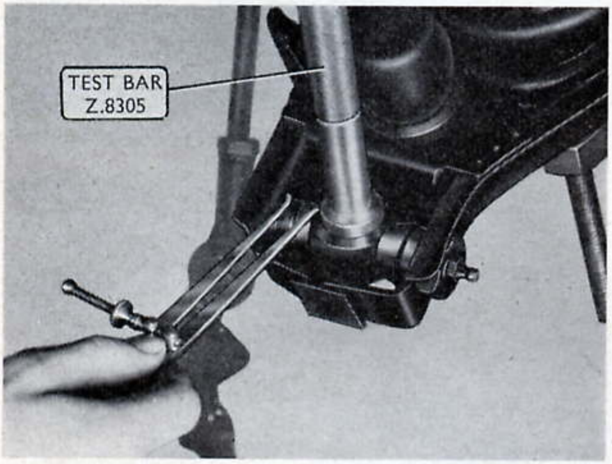


Fig. K.20. Checking that the trunnion is central in the arm using the test bar and calipers

Installation

Note the following:

1. Check that the trunnion is central in the arm (Fig. K.20) and the chamfered side of the king pin bush housing is facing upwards.

2. Check the alignment of the suspension arms, as follows:

(*a*) Hold the upper and lower arms horizontal, in turn, and compare the distances between each arm and the front and rear bosses of the cross-member in a similar manner to that shown in Fig. K.30 on page K-13. The distance at the rear of the lower arm should be greater than at the front by ·18 in. but not more than ·26 in. The distance at the front and rear of the upper arm should not differ by more than ·03 in.

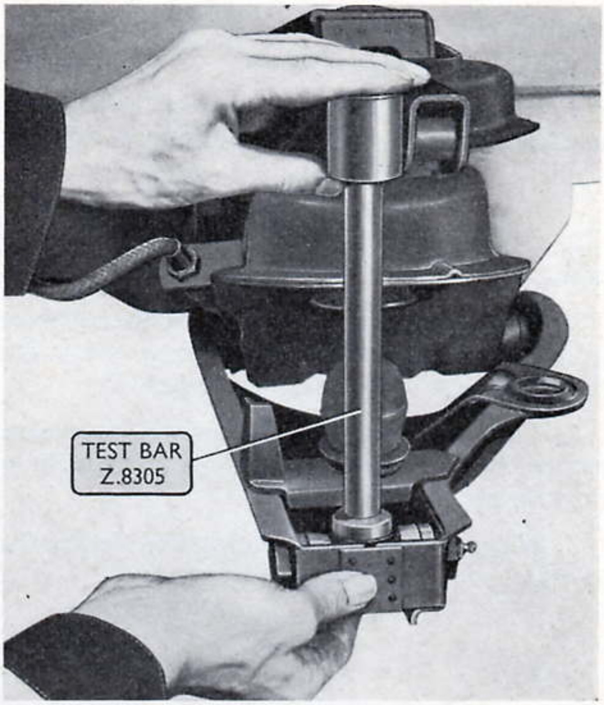


Fig. K.21. Using the test bar to check the alignment of the suspension arms

(*b*) Locate a test bar (Fig. K.21) in the trunnion bush and with the lower arm held in the horizontal position, align the upper end of the test bar against the outer rear face of the upper arm. If the arms are in correct alignment, the test bar will be free to rotate by hand and the upper end of the bar will be in line contact with the rear face of the upper arm as shown in Fig. K.22.

(*c*) If the upper end of the test bar is not in alignment with the rear face of the upper arm (Fig. K.23), twist the arm in the required direction to obtain correct alignment (Fig. K.24). If there is

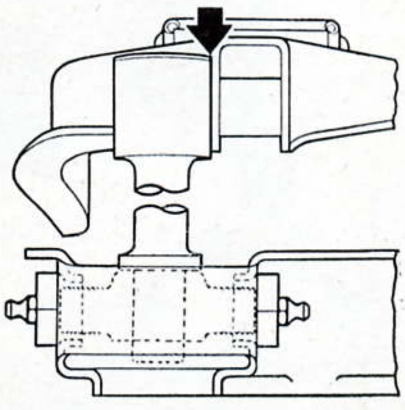


Fig. K.22. For correct arm alignment, the test bar must be in line contact with the rear face of the upper arm as indicated by the arrow

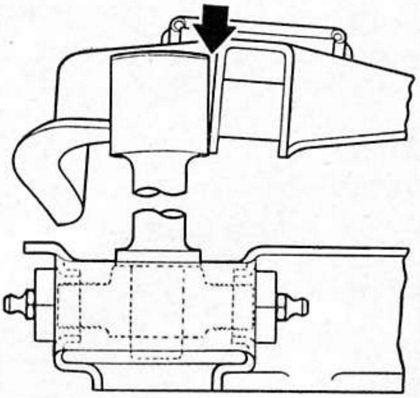


Fig. K.23. Incorrect alignment of the upper or lower suspension arms will be indicated by the test bar not making line contact with the upper arm (arrowed)

excessive misalignment, the lower arm should be removed and checked for distortion. Where necessary, remove and check the upper arm.

3. Place a new oil seal over the king pin, and lubricate the pin and trunnion bush.

4. Attach the steering knuckle to the suspension lower arm as follows:

(*a*) Install the king pin in the trunnion.

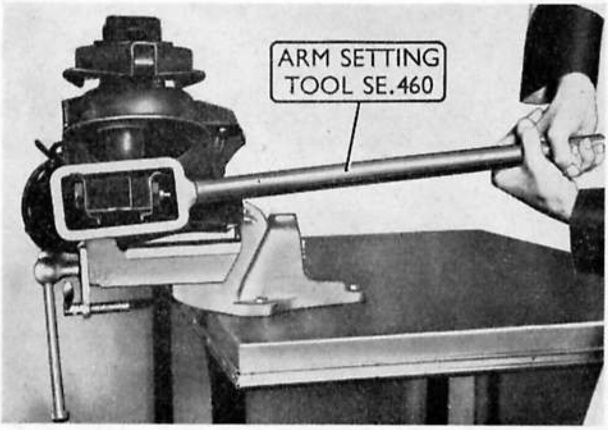


Fig. K.24. Twisting the lower arm using the arm setting tool to correct slight misalignment with the upper arm. This operation can be carried out on the vehicle if necessary

(*b*) Temporarily attach the knuckle to the upper arm.

(*c*) Coat the nylon thrust washer with lubricant and assemble it to the king pin. Install and tighten the locknut by hand until slight resistance is felt when rotating the knuckle.

(*d*) Fit the slotted nut and screw it by hand against the locknut. If necessary, slacken off the slotted nut until the split pin hole is in alignment and insert a split pin.

(*e*) Tighten the locknut firmly against the slotted nut (Fig. K.25). Discard the original split pin and insert a new pin.

NOTE: *If tightening the nut has distorted the original split pin so that it is difficult to remove, tighten the slotted nut sufficiently to allow removal.*

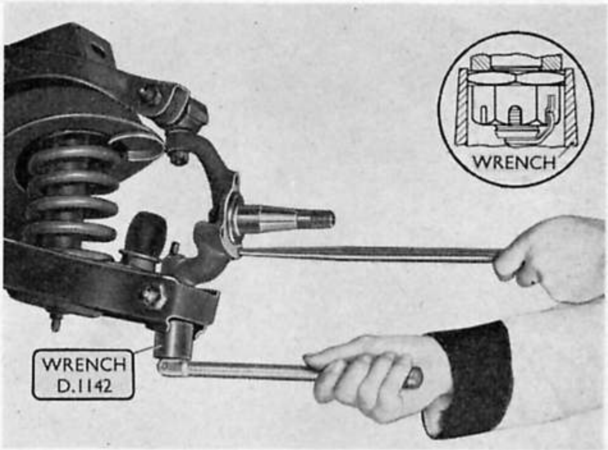


Fig. K.25. Tightening the king pin locknut back against the slotted nut. The inset shows the socket wrench engaged with the locknut

5. When attaching the brake flange plate and steering arm, the bolt heads must be on the hub side of the flange plate.

6. Adjust the hub bearings (page K-5).

7. Check the steering geometry (page K-3) and if necessary, adjust the toe-in.

STEERING KNUCKLE BALL JOINTS

Removal

1. Compress the front spring and release the ball joint from the steering knuckle upper boss (see under 'Front Springs — Removal' on page K-7).

2. Remove the nut and lockwasher securing the ball joint to the suspension upper arm. Withdraw the ball joint.

Inspection and Reconditioning

1. Check the joint for roughness or slackness. If roughness or excessive slackness is evident renew the joint.

2. Adjust the joint ball by means of the adjusting screw. The ball should move freely without any up and down movement on its seating.

3. Check the amount of adjustment necessary on the adjusting screw to tighten the ball on its seating. If, when the screw is tightened the bottom of the slot in the screw is below the level of the top face of the locknut, renew the ball joint.

Installation

Note the following:

1. Make sure that the ball joint locating dowel registers in the hole provided in the rear face of the suspension upper arm.

2. Lubricate the ball joint.

SUSPENSION UPPER ARMS AND FULCRUM SHAFTS

Removal

1. Compress the spring and release the ball joint from the steering knuckle upper boss (see under 'Front Springs—Removal' on page K-7).

2. Before removing the upper arm, check it for slackness on the fulcrum shaft. Slackness will indicate wear of the threads on the shaft and inside the screwed bushes. To check proceed as follows:

(*a*) Attach a pointer to the crossmember (Fig. K.26), and set the pointer to contact the ball joint nut when the arm is pushed right forward.

(*b*) Now pull the arm right back and measure the gap between the pointer and the nut with feeler gauges (Fig. K.26). If the gap, i.e. arm movement, exceeds the specified maximum, renew the fulcrum shaft and screwed bushes.

3. Remove the bushes and lift off the arm.

4. Remove the two oil seals from the fulcrum shaft.

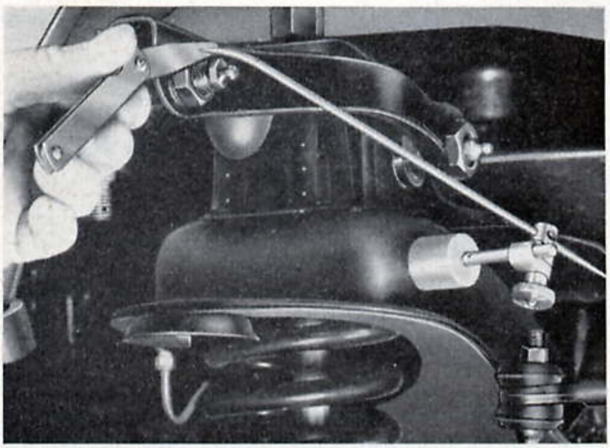


Fig. K.26. Checking the upper arm for slackness on the fulcrum shaft

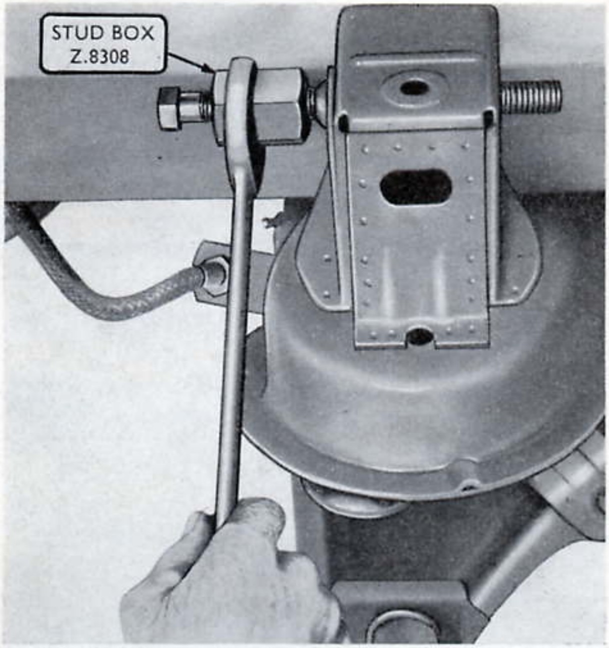


Fig. K.27. Removing the upper arm fulcrum shaft

Inspection and Reconditioning

1. Examine the arm for damage or distortion. Where necessary a comparative alignment check can be made against a new arm.

2. If the shaft is loose, worn or damaged renew as follows:

(*a*) Assemble the stud box (Fig. K.27), to the rear end of the fulcrum shaft and unscrew the shaft clockwise. Remove the stud box and withdraw the shaft from the front of the crossmember.

(*b*) Clean the shaft bores in the crossmember, also the inner threads each end of the fulcrum shaft, i.e. those which screw into the crossmember. Insert the new shaft through the front of the crossmember

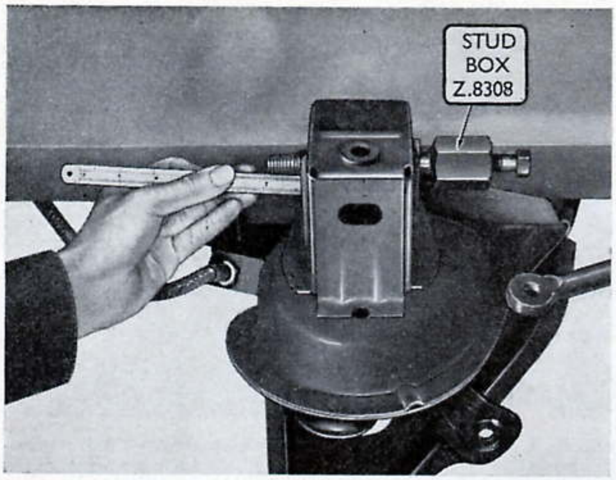


Fig. K.28. Checking the location of the upper arm fulcrum shaft

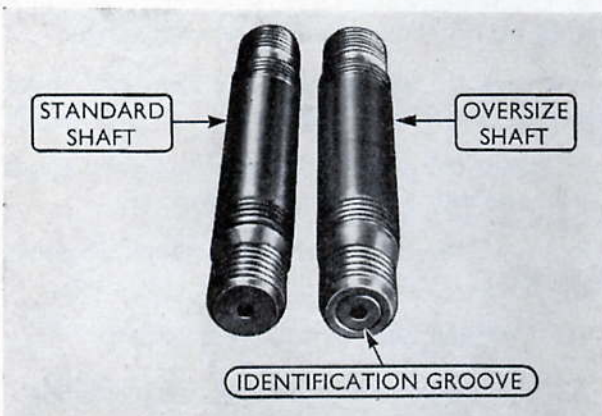


Fig. K.29. Standard and oversize fulcrum shafts. The amount of oversize is ·004 in. and applies only to the inner threads which engage the crossmember

so that the shaft end stamped 'F' is towards the front of the vehicle.

(*c*) Assemble the stud box to the front end of the fulcrum shaft and screw the shaft into the crossmember until the dimension from the rear end of the shaft to the face of the rear boss on the crossmember is ·88 in. (Fig. K.28). During the final screwing-in of the shaft note the torque reading. This must not be less than the specified minimum torque.

If the torque is less than this install an oversize shaft (Fig. K.29) following the foregoing procedure.

Installation

1. Install a new oil seal to each end of the fulcrum shaft.

2. Position the suspension arm so that the thread at each end of the shaft is projecting through the arm by the same amount both sides.

3. Lubricate the bushes with oil and holding the arm parallel to the crossmember, screw the bushes on to the shaft. The bush having the lubrication nipple is fitted at the front.

4. Where the original arm and standard bushes are being installed, proceed as follows:

(*a*) Screw in each bush by hand approximately the same amount until it is certain that the outer thread of the bush has engaged the original thread in the arm.

(*b*) With the arm held in the horizontal position, check the distance from the inner face of the arm at the front of the face of the boss on the crossmember (Fig. K.30). Make a similar check off the inner face of the arm at the rear and compare the two dimensions. These must not differ by more than ·04 in. If the difference is greater, remove the bushes and reposition the arm.

(*c*) Using a socket wrench and short bar, continue screwing in the bushes until their shoulders just contact the arm.

NOTE: *The use of a short bar will enable any undue tightness to be felt as the bushes are screwed in. Excessive tightness indicates that the bushes are not engaging the original threads in the arm, in which case they must immediately be removed and re-engaged with the arm.*

(*d*) Finally tighten the bushes to the specified torque. If, after the final tightening and lubrication of the bushes, the arm movement is excessively tight, this will indicate that there is end loading on

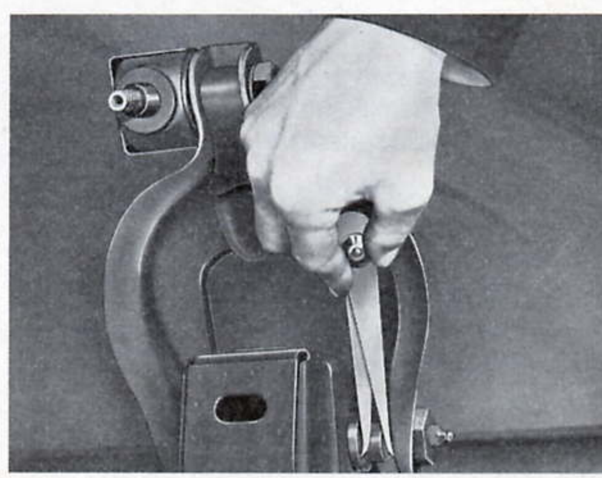


Fig. K.30. Checking the location of the upper arm in relation to the crossmember. The arm is raised from the horizontal position for the purpose of illustration

the threads of the shaft and bushes which can be overcome by installing oversize bushes (Fig. K.31).

5. Where oversize bushes or a new suspension arm are being installed, proceed as follows:

(*a*) Carry out operations 1 to 3.

(*b*) Install the small pair of spacers (Fig. K.32), one each side, between the inner face of the arm and the crossmember boss.

(*c*) With the arm held horizontal, screw in the bushes and finally tighten to the specified torque.

(*d*) Remove the spacers.

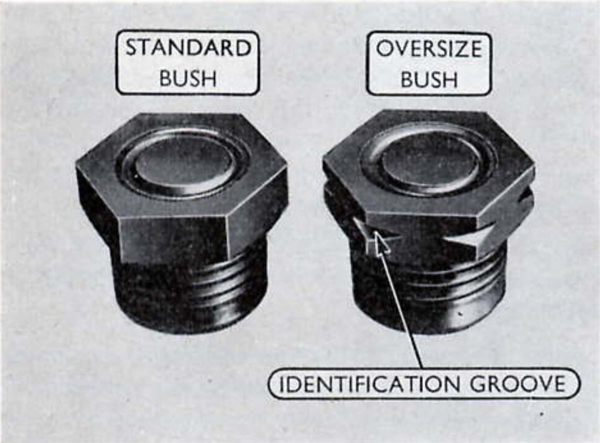


Fig. K.31. Standard and oversize screwed bushes. The amount of oversize is ·005 in. and applies only to the external threads of the bush

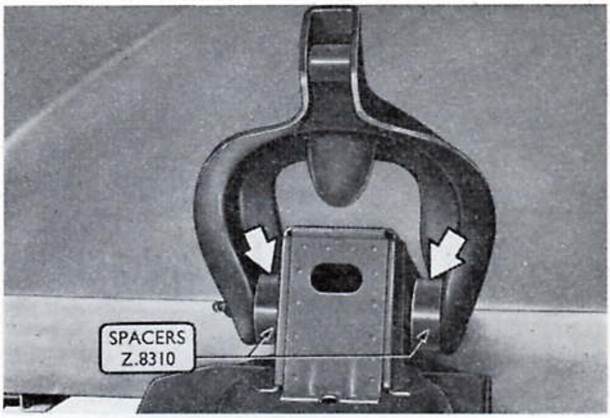


Fig. K.32. Showing the upper arm raised from the horizontal position to illustrate the location of the small spacers

6. Check the arm for free movement. The action should be smooth and not excessively tight.

7. Check the alignment of the arms (see under 'Steering Knuckles—Installation', on page K-10).

8. Install the steering knuckle ball joint (page K-11), and refit the rubber rebound stop.

9. Install the front spring and shock absorber (page K-7).

10. Lubricate the fulcrum shaft bushes.

11. Check the steering geometry (page K-3).

SUSPENSION LOWER ARMS AND FULCRUM SHAFTS

Removal

1. Remove the front spring (page K-7).

2. Remove the split pin and unscrew the slotted nut and thin adjusting nut securing the king pin to the steering knuckle trunnion.

3. Withdraw the thrust washer and detach the knuckle from the lower arm.

4. Before removing the arm, check it for slackness on the fulcrum shaft. Slackness will indicate wear of the threads on the shaft and inside the screwed bushes. To check, proceed as follows:

(*a*) Clamp a pointer to the crossmember and set the pointer to make contact with the trunnion front bush, with the arm pushed right forward.

(*b*) Now push the arm right back and measure the gap between the pointer and the bush with

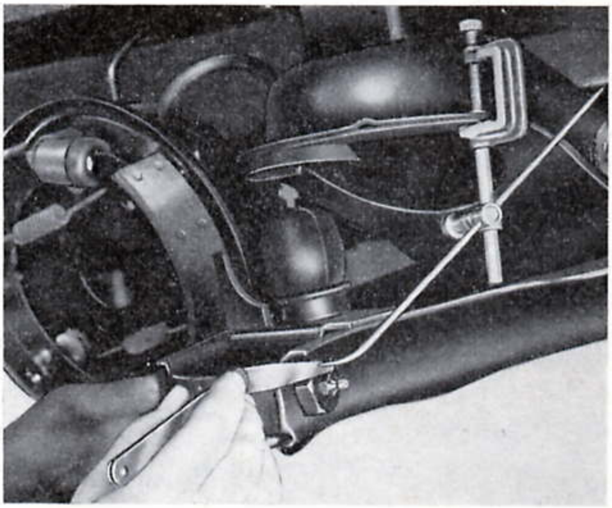


Fig. K.33. Checking the lower arm for slackness on the fulcrum shaft

feeler gauges (Fig. K.33). If the gap, i.e. arm movement, exceeds the specified maximum, renew the fulcrum shaft and bushes.

5. Remove the bushes and lift off the arm. It may be necessary to slightly spread the arm when removing it off the shaft.

6. Remove the two oil seals from the shaft.

Inspection and Reconditioning

1. Check the trunnion and king pin bush for wear (page K-16).

2. Examine the arm for damage or distortion. Where necessary, a comparative check can be made against a new arm.

3. If the shaft is worn, loose or damaged, renew as follows:

(*a*) Remove the locknut from the rear end of the shaft.

(*b*) Attach the stud box to the rear end of the shaft and unscrew the shaft in a clockwise direction. Remove the stud box and withdraw the shaft from the front of the crossmember.

(*c*) Clean the shaft bores in the crossmember, also the inner threads each end of the fulcrum shaft, i.e. those which screw into the crossmember. Insert the shaft through the front of the crossmember with the shaft end stamped 'F' towards the front of the vehicle.

(*d*) Fit the stud box to the front end of the new shaft and, using a torque wrench, screw the shaft into the crossmember until the dimension from the rear end of the shaft to the face of the boss on the crossmember (Fig. K.34), is 1·80 in. During the final screwing-in of the shaft, note the torque reading. This must not be less than the specified minimum torque.

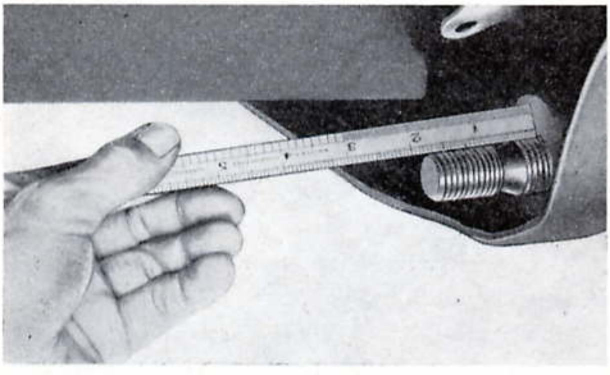


Fig. K.34. Checking the location of the lower fulcrum shaft in the crossmember

If the torque is less than this, install an oversize shaft following the foregoing procedure.

4. Install the locknut to the rear end of the shaft and tighten the nut to the specified torque. A locknut is not serviced for the oversize shaft

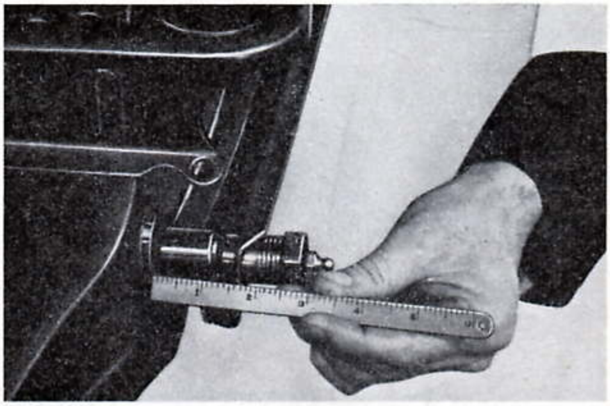


Fig. K.35. Checking the location of the lower arm in relation to the crossmember

Installation

1. Install two new oil seals, one each side of the shaft, and assemble the arm to the shaft.

2. Lubricate the bushes with oil, and screw the bushes on the shaft but do not engage the threads in the arm at this stage.

3. Where the original arm and standard bushes are being installed, proceed as follows:

(*a*) With the arm held horizontal and seating against the front bush, turn the bush until the distance between the arm inner face and the crossmember rear boss is 1·66 in. (Fig. K.35).

(*b*) With the arm maintained in the horizontal position screw in the bushes by hand to engage the original threads in the arm.

(*c*) Using a socket wrench and short bar continue screwing in the bushes until their shoulders just contact the arm.

NOTE: *The use of a short bar will enable any undue tightness to be felt as the bushes are screwed in. Excessive tightness indicates that the bushes are not engaging the original threads in the arm, in which case they must immediately be removed and re-engaged with the arm.*

(*d*) Finally tighten the bushes to the specified torque. If, after the final tightening and lubrication of the bushes the arm movement is excessively tight this will indicate that there is end loading on the

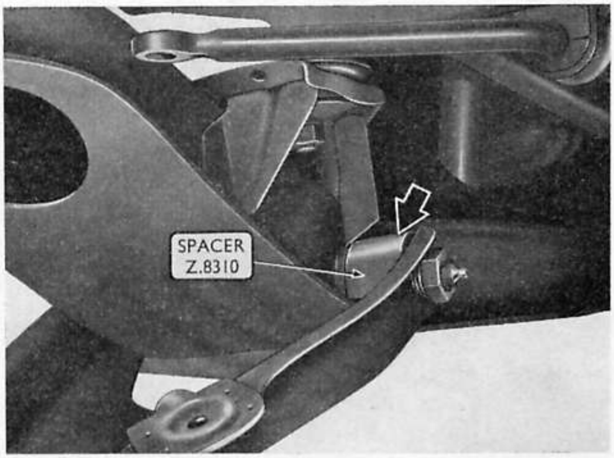


Fig. K.36. Showing location of the spacer between the front of the crossmember and the lower arm. The widest spacer is installed in a similar manner at the rear of the crossmember

threads of the shaft and bushes which can be overcome by installing oversize bushes (Fig. K.31).

4. Where oversize bushes or a new suspension arm are being installed, proceed as follows:

(*a*) Carry out operations 1 and 2.

(*b*) Install the large spacers (Fig. K.36), one each side between the inner face of the arm and the crossmember boss. The widest spacer is fitted at the rear.

(*c*) With the arm held horizontal, screw in the bushes and tighten to the specified torque.

(*d*) Remove the spacers.

5. Check the arm for free movement. The action should be smooth and not excessively tight.

6. Check the alignment of the arms (see under 'Steering Knuckles—Installation' on page K-10).

7. Install the front spring (page K-7).

8. Lubricate the fulcrum shaft bushes.

9. Check the steering geometry (page K-3).

STEERING KNUCKLE TRUNNIONS

Removal

1. Remove the steering knuckle (page K-9).

2. Before removing the trunnion, proceed with the following checks:

(*a*) Attach a dial gauge to the lower arm (Fig. K.37) and check for wear of the threads on the trunnion and inside the screwed bushes. If the gauge reading, indicating the total up and down movement of the trunnion in the bushes, exceeds the specified maximum, renew the trunnion assembly and the two screwed bushes.

(*b*) Check the trunnion bush for wear by measuring the bush bore diameter with a telescopic gauge used in conjunction with a micrometer. Check that the bush lubrication holes are aligned with those of the trunnion and free of obstruction.

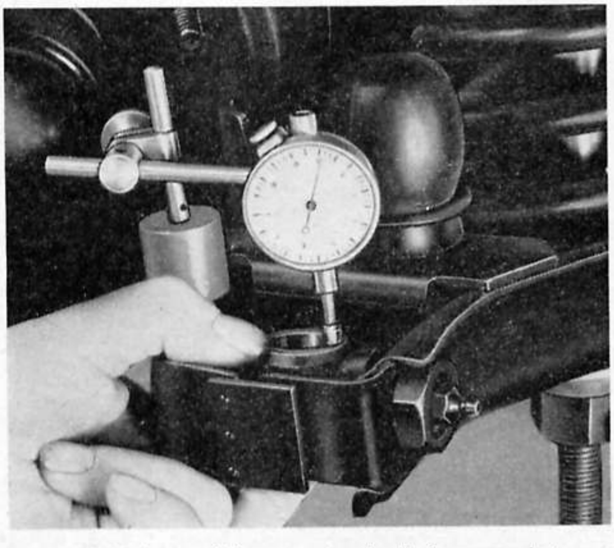


Fig. K.37. Using a dial gauge to check for wear between the trunnion and the screwed bushes

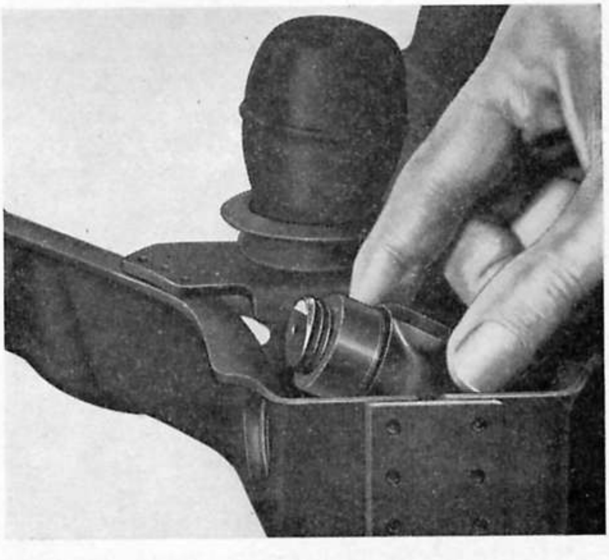


Fig. K.38. Withdrawing the trunnion from the lower arm

The trunnion and bush must be renewed as an assembly.

3. Remove the two bushes attaching the trunnion to the arm.

4. Position the trunnion so that the chamfered face of the king pin bush housing is towards the top of the arm.

5. Push the unchamfered threaded end of the trunnion into the adjacent bore of the arm and withdraw the trunnion by lifting out the opposite end (Fig. K.38).

6. Remove the two oil seals from the trunnion.

Inspection and Reconditioning

If the steering knuckle king pin is worn, renew the pin (page K-9).

Installation

1. Assemble the two oil seals, one each side of the trunnion boss.

2. Insert the unchamfered threaded end of the trunnion into one of the outer bores of the arm so that the chamfered side of the king pin bush housing is towards the upper face of the arm.

3. Centralize the trunnion in the arm.

4. Lubricate the inner and outer threads of the bushes and install the bushes. The bush with a lubrication nipple is assembled at the front of the arm.

5. Screw in each bush by hand approximately the same amount, until it is certain that the outer threads on the bushes have engaged the original threads in the arm. *Be sure the bushes are entered squarely.*

6. Check that the trunnion is central in the arm, using a test bar and calipers (Fig. K.20 on page K-10), to compare the distance each side. If they differ, remove the bushes, reposition the trunnion and re-engage the bushes.

7. Using a socket wrench and short bar, continue screwing in the bushes until their shoulders just contact the arm.

NOTE: *The use of a short bar will enable any undue tightness to be felt as the bushes are screwed in. Excessive tightness indicates that the bushes are not engaging the original threads in the arm, in which case they must immediately be removed and re-engaged with the arm.*

8. Finally tighten the bushes to the specified torque. If it is found that the distance between the outer edge of the king pin bush and the inner face of the arm is affected before the bushes tighten to the specified torque, this will indicate that there is end loading on the threads of the shaft and bushes which can be overcome by installing oversize bushes (Fig. K.31).

9. Check the alignment of the suspension arms (page K-9).

10. Install the steering knuckle (page K-9) and lubricate the bushes.

FRONT AXLE

Removal

1. Replace the brake master cylinder filler cap with a slave cap on which the vent hole has been sealed (this will minimize fluid loss when the pipes are disconnected from the axle crossmember).

2. Raise and support the front of the vehicle.

3. Remove the road wheels.

4. Disconnect the steering connecting rod sockets from the steering arms.

5. Disconnect the two brake feed pipes from the flexible hoses on the support brackets at the rear of the crossmember.

6. Disconnect the stabilizer links from the suspension lower arms.

7. With the axle crossmember supported, remove the nuts securing it to the chassis frame.

8. Lower the axle assembly and withdraw the unit forward from under the vehicle.

Disassembly

1. Mount the axle crossmember in a vice, using a block of wood each side of and as wide as the member to prevent distortion when the vice is tightened.

2. Remove the components as described under the respective headings.

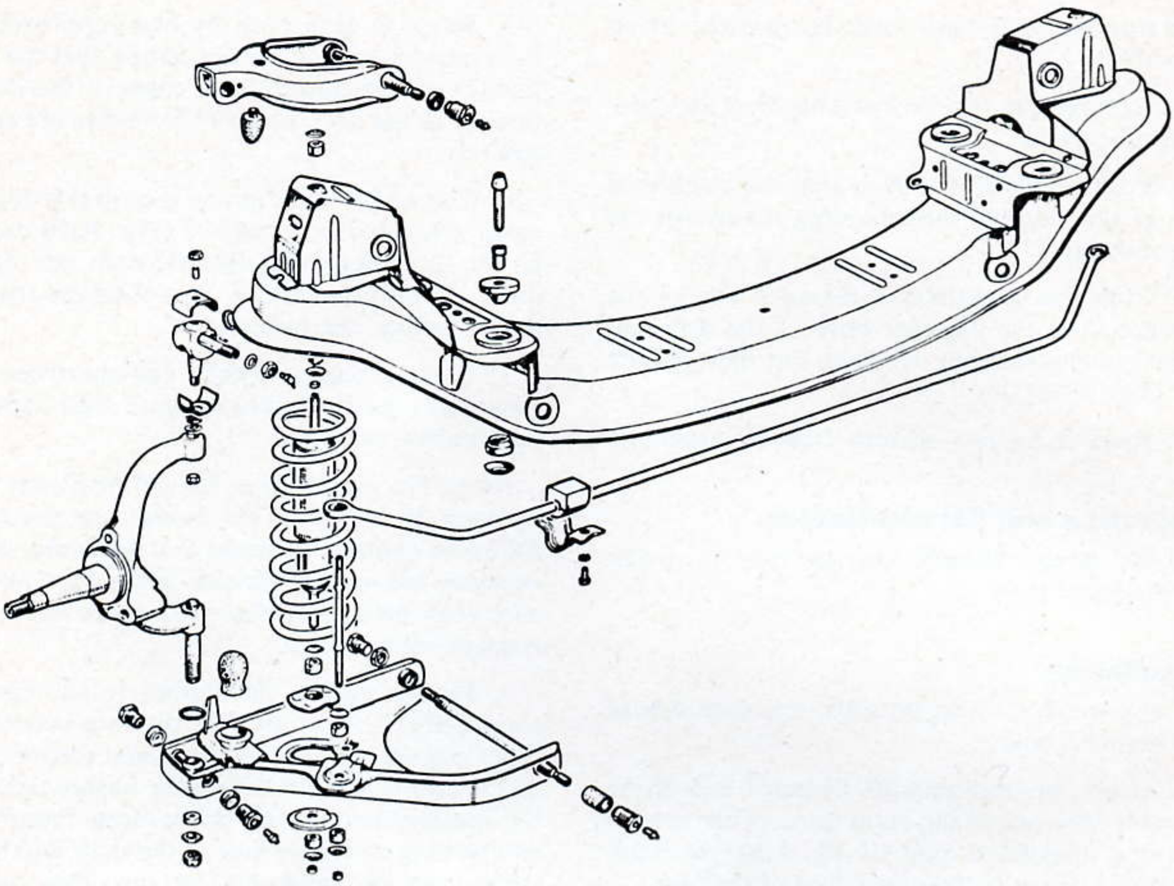


Fig. K.39. Front suspension components

Inspection and Reconditioning

1. Examine the components as detailed under the respective headings.

2. If the axle has sustained accidental damage, make a visual inspection of the crossmember for damage, particularly the mounting brackets and their welded joints with the crossmember. Check also for bent fulcrum shafts. Where no damage is apparent, continue the inspection by applying all the following alignment checks:

(*a*) Check the distance between the upper fulcrum shaft centres (Fig. K.40). The dimension can be within 31·00 to 31·24 in. provided the difference between front and rear does not exceed ·12 in. If the difference is outside these limits renew the crossmember.

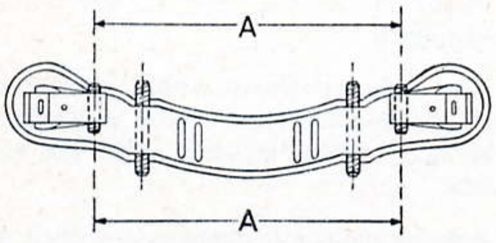


Fig. K.40. An initial check for distortion of a crossmember should be made at 'A' as indicated

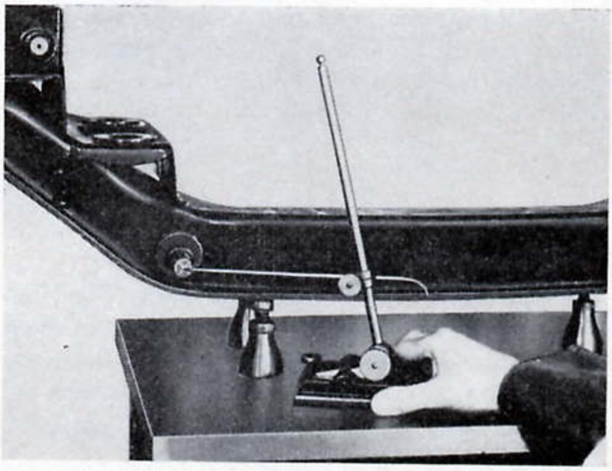


Fig. K.41. Checking the height of the lower fulcrum shaft centre with a surface gauge

Should the front and rear measurements not be within the foregoing limits although the difference

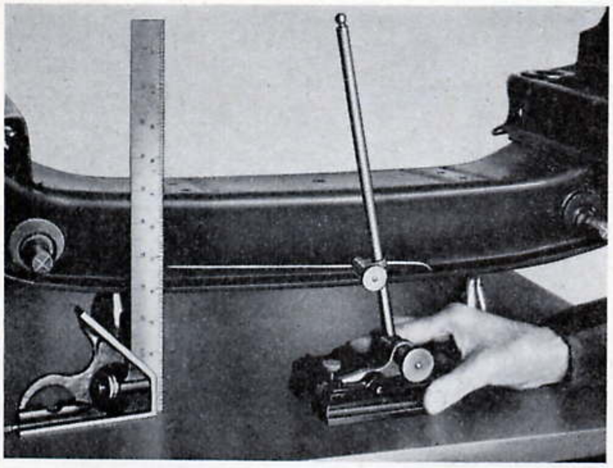


Fig. K.42. Measuring the scriber height of the lower fulcrum shaft centre on a rule

between them is satisfactory, it is probable that distortion has occurred which affects the vertical relationship of the upper and lower fulcrum shafts. Such distortion will be established by checking the shaft heights and mounting brackets as in items (*b*) to (*f*).

(*b*) Mount the crossmember on a surface table, using three viewer jacks. Adjust the jacks to bring the centres of three ends of the lower fulcrum shafts to the same height above the table. A surface gauge is used to check the heights.

(*c*) Now check the height of the remaining shaft end centre (Fig. K.41); this should be within ·06 in. of the other three.

(*d*) Measure the scriber height of the lower shafts against a rule (Fig. K.42) and record the measurement.

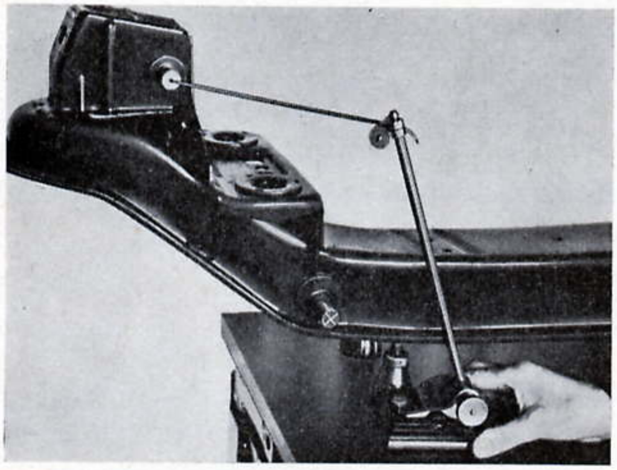


Fig. K.43. Checking the height of the upper fulcrum shaft centre with a surface gauge

(*e*) Next, check the heights of the upper fulcrum shaft centres (Fig. K.43). These heights should be within ·06 in. of each other. Again, measure and record the scriber height. The difference between the upper and lower shaft heights should be within 7·76 and 7·88 in.

(*f*) Finally, check the height at the front and rear of the mounting brackets. The height at the four points should be within ·06 in.

If, during the foregoing checks, it is found that the distortion is in excess of ·06 in. the fulcrum shafts should first be removed and checked to determine if they are bent. If the shafts are not bent the crossmember is distorted and should be renewed. *Under no circumstances should attempts be made to straighten the crossmember as the unit is pre-set during manufacture and may distort if heated.*

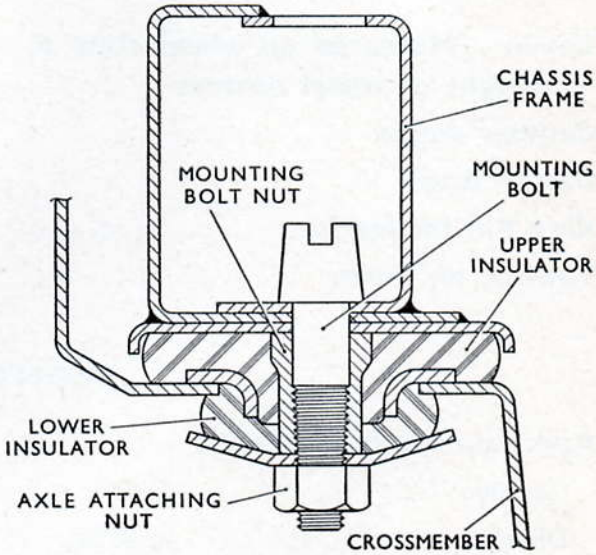


Fig. K.44. Front axle crossmember mounting details

Reassembly

Refer to the information under the respective component headings.

Installation

Note the following:

1. Before installing the axle, check that the attaching bolts are tight in the chassis frame.

2. Bleed the brakes (page O-6).

3. Check the steering geometry (page K-3).

SPECIFICATIONS

FRONT END STANDING HEIGHT

Measured vertically from a level floor to the centre of the inner lubrication nipple on the front axle lower suspension arm. The vehicle must be unladen. The heights each side should be within the specified limits and within ·26 in. of each other.

Standing Height

6·40—13 tyres	9·38 to 10·38 in.
6·70—13 tyres	9·76 to 10·76 in.

STEERING GEOMETRY

These figures are for a vehicle at correct standing height.

Toe-in — Measured on wheel rims at height of wheel centres	·09 to ·16 in.
Camber Angle	$1\frac{1}{2}°$ to $3°$
Castor Angle	$\frac{1}{4}°$ to $1\frac{1}{4}°$
King Pin Inclination	$1\frac{3}{4}°$ to $3\frac{1}{4}°$
Toe-out on Turns	$20\frac{1}{2}°$ to $22\frac{1}{2}°$

FRONT SPRINGS

Approximate Free Length

Gasoline	12·85 in.
Diesel	12·63 in.

Identification Mark (Fig. K.45)

Gasoline	One V-notch
Diesel	Two V-notches

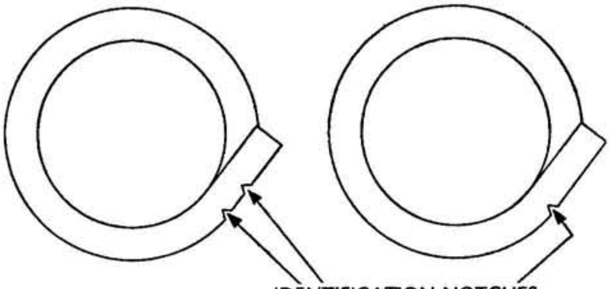


Fig. K.45. Identification notches at lower end of front spring

STEERING KNUCKLES

King Pins

Fit in trunnion bush ..	·002 to ·0036 in. clearance	King pin dia.	·7494 to ·7500 in.
		Bush bore	·7520 to ·7530 in.
Fit in knuckle boss ..	·0024 to ·004 in. interference.. ..	King pin dia.	·7494 to ·7500 in.
		Knuckle boss bore	·7460 to ·7470 in.

Wheel Spindles

Inner bearing land diameter	1·1799 to 1·1804 in.
Outer bearing land diameter	·7862 to ·7867 in.

Thrust Washers

Thickness	·190 to ·200 in.

FULCRUM SHAFTS AND SUSPENSION ARMS

Upper and Lower Shafts

Clearance in screwed bushes	·011 to ·020 in.

Upper and Lower Arms

Side play on shafts—maximum permissible measured at outer end of arms	·125 in.

Lower Arm Trunnion

Clearance in screwed bushes	·011 to ·020 in.
Maximum permissible clearance in bushes	·040 in.

FRONT HUBS

Bearing Fits

Inner bearing in hub ..	·0002 to ·002 in. interference.. ..	Outer race outside dia.	2·4403 to 2·4409 in.
		Hub bore	2·4389 to 2·4401 in.
Inner bearing on wheel spindle	·0003 to ·0012 in. clearance	Inner race bore	1·1807 to 1·1811 in.
		Spindle dia.	1·1799 to 1·1804 in.
Outer bearing in hub ..	·0002 to ·0017 in. interference.. ..	Outer race outside dia.	1·8499 to 1·8504 in.
		Hub bore	1·8487 to 1·8497 in.
Outer bearing on wheel spindle	·0003 to ·0012 in. clearance	Inner race bore	·7870 to ·7874 in.
		Spindle dia.	·7862 to ·7867 in.

TORQUE WRENCH DATA

Screwed Bushes — Standard and oversize

In original arms	*60 lb. ft.
In new arms	*80 lb. ft.

Upper Fulcrum Shaft — Standard and oversize	*70 lb. ft. minimum

Lower Fulcrum Shaft

Standard shaft in original crossmember	*5 lb. ft. minimum
Oversize shaft in original crossmember	*40 lb. ft. minimum
Lower Fulcrum Shaft Locknut	*95 lb. ft.
Axle Crossmember Attaching Nuts	†57 lb. ft

* *Oiled threads* † *Clean dry threads*

SECTION L—REAR SUSPENSION

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Have you read the General Notes on page vii?

DESCRIPTION

The rear suspension is provided by semi-elliptic wide leaf type springs and telescopic shock absorbers.

Each spring comprises seven leaves, bolted together forward of the centre and held in line by three clips. The second leaf is extended forward around the spring eye to prevent excessive movement of the axle in the event of failure of the main leaf. The spring eyes and shackles are rubber bushed.

Each spring front hanger consists of two brackets, the outer of which is bolted to the sidemember whilst the other is welded to the sidemember. The shackle pin is welded at one end

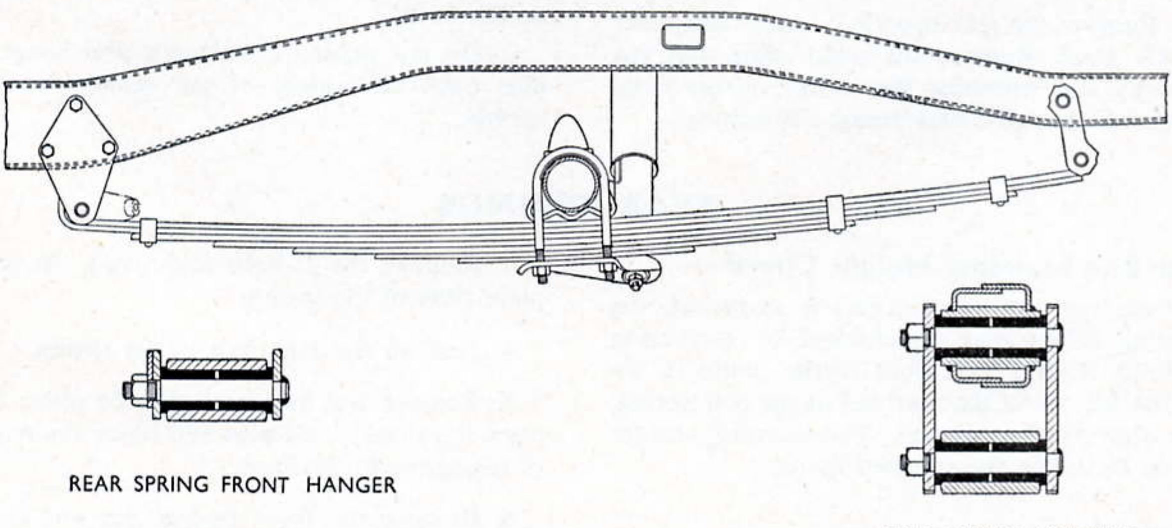

Fig. L.1. Rear suspension layout

to the outer bracket and secured to the inner bracket by a nut.

The two rear shackle pins are welded to a shackle plate and inserted through two flanged rubber bushes, located in a sleeve in the chassis sidemember and the spring eye bush. A separate shackle plate is assembled to the inner ends of the pins and secured by nuts. A shoulder on each shackle pin prevents excessive compression of the eye bush flanges when the nuts are tightened.

Rubber bumpers are secured above the rear axle tubes by retainers held in position by the spring U-bolts.

Heavy duty springs are available as a production option. These springs have eight leaves.

The telescopic, double-acting hydraulic shock absorbers are similar to those incorporated in the front suspension and are mounted behind the rear axle and inclined inwards at the top.

REAR SHOCK ABSORBERS

Removal

1. Raise and support the rear of the vehicle.

2. Remove the nut, rubber bush and retainer cup from the shock absorber upper and lower attachment studs.

3. Compress the shock absorber, withdraw the assembly and remove the remaining rubber bushes and cups.

Installation

Tighten the securing nuts to the end of the stud threads in order to obtain the correct compression of the rubber bushes.

SHACKLE AND HANGER BUSHES

Removal

1. Raise and support the rear of the vehicle.

2. Relieve the springs of the rear axle weight by supporting the axle with a jack.

3. Disconnect the shock absorber from the anchor plate.

4. Remove the rear shackle pin nuts and inner shackle plate. Remove the outer plate and pin assembly and withdraw the rubber bushes from the spring eye and chassis frame sidemember.

5. Remove the front hanger pin nut and the three bolts securing the hanger bracket to the chassis frame. Remove the pin and bracket, and withdraw the rubber bushes from the spring eye.

Installation

Note the following:

1. Install the shackle pins so that the nuts are on the inside.

2. Do not tighten the shackle and hanger pin nuts until the weight of the vehicle is on the springs.

REAR SPRINGS

Rear End Standing Height Check

Where rear spring weakness is suspected, the standing height may be checked by measuring vertically from a level floor to the centre of the top shackle pin at the rear end of the rear spring, with the vehicle unladen. The standing height should be within the specified limits.

Removal

1. Raise and support the rear of the car.

2. Remove the road wheel.

3. Remove the U-bolts and swing the anchor plate clear of the spring.

4. Jack up the axle clear of the spring.

5. Remove the nuts and shackle plate. Withdraw the shackle and pins and lower the rear end of the spring to the floor.

6. Remove the front hanger pin nut and the bolts securing the hanger bracket to the chassis frame. Support the spring, withdraw the pin and bracket and lift away the spring.

Installation

Note the following:

1. Install the spring so that the shorter end (measured from the centre bolt) is towards the front.

2. Install the shackle pins so that the nuts are on the inside, and tighten the nuts when the weight of the vehicle is on the springs.

3. When installing the left-hand spring, ensure that the brake pipe clip is located underneath the spring bumper.

4. Tighten the U-bolt nuts to the specified torque.

5. Check that the brake pipe on the rear axle is set well forward, otherwise it will foul the shock absorber when the road spring is subjected to maximum depression. Check also that the pipe is clear of the axle housing cover flange.

SPECIFICATIONS

REAR END STANDING HEIGHT

Measured vertically from a level floor to the centre of the top shackle pin at the rear end of the rear spring (Fig. L.1 on page L-1). The vehicle must be unladen. The height of each side should be within the following specified limits and within ·26 in. of each other.

Standing Height

6·40—13 tyres	18·88 to 19·88 in.
6·70—13 tyres	19·26 to 20·26 in.

TORQUE WRENCH DATA

Spring U-bolt Nuts	*33 lb. ft.

* *Clean dry threads*

SECTION M—STEERING

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Have you read the General Notes on page vii?

DESCRIPTION

The steering mechanism comprises a recirculating ball type steering gear and a four-rod linkage system connecting a drop arm and relay levers to two steering arms.

The aluminium steering gear case incorporates a side cover, a bottom end plate and a top cover which is riveted to the steering column. It is mounted in a bracket, which clamps to the drop arm shaft housing, and is bolted to a support bracket attached to the chassis frame sidemember. The upper end of the steering column is clamped to the instrument panel.

A single-start worm, threaded left-hand for right drive models and right-hand for left drive models, is welded to the steering shaft. Two ball bearings support the worm in the case, and steel shims between bottom end plate gaskets provide bearing adjustment. The end plate incorporates a rubber oil seal which protects the horn wire passing through the bore of the worm and shaft.

The upper end of the steering shaft is supported in a spring-loaded ball bearing.

Transmission of movement from the worm to the forked sector of the drop arm shaft is via a main nut in which steel balls circulate and engage the worm. A roller on the nut spigot operates in a slot in the case side cover to prevent rotation of the nut.

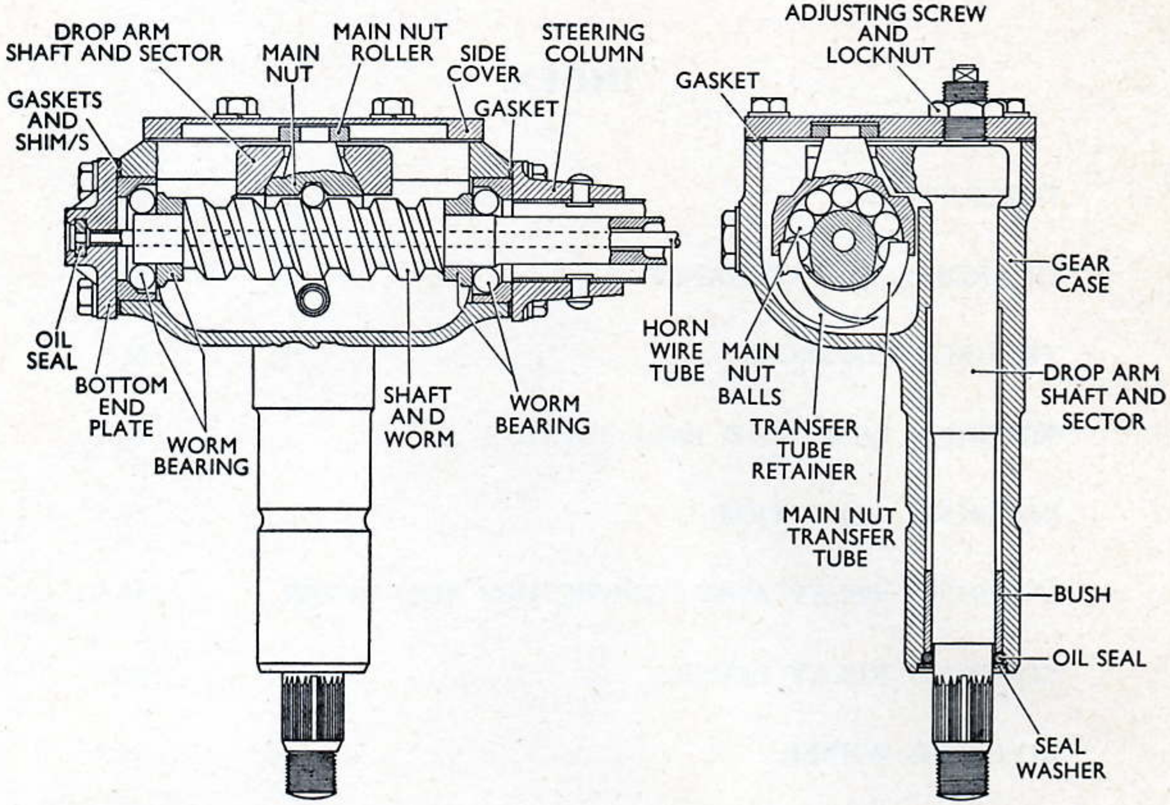

Fig. M.1. Sectioned view of steering gear

The outer end of the drop arm shaft engages a bush and oil seal whilst the inner end is supported in the housing bore. An adjusting screw with locknut located in the gear case side cover contacts the drop arm shaft to adjust the engagement of the sector with the main nut, and the main nut with the worm.

The steering wheel is retained by a nut on parallel splines.

The steering linkage consists of a tie rod, one long and two short connecting rods, and two relay levers (Fig. M.2). The non-adjustable tie rod is attached between the two relay levers which also carry the inner ends of the two short adjustable connecting rods, the outer ends being attached to the steering arms. The long connecting rod which also is not adjustable is attached to the relay lever on the drivers side and the steering drop arm. All rods are fitted with spring-loaded ball and socket joints.

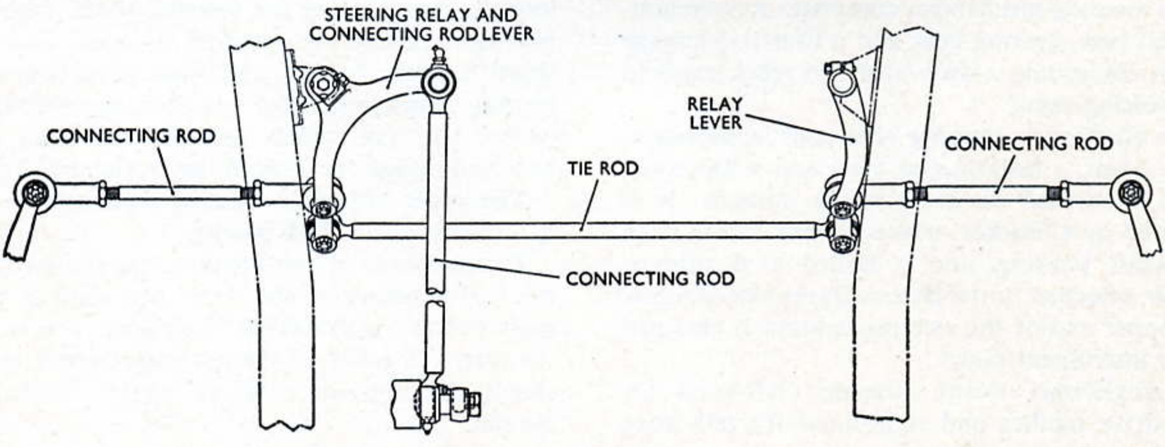

Fig. M.2. Steering linkage arrangement—right drive shown

GUARDIAN MAINTENANCE

Steering Gear

The steering gear filler plug is located in the top of the casing and is accessible through the hinged scuttle panel.

When checking the oil level, clean away all dirt from around the filler plug before removing it. The lubricant should be level with the bottom of the filler plug hole. If necessary, top-up with recommended oil.

Steering Linkage

There are ten lubrication nipples on the steering linkage, one at either end of each steering rod, one on the relay lever shaft and one on the relay and connecting rod lever housing.

Clean and examine each nipple seating for damage and if necessary, renew the nipples. Inject sufficient lubricant through the steering rod joint nipples to ensure that the rubber boots are filled. Do not over-lubricate.

TROUBLE DIAGNOSIS

Steering Stiff

Lack of Lubrication. This condition is usually the result of improper or insufficient maintenance. Observing the jacking precautions noted on page vii, raise the wheels and apply a pressure gun to all lubrication nipples on the suspension unit and steering linkage. Renew any faulty nipples and check that the lubricant reaches the component bearing surfaces. Check, and if necessary top-up the oil level in the steering gear case.

After lubricating, turn the steering several times through its full travel from lock to lock to distribute the lubricant over the bearing surfaces. With the wheels clear of the floor, it should be possible to rotate the steering wheel with one finger.

Front Tyre Pressures Low. Inflate tyres to the recommended pressure (page N-3). Low front tyre pressures increase the area of tyre contact with the road surface, and consequently a greater effort will be required to turn the wheels.

Steering Slack

Steering Gear Mounting Loose. Check that the steering gear mounting bolts are tightened to the specified torque.

Drop Arm Loose on Shaft. Ensure that the drop arm nut is tightened to the specified torque. A loose nut will allow the drop arm to slacken on the shaft and result in wear of the serrations on both shaft and arm.

Steering Linkage Joints Worn. Check the joints as described on page M-4.

Hub Bearing Adjustment Incorrect. Slack steering can be due to loose front hub bearings resulting from incorrect adjustment or wear.

Slackness in Steering Gear. Undue free play in the steering gear can be attributed to either wear or incorrect adjustment.

Steering Wander

Steering wander can be caused by excessive slackness in the steering (see under previous heading). Alternatively, it may be due to one or more of the following possible causes.

Tyre Pressures Low or Uneven. Differences in the pressures of the four tyres can cause steering wander as a tyre at low pressure lacks directional stability since it tends to follow the camber of the road.

Road Wheels Loose. If a road wheel has become loose, it should be removed and the bolts, nuts and wheel holes inspected for wear.

Front Axle Mounting Loose. Movement of the front axle assembly relative to the chassis frame, due to slack mounting bolts will create steering wander.

Steering Gear or Steering Knuckle Pivots Binding. See under 'Steering Stiff'.

Steering Geometry Incorrect. Correct steering geometry is essential for ease and stability of steering control and should be maintained within the specified limits. Excessive component wear, or distortion resulting from accidental damage, can introduce errors in the steering geometry.

Front Wheel Shimmy

Wheels and Tyres Out of Balance. Wheels and tyres which have developed an appreciable degree of unbalance can cause the wheels to 'shimmy' or jerk sideways. This out of balance condition may result from:

(*a*) Excessive or uneven tyre wear.

(*b*) Inaccurate positioning of wheel balancing weights.

(*c*) Wheel run-out due to damage to the wheel rim, or hub bearings worn or incorrectly adjusted.

Steering Geometry Incorrect. See under 'Steering Wander'.

Steering Slack. See items under this heading on page M-3.

Shock Absorbers Inoperative. Steering instability resulting from faulty shock absorber operation can create shimmy.

STEERING RODS AND BALL JOINTS

Checking Joints on Vehicle

The joints are the spring-loaded type (Fig. M.3), and it is therefore possible to move the socket in line with the stud against the compression of the spring when a load is applied.

With a new joint, this endwise movement under a load of 50 lb. can be up to ·040 in. The maximum permissible movement on a used joint is ·080 in. If this limit is exceeded, or if there is any free play in the joint which can be felt without applying pressure, the joint must be renewed.

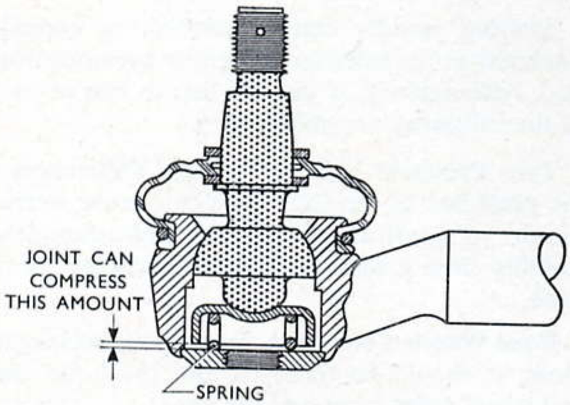

Fig. M.3. Sectioned view of steering joint showing the spring-loaded self-adjusting details

Removal

1. Raise and support the front of the vehicle.

2. Using the drag shown in Fig. M.4 disconnect the joint from the appropriate steering arm and/or relay lever and withdraw the rod.

3. Remove the garter spring and withdraw the rubber boot, retainer and washer from the joint.

4. Where applicable, slacken the joint locknut and remove the joint and locknut.

NOTE: *The threads on the two short connecting rods are left and right-hand for adjustment of the front wheel alignment. For the purpose of identification the locknuts with left-hand threads are unchamfered.*

Inspection

1. Check the joint for roughness or free play.

2. Renew the rubber boot if there is any damage which will allow entry of water or dirt into the joint.

3. Check the rods for distortion. If the rods are only slightly bent they may be straightened. *Do not heat the rod when straightening.*

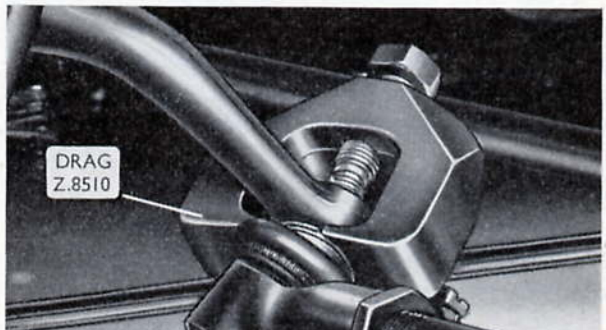

Fig. M.4. Drag positioned prior to disconnecting the steering connecting rod from the relay lever

Installation

Note the following:

1. Where applicable, check that the ends of each short connecting rod are screwed on an equal amount until a dimension of approximately 12·26 in. is obtained between the ball shank centres.

2. Install the short connecting rods so that the right-hand threaded end is to the outside on the right-hand side of the vehicle, and to the inside on the left-hand side (Fig. M.2).

3. Tighten the ball stud attaching nuts to the specified torque.

4. Check the front wheel toe-in (page K-4).

STEERING DROP ARM

Removal

1. On diesel and left drive models, remove the radiator.

2. Using the drag shown in Fig. M.5, disconnect the steering connecting rod from the drop arm.

3. Remove the nut and lockwasher securing the drop arm, and withdraw the arm (Fig. M.6).

Inspection

1. Check the arm for alignment. The arm should be straight and free from twist.

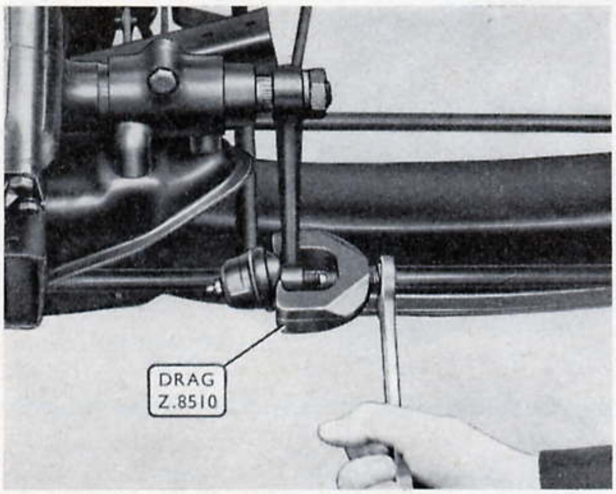

Fig. M.5. Disconnecting the steering connecting rod from the drop arm

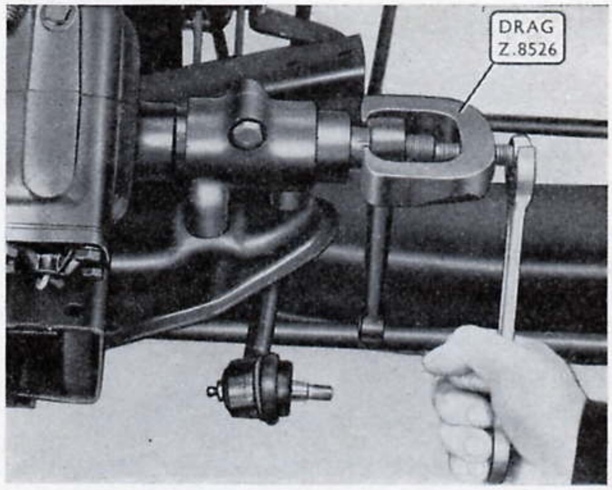

Fig. M.6. Removing the steering drop arm

2. Examine the arm and shaft serrations for wear or damage. No relative movement should be felt with the arm pushed hard on to the shaft.

Installation

Note the following:

1. Prior to fitting the arm, ensure that the serrations on both shaft and arm are clean. The serrations incorporate four equally-spaced flutes which simplify correct assembly location.

2. Tighten the drop arm and the connecting rod end attaching nuts to the specified torque.

STEERING RELAY AND CONNECTING ROD LEVER

Removal

1. Raise and support the front of the vehicle.

2. Disconnect the tie rod and the steering connecting rod from the relay lever (Fig. M.4).

3. Remove the securing bolts and lift away the relay lever and housing assembly.

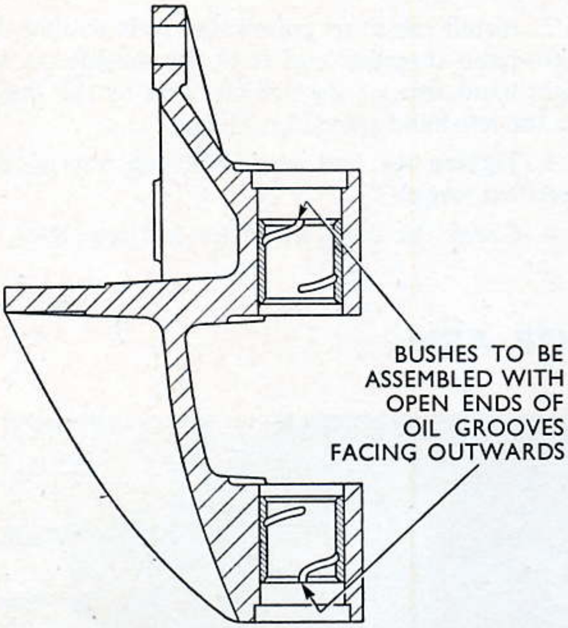

Fig. M.7. Sectioned view of relay and connecting rod lever housing, showing assembled position of bushes

Disassembly

1. Remove the lubrication nipple and relief valve from the plugs at each end of the shaft.

2. Knock back the staking and remove the plugs.

3. Remove the cotter, tap out the shaft and retain the shims (where fitted). Discard the two oil seals.

Inspection and Reconditioning

1. To renew the relay lever shaft bushes, proceed as follows:

(*a*) Drive out the bushes taking care not to damage the housing bores.

(*b*) Press in new bushes so that the open ends of the oil grooves are on the outside (Fig. M.7), i.e. towards the sealing plug counterbores and with the inner end of each bush ·12 in. below the inner face of the housing.

(*c*) Line ream the bushes to the specified diameter, and check the fit of the shaft.

2. Check the lever for alignment against the dimensions in Fig. M.8.

Reassembly

1. Install two new oil seals, lubricate and fit the shaft through the lower housing, so that the cotter flat is located as shown in Fig. M.9.

2. Assemble the lever so that the cotter hole is in line with the flat on the shaft and lightly tap the shaft through the lever boss.

3. Install sufficient shims (Fig. M.9), to take up end movement of the lever between the bracket bosses. Carefully tap the shaft through the shims

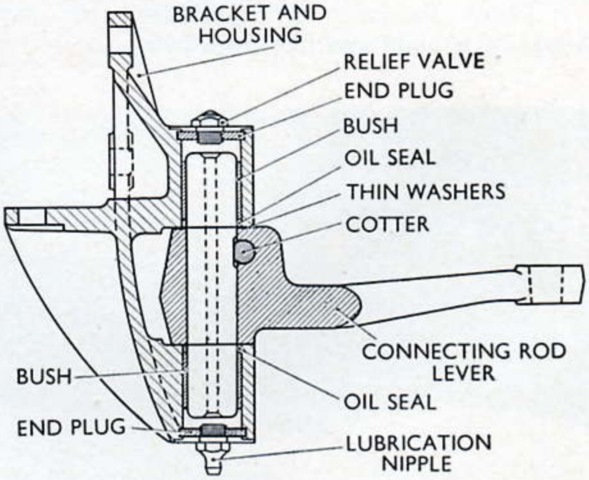

Fig. M.9. Steering relay and connecting rod lever assembly

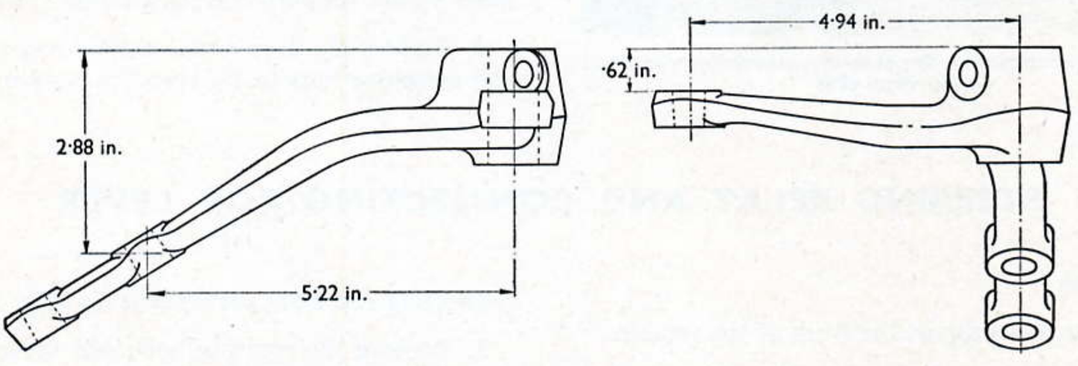

Fig. M.8. Steering relay and connecting rod lever checking dimensions

and into the upper housing. Install the cotter, plain washer and nut.

4. Fit the plugs to the housings and secure by staking at four points. Assemble the lubrication nipple and relief valve as shown in Fig. M.9.

Installation

Note the following:

1. Tighten the tie rod and connecting rod attaching nuts to the specified torque.

2. Check the front wheel toe-in (page K-4).

STEERING RELAY LEVER

Removal

1. Raise and support the front of the vehicle.

2. Disconnect the tie rod and the steering connecting rod from the relay lever as shown in Fig. M.4.

3. Remove the securing bolts and lift away the relay lever and bracket.

Disassembly

1. Remove the lubrication nipple and nut from the end of the shaft.

2. Remove the bolt securing the lever to the shaft, lift off the lever and withdraw the oil seal and thin washer. Discard the oil seal.

3. Withdraw the shaft and remove the remaining thin washer.

Inspection and Reconditioning

1. If the lever shaft bushes are worn renew as follows:

(*a*) Drive out the bushes taking care not to damage the housing bore.

(*b*) Press in new bushes flush with the outer ends of the housing and with the open end of the oil groove to the inside of the housing (Fig. M.10).

(*c*) Line ream the bushes to the specified diameter and check the fit of the shaft.

2. Check the lever for alignment against the dimensions in Fig. M.11.

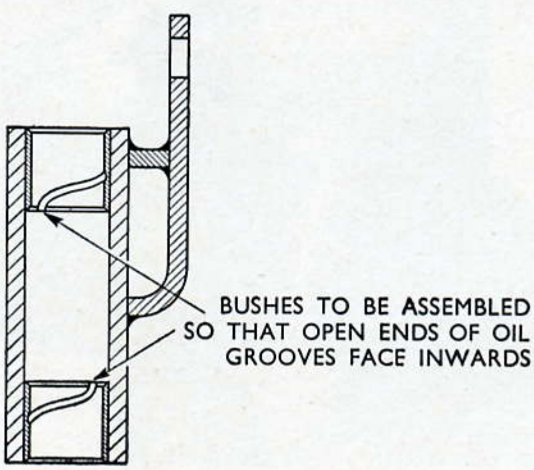

Fig. M.10. Sectioned view of relay lever housing, showing assembled position of bushes

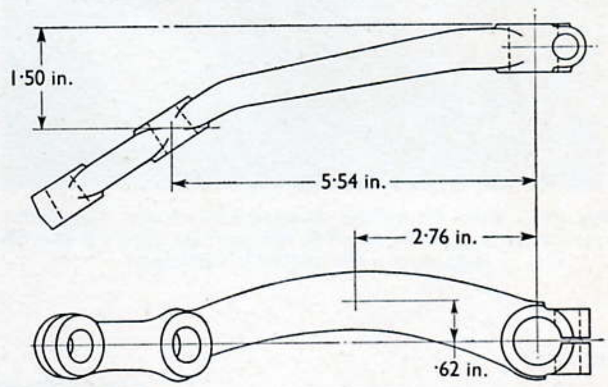

Fig. M.11. Steering relay lever checking dimensions

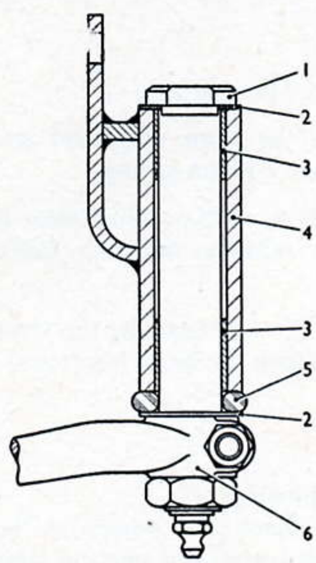

Fig. M.12. Steering relay lever assembly

1. Relay lever shaft	**4. Housing**
2. Thin washers	**5. Oil seal**
3. Bushes	**6. Relay lever**

Reassembly

1. Lubricate the shaft, fit a thin washer and install the shaft in the housing as shown in Fig. M.12.

2. Install a new oil seal and assemble the remaining thin washer and the lever. Note that the set in the lever must be in the same direction as the threaded end of the shaft.

3. Fit the lever clamp bolt but do not tighten at this stage.

4. Compress the oil seal as follows:

(*a*) Place a collar, ·50 in. thick with a bore diameter of ·82 in. and external diameter of 1·12 in., over the threaded end of the shaft and against the lever boss.

(*b*) Secure the lever assembly in a vice as shown in Fig. M.13 and tighten the vice as far as the collar will allow. Then tighten the clamp bolt.

NOTE: *Make sure that the collar is positioned so that it will pass over the shoulder on the shaft.*

5. Grip the head of the shaft in the vice and tighten the shaft nut against the shoulder. Lock the nut by staking at two points.

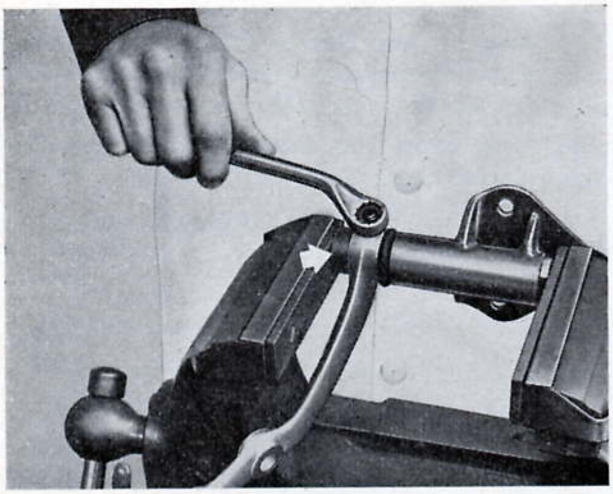

Fig. M.13. Assembling the steering relay lever. The collar (arrowed) is used to provide the correct load on the oil seal before the cotter is tightened

Installation

Note the following:

1. Tighten the tie rod and connecting rod end attaching nuts to the specified torque.

2. Check the front wheel toe-in (page K-4).

STEERING WHEEL

Removal

1. Disconnect the battery.

2. Prise out the horn push and retainer and remove the push contact spring.

3. Pull the horn wire terminal clear of the split insulator and remove the two halves of the insulator.

4. Unscrew the nut securing the steering wheel (Fig. M.14), detach the brass insert and lift off the wheel.

Installation

Note the following:

1. With the front road wheels in the straight-ahead position, install the steering wheel so that the spokes are horizontal.

2. Tighten the steering wheel securing nut to the specified torque.

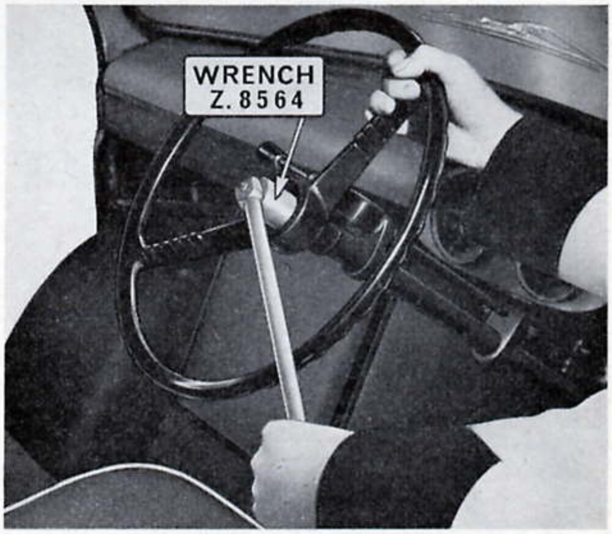

Fig. M.14. Removing the steering wheel nut

STEERING GEAR

Removal

1. Disconnect the battery.

2. Drain the cooling system.

3. Remove the steering wheel (page M-8).

4. Remove the gear shift lever (see Section F).

5. Remove the steering column clamp and insulator.

6. Disconnect the horn wire.

7. Remove the radiator.

8. Remove the steering drop arm as shown in Fig. M.6.

9. Disconnect the gear shift control rods from the levers on the steering column and remove the gear shift selector rod (see Section F).

10. On left drive models, remove the generator.

11. Remove the two bolts securing the front crossmember to the chassis frame.

12. Remove the two bolts securing the front crossmember to the radiator support frame. Remove the insulators and retainers and withdraw the crossmember.

13. Remove the bolts securing the steering gear to the support bracket.

14. Position the steering gear below its mounting bracket and forward into the lower curvature of the front lower panel. Turn the gear so that the end of the drop arm shaft is below the front suspension stabilizer and withdraw the gear downwards and towards the opposite side of the vehicle.

Disassembly

1. Remove the clamp bolt from the gear support bracket and withdraw the bracket.

2. Secure the steering gear in a vice by gripping the drop arm shaft housing with a split block of wood shaped to fit the housing.

3. Unsolder the terminal from the horn wire and withdraw the wire.

4. Remove the gear shift lever pivot jaw from the column.

5. Slacken the locknut and unscrew the drop arm shaft adjusting screw. Remove the gear side cover and gasket and lift off the roller from the main nut spigot. Withdraw the drop arm shaft.

6. Remove the bolts securing the top cover. Hold the shaft in position and withdraw the column.

7. Remove the bottom end plate, shims and gasket. Push out the bottom bearing and collect the nine balls. Remove the upper bearing and nine balls in a similar manner.

8. Withdraw the shaft and worm as shown in Fig. M.15, remove the two inner races from the shaft and unscrew the main nut from the worm.

9. Remove the twelve balls from the main nut and detach the transfer tube and retainer.

10. Knock back the staking and remove the washer and oil seal from the end of the drop arm shaft housing.

11. Drive the steering shaft upper bearing out through the top of the steering column.

Inspection and Reconditioning

1. Clean and inspect the steering shaft worm bearings (see under 'General Notes' on page vii).

NOTE: *Wear or damage to the bearing inner races may result in the balls wearing a groove in the shaft, necessitating renewal of the worm and shaft.*

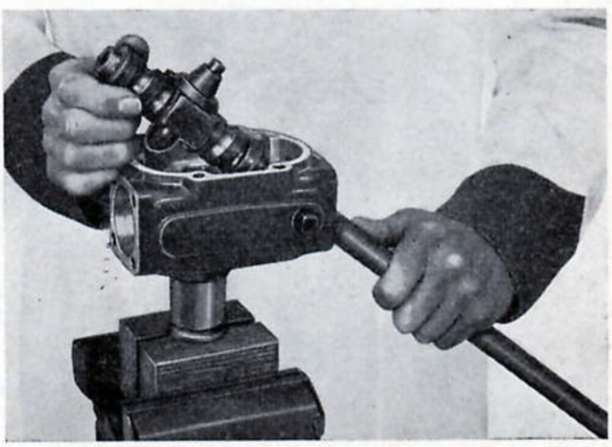

Fig. M.15. Withdrawing the steering shaft from the gear case

2. Examine the shaft worm for wear or damage, and inspect the condition of the shaft serrations and threads.

3. Examine the main nut for wear in the ball track, and on the conical seating which engages the drop arm shaft sector. Inspect the twelve balls.

4. Check the fit of the roller on the main nut spigot and in the guide slot in the gear case side cover.

5. Inspect the drop arm shaft and sector for wear. Check the shaft for excessive clearance in the bush and steering gear case. To renew the bush proceed as follows:

(*a*) Screw a 1 in. diameter tap into the bush from the outer end.

(*b*) Heat the steering gear case in hot water.

(*c*) Engage a brass drift with the inner end of the tap and press the tap together with the bush out of the case.

(*d*) Locate the new bush so that the arrow stamped on the outside points into the steering gear case and press the bush in until it is flush with the bottom of the oil seal recess. The arrow is provided so that the bush is installed with the open end of its oilway facing inwards.

(*e*) Hone the bush out to within the specified limits.

6. Inspect the steering shaft bearing for damage, or roughness indicating wear. Check that the bearing felt oil seal is in good condition. The bearing is serviced as an assembly complete with felt.

7. Check the steering gear case and support bracket for damage.

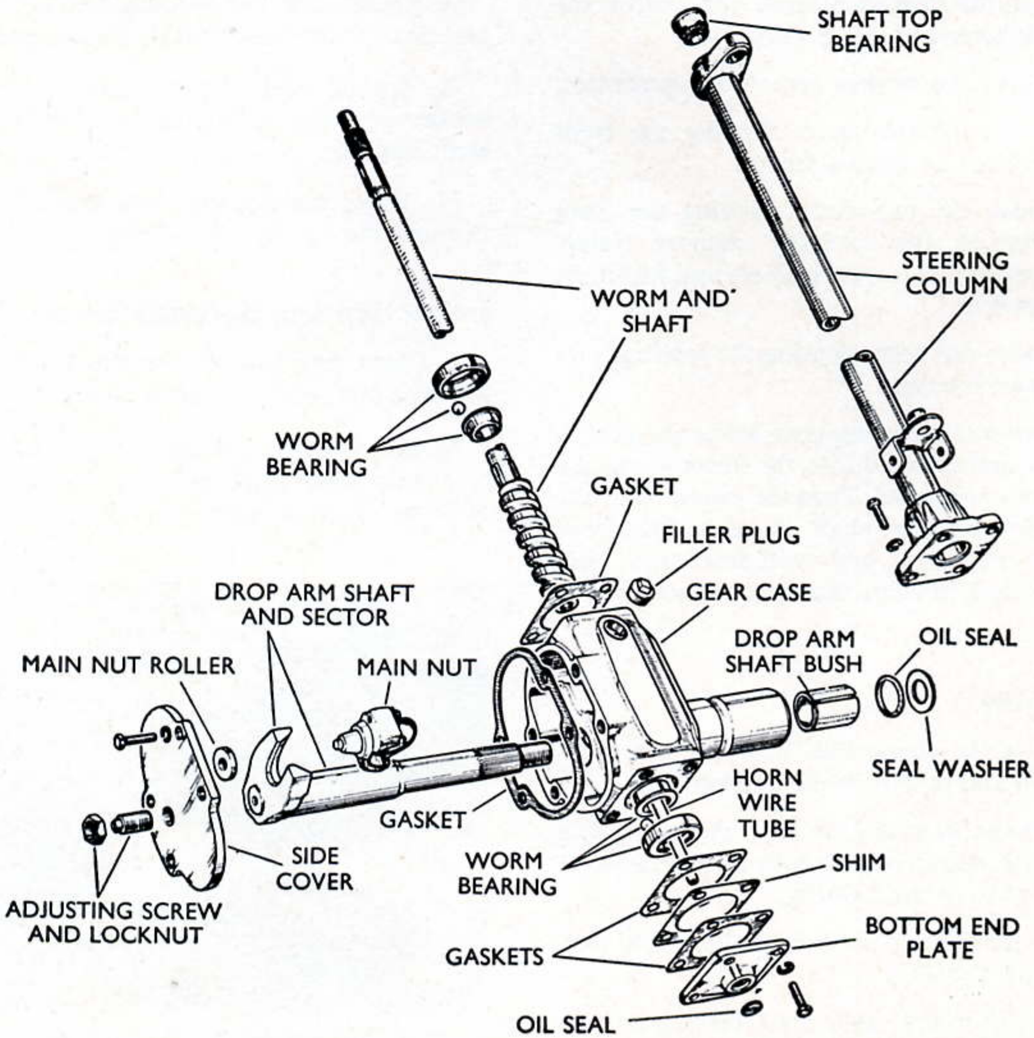

Fig. M.16. Exploded view of steering gear

8. Check the condition of the horn wire guide tube and the face of the end plate for burrs.

9. Examine the column for damage, and check the condition of the rubber dust shield.

Reassembly

Note the following:

1. Lubricate the steering shaft bearing with recommended grease and oil the shaft bearing felt. When installed, the bearing outer race flange should contact the top of the column.

2. After fitting a new drop arm shaft oil seal and washer, stake the end of the shaft housing at four points to secure the washer (Fig. M.17).

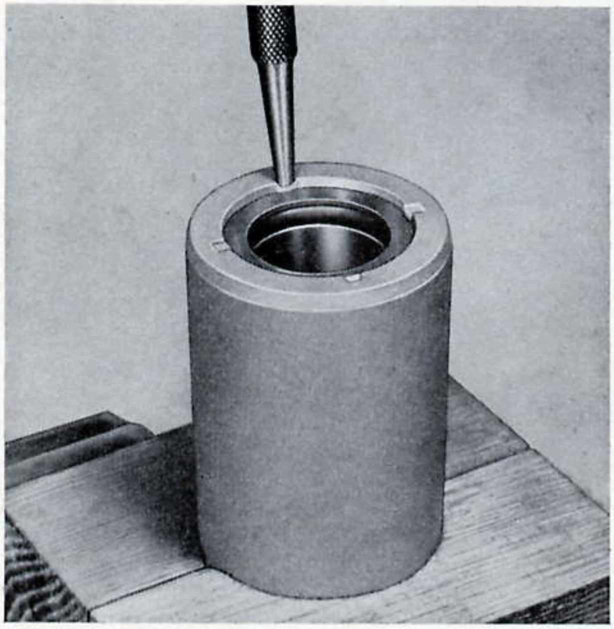

Fig. M.17. Staking the end of the drop arm shaft housing to secure oil seal washer

3. Ensure that the balls run freely through the transfer tube of the main nut.

4. Smear the worm bearing races with petroleum jelly to retain the nine balls of each bearing in position.

5. Install the bottom end plate and shims, using new gaskets, before fitting the column. The column must be located so that the selector lever bracket is towards the filler plug.

6. Before installing the drop arm shaft, adjust the pre-load of the steering worm bearings to within the specified limits by adding or removing shims at the bottom end plate.

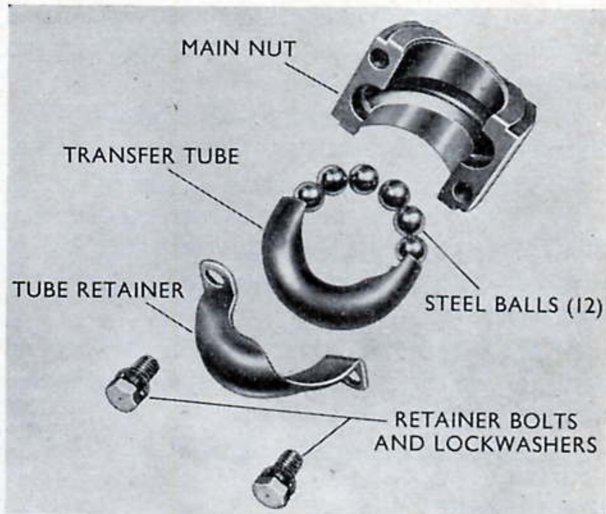

Fig. M.18. Main nut assembly—exploded view

Prior to checking the pre-load it will be necessary to temporarily install the steering wheel. Also temporarily refit the nut roller and the cover and gasket to prevent the main nut jamming against the gear case.

Check with a spring balance, pulling tangentially on the steering wheel rim (Fig. M.19).

7. Lubricate the drop arm shaft bush before installing the shaft, and adjust the shaft sector and main nut engagement as follows:

(*a*) Install the nut roller and the cover and gasket and fully tighten the cover bolts.

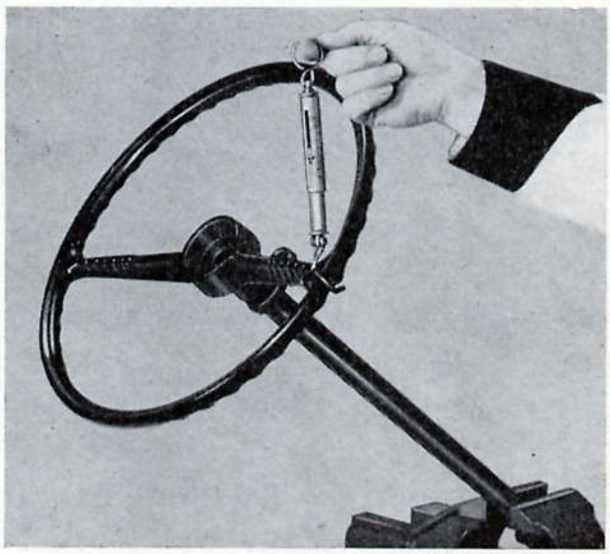

Fig. M.19. Checking the pre-load on the steering shaft worm bearings

(*b*) Set the steering wheel in the straight-ahead position, i.e., midpoint of its rotation from extreme left to right lock.

(*c*) Screw in the drop arm shaft adjusting screw until it contacts the shaft and tighten the locknut.

(*d*) Using the spring balance as shown in Fig. M.19, check the load required to rotate the steering wheel through an angle of approximately 30° on each side of the straight-ahead position or point of zero backlash.

(*e*) If the figure obtained is outside the specified limits, adjust the screw as necessary, making sure that the locknut is retightened.

(*f*) Remove the steering wheel.

Installation

Note the following:

1. Fit the thick insulators and ferrules between the brackets on the front crossmember and the radiator support frame.

2. Install and tighten the front crossmember bolts before fitting the steering gear attaching bolts.

3. Do not tighten the steering gear clamp bolt until the gear and column is correctly aligned. Tighten the column clamp nuts and gear attaching bolts evenly, then tighten the clamp bolt. Finally, tighten the gear attaching bolts and clamp bolt to the specified torque.

4. Install the steering drop arm (page M-5).

5. Install the steering wheel (page M-8).

6. On left drive models, adjust the fan belt (see Section C).

SPECIFICATIONS

GENERAL DATA

Steering Gear Oil Capacity — Nominal .. 1/2 pint

STEERING GEAR

Drop Arm Shaft			
Fit in bush	·0010 to ·0025 in. clearance	Shaft dia.	·9350 to ·9355 in.
		Bush bore	·9365 to ·9375 in.
Fit in housing	·0005 to ·0025 in. clearance	Shaft dia.	·9985 to ·9995 in.
		Housing bore	1·000 to 1·001 in.
Worm Bearings			
Outer race fit in gear case	·0005 to ·0025 in. clearance	Bearing outside dia.	1·8415 to 1·8425 in.
		Gear case bore	1·8430 to 1·8440 in.
Inner race fit on shaft ..	Zero to ·002 in. clearance	Shaft dia.	·754 to ·755 in.
		Bearing bore	·755 to ·756 in.
Bottom End Plate Shims — Thickness ..		·005 in.	
		·010 in.	
Worm Bearing Pre-load — Drop arm shaft removed		*2 to 8 oz.	
Steering Gear Total Pre-load		*12 to 16 oz.	

* Pull applied tangential to steering wheel rim

RELAY LEVERS AND HOUSINGS

Lever Shafts

Fit in bushes	·0005 to ·0021 in. clearance	Shaft dia.	·7494 to ·7500 in.
		Bush bore	·7505 to ·7515 in.

TORQUE WRENCH DATA

Drop Arm Nut	*63 lb. ft.
Steering Tie Rod Nuts	*†17 lb. ft.
Steering Connecting Rod (long) Nuts	*†17 lb. ft.
Steering Connecting Rod (short) Nuts	*†32 lb. ft.
Steering Gear Bracket Clamp Bolt	*25 lb. ft.
Steering Gear Bolts	*39 lb. ft.
Steering Wheel Nut	*53 lb. ft.

* *Clean dry threads*
† *Slotted nut. Where necessary tighten nut further to align split pin hole with slot in nut.*

SECTION N—WHEELS AND TYRES

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Have you read the General Notes on page vii?

DESCRIPTION

All models are equipped with disc type wheels and tubeless tyres. Five right-hand threaded nuts, chamfered to engage conical seatings around the wheel bolt holes, attach each wheel to bolts pressed into the hub flange. Brake cooling slots are provided by four apertures between the wheel disc and rim. A hub cover snaps over shoulders formed in the wheel disc.

The valve is of the rubber-bonded type which is a snap-in fit in the wheel rim.

A spare wheel and tyre is carried at the rear of the vehicle between the chassis frame sidemembers. Access to the wheel is provided by a hinged panel located below the rear bumper and secured by two quick release screws.

GUARDIAN MAINTENANCE

Tyre Inspection

Inspect the tyres for cuts, damaged walls, or irregular or abnormal wear. To obtain maximum tyre life, it is essential that the wear is equalized over the tread surface. This can be achieved by changing round the wheels and tyres whenever irregular tyre wear is observed.

The tyre pressures must be checked and adjusted to the specified pressures.

If abnormal tyre wear is observed, or signs of 'drag' or scuffing of the front tyres, the front wheel toe-in and steering geometry must be checked, and if necessary, corrected (see page K-3). It is equally important that the wheels and tyres are balanced.

TROUBLE DIAGNOSIS

Excessive Tyre Wear

Driving Habits. In many cases abnormal tyre wear can be due to the manner in which the vehicle is driven. Rapid acceleration and deceleration, fierce braking, cornering at excessive speeds and high speed driving all have an adverse effect on tyre life.

Operating conditions must also be considered, as frequent stops and wide variations in road surfaces have a marked effect on tyre wear.

Lack of Tyre Maintenance. Infrequent attention to tyres is one of the most common causes of excessive tyre wear. Inflation pressures must be checked regularly and the wheels and tyres changed round when necessary, to even up the wear pattern.

Steering Geometry Incorrect. Failure to maintain the steering geometry within the specified limits will result in premature and excessive tyre wear. The steering geometry should be checked if signs of abnormal tyre wear are observed.

Irregular Tyre Wear

A tyre tread having an irregular wear pattern is usually an indication of some mechanical fault or misalignment. Both these conditions may be due to worn suspension arm ball joints, distorted suspension arms, bent steering knuckles, slack front hub bearings or suspension arm or axle attachments. These conditions can be diagnosed by a steering geometry check. Defective braking, buckled wheels, wheels and tyres out of balance, are also possible causes.

The more common mechanical faults and their effects on tyre wear are as follows:

(*a*) Excessive toe-in produces a scuffing effect on the tyres which then develop feathered edges on the inner edges of the tread. Conversely, toe-out produces the same wear characteristics on the outer edges of the tread.

(*b*) Excessive positive camber causes a greater amount of wear on the outer side of the tyre tread. Negative camber creates more wear on the inner side of the tread.

WHEEL AND TYRE CHANGE ROUND

To obtain maximum tyre life and also minimize tyre noise, it is essential that the wear is equalized over the tread surface. This can be achieved by changing round the wheels and tyres whenever irregular wear is observed. The spare wheel and tyre must be included in this interchange as the spare tyre may deteriorate if allowed to remain idle. The recommended sequence in which the wheels and tyres are changed is shown in Fig. N.1. During the change round, the tyre pressures must be checked and adjusted where necessary.

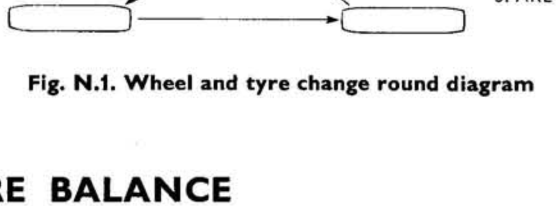

Fig. N.1. Wheel and tyre change round diagram

WHEEL AND TYRE BALANCE

Whilst correct steering geometry is essential to ensure smooth rolling of the wheels without drag or scuffing, it is equally important that the wheel and tyres are balanced in order to avoid the development of vibrating forces which would cause wheel bounce and shimmy. Wheel bounce or tramp is a condition affecting all four wheels, whereas shimmy or wobble is experienced only on the front wheels. Both these conditions will produce irregular wear of the tyre tread as well as disturb the steering stability.

A wheel and tyre assembly may lose its original balance due primarily to (*a*) irregular tyre wear caused by bad driving habits, lack of maintenance or incorrect steering geometry, and (*b*) tyre repairs. Wheel and tyre assemblies should be checked for static and dynamic balance, using special balancing equipment.

Other factors, such as tyre eccentricity with the wheel, a buckled wheel, and incorrect installation of a tyre, should also be considered as potential causes associated with wheel and tyre out-of-balance.

SPECIFICATIONS

WHEELS

Run-out—Radial and lateral .. .. .. ·070 in. maximum

TYRES

Size

Standard .. .. .. 6·40—13 (6 ply)

Optional .. .. .. 6·70—13 (6 ply)

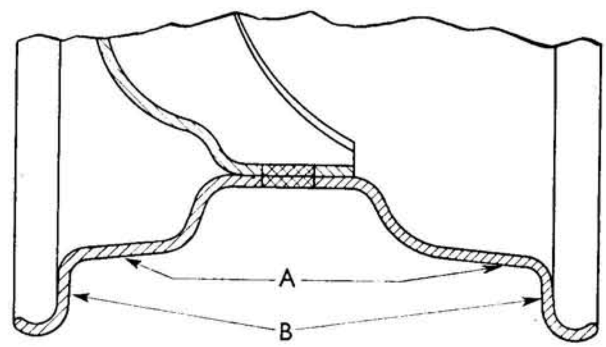

Fig. N.2. Sectioned view of wheel rim, showing the checking points for radial run-out at 'A' and lateral run-out at 'B'

Pressures

TYRE		INFLATION PRESSURE LB./SQ. IN.									
Nominal Size of Tyre	Ply Rating	18	20	22	24	26	28	30	36	40	45
		MAXIMUM LOAD PER TYRE IN LB.									
6·40–13*	6	710	775	800	840	880	920	955	1060		
6·40–13†	6	710	775	800	840	880	920	955	1060	1130	1210
6·70–13*	6	790	845	890	935	980	1025	1070	1190		
6·70–13†	6	790	845	890	935	980	1025	1070	1190	1280	1375

* *Car-type tyres*

† *Commercial-type tyres*

IMPORTANT NOTE: *The lowest pressure given in the table is the absolute minimum pressure, even if the loads are below those quoted for this pressure.*

SECTION O—BRAKES

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Have you read the General Notes on page vii?

DESCRIPTION

The footbrake operates the front and rear brakes through a hydraulic system. Each two leading shoe front brake incorporates two single ended cylinders and cam type adjusters. The rear brakes each have a floating type cylinder to operate the leading/trailing shoe combination and an expanding type adjuster operating on the ends of the shoe webs.

The parking brake is connected by a separate mechanical system incorporating a hand lever linked through a bell crank lever and equalizing bridle to cables connected to the rear brakes.

The brake pedal is mounted, together with the clutch pedal, on a spigoted bracket welded to the chassis frame.

The master cylinder (Fig. O.5) is a centre valve type with integral fluid reservoir incorporating a filter.

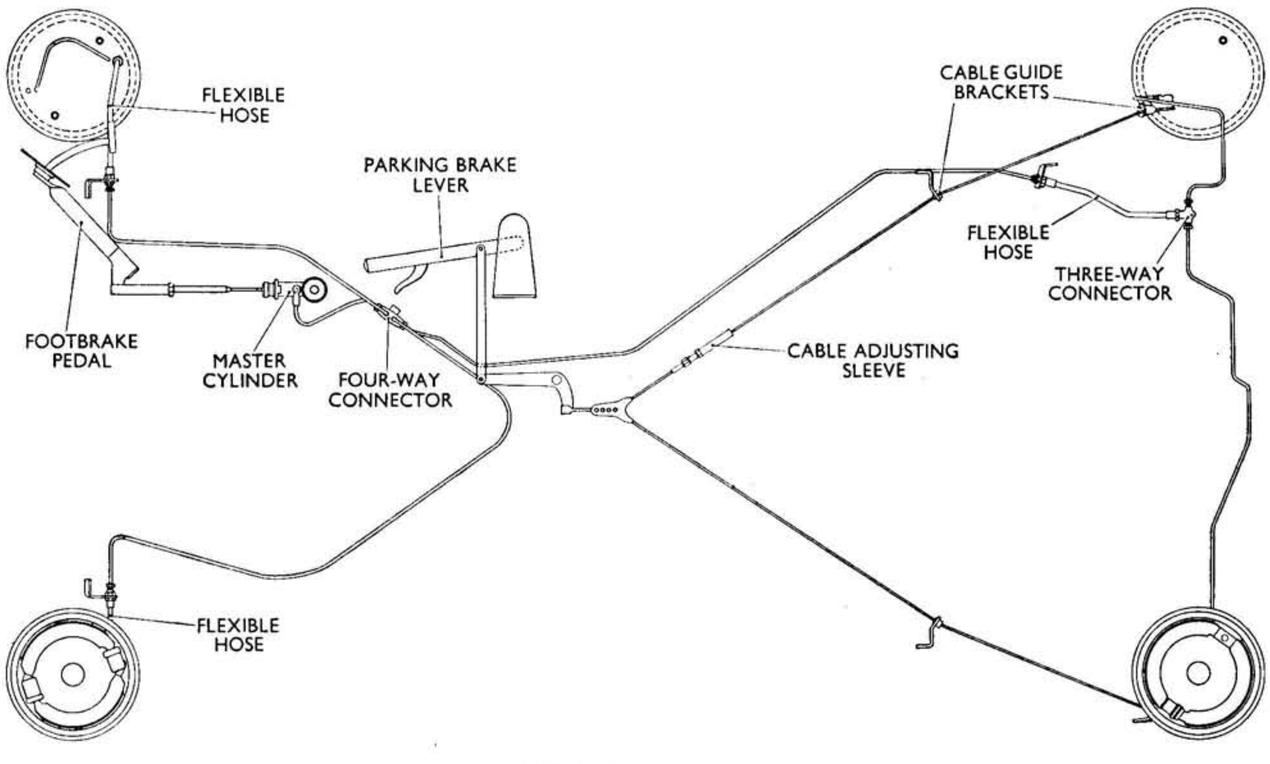


Fig. O.1. Brake system Layout

GUARDIAN MAINTENANCE

Brake Master Cylinder

The combined master cylinder and fluid reservoir is mounted on the chassis frame under the floor panel on the driver's side. The reservoir has a screw-type filler cap and a filter which is retained in the reservoir by the cap.

Before adding fluid, clean the filler cap to prevent dirt entering the reservoir. Top up the reservoir to ·30 in. below the top with the recommended brake fluid. It is important that only the correct fluid is used. *Do not use containers which have been used for mineral oils or other fluids*; mineral contamination spreads rapidly in the hydraulic system, causing a dangerous deterioration of the rubber seals, which can render the braking system liable to complete failure.

Parking Brake Linkage

Lubricate the cable bridle, guides and clevises with an oil can.

TROUBLE DIAGNOSIS

Pedal Travel Excessive

Excessive brake pedal travel is usually an indication that the clearance between the brake shoes and the drums is excessive.

Pedal Spongy

Air in Hydraulic System. Excessively low fluid level in the master cylinder reservoir, due either to lack of maintenance or to leakage at the cylinders or pipes, will cause air to enter the system. This will be apparent as a spongy action of the brake pedal.

Check for leaks at the pipes, master cylinder, front and rear brake cylinders, tighten loose connections, renew damaged parts and bleed the brakes.

Master Cylinder Seals Worn. Worn seals can give rise to a spongy pedal and if this condition persists after bleeding the brakes, the master cylinder should be overhauled.

Hydraulic System will not Maintain Pressure

If, when applying the brakes the pedal moves gradually to the floor, check for the following:

External Leaks in Hydraulic System. A small external leak in the hydraulic system, while it may not prevent the brakes being applied, will prevent pressure being maintained in the system. Check carefully for signs of leakage, and rectify as necessary. Do not neglect the brake cylinders during this check.

Master Cylinder Seals Leaking. Leakage past the gland seal or valve seal will prevent pressure being maintained, in which case the cylinder should be overhauled.

Brakes Ineffective

Incorrect Shoe Facings. Only genuine parts should be used as service replacements. This will prevent loss of braking efficiency due to incorrect facings.

Shoe Facings Contaminated. Lubricant or brake fluid on the shoe facings will seriously affect brake efficiency. Where this condition exists, the brake cylinders, rear axle shaft and hub oil seals must be examined and *any leaks rectified,* after which new facings must be installed. No attempt must be made to clean and re-use contaminated facings.

Shoe Facings Worn Excessively. Excessively worn brake shoe facings will cause loss of brake efficiency.

Brake Drums Scored. It is impossible to achieve satisfactory braking with scored brake drums. Machine or renew the drums and if necessary, renew the brake shoe facings.

Incorrect Brake Fluid. Fluid other than that recommended may be injurious to rubber, and cause restriction in the rubber hoses and swelling of the seals in the hydraulic cylinders. This can result in excessive pedal pressure being required to produce effective braking, or in some cases, may lead to complete brake failure. To rectify, flush out the complete system with Girling Cleaning Fluid, renew the flexible hoses and rubber seals, refill the system with the recommended fluid and bleed the brakes.

Brakes Bind

Shoe Adjustment Incorrect. The brake shoes must not be adjusted too close to the drum.

Parking Brake Adjustment Incorrect. Insufficient parking brake cable length can result in the rear brakes binding. Adjust the cables. Also check that the rear brake cylinders move freely in the brake flange plate slots and the levers are free in the cylinders.

Shoe Pull-off Spring Ineffective. A weak, broken or unhooked brake shoe return spring will allow the shoe facings to remain in contact with the brake drum when the pedal is released.

Brake Cylinder Piston Seized or Seal Swollen. It is important that the pistons of the brake cylinders work freely, otherwise there will be a tendency for the facings to remain in contact with the brake drum when the pedal is released. Clean or renew parts as necessary. Check also for unrestricted fluid flow in the brake hydraulic system.

Hub Bearings Slack. Slack hub bearings will allow the brake drum to tilt in relation to the shoe facings. This can cause the facings to contact the drum when the weight of the vehicle is on the tyre, although the brake may be free when the tyre is off the ground.

Fluid Reservoir Overfilled. The fluid level in the reservoir should be maintained ·30 in. below the top. Overfilling may restrict fluid flow.

Fluid Reservoir Air Vent Restricted. A restricted air vent in the master cylinder fluid reservoir will have a similar effect to overfilling the reservoir. Ensure the filter and filler cap air vent is clear.

No Pedal Free Travel. The brake pedal should have the specified free travel. This is essential to allow the plunger in the master cylinder to return to its stop and uncover the inlet port. If the port is not uncovered, the brakes will not release properly. Make sure the pedal return spring is functioning correctly.

Incorrect Brake Fluid. In addition to the effects of incorrect brake fluid given under this heading on page O-3, swollen seals or restricted hoses can result in a tendency for the brakes to remain on when the pedal is released.

Brakes Pull to One Side

Unequal Tyre Pressures. Tyre pressures which vary between one side of the vehicle and the other will cause unequal tyre contact and grip on the road, which will lead to unbalanced braking. Inflate the tyres to the specified pressure.

Front Hub Bearings Slack. The front hub bearings must be maintained in correct adjustment.

Flange Plate Loose. A loose flange plate will allow the brake shoes to tilt and cause unequal braking. Tighten the flange plate attaching bolts and nuts, and adjust the brake shoes.

Shoe Facings Contaminated. If the shoe facings of one brake are contaminated, unbalanced braking will result. Rectify as described under this heading on page O-3.

Odd Shoe Facings. It is important that only genuine parts are used. This will ensure that all the facings are of similar material. The use of odd facings will result in unbalanced braking.

Brake Drum Distorted. A distorted brake drum can be due to overtightening the wheel nuts and will result in unbalanced braking.

Flexible Hose Restricted. If restriction of a front brake hose has occurred, the compensating action of the hydraulic system will be deranged. Rectify by installing a new hose. Note that the faulty hose will be on the side opposite to the direction in which the brake pulls.

Front Suspension or Steering Worn. Slackness in the front suspension or steering can give rise to unequal braking on the front wheels. Tighten, adjust or renew as required.

Brakes Grab

Brake grab usually shows up when applying the brakes at low road speeds, when moderate pressure on the pedal results in one or more brakes suddenly jamming hard on. The most common causes of this complaint are as follows:

Flange Plate Loose. See under this heading in adjacent column.

Front Hub Bearings Slack. See under this heading in adjacent column.

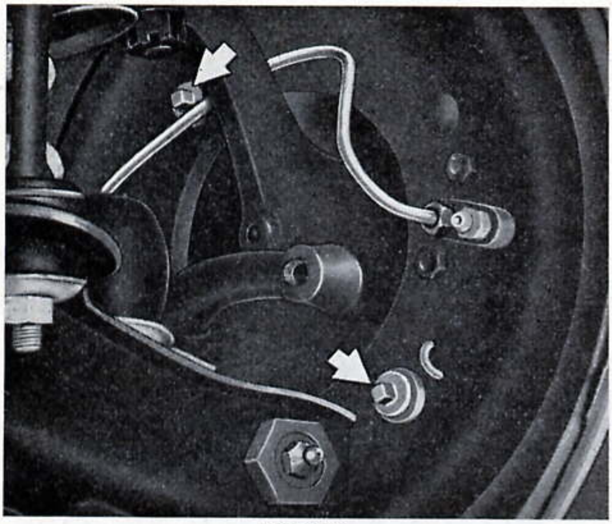
Shoe Facings Contaminated. Lubricants or brake fluid on the facings can cause brake grab. Rectify as described under this heading on page O-3.

Incorrect Shoe Facings. Genuine parts must always be used as service replacements. Nonstandard material can create brake grab and other adverse brake conditions.

Brake Drum Distorted. See above.

Suspension Worn or Loose. Slackness in the front suspension or a loose or broken rear spring can result in brake grab.

ADJUSTMENTS



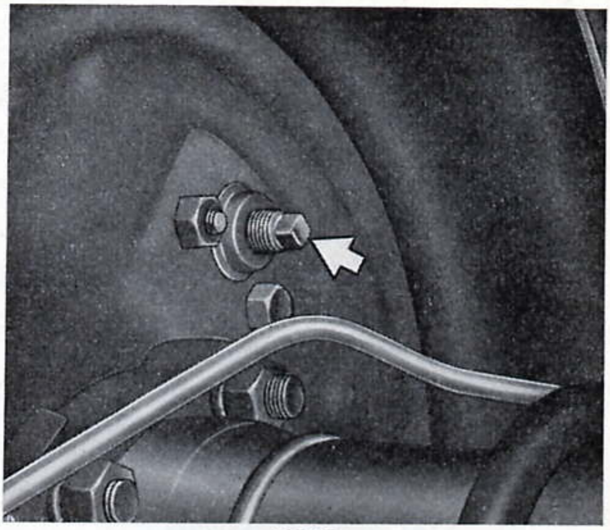


Fig. O.2. Brake shoe adjusters indicated by arrows. The adjusters are rotated clockwise to bring the shoes into contact with the drums

Brake Pedal Free Travel

To ensure correct operation of the master cylinder the pedal free travel must be maintained as specified, measured at the pedal pad. Adjustment is made as follows:

1. Ensure that the pull back spring returns the pedal smartly to the off position.

2. Slacken the push rod clevis locknut, and adjust the push rod to obtain the specified dimension. Retighten the locknut.

Footbrake

1. Set the parking brake lever to the off position.

2. Raise the front wheels clear of ground. Rotate the adjusters (Fig. O.2), clockwise (as viewed from the inside of the wheel), until the respective shoe facing is hard in contact with the drum, then back off the adjuster two notches to free the brake.

3. Raise the rear wheels clear of the ground and rotate the adjuster (Fig. O.2), clockwise until the brake is hard on, then back off two notches to free the brake.

Parking Brake

The parking brake is adjusted automatically with the footbrake, and normally no other adjustment is required. If, however, there is excessive travel of the parking brake lever after the footbrake has been adjusted, or if a cable has been renewed, adjust cables as follows:

1. Raise and support the rear of the vehicle and set the parking brake lever in the off position.

2. Adjust the brake shoes.

3. Remove the clevis pin connecting the cable bridle to the bell crank lever clevis.

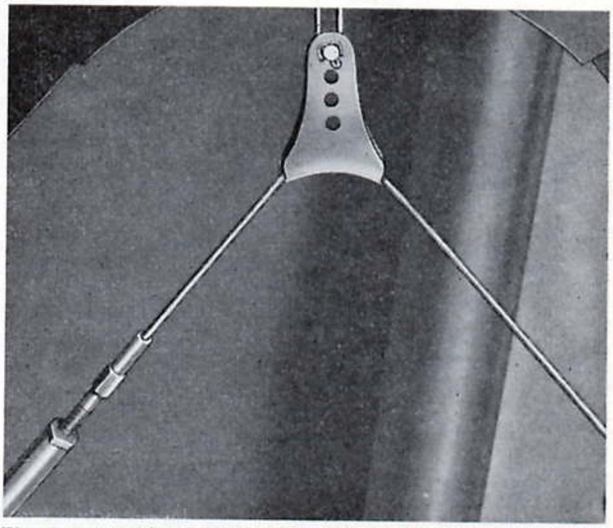


Fig. O.3. Parking brake cable adjusting sleeve and bridle. Note the three additional holes in the bridle for adjustment

4. Slacken the cable adjusting sleeve locknut (Fig. O.3), then holding the threaded rod, rotate the sleeve in the required direction so that the bridle, when pulled forward to take up the slack in the cable, has its first (front) hole aligned with the end of the clevis slot. Install the clevis pin.

5. Check that the brakes are not binding when the lever is in the off position, and are fully on when the lever is pulled on five or six notches.

6. Tighten the adjusting sleeve locknut.

7. If insufficient adjustment is available at the adjusting sleeve, it will be necessary to reset the adjustment so that the clevis pin is repositioned in the next hole in the bridle (Fig. O.3).

BLEEDING THE HYDRAULIC SYSTEM

The hydraulic system should require bleeding only if air has entered the system, due to a leak or the system being disassembled, or to excessively low fluid level in the master cylinder reservoir. Proceed as follows:

1. Remove the filler cap and filter.

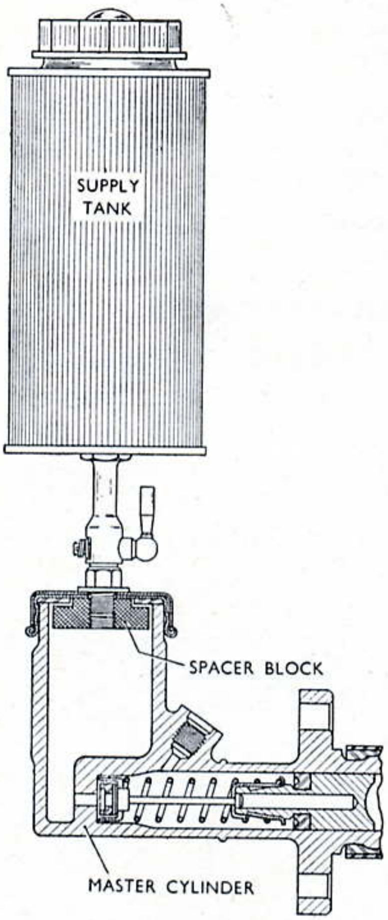


Fig. O.4. A supply tank as shown will ensure an adequate flow of fluid during bleeding. The tank can be constructed from a container of not less than 1 pint capacity, a suitable drain tap, a spare master cylinder filler cap and a spacer ·34 in. thick. The latter will ensure correct fluid level when the tap is turned off and the tank removed

2. Attach a supply tank (Fig. O.4), to the master cylinder reservoir and fill it with clean brake fluid free from aeration. The supply tank ensures that sufficient fluid is available to cover the reservoir outlet port during bleeding.

3. Back off the four front brake shoe adjusters to the limit of adjustment by rotating the adjusters anti-clockwise. Turn the rear brake shoe adjusters clockwise until the shoes contact the drums. This has the effect of reducing the capacity of the brake cylinders to the minimum and so facilitates bleeding.

4. Bleed each brake in turn, commencing with the one with the longest pipe run from the master cylinder and finishing with the one having the shortest, i.e. in the following sequence:

LEFT DRIVE	RIGHT DRIVE
Left-hand rear	Left-hand rear
Right-hand rear	Right-hand rear
Right-hand front	Left-hand front
Left-hand front	Right-hand front

The brake pedal operation during bleeding is most important. The pedal should be pumped in a series of one sharp application to the limit of its travel, followed by three short rapid strokes using the last third of the full pedal movement. The bleed screw should be tightened when the pedal is fully depressed. Rapid stroking of the pedal as described is more effective in expelling air from the system than a series of slow full strokes.

At this stage it is not essential that all air be removed from the system.

5. Repeat operation 4 keeping the same sequence. This time bleed until all air is exhausted.

6. Re-adjust the front and rear brake shoe clearances.

7. Apply foot pressure to the brake pedal, which should offer a firm resistance. Failure of the pedal to maintain its position against sustained pressure indicates the presence of air or leakage in the system. This must be corrected by further bleeding after an examination of the hydraulic system.

NOTE: *Brake fluid bled from the system must be discarded.*

8. Replace the filter and filler cap.

BRAKE PEDAL

Removal

1. Remove the clutch pedal (see Section E).

2. Remove the nut and lockwasher, and withdraw the brake pedal pad and stem. Detach the two grommets assembled between the top of the pedal and the toe panel.

3. On right drive models, unclip the fuel pipe from the master cylinder tie bar, and remove the tie bar.

4. Unhook the pedal pull back spring, and disconnect the master cylinder push rod clevis from the pedal. Remove the pedal.

Installation

Note the following:

1. Lubricate the pedal shaft with gear oil.

2. When installing the pedal grommets, fit the rubber grommet against the pedal.

3. Adjust the brake pedal free travel (page O-5).

MASTER CYLINDER

Removal

1. Unscrew the pipe union from the banjo connection on the master cylinder.

2. Disconnect the master cylinder push rod clevis from the brake pedal.

3. Remove the bolts and nuts attaching the master cylinder to the chassis frame. Withdraw the cylinder and push rod and seal the end of the pipe.

Disassembly

1. Remove the filler cap and filter.

2. Remove the rubber band from the dust cover and ease the cover off the end of the cylinder.

3. Withdraw the circlip and remove the push rod, retainer washer and dust cover as an assembly.

4. Withdraw the plunger and valve assembly from the cylinder. The assembly can usually be dislodged by a vigorous shake of the cylinder. An alternative method is to inject compressed air through the outlet port of the cylinder.

5. A spring retainer is held in position on the spigot end of the plunger by a tab, formed in the retainer, which engages a shoulder on the end of

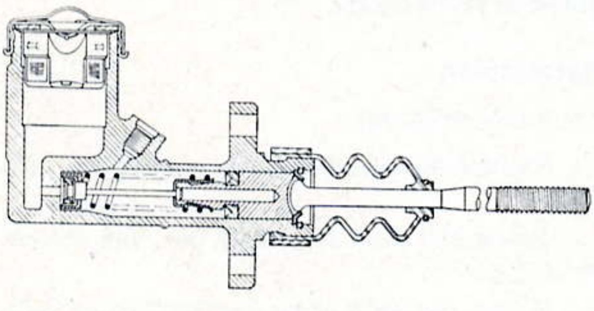


Fig. O.5. Master cylinder—sectioned view

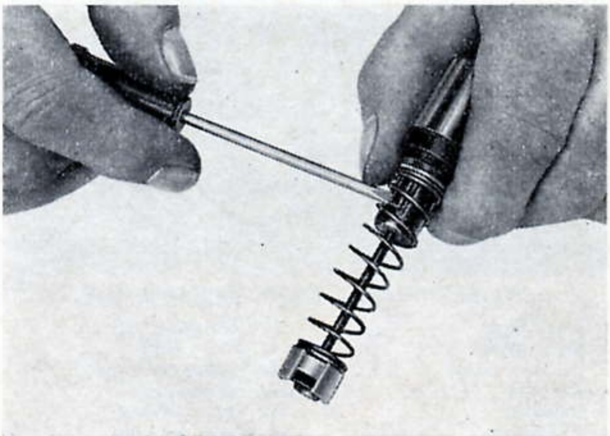


Fig. O.6. Prising the tab on the master cylinder spring retainer out of the spigot end of the plunger

the plunger. Prise up the tab (Fig. O.6) and remove the spring retainer, return spring and valve assembly from the plunger.

6. Release the valve stem from the spring retainer by compressing the spring and moving the stem in the direction of the slotted hole in the retainer.

7. Withdraw the valve stem from the valve spacer. Do not lose or damage the spring shim washer.

8. Carefully ease off the valve seal from the valve stem, and the gland seal from the plunger.

Inspection

1. Thoroughly clean all parts with Girling Cleaning Fluid.

2. Examine the cylinder bore and plunger for ridges or scores. If there is any doubt regarding the condition of the bore a new cylinder should be installed.

3. Both rubber seals should be renewed whenever a cylinder is disassembled. If the old seals show signs of swelling due to mineral oil contamination, the remainder of the brake system should be checked and flushed out with Girling Cleaning Fluid.

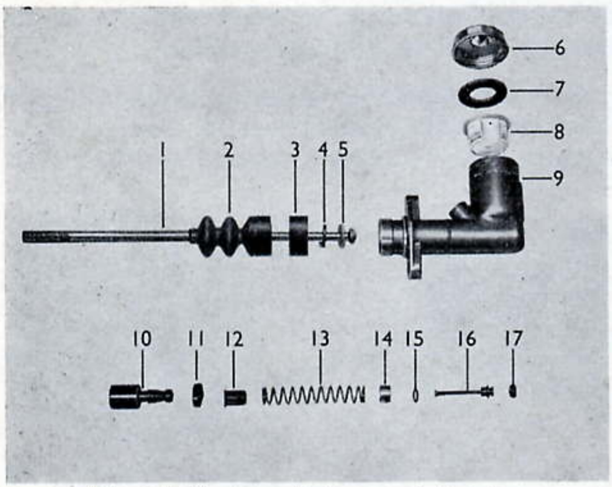


Fig. O.7. Master cylinder—exploded view

1. Push rod
2. Dust cover
3. Rubber band
4. Circlip
5. Washer
6. Filler cap
7. Gasket
8. Filter
9. Cylinder
10. Plunger
11. Gland seal
12. Spring retainer
13. Spring
14. Valve spacer
15. Shim washer
16. Valve stem
17. Valve seal

Reassembly

Note the following:

1. Assemble the valve seal, spring shim washer and valve spacer to the valve stem (Fig. O.8).

2. Locate a new gland seal on the plunger as shown in Fig. 0.9.

3. Assemble the spring with retainer to the valve stem and engage the end of the stem in the retainer.

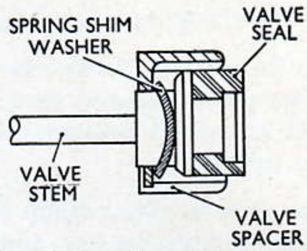


Fig. O.8. Sectioned view of master cylinder centre valve assembly showing correct location of spring shim washer

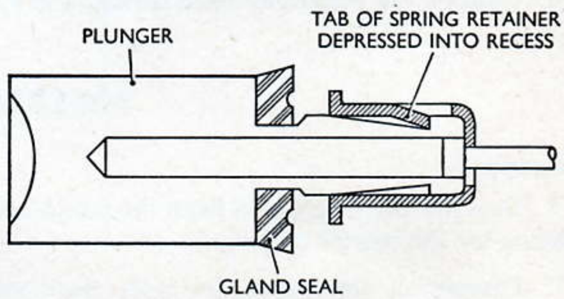


Fig. O.9. Sectioned view of master cylinder plunger and spring retainer

4. Locate the retainer over the end of the plunger then depress the retainer tab down into the recess on the plunger (Fig. O.9).

5. Smear the plunger and mouth of the cylinder with recommended grease. Insert the assembly into the cylinder, easing the seal lip carefully into the bore.

6. After installing the push rod and retainer washer, ensure that the circlip fully engages the groove in the cylinder.

Installation

Note the following:

1. Tighten the cylinder attaching bolts and nuts evenly.

2. Smear the push rod clevis pin with recommended grease.

3. Adjust the brake pedal free travel (page O-5).

4. Bleed the hydraulic system) page. O-6)

BRAKE HOSES

Removal

1. Replace the brake master cylinder filler cap with a slave cap on which the vent hole has been sealed (this will minimize fluid loss when the brake pipe is disconnected).

2. Unscrew the brake pipe to hose union.

3. Remove the hose locknut while holding the hexagon of the hose with a wrench.

4. Withdraw the hose from the bracket and seal the end of the pipe.

5. Unscrew the hose from the front brake cylinder, or three-way connector on the rear axle, using a wrench on the hose hexagon.

Installation

Note the following:

1. Use a new gasket and screw the hose tightly into the brake cylinder or three-way connector, before assembling the hose to the bracket.

2. Hold the hose with a wrench on the integral hexagon when tightening the locknut. *It is important that the hose is not twisted.*

3. After connecting the brake pipe, bleed the brakes (page O-6).

BRAKE DRUMS

Removal

NOTE: *The front brake drums are serviced as assemblies with the front hubs. The hub or the drum must not be renewed individually.*

1. Remove the road wheel and, when dealing with a rear drum, release the parking brake.

2. Remove the bolts securing the brake drum and withdraw the drum. If necessary, slacken off the brake shoe adjustment.

Inspection and Reconditioning

Slight ovality or scoring of the drum braking surface may be rectified by refacing, provided the internal diameter and maximum run-out do not exceed the specified limits.

When refacing a front brake drum, the drum must be assembled to its respective hub.

Installation

Note the following:

1. If the front hubs have been removed, refer to Section K for installation and adjustment details.

2. Ensure that the mating faces of the drum and hub or axle shaft flange are clean and free from burrs.

3. Adjust the brakes (page O-5).

BRAKE SHOES

IMPORTANT: *When handling brake shoes, always protect the facings against contamination.*

Removal

1. Ensure that the brake adjusters are in the fully off position.

2. Remove the brake drum securing bolts and withdraw the drum.

3. Remove the rear brake shoes as follows:

(*a*) Detach the spring clips retaining the brake shoes and remove the guide pins.

(*b*) Prise the leading shoe out of the adjuster (Fig. O.10) and withdraw both shoes and springs.

(*c*) Tie a length of wire around the brake cylinder and piston to prevent displacement of the piston.

4. Remove the front brake shoes as follows:

(*a*) Detach the spring clips retaining the brake shoes and remove the guide pins.

(*b*) Prise the trailing end of each shoe in turn out of the slot in the end of the respective cylinder and detach the return spring.

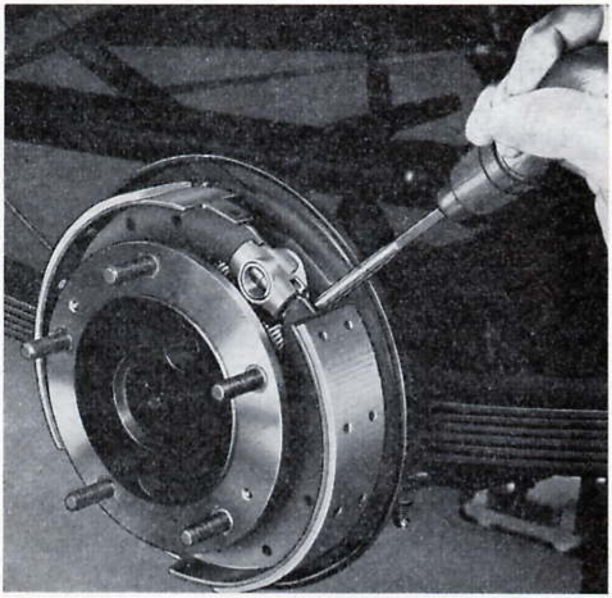


Fig. O.10. Releasing a rear brake leading shoe from the adjuster

(*c*) Tie a length of wire around each brake cylinder and piston to prevent displacement of the pistons.

Shoe Facing Renewal

1. The hydraulic method of brake operation provides full compensation and to ensure correct brake balance, only genuine facings must be used. The use of odd facings must be avoided.

2. Do not allow the facings to come in contact with oil or grease. Do not even touch the friction surfaces with the hands and never chamfer the ends of the facings. Failure to comply with these instructions will lead to persistent trouble with unbalanced braking.

Installation

Note the following:

1. Apply a thin film of recommended grease to the shoe contact pads on the brake flange plate.

2. Remove the wire used to retain the pistons.

3. On the front brakes, locate the return springs as shown in Fig. O.11.

4. On the rear brakes, locate the return springs as shown in Fig. O.12. The spring adjacent to the cylinder is located with the smallest number of coils towards the piston end of the cylinder.

5. Adjust the brakes (page O-5).

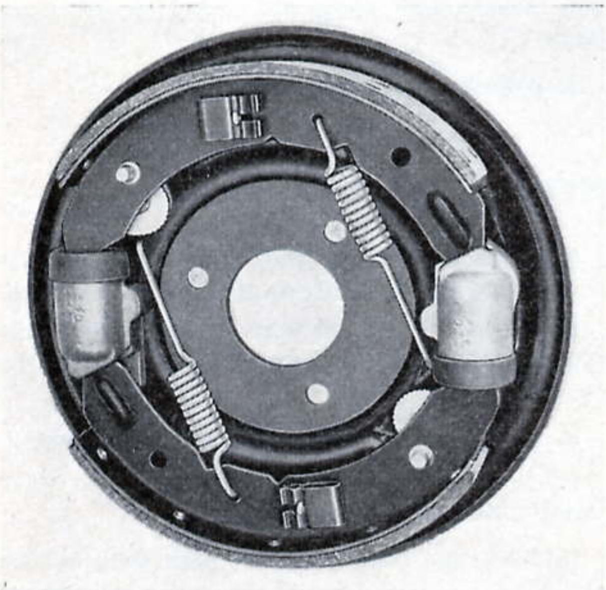


Fig. O.11. Front brake assembly

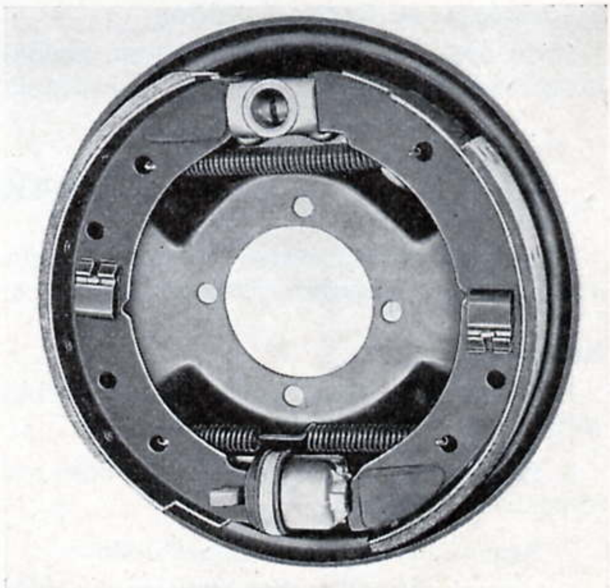


Fig. O.12. Rear brake assembly

FRONT BRAKE CYLINDERS

Removal

1. Replace the brake master cylinder filler cap with a slave cap on which the vent hole has been sealed (this will minimize fluid loss when the brake pipe is disconnected).

2. Remove the brake shoes (page O-9).

3. Remove the bridge pipe connecting the two cylinders.

4. For rear cylinder removal, disconnect the flexible hose.

5. Remove the bolts and lockwashers securing the cylinder to the flange plate and withdraw the cylinder, taking care of the sealing ring.

Disassembly

1. Remove the rubber dust excluder.

2. Withdraw the piston and seal, and spring from the cylinder.

3. Remove the bleeder screw (rear cylinder only).

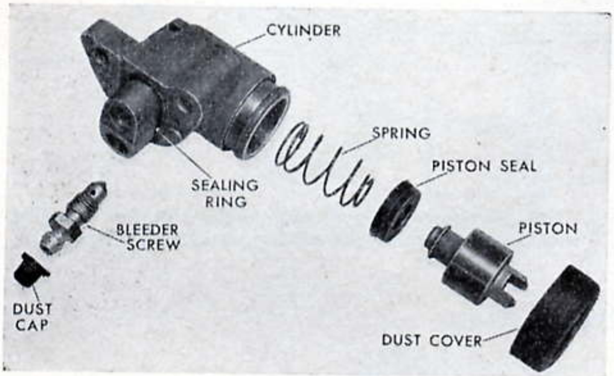


Fig. O.13. Front brake cylinder—exploded view
Note also that the smaller end of the spring is adjacent to the piston

Inspection

1. Clean the component parts with Girling Cleaning Fluid.

2. Examine the cylinder bore for ridges or scores. If there is any doubt regarding the condition of the bore, a new cylinder should be installed.

3. The piston seal should be renewed whenever a cylinder is disassembled. If the old seal shows signs of swelling due to mineral oil contamination, the remainder of the brake system should be checked and flushed out with Girling Cleaning Fluid.

Reassembly

1. Assemble a new seal to piston ensuring that the larger diameter is towards the inner end of the piston (Fig. O.13).

2. Smear the cylinder bore, piston and seal with recommended grease.

3. Locate the small end of the spring on the inner end of the piston. Ease the seal and piston into the cylinder and fit the dust excluder.

Installation

Note the following:

1. Place a new sealing ring on the cylinder around the pipe union boss, before assembling the cylinder to the brake flange plate.

2. When installing the left-hand flexible hose on right drive vehicles, make sure that the brake hose shield is correctly positioned on the underside of the anchor bracket.

3. Refer to page O-10 when installing the brake shoes.

4. Bleed and adjust the brakes (pages O-6 and O-5).

REAR BRAKE CYLINDERS

Removal

1. Replace the brake master cylinder filler cap with a slave cap on which the vent hole has been sealed (this will minimize fluid loss when the brake pipe is disconnected).

2. Remove the brake shoes (page O-9).

3. Disconnect the parking brake cable from the shoe lever.

4. Disconnect the banjo pipe connector from the cylinder body.

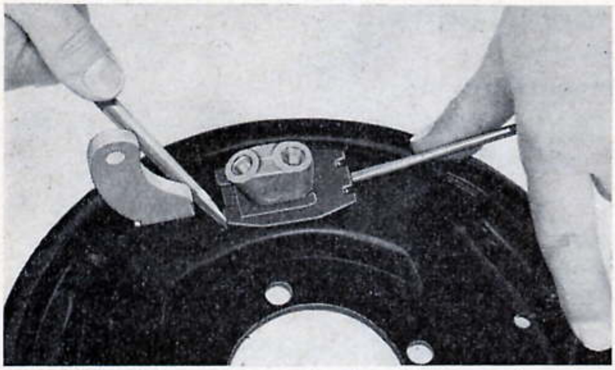


Fig. O.14. Prising up the rear brake cylinder retainer plate to release the locating tabs (brake assembly removed from vehicle for clarity of illustration)

5. Remove the bleeder screw.

6. Remove the dust cover from the brake plate.

7. Prise up the end of the retainer plate (Fig. O.14) sufficiently to disengage the tabs and remove the plate. Remove the parking brake operating lever, spring plate and locking plate. Loosen the brake flange plate attaching nuts, tilt the plate and withdraw the cylinder.

Disassembly

1. Remove the spring clip and withdraw the dust excluder.

2. Withdraw the piston and seal from the cylinder.

3. Remove the bleeder screw.

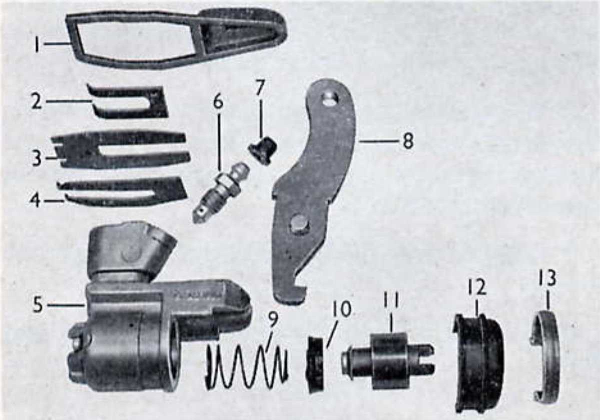


Fig. O.15. Rear brake cylinder and attaching parts—exploded view

1. Dust cover
2. Locking plate
3. Retainer plate
4. Spring plate
5. Cylinder
6. Bleeder screw
7. Dust cap
8. Parking brake shoe lever
***9. Spring**
10. Seal
11. Piston
12. Dust cover
13. Clip

* *Deleted on later models*

Inspection

1. Clean the component parts with Girling Cleaning Fluid.

2. Examine the cylinder bore for ridges or scores. If there is any doubt regarding the condition of the bore, a new cylinder should be installed.

3. The piston seal should be renewed whenever a cylinder is disassembled. If the old seal shows signs of swelling due to mineral oil contamination, the remainder of the brake system should be checked and flushed out with Girling Cleaning Fluid.

Reassembly

1. Assemble a new seal to the piston, ensuring that the larger diameter is towards the inner end of the piston (Fig. O.15).

2. Smear the cylinder bore, piston and seal with recommended grease.

3. Ease the seal and piston into the cylinder and fit the dust excluder and spring clip.

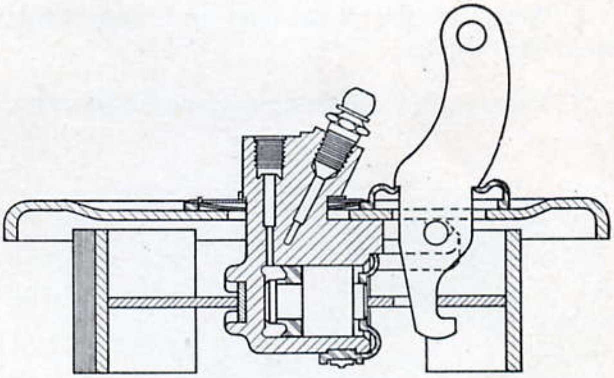


Fig. O.16. Sectioned view of rear brake cylinder showing attachment details and parking brake shoe lever

Installation

Note the following:

1. Apply a thin film of recommended grease to both sides of the brake flange plate where the cylinder slides, and on the parking brake shoe lever fulcrum pin.

2. Assemble the parking brake shoe lever with its hooked edge away from the brake cylinder.

3. Locate the cylinder in the flange plate and install the spring plate and the locking plate from the lever side of the cylinder with the convex side of the spring towards the flange plate (Fig. O.15).

4. Hold the two plates in position and insert the retaining plate between both plates, from the opposite side to the lever, until the tabs on the spring plate engage the slots in the retaining plate.

5. Ensure that the brake shoe engages the recess in the brake cylinder piston.

6. Assemble the brake springs as shown in Fig. O.12. Note that one spring has two coils of unequal length.

7. Before connecting the brake pipe, locate the dust cover over the cylinder boss and shoe lever.

8. Bleed and adjust the brakes (pages O-6 and O-5).

REAR BRAKE SHOE ADJUSTERS

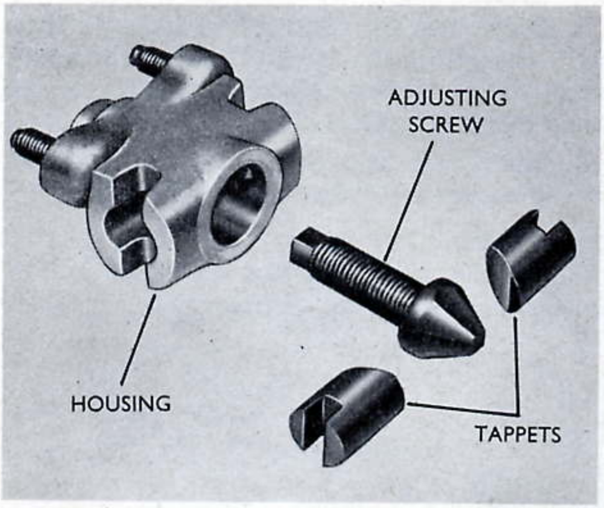


Fig. O.17. Rear brake shoe adjuster—exploded view

Removal

1. Remove the brake shoes (page O-9).

2. Remove the two nuts and lockwashers securing the adjuster to the flange plate and withdraw the adjuster.

Disassembly

1. Withdraw the tappets from the adjuster housing.

2. Unscrew the adjusting screw from the housing.

Reassembly

Smear the tappets and adjusting screw with recommended grease, and reverse the operations for disassembly.

Installation

Reverse the operations for removal, and adjust the brakes (page O-5).

PARKING BRAKE BELL CRANK LEVER

Removal

1. Working underneath the vehicle, disconnect the parking brake lever link and the cable bridle clevis from the bell crank lever.

2. Remove a split pin from one end of the bell crank lever fulcrum pin. Withdraw the pin and bell crank lever.

Installation

Note the following:

1. Ensure that the lever moves freely on the fulcrum pin and check that the pin is retained each end by a new split pin.

2. Check the operation of the parking brake, and adjust if necessary as described on page O-5.

PARKING BRAKE CABLES

Removal

1. Separate the cables by unscrewing the adjusting sleeve from the threaded rod.

2. Disconnect each cable clevis from the parking brake shoe levers and remove the clevises from the cables.

3. Withdraw the cables through the cable guides and the long cable through the bridle.

Installation

Note the following:

1. Install the short cable on the right-hand side of the vehicle.

2. Lubricate the guides, clevises and bridle with recommended grease.

3. Adjust the parking brake (page O-5).

PARKING BRAKE LEVER

Removal

1. Disconnect the parking brake lever link from the bell crank lever.

2. Remove the bolts attaching the two fulcrum brackets to the floor. Remove the parking brake lever assembly, withdrawing the link through the grommet in the floor aperture.

Disassembly

1. Remove the two bolts and nuts then detach the fulcrum brackets to release the parking brake lever and sector, also the four distance pieces. Withdraw the sector, and the fulcrum pin from the end of the lever.

2. Unhook the pawl spring, and remove the clevis pin attaching the link and pawl to the lever.

3. File down and punch out the rivet attaching the pawl to the pawl link.

4. Where necessary, remove the pin and sleeve securing the pawl trigger to the parking brake lever, and the rivet connecting the trigger to the pawl link.

Reassembly

Note the following:

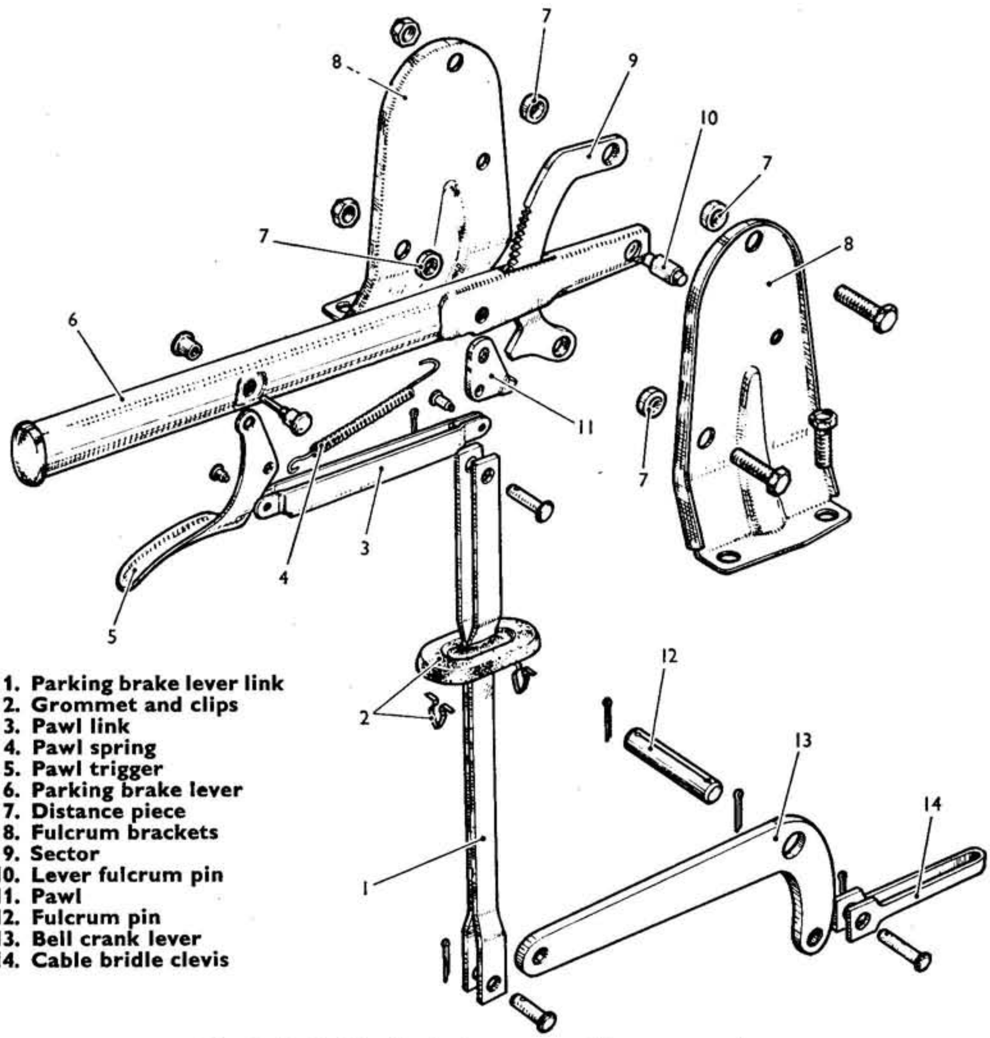
1. After assembling the pawl and link to the parking brake lever, operate the trigger and check for free movement.

2. Ensure that the parking brake lever fulcrum pin is engaged in the bracket holes and that two distance pieces are located between the sector and each bracket (Fig. O.18).

3. Operate the lever and check the pawl teeth for full engagement with those of the sector.

Installation

Check the parking brake operation and if necessary adjust the cables (page O-5).



1. Parking brake lever link
2. Grommet and clips
3. Pawl link
4. Pawl spring
5. Pawl trigger
6. Parking brake lever
7. Distance piece
8. Fulcrum brackets
9. Sector
10. Lever fulcrum pin
11. Pawl
12. Fulcrum pin
13. Bell crank lever
14. Cable bridle clevis

Fig. O.18. Parking brake lever assembly components

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FOREWORD

This group of the manual provides comprehensive information on the Suspension, Steering and Brakes of the Bedford CA, Mark 2.

Contents. The main subjects dealt with are listed on page iii. An individual index is provided on the first page of each section, and a general index is included at the end of this group.

General Notes. Recommendations on important general items which must be observed whenever service work is undertaken are collated under 'General Notes' on page vii. It is important that servicemen should become familiar with all of these points.

Recommended Lubricants. Lubricants approved and recommended for use in the United Kingdom and Overseas are listed at the end of this group.

Guardian Maintenance. The notes included under this heading in appropriate sections are confined to service procedure. For further information, reference should be made to the Guardian Maintenance booklet supplied with the vehicle.

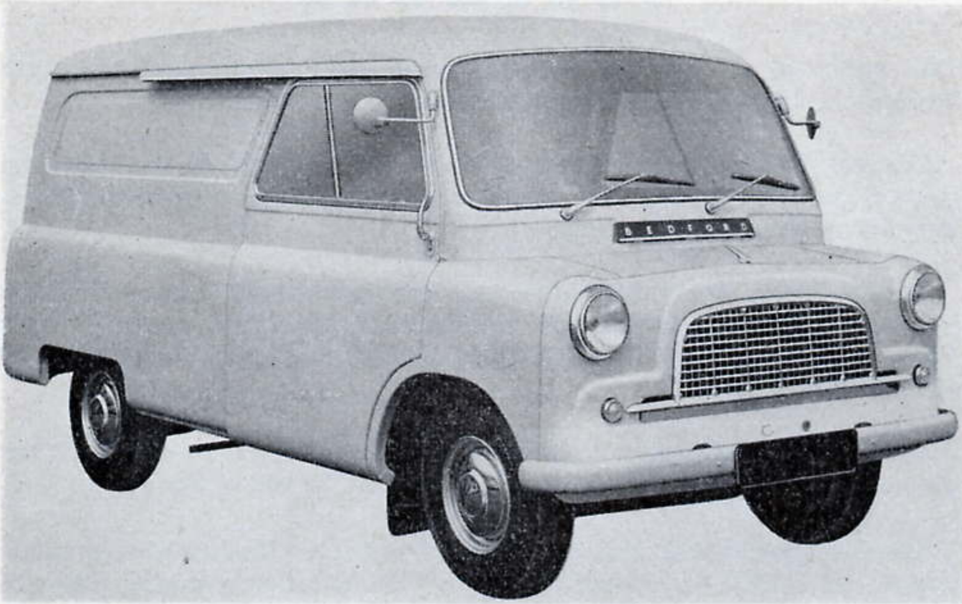
Riteway Service Tools. Reference is made throughout the manual to tools designed to facilitate service operations. All of these tools are illustrated in use.

Tools which carry a prefix 'Z' to the tool number are available to Authorized Dealers from the Parts and Accessories Department, Vauxhall Motors Limited, Dunstable, Beds.

Tools prefixed 'D' are supplied by various Factors and orders should be addressed to the Service Department, Route 2494, Vauxhall Motors Limited, Luton, Beds.

An 'SE' prefix to the number indicates that the tool must be manufactured locally. Detail drawings of 'SE' tools may be obtained from the Service Department, Route 2494.

MODEL DESIGNATIONS



CAS	..	90 in. wheelbase	Chassis No.	10/12 and 15/17 cwt.
CAL	..	102 in. wheelbase	350000 onwards	Chassis and Van

LOCATION OF MODEL IDENTIFICATION PLATE AND ENGINE NUMBERS

A plate on which is stamped the model identification letters and numbers, is attached to the footwel panel, inside the body, adjacent to the steering column.

The engine number is stamped in the following locations. On diesel-engined vehicles: on the top edg of the facing on the cylinder block to which the fuel injection pump is attached. On gasoline-engine vehicles: on a pad on the crankcase adjacent to the fuel pump.

GENERAL NOTES

Safety Precautions

Isolation of Battery

Always disconnect the battery before commencing operations where there is the slightest possibility of accidental engagement of the starter or the danger of a short circuit. Neglect to take this precaution may result in personal injury and the risk of fire.

Jacking

To prevent damage, the following precautions should be taken when jacking up and supporting the vehicle on stands.

1. When jacking up the front of the vehicle on the front axle crossmember, a block of wood should be interposed between the jack and the crossmember.

2. When jacking up the rear of the vehicle, ensure that the jack pad is in the centre of the axle housing and that any projections on the pad are not fouling the housing rear cover and taking the weight.

3. Support the vehicle on stands located below the chassis frame sidemembers.

Bearing Service (Ball and Roller)

Bearings that have been in service, excluding sealed types, must be thoroughly cleaned before they are inspected. Wash the bearings in clean flushing oil or white spirit and then blow out with compressed air. *Do not allow the air stream to spin the bearing, otherwise the rotating surfaces will be damaged.* Immediately after cleaning, lubricate the bearings with clean engine oil.

Examine the bearings for corrosion caused by the entry of water, and for discoloration (blueing) resulting from overheating. A light brown discoloration may be due to lubricant stain and is not detrimental.

When rotating the bearings to check for wear or damage, apply axial pressure to bring the balls or rollers firmly into contact with the races. Single-row radial bearings normally have a certain amount of end float when removed from a unit.

Absolute cleanliness is essential during inspection, and when reassembling bearings to units to avoid contamination with abrasive substances, otherwise the highly polished mating surfaces will be damaged, thus increasing the rate of wear.

Cleanliness of Components

Clean all components prior to inspection for wear or damage, but do not wash sealed bearings in solvent or place in a degreasing plant.

Identification of Components

When components are removed it is sometimes necessary to identify their locations relative to other parts, also to ensure that mated surfaces are correctly related on reassembly.

Some components have mating marks stamped on them during manufacture. In the absence of such marks, however, care must be taken in the method of identification employed. The location of two housings, for example, could be identified by centre-punching or with file marks, *but this treatment if applied to a stressed compound such as a steering arm could lead to fatigue failure.* Generally, the safest and most satisfactory method is to mark with a quick-drying paint.

Expendable Items

Whenever a unit is disassembled, renew all gaskets, oil seals, split pins, circlips, lockwashers and tab washers where applicable. Not all nuts and bolts are equipped with lockwashers. When in doubt on usage, refer to the Parts Catalogue.

Specifications

Refer to 'Specifications' at the end of a section for dimensional and other data for use when assessing component wear and when making adjustments. Unless otherwise stated, the dimensions given are the manufacturing limits for new parts.

Recommended Lubricants

The references to lubricants in the manual text are in general terms only. In all cases the list of 'Recommended Lubricants' at the end of the manual should be consulted for grades and specifications. This list includes particulars of lubricants to be used during initial assembly.

Use of Torque Wrench

Certain nuts and bolts must be tightened to a specified torque. These are listed under 'Specifications' at the end of each section. Bolts and nuts which have been tightened beyond the prescribed torque wrench figures, should not merely be slackened off to the correct figure, as they may work loose. The correct procedure is *that the bolt or nut should be loosened until free of all stress and then retightened to the correct figure.*

Screw Threads

The nuts, bolts and studs used on units of Vauxhall manufacture have threads of the Unified Thread Form. These threads closely resemble our previous usage of the American National Form thread and for practical purposes are interchangeable. Nuts or bolts with any other form of thread cannot be interchanged.

The wrenches for use on Unified-threaded nuts and bolts are listed below.

Wrench Sizes for Unified Nuts and Bolts

Bolt diameter in inches		$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$*	$\frac{1}{2}$	$\frac{9}{16}$*	$\frac{5}{8}$	$\frac{3}{4}$
Wrench sizes in inches across flats	Nut	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{11}{16}$	$\frac{3}{4}$	$\frac{7}{8}$	$\frac{15}{16}$	$1\frac{1}{8}$
	Bolt	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{13}{16}$	$\frac{15}{16}$	$1\frac{1}{8}$

NOTE: *For bolt diameters indicated* (*) *the hexagon size is greater for the nut than for the bolt.*

SECTION K—FRONT AXLE AND SUSPENSION

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Have you read the General Notes on page vii?

DESCRIPTION

The independent front suspension incorporates coil springs, telescopic shock absorbers and long and short arms mounted on a pressed steel crossmember which is bolted to the chassis frame through rubber insulators. A stabilizer bar is rubber mounted in two brackets attached to the chassis frame sidemembers. The cranked ends of the bar are connected to the suspension lower arms by rubber bushed links.

The suspension arms pivot on threaded fulcrum shafts through hexagon-headed bushes which have internal and external threads, the latter locking the bushes in the arms. The hexagonal end of the bushes provides a lubricant reservoir which can be recharged via the nipples in the bushes. Sleeve-type oil seals are located on the shafts between the arms and the crossmember. Rubber rebound and bump stops are assembled to the upper and lower suspension arms respectively. The fulcrum shafts are screwed and friction locked into the crossmember and the lower shafts are also fitted with a locknut at the rear end.

The outer ends of the upper arms are fitted with adjustable ball joints which have tapered shanks for attachment to the steering knuckles. The outer ends of the lower arms incorporate bronze bushed trunnions which support the king pins. The king pins are fitted with a nylon thrust washer below the trunnion and is secured by a slotted nut and locknut. An oil seal ring is assembled between the knuckle and the trunnion bush boss.

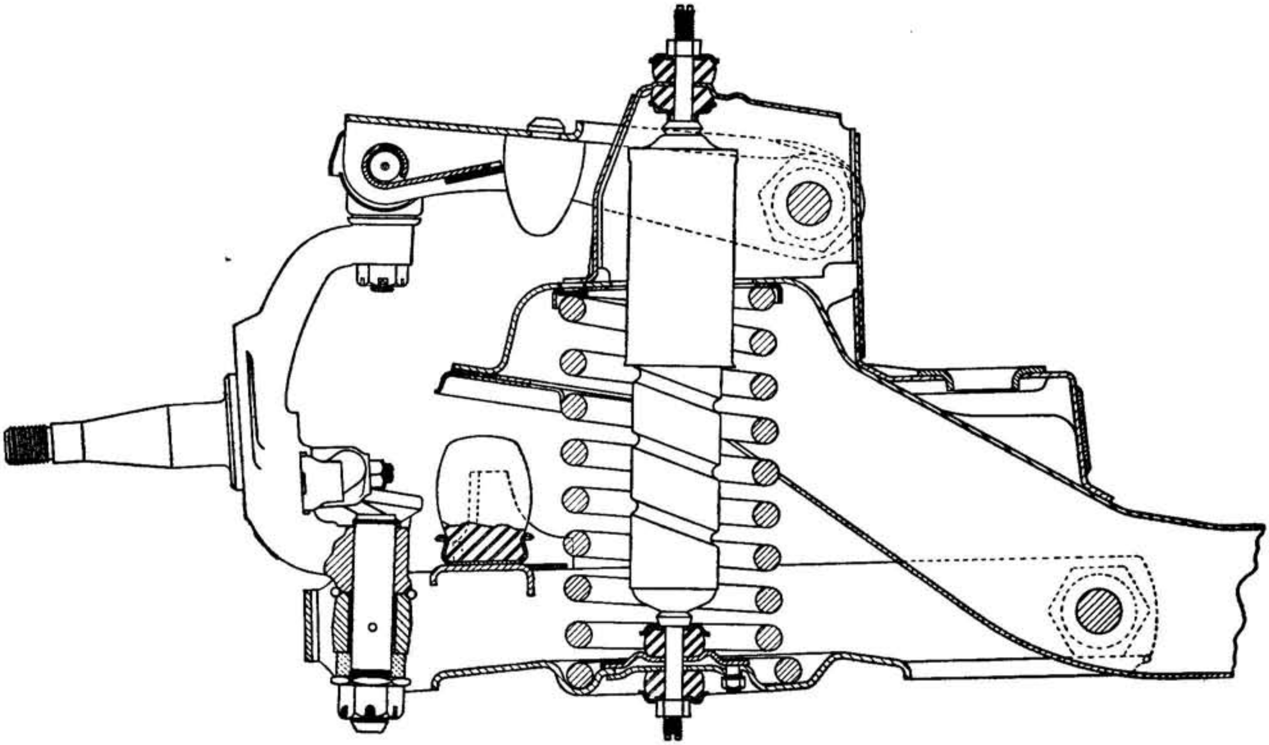

Fig. K.1. Sectioned view of front suspension unit

GUARDIAN MAINTENANCE

Front Suspension

There are ten lubrication nipples, including the steering pivots, on the front suspension arms, four each side facing forward and one each side in the rear of the lower fulcrum shaft. Clean and examine each nipple seating for damage and if necessary, renew the nipples.

Front Hub Bearings

The front hub bearings are of the taper roller type and are packed with grease during assembly to the hub. The grease is retained in the hub by a steel cap on the outer side of the hub, and a seal pressed in the inner side. It is important to use only the recommended grease when repacking the hub bearings. Other grease may melt and find its way on to the brakes.

To lubricate the bearings proceed as follows:

1. Remove the hub and drum (page K-5).

NOTE: *It is not necessary to remove the bearings from the hub unless the grease in the hub is contaminated by water or other foreign matter, in which case the bearings and seal must be renewed.*

2. Pack the races and rollers with recommended grease. *Do not pack the hub with grease* as this may result in the grease working out on to the brake facings.

3. Clean off the hub nut and washer and adjust the bearings (page K-5).

4. Adjust the brakes (page O-5).

FRONT END STANDING HEIGHT CHECK

This check must be made with the vehicle unladen and standing on a level floor.

1. Check and if necessary, correct the front and rear tyre pressures.

2. As the front end standing height is influenced by the condition of the rear springs, the rear end should be checked and adjusted where necessary, as follows:

(*a*) Observing the precautions noted on page vii, jack up centrally under the front crossmember until the road wheels are just clear of the floor. This will prevent any height irregularities at the front affecting the rear end.

(*b*) Measure the vertical height from the floor to the centre of each rear spring rear shackle upper bolt. These heights should not differ more than ·50 in. If the difference exceeds this amount, raise the lower side by inserting suitable packing under the tyre to bring the heights within the ·50 in. limit.

(*c*) Remove the jack from under the front crossmember.

3. Bounce the front end of the vehicle by hand several times and allow it to settle to normal height.

4. Measure the vertical height from the floor to the centre of each suspension lower fulcrum shaft (Fig. K.2). The heights should be within the specified limits. No adjustment is possible and where necessary, a new spring or springs must be installed.

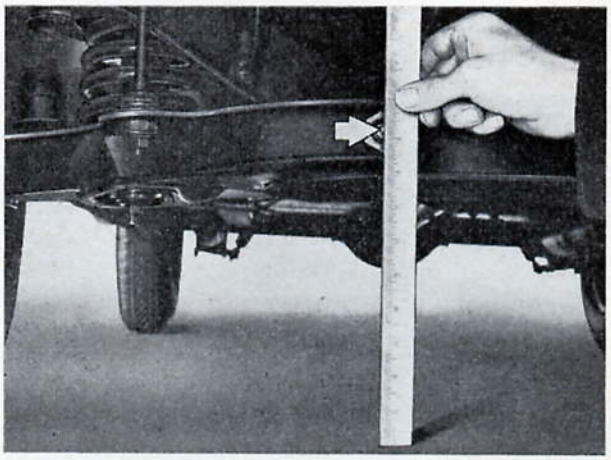

Fig. K.2. Checking the front end height

STEERING GEOMETRY

Steering Geometry Checks and Adjustments

The items included in checking steering geometry are: toe-in, camber and steering pivot inclination, castor and toe-out on turns.

There are several different types of equipment for checking steering geometry, and the respective manufacturer's operating instructions must be followed to obtain accurate readings. Irrespective of the type of equipment used, all checks must be made with the vehicle at the correct standing height.

To ensure that the steering geometry is not influenced by adverse conditions of maintenance it is recommended that the following items are checked, and corrected if necessary.

1. The front and rear tyre pressures.

2. Front hub bearing adjustment.

3. The suspension arm bushes, king pins and ball joints for slackness.

4. All joints on the steering connecting rods and the tie rod for slackness (page M-4).

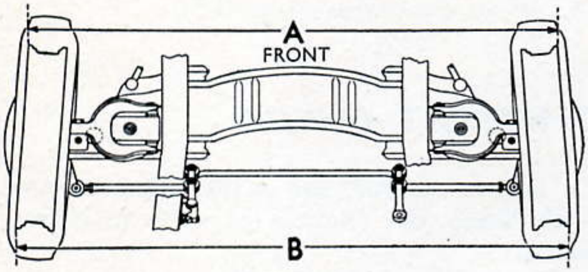

Fig. K.3. Front wheel toe-in. The specified toe-in equals 'B' minus 'A'

Toe-in (Fig. K.3)

1. Set the steering wheel in the straight-ahead position, i.e. *mid-point of its rotation from extreme left to right lock*, and push the vehicle forward a yard or so.

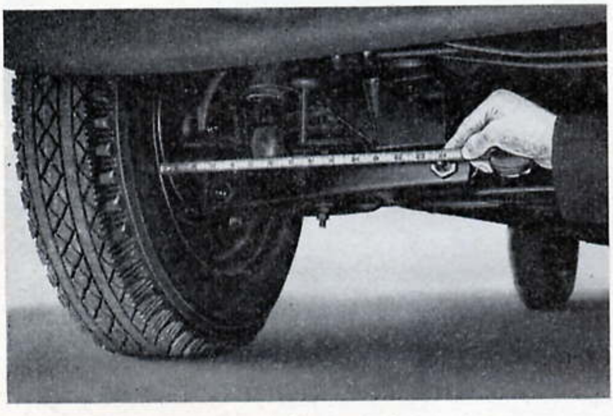

Fig. K.4. Checking the horizontal distance between the wheel rim and the suspension lower arm lubrication nipple

Now check if the road wheel on the driver's side is in the straight-ahead position by measuring the horizontal distance from the rim of the road wheel to the suspension lower arm fulcrum shaft lubrication nipple (Fig. K.4). The dimension should be 14·00 in. on right drive models and 13·80 in. on left drive models. Where necessary adjust the length of the connecting rod on the *driver's side* to give this setting. This will ensure that the toe-in

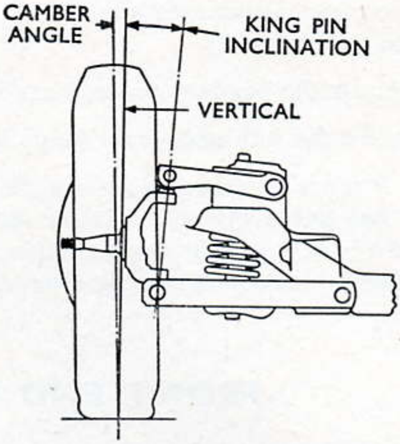

Fig. K.5. Camber angle and king pin inclination

setting is equally divided between the two connecting rods.

2. Make any further adjustment necessary to correct the toe-in by adjusting the length of the connecting rod on the *opposite side to the driver*. Tighten the locknuts. If the toe-in error is excessive it may be due to a bent steering arm, connecting rod or tie rod.

Camber Angle and King Pin Inclination (Fig. K.5)

If the camber and the steering king pin inclination angles are outside the specified limits this will indicate distorted suspension arms or mountings. Should the king pin inclination be within the limits but the camber angle outside the limits this will indicate that the steering knuckle is distorted.

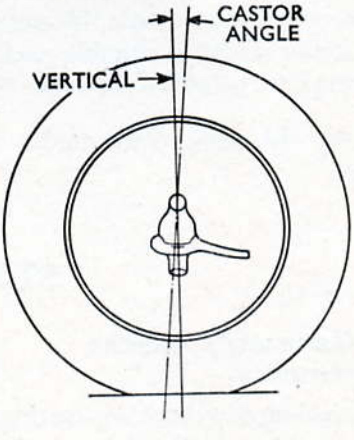

Fig. K.6. Castor angle

Castor Angle (Fig. K.6)

If the castor angle is incorrect the error may be due to one or more of the following:

(*a*) Incorrect location of suspension arms relative to crossmember (Figs. K.30 and K.35).

(*b*) Distorted suspension arm/s, axle crossmember, or crossmember mounting brackets.

(*c*) Distorted chassis sidemembers.

Toe-out on Turns (Fig. K.7)

Toe-out on turns is controlled by the angle of the steering arms. If the readings do not come within the specified limits this will indicate that one or both of the arms are distorted.

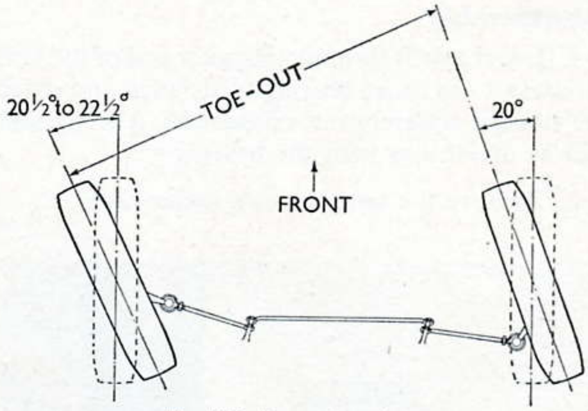

Fig. K.7. Toe-out on turns

FRONT HUBS

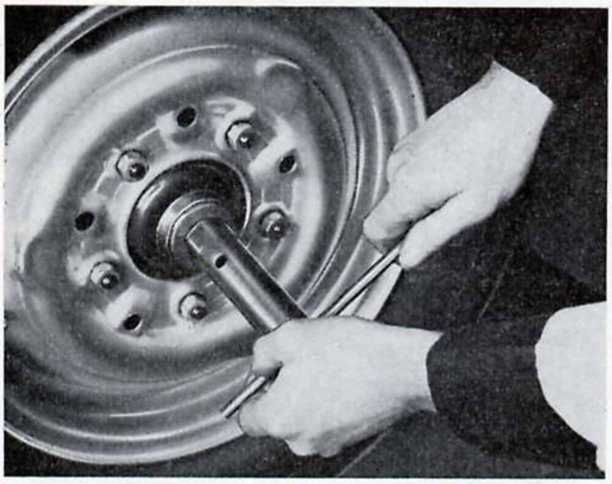

Fig. K.8. Initial tightening of the front hub nut, using a tube wrench and bar

Bearing Adjustment

1. Raise and support the front of the vehicle.

2. Check that the brakes are not binding.

3. Rock each road wheel to check for slackness in the bearings. Where the movement is excessive, remove the hub and brake drum and examine the bearings. If only slight rocking movement is perceptible, adjust the bearings as follows:

4. Remove the grease cap.

5. Remove the hub nut split pin, then tighten the nut using a tube wrench and bar (Fig. K.8).

6. Slacken the nut and remove the bar, then gripping the wrench by hand retighten the nut (Fig. K.9).

7. Where necessary, turn the nut back to align its slots with a split pin hole and install a new split pin.

8. Refit the hub grease cap and hub cover.

Removal

1. Raise and support the front of the vehicle and remove the road wheel.

2. Remove the hub grease cap, split pin, hub nut and keyed washer.

3. Withdraw the hub and drum. In some instances, it may be necessary to slacken the brake shoe adjustment before the assembly can be removed.

4. Remove the inner bearing abutment ring from the steering knuckle spindle.

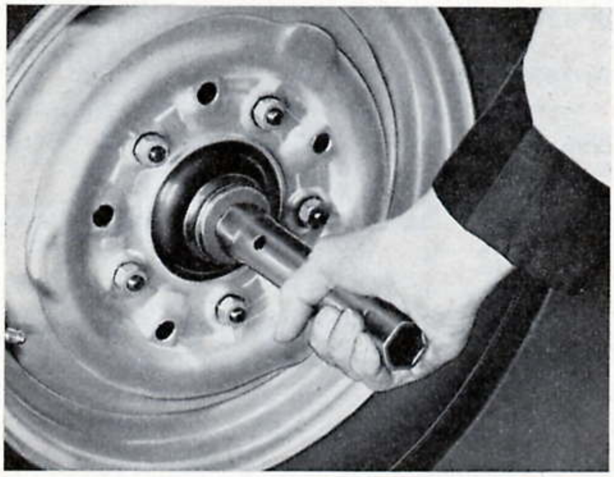

Fig. K.9. Final tightening of the hub nut by hand

Disassembly

1. Insert a drift through the outer end of the hub to contact the inner bearing outer race and drive the bearing squarely out of the hub. The oil seal will be driven out with the bearing.

2. Remove the outer bearing outer race.

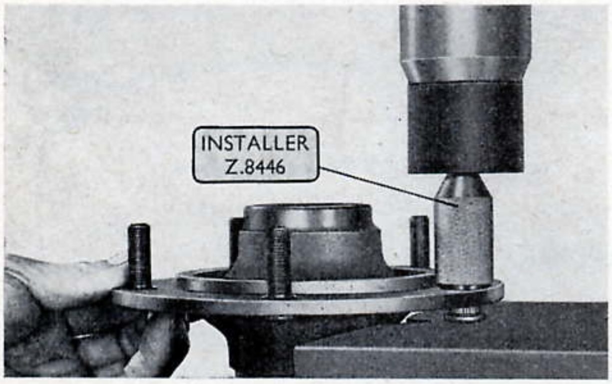

Fig. K.10. Pressing in a new hub bolt

Inspection and Reconditioning

1. Thoroughly clean all parts. For cleaning and inspection of bearings, see under 'General Notes' on page vii.

2. Where necessary, renew the hub bolts as follows:

(*a*) Remove the brake drum.

(*b*) Support the hub flange adjacent to the bolt head and press out the bolt.

(*c*) Engage the splines of the new bolt with the splines in the bolt hole and press home (Fig. K.10).

(*d*) Invert the installer and peen the bolt shoulder down into the bolt hole countersink (Fig. K.11).

(*e*) Clean the attachment faces and refit the drum.

Reassembly

1. Assemble the bearing outer races, wide end first, squarely into the hub. Be sure each race is right home against its locating shoulder. Before assembling the outer bearing outer race ensure the circlip is correctly located in its groove.

2. Pack the inner bearing race and rollers with recommended grease and position it in the outer race. *Do not pack the hub with grease.*

3. After greasing the felt, press in the oil seal, chamfered periphery first, until it is flush with the inner end of the hub.

Installation

Note the following:

1. Place the inner bearing abutment ring, chamfered end of bore first, on to the steering knuckle spindle and smear the inner bearing surface on the knuckle with grease. Reassemble the hub and drum assembly to the steering knuckle spindle.

2. Pack the outer bearing race and rollers with recommended grease and position it on the spindle. Fit the keyed washer and hub nut.

3. Adjust the hub bearings (page K-5).

4. Check brake adjustment (page O-5).

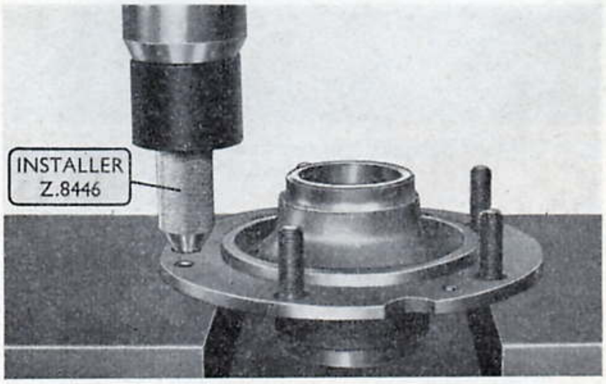

Fig. K.11. Peening the shoulder of a new hub bolt

FRONT STABILIZER

Removal

1. Remove the bolts attaching the stabilizer shaft brackets to the chassis. Remove the brackets and rubber insulators.

2. Unscrew the nuts, attaching the stabilizer links to the suspension lower arms, and withdraw the bottom cups and rubber bushes.

3. Lift away the shaft and links.

4. Disconnect the links from the shaft, remove the inner cups and rubber bushes from each link.

Installation

Tighten the link nuts to the end of the thread on the link.

FRONT SHOCK ABSORBERS

Removal

1. Raise and support the front of the car.

2. Unscrew the nut from the bottom stud of the shock absorber, and detach the cup and rubber bush.

3. Remove the nut and lockwasher, adjacent to the stud, and withdraw the lower retainer plate.

4. Contract the shock absorber to allow the upper retainer plate to be withdrawn. The plate must be tilted before it can be removed (Fig. K.12).

5. Remove the nut, cup and rubber bush from the shock absorber top stud and withdraw the shock absorber.

6. Remove the inner rubber bushes and cups.

Installation

Note the following:

1. Assemble the shock absorber attaching components as shown in Fig. K.1.

2. Tighten the nuts to the end of the stud threads to obtain correct compression of the rubber bushes.

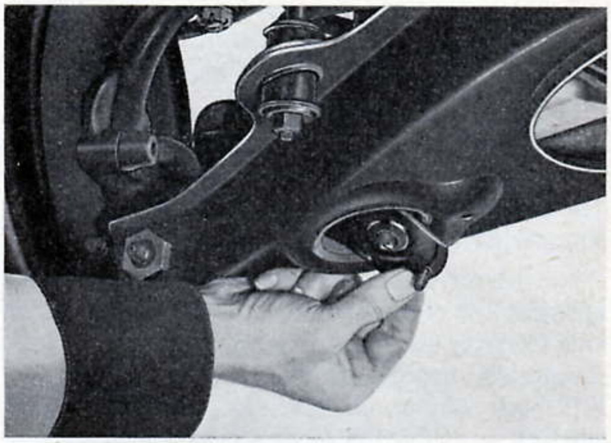

Fig. K.12. Removing the shock absorber inner retaining plate

FRONT SPRINGS

Removal

1. Raise and support the front of the vehicle. The front road wheels should be raised sufficiently to enable the spring compressor to be inserted from below the axle.

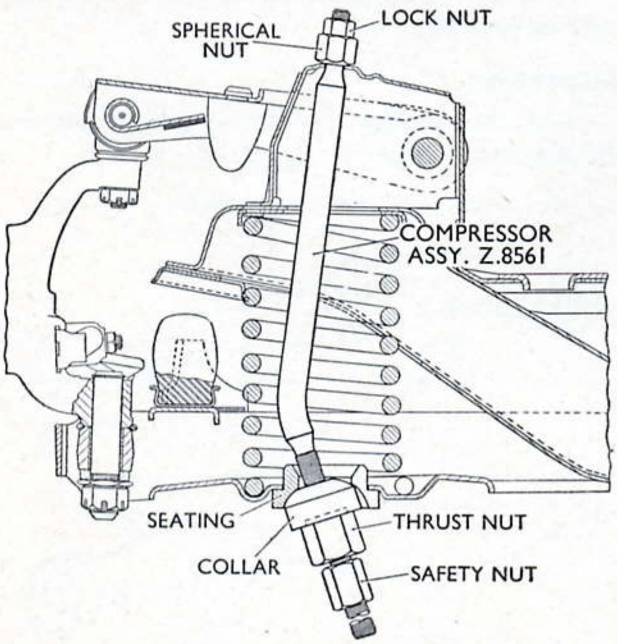

Fig. K.13. Operating position of spring compressor. The compressor screw must be positioned as shown

2. Remove the front hub and brake drum (page K-5).

3. Remove the bolts securing the brake flange plate. Two of the bolts also secure the steering arm which should be moved to one side. Carefully withdraw the flange plate over the wheel spindle and support so that it is clear of the suspension unit.

4. Disconnect the stabilizer link from the suspension lower arm.

5. Remove the shock absorber.

6. Using the compressor, shown in Fig. K.13, compress the spring as follows:

(*a*) Lubricate the compressor screw threads and the concave face of the seating, then insert the screw through the suspension lower arm and guide it through the top of the shock absorber housing.

(*b*) Screw the spherical-ended nut home to the end of the thread at the top of the compressor screw, and secure with the locknut.

(*c*) Position the spigot side of the compressor seating in the aperture of the lower arm with the large slot in the seating facing inwards.

(*d*) Make sure the compressor screw is maintained in the position shown in Fig. K.13 during compression and release of the spring and keep the safety nut within a few threads of the thrust nut at all times.

7. Compress the spring until there is just a slight load on the rubber rebound stop; this will assist in releasing the ball joint from the steering knuckle.

8. Remove the split pin and partially unscrew the nut from the upper arm ball joint. Release the ball joint taper in the steering knuckle by striking the knuckle boss with a copper hammer, then remove the ball joint nut.

9. Unscrew the compressor thrust nut until the spring is free of compression. Remove the two top nuts from the compressor screw and withdraw the compressor and the spring.

If both springs are removed, each should be labelled to enable them, if serviceable, to be installed in their original positions.

Installation

Note the following:

1. Place the flat end of the spring into the cross-member and install the compressor as detailed under 'Removal', making sure the compressor screw is located as shown in Fig. K.13.

2. Before compressing the spring, locate its bottom coil in the suspension lower arm depression and align the spring end with the hole in the arm. Check that this alignment is maintained during the initial stage of spring compression.

3. Assemble the seal and retainer to the steering knuckle ball joint.

4. Ensure that the upper arm ball joint taper and the hole in the steering knuckle boss are perfectly clean and free from grease before re-connecting the joint.

5. When connecting the stabilizer link, tighten the attaching nut to the end of the link thread.

STEERING ARMS

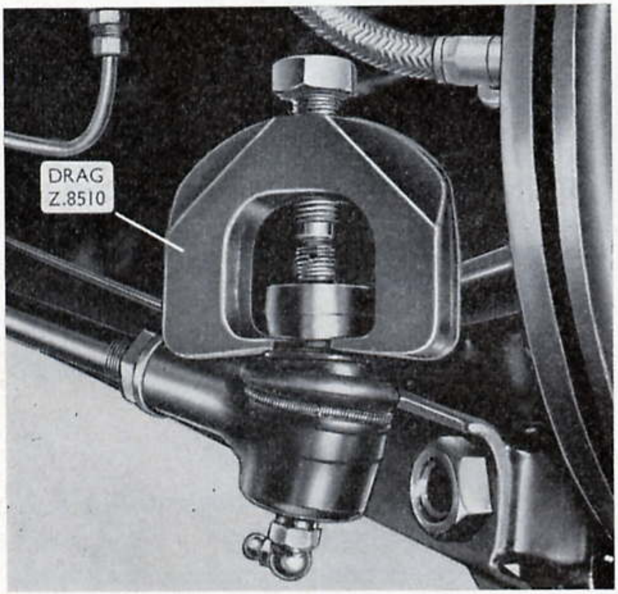

Fig. K.14. Drag positioned prior to disconnecting a steering connecting rod ball joint

Removal

1. Remove the front hub and brake drum (page K-5).

2. Disconnect the connecting rod from the steering arm (Fig. K.14).

3. Remove the bolts securing the arm to the steering knuckle.

Inspection

Check the steering arms for alignment against the dimensions given in Fig. K.15.

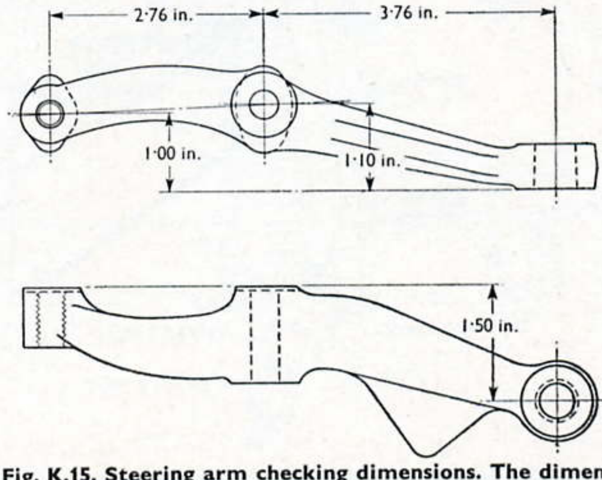

Fig. K.15. Steering arm checking dimensions. The dimensions apply to right-hand and left-hand arms

Installation

Note the following:

1. Check that the mating faces of the arm and steering knuckle are clean and free from burrs.

2. Tighten the connecting rod end attaching nut to the specified torque.

3. Adjust the hub bearings (page K-5).

4. Check the front wheel toe-in (page K-4).

STEERING KNUCKLES

Removal

1. Compress the spring and release the ball joint from the steering knuckle upper boss (see under 'Front Springs — Removal' on page K-7).

2. Remove the split pin and unscrew the slotted nut and thin adjusting nut securing the king pin to the steering knuckle trunnion.

3. Withdraw the thrust washer and detach the knuckle from the upper and lower arms.

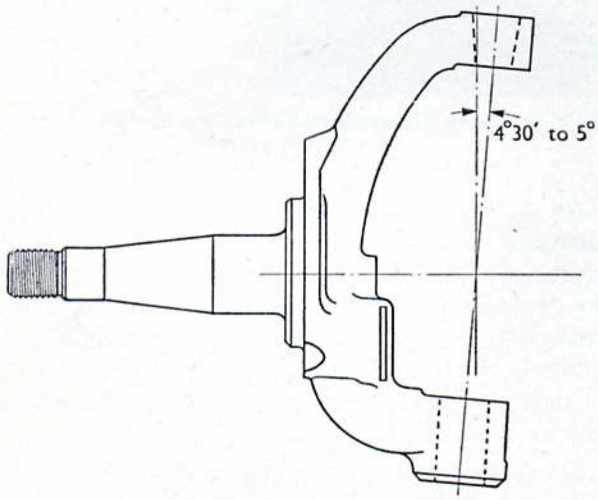

Fig. K.16. Steering knuckle checking details

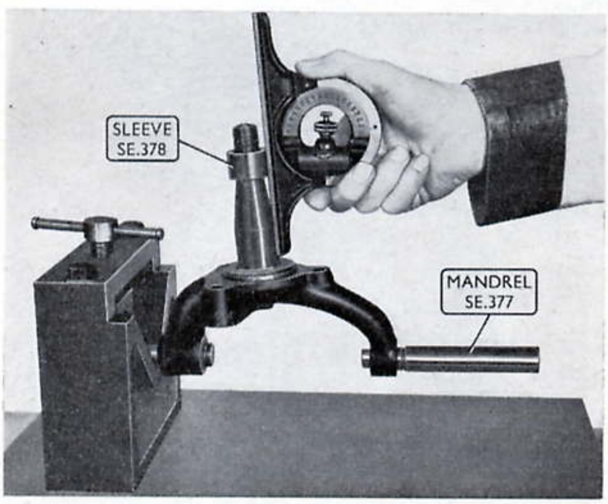

Fig. K.17. Checking the steering knuckle for distortion

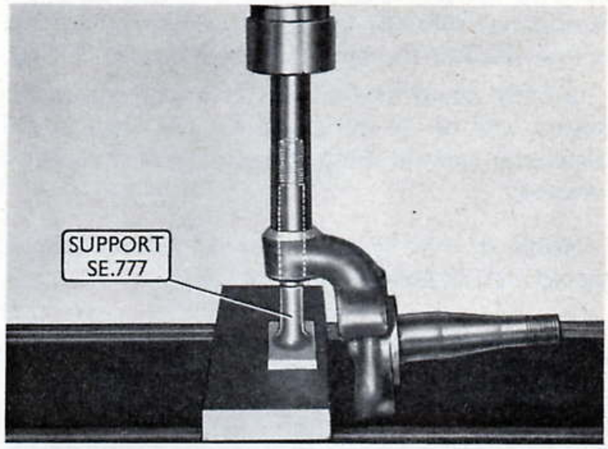

Fig. K.18. Pressing the king pin out of the steering knuckle

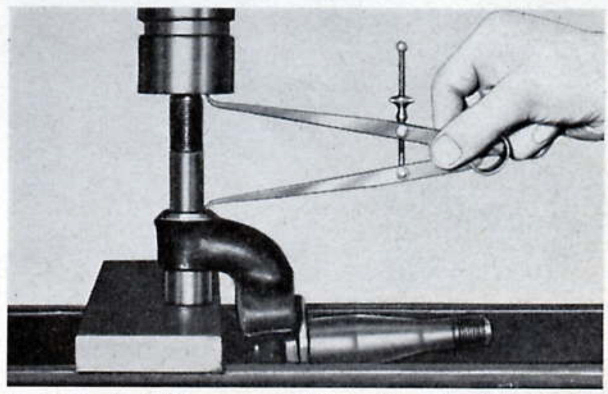

Fig. K.19. Installing a new king pin into the steering knuckle boss

4. Remove the oil seal ring from the knuckle lower boss.

Inspection and Reconditioning

1. If, during a steering geometry check, it was found that the steering knuckle was distorted, it should be renewed.

2. The steering knuckle can be checked for distortion against the details given in Fig. K.16 with the aid of a protractor, mandrel and sleeve (Fig. K.17). In addition, suitable equipment to mount the knuckle in accurate relationship with a surface table, will be required.

5. Reconnect the pipe to the brake cylinders and attach the three-way connector to the bracket on the axle housing.

6. Secure the brake pipe to the clip on the axle housing rear cover.

Installation

Note the following.

1. Tighten the U-bolt nuts evenly to the recommended torque and make a visual check on the alignment of the shock absorber anchor plate.

2. Check that the brake pipe on the rear axle is set well forward, otherwise it will foul the shock absorber when the road spring is subjected to maximum depression. Check also that the pipe is clear of the axle housing cover flange.

3. Refill the axle to the bottom of the filler plug orifice with recommended oil.

4. Bleed the brakes and adjust the parking brake cables (see Section O).

SPECIFICATIONS

AXLE OIL CAPACITY—NOMINAL

Axle Housing .. .. $3\frac{3}{4}$ Imp. pints ($4\frac{1}{2}$ U.S. pints)

Axle Housing Tubes—Each one, initial fill only $\frac{1}{4}$ pint

AXLE SHAFTS

Maximum Permissible Run-out—Checked on oil seal collar .. ·002 in.

Oil Seal Collar		
Outside diameter	1·497 to 1·503 in.	
Fit on axle shaft	·0006 to ·0018 in. interference	Collar bore 1·1547 to 1·1554 in. Shaft dia. 1·1560 to 1·1565 in.
Shaft Bearings		
Fit on shaft	·0004 to ·0013 in. interference	Bearing bore 1·1807 to 1·1811 in. Shaft dia. 1·1815 to 1·1820 in.
Fit in housing	Zero to ·0017 in. clearance	Housing bore 2·8346 to 2·8358 in. Bearing dia. 2·8341 to 2·8346 in.

PINION ASSEMBLY

Pinion Front Bearing		
Fit on pinion shaft	·0002 in. clearance to ·0008 in. interference	Bearing bore 1·3775 to 1·3780 in. Shaft dia. 1·3778 to 1·3783 in.
Fit in axle housing	·0004 to ·0020 in. interference	Housing bore 2·8326 to 2·8336 in. Bearing dia. 2·8340 to 2·8346 in.
Pinion Rear Bearing		
Fit on pinion shaft	·0004 to ·0015 in. interference	Bearing bore 1·500 to 1·5006 in. Shaft dia. 1·5010 to 1·5015 in.
Fit in axle housing	·0005 to ·0021 in. interference	Housing bore 3·1235 to 3·1245 in. Bearing dia. 3·1250 to 3·1256 in.

Pinion Bearing, Pre-load

Used bearings	4 to 6 lb. in.
New bearings	8 to 12 lb. in.

Pinion Rear Bearing Shims

Shim thicknesses	·003, ·005 and ·010 in.

DIFFERENTIAL AND HYPOID GEAR

Side Bearings

Fit on case spigot	·0014 to ·0026 in. interference	Bearing bore 1·3775 to 1·3780 in. Spigot dia. 1·3794 to 1·3801 in.
Fit in axle housing	·0006 in. clearance to ·0009 in. interference	Housing bore 2·4400 to 2·4410 in. Bearing dia. 2·4404 to 2·4409 in.

Side Bearing Spacers and Shims

Spacer thicknesses—service	·100 and ·101 in.
Shim thickness—service	·003 in.

Side Bearing Pre-load

Used bearings	1 lb.
New bearings	3 lb.

Differential Pinions

Fit on pinion shaft	·0027 to ·0053 in. clearance	Pinion bore ·6275 to ·6295 in. Shaft dia. ·6242 to ·6248 in.

Differential Pinion Shaft

Fit in case	·0013 in. clearance to ·0003 in. interference	Case bore ·6245 to ·6255 in. Shaft dia. ·6242 to ·6248 in.

Differential Side Gears

Fit of gear spigot in case	·002 to ·005 in. clearance	Case bore 1·340 to 1·342 in. Spigot dia. 1·337 to 1·338 in.

Run-out of Differential Case Hypoid Gear

Mating Face	·001 in. maximum.

Run-out of Hypoid Gear Rear Face

Gear assembled	·002 in. maximum.
Hypoid Gear Backlash with Pinion	·006 to ·008 in.

TORQUE WRENCH DATA

Differential Bearing Cap Bolts	*38 lb. ft.
Hypoid Gear Bolts	*38 lb. ft.
Rear Spring U-Bolt Nuts	*33 lb. ft.

**Clean dry threads*

RECOMMENDED LUBRICANTS

OVERSEAS

USAGE	TEMPERATURE RANGE		SAE VISCOSITY NO.	GM SPECIFICATION NO.
	CEN.	FAH.		
Gear Shift Lever and Linkage	—		—	4550—M
Transmission	Above —32° Below —32°	Above —25° Below —25°	80 80 plus 10% Kerosene	4592—M —
Transmission Main Drive Pinion Splines	—		—	4733—M
Transmission Front Cover Sleeve	—		—	4530—M
Propeller Shaft Universal Joints	—		—	4733—M
Rear Axle	Above —18° —18° to —32° Below —32°	Above 0° 0° to —25° Below —25°	90 Hypoid 80 Hypoid 80 Hypoid plus 10% Kerosene	4655—M 4654—M —

RECOMMENDED LUBRICANTS

UNITED KINGDOM

USAGE	BP	CASTROL	DUCKHAM'S	ESSO	GULF	MOBIL	REGENT	SHELL
Gearshift Lever and Linkage	—	—	KG.20 Keenol Grease	—	—	—	—	—
Transmission	Energol SAE 90	Castrol ST	SG.90 Gear Oil	Esso Gear Oil ST. 90	Transmission Oil 90	Mobilube C 90	Thuban 90	Dentax 90
Transmission Main Drive Pinion Splines	Energrease L.2	Castrolease LM	LB. 10 Grease	Esso Multipurpose Grease H	Gulflex A	Mobilgrease MP	Marfak Multipurpose 2	Retinax A
Transmission Front Cover Sleeve	Energrease C.3G or Energrease L.21 M	Castrolease Brake Cable Grease or Castrolease MS.3	GG Grease or LBM.10 Grease	Esso Graphite Grease or Esso MP Grease (Moly)	Gulfsil Grease G.C7/8G or Gulflex Moly	Mobilgrease Special	Regent Grease 904	Retinax AM
Propeller Shaft Universal Joints	Energrease L.2	Castrolease LM	LB.10 Grease	Esso Multipurpose Grease H	Gulflex A	Mobilgrease MP	Marfak Multipurpose 2	Retinax A
***Rear Axle**	Energol EP SAE 90	Castrol Thio-Hypoy 90 or Hypoy 90	—	Esso Gear Oil GP 90	Gulf Multipurpose Gear Lubricant 90	Mobilube GX 90	Universal Thuban 90	Spirax 90 EP

*IMPORTANT NOTE: *Where an axle is topped up or drained before completing the first 10,000 miles or when new hypoid gears are fitted, use only Castrol Thio-Hypoy 90 or Gulf Multi-purpose Gear Lubricant 90.*

BEDFORD CA Mark 2

Training Manual TS962

SUPPLEMENT

Transmission and Rear Axle

VAUXHALL MOTORS LTD

LUTON – ENGLAND

INTRODUCTION

This Supplement provides information on changes in design and servicing procedure introduced since publication of Training Manual TS 673.

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RITEWAY SERVICE TOOLS

Tools which carry a 'Z', 'D' or 'VR' prefix to the tool number are available from the following sources:

All territories except Continental Europe, Kent-Moore Tools Ltd, Bow Street, Birmingham 1, England.

Continental Europe, Kent-Moore International AG, Altgasse 6340, Baar-Zug, Switzerland.

Drawings of 'SE' tools are still obtainable from Service Department, Vauxhall Motors Ltd.

TRANSMISSION MODIFICATIONS

On later three and four-speed transmissions the thrust ring integral with the rear end of the layshaft gear was replaced by a D-shaped thrust washer. The flat edge of the washer locates against the inside face of the transmission bottom cover with its indented face towards the layshaft gear.

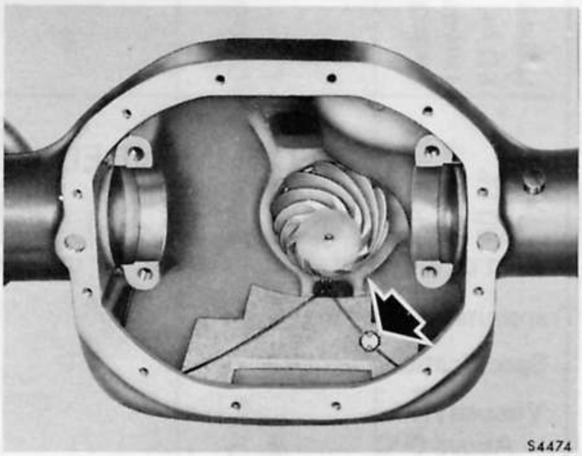
On four-speed transmission a spacer was added between the rear of the reverse idler pinion and the casing, and the detent grooves in the end of the rod in the bottom cover were repositioned. Due to partial engagement of the idler pinion when in first gear, a small area at the front of the pinion teeth may have a polished surface which must not be mistaken for incorrect engagement of the pinion.

MAIN DRIVE PINION BEARING FIT

The fit of the main drive pinion bearing in the transmission front cover was changed to eliminate transmission snatch. The revised fit is 0.0003/0.0014 in. clearance and the diameter of the front cover bearing bore is 2.4412/2.4418 in.

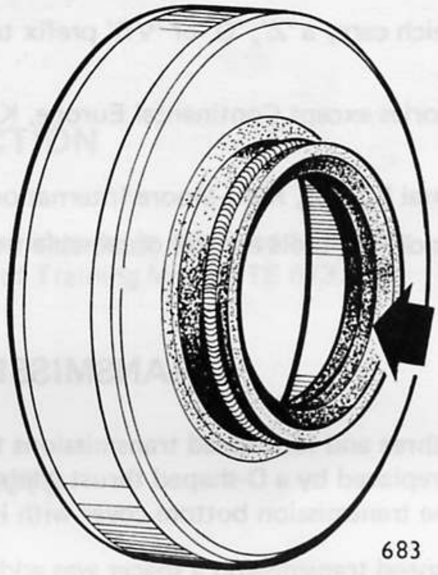
REAR AXLE FILTER PAD AND MAGNETIC PLATE

A felt filter pad and magnetic plate assembly was introduced on later rear axles, to trap any metal particles present in the lubricant. Pad and plate must be assembled in axle housing before installing differential.



HYPOID PINION OIL SEAL

An improved pinion oil seal was introduced on later axles. The seal must be installed with the sealing lip (arrowed) towards the differential unit and should be pressed into the housing until it contacts the shoulder in the housing.



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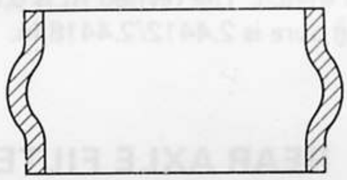
PINION BEARING PRE-LOAD SPACER

A pre-shaped spacer was introduced on later axles to facilitate easier bearing pre-loading and to ensure that the spacer collapses correctly.

The spacer locating shoulder on the pinion shaft was repositioned to accomodate the new spacer.



RECOMMENDED LUBRICANTS – OVERSEAS

The list of lubricants recommended for use overseas is amended as follows:

Transmission

Specification	GM 4753-M
Viscosity:	
Above 0°C	90
Below 0°C	80

RECOMMENDED LUBRICANTS – UNITED KINGDOM

Usage	BP	Castrol	Duckhams	Esso	Gulf	Mobil	Petrofina	Regent	Shell
Gear Shift Lever and Linkage	—	—	Keenol	—	—	—	—	—	—
Transmission	BP Gear Oil SAE 90 EP	Castrol Hypoy	Hypoid 90	Esso Gear Oil GP 90/140	Multi-purpose Gear Oil 90	Mobilube GX90	Pontonic MP SAE 90	Multigear Lubricant 90	Shell Spirax 90 EP
Transmission Front Cover Sleeve Universal Joints	Energrease C.3G or Energrease L.21M	Castrolease MS3	G.G.Grease or LBM.10 Grease	Esso Graphite Grease or Esso MP Grease (Moly)	Gulfsil Grease G.G7/8G or Gulflex (Moly)	Mobilgrease Special	Fina Marson LM2	Regent Grease 904 or Molytex Grease 2	Retinax AM
Main Drive Pinion Splines	Energrease L.2	Castrolease LM	LB.10 Grease	Esso Multipurpose Grease H	Gulflex A	Mobilgrease MP	Fina Marson HTL 2	Marfax Multi-purpose 2	Retinax A
* Rear Axle	BP Gear Oil SAE 90 EP	Castrol Thio-Hypoy FD or Hypoy	Hypoid 90	Esso Gear Oil GP 90/140	Multi-purpose Gear Oil 90	Mobilube GX 90	Pontonic MP SAE 90	Multigear Lubricant 90	Shell Spirax 90 EP

*Where an axle is topped up or drained before completing the first 10,000 miles or when new hypoid gears are fitted, use only Castrol Thio-Hypoy FD

SERVICE TRAINING MANUAL

for

SUSPENSION, STEERING, BRAKES

BEDFORD CA
Mark 2

SERVICE

VAUXHALL MOTORS LTD
LUTON · BEDFORDSHIRE · ENGLAND

TS. 674

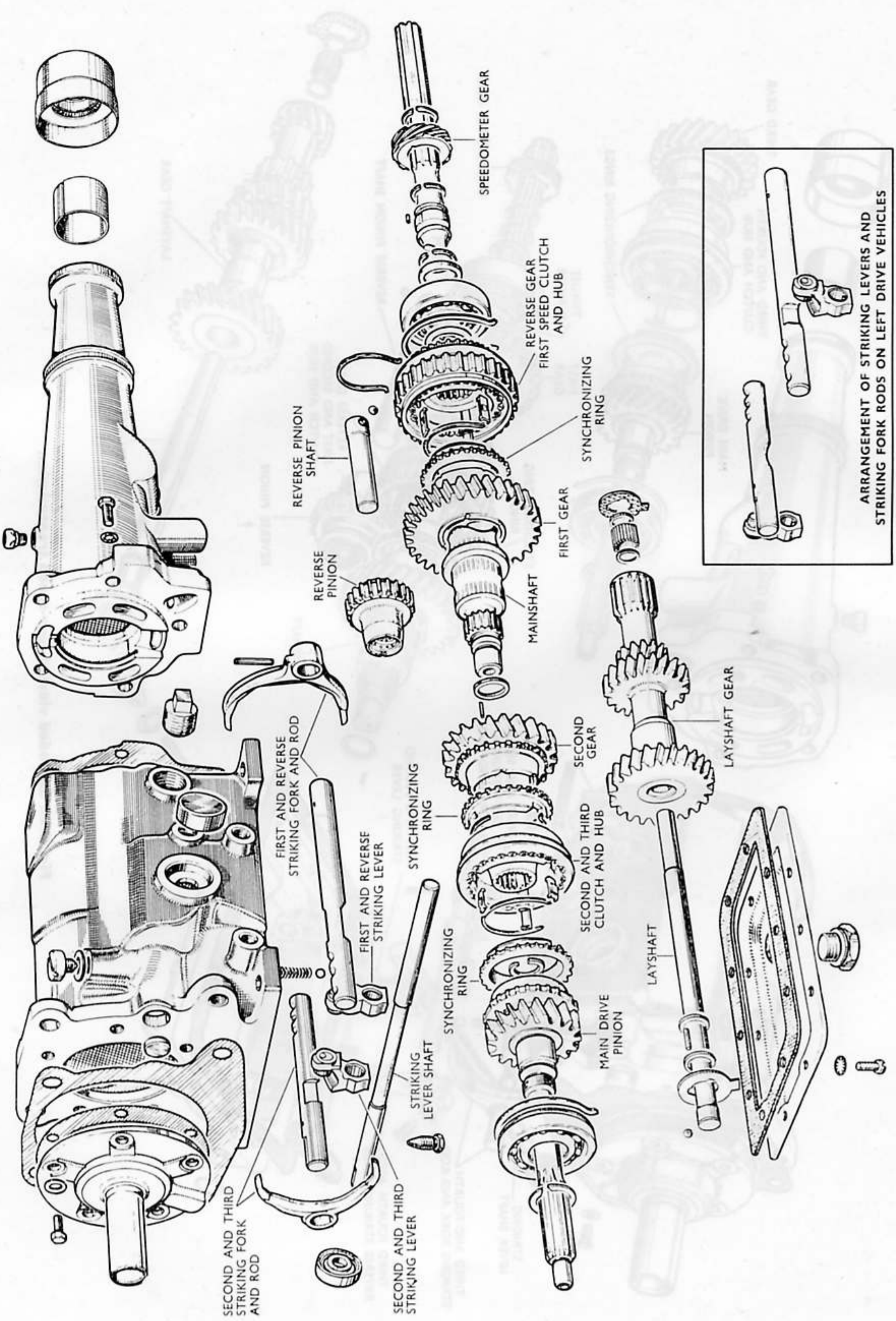


Fig. G.19. Exploded view of three-speed transmission

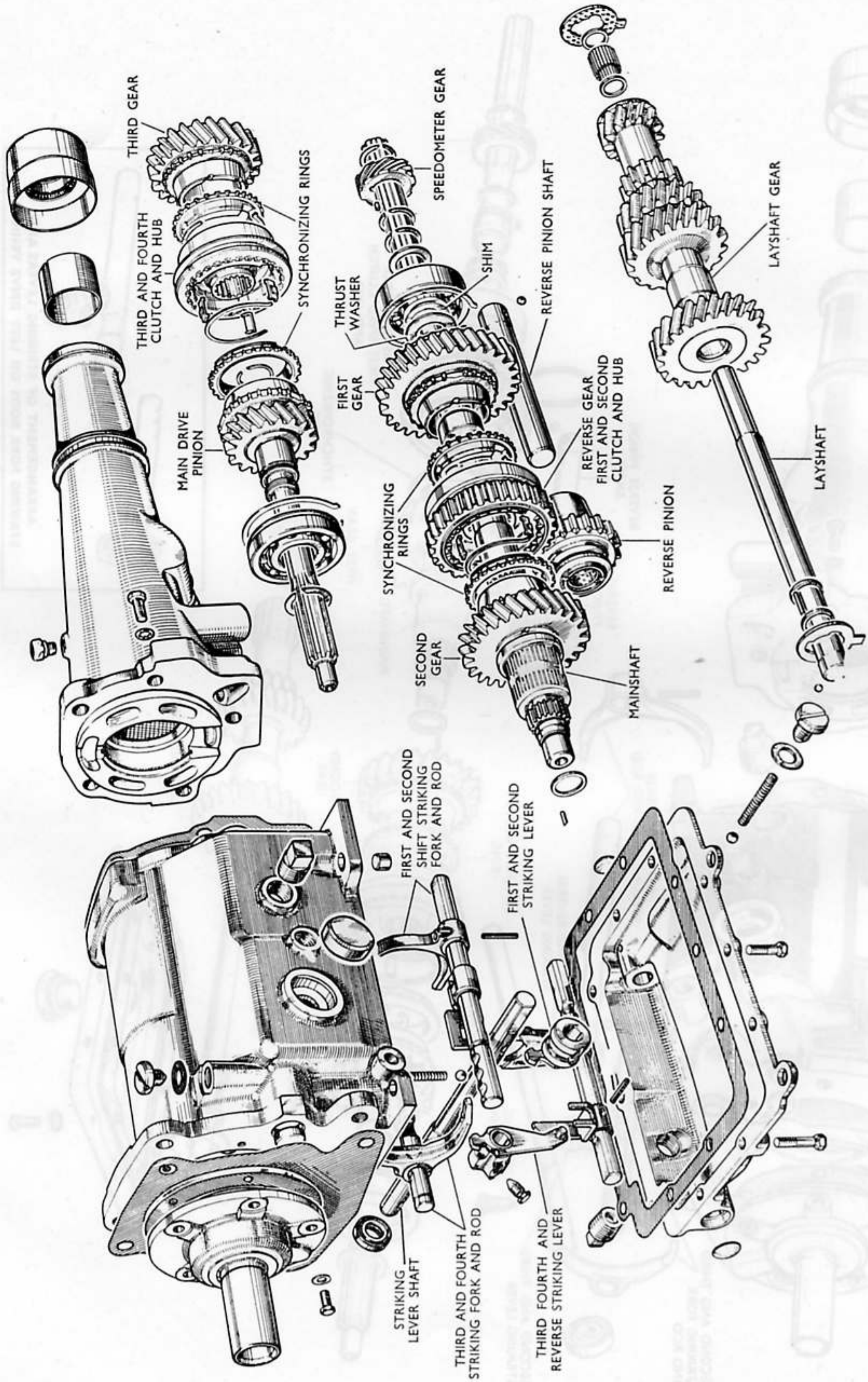


Fig. G.20. Exploded view of four-speed transmission

2. To renew the rear cover oil seal and the bush, drive the seal off the end of the rear cover using a sharp pointed drift, and press out the bush (Fig. G.18). Install the new bush so that the outer end of the bush is flush with the bottom of the chamfer in the cover. Soak a new seal in oil and press it on to the end of the rear cover.

3. Ensure that the breather in the rear cover is clean and that its cap can be rotated freely.

Shafts and Gears

1. During inspection, remove any burrs with a fine-grade carborundum stone and afterwards wash the components thoroughly to remove all traces of carborundum.

2. On four-speed transmissions, the first speed gear and bushes are only serviced as an assembly;

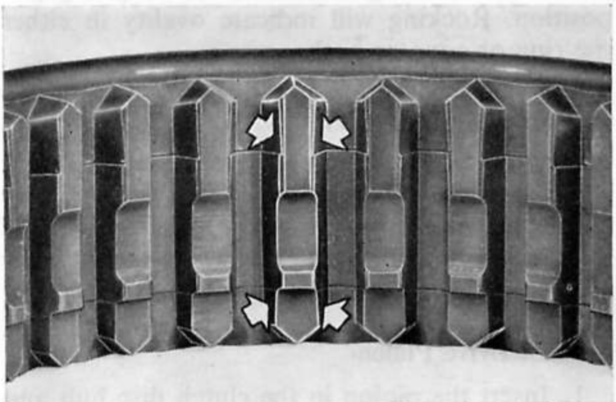


Fig. G.21. Section of the top speed clutch showing the 'keystone' on the internal splines at each end, indicated by arrows

a complete assembly must be installed if the bushes are worn.

3. Ensure the oil drillings are free from obstruction.

Synchronizing Mechanism

1. A 'keystone' contour is incorporated at each end of the clutch splines (Fig. G.21) of both clutches on four-speed transmissions and also on the second and third speed clutch on three-speed transmissions. This engages with a similar contour formed in the engagement teeth of the corresponding gear on the mainshaft.

On three-speed transmissions, the external splines on the first speed clutch and reverse gear hub are stepped on the reverse drive side (Fig. G.22).

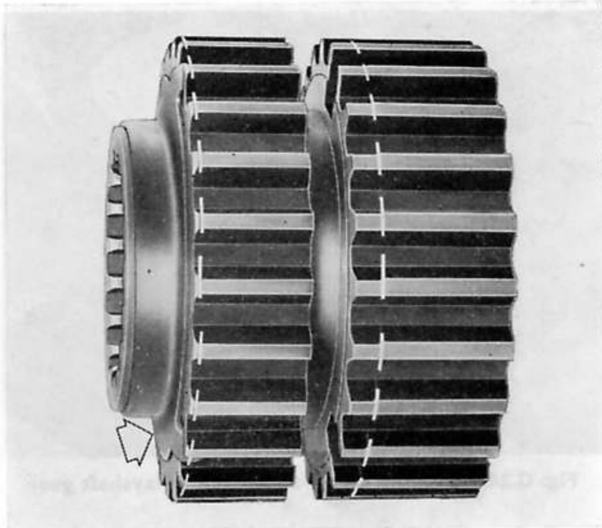


Fig. G.22. First speed clutch and reverse gear hub on a three-speed transmission. The arrow indicates the sliding key retaining plate. The extent of the stepped part is between the white lines

When reverse gear is engaged, the internal splines of the first speed clutch and reverse gear locate in the stepped section of the hub splines. In addition, at the front end of the internal splines of the first speed clutch and reverse gear a 'keystone' contour similar to that in the second and third speed clutch is provided.

These features provide anti-jump-out characteristics and must not be mistaken for localized wear when examining the components.

2. Check the fit of the clutch on the hub. If there is excessive rock or backlash the clutch and hub

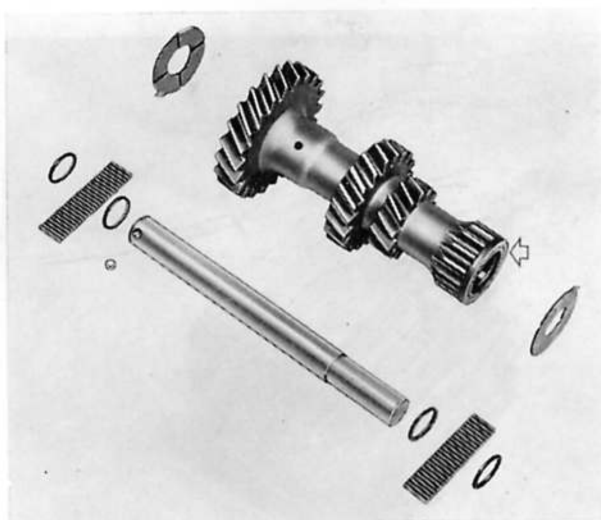


Fig. G.23. Layshaft gear, shaft and bearings on a three-speed transmission. Arrow indicates thrust ring, which is not renewable

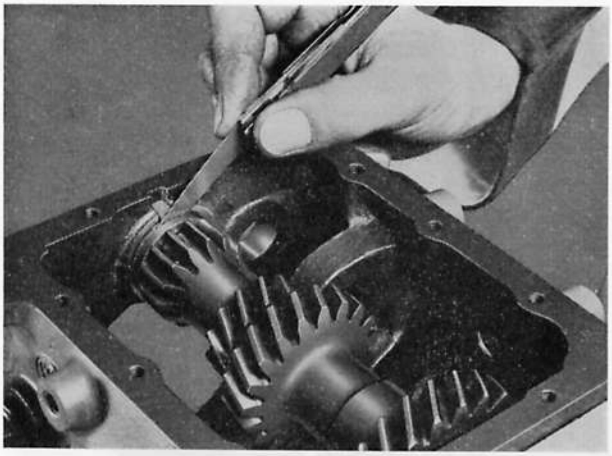


Fig. G.24. Checking the end float of the layshaft gear

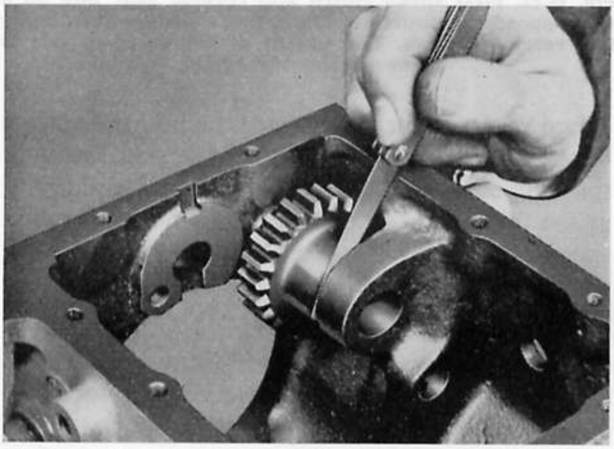


Fig. G.25. Checking the end float of the reverse pinion (three-speed)

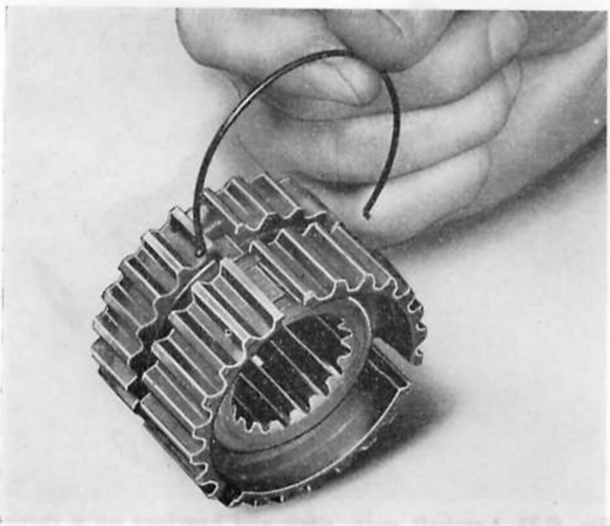


Fig. G.26. Assembling the sliding key spring with two turned-out ends to the first and reverse hub

assembly must be renewed, particularly if there is a complaint of jumping out of gear.

3. On three-speed transmissions, check that the sliding key retainer plate is securely attached to the hub. (Fig. G.22).

4. Examine the pips of the sliding keys for wear, also the faces of the keys which engage in the hub slots. Check that the keys slide freely in the hub slots. Renew the key springs.

THE CLUTCH AND HUB ARE SERVICED AS A SELECTED ASSEMBLY; THESE COMPONENTS MUST NOT BE RENEWED INDIVIDUALLY.

5. Examine the teeth on the synchronizing rings for wear or damage. Misshapen teeth will create baulking trouble. Inspect the friction surface for wear or damage. Place each ring on its respective cone and check the frictional grip. Also check for rock when the ring is held in the fully engaged position. Rocking will indicate ovality in either the ring or cone or both.

NOTE: *It is essential that the friction surfaces of the synchronizing rings are in good condition otherwise faulty synchromesh operation will result. An indication of the amount of wear on the rings can be obtained by comparing the frictional grip and relative location of the rings on the cones with new components.*

Main Drive Pinion

1. Insert the pinion in the clutch disc hub and check for backlash. To determine the amount of wear on the respective components a comparative check with new parts should also be made.

2. Check that the three oil drillings are free from obstruction.

Layshaft Gear and Shaft

1. The thrust ring at the rear end of the layshaft gear is not renewable, as it is pressed on prior to final grinding of the thrust faces during manufacture. If worn, renew the layshaft gear.

2. Check the end float of the layshaft in the casing, with new thrust washers (Fig. G.24). The front washer is identified by a flat on the periphery.

Reverse Pinion and Shaft

1. If the reverse pinion bushes are worn, a new pinion assembly must be installed. It is not a

practical proposition to renew the bushes as specialized equipment is needed when reaming.

2. On three-speed transmissions, check the end float of the pinion in the transmission casing (Fig. G.25).

Gear Shift Mechanism

Striking forks and rods are serviced as a matched assembly. Should it be necessary to renew a fork or rod, a complete striking fork and rod assembly must be installed.

Reassembly

Before reassembling, remove any sharp edges or burrs from replacement gears with a carborundum stone and wash thoroughly. Lubricate all working surfaces with oil.

Always include the following in the parts to be renewed: front cover bolt copper washers, circlips, sliding key springs, striking fork pins and striking rod end covers.

Assembling the Mainshaft

1. On three-speed transmissions, assemble the sliding keys and springs to the first speed clutch and reverse gear hub as follows:

(*a*) Place the spring with the two turned-out ends in position in the groove in the hub (Fig. G.26).

(*b*) Install the three sliding keys and position the spring so that one end is located on the slotted key as shown in Fig. G.27.

NOTE: *The pips on the sliding keys are centrally disposed; therefore, the keys can be installed either way round.*

(*c*) Install the remaining spring (Fig. G.28) so that the turned-out end engages in the slotted key and the spring is located as shown in Fig. G.27.

2. Assemble the sliding keys and springs to the second and third speed clutch hub on three-speed transmissions, and to both clutch hubs on four-speed transmissions as follows:

(*a*) Place the keys in position so that the pips on the keys are offset towards the spigoted end of the hub (Fig. G.29).

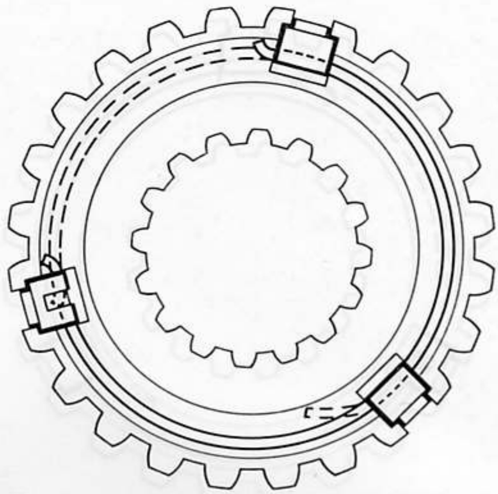


Fig. G.27. Location of the sliding key springs in the first speed clutch and reverse gear hub, viewed from the rear of the hub. The front spring shown dotted has the turned-out end engaged in the slotted key

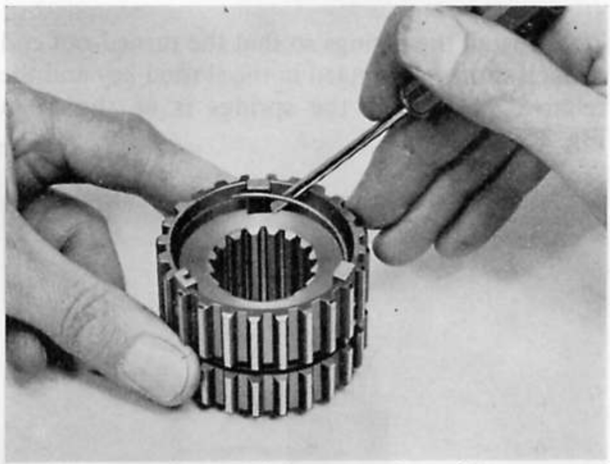


Fig. G.28. Installing the sliding key spring with one turned-out end, to the first and reverse hub

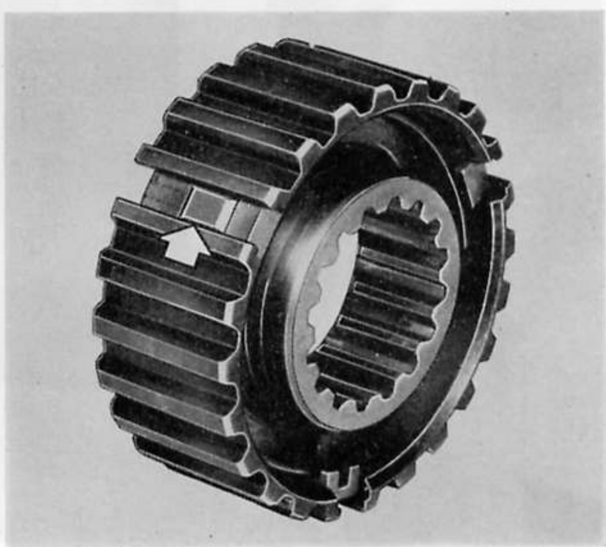


Fig. G.29. The sliding keys must be assembled so that the pips on the keys are offset towards the spigoted end of the hub

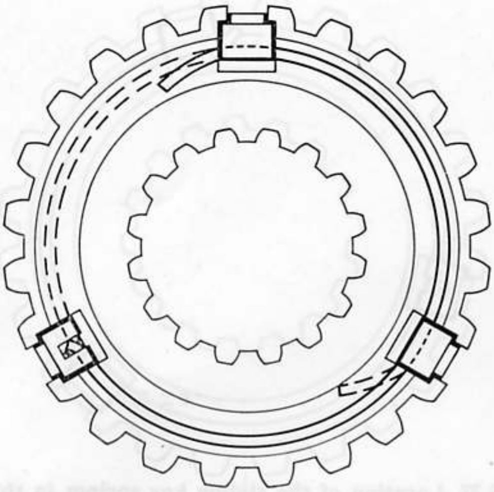


Fig. G.30. Location of the sliding key springs in the second and third speed clutch hub (three-speed) and both hubs (four-speed), viewed from the rear of the hub

(*b*) Install the springs so that the turned-out end of each spring is engaged in the slotted key and the relative location of the springs is as shown in Fig. G. 30.

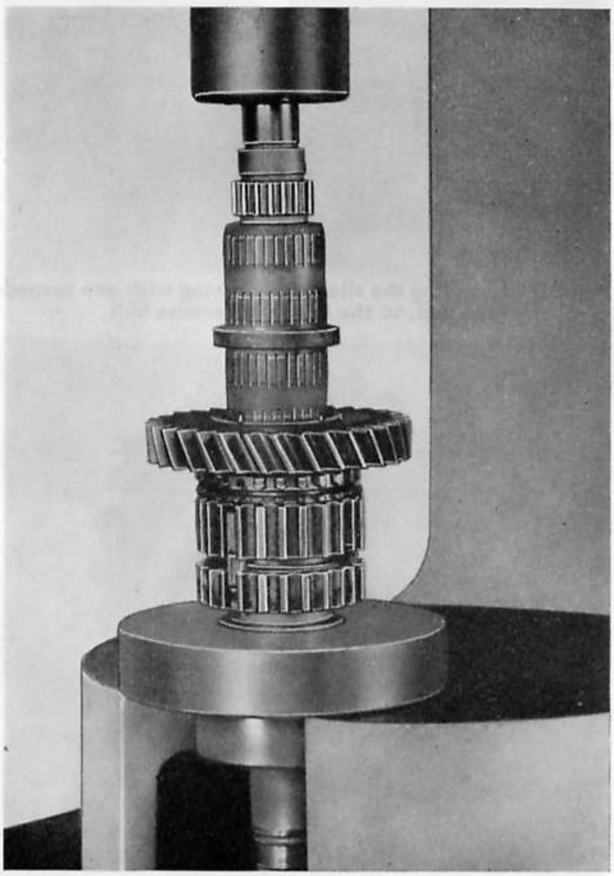


Fig. G.31. Pressing the first and reverse hub on to the mainshaft together with the synchronizing ring and first speed mainshaft gear (three-speed)

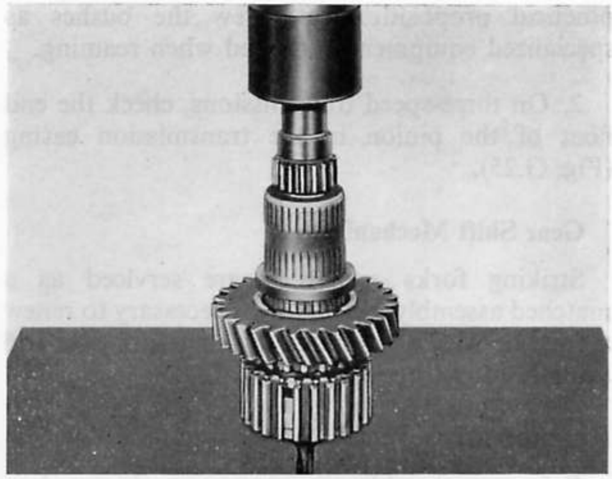


Fig. G.32. Pressing the first and second speed hub on to the mainshaft (four-speed)

3. On three-speed transmissions proceed as follows:

(*a*) Place the first speed synchronizing ring in position in the first and reverse hub so that the sliding keys engage the slots in the ring.

(*b*) Place the mainshaft first speed gear in position on the synchronizing ring and hub and feed the rear end of the mainshaft through the components.

(*c*) Locate the internal splines of the hub on the splines of the mainshaft and press the assembly home on to the mainshaft (Fig. G.31). Do not allow the components to tilt and jam.

4. On four-speed transmissions proceed as follows:

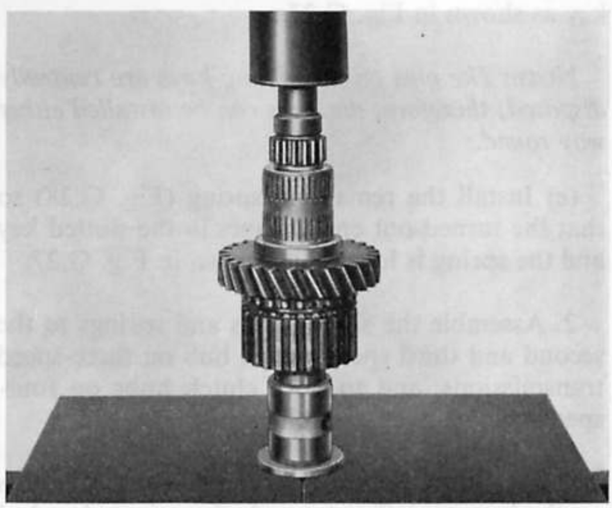


Fig. G.33. Pressing the first speed gear sleeve on to the mainshaft (four-speed)

(*a*) Place the mainshaft second speed gear in position on the rear of the shaft, followed by the synchronizing ring.

(*b*) Place the first and second speed clutch hub on the rear end of the shaft with the spigoted end of the hub towards the rear of the shaft. Locate the slots in the synchronizing ring with the sliding keys in the hub.

(*c*) Engage the internal splines of the hub with those on the mainshaft and press the assembly on to the shaft (Fig. G.32).

(*d*) Locate the first speed gear sleeve on the rear end of the mainshaft and press the sleeve on to the shaft (Fig. G.33).

(*e*) Assemble the first and second speed clutch to the hub so that the striking fork groove is towards the rear end of the mainshaft.

(*f*) Place the synchronizing ring in position on the first and second speed hub so that the sliding keys engage the slot in the ring.

(*g*) Place the first speed gear on the sleeve and install the thrust washer with the chamfered face to the rear of the shaft.

5. The longitudinal location of the mainshaft is controlled by the mainshaft ball bearing, and it is therefore imperative that the bearing is correctly located on the shaft. Where necessary, shims are interposed between the rear abutment face of the first and reverse hub and the bearing on three-speed transmissions, and between the mainshaft thrust washer and the bearing on four-speed transmissions. To determine the thickness of shims required, proceed as follows:

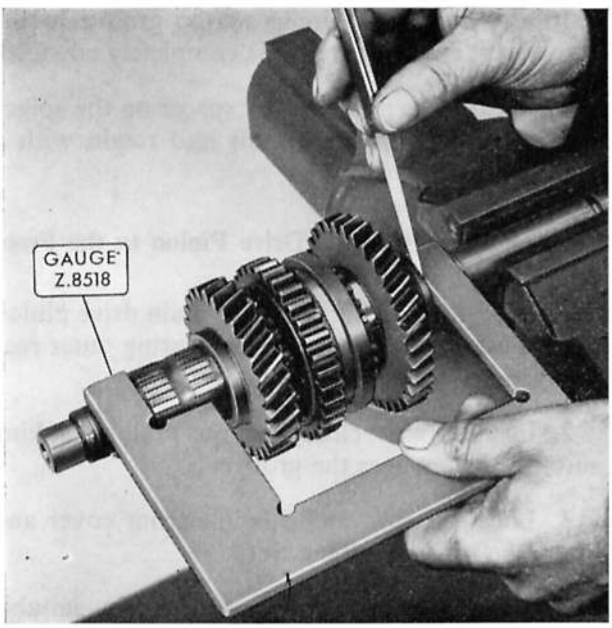


Fig. G.34. Assessing the thickness of mainshaft shims required to adjust end float

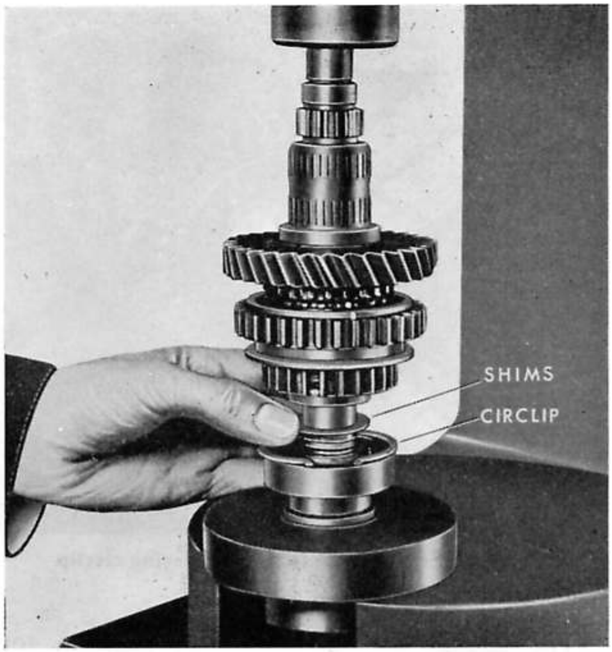


Fig. G.35. Pressing the bearing on to the mainshaft

(*a*) Assess the thickness of mainshaft shims required, as shown in Fig. G.34.

(*b*) Select a shim or shims to the required thickness and install on the shaft. Shims are serviced in three thicknesses.

6. On three-speed transmissions, assemble the first speed clutch and reverse gear to the hub with the striking fork groove towards the rear of the mainshaft.

7. Place a new mainshaft bearing circlip over the rear end of the mainshaft followed by the bearing, and press the bearing home against the shims (where fitted)—see Fig. G.35—taking care that the shims and circlip are not trapped in the circlip groove on the mainshaft.

8. Install the mainshaft bearing thrust washer, then select a circlip (Fig. G.36) which will take up all clearance between the thrust washer and the rear face of the circlip groove, and install the circlip.

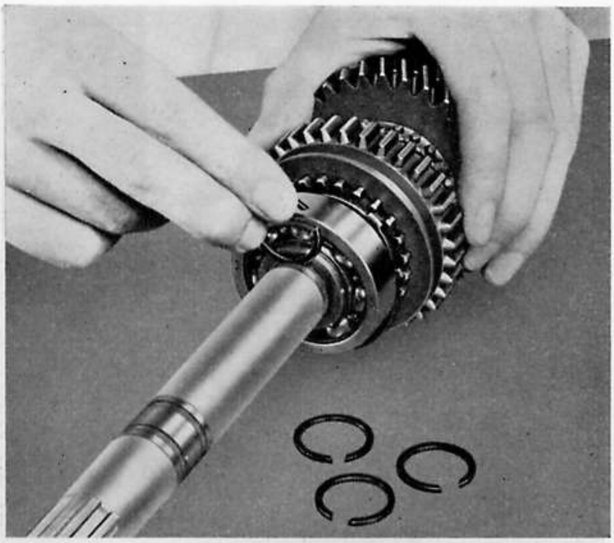


Fig. G.36. Selecting a mainshaft bearing circlip

The circlips for the mainshaft bearing, top speed hub and speedometer driving gear are serviced in seven thicknesses.

9. Assemble the speedometer driving gear front circlip to the mainshaft, place the key in position and press home the gear with the chamfered face towards the front of the shaft. Select and install a circlip which will take up all clearance between the rear face of the gear and the rear face of the circlip groove.

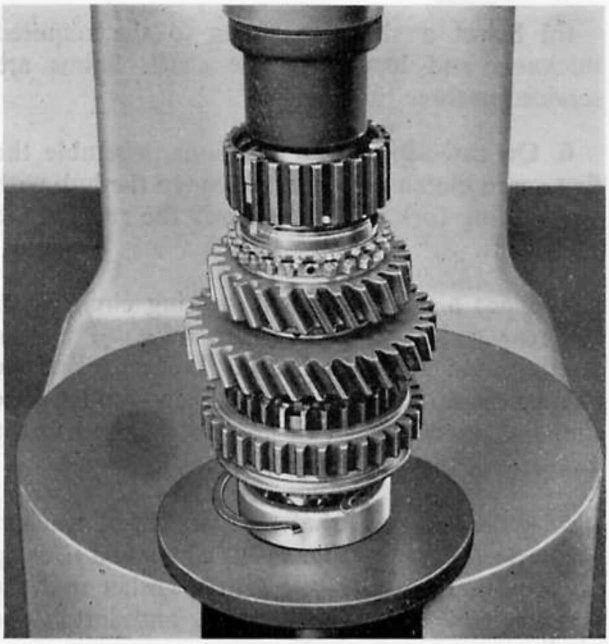


Fig. G.37. Pressing the top speed hub on to the mainshaft

10. Place the second gear (three-speed) or third gear (four-speed) in position on the shaft, followed by the synchronizing ring.

11. Place the top speed hub on the front end of the shaft with the spigoted end of the hub towards the front end. Locate the slots in the synchronizing ring with the sliding keys in the hub. Engage the internal splines of the hub with those on the shaft and press home the hub (Fig. G.37).

12. Select and install a new circlip which will take up all clearance between the hub spigot and the front face of the circlip groove.

13. Assemble the top speed clutch to the hub so that the striking fork groove is towards the front end of the mainshaft.

14. Insert a spare sliding sleeve in the rear cover bush to avoid damaging the bush when installing the mainshaft.

15. Insert the mainshaft in the rear cover and engage the splines in the sliding sleeve. Locate the mainshaft bearing in the bearing housing and press the mainshaft into the rear cover until the bearing is fully home.

NOTE: *The mainshaft rear bearing is an interference fit in the aluminium rear cover, and it may be necessary to warm the cover before installing the mainshaft and bearing assembly.*

16. Assemble the circlip to the groove in the rear cover, ensuring that it is completely engaged.

17. Install the needle roller spacer on the spigot at the front of the mainshaft and retain with a smear of petroleum jelly.

Assembling the Main Drive Pinion to the Front Cover

1. Press the bearing on to the main drive pinion so that the circlip groove in the bearing outer race is nearest to the gear (Fig. G.38).

2. Install a new circlip on the pinion, making sure it fully engages the groove.

3. Locate a new circlip in the front cover and insert the pinion in the cover.

4. Lightly secure the front cover in suitable blocks of wood, expand the circlip and tap the pinion and bearing assembly home into the cover

with a rubber mallet. Make sure the circlip fully engages the groove in the bearing outer race.

5. Lightly smear the counterbore in the pinion with petroleum jelly and position the 24 needle rollers. Do not use more petroleum jelly than is necessary to hold the rollers in position, otherwise the oil drillings will be choked.

Assembling the Layshaft Gear

1. Place a needle roller spacer in the rear counterbore of the layshaft gear, coat the bore with petroleum jelly and install 25 needle rollers, followed by the other spacer.

NOTE: *The spacers for the rear counterbore are smaller in diameter than those used in the front counterbore.*

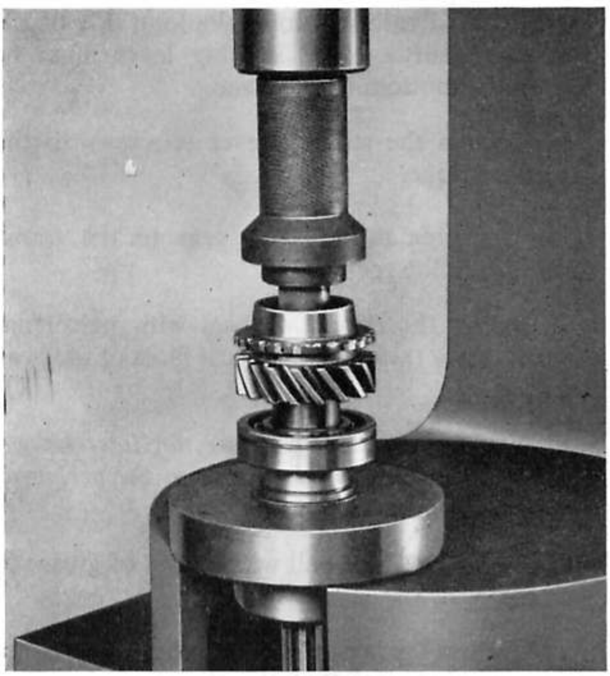


Fig. G.38. Installing the main drive pinion bearing. Note position of circlip groove in outer race relative to the gear

2. Install the larger spacers and 26 needle rollers to the front counterbore.

Final Assembly Operations

1. Lightly smear the front face of the rear cover with grease and place a new gasket in position.

2. Insert the mainshaft assembly into the transmission casing and locate the rear cover radially to permit installation of the reverse pinion shaft.

3. Locate a steel ball with a spot of grease in the drilling in the reverse pinion shaft.

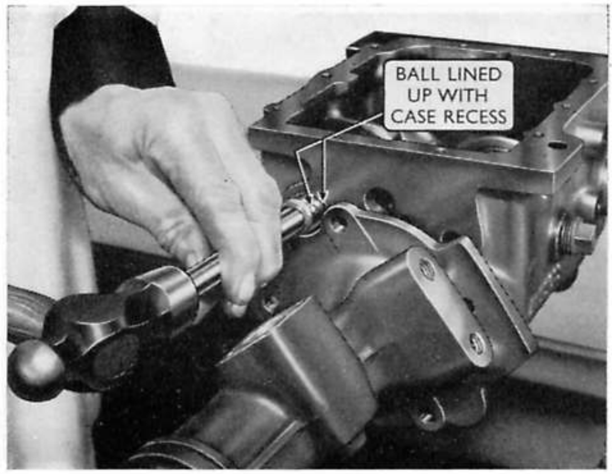


Fig. G.39. Installing the reverse pinion shaft

4. Assemble the reverse pinion to the casing with the chamfered end of the teeth towards the front; insert the pinion shaft, lining up the ball with the recess in the casing and drive the shaft home with a brass drift (Fig. G.39).

5. Rotate the rear cover to the correct position and on four-speed transmissions locate the selector bar fulcrum bracket in position with the two longer bolts and install the remaining bolts, but do not fully tighten.

NOTE: *If the rear cover bolts are fully tightened a pneumatic lock may be created when the layshaft is driven home.*

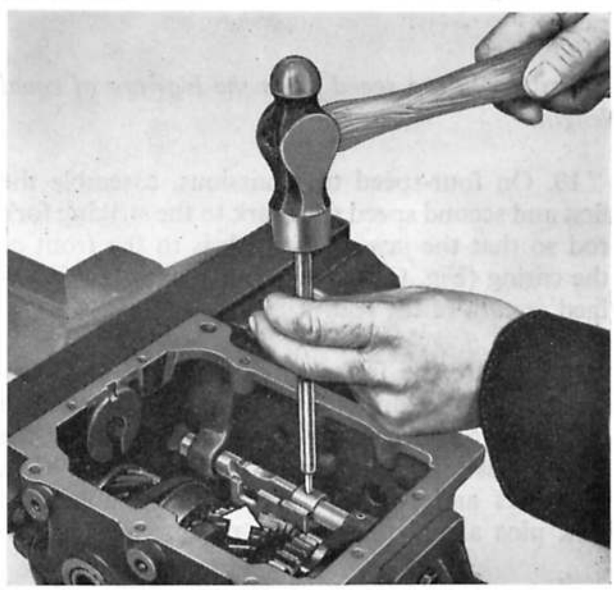


Fig. G.40. Securing the first and second shift fork with a new pin. The fork jaw must be to the front of the casing as indicated by arrow

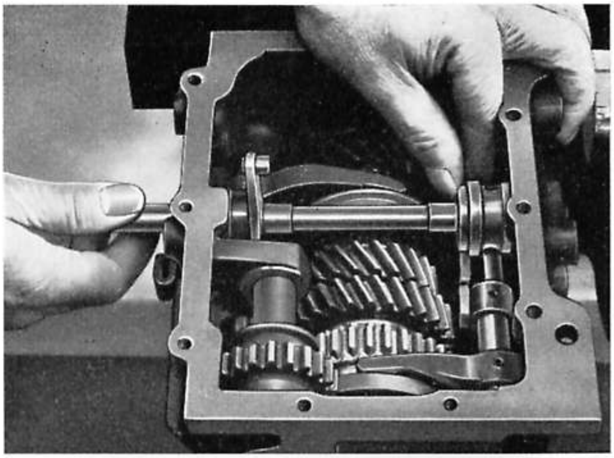


Fig. G.41. Installing the striking lever shaft

6. Lightly smear the front cover face with grease and place a new gasket in position. Place the synchronizing ring on the top speed synchronizing cone integral with the main drive pinion.

7. Carefully insert the main drive pinion into the casing to engage the mainshaft spigot with the pinion needle rollers. Locate the synchronizing ring so that the sliding keys engage the slots in the ring.

8. Using new copper washers, install and tighten the front cover bolts.

9. Place the striking forks in position, and insert each striking fork rod from the front end of the casing.

NOTE: *On top speed forks the legs are of equal length.*

10. On four-speed transmissions, assemble the first and second speed shift fork to the striking fork rod so that the jaw of the fork is to the front of the casing (Fig. G.40) and in line with the machined section of the rod.

11. Secure the forks with new pins. On four-speed transmissions, the short pin is installed in the first and second speed shift fork. Drive the pins in flush with the face of the fork boss. When the forks and rods are correctly assembled the fork pins are in the vertical plane.

NOTE: *On three-speed transmissions, engage reverse to support the rear of the rod when installing the first and reverse fork retaining pin.*

12. Insert the striking fork rod end covers in the front face of the casing (open end first) and drive home until they are flush with the front face.

13. Using a suitable drift, install a new striking lever shaft oil seal with the seal lip towards the inside of the transmission casing.

14. Assemble the striking lever shaft and striking levers to the transmission as follows:

(*a*) Remove from the shaft any sharp edges or burrs likely to damage the oil seal during installation.

(*b*) Place a new outer seal on the shaft. Lubricate the oil seal in the transmission casing with oil and carefully insert the striking lever shaft, at the same time locating the levers on the shaft (Fig. G.41). On four-speed transmissions, the long side of the third and fourth speed striking lever must be towards the bottom of the casing.

(*c*) Tighten the striking lever setscrews to the specified torque.

15. Assemble the layshaft gear to the transmission as follows:

(*a*) Smear the thrust washers with petroleum jelly and place them on the thrust faces of the gear assembly.

NOTE: *The thrust washers are not interchangeable. The front washer has a flat on the periphery for identification.*

(*b*) Locate the steel ball with a spot of grease in the drilling in the layshaft.

(*c*) Position the layshaft gear in the transmission casing, making sure that the thrust washers are

Fig. G.42. Driving the layshaft into the casing correctly located, then insert the layshaft and line up the ball with the recess in the casing front face.

(*d*) Drive the layshaft home with a brass drift (Fig. G.42).

(*e*) Tighten the rear cover bolts.

16. On four-speed transmissions, assemble the reverse striking fork and rod to the transmission bottom cover as follows:

(*a*) Insert the striking fork rod in the bottom cover with the locking ball grooves to the rear, at the same time locating the striking fork and shift fork on the rod. The striking fork must be located on the shaft with the retaining pin hole offset to the front of the cover, and the shift fork with the jaw towards the centre of the cover.

Secure the forks with new pins and drive them in flush with the fork boss.

(*b*) Install a new expansion plug in each end of the striking fork rod bore.

(*c*) Insert the striking fork rod locking ball and spring, install the fibre washer and special screw and tighten securely.

(*d*) Replace the bottom cover, and make sure the reverse striking fork engages the groove in the reverse pinion.

17. Invert the transmission in the vice, insert the striking fork rod locking balls and springs, install the fibre washers and special screws and tighten securely.

18. Renew the oil seal in the speedometer housing, install the driven gear, and refit the housing so that it is located radially as shown in Fig. G.43. After tightening, lock each screw by staking.

19. Invert the transmission in the vice. Check for correct selection of all gears and replace the bottom cover.

Installation

Note the following:

1. Before installing the transmission, check the clutch release bearing for wear.

2. Lightly smear the main drive pinion splines and the transmission front cover sleeve with recommended grease.

3. Prior to installing the transmission inject $\frac{1}{8}$ pint of transmission oil through the end of the rear cover to provide initial lubrication for the speedometer gears and rear cover bush. In addition the oil seal and felt in the rear cover must be smeared with oil.

After lubricating, insert a spare sliding sleeve into the end of the rear cover to prevent oil draining out during installation.

4. Check that the mating faces of the transmission and clutch housing are clean and free from burrs.

5. Do not allow the weight of the transmission to hang on the main drive pinion after it has entered the hub of the clutch disc.

6. Fit new lockwashers to the transmission bolts and tighten the bolts evenly.

7. After fitting the gear shift control rods, check the gear shift adjustment (see Section F).

8. Refill the transmission with recommended oil. Run the engine to stabilize the oil level in the rear cover, then top-up to the filler plug orifice.

SPECIFICATIONS

Oil Capacity—Nominal

Transmission casing:	
Three-speed	2 Imp. pints ($2\frac{1}{2}$ U.S. pints)
Four-speed	$2\frac{1}{2}$ Imp. pints (3 U.S. pints)
Rear cover—initial fill only	$\frac{1}{8}$ pint

Fig. E.11. Locking an eye bolt nut by staking the nut collar into each end of the bolt slot

(*e*) Make a final check on the height of the levers. Adjust if necessary then lock each eye bolt nut by staking it into each end of the bolt slot (Fig. E.11).

Installation

Note the following:

1. When installing the flywheel, tighten the bolts evenly to the specified torque.

2. Be sure to install the disc as shown in Fig. E.12.

3. Insert the clutch disc aligner (Fig. E.13) before tightening the clutch cover attaching bolts to the specified torque.

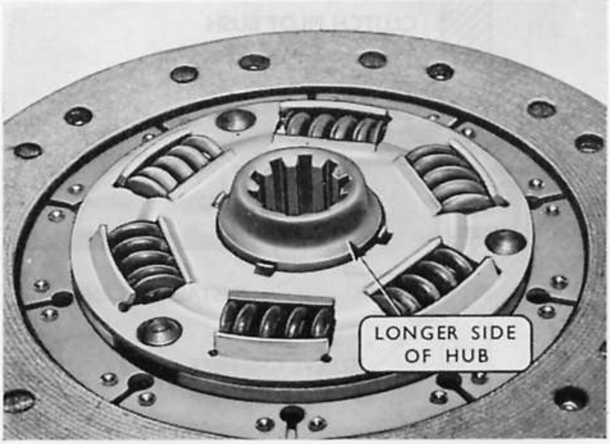


Fig. E.12. Clutch disc, showing the longer side of the hub which must be installed away from the flywheel

4. Check that the release bearing slides freely on the transmission front cover. Smear the bearing sleeve and the main drive pinion splines sparingly with recommended grease.

5. Adjust the clutch pedal free travel (page E-2).

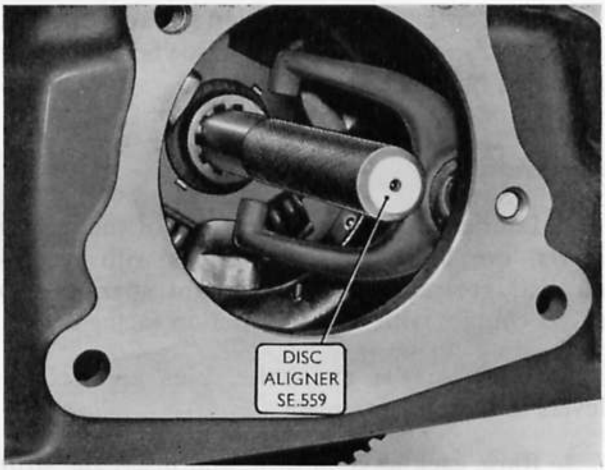


Fig. E.13. Align clutch disc prior to tightening the clutch cover bolts evenly to the specified torque

CLUTCH HOUSING

Removal

1. Remove the clutch assembly (see previous heading).

2. Remove the flywheel (see Section A).

3. Disconnect the cable from the starter, remove the attaching bolts and lockwashers, and withdraw the starter.

4. Remove the clutch fork (page E-3).

5. Detach the rubber plug from the ignition timing aperture.

Installation

Note the following:

1. Renew the clutch fork ball stud lockwasher, and assemble the fork slot seal plate and mask as shown in Fig. E.4.

2. Clean the mating faces of the housing and cylinder block, and remove any burrs. Check that the dowels are secure in the crankcase.

3. Tighten the clutch housing bolts evenly, otherwise the housing may be damaged.

4. Before fitting the bottom cover, check that the jiggle split pin is installed in the drain hole.

5. Before reconnecting the engine stay rod, check its length in relation to the rear attaching hole. Adjust the rod, if necessary, to align the holes without displacing the position of the engine on its mountings.

6. Adjust the pedal free travel (page E-2).

SPECIFICATIONS

GENERAL DATA

Clutch—Make and Type	Borg and Beck, 8A6
Pedal Free Travel	1 in.

CLUTCH COVER AND PRESSURE PLATE

Pressure Plate Thickness

Minimum after refacing	·483 in. (Fig. E.14)

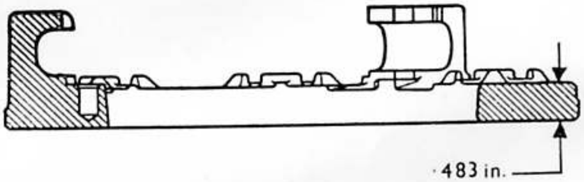


Fig. E.14. Clutch pressure plate machining data diagram

Thrust Springs

Load at 1·56 in.	195 to 205 lb
Identification colour	Cream/Light Green
Release Lever Height	1·805 to 1·825 in. using gauge plate ·284 to ·286 in. thick; lever heights must be same within ·015 in.

CLUTCH DISC

Hub Springs

Identification colour	6 Maroon/Light Green

TORQUE WRENCH DATA

Clutch to Flywheel Bolts	*14 lb.ft.
Flywheel Bolts	*48 lb.ft.

* *Clean dry threads*

RECOMMENDED LUBRICANTS

OVERSEAS

USAGE	GM SPECIFICATION NO.
Gasoline Engine	4745–M
Diesel Engine	MIL–L–2104A Supplement 1
Clutch Fork Ball Clutch Release Levers, Pins and Struts Clutch Release Bearing Sleeve	4530–M
Clutch Pedal Shaft	4550–M
Main Drive Pinion Splines	4733–M
Water Pump Seal	Castor oil base grease harmless to rubber
Crankshaft Rear Bearing Oil Seal	Paste of heavy mineral oil with 25% by weight of molybdenum disulphide
Camshaft Cams and Tappets Oil Pump Spindles Piston Pins Valve Stems	Mineral oil containing colloidal graphite
Battery Terminals Earthing Points	Petroleum Jelly

RECOMMENDED LUBRICANTS

UNITED KINGDOM

USAGE	BP	CASTROL	DUCKHAM'S	ESSO	GULF	MOBIL	REGENT	SHELL
*Gasoline Engine	Energol DSI-20W or Energol SAE 20W	Castrol CR20 or Castrolite	NOL Diesel HD 20/1 or NOL Twenty	Essofleet HDX20/20W or Esso Extra Motor Oil 20W/30	Gulflube Motor Oil HD20/20W or Gulfpride Motor 20/20W	Mobiloil Special or Mobiloil Arctic	Super RPM Delo Special SAE 20 or Advanced Havoline 20/20W	Rotella T20/20W or Shell X-100 20/20W
*Diesel Engine	Energol DSI-20W	Castrol CR20	NOL Diesel HD 20/1	Essofleet HDX20/20W	Gulflube Motor Oil HD20/20W	Delvac 1120	Super RPM Delo Special SAE 20	Rotella T20/20W
Clutch Fork Ball Clutch Release Levers, Pins and Struts Clutch Release Bearing Sleeve	Energrease C.3G or Energrease L21 M	Castrolease Brake Cable Grease or Castrolease MS 3	G.G. Grease or LBM.10 Grease	Esso Graphite Grease or Esso MP Grease (Moly)	Gulfsil Grease G.G7/8G or Gulflex Moly	Mobil-grease Special	Regent Grease 904	Retinax AM
Clutch Pedal Shaft	Duckham's KG.20 Keenol Grease							
Main Drive Pinion Splines	Energrease L.2	Castrolease LM	LB.10 Grease	Esso Multi-purpose Grease H	Gulflex A	Mobil-grease MP	Marfak Multi-purpose 2	Retinax A
Water Pump Seal	—	Castrol No. 3 Rubber Grease	Q4590 Rubber Grease	TSD 803	—	—	—	Shell Rubber Proof Grease
Crankshaft Rear Bearing Oil Seal	Rocol Anti-Scuffing Paste or Croda Grease GP/G.6591							
Camshaft Cams and Tappets Oil Pump Spindles Piston Pins Valve Stems	Acheson's Oildag							
Battery Terminals Earthing Points	Petroleum Jelly							

**We also approve the appropriate multi-grade oil (of Supplement 1 type), marketed by the above-named companies.*

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BEDFORD CA Mark 2

Training Manual

TS 961

SUPPLEMENT

Engine and Clutch

VAUXHALL MOTORS LTD

LUTON – ENGLAND

INTRODUCTION

This Supplement provides information on changes in design and servicing procedure introduced since publication of Training Manual TS 672.

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RITEWAY SERVICE TOOLS

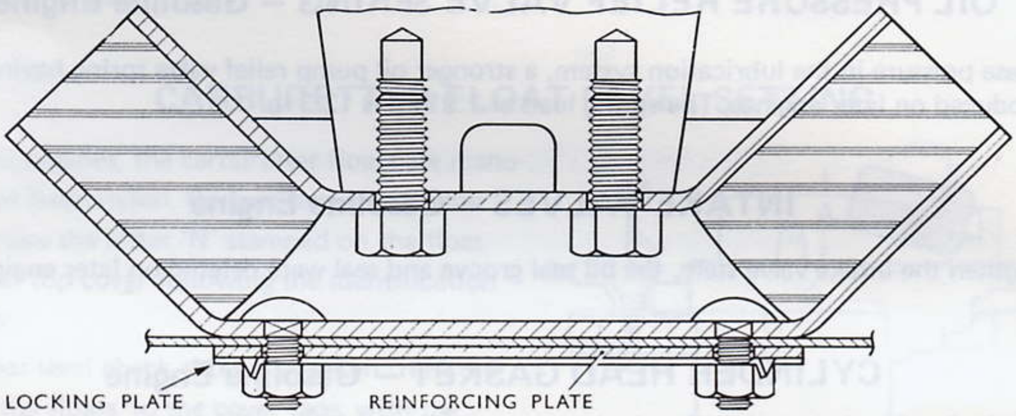
Tools which carry a 'Z', 'D' or 'VR' prefix to the tool number are available from the following sources:

All territories except Continental Europe, Kent-Moore Tools Ltd, Bow Street, Birmingham 1, England.

Continental Europe, Kent-Moore International AG, Altgasse 6340, Baar-Zug, Switzerland.

Drawings of 'SE' tools are still obtainable from Service Department, Vauxhall Motors Ltd.

ENGINE REAR MOUNTING CROSSMEMBER



The engine rear mounting crossmember was strengthened on later models, by the introduction of a reinforcing plate.

TIMING COVER AND FRONT PLATE GASKETS – Gasoline Engine

On later engines, improved gaskets were introduced on either side of the crankcase front plate. These gaskets swell on contact with oil, therefore, it is essential that no sealer or jointing compound be used on assembly.

TIMING COVER ALIGNMENT – Gasoline Engine

It is not sufficiently accurate to use the crankshaft pulley for aligning the timing cover oil seal concentric with the pulley hub land.

Aligner Z8575 should be used for this purpose.

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OIL PUMP – Gasoline Engine

A revised oil pump assembly was introduced on later engines. The revised pump differs from the earlier pump in that the driving and driven impellers are identical, and the driving impeller is a press fit on its spindle, without a key.

Specifications are revised as follows:

Driven Impeller Spindle Diameter	0.4951/0.4956 in.
Driving and Driven Impeller Bore	0.4966/0.4974 in.
Backlash between Impeller Teeth	0.005/0.013 in.
Fit of Driven Impeller on Spindle	0.0010/0.0025 in. clearance

OIL PRESSURE RELIEF VALVE SPRING – Gasoline Engine

To increase pressure in the lubrication system, a stronger oil pump relief valve spring having 22 coils was introduced on later engines. The spring load at 1.91 in. is 12.3 lb.

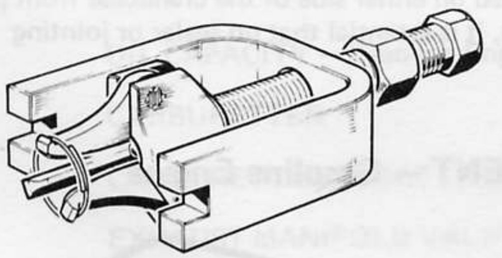
INTAKE VALVES – Gasoline Engine

To strengthen the intake valve stem, the oil seal groove and seal were deleted on later engines.

CYLINDER HEAD GASKET – Gasoline Engine

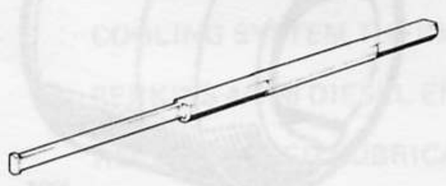
The cylinder head gasket serviced for the low compression engine is a lamination of steel, asbestos and copper. The gasket must be installed with its identification tab to the rear of the engine. Cylinder head nut torque remains at 73 lb ft.

CUP PLUG REMOVAL – Gasoline Engine



Cup Plug Remover D1059 has been superseded by VR2022.

CRANKSHAFT BEARING CAP SEAL INSTALLATION – Gasoline Engine



Installer D1014 has been superseded by VR202

OIL CAPACITY – Gasoline Engine

The nominal quantity of oil required for engine refill following filter element change has been revised to 7 Imp. pints.

CARBURETTER

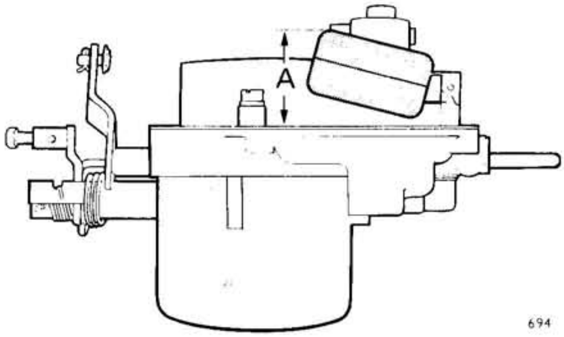
For a limited production run a 34IV carburetter incorporating a double choke tube was used. Revised jet settings for this carburetter are as follows:

Compensating Jet	135
Pump Jet	50
Air Bleed Screw	3 mm

CARBURETTER FLOAT LEVEL SETTING

On later engines, the carburetter floats are manufactured from nylon. Carburetters with nylon floats have the letter 'N' stamped on the float chamber top cover following the identification number.

The float level check should be taken from the top of the floats to the cover face, with the gasket in position. Dimension 'A' should be 30.5/31.5 mm.



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EXHAUST MANIFOLD VALVE – Gasoline Engine

The use of a heat valve in the exhaust manifold was discontinued on later engines.

RADIATOR FILLER CAP

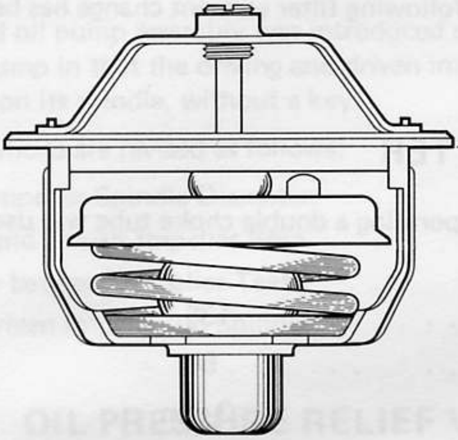
On later models the 4 lb/sq in. pressure filler cap was replaced by a revised cap, the valve opening pressure of which is 6¼ – 7¾ lb/sq in.

FAN BELT ADJUSTMENT – Vehicles with Alternator

On alternator-equipped vehicles a jockey pulley is provided for fan belt adjustment. To adjust belt, slacken nut at centre of jockey pulley and move pulley vertically.

Belt should deflect 0.38 in. under a load of 10 lb, applied midway between fan pulley and jockey pulley.

COOLING SYSTEM THERMOSTAT – Gasoline Engine



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On later engines the AC capsule type thermostat, formerly used only with a heater, became standard usage.

PERKINS 4/108 DIESEL ENGINE

The Perkins 4/99 diesel engine was replaced by the Perkins 4/108 diesel engine on later models. A comprehensive Workshop Manual, Publication No. 7764, dealing with the 4/108 engine is available from Perkins Engines Ltd, Service Division, Peterborough, Northants.

RECOMMENDED LUBRICANTS – OVERSEAS

The list of lubricants recommended for use overseas is amended as follows:

Gasoline Engine	
Specification	GM6041-M or GM4745-M or oil intended for Service MS
Viscosity:	
Above 0°C	20W or 10W – 40
0°C to -12°C	10W or 10W – 30
Below -12°C	5W or 5W – 20
Diesel Engine	
Specification	MIL-L-2104B
Viscosity:	
Above 27°C	30
27°C to 7°C	20 – 20W
7°C to -18°C	10 – 10W

RECOMMENDED LUBRICANTS -- UNITED KINGDOM

Usage	BP	Castrol	Duckhams	Esso	Gulf	Mobil	Petrofina	Regent	Shell
Gasoline Engine	Vanellus 20W or Super Viscostatic SAE 20W/50 or Energol SAE 20W	Castrol CR1 20 or Deusol CR1 20 or Castrol GTX or Castrolite 10W/30	NOL Diesel HD 20/1 or Q20-50 or NOL 20	Essolube HDX 20/20W or Uniflo or Esso Motor Oil 20W/30	Gulflube Motor Oil HD 20/20W or Gulfpride Single G 10W/30 or Gulfpride Motor Oil 20/20W	Delvac 1120 or Mobiloil Super	Fina Delta Motor Oil SAE 20W/20 or Fina Multi-grade Motor Oil 10W/30 or Fina Motor Oil 20/30	Ursa S1 SAE 20-20W or Havoline Oil 10W/30 or Havoline Oil 20/20W	Rotella T20/20W or Shell Super Motor Oil 100 or Shell X100 20/20W
Diesel Engine	Vanellus 20	Castrol CRB 20	Fleetol HDX 20	Essolube HDX 20/20W	Gulflube XHD 20	Delvac 1120	Fina Delta Motor Oil SAE 20W/20	Ursa Extra Duty SAE 20	Rotella T 20/20W
Clutch Fork Ball Clutch Release Levers, Pins and Struts Transmission Front Cover Sleeve	Energrease C.3G or Energrease L.21M	Castrolease MS3	G.G.Grease or LBM.10 Grease	Esso Graphite Grease or Esso MP Grease (Moly)	Gulfsil Grease G.G7/8G or Gulflex (Moly)	Mobilgrease Special	Fina Marson LM2	Regent Grease 904 or Molytex Grease 2	Retinax AM
Clutch Pedal Shaft	—	—	Keenol	—	—	—	—	—	—
Main Drive Pinion Splines	Energrease L.2	Castrolease LM	LB.10 Grease	Esso Multi-purpose Grease H	Gulflex A	Mobilgrease MP	Fina Marson HTL 2	Marfax Multi-Purpose 2	Retinax A
Water Pump Seal	—	Castrol/ Girling Rubber Grease (Red)	Q.4590 Rubber Grease	TSD 803	—	—	—	—	—
Oil Seals	Rocol Anti-scuffing Paste or Croda Grease GP/G.6591								
Camshaft Cams and Tappets Oil Pump Spindles Piston Pins Valve Stems	Acheson's Oildag								

SERVICE TRAINING MANUAL

for

TRANSMISSION, PROPELLER SHAFT, REAR AXLE

BEDFORD CA
Mark 2

SERVICE

VAUXHALL MOTORS LTD

LUTON · BEDFORDSHIRE · ENGLAND

TS.673

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FOREWORD

This group of the manual provides comprehensive information on the Transmission, Propeller Shaft and Rear Axle of the Bedford CA, Mark 2.

Contents. The main subjects dealt with are listed on page iii. An individual index is provided on the first page of each section, and a general index is included at the end of this group.

General Notes. Recommendations on important general items which must be observed whenever service work is undertaken are collated under 'General Notes' on page vii. It is important that servicemen should become familiar with all of these points.

Recommended Lubricants. Lubricants approved and recommended for use in the United Kingdom and Overseas are listed at the end of this group.

Guardian Maintenance. The notes included under this heading in appropriate sections are confined to service procedure. For further information, reference should be made to the Guardian Maintenance booklet supplied with the vehicle.

Riteway Service Tools. Reference is made throughout the manual to tools designed to facilitate service operations. All of these tools are illustrated in use.

Tools which carry a prefix 'Z' to the tool number are available to Authorized Dealers from the Parts and Accessories Department, Vauxhall Motors Limited, Dunstable, Beds.

Tools prefixed 'D' are supplied by various Factors and orders should be addressed to the Service Department, Route 2494, Vauxhall Motors Limited, Luton, Beds.

An 'SE' prefix to the number indicates that the tool must be manufactured locally. Detail drawings of 'SE' tools may be obtained from the Service Department, Route 2494.

MODEL DESIGNATIONS

CAS	90 in. wheelbase	Chassis No.	10/12 and 15/17 cwt.
CAL	102 in. wheelbase	350000 onwards	Chassis and Van

LOCATION OF MODEL IDENTIFICATION PLATE AND ENGINE NUMBERS

A plate on which is stamped the model identification letters and numbers, is attached to the footwell panel, inside the body, adjacent to the steering column.

The engine number is stamped in the following locations. On diesel-engined vehicles: on the top edge of the facing on the cylinder block to which the fuel injection pump is attached. On gasoline-engined vehicles: on a pad on the crankcase adjacent to the fuel pump.

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GENERAL NOTES

Safety Precautions

Isolation of Battery. Always disconnect the battery before commencing operations where there is the slightest possibility of accidental engagement of the starter or the danger of a short circuit. Neglect to take this precaution may result in personal injury and the risk of fire.

Jacking. To prevent damage, the following precautions should be taken when jacking up and supporting the vehicle on stands.

1. When jacking up the front of the vehicle on the front axle crossmember, a block of wood should be interposed between the jack and the crossmember.

2. When jacking up the rear of the vehicle, ensure that the jack pad is in the centre of the axle housing and that any projections on the pad are not fouling the housing rear cover and taking the weight.

3. Support the vehicle on stands located below the chassis frame sidemembers.

Bearing Service (Ball and Roller)

Bearings that have been in service, excluding sealed types, must be thoroughly cleaned before they are inspected. Wash the bearings in clean flushing oil or white spirit and then blow out with compressed air. *Do not allow the air stream to spin the bearing, otherwise the rotating surfaces will be damaged.* Immediately after cleaning, lubricate the bearings with clean engine oil.

Examine the bearings for corrosion caused by the entry of water, and for discoloration (blueing) resulting from overheating. A light brown discoloration may be due to lubricant stain and is not detrimental.

When rotating the bearings to check for wear or damage, apply axial pressure to bring the balls or rollers firmly into contact with the races. Single-row radial bearings normally have a certain amount of end float when removed from a unit.

Sealed bearings are charged with grease during manufacture and *must not be placed in cleaning fluid or a degreasing plant.* Likewise if the shields are damaged, lubricant retention will be affected and the bearing must be discarded.

Absolute cleanliness is essential during inspection, and when reassembling bearings to units, to avoid contamination with abrasive substances, otherwise the highly polished mating surfaces will be damaged, thus increasing the rate of wear.

Cleanliness of Components

Clean all components prior to inspection for wear or damage, but do not wash sealed bearings in solvent or place in a degreasing plant.

Identification of Components

When components are removed it is sometimes necessary to identify their locations relative to other parts, also to ensure that mated surfaces are correctly related on reassembly.

Some components have mating marks stamped on them during manufacture. In the absence of such marks, however, care must be taken in the method of identification employed. The location of two housings, for example, could be identified by centre-punching or with file marks, *but this treatment if applied to a stressed component such as an axle shaft could lead to fatigue failure.* Generally, the safest and most satisfactory method is to mark with a quick-drying paint.

Expendable Items

Whenever a unit is disassembled, renew all gaskets, oil seals, split pins, circlips, lockwashers and tab washers where applicable. Not all nuts and bolts are equipped with lockwashers. When in doubt on usage, refer to the Parts Catalogue.

Specifications

Refer to 'Specifications' at the end of a section for dimensional and other data for use when assessing component wear and when making adjustments. Unless otherwise stated, the dimensions given are the manufacturing limits for new parts.

Recommended lubricants

The references to lubricants in the manual text are in general terms only. In all cases the list of 'Recommended Lubricants' at the end of the group should be consulted for grades and specifications. This list includes particulars of lubricants to be used during initial assembly.

Use of Torque Wrench

Certain nuts and bolts must be tightened to a specified torque. These are listed under 'Specifications' at the end of each section. Bolts and nuts which have been tightened beyond the prescribed torque wrench figures, should not merely be slackened off to the correct figure, as they may work loose. The correct procedure is *that the bolt or nut should be loosened until free of all stress and then retightened to the correct figure.*

Screw Threads

The nuts, bolts and studs used on units of Vauxhall manufacture have threads of the Unified Thread Form. These threads closely resemble our previous usage of the American National Form thread and for practical purposes are interchangeable. Nuts or bolts with any other form of thread cannot be interchanged.

The wrenches for use on Unified-threaded nuts and bolts are listed below.

Wrench Sizes for Unified Nuts and Bolts

Bolt diamater in inches		$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$ *	$\frac{1}{2}$	$\frac{9}{16}$ *	$\frac{5}{8}$	$\frac{3}{4}$
Wrench sizes in inches across flats	Nut	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{11}{16}$	$\frac{3}{4}$	$\frac{7}{8}$	$\frac{15}{16}$	$1\frac{1}{8}$
	Bolt	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{13}{16}$	$\frac{15}{16}$	$1\frac{1}{8}$

NOTE: *For bolt diameters indicated* (*) *the hexagon size is greater for the nut than for the bolt.*

SECTION F— GEAR SHIFT LINKAGE

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Have you read the General Notes on page vii ?

DESCRIPTION

The gear shift lever is retained by two spring-loaded pivots to a pivot jaw screwed into the steering top bearing housing, in the bore of which is located a selector rod having a right-angled set. A spring-loaded spherical bush assembled to the end of the rod locates in the tubular end of the lever. With a four-speed transmission the lever is fabricated (see Fig. F.4) having an adjustable tube, housing a rod to which is attached a stepped shoe at the inner end. The shoe engages the end of the selector rod to provide a reverse gear stop.

The lower end of the selector rod is supported by a bracket on the steering column cover and carries a change speed lever. Above the lever is an

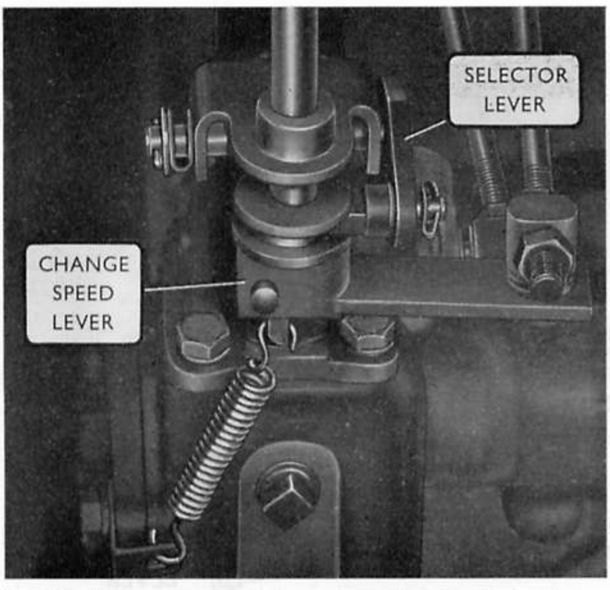


Fig. F.1. Arrangement of change speed and selector levers on the steering column

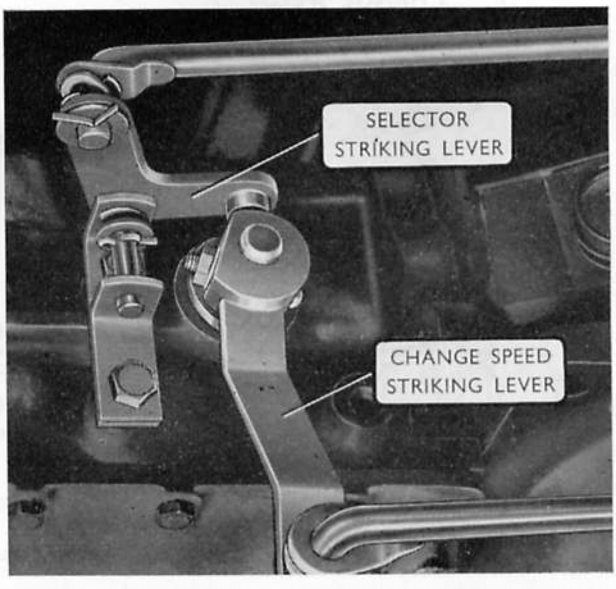


Fig. F.2. Arrangement of change speed and selector striking levers on the transmission

integral slotted boss which provides engagement for the fulcrum pin of a bell-crank selector lever (Fig. F.1). The rod is held in the lower neutral position by a tension spring attached to the steering gear casing. The outer ends of the change speed lever and the selector lever are each fitted with a control rod adjuster.

Two short adjustable control rods connect the change speed and selector levers to relay levers and these are connected with the change speed striking and selector striking levers on the transmission (Fig. F.2) by non-adjustable rods. The change speed lever is secured with a cotter to the outer end of the transmission striking lever shaft. The boss of the lever is slotted to provide engagement for a fulcrum pin fitted to the inner end of the selector striking lever.

OPERATION

Gear selection is made through the upward and downward movement of the gear shift lever. This movement is changed to forward and rearward movement of the selector control rods by the pivoting of the selector lever engaged with the slotted boss at the bottom of the selector rod. The operation of the selector control rods then causes the selector striking lever, engaged with the slot in the change speed striking lever, to move the

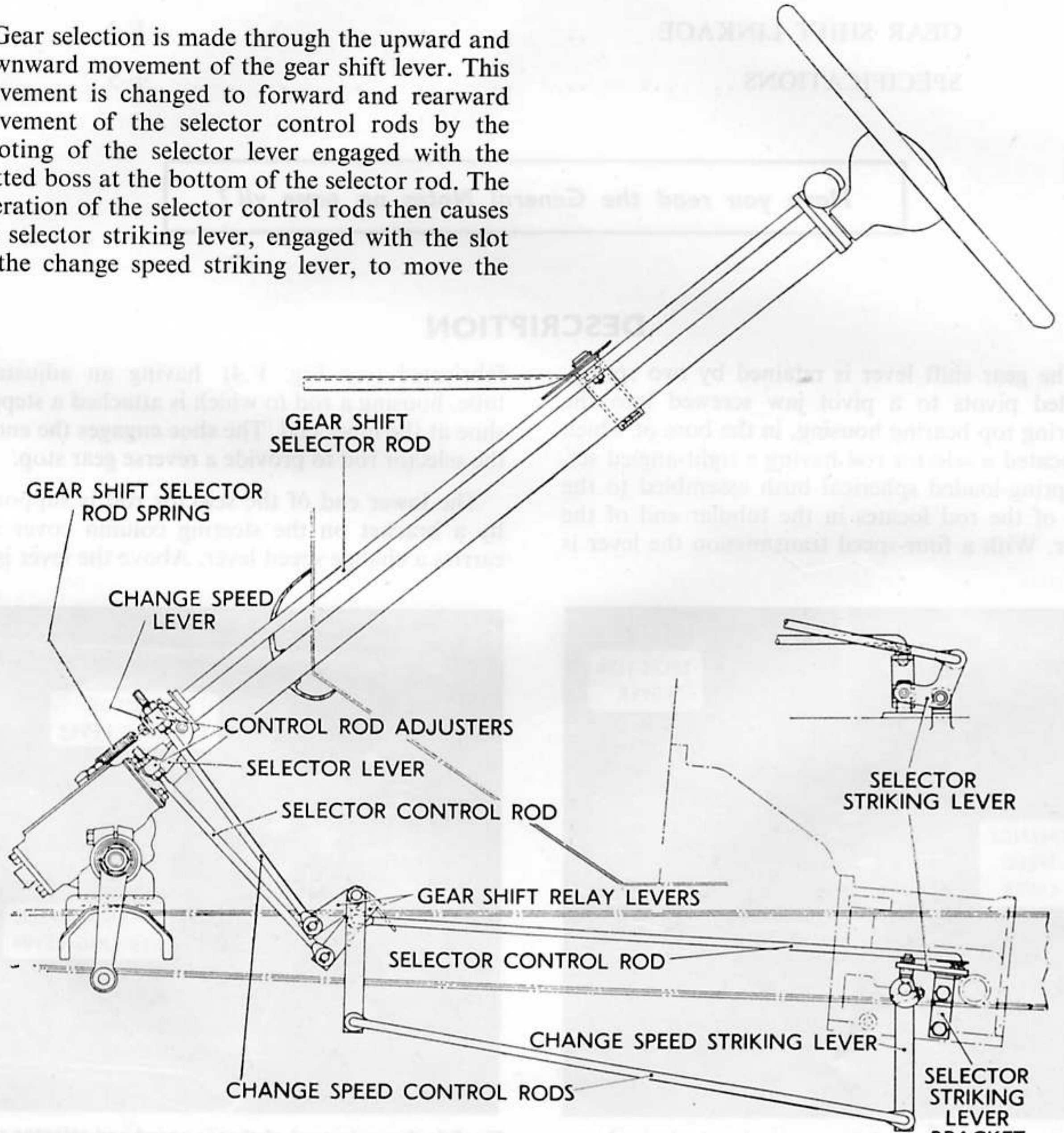


Fig. F.3. Gear shift linkage layout

transmission striking lever shaft transversely to the position required for gear engagement.

Angular movement of the gear shift lever, either forwards or rearwards, transmits movement through the change speed lever at the bottom of the selector rod to the change speed control rods. The operation of the control rods then pivots the lever on the transmission striking lever shaft and rotates the shaft to engage the required gear.

GUARDIAN MAINTENANCE

The gear shift lever is connected to the controls on the transmission by rods and relay levers. The working parts require lubricating periodically with engine oil.

GEAR SHIFT LEVER
(Four-speed Transmission)

Removal

Compress the two spring-loaded pivots securing the lever to the pivot jaw, withdraw the lever and remove the pivots and springs.

Disassembly

1. Unscrew the knob anti-clockwise.
2. Loosen the locknut and unscrew the tube from the adaptor.
3. Remove the adaptor and withdraw the rod and reverse stop spring.
4. Unscrew the shoe from the rod.

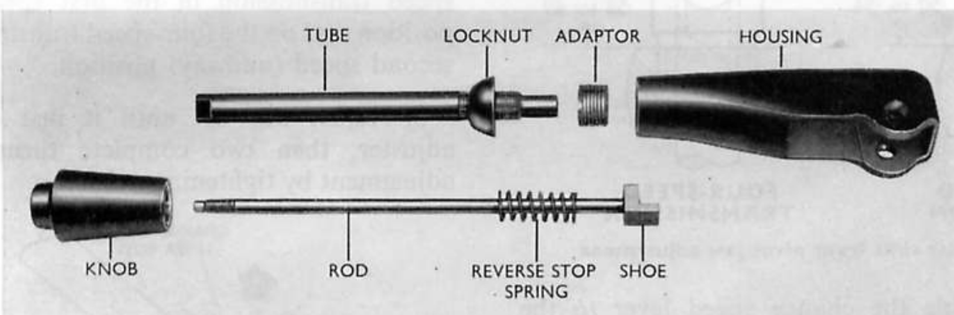


Fig. F.4. Exploded view of four-speed gear shift lever

Reassembly

1. Screw the shoe tightly on the short-threaded end of the rod and lubricate the shoe with recommended grease.
2. Assemble the reverse stop spring to the rod and insert the rod into the housing. Ensure that the shoe is the correct way round in the slot (Fig. F.4).
3. Screw the adaptor into the housing.
4. Screw the locknut on to the tube and the tube into the adaptor.
5. Screw the knob on to the rod and hand tighten.
6. Adjust the position of the tube in the adaptor to obtain the specified dimension from the step of the shoe to the end of the bore (Fig. F.5) and secure with the locknut.

Installation

1. Lubricate the pivots and springs with recommended grease and insert in the jaw.
2. Assemble the gear shift lever to the jaw.

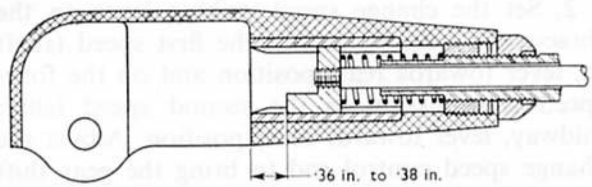


Fig. F.5. Four-speed gear shift lever shoe adjustment

GEAR SHIFT LINKAGE

Gearshift Lever Jaw Adjustment

1. Detach the spring from the lower end of the selector rod.

2. Detach the control rod adjuster from the change speed lever at the bottom of the steering column and rotate the rod through 90°. Remove the cotter from the lever.

3. Compress the two spring-loaded pivots securing the gear shift lever to the pivot jaw, withdraw the lever and remove the pivots and springs.

4. Lift the selector rod clear of the pivot jaw and adjust the height of the jaw to the specified dimensions (Fig. F.6).

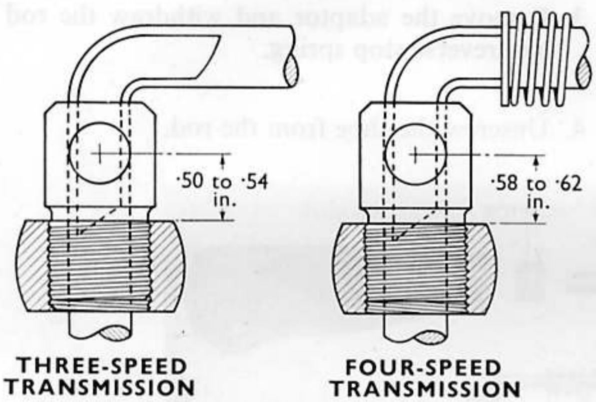


Fig. F.6. Gear shift lever pivot jaw adjustment

5. Reassemble the change speed lever to the selector rod and secure with the cotter.

6. Reassemble the gear shift lever to the pivot jaw.

7. Attach the spring to the lower end of the selector rod.

Linkage Adjustment

1. Check that the gear shift lever jaw height is within the specified limits.

2. Set the change speed striking lever on the three-speed transmission in the first speed (shaft in, lever towards rear) position and on the four-speed transmission in the second speed (shaft midway, lever towards rear) position. Adjust the change speed control rod to bring the gear shift lever 20° below the horizontal (Fig. F.7).

Fig. F.7. Gear shift lever location after adjustment of change speed linkage

3. With nuts 'A' and 'B' (Fig. F.8) slackened off, pull the gear shift lever upwards as far as possible and lash to the steering wheel.

4. Set the selector striking lever on the three-speed transmission in the first speed (forward) position and on the four-speed transmission, in the second speed (midway) position.

5. Adjust nut 'B' until it just contacts the adjuster, then two complete turns. Lock the adjustment by tightening nut 'A'.

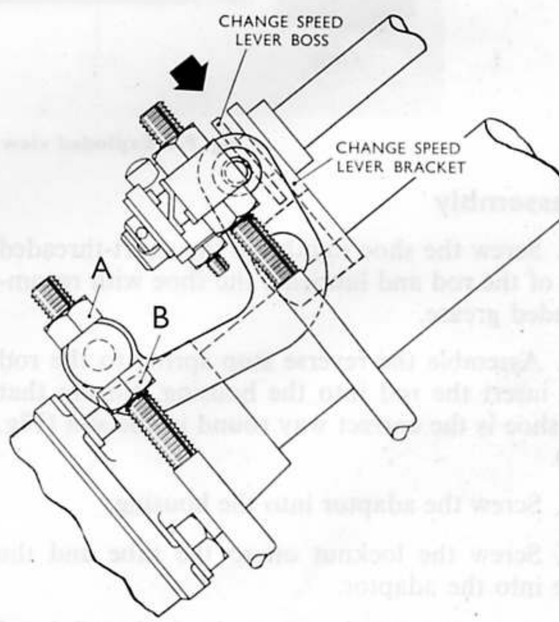


Fig. F.8. Selector lever setting details. On four-speed transmissions, with reverse gear engaged, check that clearance exists between the change speed lever boss and the lever bracket, indicated by arrow

GUARDIAN MAINTENANCE

The needle roller bearings are filled with grease during assembly, but need replenishing periodically through the lubrication nipples screwed into the trunnions.

The splines of the sliding sleeve yoke are lubricated by oil in the transmission rear cover.

PROPELLER SHAFT

Removal

1. Raise and support the rear of the vehicle.

2. Remove the nuts and bolts securing the universal joint flange to the axle pinion shaft flange.

3. Withdraw the sliding sleeve and propeller shaft assembly away from the transmission rear cover and insert a spare sliding sleeve in the cover to prevent oil loss.

Installation

Note the following points:

1. Install the rear flange bolts with the heads towards the universal joint.

2. Run the engine for a few minutes to circulate oil from the transmission casing into the rear cover. Stop the engine and top up the transmission.

UNIVERSAL JOINTS

Renewal

1. Remove the propeller shaft.

2. Remove the lubrication nipple from the trunnion.

3. Clean away paint from the bearing snap rings.

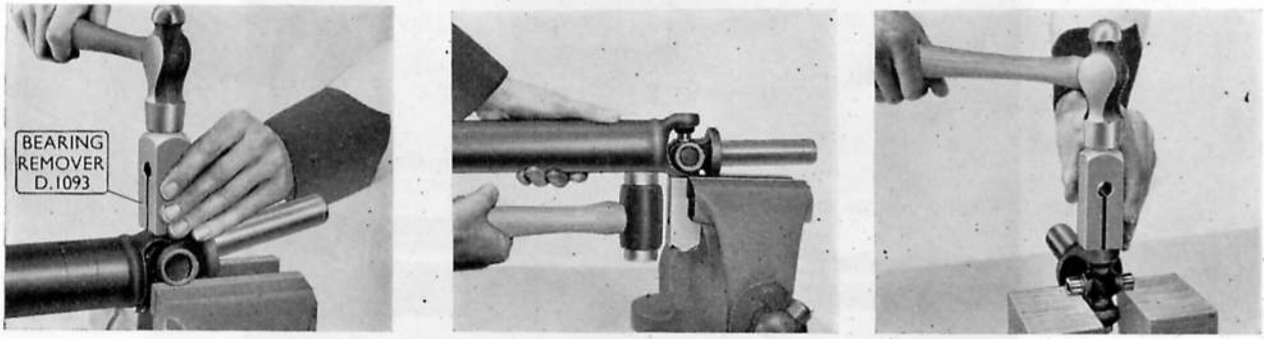
4. Tap the end of one of the bearing races with a brass drift to relieve end thrust on the snap ring and remove the ring. Remove the remaining snap rings in a similar manner.

5. Support the sliding sleeve yoke, or flange yoke, on the jaws of a vice so that the lubrication nipple boss in the trunnion is facing downwards.

6. Using the remover shown in Fig. H.2, tap the propeller shaft yoke to withdraw the bearing race as far as possible from the yoke.

7. Complete the removal of the race by clamping the remover in a vice and tapping the propeller shaft (adjacent to the yoke) with a soft metal hammer.

8. Remove the bearing race from the other



Stage 1 Stage 2 Stage 3

Fig. H.2. Disassembling a universal joint side of the propeller shaft yoke in a similar manner and detach the trunnion and sliding sleeve from the propeller shaft.

9. Support the exposed bearing journals of the trunnion on hardwood blocks with the lubrication nipple boss facing downwards and remove the top race in the manner described in operations 6 and 7. Invert the assembly and remove the remaining bearing race.

10. Install the new trunnion and bearing races, noting the following:

(*a*) If necessary, coat the needle rollers with petroleum jelly to retain them in the races.

(*b*) Assemble the trunnion to the yokes so that the lubrication nipple boss faces towards the sliding sleeve and is in line with the nipple boss on the other joint.

(*c*) The seals should be kept as dry as possible.

(*d*) Use a flat faced drift of ·80 in. diameter for tapping home the bearing races.

(*e*) Ensure that all snap rings are seated correctly

(*f*) Install the lubrication nipple and charge the joint with recommended grease.

SPECIFICATIONS

Universal Joints

Number of needle rollers—each bearing 22

Sliding Sleeve

Diameter .. .. 1·3735 to 1·3750 in.

SECTION J— REAR AXLE

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Have you read the General Notes on page vii ?

DESCRIPTION

The semi-floating type rear axle incorporates a hypoid final drive with an overhung mounted pinion.

Axle Housing

The housing is a fabricated unit comprising a cast differential carrier with pressed-in tubular assemblies dowelled for location. Welded to the outer ends of the tubes are the axle shaft bearing housings which also provide attachment for the brake flange plates. Seats for the rear springs are welded to the underside of the tubes. A detachable rear cover incorporating a combined oil filler and level plug, is bolted to the rear face of the housing.

Differential, Hypoid Gear and Pinion

The differential case and cover are clamped together and attached to the hypoid gear by eight bolts screwed into the gear. Housed in the case and cover assembly are two differential pinions operating on a fixed shaft and two internally splined side gears. The differential and hypoid gear assembly is carried in the axle housing by two taper roller bearings secured by caps and bolts. Lateral location of the assembly and pre-load of the bearings is controlled by spacers interposed between the end face of the bearing outer races and the axle housing.

The hypoid pinion is overhung mounted in the axle housing in two pre-loaded taper roller bearings. A compressible spacer assembled between the front and rear bearing inner races provides a clamping force on the universal joint coupling flange nut. Shims assembled between the front face of the rear bearing outer race and the bearing abutment face in the axle housing locate the pinion in correct relationship to the hypoid gear.

A universal joint coupling flange is assembled to the splined end of the pinion shaft. A pinion oil seal of the spring-loaded type is pressed into the front of the axle housing, and operates direct on the universal joint flange land. The seal is protected from foreign matter by a dust shield.

Positive lubrication of the pinion bearings is provided by oil circulating via oilways in the axle housing.

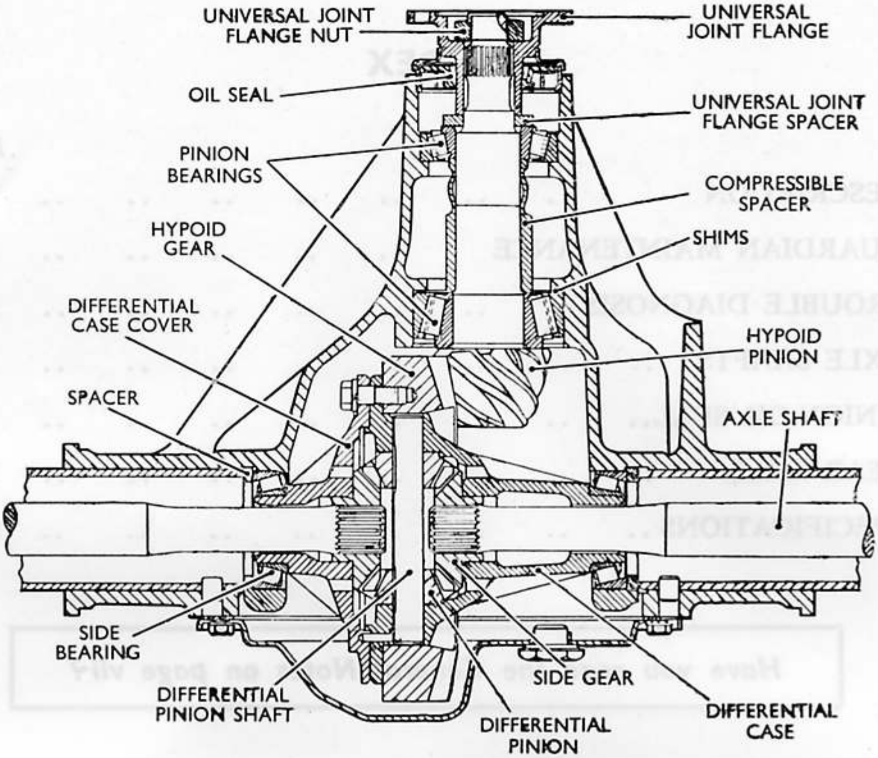


Fig. J.1. Sectioned view of rear axle

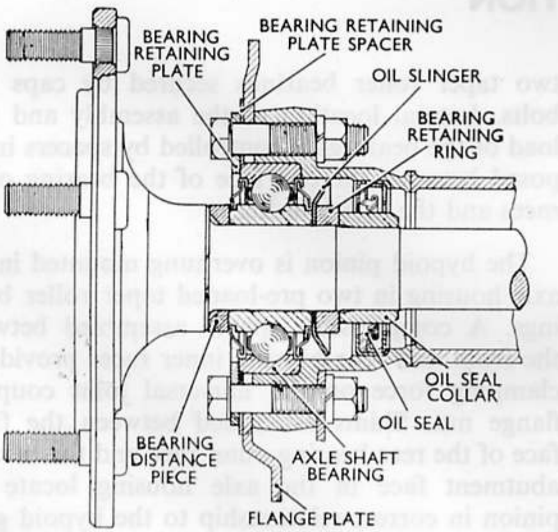


Fig. J.2. Sectioned view of axle shaft bearing installation

Axle Shafts

The flanged-type axle shafts are carried in sealed ball bearings (Fig. J.2), located in the housings at the outer ends of the axle tubes by retaining plates which, with the brake flange plates, are bolted to the flanges on the housing. A distance piece is assembled between the bearing and the shoulder on the axle shaft. A shrunk-on ring retains the bearing on the shaft with an oil slinger assembled between the ring and the bearing. A spring-loaded oil seal pressed into the housing at the inner side of the bearing operates on a ground collar pressed on to the shaft. The wheel bolts assembled to the flanged end of each shaft also locate the brake drum which is secured by two bolts screwed into the flange.

GUARDIAN MAINTENANCE

The hypoid gears in the rear axle require special lubricant, as listed under 'Recommended Lubricants.'

The combined oil level and filler plug is located on the axle housing rear cover. Clean away all dirt from around the filler plug before removing it. The lubricant should be level with the bottom of the filler plug hole. When installing the filler plug, make sure the plug is clean and renew the filler plug gasket if necessary.

Periodic draining and refilling is not required.

TROUBLE DIAGNOSIS

Rear Axle Noisy

When dealing with a complaint of alleged rear axle noise, a thorough road test should be carried out before the axle is disassembled. One important point to remember is that all rear axles generate a certain degree of noise, but normally the noise level is so low that it is not audible above normal vehicle or road noises. Axles within this category are therefore classified as quiet.

Whilst the trained ear can sometimes detect a slight axle noise under certain speed or load conditions, this does not necessarily indicate a case of potential axle failure or that the noise level will increase with mileage build-up. Therefore, the tester must be able to determine normal and abnormal axle noise in order to avoid unnecessary rejection of units.

Quite often noise emanating from another component on the vehicle is wrongly attributed to the rear axle, with the result that the axle is unnecessarily disassembled.

To assist in accurate diagnosis, information regarding items which can be confused with axle noise as well as complaints directly associated with the axle are given below.

Road Noise. In some cases noise created when operating on certain road surfaces such as cobbles or rough surfaced concrete can be mistaken for rear axle noise, but usually with road noise the intensity and range of sound remains the same on drive or over-run. Testing the vehicle on a different type of surface such as macadam or smooth asphalt will immediately determine whether the noise is due to road surface.

Tyre Noise. Experience has shown that the various makes of tyre provided as standard or optional equipment do not normally generate undue noise. However, if due to harsh driving the tyres (front or rear) are unevenly worn, tyre noise could result, likewise if the tyre pressures are low. During test it will be found that any noise associated with tyres will change with different road surfaces, whilst rear axle noise will not be affected. Furthermore, tyre noise remains fairly constant on drive or over-run, whereas axle noise invariably changes.

Axle Shaft Bearing or Front Wheel Bearing Noise. The noise produced by a rough or slack bearing can be misleading and appear to emanate from the axle gears. Test the vehicle on a road having a smooth surface and steer the vehicle sharply left and right. If the trouble is due to axle shaft or wheel bearings the noise will tend to increase with the thrust imposed on the bearings. Furthermore, a defective wheel bearing will remain audible under drive or over-run conditions, and when coasting in neutral.

Transmission Noise. It is possible that a noise generated by the transmission may appear to originate from the rear axle due to the sound travelling down the propeller shaft. The source of the trouble can sometimes be determined by running the engine, with transmission in neutral and varying the engine speed up and down the range.

Reproduction of the noise in this manner will confirm that the trouble is not associated with the rear axle and more likely to emanate from the transmission.

It should be remembered that if the noise is due to a worn or rough bearing in the transmission, it may only become apparent under loaded conditions and therefore may not be reproduced during the above check.

Hypoid Gear and Pinion Noise. Abnormal noise from this source is usually most pronounced in a speed range of 35 to 45 m.p.h. and occurs under either drive or over-run conditions. Testing should be carried out on a road having a smooth level surface, to avoid false impressions created by road noise.

Whilst excessive noise from the gear and pinion is rare, it can be the result of any of the following:

(*a*) Incorrect or insufficient lubricant resulting in scuffed teeth. The effect of scuffed teeth will be a sudden development of noise on either drive or over-run.

(*b*) Incorrect backlash between hypoid gear and pinion teeth or incorrect setting of the pinion relative to the hypoid gear. In either case the noise may be apparent on drive, over-run or both conditions.

(*c*) Insufficient pre-load on bearings allowing variable mounting of gear or pinion or both. Lack of pre-load or slackness in bearings will result in excessive noise on both drive and over-run, distinctly audible with change of loading.

Bearing Noise. Unlike noise arising from the gear and pinion, the noise produced by a defective bearing remains constant whether the axle is operating on drive, float or over-run conditions and, furthermore, will continue when coasting in neutral. In view of the fact that the pinion bearings rotate at a greater speed than the differential side bearings, a defective pinion bearing will reproduce a higher note than that created by a defective side bearing. Bearing failure can be the result of any of the following:

(*a*) Incorrect or insufficient lubricant.

(*b*) Excessive pre-load during initial assembly.

(*c*) Damage due to careless handling prior to installation.

AXLE SHAFTS

Removal

1. Raise and support the rear of the vehicle.

2. Remove the road wheel and release the parking brake.

3. Remove the two bolts securing the brake drum to the axle shaft flange and withdraw the drum.

4. Remove the four bolts, nuts and spring washers securing the axle shaft bearing retaining plate.

5. Withdraw the shaft sufficiently to insert an axle shaft guide (Fig. J.3), then complete the removal of the shaft; do not allow the splines to foul the oil seal.

Inspection and Reconditioning

Axle Shaft

1. If the splines are worn excessively, twisted or damaged, renew the corresponding differential side gear in addition to the axle shaft.

2. The shaft can be checked for run-out by mounting it between centres and taking a reading off the oil seal collar.

3. If the oil seal collar is only slightly worn or scored it can be polished with very fine emery cloth, but if excessively worn it must be renewed (see below).

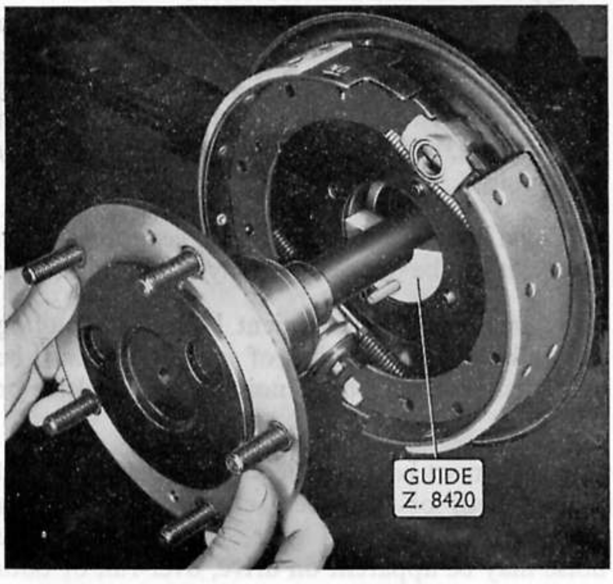


Fig. J.3. Removing an axle shaft

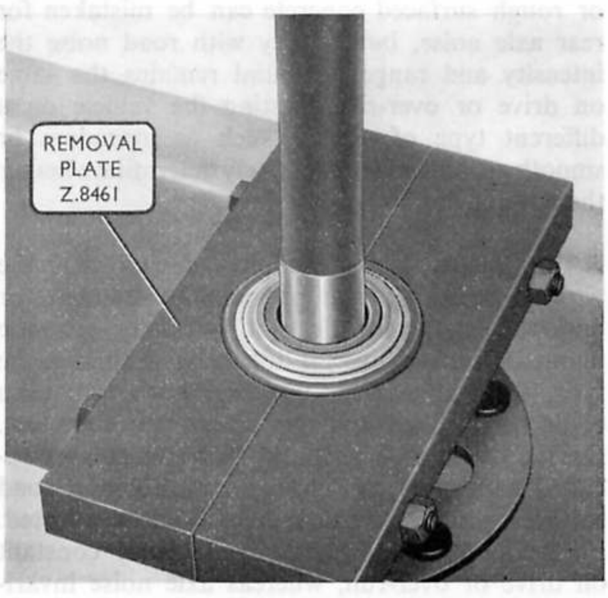


Fig. J.4. Pressing off an axle shaft bearing

Axle Shaft Bearing

Examine the axle shaft bearing (see page vii). To renew the bearing, proceed as follows:

1. Support the oil seal collar on an anvil or steel block and release it from the shaft by nicking it with a chisel. After striking the chisel a few blows, the collar will slacken off and can be withdrawn.

2. Bend back the oil slinger and release the bearing retaining ring in a similar manner to the oil seal collar.

3. Press the shaft out of the bearing (Fig. J.4) and withdraw the bearing retaining plate, spacer and distance piece from the shaft.

4. Check the diameter of the shaft bearing land and the fit of the new bearing in the axle housing.

5. Place the bearing retaining plate and spacer in position on the shaft and locate the distance piece with the internal chamfer towards the flanged end of the shaft.

6. Press the new bearing home against the distance piece.

7. Place a new oil slinger on the shaft with the concave side towards the splines.

8. Heat a new bearing retaining ring on a hot plate to dark blue coloration. Quickly place the ring in contact with the bearing using tongs (Fig. J.5) and rapidly slide the installer over the shaft into contact with the ring (Fig. J.6) and leave in position until the ring has cooled.

Fig. J.5. Installing an axle shaft bearing retaining ring. The shaft must be supported so that the wheel bolts are clear of the bench

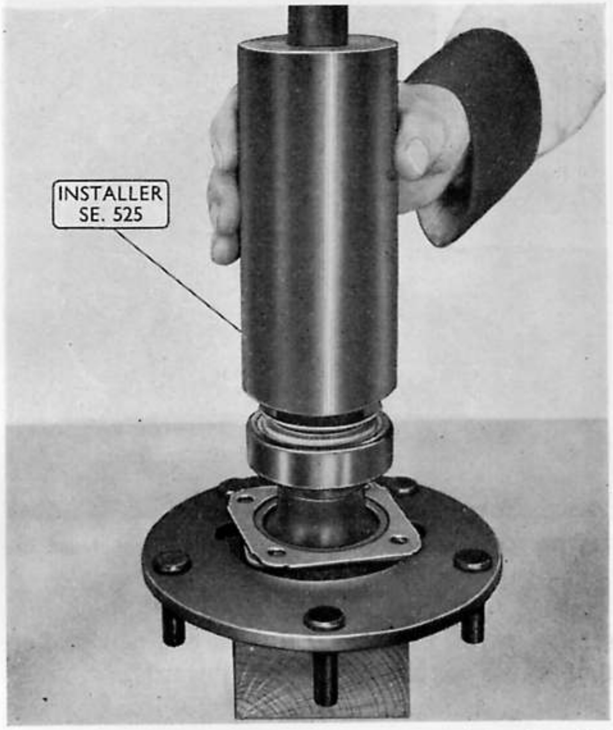


Fig. J.6. Installer in position on bearing retaining ring. The installer must not be removed until the ring has cooled

9. Press the oil seal collar home with the external chamfered end towards the splined end of the shaft.

Axle Shaft Oil Seal

To renew the axle shaft oil seal, withdraw the

Fig. J.7. Removing an axle shaft oil seal

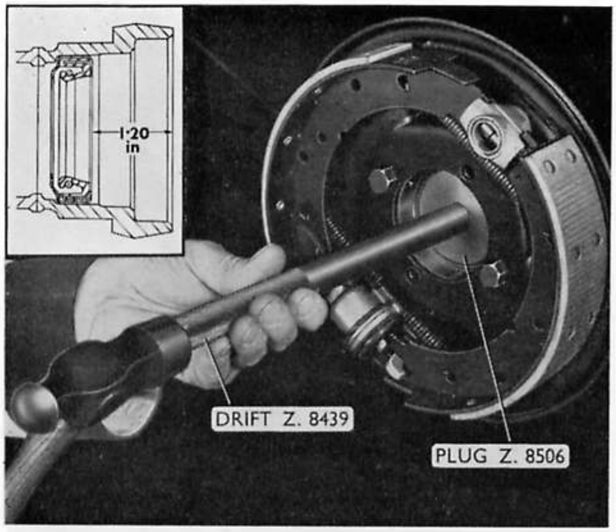


Fig. J.8. Driving home the axle shaft oil seal. Inset indicates location of seal in housing

seal as shown in Fig. J.7. Locate the new seal so that the lip of the seal is facing inwards.

Drive the seal in to the housing (Fig. J.8) until the dimension from the outer face of the seal casing to the outer face of the axle housing flange is as shown. It is important that the seal is squarely located in relation to the housing bore.

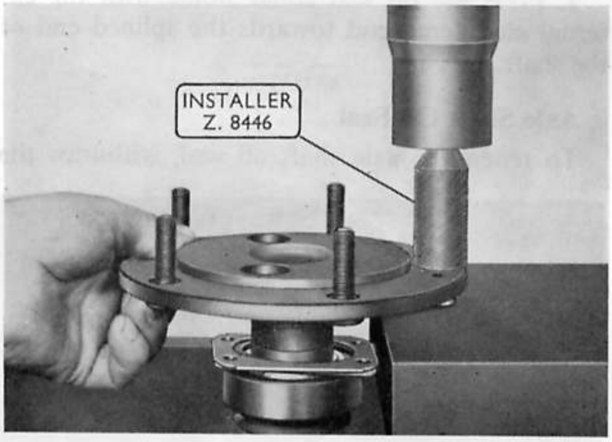


Fig. J.9. Pressing home a new wheel bolt

Wheel Bolts

To renew, press out the bolt and install the new bolt as shown in Fig. J.9, then peen the end of the bolt shoulder into the countersink of the bolt hole in the flange (Fig. J.10).

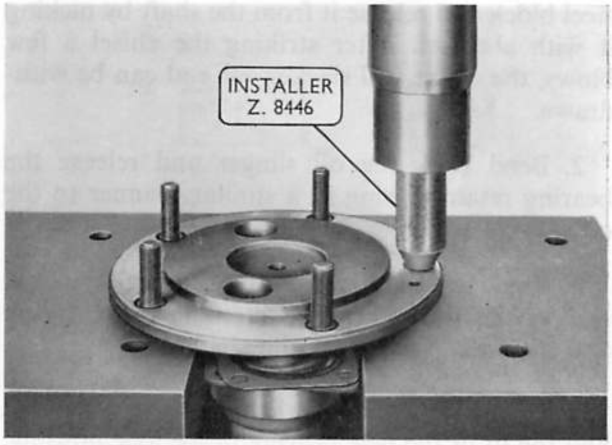


Fig. J.10. Peening the shoulder of a new wheel bolt

Installation

Note the following:

1. Ensure that the axle shaft assembly and the bearing bore in the axle housing are thoroughly clean.

2. If the axle tube has been drained recharge with a $\frac{1}{4}$ pint of recommended oil. Coat the oil seal, and the shaft from the bearing to the splined end, with oil.

3. It is essential that an axle shaft guide (Fig. J.3) is used when installing the axle shaft, otherwise the oil seal will be damaged and rendered unserviceable.

4. Insert the bolts through the bearing retaining plate with the heads adjacent to the shaft flange. The parking brake cable guide brackets are secured by the front and lower bolts.

5. Check the axle oil level and, if necessary, top up with recommended oil.

PINION OIL SEAL

Renewal

The oil seal can be renewed without disassembling the axle by adopting the following procedure:

1. Raise and support the rear of the vehicle.

2. Disconnect the propeller shaft at the rear universal joint coupling flange. Withdraw the shaft and insert a spare sliding sleeve in the transmission rear cover to prevent oil loss.

3. Tap back the staking on the pinion nut and remove the nut (Fig. J.13).

4. Withdraw the universal joint coupling flange (Fig. J.14).

5. Cut through the pinion oil seal case with a small chisel and prise the seal from the housing with a small tommy bar.

6. Using a $\frac{3}{16}$ in. round file, cut a slot similar to and opposite the existing slot in the end of the pinion shaft.

7. Check that the seal recess is clean and install the new seal (Fig. J.31) with its lip facing inwards.

8. Check the seal land on the universal joint flange for burrs. Clean off, if necessary, with a carborundum stone, otherwise the seal will be damaged.

9. Smear the seal with oil and install the universal joint flange.

10. Fit the existing pinion nut and tighten to its original position, indicated by the original staking marks being in alignment. Lock the nut by staking the lip of the nut into the new slot filed in the end of the shaft.

11. Install the propeller shaft and top up the axle with recommended oil.

REAR AXLE

Removal

1. Raise and support the rear of the vehicle.

2. Remove the road wheels.

3. Disconnect the propeller shaft at the rear universal joint coupling flange. Withdraw the shaft and insert a spare sliding sleeve in the transmission rear cover to prevent oil loss.

4. Disconnect the parking brake cable clevis from the brake shoe levers and remove the clevis from each cable.

5. Withdraw the cables through the guide brackets attached to the axle.

6. Disconnect the brake pipe union nut from the flexible hose.

7. Remove the hose locknut at the bracket while holding the hexagon of the hose with a wrench to prevent the latter rotating, and withdraw the hose from the bracket.

8. Remove the U-bolt nuts, withdraw the U-bolts from the shock absorber anchor plates, then move the plates round clear of the road springs and compress the shock absorbers.

9. Raise the axle clear of the springs and remove.

Disassembly

1. Place the axle in a stand.

2. Remove the rear cover and drain the oil.

3. Remove the axle shafts (page J-4). Disconnect the pipes from the brake cylinders and lift away the brake flange plates.

4. Remove the bolt attaching the brake pipe three-way connector to the bracket on the axle housing and release the pipe from the clips on the housing.

5. Remove the axle shaft oil seals (Fig. J.9), and discard.

6. Remove the bolts securing the differential side bearing caps and lift away the caps. The

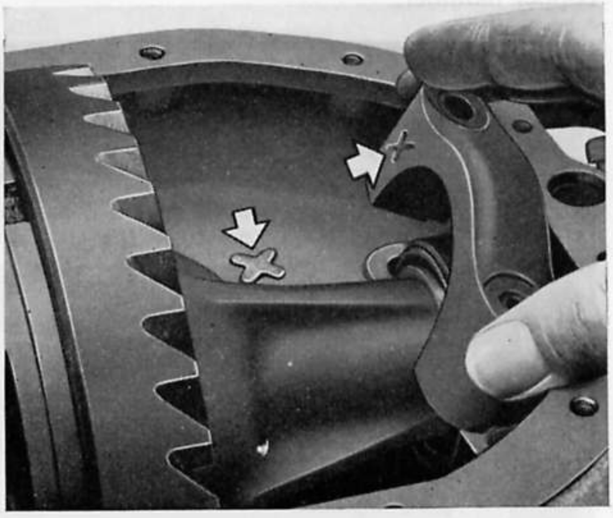


Fig. J.11. The identification mark cast in the housing and stamped on the right-hand bearing cap to ensure correct reassembly of caps

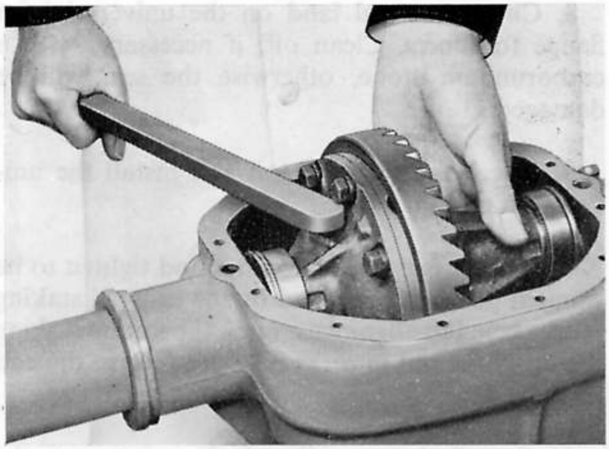


Fig. J.12. Removing the differential from the axle housing

right-hand cap and housing adjacent to the cap are marked with an 'X' (Fig. J.11) to ensure the caps are not interchanged during reassembly.

7. Locate a bar under one of the differential case bolts, and, levering against the axle housing, withdraw the hypoid gear and differential from the housing (Fig. J.12). Remove the spacers and shims. Retain the bearing outer races with their respective side bearings.

8. Tap back the staking on the universal joint coupling flange nut and remove the nut (Fig. J.13).

9. Withdraw the universal joint coupling flange (Fig. J.14).

10. Support the pinion inside the housing with one hand and tap it out from the front with a copper hammer.

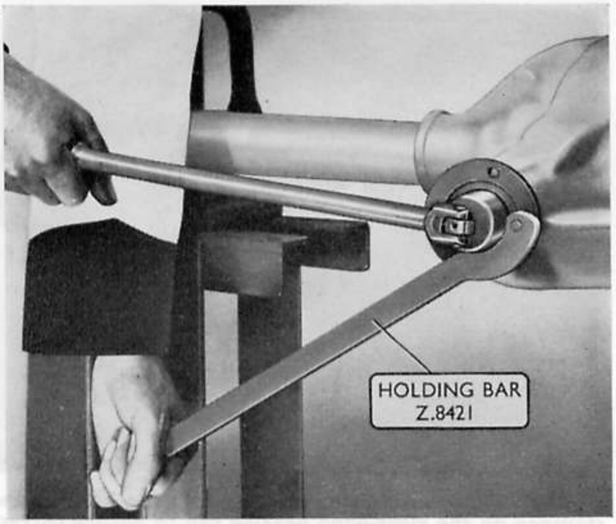


Fig. J.13. Removing the universal joint coupling flange nut

11. Prise the oil seal out of the axle housing.

NOTE: *If the pinion bearings are to be used again the pinion must be pressed from the axle housing in order to avoid damage to the bearings.*

12. Remove the universal joint flange spacer, pinion front bearing inner race from the housing, and the compressible spacer from the pinion shaft.

13. Press the pinion rear and front bearing outer races out of the axle housing (Fig. J.15).

14. Press the pinion rear bearing inner race off the pinion shaft (Fig. J.16).

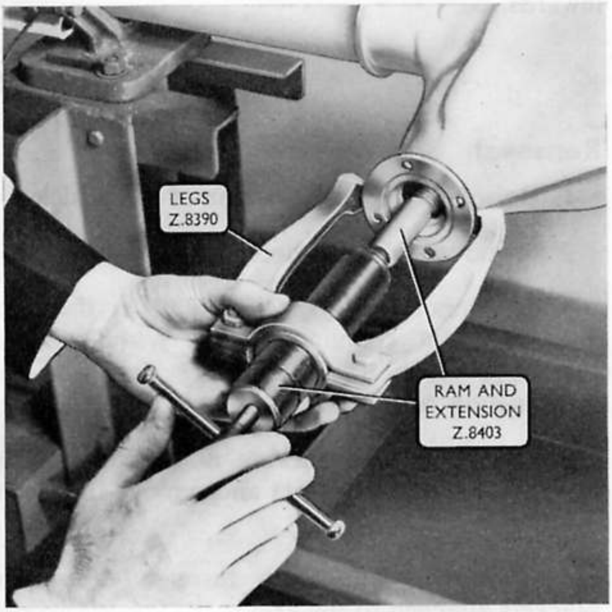


Fig. J.14. Withdrawing the universal joint coupling flange

15. Disassemble the hypoid gear and differential as follows:

(*a*) Remove the bolts attaching the differential cover and case to the hypoid gear, and remove the gear by lightly tapping at alternate sides with a copper hammer.

(b) Remove the cover and side gear.

(c) Tap the differential pinion shaft out of the differential case from the dowel end and withdraw the pinion and side gear.

Inspection and Reconditioning

Bearings

Clean and inspect all bearings (see page vii). Where a side bearing requires renewal remove

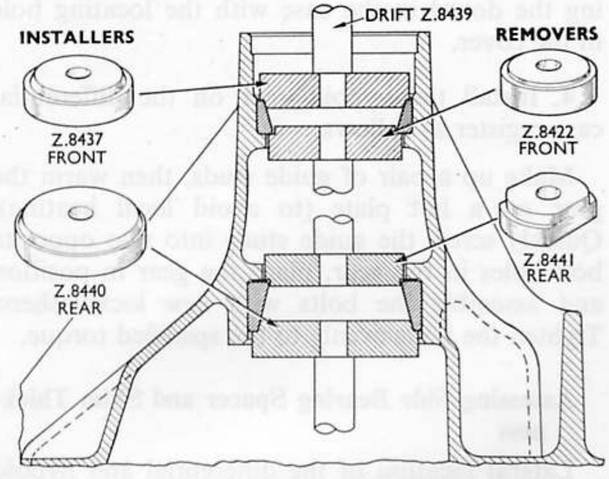


Fig. J.15. Application of service tools for removal and installation of pinion bearing outer races

it as shown in Fig. J.17. Ensure that the new bearing is right home against the spigot shoulder.

Gears

Hypoid gears and pinions are serviced as matched pairs and must not be renewed individually.

Differential Case and Cover

Ensure that the contact faces of the case and cover, also the hypoid gear mating face, are clean and free from burrs.

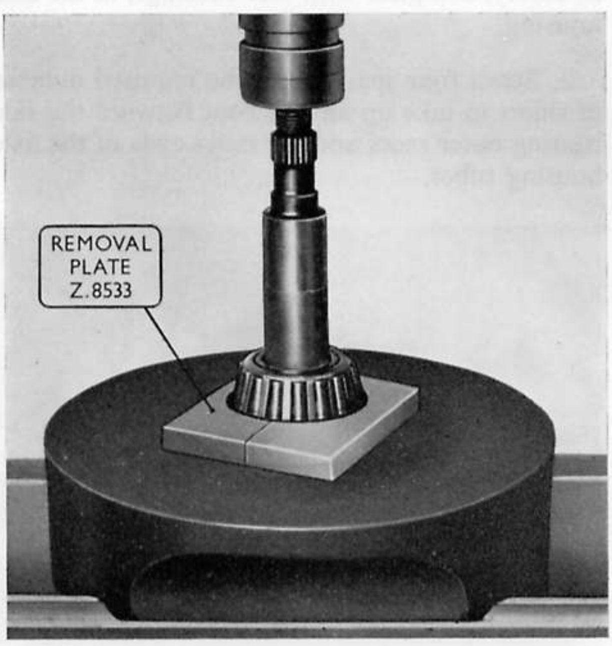


Fig. J.16. Pressing the pinion rear bearing inner race off the pinion shaft

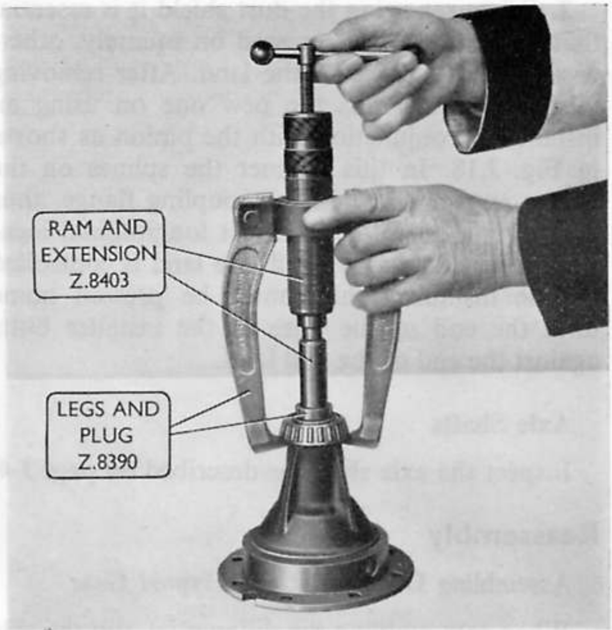


Fig. J.17. Removing a differential side bearing

Axle Housing and Cover

1. When checking the housing ensure that the oil drain slots in the axle shaft bearing housing flanges are free from obstruction.

2. Make sure that the breather in the housing is clean and that its cap can be rotated freely.

Universal Joint Coupling Flange

1. If the oil seal land is only slightly worn or scored, polish with very fine emery cloth; if excessively worn renew the flange.

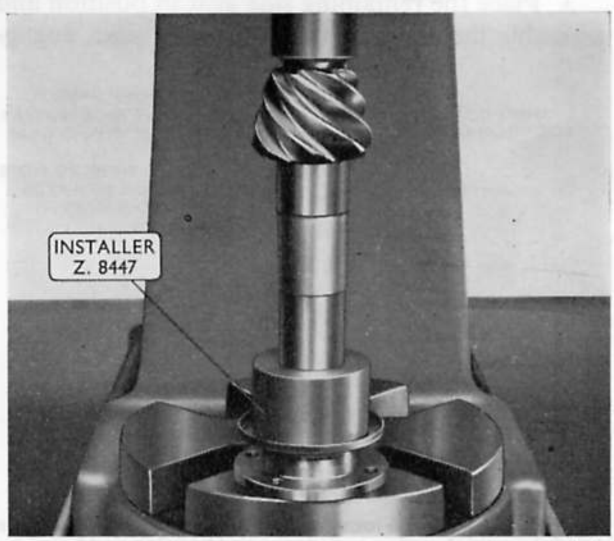


Fig. J.18. Pressing a new dust shield on the universal joint coupling flange

2. When renewing the dust shield it is essential that the new shield is pressed on squarely, otherwise it will be slack on the land. After removing the old shield, press the new one on using an installer in conjunction with the pinion as shown in Fig. J.18. In this manner the splines on the pinion engage those in the coupling flange, thus providing a guide. The correct longitudinal location of the slinger on the flange land is controlled by the installer, which must be pressed home until the end of the bore in the installer butts against the end of the seal land.

Axle Shafts

Inspect the axle shafts as described on page J-4.

Reassembly

Assembling Differential and Hypoid Gear

When reassembling the differential, dip the side gears, differential pinions and pinion shaft in oil to ensure adequate lubrication when the axle is first put into service.

Reassemble the differential as follows:

1. Place a differential side gear in the differential case.

2. Locate the two differential pinions in position, insert the pinion shaft in the case at the side opposite to the dowel and tap the shaft home so that the slot in the end of the shaft engages the dowel.

3. Place the remaining side gear in position and assemble the cover to the differential case, engaging the dowel in the case with the locating hole in the cover.

4. Install the hypoid gear on the differential case register as follows:

Make up a pair of guide studs, then warm the gear on a hot plate (to avoid local heating). Quickly screw the guide studs into two opposite bolt holes in the gear, place the gear in position and assemble the bolts with *new* lockwashers. Tighten the bolts evenly to the specified torque.

Assessing Side Bearing Spacer and Shim Thickness

Lateral location of the differential and hypoid gear, and pre-load of the differential side bearings, is controlled in service by spacers and shims (Fig. J.19). On production-built axles only, spacers with a thickness range of ·200 to ·243 in., are used. For service, two grades of special spacers ·100 in. and ·101 in. and one grade of shim ·003 in. thick are available. With the combination of the two spacers and one shim thickness, the entire range of production spacers from ·200 in. upwards can be covered in steps of ·001 in. by using two spacers and the required number of shims for each bearing. The ·100 in. spacer is identified by a localized chamfer ground on the face of the spacer.

1. Locate the differential and hypoid gear assembly, complete with side bearings, in the axle housing.

2. Select four spacers and the required number of shims to take up all end float between the side bearing outer races and the inner ends of the axle housing tubes.

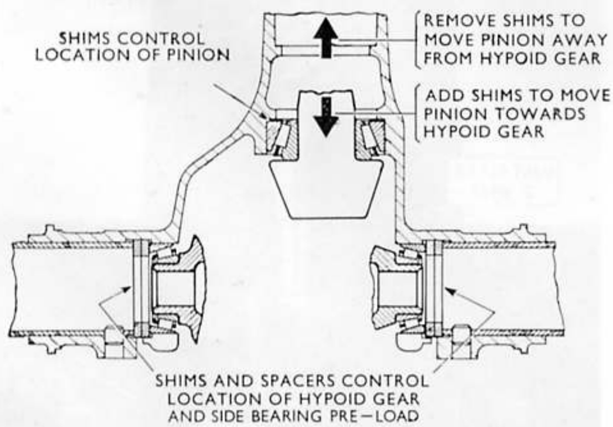


Fig. J.19. Showing the location of shims interposed between the pinion rear bearing outer race and housing and between the differential side bearing spacers

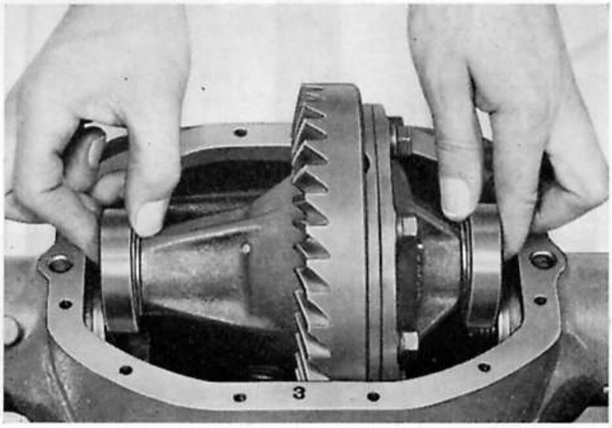


Fig. J.20. Inserting the differential in the axle housing

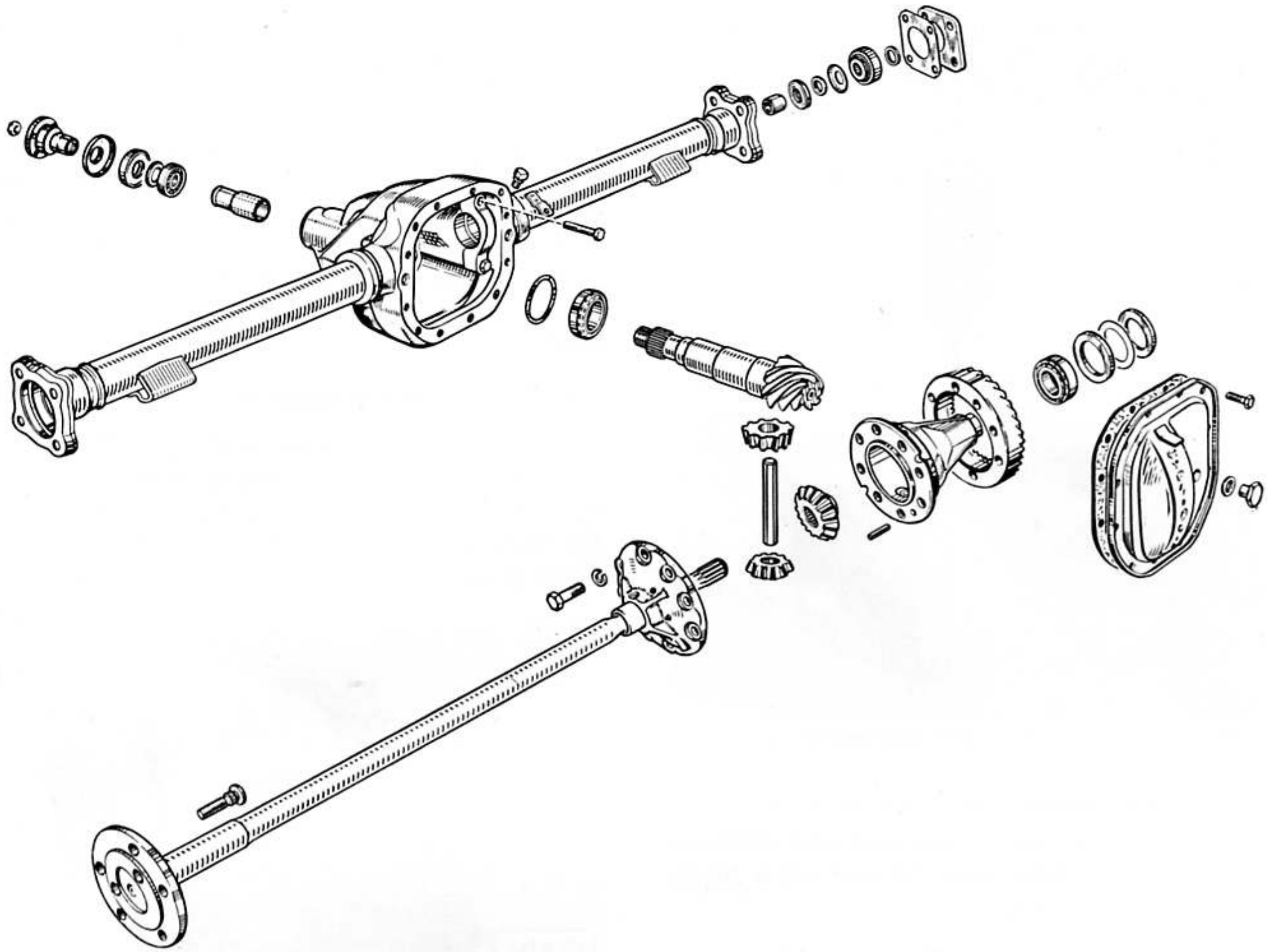


Fig. J.21. Exploded view of rear axle

3. Remove the differential and hypoid gear assembly from the axle housing.

4. Place two of the selected spacers with half of the shims interposed between them in one side of the axle housing, and interpose the remaining shims, plus another one, between the other two spacers and locate them in the other side of the housing.

5. Insert the differential and hypoid gear assembly in the axle housing (Fig. J.20), taking care that the bearing outer races do not tilt and jam.

6. Tap the axle housing lightly with a copper hammer and rotate the assembly to settle the bearings.

7. Install the bearing caps in their correct relative locations, as identified by the marking on the right-hand cap (Fig. J.11), and tighten the bolts to the specified torque.

8. Check the bearing pre-load, using a spring balance in conjunction with a length of twine wound around the periphery of the differential case as shown in Fig. J.22.

9. If necessary, adjust the pre-load by adding or removing shims, or changing the spacer thickness until the correct reading is obtained.

Checking Hypoid Gear for Run-out

1. With the differential and hypoid gear assembly installed in the axle housing, mount a dial gauge on the housing, and check for run-out on the back face of the hypoid gear as shown in Fig. J.23. The run-out must not exceed the specified maximum. If in excess of this figure, the gear must be removed from the differential and a check made for foreign matter on the mating faces, or a further check made for run-out of the differential case flange.

2. Upon completion of the check, remove the differential and hypoid gear assembly and place

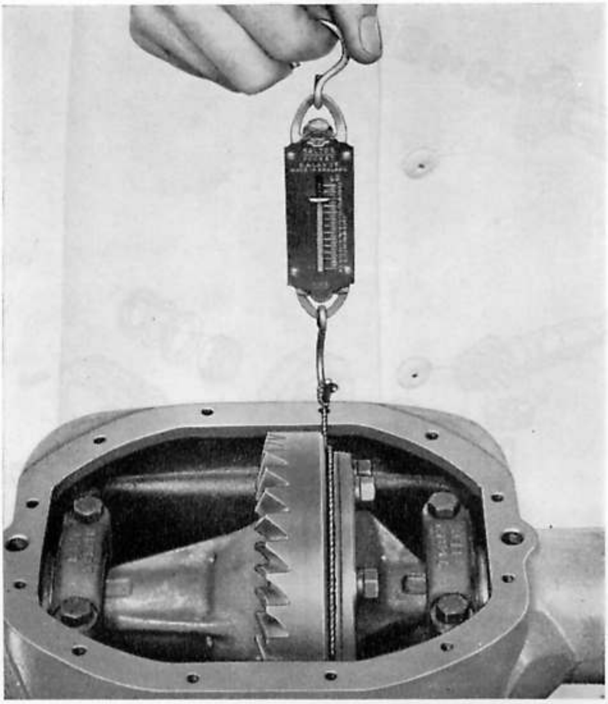


Fig. J.22. Checking differential side bearing pre-load

the selected spacers and shims in a safe place. *This is important, as the assessed total thickness of spacers and shims must be used when finally reassembling the axle.*

Measuring Pinion Rear Bearing Thickness

1. Ensure that the pinion rear bearing is thoroughly clean, then assemble it to the measuring jig shown in Fig. J.24, tightening the knurled nut only sufficiently to partially compress the thackray washer. Settle the bearing by pressing down the outer race and rotating it backwards and forwards through a few degrees.

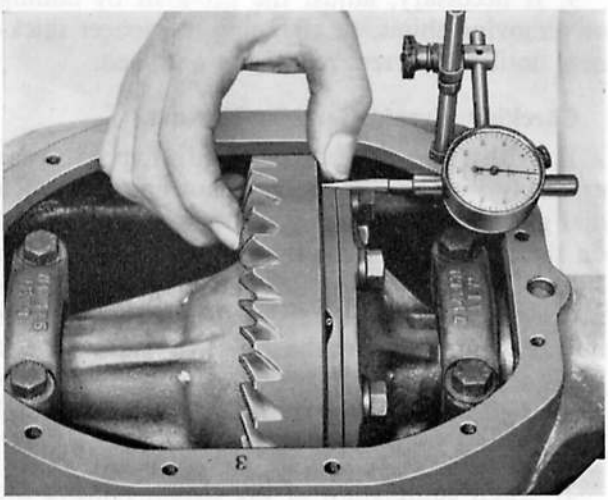


Fig. J.23. Checking the hypoid gear for run out

2. Measure the overall dimension of the bearing and jig plate, i.e. end face of bearing outer race to rear face of plate, at two opposite points, with a micrometer (Fig. J.25). From the dimension obtained subtract the thickness of the jig plate which is etched on the plate. The resultant figure is the overall dimension of the pinion bearing.

Calculating Pinion Shim Thickness

Correct endwise location of the pinion, relative to the hypoid gear, is obtained by shims interposed between the pinion rear bearing outer race and the bearing abutment face in the axle housing. Three grades of shims are serviced, ·003, ·005 and ·010 in. Increasing the total shim thickness moves the pinion towards the centre of the hypoid gear. Decreasing the total shim thickness moves the pinion away from the centre of the gear.

Fig. J.24. Settling the pinion bearing on the measuring jig

The shims compensate for the manufacturing tolerances of the pinion and associated components, and the three controlling factors which determine the thickness of pinion shims required are as follows:

(*a*) The overall dimension of the pinion rear bearing:

The thickness of shim correction required for the bearing is determined by subtracting the actual dimension of the bearing from the maximum dimension, which is 1·1643 in.

(*b*) The depth of the pinion rear bearing abutment face in the axle housing:

The thickness of shims necessary to compensate for any deviation from the nominal depth of the abutment face marked on the rear face of the axle housing (Fig. J.26) and represents in thousandths of an inch the amount of shim correction required.

(*c*) The pinion meshing correction:

Any departure from the normal setting found necessary when the hypoid gear and pinion are meshed on production is etched on the pinion

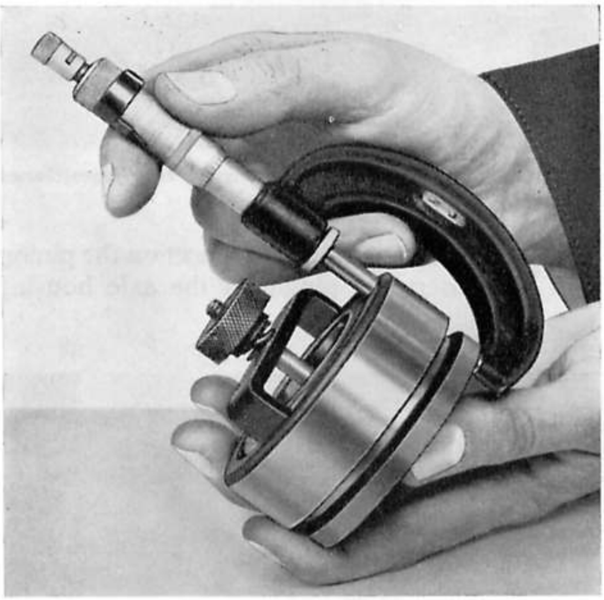


Fig. J.25. Measuring the overall dimension of the pinion rear bearing and jig plate

nose (Fig. J.27). This figure represents in thousandths of an inch the thickness of shim correction required.

In cases where the marking on the axle housing or the pinion is 'O' or the pinion bearing overall dimension is the same as the maximum dimension, no shim correction is required for the respective component.

To obtain the shim thickness required, subtract the actual dimension of the pinion bearing from 1·1643 in. The dimension obtained represents the thickness of shim correction required for the pinion bearing. Then add together the following:

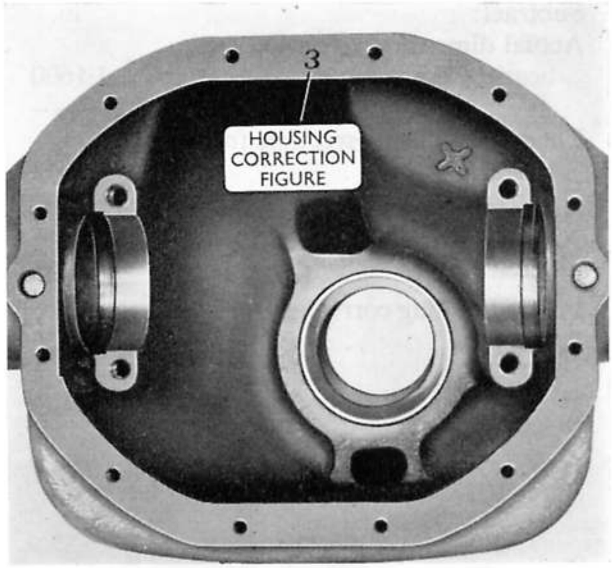


Fig. J.26. Housing correction figure for pinion shim calculation

(*a*) The pinion bearing correction.

(*b*) The axle housing correction.

(*c*) The pinion meshing correction.

The result obtained is the total thickness of shims required for correct location of the pinion.

Example of Shim Calculation:

	in.
Pinion rear bearing maximum dimension	1·1643

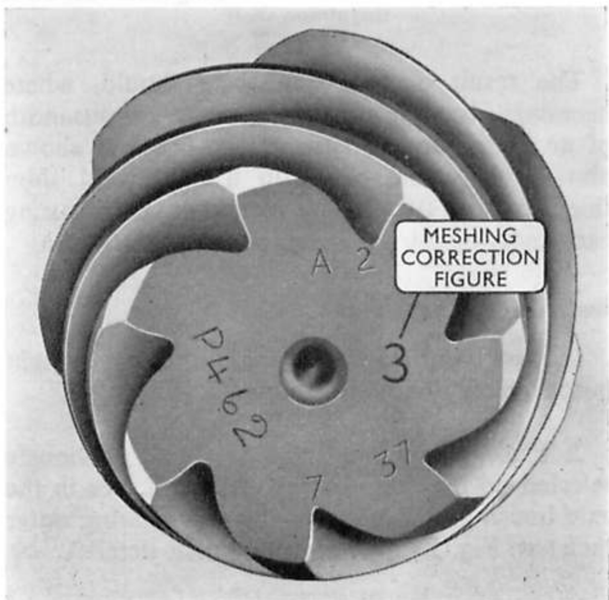


Fig. J.27. Meshing correction figure for pinion shim calculation

Subtract:	in.
Actual dimension of pinion rear bearing, e.g.	1·1600
Therefore shim correction for bearing (*a*) is	·0043
Add:	
Axle housing correction (*b*), e.g. 3—	·0030
Pinion meshing correction (*c*), e.g. 3—	·0030
Total	·0103

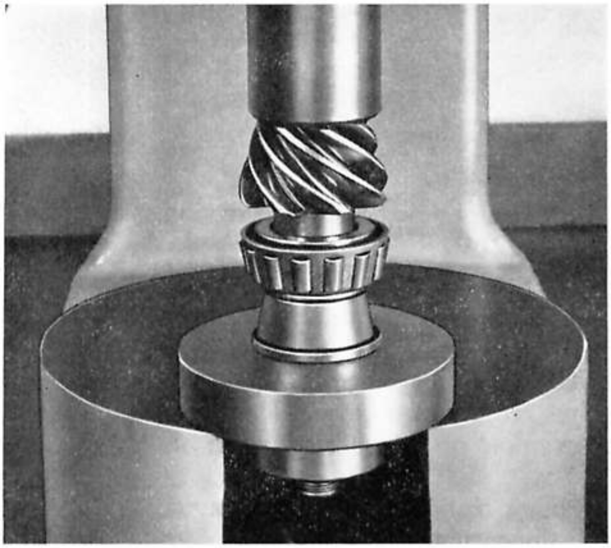


Fig. J.28. Pressing the pinion rear bearing inner race on to the pinion shaft

The result of the calculation should, where necessary, be adjusted to the nearest thousandth of an inch. In the case of the example shown above this would result in a final total shim thickness of ·010 in. Select shims, measuring each individually to ensure accuracy.

Installing the Pinion

1. Press the pinion rear bearing inner race right home against the pinion shoulder (Fig. J.28).

2. Place the pinion shim or shims previously selected on the rear bearing abutment face in the axle housing, and press in the rear bearing outer race (see Fig. J.15 for plug and drift details).

3. Press the pinion front bearing outer race into the axle housing.

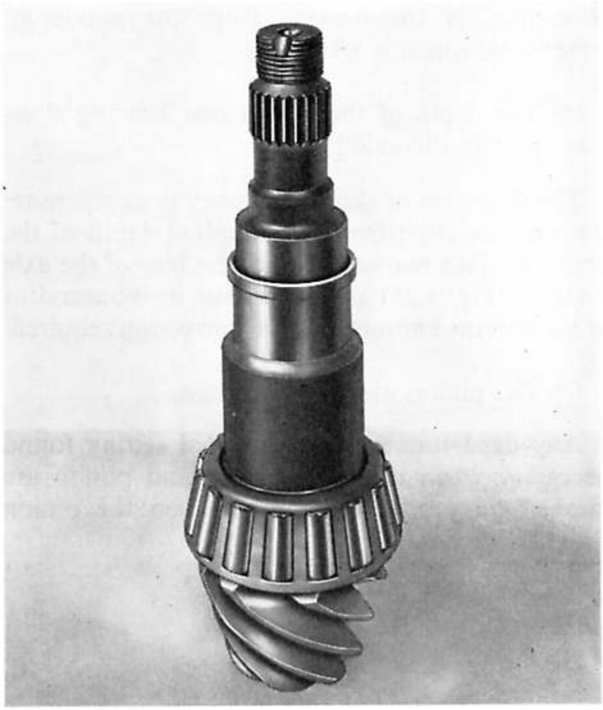


Fig. J.29. A new compressible spacer correctly positioned on the pinion shaft

4. Place a new compressible spacer on the pinion shaft and insert the pinion in the axle housing (Fig. J.29).

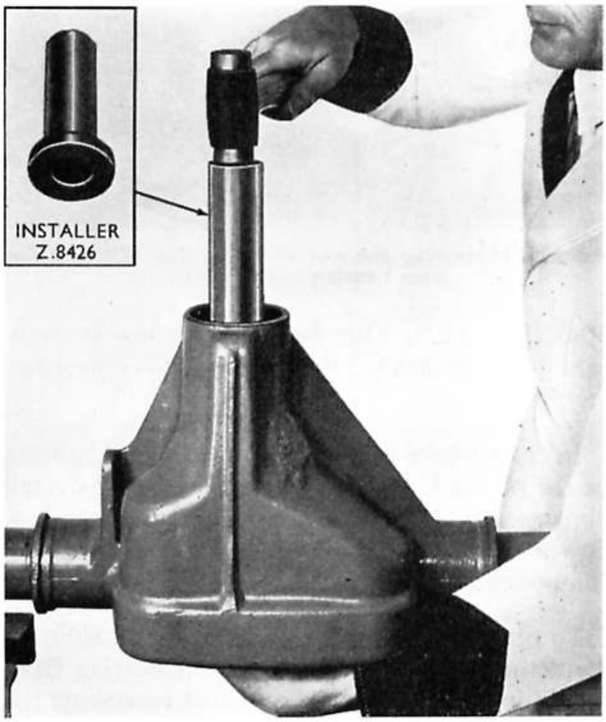


Fig. J.30. Installing the pinion front bearing inner race on the pinion shaft

Fig. J.31. Installing the pinion oil seal

5. Assemble the front bearing inner race to the pinion shaft and tap the race on the shaft using an installer whilst the pinion is supported inside the axle housing (Fig. J.30).

6. Assemble the universal joint flange spacer on the pinion shaft. Position a new pinion oil seal, with the lip of the seal facing inwards, in the housing and install the seal (Fig. J.31).

7. Smear the oil seal land of the universal joint coupling flange with oil, then tap the coupling flange on to the pinion shaft sufficiently to permit a new nut to be screwed on.

8. Using the holding bar to anchor the flange, tighten the pinion nut until positive resistance on the nut is felt; this will indicate that all end float between the bearing inner races and compressible spacer has been absorbed, although at this stage there will be end float between the bearing rollers and the outer races. Making frequent checks with a pre-load gauge (Fig. J.32) tighten the nut further to compress the spacer until the correct bearing pre-load is obtained.

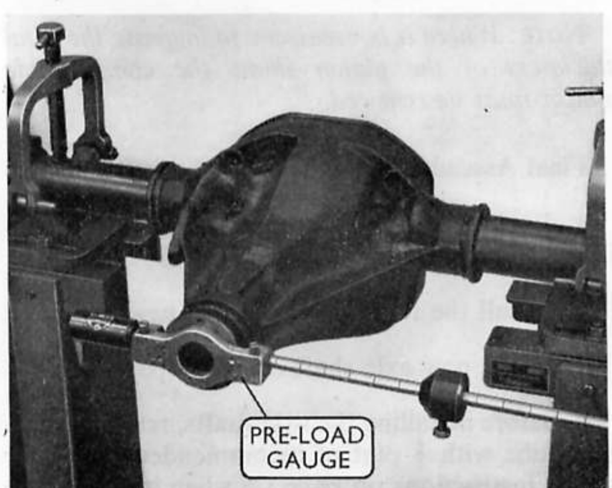


Fig. J.32. Checking the pinion bearing pre-load

Should the pinion nut be overtightened and the pre-load limit exceeded, it will be necessary to remove the pinion from the housing and renew the compressible spacer.

9. Do not secure the pinion nut by staking at this stage.

Installation and Location of Hypoid Gear and Differential Assembly

1. Place the side bearing spacers and shims in position in the axle housing so that there is a greater number of shims interposed between the spacers at the right-hand side of the housing.

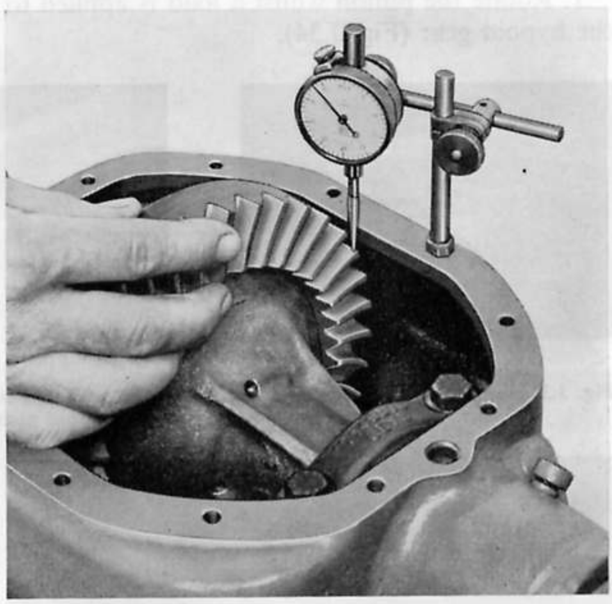


Fig. J.33. Checking the backlash between the hypoid gear and pinion teeth

2. Place the differential and hypoid gear assembly in the axle housing, and mount a dial gauge on the housing to check the backlash between the hypoid gear and pinion teeth (Fig. J.33).

3. Locate the differential so that the backlash between the gear and pinion is within the specified limits by interchanging the previously selected spacers and shims side for side, ensuring that any shims are interposed between the spacers.

IMPORTANT: *The* TOTAL *spacer and shim thickness must be maintained, otherwise the bearing pre-load will be affected.*

4. Preliminary checks on the backlash can be made without installing the bearing caps, but the final check must be made with the caps in position (Fig. J.33).

5. Make sure that the bearing caps are installed in their correct location side for side as identified by the marking on the right-hand cap (Fig. J.11) and tighten the cap bolts to the specified torque.

Hypoid Gear Teeth Contact Check

As a final test for correct hypoid gear and pinion location carry out the following gear marking check:

1. Rotate the pinion whilst a load is applied to the hypoid gear (Fig. J.34).

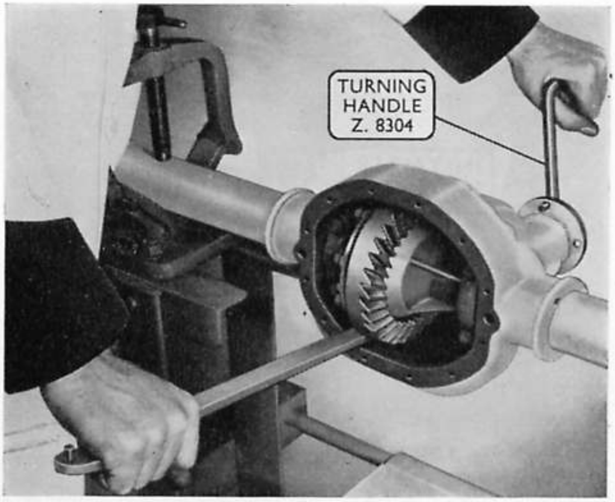
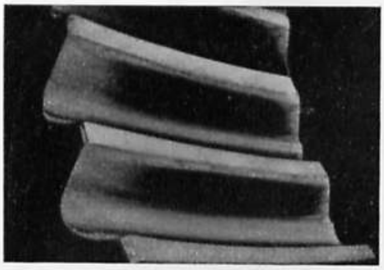
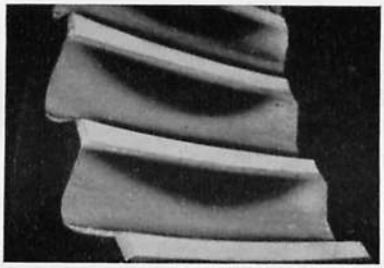


Fig. J.34. Checking the gear and pinion tooth contact



Correct



Pinion too far out

Pinion too far in

Fig. J.35. Hypoid gear tooth contact markings on drive side of gear. The marking shown in the illustration on the left is obtained when the hypoid gear and pinion are correctly positioned

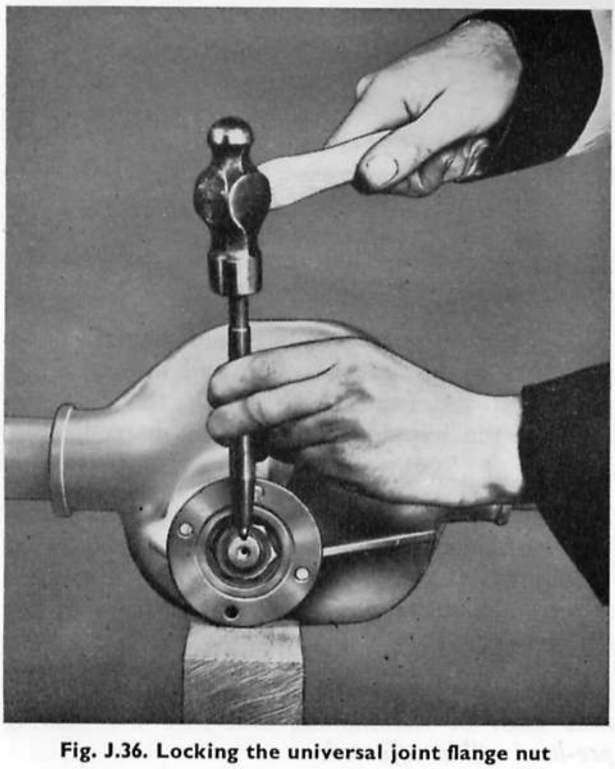


Fig. J.36. Locking the universal joint flange nut

2. Compare the marking obtained on the drive side of the hypoid gear teeth with those shown in Fig. J.35. An unsatisfactory marking indicates either an error has been made in the assessment of the pinion shim thickness or incorrect backlash between the gear and pinion and the necessary corrective action must be taken.

NOTE: *Where it is necessary to increase the total thickness of the pinion shims the compressible spacer must be renewed.*

Final Assembly Operations

1. Lock the pinion nut by staking the nut lip in the slot in the pinion shaft (Fig. J.36).

2. Install the rear cover, using a new gasket.

3. Install new axle shaft oil seals (page J-5).

4. Before installing the axle shafts, recharge each axle tube with $\frac{1}{4}$ pint of recommended oil. Refer to the instructions on page J-6 when installing the shafts.

SECTION E—CLUTCH

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Have you read the General Notes on page vii ?

DESCRIPTION

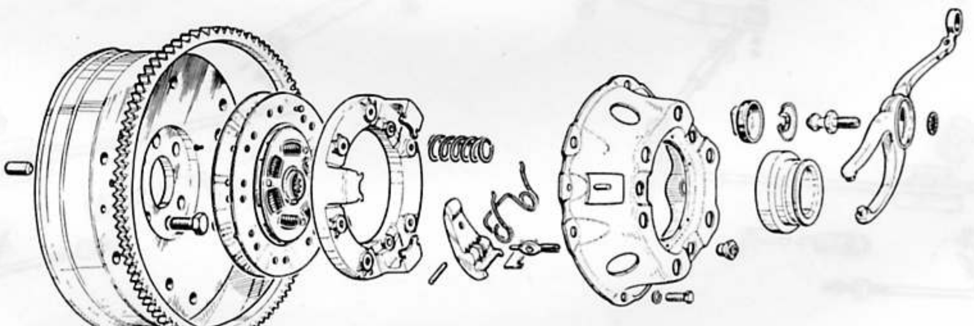


Fig. E.1. Clutch and clutch fork components

Clutch Assembly

The clutch comprises a pressure plate and cover assembly and a disc. Coil type thrust springs provide the driving pressure, and release levers equipped with anti-rattle springs, are incorporated for clutch release. The clutch disc has riveted friction facings and a splined hub spring-loaded by damper springs.

Fork and Release Bearing

The fork is engaged with the release bearing sleeve and pivots on a ball stud screwed into the rear of the clutch housing. The bearing is a sealed type and is packed with lubricant during manufacture. A plate and rubber mask seal the housing slot occupied by the fork. The slot in the opposite side of the housing is blanked off by a plate secured by a screw and nut.

Pedal and Controls

Movement of the pedal is conveyed by a link and relay lever to operate a rod connected to the clutch fork. The pedal arm pivots on a fixed shaft on right drive, whereas for left drive the arm is clamped to and rotates a shaft supported in a fixed sleeve.

GUARDIAN MAINTENANCE

To maintain free operation of the controls, lubricate the pedal shaft, rod connections, also the clutch fork outer end and the rod adjusting nut, with engine oil.

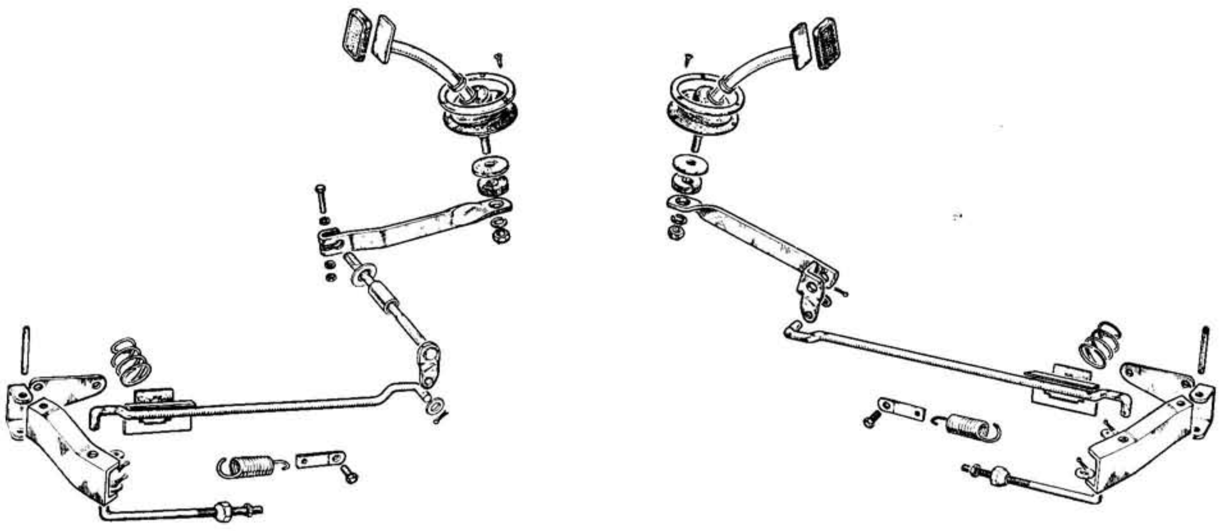
PEDAL FREE TRAVEL ADJUSTMENT

Clutch pedal free travel should be maintained at 1 in. measured at the centre of the pedal pad.

Adjustment is made by turning the adjusting nut on the rod connected to the clutch fork.

Slacken the locknut and turn the adjusting nut until the 1 in. free travel is obtained then hold the adjusting nut and tighten the locknut. Recheck the free travel.

PEDAL AND CONTROLS



Left Drive **Right Drive**

Fig. E.2. Clutch operating linkage components

Removal

1. Remove the nut and lockwasher, and withdraw the pedal pad and stem.

2. Disconnect the pedal return spring and the link from the pedal arm, or shaft lever on left drive.

3. On right drive, remove the split pin and plain washer, and withdraw the pedal arm. On left drive, remove the clamp bolt and withdraw the arm.

4. Disconnect the fork operating rod from the relay lever and remove the rod by passing it through the fork eye. Remove the clevis pin and lift away the relay lever and link assembly.

5. On left drive, withdraw the pedal shaft and detach the distance piece and plain washer from the shaft.

Installation

Note the following:

1. Lubricate the pedal shaft with recommended grease.

2. Adjust the clutch pedal free travel.

FORK AND RELEASE BEARING

Removal

1. Remove the transmission (see Section G of TS.673) and detach the release bearing from the clutch fork.

2. Unhook the clutch fork return spring.

3. Disconnect the fork operating rod from the relay lever, and detach the rod by passing it through the fork eye.

4. Remove the spring, rubber mask and seal plate from the clutch fork.

5. Check the fork for slackness on the ball.

6. Using a thin open-end wrench, unscrew the ball from the housing (Fig. E.3), and remove the fork.

7. Remove the nut and retainer and withdraw the ball from the fork.

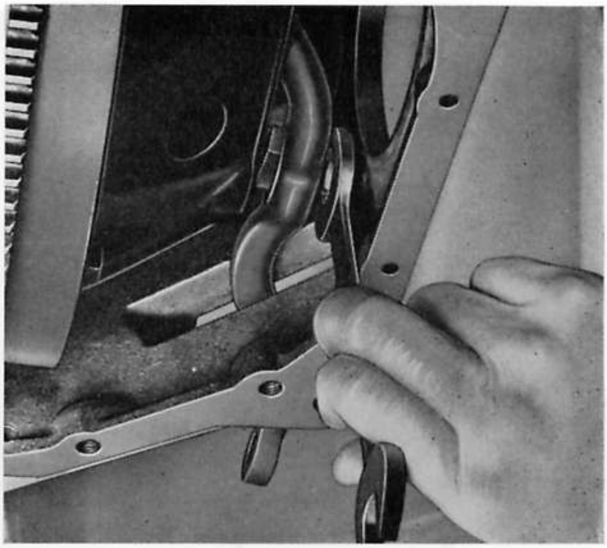


Fig. E.3. Unscrewing the clutch fork ball from the housing

Inspection

When inspecting components, do not wash or degrease bearing. The sealed bearing is packed with lubricant during manufacture.

Installation

Note the following:

1. When assembling the ball to the fork, lubricate the fork ball also the seating faces of the retainer and nut with recommended grease.

2. Fit a new lockwasher to the ball stud and tighten it firmly in the clutch housing.

3. Assemble the sealing components against the housing fork aperture as shown in Fig. E.4. The seal plate must be fitted with its flange uppermost and facing towards the clutch housing.

4. Check that the release bearing slides freely on the transmission front cover. Smear the bearing sleeve, and the main drive pinion splines sparingly with recommended grease.

5. Adjust the clutch pedal free travel (page E-2).

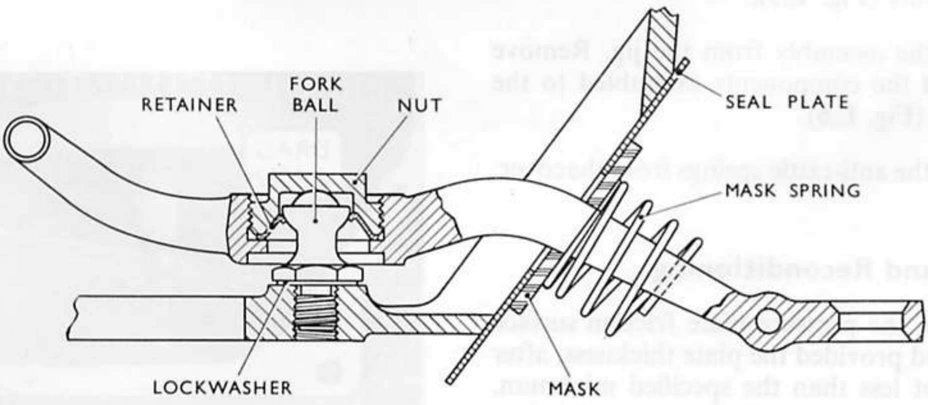


Fig. E.4. Sectioned view showing clutch fork assembly details

CLUTCH ASSEMBLY

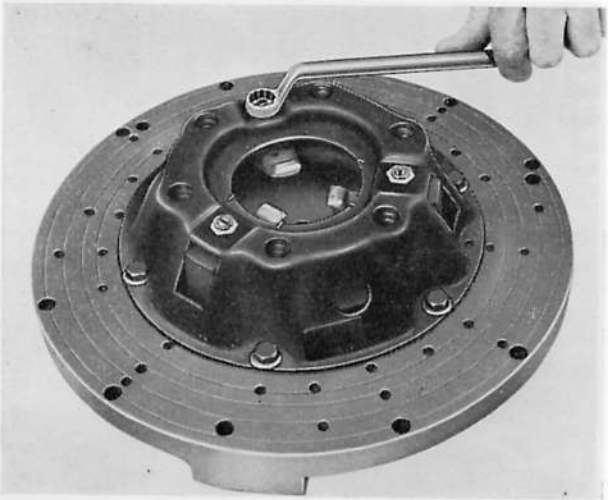


Fig. E.5. Disassembling the clutch

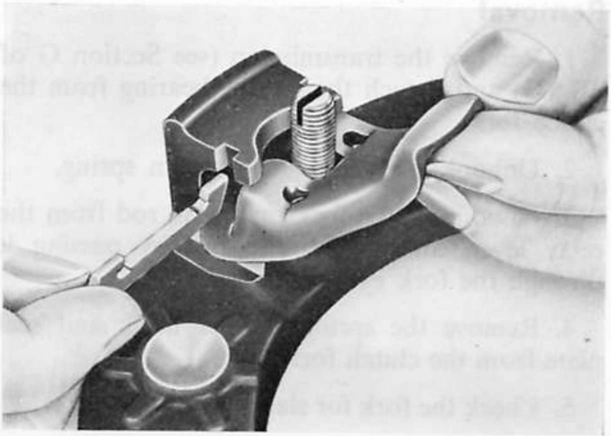


Fig. E.6. Withdrawing a strut for removal of a release lever and eye bolt

Removal

1. Remove the transmission (see Section G of TS.673) and detach the release bearing from the clutch fork.

2. Unscrew the clutch cover attaching bolts evenly and remove the clutch assembly and disc.

Disassembly

1. Mark the clutch cover and pressure plate so that they can be reassembled in the original relative position if neither has to be renewed.

2. Bolt the assembly to a clutch jig and unscrew the eye bolt nuts (Fig. E.5).

3. Release the assembly from the jig. Remove the cover, and the components assembled to the pressure plate (Fig. E.6).

4. Remove the anti-rattle springs from the cover.

Inspection and Reconditioning

1. Scores on the pressure plate friction surface can be removed provided the plate thickness, after refacing, is not less than the specified minimum. The thickness must be checked at several points around the plate.

2. Check the clutch cover attaching flange for distortion, using the jig base as a surface plate.

3. To renew a worn or slack clutch pilot bush, proceed as follows:

(*a*) Withdraw the bush (Fig. E.7).

(*b*) Saturate the new bush with engine oil, using finger pressure against the ends of the bush after filling it with oil.

(*c*) Assemble the bush to the installer and check that the pilot projects slightly through the bush with the nut in contact with the sleeve. The pilot is used for correct sizing of the bush bore and must be free from burrs.

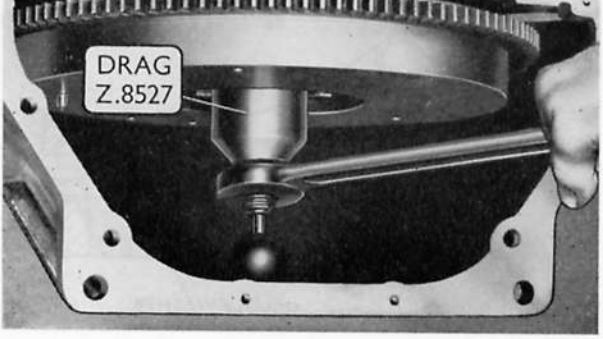


Fig. E.7. Removing the clutch pilot bush

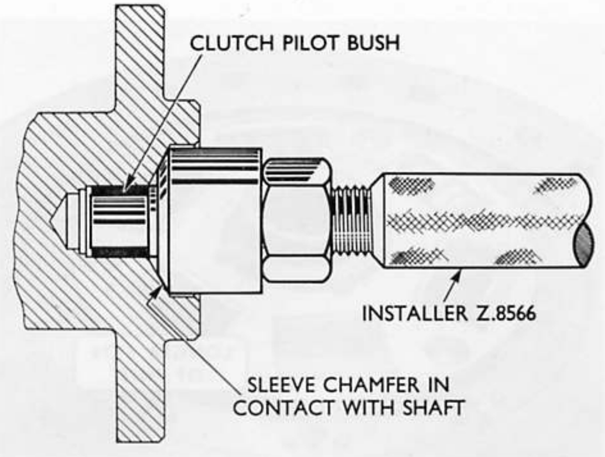


Fig. E.8. Clutch pilot bush and installer. The pilot of the installer must project through the bush with the installer nut contacting the sleeve

(*d*) Drive the bush squarely into the crankshaft until the installer sleeve chamfer contacts the shaft (Fig. E.8). Withdraw the pilot by screwing down the nut.

4. Inspect the flywheel friction surface for wear. If necessary, remove and reface (see Section A for gasoline; Section D for diesel).

Reassembly

1. Lubricate the bearing surfaces of the release levers, eye bolts, pins and struts with recommended grease. Use the lubricant sparingly to avoid contact with the disc friction facings.

2. Assemble the eye bolts, pins and release levers to the pressure plate.

3. Raise each lever in turn, and insert the strut so that the lugs engage the groove in the pressure plate boss (Fig. E.9). Release the lever, making sure the eye bolt is located in the pressure plate hole and the bottom edge of the strut locates in the recess in the lever.

4. Fit the anti-rattle springs in the holes in the clutch cover so that the spring ends are towards the centre of the cover.

5. Using the jig, complete the reassembly noting the following:

(*a*) Install new thrust springs.

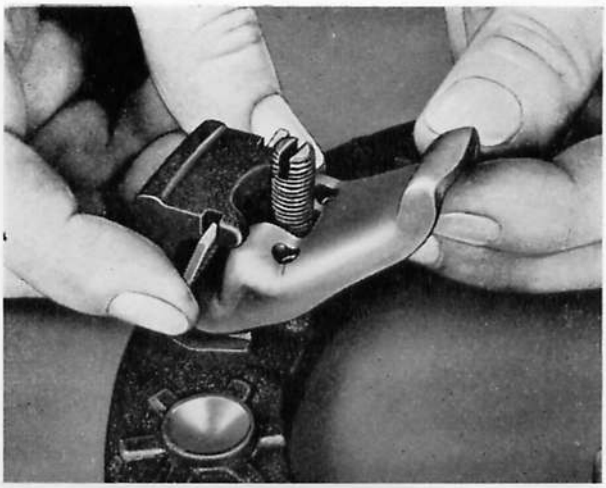


Fig. E.9. Assembling a release lever to the pressure plate. The strut must engage the grooves in the plate boss and the recess in the lever

(*b*) Where applicable, ensure that the marks made on the cover and plate during disassembly, are aligned.

(*c*) Check and adjust the height of the release levers (Fig. E.10). Do not lock the new eye bolt nuts at this stage.

(*d*) Using the handle supplied with the jig, operate the release levers several times so that the moving parts can settle into their working positions.

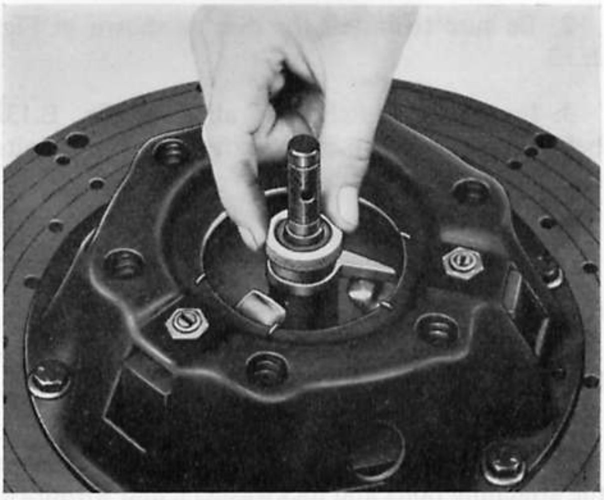


Fig. E.10. Checking the height of a release lever. Height adjustment is made by rotating the eye bolt nuts

DESCRIPTION

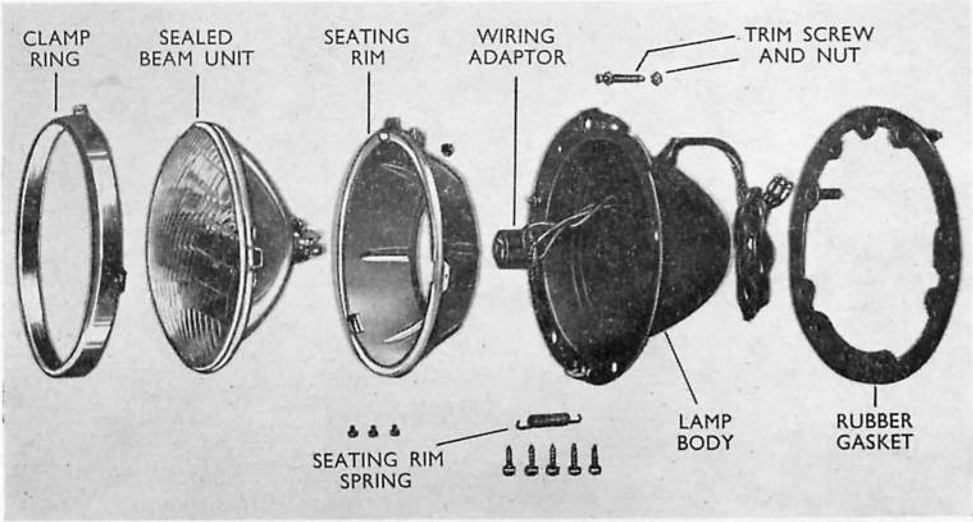


Fig. S.1. Exploded view of head lamp with sealed beam light unit

Lighting System

The head lamps are either the sealed beam or pre-focus type. The sealed beam lamp incorporates built-in filaments (main and dipped beams) assembled in one sealed unit (Fig. S.1). The pre-focus head lamp has a detachable bulb holder which retains a pre-focus bulb in the rear of the reflector (Fig. S.2). On Unified European head lamps the bulb and holder are integral. All head lamps are provided with trim screws for adjusting alignment.

The parking lamps incorporate a moulded rubber body and a twin filament bulb. The lamp lens is retained by a lip formed in the periphery of the body (see Fig. S.7 on page S-6).

The tail and stop lamps are of the same design as the parking lamps. Each lamp is located below a red reflector and attached to a metal base riveted to the body.

The rear number plate lamp comprises two bulbs mounted behind an aperture in the spare wheel lid.

The lamps are controlled by a push-pull type switch on the instrument panel, the head lamp circuit being completed through a dip switch mounted on the footwell panel. For certain overseas territories, the lamp circuit is changed to suit regulations which stipulate that the parking lamps must be extinguished when the head lamps are on.

A mechanical-type stop lamp switch is mounted on the underside of the driver's toe panel and operated by a lever contacting the brake pedal.

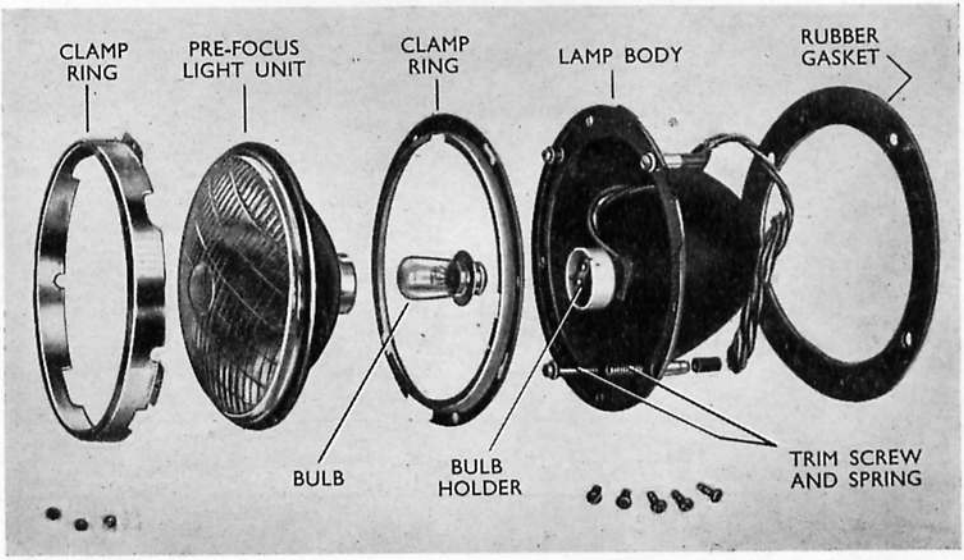


Fig. S.2. Exploded view of head lamp with pre-focus light unit. On Unified European head lamps, the bulb and holder are integral

Signal System

The system comprises front and rear flasher lamps, a flasher unit, an operating switch and an indicator lamp.

The front flasher lamps are combined with the parking lamps. The rear flasher lamps are located separately above the stop and tail lamps.

The lamps are operated by a manually controlled switch mounted on the instrument panel, and an indicator lamp is located in the centre of the cluster panel. The sealed type flasher unit is located behind the cluster panel.

Lighting Switch

This is a three position push-pull type incorporating a thermal circuit breaker which protects the head and parking lamp circuits.

Warning System

A high note horn is standard equipment but an additional horn having a low note is optional. Where twin horns are installed, a relay unit is included in the horn circuit.

The horns are mounted underneath and at the forward end of the front side panel and controlled by a push located in the hub of the steering wheel.

TROUBLE DIAGNOSIS

Lights Flicker

In the event of a short occurring in the head lamp and parking lamp circuits, the lights will flicker due to operation of the thermal circuit breaker. Apart from this, the most likely causes of lights flickering are loose connections in these circuits, bad earthing, or poor contact between harness plug and socket connectors.

Stop Lamps Inoperative

If one stop lamp fails, check the lamp bulb, socket connector and wiring. Failure of both stop lamps suggests an open circuit or a faulty switch. Check the line fuse, wiring and connections. If the stop lamps remain on when the brake pedal is released the switch is faulty and must be renewed.

One or Both Flasher Lamps on One Side Inoperative

This is indicated by no light from the indicator lamp and no clicks from the flasher unit. Check the flasher lamp bulbs, wiring and connections. If satisfactory, check the connections to the flasher unit.

Flasher Indicator Lamp Inoperative

In this case the flasher lamps will be operative and clicks from the flasher unit will be heard at normal frequency. Check for bulb failure or loose connections.

All Flasher Lamps and Indicator Lamp Inoperative

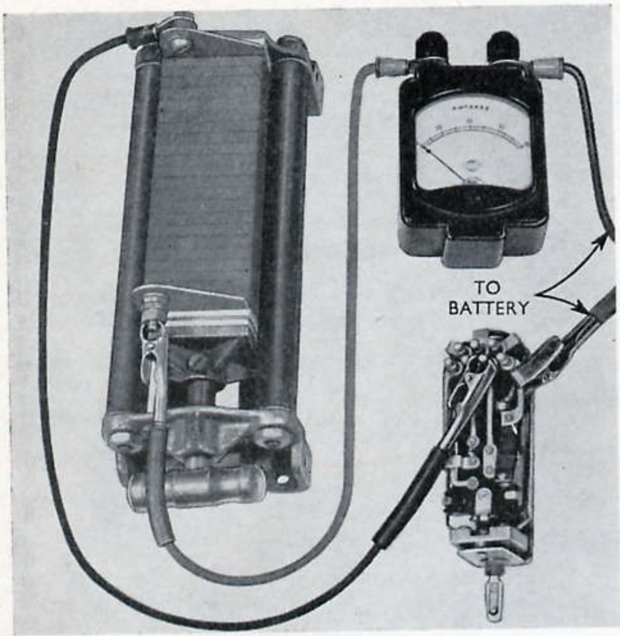
First check the line fuse. If the fuse has blown no light will be seen from the ignition/generator warning lamp and the fuel gauge will be inoperative when the ignition is switched on. If the fuse has not blown, check the flasher unit for failure by substituting a new unit.

Horns Inoperative

Check single-horn equipment by earthing the purple-black terminal connection on the horn. If the horn sounds, the wiring to the horn push is open-circuited. If the horn does not sound and a check shows that current is reaching the horn feed terminal, then the horn is faulty.

The latter check should also be applied if one horn of a twin-horn installation is inoperative.

With twin horns, if both are inoperative, check the relay and circuit (page S-10).



NOTE: *Do not adjust the setting of the circuit breaker by bending the bi-metal blade. If the test figures are not within the specified limits the lighting switch must be renewed. Do not clean the contacts.*

Fig. S.11. Checking the thermal circuit breaker of the lighting switch

LIGHTING SWITCH

Removal

1. Disconnect the battery.
2. Remove the four screws securing the instrument cluster panel. Withdraw the panel and disconnect the cable from the speedometer.
3. Pull the switch knob out to its extreme position, depress the retaining plunger and withdraw the knob (Fig. S.12).
4. Unscrew the switch locking ring (Fig. S.13), withdraw the switch and disconnect the multi-socket connector.

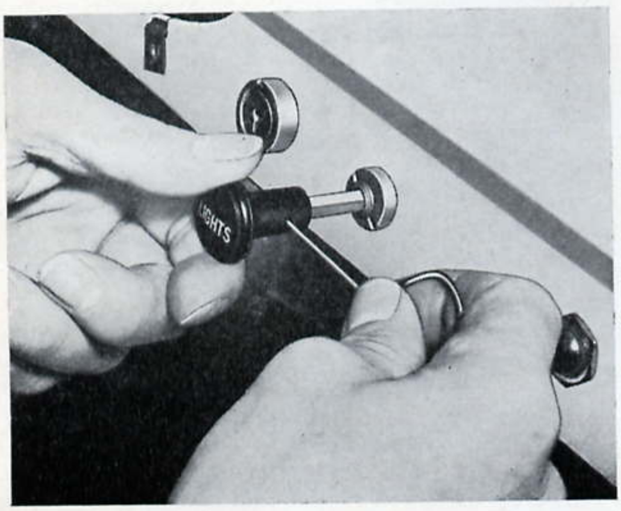


Fig. S.12. Depressing the plunger to release the lighting switch knob

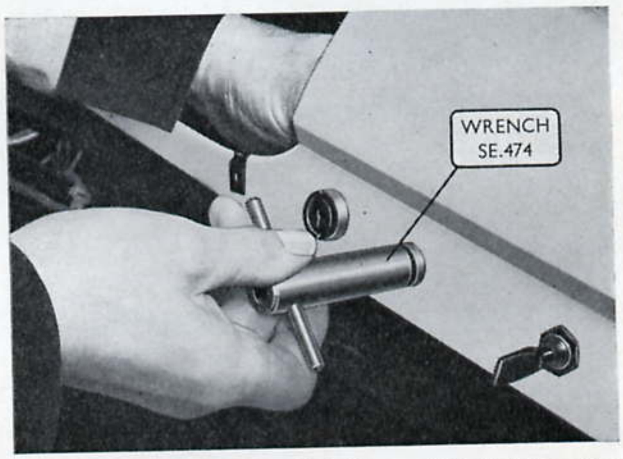


Fig. S.13. Removing the lighting switch locking ring

Installation

Note the following:

1. Assemble the connector before installing the switch in the panel. It is important that the connector is correctly assembled. In the event of it having been only partly pressed home, there could be serious consequences if it fell off during the hours of darkness, and all lighting was suddenly extinguished.

2. Before tightening the switch locking nut, ensure that the locating key on the switch engages the slot in the panel.

Centrifugal Advance Data

SYNCHROSCOPE TEST	
DISTRIBUTOR R.P.M.	DISTRIBUTOR DEGREES ADVANCE
400	0 to 1¾
600	2½ to 5
800	5¾ to 8¼
1000	8¾ to 11½
1200	9¾ to 12½
1400	10¾ to 13½
1600	11¾ to 14½
1800	13 to 15½
2000	14 to 16½
2200	14 to 16½
2400	14 to 16½
Cutting-in Speed	300 to 425 r.p.m.
Zero Checking Speed	Below 250 r.p.m.

TEST ON VEHICLE	
CRANKSHAFT R.P.M.	CRANKSHAFT DEGREES ADVANCE
800	0 to 3½
1200	5 to 10
1600	11½ to 16½
2000	17½ to 23
2400	19½ to 25
2800	21½ to 27
3200	23½ to 29
3600	26 to 31
4000	28 to 33
4400	28 to 33
4800	28 to 33
Cutting-in Speed	600 to 850 r.p.m.

COIL

Make and Type ... ... Delco-Remy oil filled

Current Consumption

Standard coil ... ... ·40 amp. at 1000 distributor r.p.m.

Cold start coil ... ... ·78 amp. at 1000 distributor r.p.m.

Resistance Data

Standard coil primary ... ... 4·15 to 4·55 ohms at 20°C (68°F)

Cold start coil primary ... ... 1·3 to 1·5 ohms at 20°C (68°F)

Cold start coil resistor ... ... 2 ohms at 20°C (68°F)

SPARK PLUGS

Make and Type*

Standard ... ... AC 445V

To cure plug overheating ... ... AC C43

To cure plug fouling ... ... AC VF9

Plug Gap ... ... ·028 to ·032 in.

HIGH TENSION LEADS

Resistance—Suppressor type ... ... 4000 to 8000 ohms per foot of cable

* *See 'Trouble Diagnosis', page R-3*

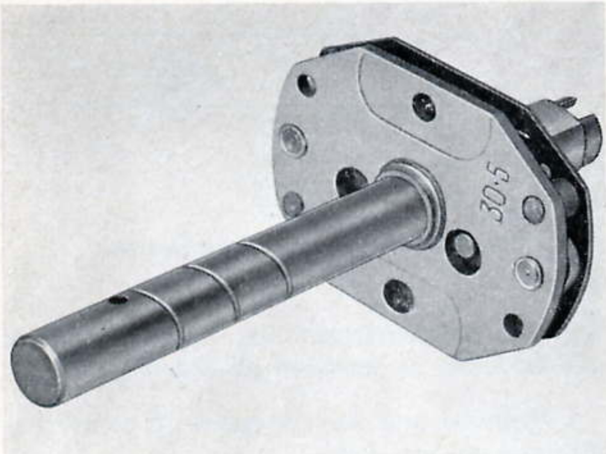


Fig. R.16. Underside of centrifugal advance mechanism showing location of identification number '30·5'

7. Check that the circuit breaker upper plate moves smoothly on its lower plate. Check the tension between the two plates (Fig. R.12). The plates are not serviced separately.

8. Ensure that the hole in the oil seal groove in the housing shank is not obstructed.

Reassembly

Note the following:

1. Check that the mainshaft has the identification number 30·5 stamped on the underside of the plate (Fig. R.16).

2. When installing a used mainshaft:

(*a*) Ensure there are no burrs on the end of the shaft to damage the bushes.

(*b*) Fit new springs to the centrifugal advance weights.

(*c*) Lubricate the shaft, felt in the housing, and the cam with engine oil.

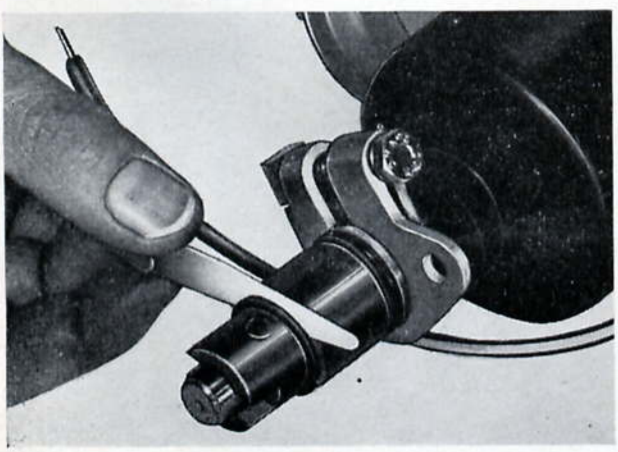


Fig. R.17. Checking end float of distributor shaft

(*d*) With the upper thrust washer in position, install the shaft and assemble the lower thrust washer.

(*e*) Line up the location marks and press on the driving sleeve so that the rivet holes are aligned. Check the shaft end float (Fig. R.17) which should not exceed the specified maximum. Install a new rivet.

3. When installing a new shaft:

(*a*) Carry out operations 2(a), 2(c) and 2(d).

(*b*) Press on the driving sleeve so that the angle of the sleeve slots in relation to the rotor corresponds with Fig. R.18 and the specified end float is obtained.

(*c*) Drill the rivet hole through the shaft with a No. 12 drill. Install a new rivet.

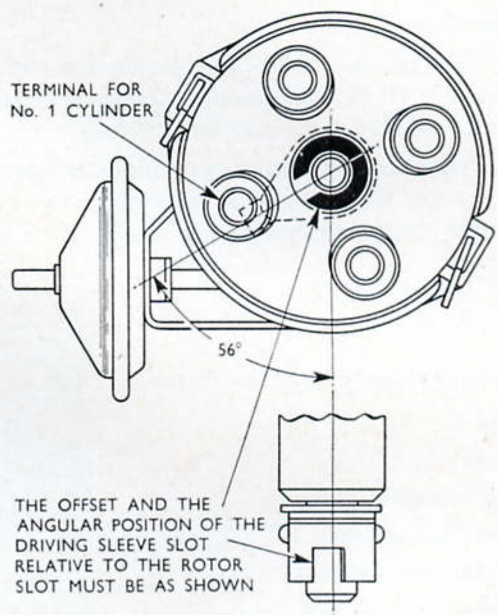


Fig. R.18. Location of driving sleeve on the distributor shaft

4. When installing a new shaft and driving sleeve:

(*a*) Carry out operations 2(a), 2(c), 2(d) and 3(b).

(*b*) Drill the rivet hole ·44 in. from the bottom of the sleeve, and at right angles to the slots, with a No. 12 drill.

5. After installing the circuit breaker plate assembly, adjust the contacts (page R-9).

6. Check the distributor performance on a synchroscope.

Installation

Refer to page R-5 for information on ignition timing.

SPECIFICATIONS

DISTRIBUTOR

Make and Type	Delco-Remy, D.202
AC-Delco Part Number	7952993
Direction of Rotation	Anti-clockwise, viewed from top
Firing Order	1, 3, 4, 2
Circuit Breaker Contacts	
Initial gap setting—new contacts	·021 to ·023 in.
Service gap setting	·019 to ·021 in.
Moving contact spring tension	17 to 21 oz.
Circuit Breaker Plate	
Load required to rotate upper plate	10 to 16 oz.
Cam Dwell Angle	35° to 37°
Condenser Capacity	·18 to ·23 microfarad
Distributor Shaft	
Diameter	·4895 to ·4900 in.
Clearance in bushes	·0003 to ·0013 in.
End float—initial assembly	·002 to ·005 in.
End float—service maximum	·010 in.
Thrust Washer Thickness	
Upper	·029 to ·033 in.
Lower	·056 to ·066 in.
Ignition Timing	
Setting	Contacts open 9° before T.D.C. (U/C mark on flywheel), with steel ball in line with notch in clutch housing aperture
Vacuum advance—maximum	11° (crankshaft)
Centrifugal advance—maximum	33° (crankshaft)

DISTRIBUTOR TEST DATA

Vacuum Advance in Distributor Degrees

Advance commences at	5 to 7 inHg
Advance of 4° at	9 to 11 inHg
Advance of 5° 30′ (maximum) at	20 inHg

PARKING/FRONT FLASHER LAMPS

Bulb Renewal

Ease the retaining rim and lens from the lips of the lamp body. The bulb has offset pins and can only be fitted in one position.

After renewing the bulb, install the lens and rim so that they are securely held by the lips of the lamp body.

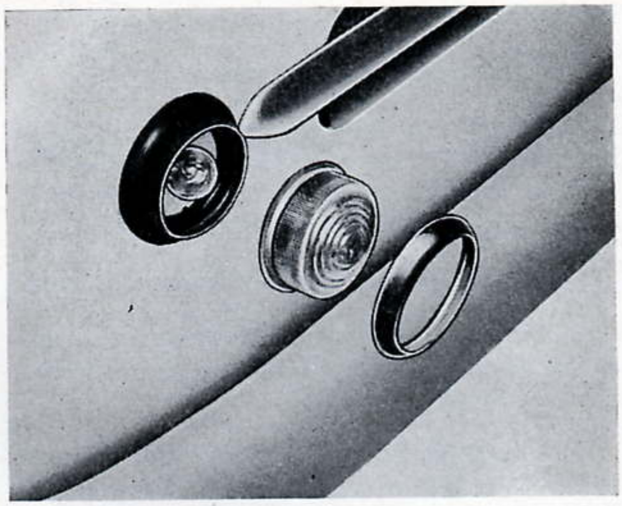


Fig. S.7. Parking/front flasher lamp details

Removal

1. Disconnect the lamp wires at the connector adjacent to the top of the radiator and pull the wires through the wing splashguard.

2. Ease the retaining rim and lens from the lamp body and remove the lamp attaching screws. Withdraw the lamp.

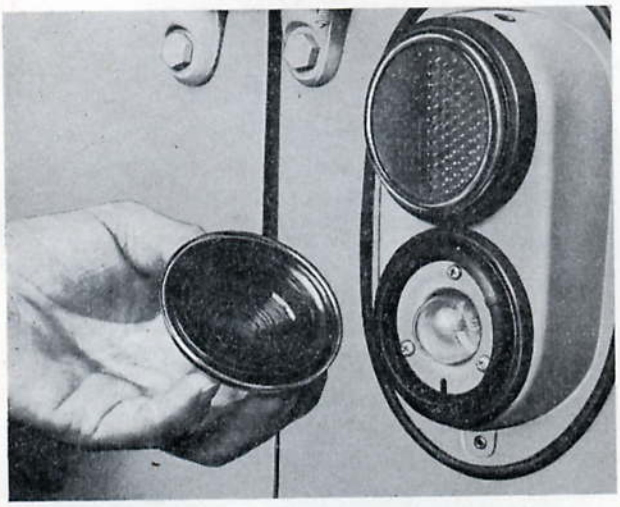
Installation

Note the following:

1. The lamp attaching screw holes are staggered to ensure that the lamp is installed in its correct position.

2. Ensure that the lens and rim are securely held by the lips of the lamp body.

TAIL/STOP, AND REAR FLASHER LAMPS



Bulb Renewal, Lamp Removal and Installation

Proceed as for the parking/front flasher lamps.

Fig. S.8. Tail/stop lamp lens removed.

REAR NUMBER PLATE LAMP

Bulb Renewal

Rotate the two quick release screws securing the spare wheel lid and swing the lid upwards. This will provide access to both bulbs.

SERVICE TRAINING MANUAL

for

ENGINE & CLUTCH

BEDFORD CA
Mark 2

SERVICE

VAUXHALL MOTORS LTD.

LUTON · BEDFORDSHIRE . ENGLAND

TS. 672

HEAD LAMP DIP SWITCH

Testing

If the head lamp beam direction is not affected when the switch is depressed, check the switch for faulty operation as follows:

1. Switch on the head lamps.

2. Short the centre terminal with each outer terminal in turn. If the lamps illuminate on main and dipped filaments the circuits are satisfactory but the switch is faulty.

Removal

1. Remove the engine cowl centre panel.

2. Remove the securing screws, withdraw the switch and disconnect the wires.

Installation

Refer to the wiring diagrams (pages V-2 and V-3) when reconnecting the wires.

STOP LAMP SWITCH

Removal

1. Remove the screws securing the switch to the toe panel.

2. Raise and support the vehicle, disconnect the wires and withdraw the switch.

DIRECTION INDICATOR SWITCH

Removal

1. Disconnect the battery.

2. Remove the four screws securing the instrument cluster panel. Withdraw the panel and disconnect the cable from the speedometer.

3. Remove the nut securing the direction indicator switch, withdraw the switch and disconnect the wires.

FLASHER UNIT

Renewal

As it is not a practical proposition to repair a defective flasher unit, in the event of failure the unit must be renewed.

The flasher unit is clipped to the instrument panel behind the cluster panel as shown in Fig. S.14. To withdraw the panel, disconnect the battery, remove the four attaching screws and disconnect the speedometer cable.

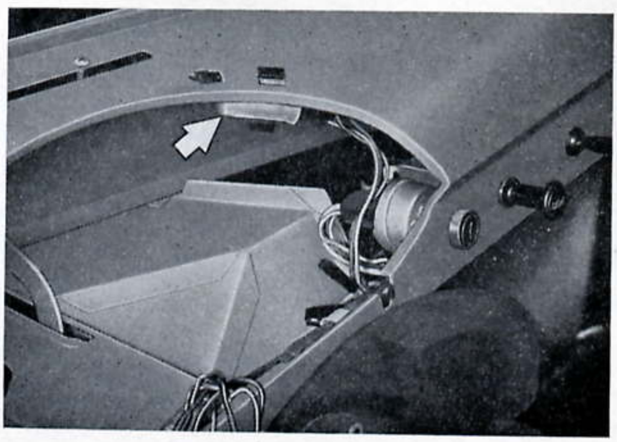


Fig. S.14. The flasher unit, indicated by arrow, is clipped to the panel and accessible after the instrument cluster panel is removed

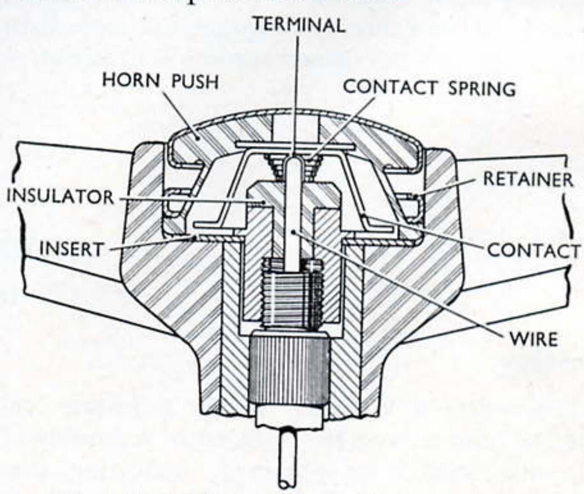


Fig. S.15. Sectioned view of horn push

HORN PUSH

Removal

1. Disconnect the battery.

2. Prise out the horn push and retainer and remove the push contact spring (Fig. S.15).

3. Pull the horn wire terminal clear of the split insulator and remove the two halves of the insulator.

Inspection and Reconditioning

1. If renewal of the brass insert is required, remove the steering wheel nut (see Section M). Tighten the nut to the specified torque.

2. When renewing the horn push wire, unsolder the terminal at the top end and attach a draw wire before withdrawing downwards. The draw wire will assist installation of the new wire.

Installation

Assemble the contact spring with the small coils to the wire terminal.

HORNS

Adjustment

Adjustment of the horn is permissible, but the setting instructions must be strictly adhered to otherwise damage will result.

1. Ensure that the horn terminals are clean.

2. Connect a 0–50 range ammeter in series with the horn and check the current consumption with the horn sounding. The correct current consumption should be within the following limits:

Voltage at horn terminals when sounding	12·0 to 14·0
Current consumption in amps ...	8·5 to 9·5

3. If the consumption is low, turn the current adjusting screw, adjacent to the wire terminals, in an *anti-clockwise* direction through not more than half a turn until the correct reading is obtained.

If the consumption is high, turn the adjusting screw in a *clockwise* direction through not more than half a turn until the correct reading is obtained.

IMPORTANT: *Do not exceed the specified screw adjustment.*

4. After final adjustment, seal the screw with a hard-drying sealing compound.

Removal and Installation

1. Disconnect the battery.

2. Turn the road wheel inwards to obtain access to the horn attaching bolts.

3. Remove the attaching bolts before disconnecting the wires.

HORN RELAY
(Twin Horns)

Testing

1. Connect a voltmeter across terminals 'C2' and 'W1' and depress the horn push. A reading of 12 volts should be obtained, indicating that current is reaching the relay. If no reading is obtained this will indicate that the horn push is not making contact or there is an open circuit in the wiring.

2. If a satisfactory reading is obtained, connect the voltmeter across terminal 'C1' and earth. Upon

FOREWORD

This group of the manual provides comprehensive information on the Engine and Clutch of the Bedford CA, Mark 2, including the differences associated with the application of the Perkins diesel engine option to this model.

Contents. The main subjects dealt with are listed on page iii. An individual index is provided on the first page of each section, and a general index is included at the end of this group.

General Notes. Recommendations on important general items which must be observed whenever service work is undertaken are collated under 'General Notes' on page vii. It is important that servicemen should become familiar with all of these points.

Recommended Lubricants. Lubricants approved and recommended for use in the United Kingdom and Overseas are listed at the end of this group.

Guardian Maintenance. The notes included under this heading in appropriate sections are confined to service procedure. For further information, reference should be made to the Guardian Maintenance booklet supplied with the vehicle.

Riteway Service Tools. Reference is made throughout the manual to tools designed to facilitate service operations. All of these tools are illustrated in use.

Tools which carry a prefix 'Z' to the tool number are available to Authorized Dealers from the Parts and Accessories Department, Vauxhall Motors Limited, Dunstable, Beds.

Tools prefixed 'D' are supplied by various Factors, and orders should be addressed to the Service Department, Route 2494, Vauxhall Motors Limited, Luton, Beds.

An 'SE' prefix to the number indicates that the tool must be manufactured locally. Detail drawings of 'SE' tools may be obtained from the Service Department, Route 2494.

MODEL DESIGNATIONS

CAS	...	90 in. wheelbase	Chassis No.	10/12 and 15/17 cwt.
CAL	...	102 in. wheelbase	350000 onwards	Chassis and Van

LOCATION OF MODEL IDENTIFICATION PLATE AND ENGINE NUMBERS

A plate on which is stamped the model identification letters and numbers, is attached to the footwell panel, inside the body, adjacent to the steering column.

The engine number is stamped in the following locations. On diesel-engined vehicles: on the top edge of the facing on the cylinder block to which the fuel injection pump is attached. On gasoline-engined vehicles: on a pad on the crankcase adjacent to the fuel pump.

GENERAL NOTES

Safety Precautions

Isolation of Battery. Always disconnect the battery before commencing operations where there is the slightest possibility of accidental engagement of the starter or the danger of a short circuit. Neglect to take this precaution may result in personal injury and the risk of fire.

Jacking. To prevent damage, the following precautions should be taken when jacking up and supporting the vehicle on stands.

1. When jacking up the front of the vehicle on the front axle crossmember, a block of wood should be interposed between the jack and the crossmember.

2. When jacking up the rear of the vehicle, ensure that the jack pad is in the centre of the axle housing and that any projections on the pad are not fouling the housing rear cover and taking the weight.

3. Support the vehicle on stands located below the chassis frame sidemembers.

Cleanliness of Components

Clean all components prior to inspection for wear or damage, but do not wash sealed bearings in solvent or place in a degreasing plant.

Identification of Components

When components are removed it is sometimes necessary to identify their locations relative to other parts, also to ensure that mated surfaces are correctly related on reassembly.

Some components have mating marks stamped on them during manufacture. In the absence of such marks, however, care must be taken in the method of identification employed. The location of two housings, for example, could be identified by centre-punching or with file marks, *but this treatment if applied to a stressed component such as a connecting rod could lead to fatigue failure.* Generally, the safest and most satisfactory method is to mark with a quick-drying paint.

Expendable Items

Whenever a unit is disassembled, renew all gaskets, oil seals, split pins, circlips, lockwashers and tab washers where applicable. Not all nuts and bolts are equipped with lockwashers. When in doubt on usage, refer to the Parts Catalogue.

Specifications

Refer to 'Specifications' at the end of a section for dimensional and other data for use when assessing component wear and when making adjustments. Unless otherwise stated, the dimensions given are the manufacturing limits for new parts.

Recommended Lubricants

The references to lubricants in the manual text are in general terms only. In all cases the list of 'Recommended Lubricants' at the end of the manual should be consulted for grades and specifications. This list includes particulars of lubricants to be used during initial assembly.

Use of Torque Wrench

Certain nuts and bolts must be tightened to a specified torque. These are listed under 'Specifications' at the end of each section. Bolts and nuts which have been tightened beyond the prescribed torque wrench figures, should not merely be slackened off to the correct figure, as they may work loose. The correct procedure is *that the bolt or nut should be loosened until free of all stress and then retightened to the correct figure.*

Screw Threads

The nuts, bolts and studs used on units of Vauxhall manufacture have threads of the Unified Thread Form. These threads closely resemble our previous usage of the American National Form thread and for practical purposes are interchangeable. Nuts or bolts with any other form of thread cannot be interchanged.

The wrenches for use on Unified-threaded nuts and bolts are listed below.

Wrench Sizes for Unified Nuts and Bolts

Bolt diameter in inches		1/4	5/16	3/8	7/16 *	1/2	9/16 *	5/8	3/4
Wrench sizes in inches across flats	Nut	7/16	1/2	9/16	11/16	3/4	7/8	15/16	1 1/8
	Bolt	7/16	1/2	9/16	5/8	3/4	13/16	15/16	1 1/8

NOTE: *For bolt diameters indicated* (*) *the hexagon size is greater for the nut than for the bolt.*

SECTION A—GASOLINE ENGINE
(Including Lubrication)

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Have you read the General Notes on page vii?

DESCRIPTION

The engine is a 97·4 cu.in. four cylinder 'over-square' unit with push rod operated overhead valves.

Crankshaft, Pistons and Connecting Rods

A three-bearing crankshaft is used and end float is controlled by thrust washers each side of the centre bearing. Semi-circular oil seals are provided at the rear of shaft (Fig. A.1) and a spring-loaded seal at the front. Solid skirt type pistons have offset pins which are fully-floating and retained by circlips. Each connecting rod has an oil bleed hole drilled through one side to direct an oil spray from the bearing on to the side of each cylinder wall.

Camshaft and Timing Gear

The camshaft is supported by three bearings and driven by a duplex roller chain. A thrust plate bolted to the crankcase, controls camshaft end float. A self-adjusting chain tensioner (Fig. A.2) is bolted against the crankcase front plate and connected by an oil drilling to the front main bearing. Oil fed from the bearing, lubricates the slipper pad contacting the timing chain and also provides a degree of hydraulic damping of the tensioner.

Cylinder Head and Rocker Gear

A standard low compression head marked 'L' as shown on page A-24 and an optional high compression head marked 'H' are available. A common cylinder head gasket is used.

The valves operate in removable guides pressed into bores in the head. Oil seals are assembled to the stems of the intake valves. The rockers operate direct on a hollow shaft supported in brackets bolted to the head.

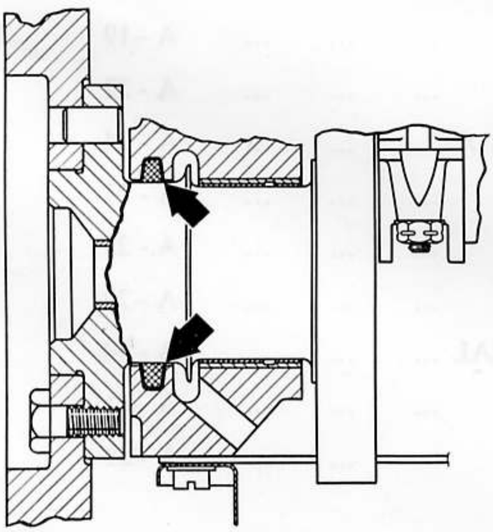


Fig. A.1. Location of crankshaft rear bearing oil seal in the crankcase and main bearing cap (indicated by arrows)

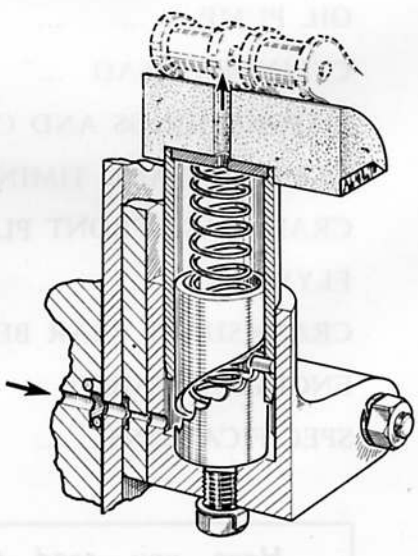


Fig. A.2. Sectioned view of timing chain tensioner

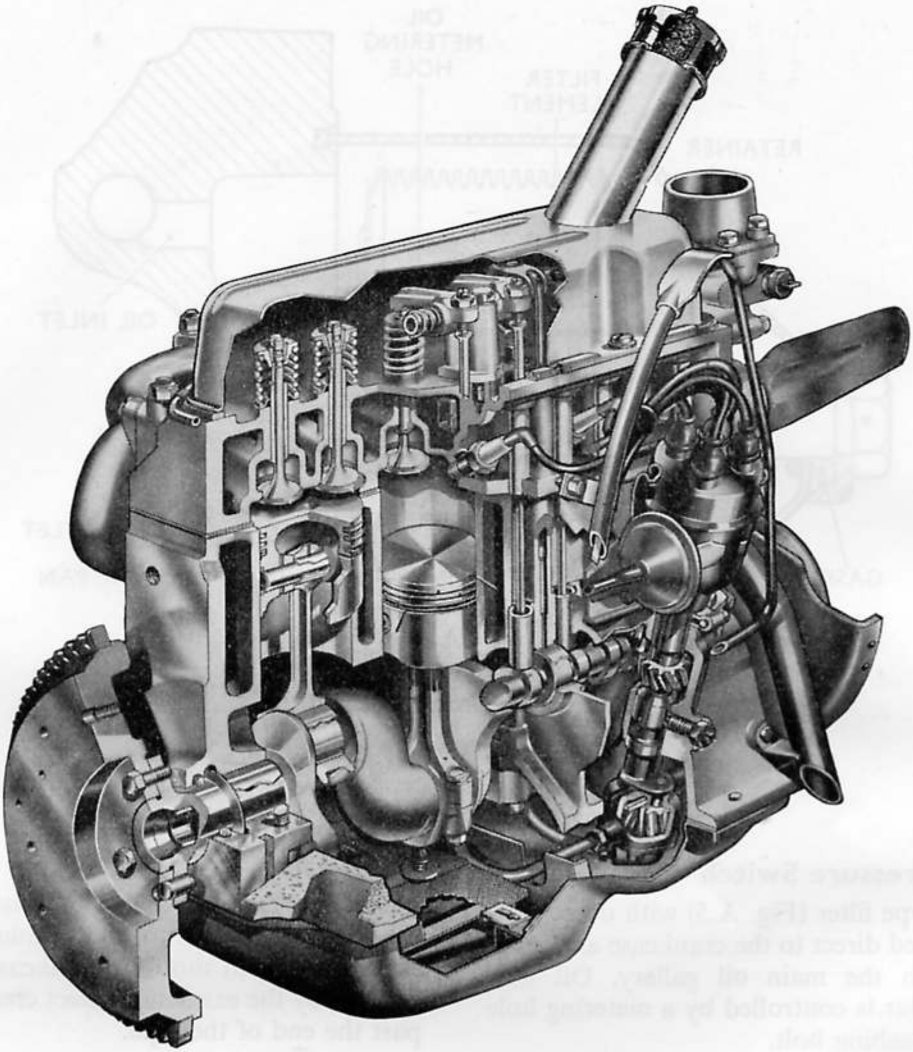


Fig. A.3. Cut-away view of engine assembly

Oil Pump

The pump (Fig. A.4) is driven from the camshaft by skew gears one of which is riveted to the top end of the pump driving impeller spindle. This spindle is drilled to conduct oil under pressure up to two radial metering holes which discharge oil through a slot in the upper face of the pump body for lubrication of the skew gears.

A spring-loaded relief valve is incorporated. Pipes connect the pump inlet to a strainer in the oil pan, and the outlet to a main oil gallery in the crankcase.

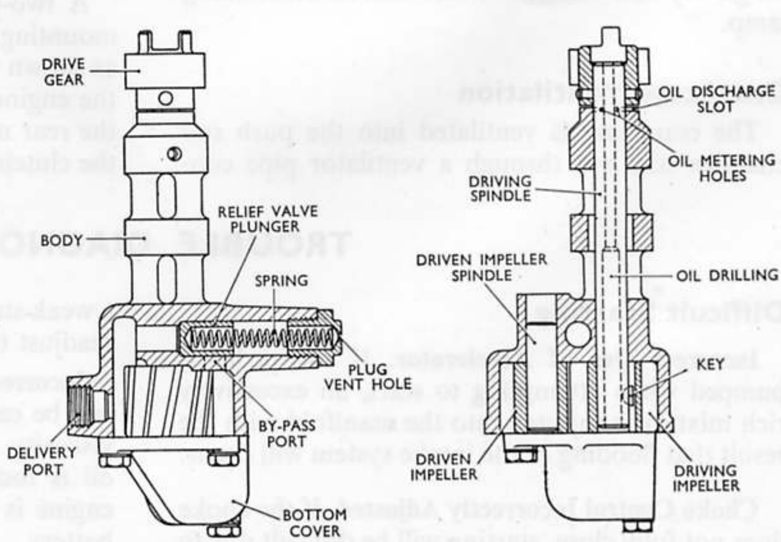


Fig. A.4. Sectioned views of oil pump

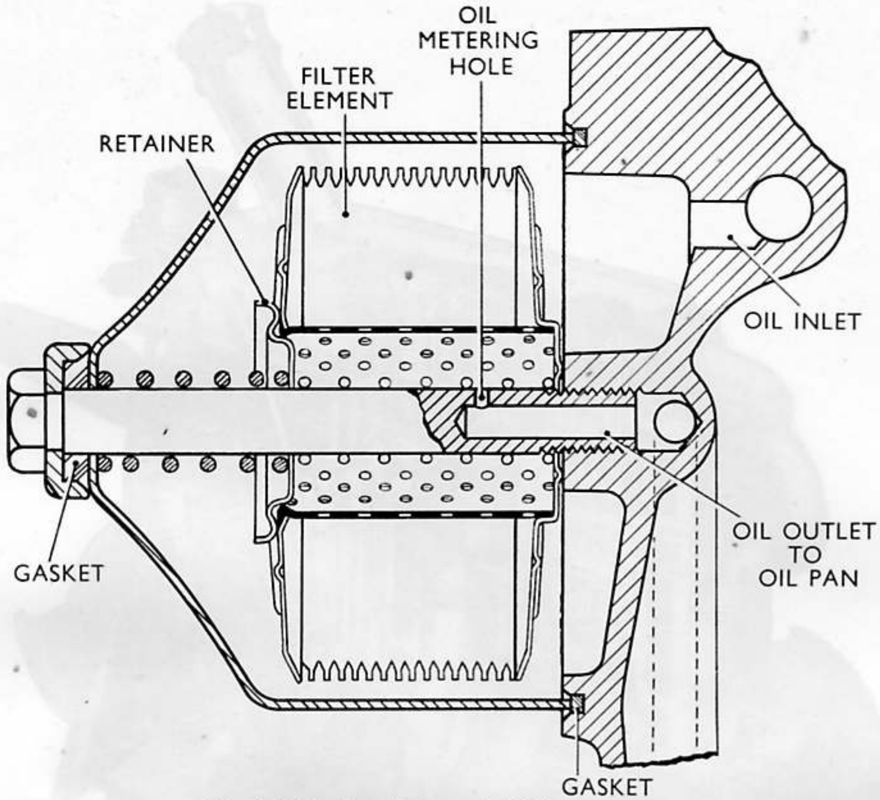


Fig. A.5. Sectioned view of oil filter

Filter and Pressure Switch

A by-pass type filter (Fig. A.5) with detachable element is bolted direct to the crankcase and communicates with the main oil gallery. Oil flow through the filter is controlled by a metering hole in the filter attaching bolt.

An oil pressure switch is screwed into the main oil gallery and wired in circuit with an oil warning lamp.

Crankcase Ventilation

The crankcase is ventilated into the push rod chamber and out through a ventilator pipe connected to the push rod cover. Air drawn through the oil filler cap flows down the push rod tubes into the chamber and out of the ventilator pipe. When the vehicle is in motion, crankcase ventilation is assisted by the extraction effect created by air flow past the end of the pipe.

Engine Mountings

A two-point front mounting and a single rear mounting support the engine and transmission unit as shown on page A-12. Fore and aft movement of the engine is controlled by a stay rod attached to the rear mounting crossmember and a bracket on the clutch housing.

TROUBLE DIAGNOSIS

Difficult Starting

Incorrect Use of Accelerator. If the pedal is pumped when attempting to start, an excessively rich mixture is injected into the manifold with the result that flooding of the intake system will occur.

Choke Control Incorrectly Adjusted. If the choke does not fully close, starting will be difficult due to a weak starting mixture. To overcome this trouble, readjust the choke control.

Incorrect Grade of Engine Oil. Difficult starting can be caused by using an engine oil of a higher viscosity number than that recommended. If the oil is too heavy, the effort required to turn the engine is increased with consequent drain on the battery.

Idling Adjustment Incorrect. Incorrect adjustment of the carburetter can affect starting by causing either a too weak or a too rich starting mixture.

Idling Jet Choked. Difficult starting, usually when the engine is hot, may be caused by a choked idling jet. To overcome this trouble, remove the jet and blow out the jet and appropriate drillings.

Air Leaks. Air leaks at the carburetter flange and intake manifold flange joints, or the ignition control suction pipe connections, can cause weak fuel mixture resulting in difficult starting. To confirm whether an air leak is the cause, carry out a vacuum test.

High Fuel Level. This trouble is usually recognised by flooding of the carburetter and may be due to a leaking needle valve, damaged float/s or excessive fuel pump pressure. Check the float position (Operation 5 under 'Reassembly', page B-11). If the fuel pump pressure is suspected, carry out a pressure test.

Ignition or Electrical Faults. Difficult starting can also be associated with a partly discharged battery, faulty distributor or coil, spark plugs dirty or gaps incorrect, starter and/or switches faulty, or loose starter cable connections.

Lack of Power

To determine whether lack of power actually exists, the vehicle should be driven over a known route where a standard performance has already been assessed.

Throttle Not Opening Fully. This is a common cause of loss of power and is particularly noticed when driving at top speed or whenever maximum engine power is desired. To rectify, adjust the throttle control linkage.

Choke Flap Not Opening Fully. A partially closed choke flap will restrict air intake and cause loss of power due to an over-rich mixture. When correctly adjusted the flap should be in the vertical position with the control knob pushed right home.

Air Cleaner Dirty. An over-rich mixture due to restricted air intake through a dirty air cleaner will also cause loss of power. Check the condition of the air cleaner and rectify where necessary.

Fuel Starvation. Insufficient fuel delivered to the carburetter may be due to the carburetter needle valve sticking, bent float arm, partially choked fuel pump filter screen, kinked or leaking pipes and hoses, or pump delivery pressure low. Where necessary, check the float position (Operation 5 under 'Reassembly', page B-11).

Ignition System Faulty. When loss of power together with misfiring occurs, a complete check of the ignition system should be made.

Cylinder Compression Low. Good cylinder compression is essential for maximum engine performance. Low or uneven pressures can be caused by burnt valves, worn pistons, rings or cylinder bores. Insufficient valve clearance or weak valve springs also contribute to loss of power.

Overheating. See under 'Overheating' on page A-6.

Detonation

Detonation can be recognised by a sound similar to a hard metallic knock and may occur when accelerating from low speed in top gear.

Light detonation is not injurious to the engine. Heavy detonation, however, will harm the engine if allowed to continue by causing damage to the pistons, bearings or cylinder head gasket.

Incorrect Grade of Fuel. To avoid detonation, it is essential that a high compression engine, where fitted, operates on premium grade fuel.

Ignition Timing Incorrect. Detonation can be caused by the ignition timing being too far advanced. In such cases the timing should be set so that detonation is just avoided when accelerating from low speed in top gear.

Where a premium grade fuel is used on a high compression engine, it is possible to over-advance the ignition without any sign of detonation. The ignition timing should not, therefore, be advanced beyond the steel ball which is located 9° before T.D.C. (U/C mark on flywheel).

Spark Plugs Incorrect Type. Detonation can be caused by using the incorrect type of spark plug which may overheat and pre-ignite the mixture.

Distributor Faulty. Worn distributor mechanism can cause excessive spark advance with consequent detonation. If this condition is suspected, the distributor should be tested for correct advance characteristics.

Overheating. Excessive carbon deposits in the cylinder head will create local hot spots which pre-ignite the incoming mixture and cause detonation.

Overheating of the cooling system can also have a similar effect. If the cooling system is suspected, check the possible causes given under 'Overheating' on this page.

Detonation from overheating may also result from a weak mixture caused by carburetter jets of incorrect size, or air leaks, see under 'Weak Fuel Mixture' below.

Popping and Spitting

This trouble indicates some fault in the mechanical condition of the engine, ignition system or fuel system. The complaint can usually be diagnosed with the aid of an engine analyser and may be due to either one or more of the following causes.

Ignition System Faulty. Check the spark plugs for cracked insulators. Examine the distributor cap for cracks or arcing across the segments; defects of this nature can cause simultaneous sparking at two plugs. Arcing across the segments may originate from moisture inside the cap.

Weak Fuel Mixture. Weak mixture due to air leaks, carburetter jet sizes incorrect or fuel starvation may cause popping or spitting.

To confirm whether air leaks exist, check the idling adjustment. If fuel starvation is suspected, check the items listed under this subject on page A-5. Check for correct jet sizes.

Engine Mechanical Faults. The absence of valve clearance, sticking valves or a cylinder head gasket leak between two adjacent cylinders can encourage popping or spitting. Weak valve springs or incorrect timing can have a similar effect. If necessary, carry out a vacuum test, or check the valve timing.

Engine Misfire When Accelerating

If the trouble is not due to a faulty spark plug, the use of an engine analyser will assist in tracing the cause. This may be some fault in the fuel system, ignition system or poor condition of the valves or seatings.

Idling Uneven

This complaint is usually associated with incorrect idling adjustment, choked jet, air leaks, incorrect fuel level or some fault in the ignition system. Further details covering these points are included under 'Difficult Starting' on page A-4.

Consideration should also be given to the mechanical condition of the engine. Uneven compression pressures caused by incorrect valve clearance, burnt or sticking valves, can upset slow running. Check the valve clearances.

Fuel Consumption Excessive

When investigating complaints of excessive fuel consumption the first step is to establish whether consumption is really excessive. This can be checked by installing a calibrated test tank and running the vehicle over a predetermined and accurate distance.

Driving conditions can seriously affect fuel economy. Short journey work, door to door operation, overloading or high speed driving have an adverse effect on fuel consumption.

In addition, the mechanical condition of the engine and the ignition and fuel systems must be considered. Poor engine performance will result in excess fuel consumption through the need to use the lower gears more frequently. Therefore, check for lack of power as described on page A-5.

Overcooling

During low climatic temperatures it may be necessary to blank off the lower part of the radiator.

Thermostat Faulty. If overcooling is experienced during moderate or warm climatic temperature then the trouble may be due to the cooling system thermostat valve remaining open. The bellows-type thermostat, where fitted, is so designed that in the event of failure, the valve remains in the fully open position, consequently the engine will take considerably longer to warm up. Where necessary, check the operation of the thermostat valve. Check that the correct type thermostat is installed (page C-6).

Manifold Valve Seized. Delayed warming up will also be caused by a manifold valve which is seized in the 'engine hot' position so restricting the flow of exhaust heat around the intake manifold vaporizing chamber. The end of the spring stop should be in contact with the stop spindle when the engine is cold, and away from the spindle when the engine is hot.

Overheating

Water Level Low. If continual topping-up is required, see under 'Loss of Coolant' page A-7.

Fan Belt Loose. A loose belt will slip and cause the water pump and fan to be driven at a speed lower than that required for efficient operation. Adjust the belt tension.

Radiator Filler Cap Faulty. The radiator filler cap contains a valve which controls the pressure in the cooling system. The valve opens at a predetermined pressure, and allows steam or water to escape through the overflow pipe. Where a faulty pressure valve is suspected, test the filler cap.

Thermostat Faulty. If the thermostat valve sticks in the closed position despite rise in operating temperature, overheating will result. The capsule-type thermostat, where fitted, will, in the event of failure, cause the valve to remain fully closed. Check that the valve is operating satisfactorily.

Cooling System Blocked. Whenever a restriction in the cooling system is suspected, it is recommended that the complete system is reverse flushed. This will remove any sediment or sludge which has settled in the radiator or cylinder block and head water passages. In severe cases, where blockage of the water passages has occurred, the obstruction must be removed.

Ignition Timing Retarded. Check the ignition timing and reset if necessary.

Manifold Valve Seized. If the manifold valve is seized in the 'engine cold' position, exhaust gases will continue to flow around the intake manifold and cause overheating.

Loss of Coolant

If the radiator is over-filled when cold, expansion of the coolant when hot will cause loss through the overflow pipe. Adding water where anti-freeze solution is in use will weaken the solution and increase the risk of freezing. To avoid this possibility, top-up the coolant level, with anti-freeze mixture of the correct strength, not higher than one inch below the bottom of the filler neck.

If frequent topping-up is required, the source of leakage may be indicated by water stains. Check for one or more of the following possible causes.

Damaged or Perished Hoses, or Loose Connections. Damaged or perished hoses should be renewed. When checking for perished hoses the following test should be carried out: with the vehicle stationary, run the engine at a safe high speed for a few seconds and at the same time observe the effect on the hoses. If the hoses partially collapse as the engine speed is increased, this indicates that the hoses are perished (assuming the radiator element is not blocked).

Check for loose hose clips and where necessary tighten sufficiently only to stop the leak.

Radiator Leaking or Choked. This may be due to damaged or corroded element or tanks. To locate the source of the leak, pressure test the radiator. If a choked element is suspected, the water passages must be cleaned.

Water Pump Leaking. The water pump seal is of the self-adjusting type and normally requires no service attention. If a leak should develop from this source the water pump must be removed and a new seal and rotor installed. A faulty seal can also cause air to be drawn into the system (see under 'Air or Gas Leaks').

Cylinder Head or Gasket Faulty. A water leak from the cylinder head gasket face is usually caused by some fault in the gasket, loose or incorrectly tightened cylinder head nuts or a distorted head. Detonation also will cause an internal water leak by damaging the gasket, particularly between two adjacent cylinders; a clue may be given by contamination of the engine oil. Similar symptoms can also be caused by a cracked cylinder head. Renew the gasket or check the cylinder head for distortion or cracks.

Cylinder Block Faulty. If a cracked cylinder block is suspected, it is advisable to pressure test the block before deciding corrective action. If signs of water leaks from a cup plug are visible, a new plug should be installed after coating with sealing compound.

Air or Gas Leaks. An internal fault, which may not be sufficiently serious to show visible evidence of a water leak, can cause air or gas to enter the cooling system. This condition may raise the level in the radiator and cause loss of water through the overflow pipe. To check whether this trouble exists, proceed as follows:

1. With the cooling system cold, top-up the radiator to one inch below the bottom of the filler neck.

2. To eliminate any restriction on the flow of air or gas from the system, replace the normal filler cap with one from which the vacuum valve has been removed to allow any air or gas to flow into the overflow pipe.

3. Place the lower end of the overflow pipe in a glass jar filled with water. Make sure the pipe is not kinked or has sharp bends which might restrict the flow of air.

4. Run the engine at a moderate speed to attain normal operating temperature. Then run the engine at a safe high speed, and at the same time check for air bubbles in the jar.

5. A continuous flow of bubbles will indicate that air or gas is being drawn into the cooling system. Entry of air in the cooling system can be caused by a faulty water pump seal, whereas gas in the system is usually due to a faulty cylinder head gasket.

6. On completion of the check, refit the original filler cap.

Engine Vibration or Noise

Unusual vibration or noise is generally more pronounced at certain road speeds. If the condition exists when the engine is run at the corresponding speed with the vehicle stationary, then the trouble is due to some fault related to the engine or clutch. If it does not show up on this test, the trouble is probably due to a fault in the rear axle or transmission.

Where unusual vibration or noise is confirmed as associated with the engine or clutch, it may be due to one or more of the following causes:

Fan, Belt or Water Pump. If the noise or vibration is eliminated when the engine is run with the belt removed, check the fan bolts for tightness, and the blades for fracture or distortion. Check the pump for rough or noisy bearings and the pump shaft for excessive end float. Recondition the pump if necessary. Examine the belt and pulleys, and check that the pulley is secure on the crankshaft. Refit the belt and adjust tension.

Generator. If noise or vibration is still present after checking the fan, belt and pump, check the generator as follows. First check the generator mounting bolts for tightness, then with the engine running, place one hand on the generator and slowly increase engine speed. Excessive noise or vibration will be indicated by acute vibration through the hand. Noise and vibration from the generator usually occurs simultaneously at certain speeds.

Timing Chain Tensioner, Chain or Wheels. A harsh metallic noise or rattle audible at the front of the engine, particularly when idling, and usually diminishing as the engine speed is increased, indicates a defective chain tensioner and/or wear of the chain and timing wheels. If the tensioner or tensioner components are renewed, the chain should also be checked for wear and, if necessary, renewed together with the timing wheels.

Engine Mountings. Loose engine mountings or perished mounting rubbers will cause vibration. Check the condition of the rubbers, and the mounting attaching bolts and nuts for tightness.

Clutch. Noise from the clutch can be due to lack of lubricant on the pedal shaft, a faulty release bearing, or collapse of the clutch disc springs. If the noise occurs with slight depression of the pedal a faulty release bearing is indicated. Collapsed disc hub springs can usually be detected by a rattle when the engine is idling and the clutch is moved in and out of engagement.

A harsh constant noise occurring when the engine is idling in neutral is sometimes diagnosed as a clutch fault. If, however, the noise disappears when the clutch pedal is depressed, the cause may be a worn clutch pilot bush, or worn constant mesh gears.

Engine Lubrication Faults

Warning Lamp Fails to Light with Ignition On and Engine Stopped. This can be due to a blown line fuse or faulty bulb, or a bad connection in the bulb and switch circuit. The fault is in the oil pressure switch if the warning lamp is lit when the wire is disconnected and earthed on the crankcase.

Warning Lamp Lights Intermittently with Engine Running. Check for low oil level and top-up if necessary. If the oil level is too low, surging, created by cornering or hard braking, uncovers the pump suction pipe and causes momentary starvation of the oil supply. Check also for a short circuit in the wire from switch to bulb holder.

Warning Lamp Lights Continuously. This can be caused by oil level too low, short circuit in the wire from lamp to switch, a defective switch or low oil pressure. A defective switch can be checked by substituting a pressure gauge. The oil pressure must not fall below the specified limit otherwise the pressure will be insufficient to open the switch contacts. Loss of oil pressure can be due to a scored or sticking oil pump relief valve plunger, weak spring, or excessively worn crankshaft bearings.

Oil Pressure Excessive. Excessive oil pressure may be revealed by repeated switch failure. Check the pressure. This can be done by substituting a pressure gauge for the switch and run the engine at 3000 r.p.m. If oil pressure is normal the gauge should record a pressure within the specified limits. If the oil pressure is excessive, the fault may be due to a seized oil pump relief valve plunger or obstruction of the relief valve plug bleed hole. Remove the oil pump and free out the plunger. Inspect the bore for foreign matter. Examine for dirt or other foreign matter in the lubrication system, and clean as necessary.

Oil Consumption Excessive

A new engine or an engine in which new piston rings have been installed requires sufficient running to bed-in the rings. During the first 5000 miles which represents the bedding-in period, the oil consumption will be higher than normal and no attempt should be made to improve oil economy under these conditions by renewing internal parts.

When investigating cases of alleged excessive oil consumption it is essential first to make a thorough check for external oil leaks. The engine should be cleaned, and a sheet of clean paper placed on the floor beneath. Run the engine at medium speed until thoroughly warmed up, then stop the engine and check carefully for oil leakage.

If the external oil leakage is not sufficient to justify the complaint, consideration must be given to the internal condition of the engine in relation to the mileage covered.

With an engine which has covered the 5000 mile bedding-in period and has been in operation for a comparatively short period, it is recommended that the reported oil usage is verified before attempting corrective action. With the vehicle on level ground and the engine cold, carefully top-up the oil level. Then run the vehicle for a further 200 miles without adding additional oil. After this test the oil level should be checked and topped-up again under the same condition as before, and the quantity used compared with the mileage covered under test.

When an engine has had considerable service life without any internal rectification to improve oil economy, then worn pistons, rings or cylinders can be expected.

Excessive oil pressure (see above) can be another cause of heavy oil consumption, and should be considered before attempting any major rectification.

Clutch Fierce or Judders

Pedal Operation Faulty. The clutch pedal should operate smoothly and quietly. If necessary, lubricate the pedal shaft. Check, and if necessary, adjust the pedal free travel.

Disc Facings Worn or Oily. Excessive wear of the disc facings or contamination with oil or grease will cause fierce operation or judder of the clutch when taking up the drive. New facings should be installed and the clutch pressure plate and flywheel examined for scoring of the friction surfaces. Check also for oil leaks at the transmission front cover or crankshaft rear main bearing.

Disc Distorted. Even distribution of pressure over the friction area is essential for proper operation. Examine the friction facings for uneven or excessive wear and, if necessary, renew the disc.

Clutch Release Levers Worn or Sticking. Excessive wear or sticking of the release levers will cause uneven release of the clutch and may result in distortion of the clutch disc and worn hub splines. To remedy this condition it will be necessary to remove and recondition the clutch.

Engine Mountings. Loose or perished mountings will cause clutch judder. A loose or worn stay rod will also create this condition.

Clutch Spin

Clutch spin is a condition which prevents a quiet gear engagement from neutral with engine idling, after the clutch pedal has been fully depressed for a short period. Check by fully depressing the pedal and pausing for a second or two before engaging gear. If gear clash is experienced, check the following items.

Pedal Free Travel Excessive. To obtain full throw of the pedal it must be adjusted to give the specified free travel.

Disc Facings Oily. To ensure quick release from the friction surfaces of the flywheel and clutch pressure plate after the pedal is depressed, the disc facings must be perfectly clean and free from any trace of oil or grease. Where there is evidence of contamination, new facings or disc assembly should be installed, and a check made for oil leaks from the transmission front cover or crankshaft rear main bearing.

Clutch Release Levers Incorrectly Adjusted. Incorrect release lever height adjustment can restrict the maximum release movement of the clutch mechanism and thereby prevent complete release of the clutch disc. To adjust the height of the release levers, proceed as described on page E-4.

Clutch Slip

To confirm clutch slip, first carry out the following check. Start the engine, apply the parking brake and engage top gear. Increase engine speed as the pedal is released when the engine should stall.

If the engine does not stall after the pedal is fully released then the clutch is slipping and the following checks should be made.

Pedal Free Travel Insufficient. When correctly adjusted the pedal should have the specified free travel.

Disc Facings Worn or Oily. Check for excessive wear of the disc facings and evidence of oil or grease. If the facings are worn flush with the rivet heads or appear glazed and black due to oil contamination, new facings or disc assembly should be installed.

Clutch Thrust Springs Weak. Weak thrust springs reduce the clutch drive pressure and cause clutch slip which, in turn, increases wear of the disc friction facings. When checking for weak thrust springs, consider also the condition of the clutch release mechanism. Partial seizure of the release levers through lack of lubricant during reconditioning can produce symptoms similar to weak thrust springs. Recondition the clutch assembly if necessary.

GUARDIAN MAINTENANCE

Engine Oil

Check that drain plug gasket is serviceable. Refill with recommended oil. The refill capacities of the oil pan, with or without oil filter element change, are specified on page A-39.

The engine oil dipstick, is marked 'FULL' and 'ADD OIL'. The amount of oil required to bring the oil level from the 'ADD OIL' to the 'FULL' mark is $3\frac{1}{2}$ Imp. pints (4·2 U.S. pints).

Provided the oil level is above the 'ADD OIL' mark, it is unnecessary to top-up the oil level prior to changing the oil.

Oil Filler Cap Filter

Remove the wire mesh filter, rinse in clean paraffin then blow out with compressed air. Oil the filter and install it in the cap. Check the condition of the cap oil seal ring.

Oil Filter

To renew the filter element, proceed as follows:

1. Clean around the inner end of the filter casing, and place an oil tray beneath the filter.

2. Unscrew the bolt and release the filter from the crankcase to allow the oil to drain into the tray.

3. On left drive, withdraw the casing assembly.

4. On right drive, reverse the filter so that the bolt head is towards the engine. Withdraw the filter by passing it between the generator and engine mounting and up beside the radiator. On some models it may be necessary to slacken the fan belt and swing the generator towards the engine.

5. Discard the element and clean the casing thoroughly. Check the bolt bore and metering hole (see Fig. A.5 on page A-4) for obstruction. *The bolt is peened to retain it, together with the spring and retainer, in the casing.*

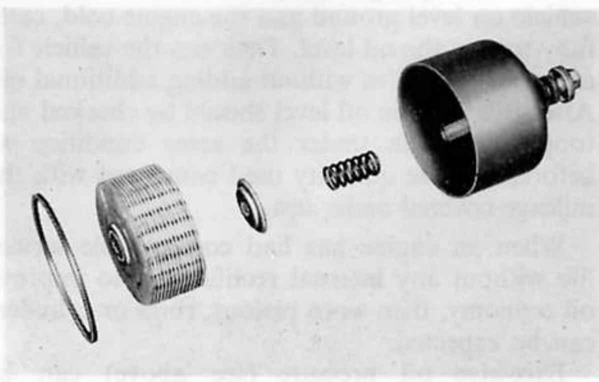


Fig. A.6. Exploded view of oil filter

6. Install the new gasket in the crankcase, making sure that the gasket is located flat and without kinks (Fig. A.7).

7. Place the new element in the casing so that the projecting boss of the element is towards the crankcase.

8. Install the filter and tighten the bolt to the specified torque.

9. Where necessary, adjust the fan belt (page C-5).

10. Top up the engine with recommended oil. Run the engine for two or three minutes and check for leaks. Finally, recheck the oil level.

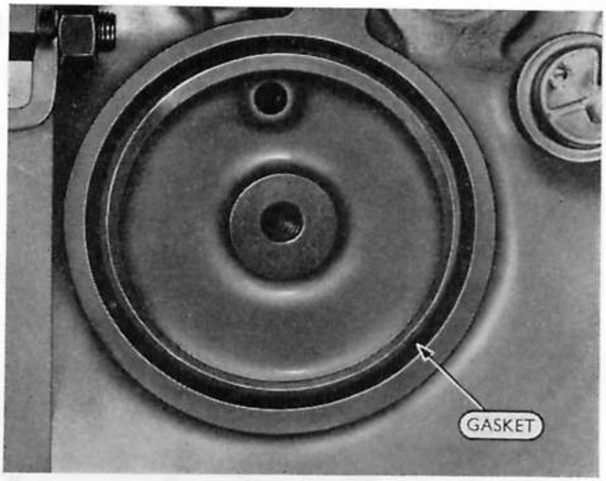


Fig. A.7. Attachment face for oil filter

VALVE CLEARANCE ADJUSTMENT

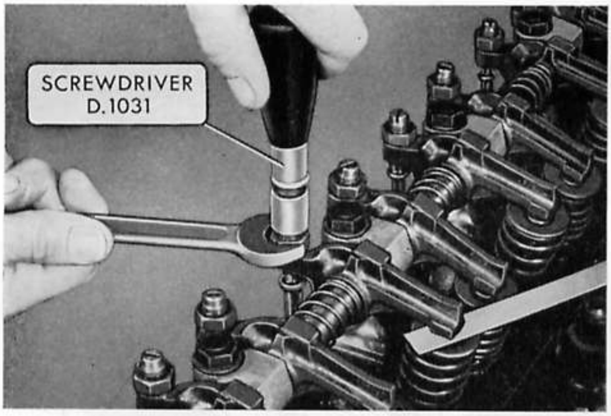


Fig. A.8. Adjusting the valve clearances

Except for initial adjustment after the valve rocker gear has been disturbed, valve clearance adjustment must be carried out with engine at normal operating temperature and running at idling speed.

With the locknut slackened, adjustment is effected by turning the rocker adjusting screw clockwise to decrease clearance and anti-clockwise to increase (Fig. A.8). When the clearance is correct, retighten the locknut and recheck.

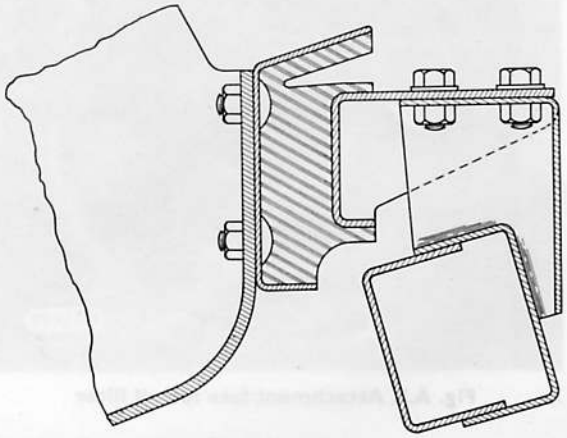
VALVE TIMING CHECK

Correct valve timing is normally obtained when installing the timing chain by aligning the marks on the timing wheels (page A-16).

Valve timing can, however, be checked without removing the timing cover to inspect for alignment of the markings, by carrying out the following procedure:

1. Remove the clutch housing bottom cover.
2. Mark between the 34th and 35th teeth from the T.D.C. (U/C mark on flywheel) counting anti-clockwise as viewed from the front, i.e. in the opposite direction to normal engine rotation.
3. Detach the timing aperture plug (Fig. A.21).
4. Mount a dial gauge over No. 1 intake valve so that the gauge plunger contacts the valve spring cap.
5. Turn the engine in the normal direction of rotation until, by observing the dial gauge, the valve is fully open. At this point the mark on the flywheel should be in line with the notch in the timing aperture.

ENGINE FRONT MOUNTINGS



Renewal

Either front mounting can be renewed provided the front of the engine is supported.

Secure the mountings to the engine before removing the support. Plain washers are assembled under the heads of the mounting-to-chassis frame bracket bolts.

Fig. A.9. Sectioned view of left-hand front engine mounting—right drive

ENGINE REAR MOUNTING

Renewal

Support the engine at the rear and detach the stay rod clear of the crossmember. Remove the crossmember then the rear mounting. Check the stay rod front eye and the support for slackness.

Secure the mounting stud nuts with a new locking plate. Before reconnecting the stay rod, its length should be checked and if necessary, adjusted to align the rod eye with the attaching bolt hole without displacing the position of the engine on its mountings.

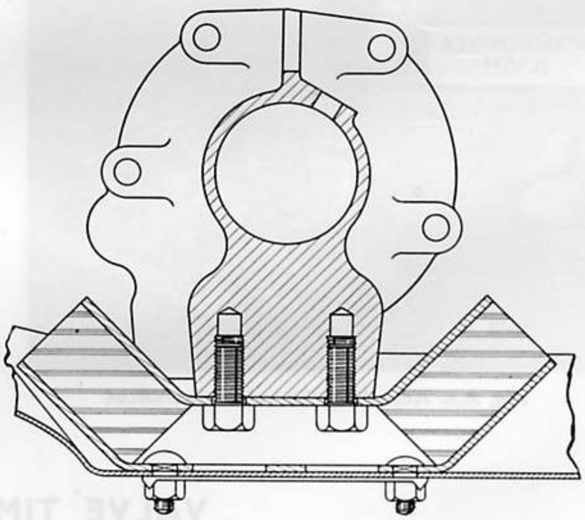


Fig. A.10. Sectioned view of engine rear mounting

PUSH RODS

Removal

1. Where it is required to remove all the push rods, first remove the rocker gear. Withdraw the push rods and place them in a numbered rack.

2. To remove an individual push rod, proceed as follows:

(*a*) Remove the air cleaner and rocker cover.

(*b*) Unscrew the rocker adjusting screw, slide the rocker on the shaft and withdraw the push rod, taking care to avoid lifting the tappet out of the bore.

Where necessary, remove the rocker shaft oil pipe. Remove the lock spring and tension spring when dealing with the front or rear rocker.

Inspection

Inspect the rod cups and bottom contact faces for wear or cracks. If a cup has excessive wear, renew also the corresponding rocker adjusting screw.

Installation

Note the following:

1. Lubricate both ends of the push rods with engine oil.

2. Where necessary, install the rocker gear or rocker shaft oil pipe as described on page A-14.

3. Warm up the engine to normal operating temperature. Run the engine at idling speed and recheck the valve clearances.

PUSH ROD COVER

Removal

1. Remove the carburetter to fuel pump pipe.

2. Remove the crankcase ventilator pipe and gasket.

3. Remove the distributor (see TS.675 page R-10).

4. Remove the push rod cover attaching bolts, clips and the cover reinforcements. Remove the cover and gasket.

Inspection and Reconditioning

1. Inspect the cover attaching face for distortion around the bolt holes. Rectify any distortion.

2. Check that the cover baffle chamber and the ventilation pipe are clean.

Installation

Note the following:

1. Position the new cover gasket on the cylinder block, using grease.

2. Attach the reinforcement incorporating the cut-out in its flanges to the bottom of the cover.

3. Reconnect the dipstick tube bracket and wire clip to the cover top bolts, and the ignition control suction pipe to the bottom rear bolt.

4. Install the distributor as described (see TS.675 page R-10).

VALVE ROCKER GEAR

Removal

1. Remove the air cleaner and rocker cover.

2. Withdraw the rocker shaft oil pipe.

3. Remove the bolts and plain washers attaching the rocker shaft brackets to the cylinder head. Lift off the rocker gear.

Disassembly

1. Remove the lock springs and tension springs from the ends of the rocker shaft, and slide off the components.

2. Slacken the locknuts and remove the rocker adjusting screws.

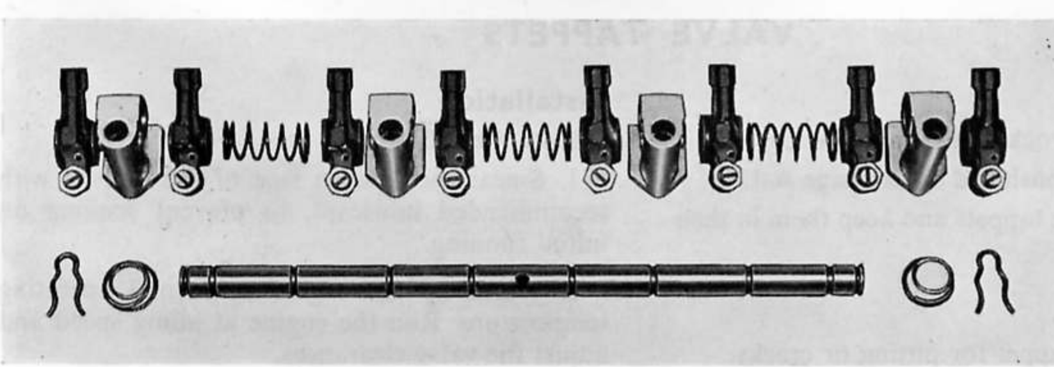


Fig. A.11. Exploded view of rocker gear

Inspection

1. Inspect the rocker shaft, most wear occurs on the underside.

2. Make sure the shaft oil holes and grooves are free from obstruction. Where an accumulation of sludge is evident, remove the plugs and clean the shaft bore. Install new plugs.

3. Inspect the ball end of the rocker adjusting screws. If wear is uneven or the end of the ball is polished, renew also the corresponding push rod.

4. If there is evidence of inadequate lubrication of the rocker gear, rotate the engine and check for oil flow from the oil feed drilling in the cylinder head. Check the crimped end of the rocker shaft oil pipe (Fig. A.12).

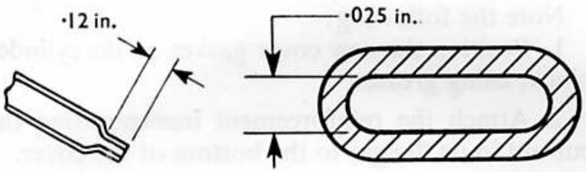


Fig. A.12. Dimensional details of crimped end of rocker shaft oil pipe. The shape and aperture width of the crimped portion are shown in the enlarged section

Reassembly

Note the following:

1. Lubricate the shaft and rockers with engine oil. Position the shaft so that the large hole is at the top, and assemble the component parts (Fig. A.11).

2. Assemble the tension springs with the wider coils contacting the lock springs.

Installation

Note the following:

1. Assemble a plain washer to each rocker bracket attaching bolt. All push rods must engage the tappets and rocker adjusting screws before screwing down the bracket bolts. Do not fully tighten the bolts at this stage.

2. Be sure the oil pipe peg is fully engaged with the shaft. Secure the pipe assembly with the retaining clip (Fig. A.13).

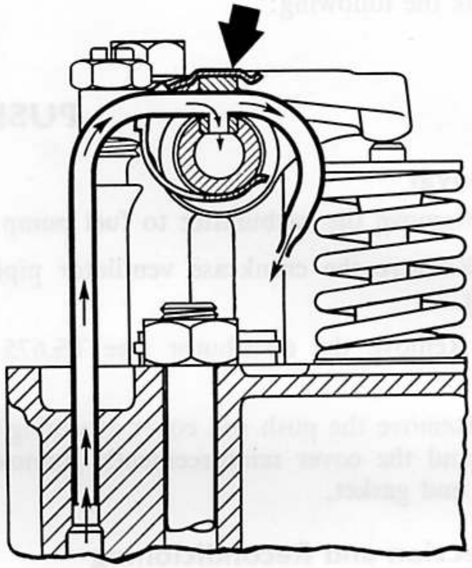


Fig. A.13. Section showing the rocker shaft oil pipe. Oil flow to shaft and rockers (indicated by small arrows) is controlled, as only a portion of the oil in the pipe flows down the peg into the shaft. The large arrow indicates the clip engaged with the shaft and the top of the peg

3. Tighten the rocker bracket attaching bolts to the specified torque.

4. Turn the engine until the appropriate cylinder is on compression stroke, and adjust the valve clearances.

5. Warm up the engine to normal operating temperature. Run the engine at idling speed and recheck the valve clearances.

VALVE TAPPETS

Removal

1. Remove the rocker gear (page A-13).

2. Remove the push rod cover (page A-13).

3. Withdraw the tappets and keep them in their correct order.

Inspection

Examine each tappet for pitting or cracks.

Installation

Note the following:

1. Smear the bottom face of the tappets with recommended lubricant, to prevent scuffing on initial running.

2. Warm up the engine to normal operating temperature. Run the engine at idling speed and adjust the valve clearances.

CRANKSHAFT PULLEY

Removal

1. Remove the fan belt (page C-5).

2. Unscrew the starting handle dog and remove the pulley. No drag is required.

If the pulley oil seal land is escessively worn, the timing cover oil seal should also be renewed (see this page).

Installation

Note the following:

1. Lubricate the oil seal land with engine oil before installing the pulley.

2. Adjust the fan belt tension (page C-5).

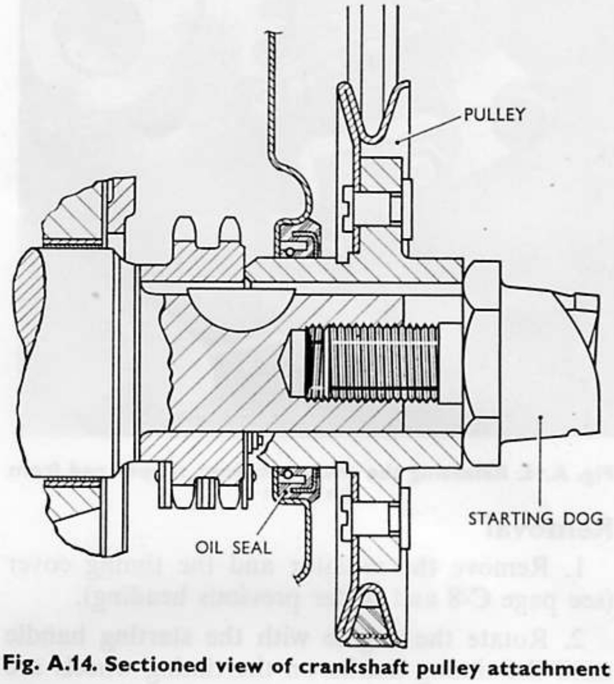


Fig. A.14. Sectioned view of crankshaft pulley attachment

TIMING COVER

Removal

1. Remove the crankshaft pulley (see under previous heading).

2. Remove the bolts and reinforcement attaching the timing cover. Remove the cover and gasket.

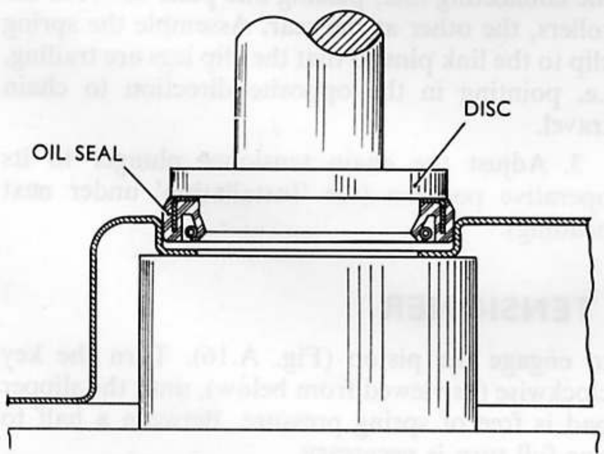


Fig A. 15. Sectioned view showing timing cover oil seal installation. The cover oil seal recess must be supported and pressure applied through a disc contacting the seal periphery

Inspection and Reconditioning

1. Examine the oil seal, and check for wear on the crankshaft pulley oil seal land.

2. To renew the oil seal, drive out the seal and thoroughly clean the cover seal recess. With the cover supported, press in the new seal using a disc against the periphery of the seal (Fig. A.15). The seal lip must be towards the inside of the cover.

3. Slight distortion of the cover flange may be corrected.

Installation

Note the following:

1. Oil the lip of the seal.

2. Before tightening the cover bolts, fit the crankshaft pulley to align the seal concentric with the pulley hub land. The bolts must be tightened to the specified torque.

TIMING CHAIN

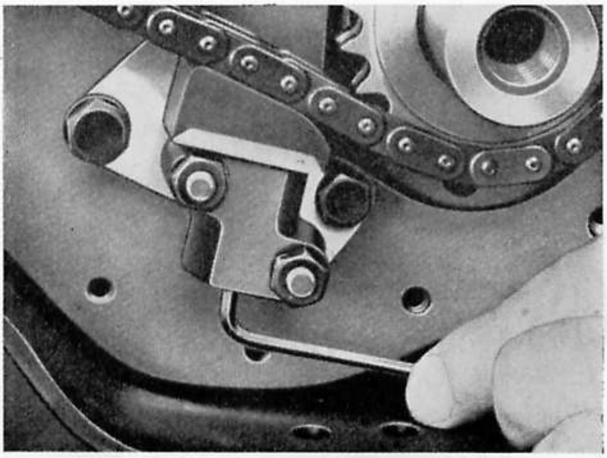


Fig. A.16. Releasing the chain tensioner slipper pad from the chain

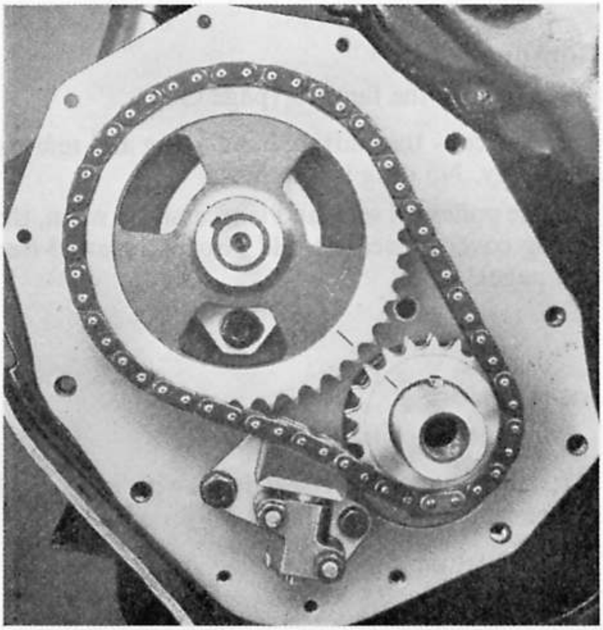


Fig. A.17. Alignment of valve timing marks

Removal

1. Remove the radiator and the timing cover (see page C-8 and under previous heading).

2. Rotate the engine with the starting handle until the timing marks on the timing wheels are aligned adjacent to each other (Fig. A.17).

3. Bend back the tab washer and remove the plug from the bottom of the tensioner body.

4. Insert a $\frac{1}{8}$ in. Allen key through the plug hole to engage the piston (Fig. A.16). Turn the key clockwise (as viewed from below), until the slipper pad is free of spring pressure. Between a half to one full turn is necessary.

5. Remove the spring clip from the rear of the timing chain connecting link; this link is polished for identification. Withdraw the link, taking care not to lose the two plates, one at the rear and the other between the two rows of rollers.

6. Detach the chain from the timing wheels.

Inspection

1. Inspect the timing chain tensioner for wear on the slipper pad.

2. Do not install a new timing chain to timing wheels which are noticeably worn, otherwise the new chain will wear rapidly.

Installation

Note the following:

1. Immerse the timing chain in engine oil prior to installing.

2. Ensure that the valve timing marks on the wheels are aligned adjacent to each other (Fig. A.17) then assemble the chain to the wheels. Insert the connecting link, placing one plate between the rollers, the other at the rear. Assemble the spring clip to the link pins so that the clip legs are trailing, i.e. pointing in the opposite direction to chain travel.

3. Adjust the chain tensioner plunger to its operative position (see 'Installation' under next heading).

TIMING CHAIN TENSIONER

Removal

1. Remove the radiator (page C-8).

2. Remove the timing cover (page A-15).

3. Bend back the tab washer and remove the plug from the bottom of the tensioner body.

4. Insert a $\frac{1}{8}$ in. Allen key through the plug hole to engage the piston (Fig. A.16). Turn the key clockwise (as viewed from below), until the slipper pad is free of spring pressure. Between a half to one full turn is necessary.

5. Remove the two bolts and lockwashers securing the tensioner to the engine.

Disassembly

1. Withdraw the plunger assembly from the tensioner body.

2. Engage the key with the piston and turn the key anti-clockwise, as viewed from the bottom, until the piston and spring are released from inside the plunger sleeve.

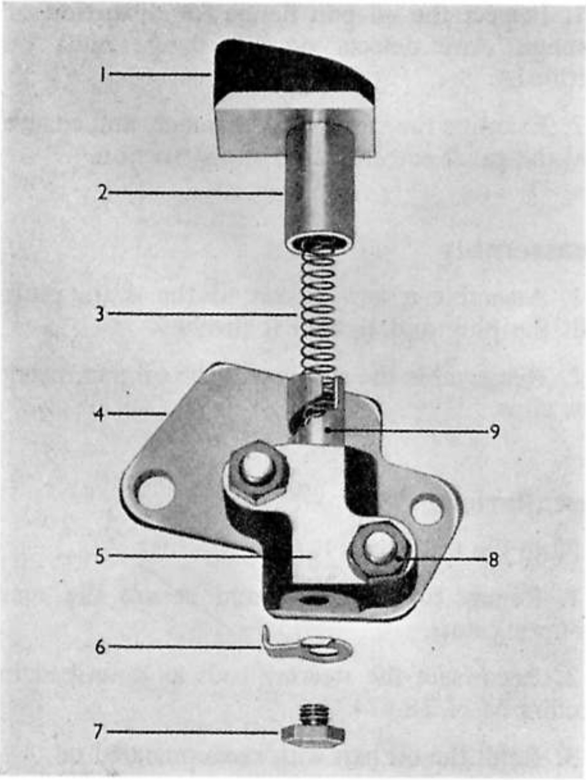
3. Remove the countersunk screws, nuts and lockwashers, and detach the back plate.

Reassembly

1. Be sure the rear face of the body and both faces of the back plate are clean and free from burrs.

2. Secure the body to the plate and check that the screw heads are below the plate face. Make sure the oil feed hole (Fig. A.19) is free from obstruction.

3. Insert the spring in the upper end of the piston and place the plunger sleeve over the other end of the spring. Compress the spring until the piston enters the sleeve, with the pin engaging the helical slot. Hold the assembly compressed and insert the key in the bottom of the piston. Turn the key clockwise until the pin on the sleeve is out



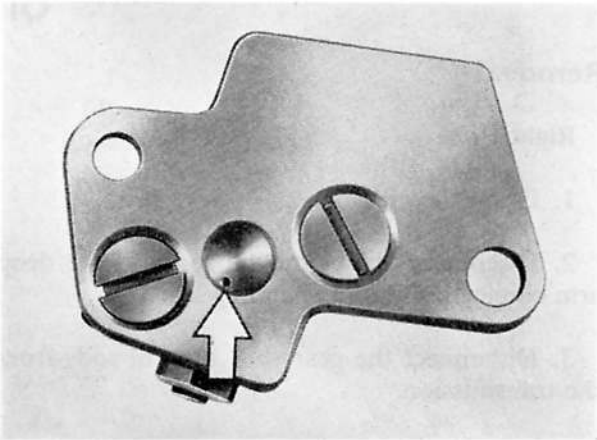


Fig. A.19. Rear view of timing chain tensioner. The arrow indicates the oil feed hole to the tensioner body

of the slot, then continue turning until the piston slot is opposite to the pin.

4. Insert the compressed assembly into the body. Recheck that the sleeve moves freely.

Installation

Note the following:

1. Ensure that the tensioner back plate and crankcase front plate mating faces are clean and free from burrs.

2. After installing the tensioner, adjust the plunger to its operative position as follows:

(*a*) Turn the piston clockwise, as viewed from below, with the key until the piston is felt to click into its released position. Automatically the plunger will move upwards out of the body until the slipper pad contacts the chain. Do not turn the key anti-clockwise.

NOTE: *Under no circumstances must manual pressure be applied to the plunger assembly as this will cause incorrect adjustment resulting in rapid pad wear and excessive tension in the chain.*

(*b*) Replace the plug in the tensioner body and lock with a new tab washer.

3. Install the timing cover (page A-15).

Fig. A.18. Exploded view of timing chain tensioner

1. Slipper pad	**6. Tab washer**
2. Plunger sleeve	**7. Plug**
3. Spring	**8. Body attaching screw and nut**
4. Back plate	**9. Adjusting piston**
5. Body	

OIL PAN

Removal

Right Drive

1. Drain the oil pan.

2. Disconnect the centre tie rod and the drop arm connecting rod at the relay lever.

3. Disconnect the gear shift control rods from the transmission.

4. Remove the clutch housing bottom and front covers.

5. Knock back the locking tabs and unscrew the nuts securing the transmission to the rear mounting crossmember.

6. Raise the rear of the engine with a jack under the transmission, using a block of wood to avoid damage to the transmission bottom cover.

7. Remove the attaching screws (Fig. A.20) and lower the oil pan. Tilt the left-hand side downwards to clear the oil pump and pipes, then move the pan towards the right-hand side and withdraw it rearwards. Remove the gasket.

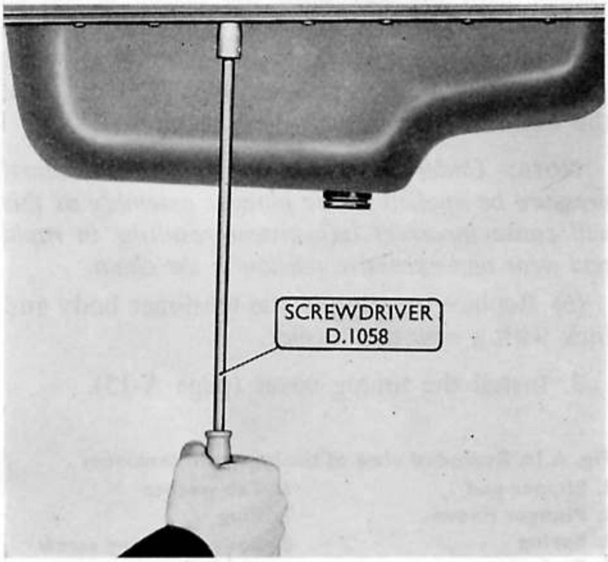


Fig. A.20. Removing oil pan screws

Left Drive

1. Remove the four bolts attaching the stabilizer bar to the underbody sidemembers.

2. Remove the front axle assembly (see Section K of TS.674).

3. Drain the oil pan.

4. Remove the bolts and screws attaching the clutch housing bottom and front covers. Detach the front cover, and position the bottom cover rearwards as far as possible to give access to the rear screws securing the oil pan.

5. Remove the oil pan attaching screws. Remove the oil pan and gasket.

Disassembly

1. Remove the drain plug and detach the gasket.

2. Withdraw the three clips and lift out the strainer.

Inspection and Reconditioning

1. Inspect the oil pan flange for distortion or damage. Any defects on the flange must be rectified.

2. Examine the strainer for damage, and ensure that the gauze screen is free of obstruction.

Reassembly

1. Assemble a new gasket to the drain plug, refit the plug and tighten it firmly.

2. Reassemble the strainer to the oil pan, using new clips.

Installation

Note the following:

1. Renew the lockplate and secure the rear mounting nuts.

2. Reconnect the steering rods as described in Section M of TS.674.

3. Refill the oil pan with recommended oil.

OIL PUMP

Removal

1. Remove the plug from the timing aperture in the top right-hand side of the clutch housing.

2. Turn the engine with the starting handle until the steel ball in the flywheel is aligned with the centre of the notch in the timing aperture (Fig. A.21) with the distributor rotor corresponding with No. 1 cylinder segment.

3. Remove the distributor.

4. Remove the oil pan (page A-18).

5. Slacken the oil pump retaining screw locknut and turn back the screw to release the pump.

6. Unscrew the delivery pipe union from the crankcase, at the same time lowering the pump as the union is unscrewed. Withdraw the pump.

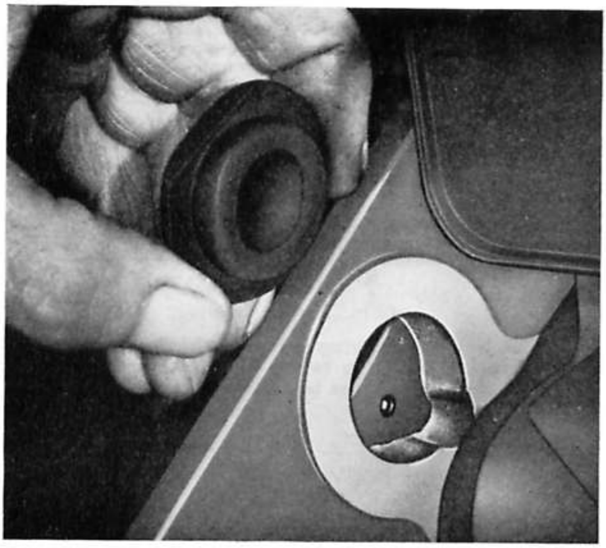


Fig. A.21. The timing aperture plug removed showing steel timing ball in line with the aperture notch

Disassembly

1. Disconnect the suction and delivery pipes. Remove the pump bottom cover.

2. Mark the meshed teeth of the impellers to facilitate correct reassembly if suitable for further service. Withdraw the driven impeller.

3. Unscrew the oil relief valve plug and withdraw the spring and plunger.

4. Remove the rivet securing the drive gear, and tap the spindle out of the gear. Withdraw the spindle and impeller assembly.

Inspection and Reconditioning

1. Check the impellers for end clearance, radial clearance and backlash (Fig. A.22).

2. To renew a driven impeller spindle, drive the original spindle out from outside the impeller chamber, then press in the new spindle to the

Fig. A.22. Checking oil pump impellers. From left to right—end clearance, radial clearance, and backlash

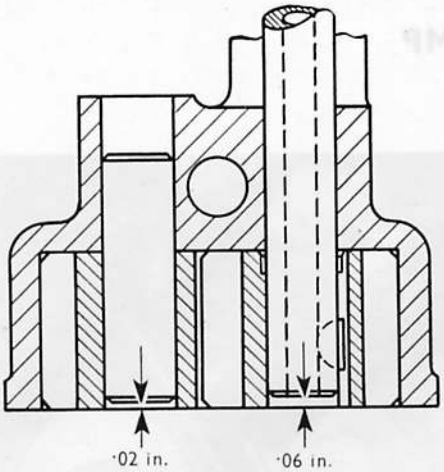


Fig. A.23. Section showing the assembled position of the driving spindle relative to its impeller, and the driven spindle relative to the body cover face

position shown in Fig. A.23. The spindle must be a tight fit in the body.

3. Where renewal is necessary, install the key and press on the driving impeller until the spindle end is recessed below the impeller by the amount shown in Fig. A.23. If the original impeller is being refitted, ensure that its previously marked end face is towards the bottom cover face of the body.

Insert the assembly in the body and, with the impeller pressed against the body, check that the spindle oil metering holes align with the slot in the body end face (Fig. A.24).

4. Examine the valve plunger also the plunger bore in the body, for wear or scores. The plunger should slide freely in the bore without slackness. Renew the spring if its condition is doubtful.

5. Inspect the machined face of the bottom cover for wear or scores. Provided the indentation is not excessive the cover may be refaced, using fine emery cloth on a surface table.

Fig. A.24. With the driving impeller pressed against the body, check that each oil metering hole in the shaft (arrowed) is fully uncovered when facing the slot

6. Remove and clean the strainer in the oil pan.

Reassembly

Note the following:

1. Lubricate the spindles with recommended lubricant.

2. When assembling the drive gear, the lower end of the spindle must be held against a dolly of lesser diameter than the impeller bore; if this is not done, the spindle may be driven further into the impeller resulting in loss of end float with an original spindle, and the covering of the oil metering holes.

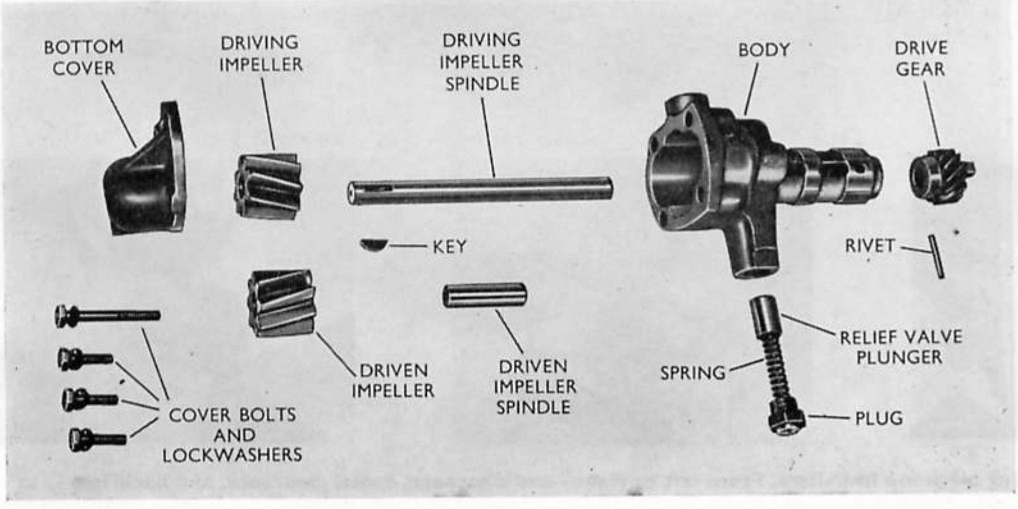


Fig. A.25. Exploded view of oil pump

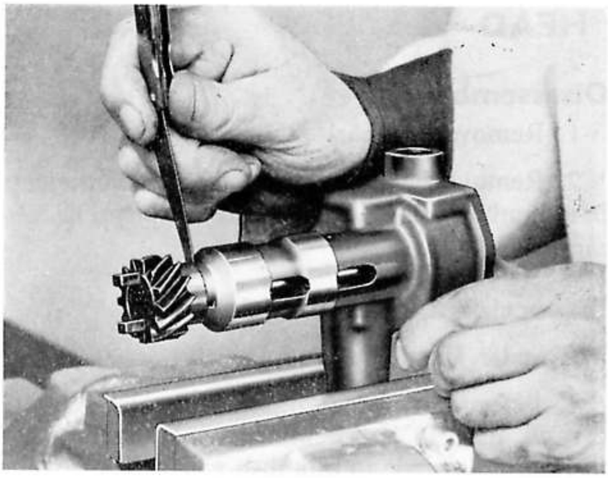


Fig. A.26. Checking the end float between the drive gear and pump body

3. Before peening the gear rivet, check that the driving spindle end float (Fig. A.26) is within the specified limits.

4. Where a new driving impeller spindle is installed, use a $\frac{5}{32}$ in. diameter drill for drilling the rivet hole.

5. If the original driven impeller is installed, ensure that its previously marked end face is towards the bottom cover face of the body.

6. Be sure that the relief valve plunger and body bore are clean. Check that the valve plug vent hole is clear.

Installation

Note the following:

1. Prior to installing the oil pump, check that the steel ball in the flywheel is aligned with the centre of the timing aperture notch (see Fig. A.21 on page A-19) with No. 1 piston on compression stroke.

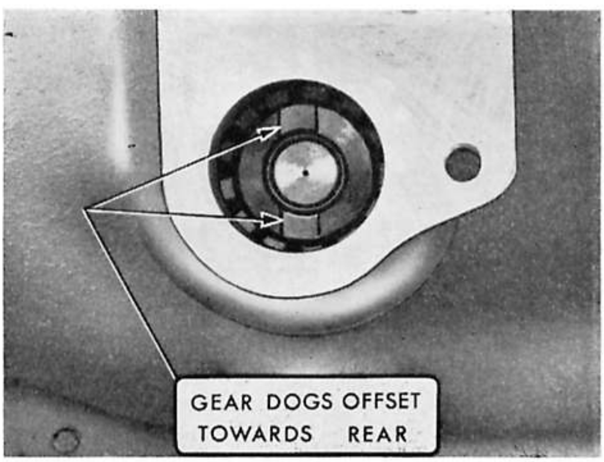


Fig. A.27. Installed position of oil pump drive gear offset dogs

2. Oil the drive gear teeth. Install the pump so that the distributor driving dogs are at right-angles to the camshaft axis or within 14° clockwise of this position, with the dogs offset towards the rear of the engine (Fig. A.27).

3. When the pump is assembled to the crankcase, be sure the retaining screw, threads smeared with jointing compound, is engaged with the chamfered hole in the pump body (Fig. A.28). Do not overtighten the screw; a quarter of a turn beyond finger tight is sufficient. Hold the screw in this position and tighten the locknut.

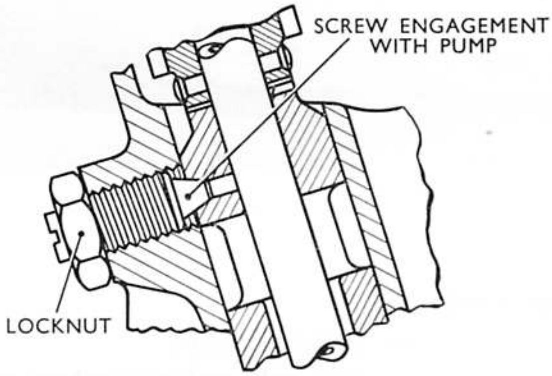


Fig. A.28. Sectioned view showing oil pump attachment

4. To install the suction pipe, proceed as follows:

(*a*) Connect the suction pipe to the pump but do not fully tighten the union at this stage.

(*b*) Engage the jig locating pin in the end of the pipe and secure the jig to the crankcase with two oil pan screws (Fig. A.29).

(*c*) Tighten the pipe union and remove the jig.

5. Refill the oil pan with recommended engine oil.

6. Check the ignition timing, and replace the rubber plug in the timing aperture.

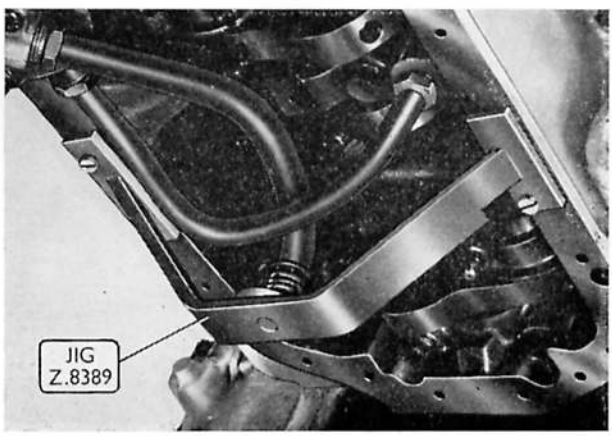


Fig. A.29. Oil pump suction pipe correctly located by the jig

CYLINDER HEAD

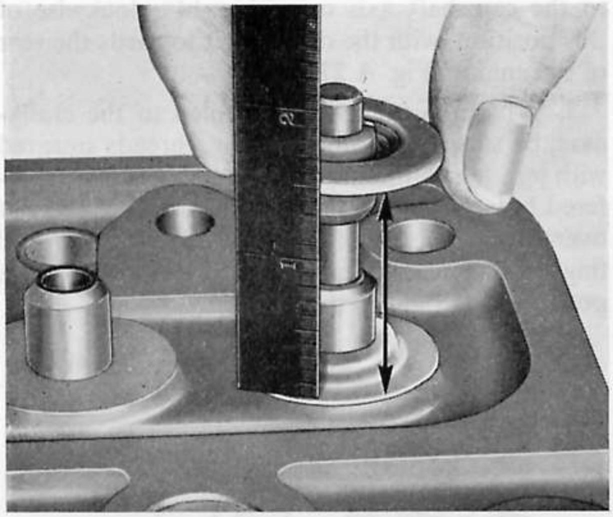


Fig. A.30. Checking valve spring assembled height. Note that the valve spring retainer is installed

Removal

1. Drain the cooling system.

2. Remove the four bolts and lockwashers, and disconnect the water pump from the engine.

3. Remove the push rod cover (page A-13).

4. Remove the intake and exhaust manifolds (page B-12).

5. Remove the rocker gear (page A-13). Place the push rods in a numbered rack.

6. Remove the cylinder head and gasket.

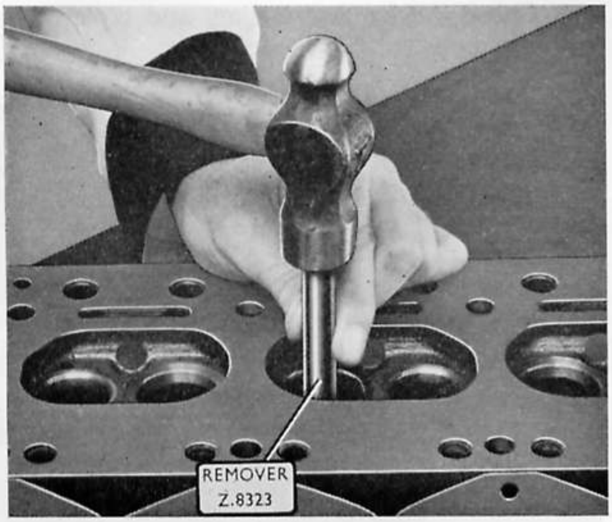


Fig. A.31. Removing a valve guide

Disassembly

1. Remove the spark plugs.

2. Remove the valves, and place the components in a numbered rack. Discard the valve springs.

Inspection and Reconditioning

Cylinder Head

1. Before any reconditioning operations are carried out, it is essential that a preliminary inspection is made to establish whether or not the head can be reconditioned for further service. The relevant inspection items are as follows:

(*a*) Check the cylinder head contact face for distortion, and measure the depth of the head between the top and bottom faces. See specified limits on page A-39.

(*b*) Insert new valves. Assemble the spring retainer, spring cap and split collars to each valve in turn. Pull the valve firmly against the seat, and measure the distance between the underside of the cap and the retainer (Fig. A.30). If this distance exceeds 1·54 in. the assembled height for the valve spring will be outside the limit and the valve seating too deep in the head to permit further refacing.

2. If the valve clearance in the valve guide bore exceeds the specified maximum, renew the guide (Figs A.31 and A.32). The guide must be pressed in until the installer contacts the top of the cylinder head.

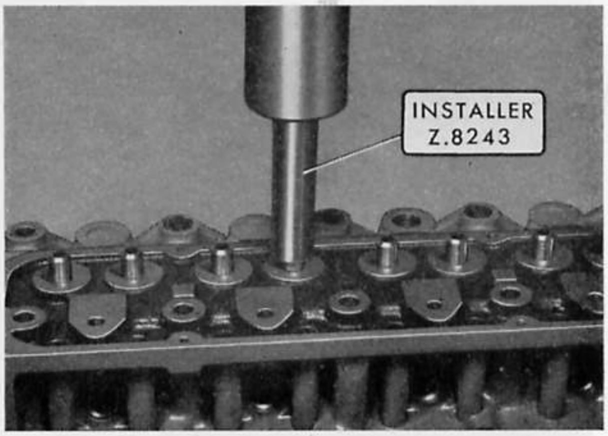


Fig. A.32. Installing a valve guide

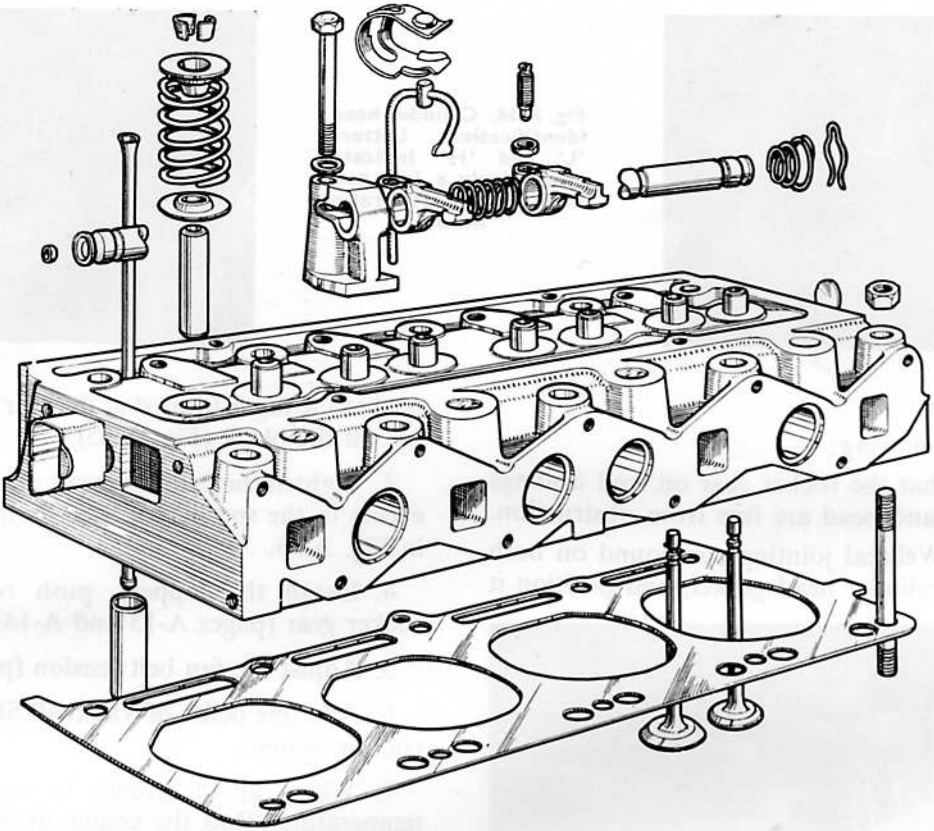


Fig. A.33. Cylinder head, valve and rocker gear components

3. When refacing valve seats, note that the seats should be kept within the specified limits. After refacing, check valve seats and valve faces for concentricity.

4. When refacing the cylinder head, care must be taken to ensure that the depth of the head from the top machined face to the bottom face is not reduced to less than the specified minimum, otherwise the compression ratio will be increased considerably and cause pre-ignition, overheating and attendant troubles.

5. Where renewal of the expansion plugs is necessary, smear sealing compound around the edge of the plug, insert the plug with its convex side facing outwards and expand the plug in position using a flat-faced drift.

Valves

1. Thoroughly clean and examine for burnt heads, cracked faces and damaged or worn stems. Inspect the split collars and spring caps for wear.

2. Reface the valves to the specified angles. A refaced valve should be renewed if the edge of the head is less than the minimum specified. Reface the stem ends, if worn. Install the refaced valves and recheck valve spring height as described in paragraph (*b*) under the previous heading.

The exhaust valves have a thin aluminium coating fused to the seat faces, to improve heat conductivity. These valves, which are identified by the soft matt finish on the seat face, are ready for installation and no attempt must be made to remove the matt finish from a new valve by polishing or grinding. Such treatment will destroy the effects of aluminizing. Used valves of this type may, however, be refaced in the normal way.

Valve Rocker Gear, Push Rods and Tappets

Follow instructions on pages A-12, A-13 and A-14.

Reassembly

Note the following:

1. Flush out the cylinder head water passages, clean and install the water distributor tube.

2. Lubricate the valve stems with recommended lubricant, and install the valves in their correct order.

3. Install new valve springs. Note that a retainer is used below each spring, and an oil seal fitted to the lower groove of each intake valve stem.

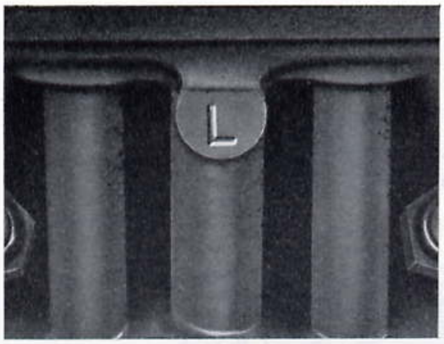
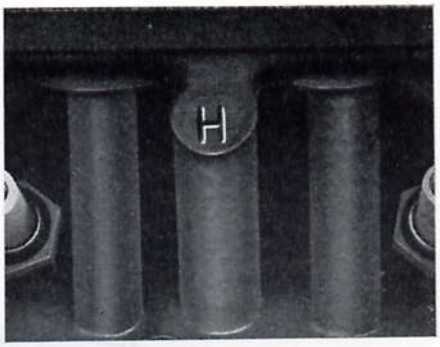


Fig. A.34. Cylinder head identification. Letters 'L' and 'H' indicate respectively a low and high compression ratio head



Installation

Note the following:

1. Check that the rocker gear oil feed drillings in the block and head are free from obstruction.

2. Smear Wellseal jointing compound on both sides of the cylinder head gasket, and position it so that the tag is located at the rear and right-hand side of the block (Fig. A.35).

3. Tighten the cylinder head nuts gradually and evenly to the specified torque, in the order shown in Fig. A.36.

4. Install the tappets, push rods and valve rocker gear (pages A-13 and A-14).

5. Adjust the fan belt tension (page C-5).

6. Add one pellet of Vauxhall Stop Leak to the cooling system.

7. Warm up the engine to normal operating temperature. Run the engine at idling speed and re-check the valve clearances.

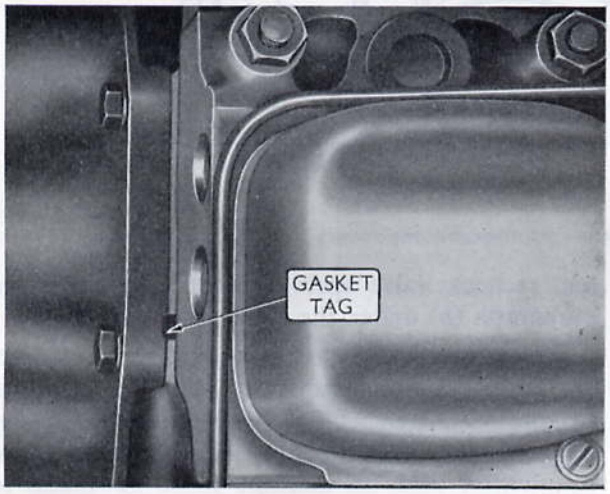


Fig. A.35. Correct location of the identification tag at the rear end of the cylinder head gasket

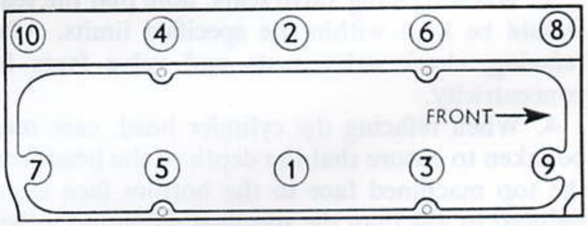


Fig. A.36. Cylinder head nut tightening sequence diagram

PISTONS, RINGS AND CONNECTING RODS

Removal

1. Remove the cylinder head (page A-22).

2. Remove the oil pan (page A-18).

3. Mark each piston and connecting rod assembly with the cylinder number. Do not use a file or centre punch as such markings may cause fatigue failure.

Each connecting rod and cap is machined together in non-interchangeable pairs which are identified by production pairing numbers on one side of both rod and cap.

4. Unscrew the nuts and remove the caps and bearings.

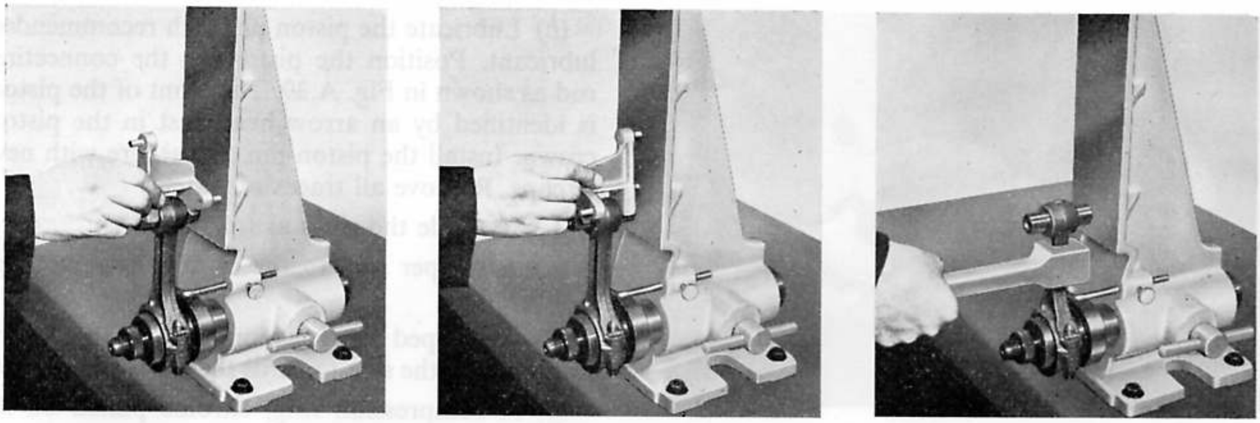
5. Withdraw the piston and connecting rods after removing carbon from the top of each bore.

Disassembly

1. Remove the piston rings.

2. Remove the piston pin circlips. Heat the piston in water to a temperature of 48°C. (120°F.) and push out the pin.

3. Remove the half bearings, taking care to place them with their respective connecting rod and cap.



Checking for parallelism — Checking for twist — Re-aligning

Fig. A.37. **Using a jig to check a connecting rod for parallelism and twist. The rod can be re-aligned on the jig**

Inspection and Reconditioning

Connecting Rods

1. Assemble the connecting rods and caps without the bearings and tighten the nuts. Check the bearing housing bore diameter of each rod to ascertain whether the cap or rod faces have been filed. Install a new rod assembly if cap or rod have been filed.

2. Check the fit of each piston pin in its connecting rod bush. The pin should be a sliding fit without slackness. Where new bushes are required, press the bush in so that the oil hole in the bush coincides with that in the rod. Hone the bush and check the fit of the piston pin.

3. After attention to the bushes as necessary, check the alignment of the connecting rods, using an alignment jig. The connecting rod bush bore must be parallel with the bearing housing bore in all planes. Reset if necessary to eliminate any misalignment. With the jig illustrated in Fig. A.37, it is possible to check a connecting rod for parallelism and twist, and also reset if necessary without altering the position of the rod or removing it from the jig. Make sure that the jig and connecting rod are thoroughly clean before assembling the rod to the jig, otherwise a false reading will result.

Bearings

1. Inspect the condition of the bearings. The bearing size can be obtained by reference to the part number or size stamped on the back.

The bearing to crankpin clearance can be checked with Plastigage as described on page A-34.

Do not use steel feeler strip, otherwise the bearing surface will be damaged.

2. If necessary, regrind the crankpins in accordance with the regrind data on page A-44, and fit undersize bearings. Regrinding will entail removal of the engine and crankshaft.

Cylinder Bores

1. Examine each cylinder bore for wear or scores as described in Operation 4 on page A-32. If the cylinder bores and pistons are still serviceable, install new standard piston rings or special service Vauxhall Oil Control piston rings.

2. Remove any wear ridge at the top of each bore with a cylinder ridge reamer. Plug the bottom end of the bore with a clean rag to prevent swarf collecting on the crankshaft.

CAUTION: *Do not over-cut the ridge.*

3. After removing the ridge, pass a hone equipped with fine grade stones wetted with clean paraffin, three or four times through each bore just sufficient to remove the highly polished surface caused by oil glaze. This will facilitate bedding-in of the new rings.

Protect the crankshaft and bearings, and after honing, wash the cylinders thoroughly to remove all grit.

Pistons and Rings

1. Inspect the pistons for wear. Pistons must be measured at the diameter indicated in Fig. A.49 on page A-32. Check the fit of the pin, which should be a finger push fit through each piston boss individually, at the specified temperature.

2. Should the condition of the original pistons be satisfactory except for slackness of the piston pins, further service can be obtained by fitting oversize pins. Hone the piston bosses until the pin fit is as recommended in Operation 1.

Fig. A.38. Checking piston ring side clearance in piston groove

3. Check each new ring by placing it about 2 in. down the cylinder bore, using a piston to keep it square. Measure the ring gap to ensure it is within the specified limits.

IMPORTANT: *The ring gap should not be less than the lower limit, otherwise the ring ends may butt at normal operating temperature and cause damage.*

4. Check the side clearance of the rings in the piston grooves (Fig. A.38). If the clearances are excessive, renew the piston.

Reassembly

1. Assemble the pistons to the connecting rods as follows:

(*a*) Heat the piston in water to a temperature of 48°C. (120°F.).

(*b*) Lubricate the piston pin with recommended lubricant. Position the piston on the connecting rod as shown in Fig. A.39. The front of the piston is identified by an arrow head cast in the piston crown. Install the piston pin and secure with new circlips. Remove all traces of water.

2. Assemble the rings as follows:

(*a*) A scraper ring to the bottom groove (Fig. A.40).

(*b*) A stepped compression ring to the centre groove, with the step towards the top of the piston.

(*c*) A compression ring, chrome plated on its outer face, to the top groove.

Markings on a ring such as 'TOP' or 'BOTTOM' indicate the correct way in the groove, i.e. with the marked face towards the top or bottom of the piston.

3. When installing a special service Vauxhall Oil Control ring set, assemble the oil control ring components to the piston bottom ring groove, with the gaps in line. Proceed as follows:

(*a*) Assemble the insert against the bottom land of the groove (inset of Fig. A.40).

(*b*) Install the spring expander.

(*c*) Install the rails and spacer which are a unitized assembly, i.e. temporarily bonded together with an oil soluble material, and should not be separated before installation. The rail and spacer gaps must be in line.

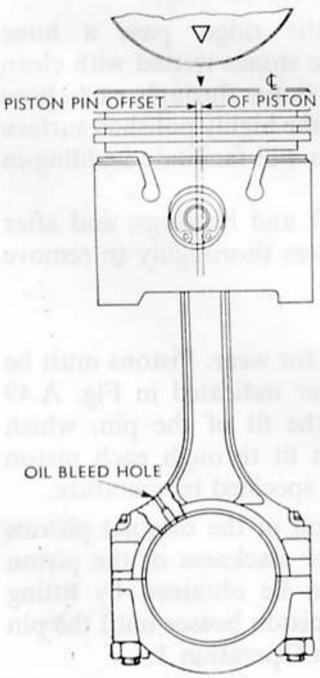


Fig. A.39. Correct assembly of piston to connecting rod. The front of the piston is identified by an arrow head cast in the piston crown

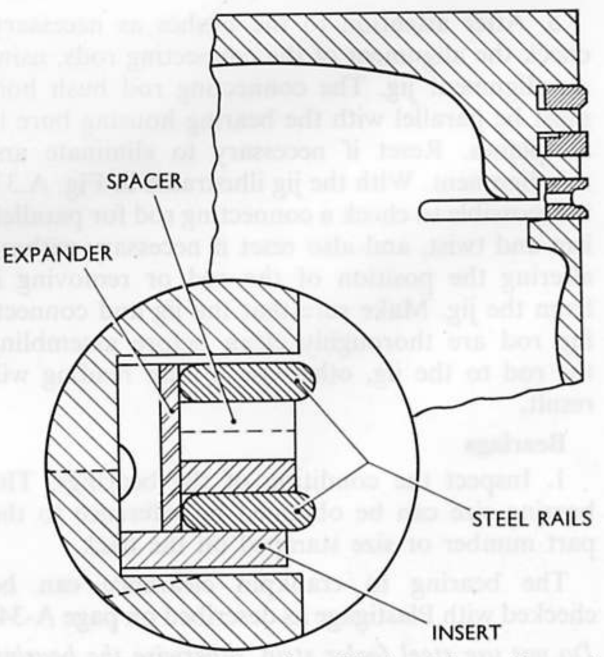


Fig. A.40. Piston ring locations. The inset shows the special service Vauxhall Oil Control ring components

Installation

Note the following:

1. Lubricate the cylinder bores, pistons and rings with engine oil.

2. The piston ring gaps must be equally spaced around the piston, with the scraper or oil control ring gap away from the camshaft.

Where a special service Vauxhall Oil Control ring set is installed, the gaps of the two compression rings must be equally spaced with the gaps of the steel rails in the bottom groove.

3. Install each piston and connecting rod assembly so that the arrow head on the piston is facing forward.

4. Lubricate the crankpins and assemble the cap to each rod so that the pairing numbers are together. *No scraping of the bearings or adjustment by rubbing down the caps is permissible.* Assemble and tighten the bolt nuts to the specified torque.

5. Install the oil pan and cylinder head as described on pages A-18 and A-24.

CAMSHAFT AND TIMING WHEELS

Removal

1. Remove the radiator (page C-8).

2. Remove the front lower panel (see Section W of TS.675).

3. Remove the six bolts and nuts securing the radiator support frame to the wing splashguards. Note that two of the bolts, on the driver's side, also secure the horn bracket. Remove one bolt and nut, on the driver's side, securing the support frame to the air duct panel, also remove the spring clip each side securing the air duct gauze.

4. Remove the two bolts securing the support frame to the front crossmember. Detach the insulator, retainers and ferrules, and lift away the support frame.

5. Remove the fan and distance piece.

6. Remove the valve tappets (page A-14).

7. Remove the fuel pump.

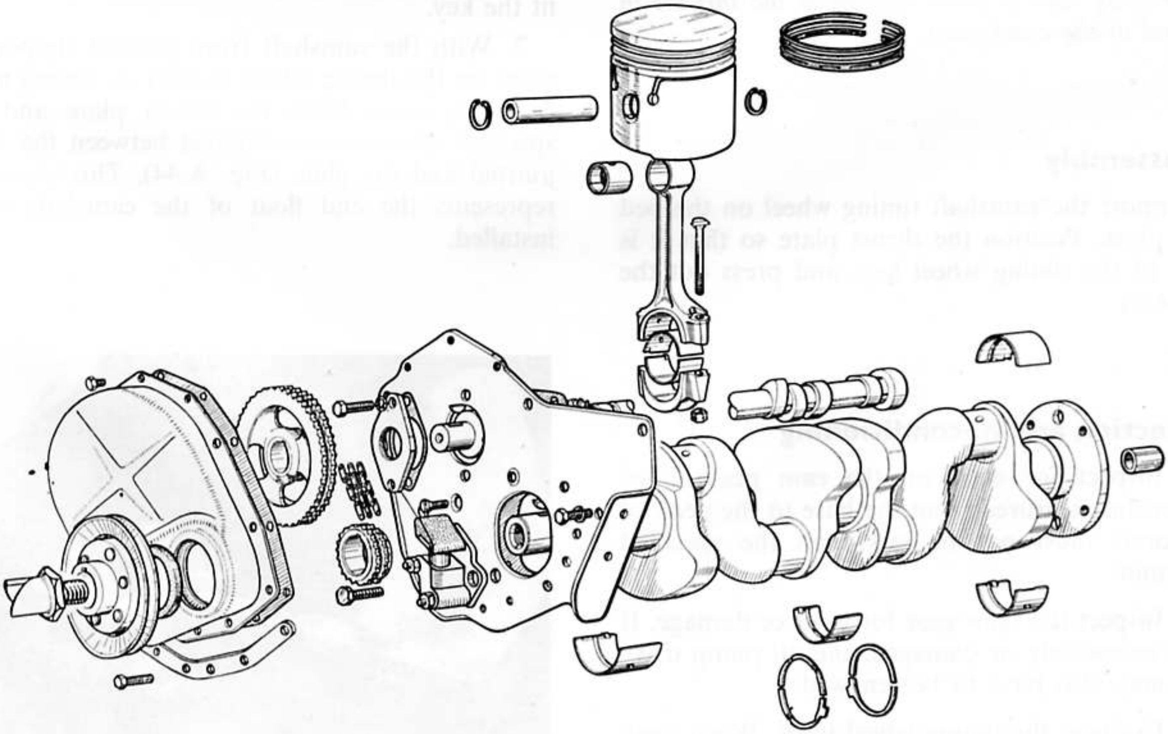


Fig. A.41. Crankshaft, piston, connecting rod and timing gear components

EXHAUST SYSTEM

Removal

1. Slacken the U-bolt securing the tail pipe to the silencer, disconnect the pipe insulator from its support bracket and withdraw the pipe.

2. Remove the nuts securing the front exhaust pipe to the manifold.

3. Disconnect the silencer insulator from its support bracket and withdraw the silencer and exhaust pipe.

Installation

Note the following:

1. Fit a new packing to the front pipe.

2. Loosely attach the front pipe to the manifold and then secure the silencer insulator to its support bracket. Tighten the pipe to manifold nuts.

3. Tighten the tail pipe U-bolt after securing the pipe insulator to its support bracket.

SPECIFICATIONS

FUEL

Tank Capacity—Nominal ... ... $7\frac{1}{2}$ Imp. gal. (9·0 U.S. gal.)

Fuel Pump

Make and type	AC, FG
Delivery pressure	$2\frac{1}{2}$ to $3\frac{1}{2}$ lb/sq.in.
Diaphragm spring—load at .64 in.	$7\frac{1}{2}$ to 8 lb.
Flow test—maximum time to fill AC Analyser at 2000 r.p.m. of engine crankshaft	60 secs.

Carburetter

Make and type	Zenith, 34 IV
Identification on float chamber cover	C1844
Choke tube diameter	24 mm.
Main jet	97
Compensating jet	85
Idling jet	50
Pump jet	55
Air bleed screw	2·2 mm.
Needle and seating	1·75 mm.
Seating washer thickness	2·0 mm.

IMPORTANT: *The jet settings are determined after considerable research and no advantage will be gained by altering these settings unless the circumstances are very exceptional* (*page B-15*).

Carburetter Jet Settings for Altitude

ALTITUDE (above sea level)	MAIN JET	COMPENSATING JET
5000 to 7000 ft.	95	82
7000 to 10 000 ft.	92	80
10 000 to 15 000 ft.	90	80

MANIFOLDS

Flange Distortion—Maximum ... ... ·002 in.

Flange Relationship (checked on surface plate)... ... Intake flange faces to be equidistant from exhaust flange faces but not more than ·014 in.

Exhaust Manifold Valve

Shaft diameter ... ... ·3080 to ·3085 in.

Bush bore (reamed) ... . ·3115 to ·3135 in.

Shaft clearance in bushes ... ... ·0030 to ·0055 in.

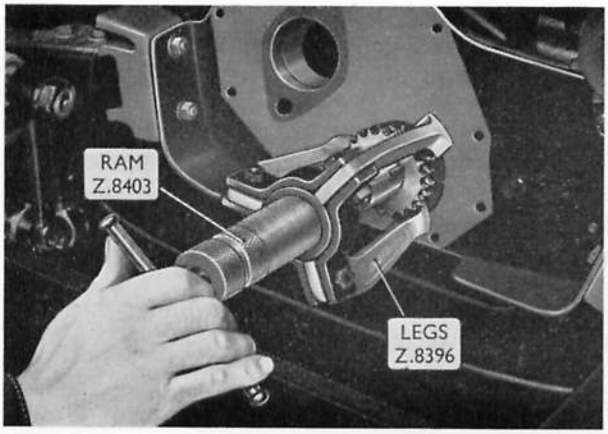


Fig. A.42. Removing the crankshaft timing wheel

8. Remove the timing cover and chain (pages A-15 and A-16).

9. Remove the oil pump (page A-19).

10. Unscrew the camshaft thrust plate bolts. Withdraw the camshaft carefully to avoid damage to shaft and bearings. Detach the thrust plate gasket.

11. Where necessary, withdraw the crankshaft timing wheel (Fig. A.42). *Use packing at the end of the drag ram to avoid damaging the threads in the end of the crankshaft.*

Disassembly

Support the camshaft timing wheel on the bed of a press. Position the thrust plate so that it is clear of the timing wheel key, and press out the camshaft.

Inspection and Reconditioning

1. Inspect for wear on the cam peaks. The dimension measured from the base to the peak of the cams must not be less than the specified minimum.

2. Inspect the skew gear for wear or damage. If worn excessively or damaged, the oil pump drive gear may also have to be renewed.

3. Examine the timing wheel teeth. Worn teeth will cause rapid wear of a new chain.

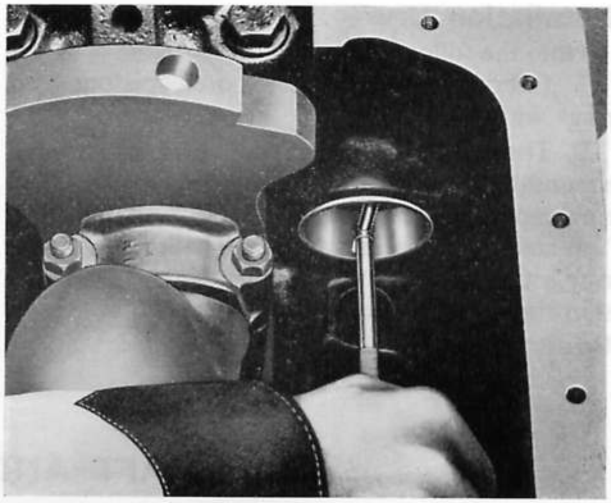


Fig. A.43. Checking a camshaft bearing bore for wear, using a telescopic gauge

4. Inspect for worn camshaft bearings by measuring the bearing bore diameter (Fig. A.43). To renew the bearings it will be necessary to remove the engine (page A-31).

Reassembly

1. Assemble the thrust plate to the camshaft and fit the key.

2. With the camshaft front journal supported, press on the timing wheel so that its timing mark is facing away from the thrust plate and the specified clearance is obtained between the front journal and the plate (Fig. A.44). This clearance represents the end float of the camshaft when installed.

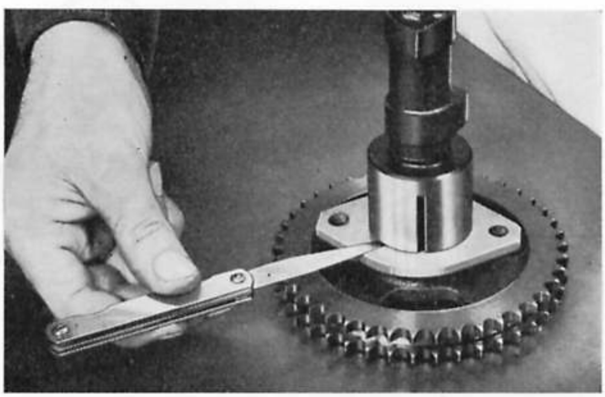


Fig. A.44. Checking the camshaft thrust plate clearance

Installation

Note the following:

1. Drive the timing wheel right home against the crankshaft shoulder (Fig. A.45) with the wheel timing mark facing away from the engine.

2. Smear the cams and the bottom face of the tappets with recommended lubricant, to prevent scuffing on initial running. Assemble a gasket to the camshaft thrust plate.

3. Align the valve timing marks on the timing wheels when assembling the chain as described on page A-16.

4. Install the oil pump as described on page A-21.

5. When installing the radiator support-frame, locate the thick insulators between the support frame and the bracket on the crossmember.

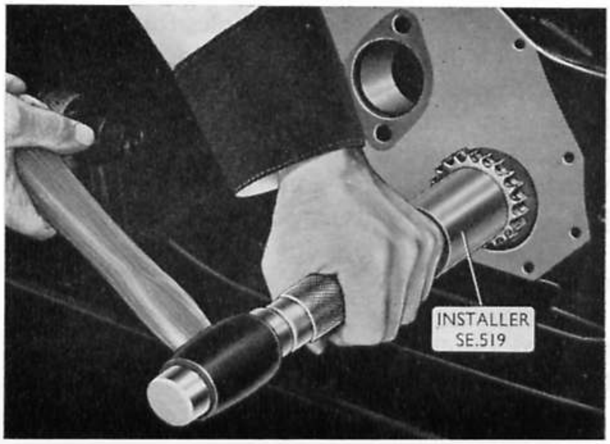


Fig. A.45. Installing the crankshaft timing wheel

6. Warm up the engine to normal operating temperature. Run the engine at idling speed and re-check the valve clearances.

CRANKCASE FRONT PLATE

Removal

1. Remove the camshaft as described under the previous heading. *It is not necessary to remove the crankshaft timing wheel.*

2. Remove the generator and its front mounting bolt and disconnect the earth lead and wire from the front plate.

3. Support the engine and remove the bolts securing the engine front mountings to the chassis frame crossmember.

4. Disconnect the handle from the water drain tap in the engine.

5. Remove the chain tensioner and the bolt and countersunk screw securing the front plate to the crankcase.

6. Detach the front plate, guiding it carefully over the crankshaft timing wheel. Remove the gasket. Detach the oil seal from the chain tensioner oil feed hole in the front main bearing cap (see Fig. A.65 on page A-38).

Installation

Note the following:

1. Smear a new oil seal with grease and install it in the front main bearing cap (see Fig. A.65 on page A-38).

2. After securing the front plate with the bolt and countersunk screw, the latter must be locked by staking metal into the ends of the slot.

3. Install the camshaft as described under the previous heading.

4. Reconnect the earth lead and black wire to the crankcase front plate.

FLYWHEEL

Removal

1. Remove the starter.

2. Remove the clutch (page E-4).

3. Remove the bolts securing the flywheel. Support the flywheel and tap it off the crankshaft flange register evenly, using a copper or lead hammer.

Inspection and Reconditioning

1. Examine the clutch friction face of the flywheel for scores or cracks. Scores can be removed by machining within the specified limits.

2. Inspect the crankshaft dowels for wear or slackness.

3. Check the flywheel bolt holes for elongation due to running with the flywheel loose. If the flywheel has been loose, examine the crankshaft flange for embedded flywheel material due to fidgeting. Embedded material should be removed with a carborundum stone provided the clutch pilot bush is fully protected.

4. Examine the bolts for signs of stretching or damaged threads.

5. If any section of the ring gear is unduly worn, the gear should be renewed. If necessary, renew the starter pinion.

6. To renew the ring gear, proceed as follows:

(*a*) Remove the gear by striking evenly and alternately, at points equally spaced around the gear.

(*b*) Using emery cloth, polish three equally spaced areas on the outer face of the new gear.

(*c*) Heat the gear evenly. The temperature of the gear can be judged by the changing colour of the polished areas. The correct temperature is reached when the colour has changed from purple to dark blue. Hold at this temperature for five minutes. Do not allow the temperature to exceed dark blue colour. If the colour changes to light blue, the original heat treatment of the gear will be destroyed.

(*d*) Quickly remove any scale and position the gear on the flywheel with the teeth chamfer facing towards the rear of the flywheel. If necessary, gently tap the gear home and allow to cool in air.

7. Check the clutch pilot bush for wear or slackness. To renew, see page E-4.

Installation

Note the following:

1. Clean the mating faces of the flywheel and crankshaft flange, and ensure that the flywheel is correctly located on the dowels.

2. Tighten the bolts evenly to the specified torque.

3. Install the clutch (page E-6).

CRANKSHAFT REAR BEARING OIL SEAL

Renewal

1. Remove the engine assembly complete with the transmission (page A-31).

2. Remove the transmission unit.

3. Remove the carburetter, generator, water pump and distributor.

4. Remove the oil pan and oil pump.

5. Remove the camshaft (page A-27) and the crankcase front plate.

6. Remove the clutch housing covers.

7. Mark each connecting rod with the cylinder number, and remove the caps and bearings.

8. Remove the main bearing caps and lift out the crankshaft complete with flywheel and clutch. Remove the bearings from the crankcase. Do not lose the thrust washers of the centre bearing.

9. Remove the rear bearing oil seals, also the seals installed in the slots each side of the front and rear main bearing caps.

10. To install a new rear bearing oil seal in the crankcase and rear main bearing cap, follow the procedure described on page A-36.

11. Refit the main bearings and lubricate with engine oil. Install the crankshaft and centre bearing thrust washers. Tighten the main bearing cap bolts to the specified torque.

12. Install new felts in the front and rear bearing caps (page A-38).

13. Reconnect the connecting rods, and tighten the nuts to the specified torque.

14. Install the crankcase front plate as described on page A-29.

15. Install camshaft (page A-29).

16. Refit the oil pump and oil pan (pages A-18 and A-19).

17. Install the engine assembly (page A-38).

ENGINE ASSEMBLY

Removal

1. Remove the radiator (page C-8). Disconnect the heater hoses, where fitted.

2. Remove the front lower panel and radiator support frame (see Section W of TS.675).

3. Remove the front axle stabilizer bar, the chassis frame front crossmember and where fitted, the front axle crossmember guard.

4. Remove the air cleaner and the rocker cover.

5. Disconnect the controls from the carburetter, and the feed pipe hose from the fuel pump.

6. Disconnect the engine wiring harness, starter cable and earth strap.

7. Disconnect the exhaust pipe from the manifold.

8. Disconnect the stay rod bracket from the clutch housing, and the gear shift control rods from the transmission levers.

9. Disconnect the clutch control rod from the relay lever and remove the rod through the clutch fork.

10. Disconnect the speedometer cable from the transmission.

11. Remove the propeller shaft, and insert a spare sliding sleeve in the transmission rear cover to prevent oil leakage.

12. Use a jib crane with a suitable adapter to support the engine, and remove the engine front mountings and the rear mounting crossmember.

13. Withdraw the engine and transmission assembly.

Disassembly

1. Remove the transmission and all external assemblies and components.

2. Remove the rocker gear, push rods, dipstick tube, push rod cover and valve tappets.

3. Remove the cylinder head and unscrew the cylinder head studs.

4. Invert the engine. Remove the clutch housing covers and oil pan.

5. Remove the oil pump.

6. Check the connecting rods and pistons for cylinder number identification, and if necessary, mark them. *Do not use a centre punch or file as such markings may cause fatigue failure.*

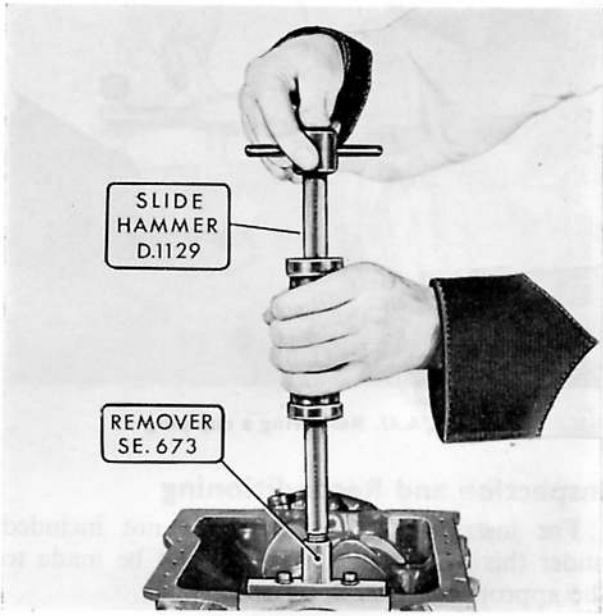


Fig. A.46. Removing the rear main bearing cap. This method can also be used for the front cap removal

7. Remove the pistons and connecting rods. Refit the bearings and caps to their respective rods.

8. Remove and discard the piston rings.

9. Remove and discard the piston pin circlips. Heat the pistons in water to approximately 48°C. (120°F.) and push out the pins.

10. Remove the timing cover, chain tensioner and chain.

11. Unscrew the camshaft thrust plate bolts. Withdraw the camshaft carefully to avoid damage to the bearings, and detach the thrust plate gasket.

12. Withdraw the timing wheel from the crankshaft using the drag shown in Fig. A.42 on page A-28.

13. Remove the crankcase front plate.

14. Remove the clutch fork and clutch assembly.

15. Remove the flywheel and clutch housing.

16. Mark the main bearing caps and remove the caps and bearings. The front and rear caps can be withdrawn as in Fig. A.46. Lift out the crankshaft and remove the bearings.

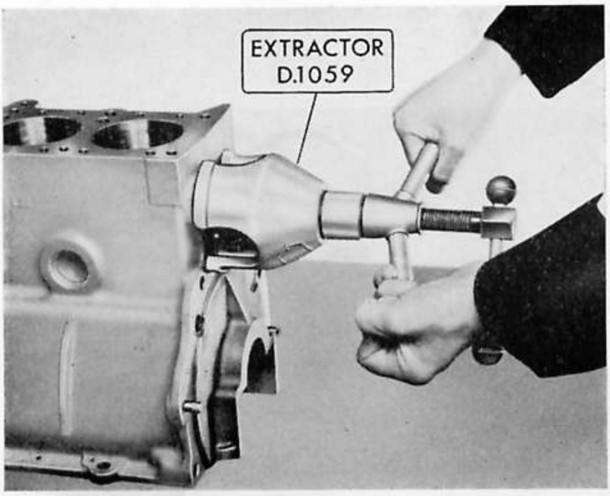


Fig. A.47. Removing a cup plug

Fig. A.48. Installing a small cup plug, using Drift SE.517. Use Drift SE.123 when installing the larger cup plugs

Inspection and Reconditioning

For instructions covering units not included under this heading, reference should be made to the appropriate section of this group.

Cylinder Block

1. Remove the cup plugs from the cylinder block (Fig. A.47). Flush out sediment from the water jackets.

2. Remove the plug from each end of the oil gallery. Using compressed air, blow out the gallery, oil drillings to the main bearings and camshaft bearings, also the rocker shaft oil drilling from the camshaft centre bearing. Thoroughly clean out the crankshaft and camshaft oilways.

3. Use sealing compound when installing the cup plugs. The plugs in the front and rear of the cylinder block must not protrude above the machined face.

4. Exercise particular care when checking the cylinder bores where maximum wear occurs (i.e. just below the highest point of ring travel). If the bore is scored or the maximum wear exceeds ·010 in., the cylinders should be rebored or liners installed.

If the bore is free from scores and the maximum wear is less than ·010 in., new piston rings may be installed (page A-24).

5. When reboring the cylinder block, observe the following instructions:

(*a*) To determine the required finished bore diameter, measure and record the graded size of each piston and add to the micrometer reading the lower limit of the specified piston-to-cylinder bore clearance.

IMPORTANT: *As the piston skirt is ground both oval and taper it is imperative that the measurement is made at the diameter indicated in Fig. A.49, and at right-angles to the piston pin. Only at this point can the correct piston graded size be established.*

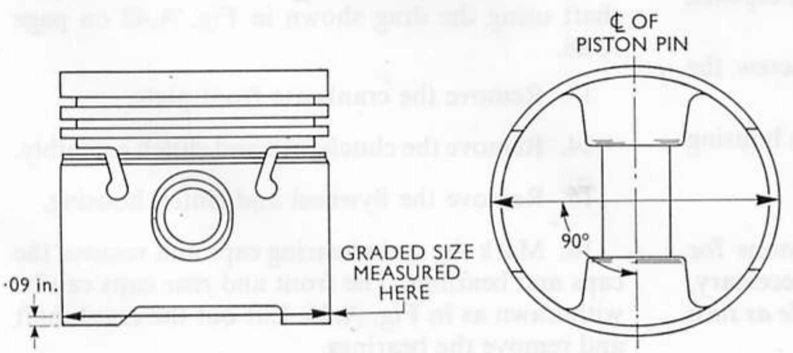


Fig. A.49. The piston graded size must only be measured at the diameter indicated and at right angles to the piston pin

(*b*) Set the boring bar to cut within ·0005 to ·0010 in. of the finished cylinder bore diameter, and bore out the cylinder.

(*c*) Hone out each cylinder to the appropriate finished bore diameter with stones classified as fine and using clean paraffin as a lubricant. At intervals during the honing procedure, check the cylinder bore for taper and ovality. The finished bore should be true within ·0005 in.

No attempt must be made to check piston-to-bore clearance with a feeler gauge as the ovality and taper of the piston skirt will give a false indication of clearance.

(*d*) Wash the cylinder block thoroughly in clean paraffin and blow out the main oil gallery, aiso all oilways and drillings with compressed air.

6. When worn cylinder bores fail to clean up to suit the maximum oversize pistons, the cylinder block can be made serviceable by fitting liners. These liners enable standard pistons to be installed, and can subsequently be rebored as necessary to accommodate pistons up to ·020 in. oversize, before renewal of the liners is necessary. The liners are installed as follows:

(*a*) Bore out the cylinder to within the specified limits, maintaining a smooth finish throughout.

(*b*) Insert a liner, external chamfered end first, into the bore.

(*c*) Make sure that the liner is parallel with the bore. Press the liner into the bore using a press (hydraulic if possible), protecting the end of the liner with a spigoted or flat plate. Face up the liners flush with the cylinder block top face.

(*d*) Bore the liners for standard size pistons, see Operation 5.

7. Check the main bearing housing bores to ensure that the caps have not been filed. Assemble the caps to the crankcase without the bearings, and after tightening the bolts to the specified torque, measure each bearing housing bore vertical diameter with a cylinder gauge (Fig. A.50).

If a vertical diameter measures less than the specified limits, owing to filing of the cap, the diameter can be restored to specification by fitting a special service main bearing cap with shims. These special caps are serviced individually and, unlike those supplied with an engine or cylinder block, are not machined as an assembly with the

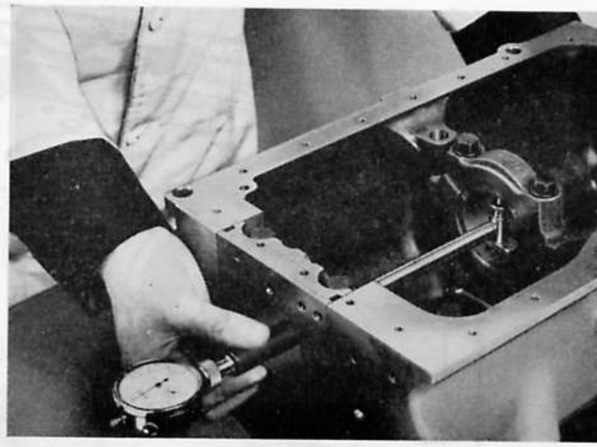


Fig. A.50. Checking the vertical diameter of a main bearing housing bore with a cylinder gauge used in conjunction with a micrometer

block. The joint face of the service cap is machined ·004 to ·005 in. below the bearing housing bore axis, and shims ·002 and ·003 in. thick are supplied for insertion between the cap and crankcase to adjust the bore vertical diameter to within the specified limits. Where necessary, shim thickness, side for side, can differ by ·001 in. to give a ·0005 in. variation in the bore vertical diameter.

It is important that the shims are correctly positioned, i.e. clear of and parallel with the edge of the bearing in the crankcase, to avoid being trapped between the ends of each half bearing. For this reason, lightly smear petroleum jelly on the bearing cap joint faces of the crankcase to retain the shims clear of the bearings.

NOTE: *The probability that the bottom half bearing has also been filed should be considered. If in doubt, the complete bearing (i.e. both half bearings) should be renewed.*

Crankshaft and Bearings

1. Check the crankshaft for alignment by supporting it between centres and taking indicator readings on the main bearing journals. When checking the alignment of a worn shaft, allowance must be made for the possibility of the journals being out-of-round. Inspect the dowels for wear or slackness.

2. Examine the condition of the journals and main bearings. Assemble the main bearings and crankshaft to the crankcase.

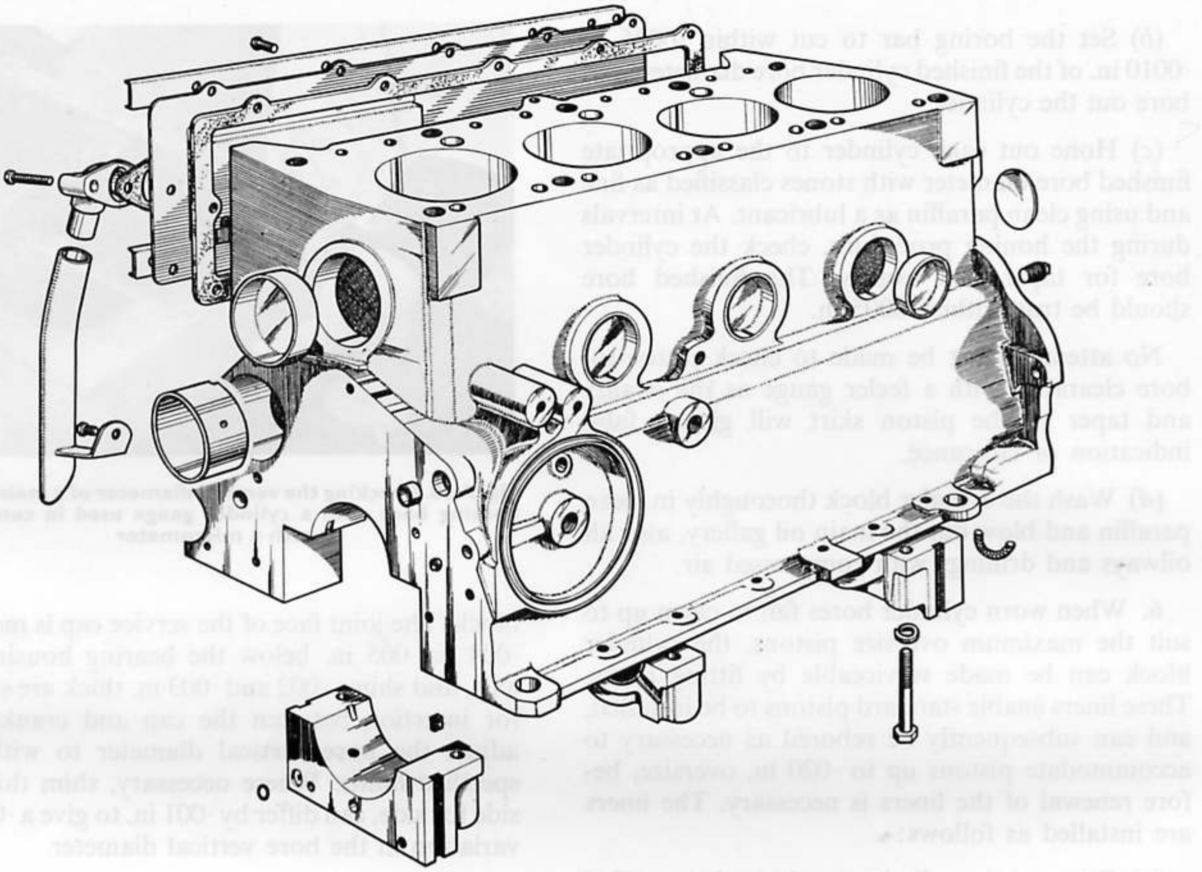


Fig. A.51. Cylinder block and crankcase components

3. Check the crankshaft to bearing clearance. Do not use steel feeler strip for checking bearing clearance, otherwise the bearing surface will be damaged. The bearing clearances can be checked individually with Plastigage as follows:

(*a*) Wipe the oil from the bearing and main journal. *Note that Plastigage is soluble in oil.* Cut a piece of Plastigage of the correct thickness, i.e. clearance range, from the length supplied; *do not pull or stretch the Plastigage as this will render it useless.* Place the Plastigage across the centre of the journal (Fig. A.52). Assemble the cap and bearing, and tighten the bolts to the specified torque. *Do not turn the crankshaft.*

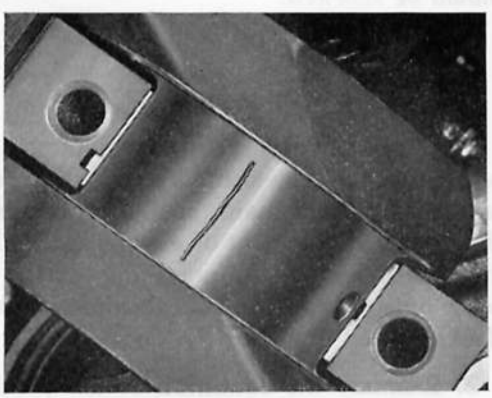


Fig. A.52. Use Plastigage for checking journal to bearing clearance. Left: Plastigage placed on journal. Right: Measuring width of compressed Plastigage; in this example the clearance is ·0015 in.

(*b*) Remove the bearing cap. The flattened Plastigage will be adhering to either the journal or the bearing and should not be removed at this stage.

Using the scale printed on the side of the Plastigage envelope, measure the compressed Plastigage at its widest point. The numbered graduation within the scale which most closely corresponds to the compressed width of the Plastigage, indicates by its number, the bearing clearance in thousandths of an inch (Fig. A.52). For example, the inch graduation marked '2' indicates ·002 in. clearance.

Where ovality of the journal is suspected, the bearing clearance should be checked at several points around the journal. Bearing size can be established by checking the part number or size on the back of the bearing.

(*c*) If the main journals and crankpins are worn or scored, the shaft must be renewed or reground. If regrinding is necessary, the crankshaft must be ground in accordance with the specified regrind data. This will ensure that the correct diametrical clearance is provided between the shaft journals and crankpins and the appropriate undersize main and connecting rod bearings.

4. Check the clutch pilot bush in the crankshaft flange for wear or slackness. To renew, see page E-4.

Camshaft and Bearings

Inspect the camshaft and bearings for wear (page A-28). To renew the bearings, proceed as follows:

1. Using the appropriate drift plug drive out the front (No. 1) bearing. Insert the drift pilot in the front bearing housing and using the appropriate drift plug drive out the centre bearing (Fig. A.53). Remove the rear bearing in a similar manner, noting that the expansion plug will be driven out with the bearing.

2. Replacement bearings have the bore diameter already finished to size, therefore line boring is unnecessary.

3. When installing new bearings, commence with the rear bearing and work towards the front of the crankcase. To ensure that the bearing oil holes coincide with the oilways in the crankcase, locate the rear and front bearings so that the notch in each bearing is at the top of the housing and towards the rear of the crankcase.

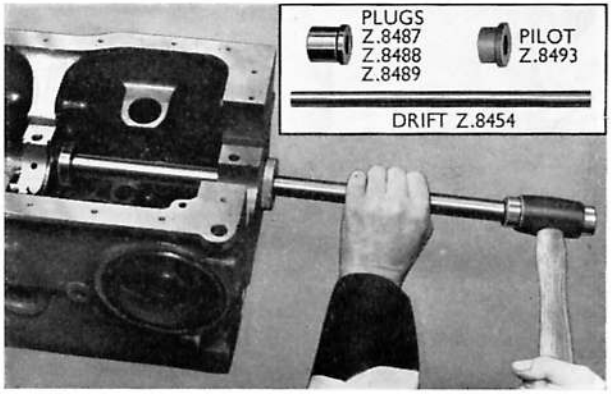


Fig. A.53. Renewing the camshaft bearings

The replacement centre bearing does not incorporate a notch. When installing this bearing, align the small diameter hole in the bearing with the rocker shaft oil feed drilling in the top of the bearing housing; the large hole of the bearing being aligned with the oil drilling to the adjacent main bearing (Fig. A.54). Ensure that the front bearing does not project beyond the crankcase front face.

4. Remove any overlapping bearing metal obstructing the oilways in the crankcase.

5. When installing a new expansion plug behind the rear bearing, ensure that there are no flats or burrs on the edge of the plug. Use sealing compound to obtain an oil-tight joint.

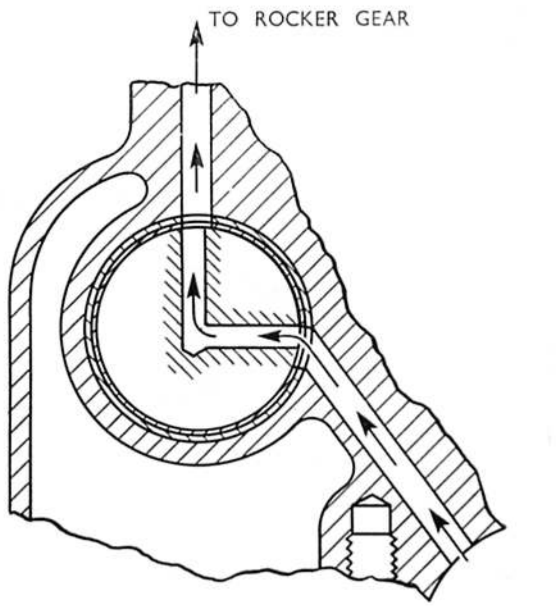


Fig. A.54. Section showing camshaft centre bearing installed in crankcase. The small hole of the bearing must be aligned with the vertical oil drilling to the rocker gear. The arrows indicate direction of oil flow

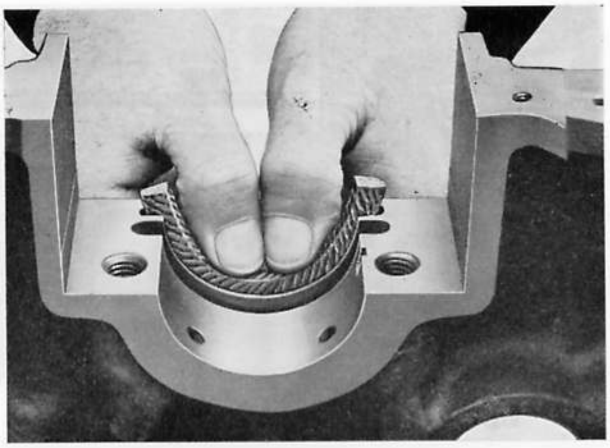


Fig. A.55. Initial installation of the crankshaft rear bearing oil seal

Reassembly

Note the following:

1. Apply sealing compound when installing the plugs at each end of the oil gallery. Check that the cup plugs, sealing the oil gallery and the drilling to the filter boss, do not project above the machined front face of the crankcase.

2. Install the crankshaft rear bearing oil seals as follows:

(*a*) Ensure that the oil seal grooves in the crankcase and rear main bearing cap are perfectly clean. Check that the vertical grooves in the front and rear bearing caps are also clean.

(*b*) Press a new oil seal into the rear groove of the crankcase, commencing at the centre (Fig. A.55) and working towards the sides. Both ends of the seal must project above the face of the housing. Smear the seal with recommended lubricant.

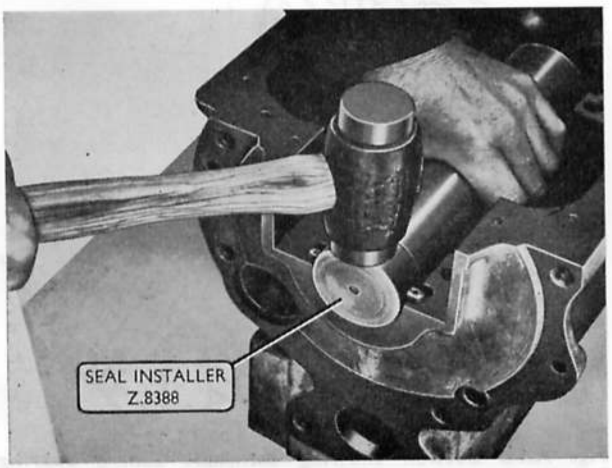


Fig. A.56. Driving the oil seal firmly into its location groove

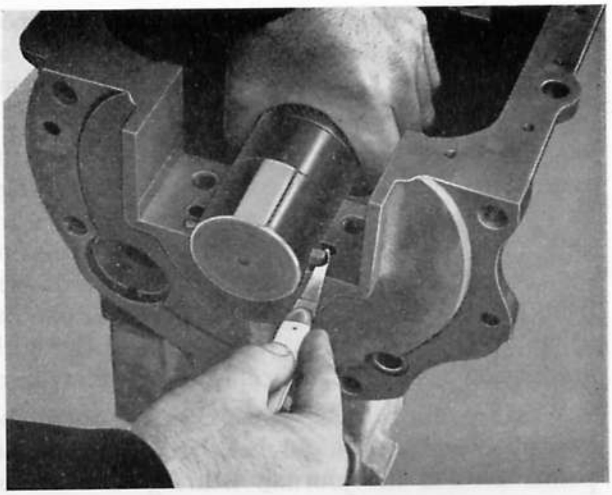


Fig. A.57. Cutting the oil seal ends flush with the bearing joint face. The seal must then be smeared liberally with the recommended lubricant

(*c*) Drive the seal into position by hammering on the flat of the installer (Fig. A.56), at the same time applying a semi-rotary movement until the installer is felt to bottom.

(*d*) With the installer held firmly in position and using a sharp knife, cut off the projecting ends of the seal clean and flush with the bearing joint face (Fig. A.57).

(*e*) Place the front and rear bearing caps on a level surface, using a wood block of uniform thickness. Install a new seal in the rear cap as shown in Fig. A.58 and cut off the seal ends, following the procedure already described.

(*f*) Smear the seals liberally with the recommended lubricant.

3. Reassemble the crankshaft to the crankcase as follows:

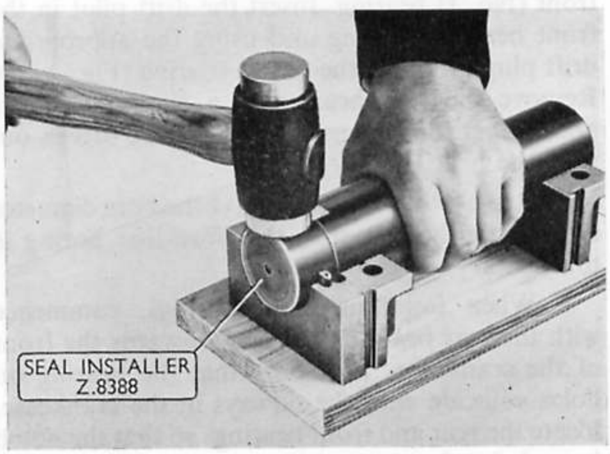


Fig. A.58. Driving the bearing oil seal firmly into the cap groove

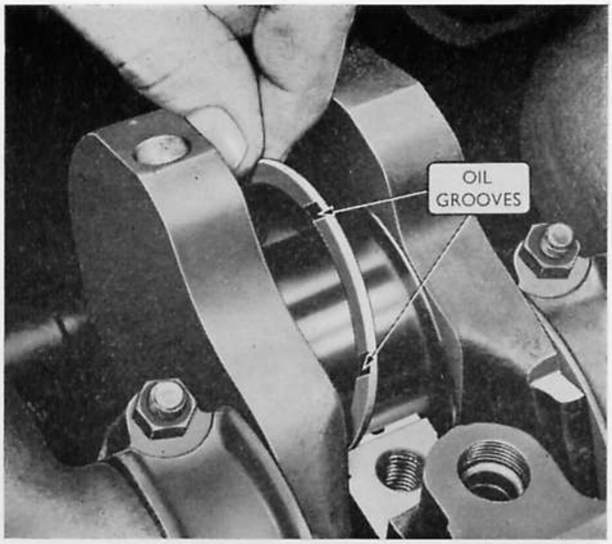


Fig. A.59. Installing a thrust washer to the centre main bearing. The washer oil grooves must face towards the adjacent thrust face of the crankshaft

(*a*) Assemble the main bearings in the crankcase and lubricate each bearing with engine oil. Carefully lower the crankshaft into position.

(*b*) Centralize the crankshaft endwise so that the upper halves of the thrust washer can be fed into position and located correctly each side of the centre bearing. The oil grooved face of each thrust washer must face towards the adjacent thrust face of the crankshaft (Fig. A.59).

(*c*) Fit the lower halves of the thrust washers to the centre bearing cap, using clean grease to hold the washers in position. Install the bearings in the caps, making sure that the bearing oil hole coincides with the front cap oil drilling for the chain tensioner (Fig. A.60). Commencing with the centre bearing, assemble the caps and bolts, using new lockwashers. *No scraping of the bearings or adjustment by rubbing down the caps is permissible.*

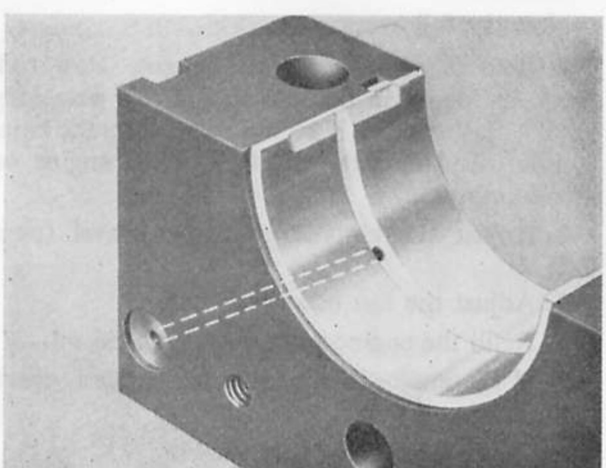


Fig. A.60. Front main bearing cap, showing the oilway for feeding the timing chain tensioner

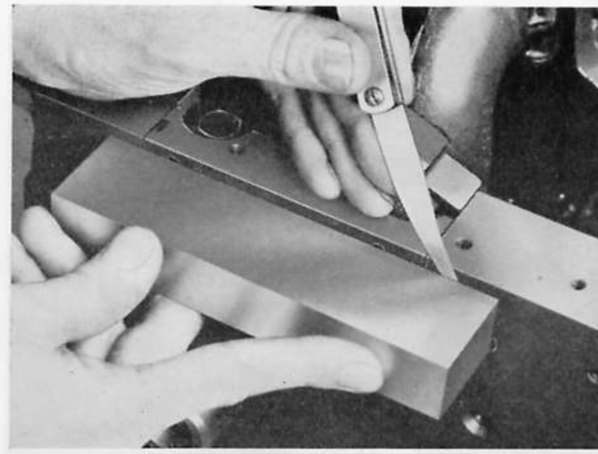


Fig. A.61. Checking the front main bearing cap for alignment with the face of the crankcase

(*d*) Before tightening the bolts securing the centre bearing cap, push the crankshaft forward until it contacts the rear upper thrust washer. With the crankshaft held in this position, push the cap rearwards as far as possible and tighten the cap bolts. This will ensure that the thrust is taken evenly on both halves of the thrust washers.

(*e*) Before tightening the bolts securing the front main bearing cap, place a straight edge across the front face of the crankcase and cap, and line up the two faces. Check the alignment again after the bolts have been tightened (Fig. A.61).

(*f*) Tighten all main bearing cap bolts to the recommended torque.

(*g*) Using a dial gauge, check the crankshaft end-float (Fig. A.62) by moving the shaft to its

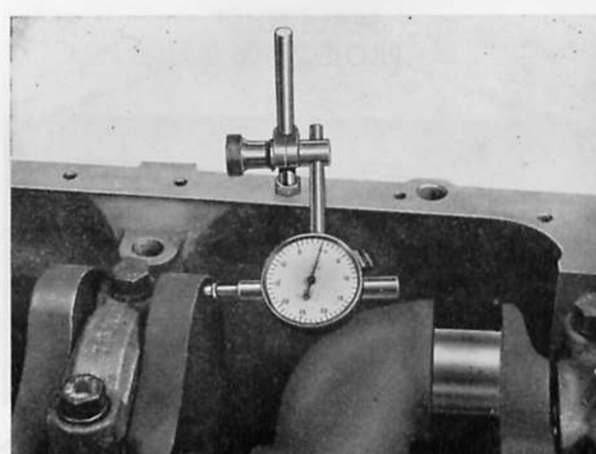


Fig. A.62. Checking the crankshaft end-float

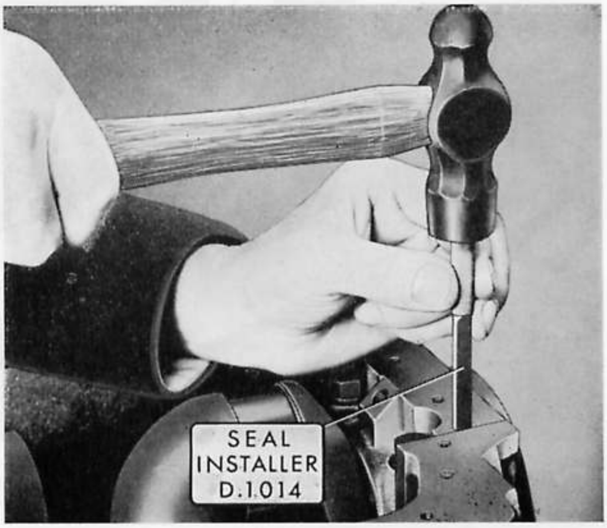


Fig. A.63. Installing the bearing cap oil seals

extreme forward and rearward positions. Oversize thrust washers are supplied to correct excessive end float.

4. Install the front and rear main bearing cap oil seals (Fig. A.63). Coat the first piece of felt with jointing compound and drive home this and subsequent felts. Approximately six felts are required for each groove. Ensure that the felts are tightly packed, and leave about ·06 in. of felt projecting for compression when the oil pan is installed (Fig. A.64).

5. Smear a new oil seal with grease and install in the front main bearing cap front face (Fig. A.65).

6. Install the remaining components as described under the appropriate headings.

7. Renew the oil filter element.

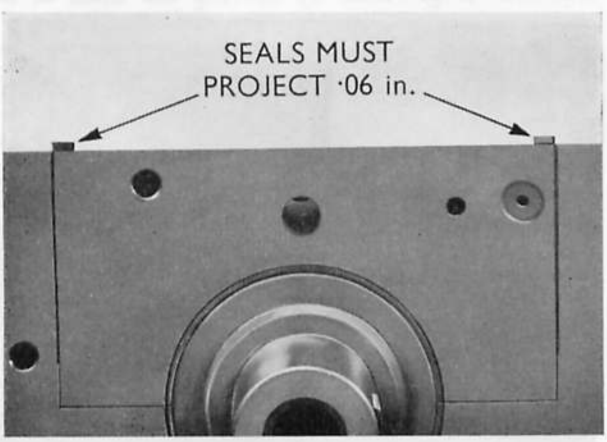


Fig. A.64. The oil seals, when packed firmly in the cap, must have ·06 in. projecting above the cap face (as shown by the arrows) for compression when the oil pan is installed

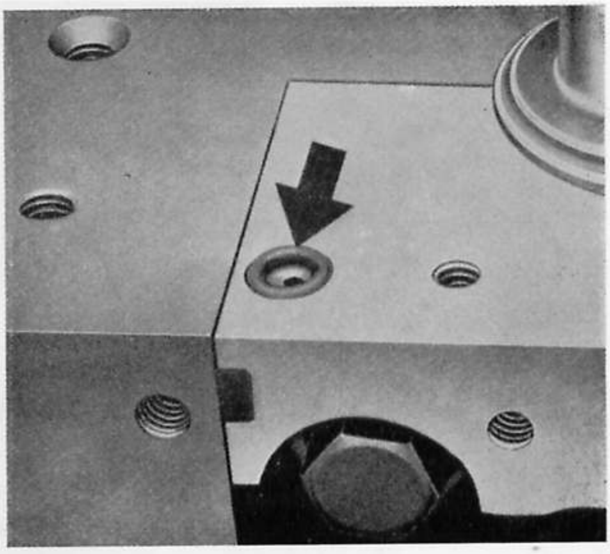


Fig. A.65. Showing the oil seal assembled to the front main bearing cap

8. When reassembling the generator and mounting bracket, proceed as follows:

(*a*) Loosely attach the mounting bracket to the crankcase with the two bolts and washers.

(*b*) Temporarily tighten the two generator mounting bolts to bring the end brackets of the generator into contact with the mounting stud and bracket. Tighten the mounting bracket bolts.

9. Check that the oil filler cap wire gauze is clean.

10. Lightly smear the main drive pinion splines and clutch release bearing sleeve with recommended grease.

Installation

Note the following:

1. Before reconnecting the engine stay rod, check its length in relation to the rear attaching hole. Adjust the rod, if necessary, to align the holes without displacing the position of the engine on its mountings.

2. Adjust the clutch pedal free travel (page E-2).

3. Adjust the fan belt (page C-5).

4. Refill the engine with recommended oil.

5. If the engine has been disassembled, check the following:

(*a*) Valve clearances (page A-11).

(*b*) Ignition timing (see TS.675, page R-5).

(*c*) Idling adjustment (page B-6).

SPECIFICATIONS

CAPACITIES

Capacity—Nominal

Total—dry engine	$7\frac{1}{2}$ Imp. Pints (4·5 U.S. quarts)
Refill	6 Imp. Pints (3·6 U.S. quarts)
Refill—with filter element change	$6\frac{1}{2}$ Imp. pints (3·9 U.S. quarts)

GENERAL DATA

Firing Order 1, 3, 4, 2

Compression Ratio—Mean

Standard	7·0 to 1
Optional	8·5 to 1

Minimum Compression Pressure ... ... 125 lb/sq. in. (Pressure variation between cylinders must not exceed 20 lb/sq. in.)

CYLINDER HEAD AND VALVES

Cylinder Head

Maximum permissible distortion:	
Longitudinally	·005 in.
Transversely	·003 in.
Manifold attaching faces	·002 in.
Depth of head	3·292 to 3·302 in.
Minimum depth of head after refacing ...	3·282 in. (Fig. A.66)

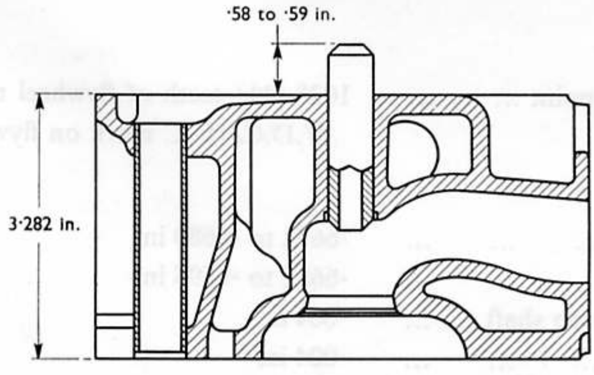


Fig. A.66. Sectioned view of cylinder head showing minimum depth after refacing, and assembled height of valve guides

Valve and Valve Seat Refacing Data (Fig. A.67)

	INTAKE	EXHAUST
'A'—valve head minimum thickness	·025 in.	·035 in.
'B'—seat width	·035 to ·060 in.	·060 to ·090 in.
'C'—seat angle	45°	45°
'D'—valve angle	44°	44°

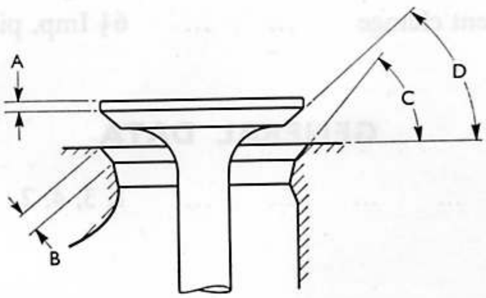


Fig. A.67. Valve and valve seat refacing data diagram

Valve Guides

Bore	·312 to ·313 in.
Standing height above cylinder head machined face	·58 to ·59 in. (Fig. A.66)

Valve Clearance—Hot ... ... ·013 in.

Valves

Stem diameter	·3102 to ·3110 in.
Maximum stem clearance in guide	·005 in.

Valve Springs

Maximum assembled height	1·54 in.
Free length—nominal	1·78 in.
Spring load at 1·52 in.	35 to 55 lb.

Valve Timing

Intake valve maximum opening point	102° (34½ teeth of flywheel ring gear) after T.D.C. (U/C mark on flywheel)

Rockers and Shaft

Shaft diameter	·6672 to ·6680 in.
Rocker bore	·6682 to ·6695 in.
Maximum permissible clearance on shaft ...	·004 in.
Maximum shaft run-out	·004 in.

CYLINDER BLOCK

Cylinder Block

Depth of block, top face to main bearing cap face	8·660 to 8·670 in.
Minimum depth after refacing	8·650 in.
Maximum permissible distortion on top face:	
Longitudinally	·005 in.
Transversely	·003 in.

CYLINDER LINERS (SERVICE)

Cylinder Bore Diameter for Liner Installation... 3·353 to 3·354 in.

Maximum Piston Oversize for use with Liners ·020 in.

PISTONS AND RINGS

Piston Pins

Fit in piston bosses ... ... Finger push fit through each boss individually at a temperature of 18° to 24°C. (65° to 75°F.)

Piston Rings

	WIDTH (TOP TO BOTTOM FACE)	CLEARANCE IN PISTON GROOVES	RING GAP IN CYLINDER BORE
Top (chrome plated) compression ring	·0928 to ·0938 in.	·0015 to ·0035 in.	·008 to ·021 in.
Centre (stepped) compression ring	·0928 to ·0938 in.	·0010 to ·0030 in.	·008 to ·021 in.
Scraper ring	·1865 to ·1875 in.	·0017 to ·0037 in.	·008 to ·021 in.

Pistons

Ring groove width:	
Top groove	·0953 to ·0963 in.
Centre groove	·0948 to ·0958 in.
Bottom groove	·1892 to ·1902 in.
Clearance in cylinder bore	·00095 to ·00145 in.

Piston Grades and Sizes

For production purposes, eight grades of piston are used, identified by a letter on the piston crown. These grades represent ·00025 in. sub-divisions of an overall size range of ·002 in.

For service, replacement standard size pistons are of Grades Y, TY, W and TW, and oversize pistons are of Grades Y and W.

NOMINAL SIZE	GRADE	*GRADED SIZE
Standard	R	3·21280 to 3·21305 in.
	TR	3·21305 to 3·21330 in.
	B	3·21330 to 3·21355 in.
	TB	3·21355 to 3·21380 in.
	Y	3·21380 to 3·21405 in.
	TY	3·21405 to 3·21430 in.
	W	3·21430 to 3·21455 in.
	TW	3·21455 to 3·21480 in.
·005 in. Oversize	Y	3·21880 to 3·21930 in.
	W	3·21930 to 3·21980 in.
·020 in Oversize (maximum for liners)	Y	3·23380 to 3·23430 in.
	W	3·23430 to 3·23480 in.
·040 in. Oversize	Y	3·25380 to 3·25430 in.
	W	3·25430 to 3·25480 in.

* *Piston graded size must be measured ·09 in. above the bottom of the skirt and at right-angles to the piston pin. (Fig. A.49 on page A-32).*

CONNECTING RODS AND BEARINGS

Connecting Rods

Bearing housing bore	1·9945 to 1·9950 in.
Bush bore:	
Standard	·8664 to ·8667 in.
·003 in. oversize	·8694 to ·8697 in.
Rod alignment	Bush bore must be parallel with the bearing housing bore in all planes

Bearings

Bore:	
Standard	1·8740 to 1·8752 in.
Grade P (see note under 'Crankshaft and Bearings')	1·864 to 1·865 in.
Clearance on crankpin	·0005 to ·0025 in.

CRANKSHAFT AND BEARINGS

Production crankshafts which vary from the standard dimensions are identified as follows:

Grade P in which only the crankpin diameters vary from standard.

Grade J in which only the main bearing journal diameters vary from standard.

Grade PJ in which both crankpin and main bearing journal diameters vary from standard.

The crankshaft is identified, if varying from standard, by the letter 'P' and/or 'J' stamped on the web adjoining the centre main bearing journal. The letter 'P' is accompanied by a dab of red paint and the letter 'J' by a dab of yellow paint. The appropriate bearings are also marked 'P' or 'J' on their backs.

Replacement crankshafts will be of standard dimensions only.

Crankpins

Diameter:	
Standard	1·8725 to 1·8735 in.
Grade P	1·8625 to 1·8635 in.
Length	1·065 to 1·069 in.

Main Journals

Diameter:	
Front (Standard)	2·1198 to 2·1208 in.
Front (Grade J)	2·1098 to 2·1108 in.
Centre (Standard)	2·1203 to 2·1208 in.
Centre (Grade J)	2·1103 to 2·1108 in.
Rear (Standard)	2·1201 to 2·1206 in.
Rear (Grade J)	2·1101 to 2·1106 in.
Length:	
Front	1·800 to 1·820 in.
Centre	1·123 to 1·127 in.
Rear	1·480 to 1·490 in.
End float	·002 to ·012 in.
Maximum run-out	·0015 in.
Oil seal journal diameter	2·207 to 2·211 in.

Main Bearings

Bearing housing bore	2·2657 to 2·2662 in.
Bearing bore:	
Standard	2·1213 to 2·1222 in.
Grade 'J'	2·1113 to 2·1122 in.
Clearance on journal:	
Front	·0005 to ·0024 in.
Centre	·0005 to ·0019 in.
Rear	·0007 to ·0021 in.
Thrust washer thickness:	
Standard	·091 to ·093 in.
·003 in. oversize	·094 to ·096 in.
·006 in. oversize	·097 to ·099 in.
·009 in. oversize	·100 to ·102 in.

Service Main Bearing Cap Shims

Thickness	·002 and ·003 in.

Crankshaft Regrind Data (Fig. A.68)

UNDERSIZE	DIA. 'A'	DIA. 'B'	DIA. 'C'	DIA. 'D'
·005 in.	—	—	—	1·8675 to 1·8685 in.
·010 in.	2·1098 to 2·1108 in.	2·1103 to 2·1108 in.	2·1101 to 2·1106 in.	1·8625 to 1·8635 in.
·020 in.	2·0998 to 2·1008 in.	2·1003 to 2·1008 in.	2·1001 to 2·1006 in.	1·8525 to 1·8535 in.
·030 in.	2·0898 to 2·0908 in.	2·0903 to 2·0908 in.	2·0901 to 2·0906 in.	1·8425 to 1·8435 in.
·040 in.	2·0798 to 2·0808 in.	2·0803 to 2·0808 in.	2·0801 to 2·0806 in.	1·8325 to 1·8335 in.
·050 in.	2·0698 to 2·0708 in.	2·0703 to 2·0708 in.	2·0701 to 2·0706 in.	1·8225 to 1·8235 in.
·060 in.	2·0598 to 2·0608 in.	2·0603 to 2·0608 in.	2·0601 to 2·0606 in.	1·8125 to 1·8135 in.

THRUST WASHER OVERSIZE	DIMENSION 'E'	DIMENSION 'F'
·003 in.	1·129 to 1·133 in.	9·148 to 9·158 in.
·006 in.	1·135 to 1·139 in.	9·145 to 9·155 in.
·009 in.	1·141 to 1·145 in.	9·142 to 9·152 in.

NOTE: *It is important when regrinding the thrust faces that whatever dimension under 'E' is obtained, the corresponding dimension under 'F' must be maintained. This is to ensure correct location of the crankshaft relative to the crankcase.*

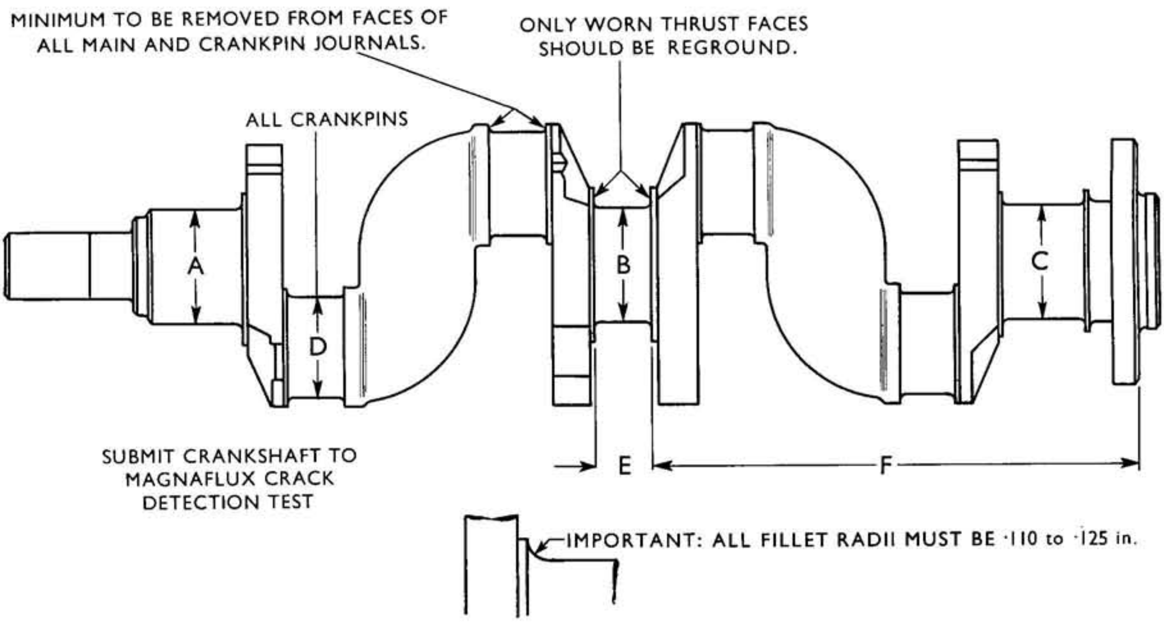


Fig. A.68. Crankshaft journal regrind data diagram. The crank throw must be within 1·4975 to 1·5025 in.

CAMSHAFT AND BEARINGS

Journal Diameters

Front	1·7882 to 1·7887 in.
Centre	1·7570 to 1·7575 in.
Rear	1·7258 to 1·7263 in.

Bearing Bores

Front	1·7912 to 1·7922 in.
Centre	1·7600 to 1·7610 in.
Rear	1·7288 to 1·7298 in.

Maximum Clearance in Bearings

Front	·0063 in.
Centre	·0065 in.
Rear	·0067 in.

End Float	·002 to ·004 in.
Thrust Plate Thickness	·195 to ·200 in.

Cams

Dimension from peak to base	1·4906 in.
Minimum permissible dimension	1·465 in.

FLYWHEEL

Minimum Thickness after Refacing	·490 in. (dimension 'A', Fig. A.69)

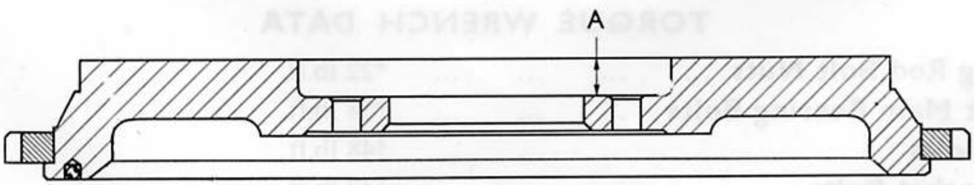


Fig. A.69. Flywheel machining data diagram

OIL FILTER

Element Type	AC 90
Element Spring—Load at 1·38 in.	12 to 20 lb.

OIL PUMP

Driving Impeller Spindle

Diameter	·4982 to ·4987 in.
End Float	·003 to ·006 in.
Fit in body	·0012 to ·0025 in. clearance

Driven Impeller Spindle

Diameter	·5007 to ·5012 in.
Fit in body	Zero to ·0013 in. interference

Impellers

Backlash between teeth	·006 to ·012 in.
Fit on spindle:	
Driven impeller	·001 to ·002 in. clearance
Driving impeller	·001 in. interference to ·0005 in. clearance
End float in body	·002 to ·005 in.
Radial clearance in body	·0015 to ·0035 in.

Drive Gear

Bore	·4982 to ·4987 in.
Fit on spindle	·0005 in. interference to ·0005 in. clearance

Oil Pressure Relief Valve

Plunger diameter	·5605 to ·5613 in.
Plunger fit in body	·0007 to ·0025 in. clearance
Spring free length...	2·22 in.
Spring load at 1·72 in.	16 lb.

Oil Pressure—Hot	35 to 45 lb/sq. in. at 3000 r.p.m.

Oil Pressure Switch

Contact opening pressure	3 to 5 lb/sq. in.

TORQUE WRENCH DATA

Connecting Rod Bolt Nuts	*22 lb.ft.
Crankshaft Main Bearing Bolts	*58 lb.ft.
Flywheel Bolts	†48 lb.ft.
Rocker Bracket Bolts	†42 lb.ft.
Cylinder Head Nuts	†73 lb.ft.
Clutch to Flywheel Bolts	†14 lb.ft.
Timing Cover Bolts	†16 lb.ft.
Front Plate to Crankcase Bolt	†16 lb.ft.
Oil Filter Attaching Bolt	†10 lb.ft.

* *Oiled threads* † *Clean dry threads*

SECTION B—FUEL AND EXHAUST

(Gasoline Engine)

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Have you read the General Notes on page vii?

DESCRIPTION

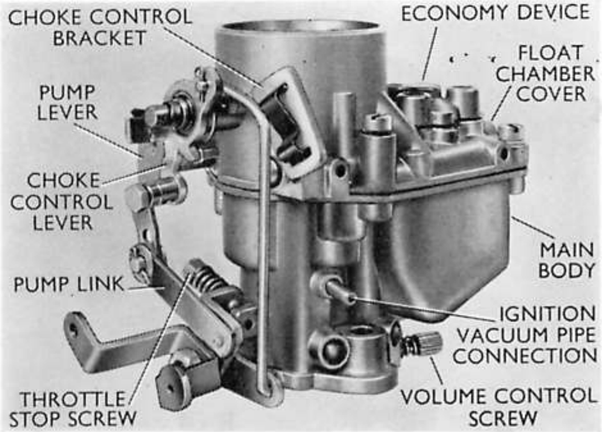


Fig. B.1. External features of the carburetter

Carburetter

Starting

When starting from cold, the choke flap is closed and interconnecting linkage opens the throttle flap beyond the normal idle setting. Manifold depression when the engine is motored, draws air past the spring-loaded choke flap and mixes with fuel drawn through the emulsion block outlet to form a rich mixture for starting. The choke control must be pushed in immediately the engine is running satisfactorily, and must not be used to start a warm engine.

Idling

At idling speed, when the throttle is practically closed, the manifold depression is concentrated on the idling discharge orifice located below the throttle flap. Fuel supplied by the idling jet is fed from the metered side of the main jet through a calibrated restriction. The fuel from the idling jet is emulsified by an air bleed from the carburetter air intake. The resulting mixture is then drawn down a drilling to the idling discharge orifice which has a volume control screw.

As the throttle is opened from the idling position, fuel is also drawn out of two small holes above the idling discharge orifice to provide additional mixture to meet engine requirements until the throttle opens sufficiently for the main circuit to become operative.

Main Circuit

As the throttle is opened further, increased depression in the choke tube causes fuel to be discharged from the emulsion block outlet fed by the main and compensating jets. As the fuel level falls in the channels above the jets, air will enter the top of the capacity wells and channels to these jets. The amount of air bleeding is controlled by the full throttle air bleed, and also at times by the air bleed screw which is controlled by the economy device diaphragm valve. The mixture of fuel and air discharged from the emulsion block outlet is further atomized by air flow through the choke tube.

Economy Device

Under part throttle cruising conditions the relatively high manifold depression transmitted through a drilling below the throttle flap, lifts the economy device diaphragm against its spring pressure. This allows additional air to be drawn through the air bleed screw to weaken the mixture from the jets.

When manifold depression is low, as at wide throttle openings, and maximum power is required, the diaphragm valve is held on its seating by the spring and the air flow to the jets is restricted to the small full throttle air bleed into the channel

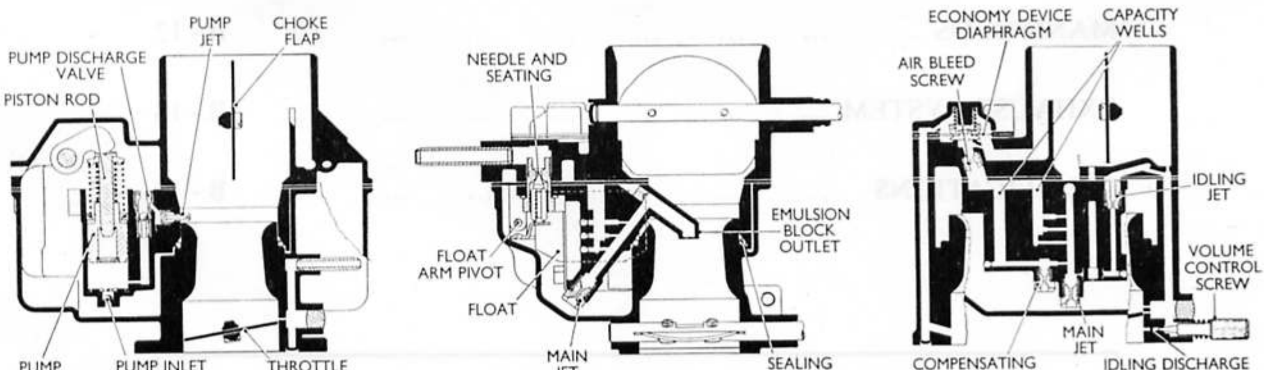


Fig. B.2. Diagrammatic section of carburetter

below the valve. The action of the economy device is entirely automatic and is controlled by the demands of the engine.

Acceleration

Quick depression of the accelerator pedal forces the pump piston rod down when, initially, both the inner and outer springs are compressed. This is followed by expansion of the inner spring which pushes down the piston to discharge fuel out of the pump jet in the choke tube to provide additional richness for rapid acceleration and increased power. Continued expansion of the inner spring ensures a follow-up of the pump operation after the throttle movement, accelerating the engine, has ceased. When the accelerator pedal is released, the piston rises and the pump cylinder is re-charged with fuel flowing through the pump inlet from the float chamber.

The extra supply of fuel from the pump is not required on gradual opening of the throttle. The design provides for the return of fuel from the pump back into the float chamber past the seating of the discharge ball valve, the fuel pressure under such conditions being insufficient to lift the ball and seal the upper bore of the valve.

Air Cleaner

The air cleaner is mounted on a support attached to the rocker cover and connected by a hose to the carburetter. Two types of air cleaner are used, a standard oil wetted type, and an optional oil bath type.

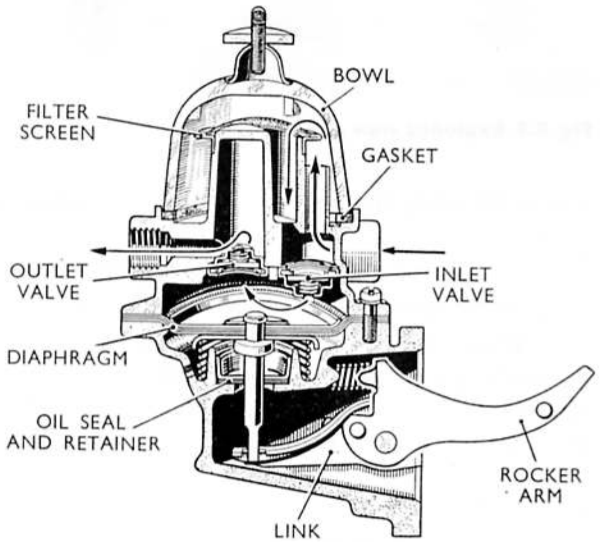


Fig. B.3. Sectioned view of fuel pump. The arrows indicate the direction of fuel flow

Fuel Pump

This is mounted on the crankcase with a heat insulator and gaskets behind its attaching flange. A diaphragm is operated through a rod and link from the rocker arm (Fig. B.3), and when deflected downwards, draws fuel through the filter screen and inlet valve into the chamber above the diaphragm. A spring pushes the diaphragm upwards which closes the inlet valve and discharges fuel through the outlet valve and pipe to the carburetter.

Fuel Tank

The rear-mounted tank is below the body floor and has extended filler and vent pipes connected by hoses to the tank. The filler pipe projects through a grommet in the body side panel and has a bayonet type cap. A hose connects the tank outlet to the main fuel pipe.

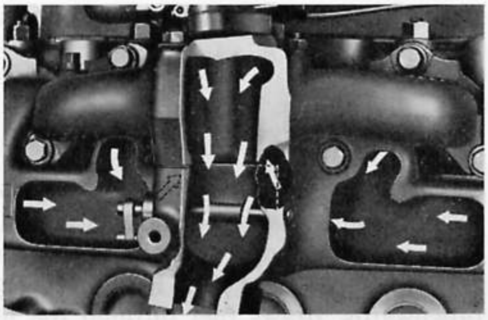
A fuel gauge unit, embodying a float-operated rheostat, is installed in the top of the tank and operates a fuel level gauge in the instrument panel.

Manifolds

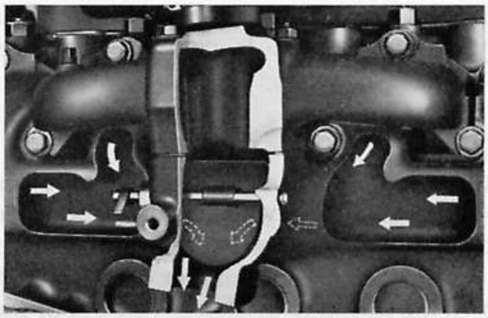
The intake and exhaust manifolds are attached together at the centre by studs and nuts, and a gasket seals the joint. Circular collars to which gaskets are fitted, locate the intake manifold ports with those of the cylinder head. The exhaust manifold makes direct contact with the head.

An integral vaporizing chamber in the intake manifold communicates with the interior of the exhaust manifold which has a heat valve controlling exhaust gas flow through the chamber. The valve carries a balance weight, and a thermostat and spring stop are mounted on the valve shaft.

When the engine is cold, the exhaust gases, prior to entering the exhaust pipe, are directed through the vaporizing chamber by the valve (Fig. B.4). As the manifold temperature rises, the thermostat engaged with the shaft weakens, and so allows the valve balance weight to rotate the shaft and alter the position of the valve, thus permitting the gases to flow direct into the exhaust pipe.



Engine Cold



Engine Hot

Fig. B.4. Exhaust manifold valve operation. The arrows indicate the direction of exhaust gas flow around the vaporizing chamber when the engine is cold, and directly out of the manifold when the engine is hot

It is not advisable to use all the heating effect of the exhaust gases at full throttle even with a cold engine. The valve is so balanced, therefore, that it is opened by the gas pressure at the larger throttle openings and allows the greater part of the gases to flow direct into the exhaust pipe.

Exhaust System

The system is suspended on two rubber insulators and has a silencer with an integral front pipe connected to the manifold. The detachable tail pipe is clamped by a U-bolt to the silencer. On right drive, the tail pipe extends across the chassis.

GUARDIAN MAINTENANCE

Air Cleaner

Air entering the carburetter is filtered by an air cleaner. An oil wetted type cleaner is installed as standard, and an oil bath type cleaner from which the filter and the bath can be detached, is an optional fitting. The air cleaner is mounted on a support attached to the rocker cover.

Oil Wetted Type Cleaner

1. Rinse the filter end only of the air cleaner in clean paraffin and then blow out with compressed air.

2. Saturate the filter element in clean engine oil then allow the surplus oil to drain off before installing the air cleaner.

Oil Bath Type Cleaner

1. Hold the air cleaner upright and remove the support. Lift off the lid; this will remove the integral filter element from the oil bath.

2. Rinse the element in clean paraffin then blow out with compressed air to dry out the element thoroughly. Inspect the gasket in the filter bore.

3. Remove and clean the oil bath. Clean also the casing and air intake tube. Refit the oil bath

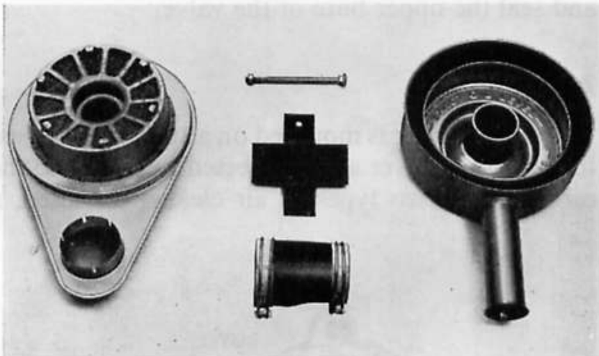


Fig. B.5. Exploded view of oil bath air cleaner and silencer

and refill with engine oil to the level indicated inside.

4. Reassemble the air cleaner but do not tighten the bolt nut securing the support at this stage.

5. When the air cleaner hose is reconnected to the carburetter, position the air intake tube 35° to the left of the rocker cover. Tighten the bolt nut securing the cleaner to the support.

Fuel Pump Filter

The pump is mounted on the crankcase and has a gauze filter screen inside the glass bowl.

Fig. B.6. Fuel pump with filter bowl and screen removed

To clean the filter screen, detach the main fuel pipe hose from the pump, and plug the hose to prevent fuel loss. Remove the bowl and lift off the screen (Fig. B.6). Wash the screen and bowl in paraffin and blow through the screen with compressed air. Clean out the pump chamber if necessary. Renew the bowl gasket.

Refit the screen and bowl, and tighten the bail screw firmly by hand. Check that the pipe hose is fully engaged with the pump pipe.

Throttle Control Linkage

To maintain free operation of the controls, lubricate the linkage joints with engine oil.

THROTTLE CONTROL LINKAGE

Adjustment

1. Unhook the throttle return spring and slacken the cross-shaft lever clamp bolt.

2. With the accelerator pedal depressed to ·30 in. from the toe panel, move the carburetter throttle lever to the fully open position and re-tighten the bolt.

3. Reconnect the return spring and check for full throttle opening.

CARBURETTER PUMP STROKE SETTING

In summer or warm climates the pump link is connected to the outer hole in the pump lever to provide a short pump stroke. For winter or cold climates the link must be located in the inner hole to give a long pump stroke (Fig. B.7).

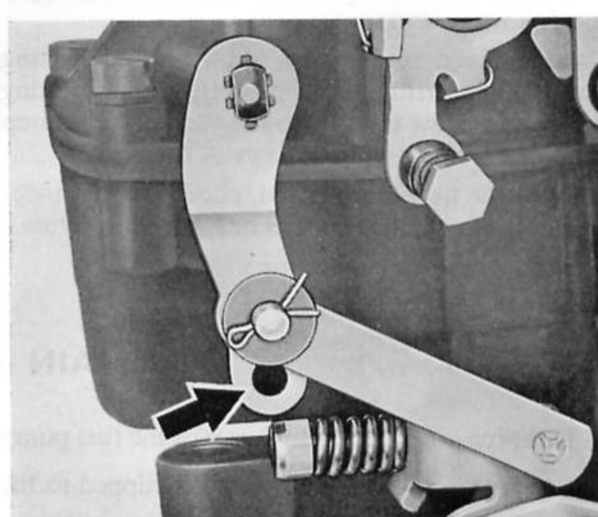


Fig. B.7. Carburetter pump stroke adjustment. As shown the linkage is connected for winter setting. For summer or warm climates, the link is connected to the outer hole indicated by the arrow

IDLING ADJUSTMENT

1. Check for air leaks in the intake system. With the throttle fully closed (unscrew stop screw) and the choke flap fully open, operate the starter for approximately 15 seconds and check the reading on a vacuum gauge connected to the intake manifold. The reading should be 15 to 17 in.

A low or erratic reading indicates leakage at either the carburetter joints, intake manifold or the ignition control suction pipe connections. The leak must be traced and rectified before proceeding with the idling adjustment.

2. With the engine warmed up, adjust the idling mixture volume control screw in combination with the throttle stop screw until the highest steady reading, approximately 18 to 20 in., is recorded. The idling speed is 550 to 600 r.p.m.

3. If adjustment does not provide satisfactory idling, an exhaust gas analyser should be used to check the air-fuel ratio, which should be approximately 12·5 to 1. Should the ratio be considerably less than this, inspect the carburetter for flooding.

JET SETTINGS FOR ALTITUDE

The standard jet settings included in the carburetter data are most suitable for altitudes up to 5000 ft. Alternative settings, recommended where the vehicle is consistently operating at higher altitudes, are specified on page B-15.

Before jet changes are made, be sure the acceleration pump is operating satisfactorily, pump stroke setting is correct, and that the ignition setting and valve clearances are correctly adjusted to eliminate any possibility of misfiring on acceleration, which would prevent correct estimation of results after making jet changes.

FUEL PUMP TESTS

1. The pump can be tested on the engine for fuel flow and delivery pressure with an AC Fuel Pump Analyser. The flow and pressure should be as specified.

2. Should an analyser not be available, apply the following test:

(*a*) Make a rough flow test by disconnecting the fuel pipe from the carburetter, and rotating the engine a few times with the starter. The pump should show an ample delivery of fuel.

(*b*) If the flow is restricted, check the fuel pipes and hoses for damage, leaks or loose connections. Ensure that the pump filter is clean and that the gasket of the filter bowl is sound. If the flow is still insufficient, remove the pump for examination.

(*c*) To check the pump after removal, work the rocker arm by hand. When a finger is placed over the inlet port, the pump should develop an appreciable suction after a few strokes, and maintain a vacuum for a few seconds. The pump should also hold pressure for a few seconds against a finger held over the outlet port when the rocker arm has been pressed towards the pump and then released.

MAIN FUEL PIPE

This pipe is connected by hoses to the fuel pump and the fuel tank outlet pipe, and is clipped to the chassis frame. Removal entails the removal of the body rear floor board for access to the pipe rear hose connection.

When reconnecting the pipe, the hoses must engage at least 1 in. of pipe at each end.

FUEL TANK

Removal

1. Drain the fuel tank and refit the drain plug. *Exercise the usual precautions when draining and storing the fuel.*

2. Remove the body rear floor board.

3. Remove the spare wheel.

4. Disconnect the three hoses from the tank pipes and the wire from the fuel gauge tank unit.

5. Remove the tank mounting bolts and withdraw the tank.

6. Remove the fuel gauge tank unit and gasket.

Installation

Note the following:

1. Ensure that the main fuel pipe is re-engaged with 1 in. of the tank outlet hose.

2. Fit the filler pipe hose clips with the screw heads towards the rear of the vehicle.

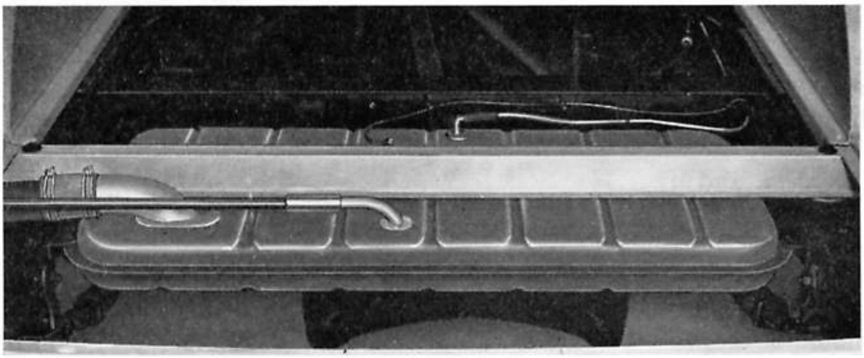


Fig. B.8. Fuel tank mounting

FUEL PUMP

Removal

1. Detach the main fuel pipe hose from the pump and plug the hose to prevent fuel leakage. Disconnect the carburetter feed pipe from the pump.

2. Remove the bolts attaching the pump to the crankcase, and lift away the pump complete with heat insulator and gaskets.

Disassembly

1. Remove the bowl, gasket and filter screen.

2. Mark across the flanges of the pump cover and body to ensure correct relationship when reassembling. Remove the cover.

3. Release the diaphragm assembly by depressing and turning it 90°.

4. Carefully prise out the staked valves. Remove the gaskets.

5. Do not remove the rocker arm unless excessive wear of the arm and associated components is evident.

Inspection and Reconditioning

1. Inspect the rocker arm and associated components for excessive wear. To renew, remove the rocker arm pin retainers, tap out the pin and remove the component parts.

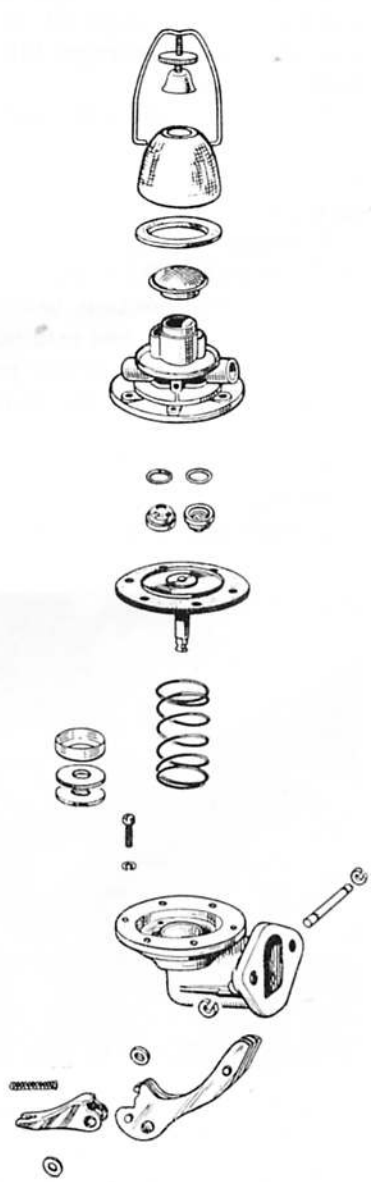


Fig. B.9. Exploded view of fuel pump

Install the rocker arm, the link with a spacing washer each side, and the arm spring. Fit the pin and secure it with new retainers.

2. To renew the diaphragm rod oil seal, proceed as follows:

(*a*) Scrape away the staked metal at four points securing the seal retainer in the body boss.

(*b*) Withdraw the retainer and seal, using a draw bolt and sleeve.

(*c*) Install two new oil seal washers, and a new retainer if damaged during removal. Stake the body boss at four points to secure the retainer.

Reassembly

1. Install the diaphragm assembly, depressing and rotating it through 90° to engage the link and also align the diaphragm tab with the lug of the body (Fig. B.10).

2. Clean the valve recesses of the body, and if necessary, remove any burrs left by the staking identations so that new valves can be correctly seated in the body.

3. Install new gaskets and valves. See valve positions in Fig. B.11. The valves should be tapped or pressed into position, using a sleeve with a bore diameter of ·56 in. and external diameter of ·68 in.

4. Stake the body in four positions around each valve as indicated in Fig. B.11.

5. Assemble the filter screen, gasket and bowl.

6. Assemble the pump cover as follows:

(*a*) Push the rocker arm towards the pump until the diaphragm is level with the body flange face.

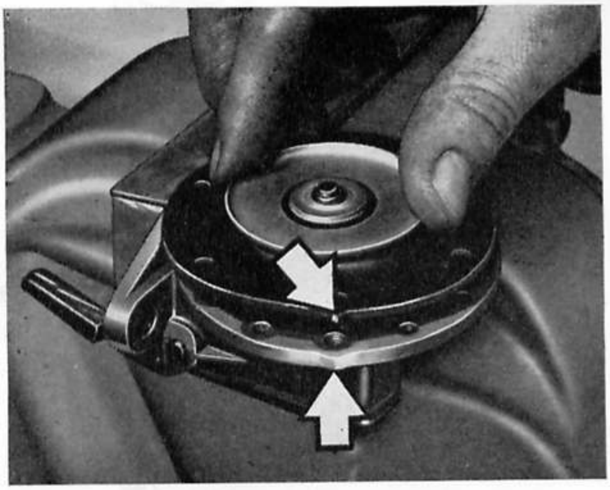


Fig. B.10. Assembling the diaphragm and rod assembly to the pump body. The assembly must be pressed down and turned through 90° to engage the rod with the rocker arm link and align the location tab on the diaphragm with the lug on the body, indicated by arrows

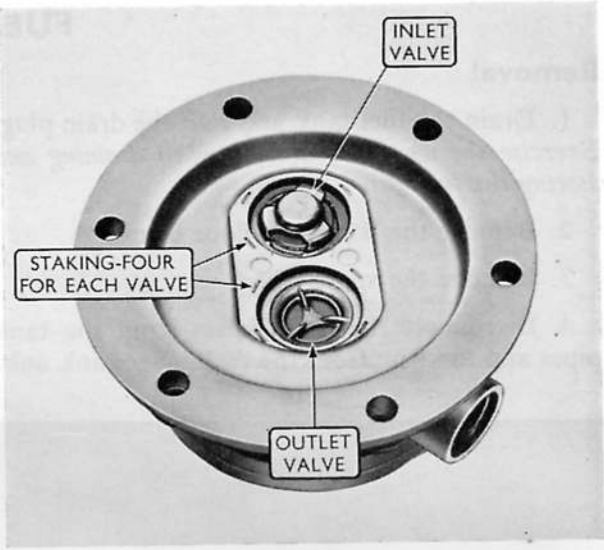


Fig. B.11. Installed position of valve assemblies

(*b*) Place the pump cover in position so that the marks, made across the flanges during disassembly, are in line.

(*c*) Fit the cover attaching screws then tighten until the heads just engage the lockwashers.

(*d*) Operate the rocker arm several times to align the diaphragm. Then, with the rocker arm held away from the pump so as to hold the diaphragm at the top of the stroke, tighten the cover screws diagonally and evenly.

Installation

Note the following:

1. Be sure the heat insulator and gaskets are assembled to the pump flange as shown in Fig B.12.

2. When connecting the hose to the fuel pump pipe, ensure that approximately 1 in. of the hose is engaged with the pipe.

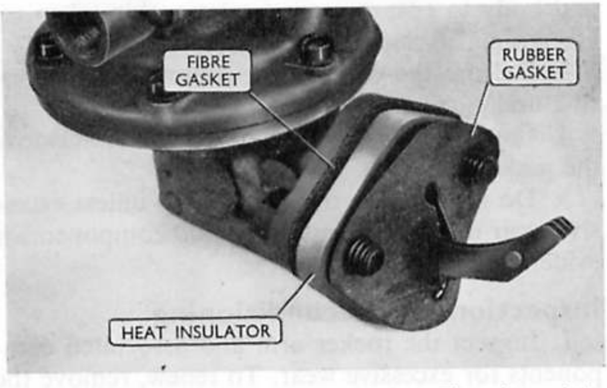


Fig. B.12. Fuel pump flange components. The edges of the rubber gasket slit must project away from the pump as shown

CARBURETTER

Removal

1. Remove the air cleaner.
2. Disconnect the pipes and controls from the carburetter.
3. Remove the carburetter, gaskets and heat insulator.

Disassembly

1. Disconnect the pump spindle lever from the link, and the rod from the choke control lever.
2. Remove the float chamber cover screws and lift away the cover and emulsion block assembly.
3. Remove the floats then the needle valve, seating and washer.

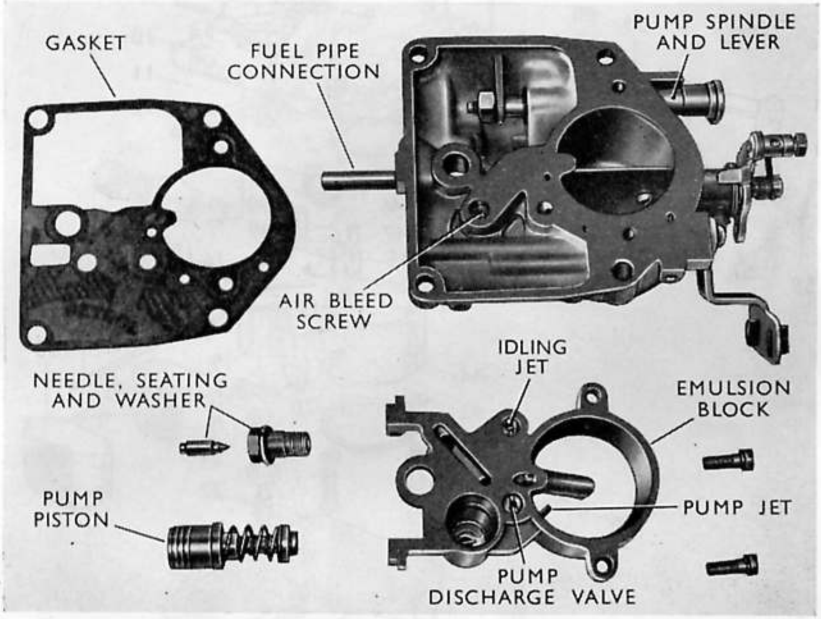


Fig. B.13. Emulsion block detached from the float chamber cover

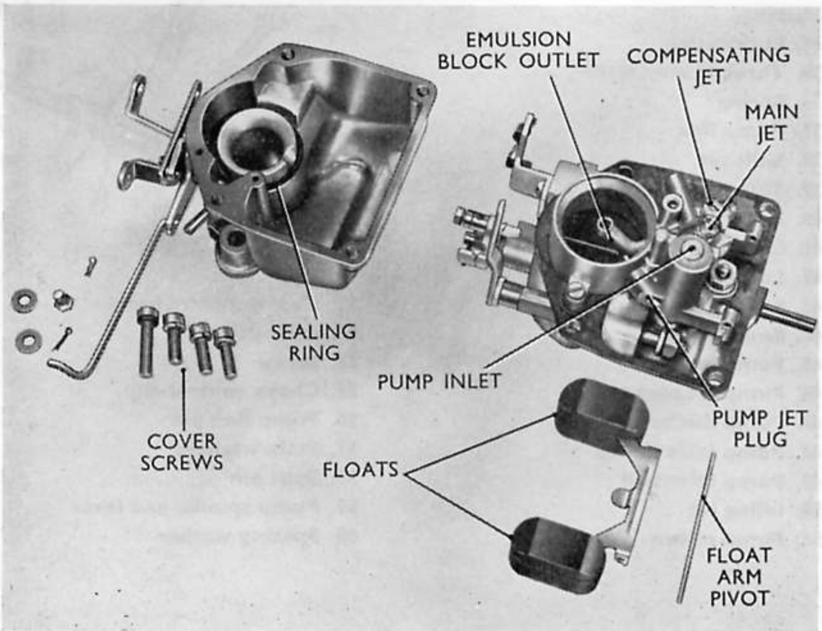
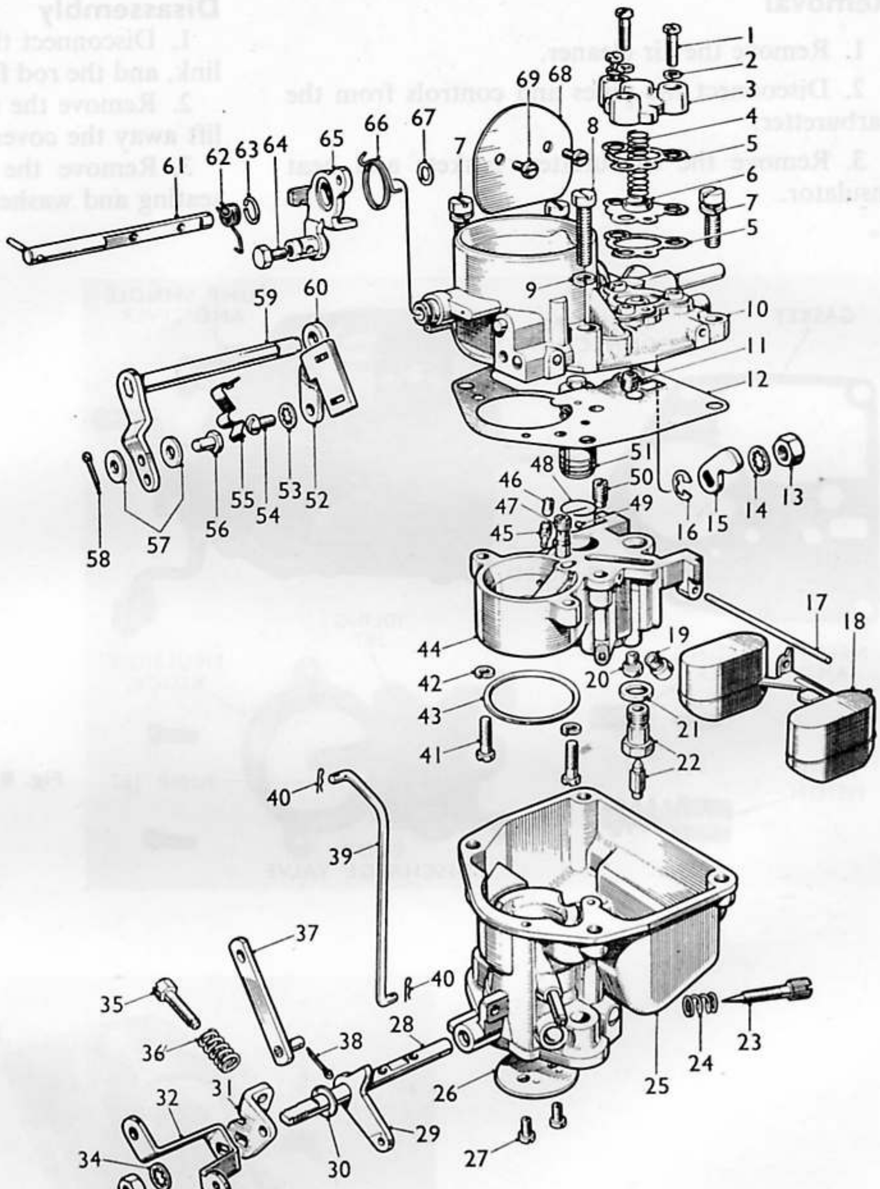


Fig. B.14. Float chamber cover removed from carburetter body, and floats detached

Fig. B.15. Exploded view of carburetter



1. Cover screw
2. Lockwasher
3. Diaphragm cover
4. Economy valve diaphragm spring
5. Gasket
6. Diaphragm
7. and 8. Float chamber cover screws—short and long
9. Lockwasher
10. Float chamber cover
11. Air bleed screw
12. Gasket
13. Pump lever nut
14. Lockwasher
15. Pump lever—internal
16. Retaining ring
17. Float arm pivot
18. Float
19. Main jet
20. Compensating jet
21. Needle seating washer
22. Needle and seating
23. Volume control screw
24. Spring
25. Main body
26. Throttle flap
27. Screws
28. Throttle spindle
29. Floating lever
30. Plain washer
31. Throttle stop
32. Throttle lever
33. Nut
34. Lockwasher
35. Throttle stop screw
36. Spring
37. Pump link
38. Split pin
39. Throttle to choke rod
40. Link pins
41. Emulsion block screw
42. Lockwasher
43. Sealing ring
44. Emulsion block
45. Pump jet
46. Pump jet plug
47. Pump discharge valve
48. Pump inlet circlip
49. Pump inlet ball
50. Idling jet
51. Pump piston
52. Choke control bracket
53. Lockwasher
54. Screw
55. Choke control clip
56. Pump link pin
57. Plain washers
58. Split pin
59. Pump spindle and lever
60. Spacing washer
61. Choke spindle and pin
62. Choke spindle spring
63. Circlip
64. Choke cable screw
65. Choke control lever
66. Choke lever spring
67. Choke spindle washer
68. Choke flap
69. Choke flap screw

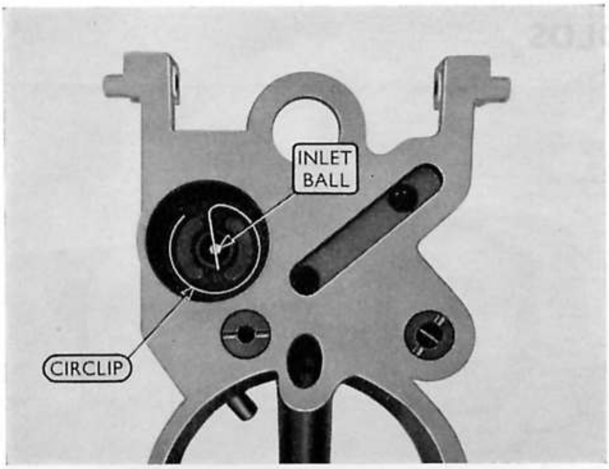


Fig. B.16. Pump piston removed from emulsion block to show location of pump inlet ball and circlip

Fig. B.17. Sealing ring in position around the choke tube extension

4. Remove the screws securing the emulsion block. Lift off the block, taking care of the pump piston which will drop out as the block is removed.

5. Remove the jets and pump discharge valve.

6. Remove the economy device cover, spring, diaphragm and gaskets.

Inspection

1. Check the jet sizes against the specifications.

2. Renew the economy device diaphragm if the condition is doubtful.

Reassembly

Note the following:

1. Ensure that the circlip is installed in the bottom of the pump cylinder to retain the inlet ball (Fig. B.16).

2. When the pump jet is installed be sure the jet plug is refitted.

3. Where necessary, renew the sealing ring around the choke tube (Fig. B.17). It must fit closely around the tube. A defective seal will cause neat fuel to leak from the float chamber into the choke tube.

4. Make sure the pump piston is in position and the pump lever is correctly located before re-assembling the emulsion block. Use a new gasket.

5. Check the float position. With the float chamber cover inverted so that the needle valve is closed, measure the distance from the gasket to the top of each float at the position shown in Fig. B.18.

The float position can be altered by bending carefully the float arm tag which contacts the needle valve.

6. Reconnect the pump link to the appropriate hole in the pump spindle lever (page B-5).

Installation

Note the following:

1. Assemble a gasket each side of the heat insulator. Avoid excessive force when tightening the carburetter flange nuts.

2. Check the operation of the choke flap after reconnecting the control.

3. Adjust the idling setting (page B-6).

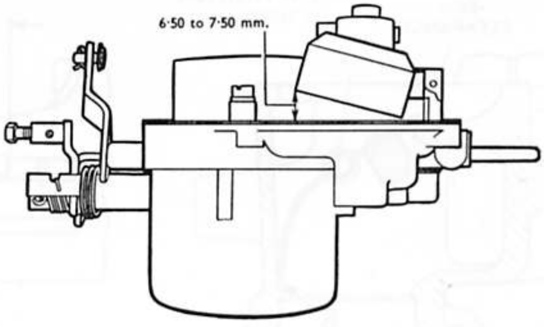


Fig. B.18. Location for checking the carburetter float position. The dimension should be within the limits shown

MANIFOLDS

Removal

1. Remove the engine cowl centre and left-hand side panels.

2. Remove the air cleaner.

3. Disconnect the pipes and controls from the carburetter.

4. Remove the exhaust pipe flange attaching nuts and disconnect the pipe from the manifold.

5. Remove the bolts and washers securing the manifolds, and the throttle spring anchor bracket. Lift away the assembly complete with carburetter. Remove the intake manifold collars, gaskets and the pipe packing.

Disassembly

1. Remove the carburetter, heat insulator and gaskets from the intake manifold.

2. Remove the nuts securing the intake and exhaust manifolds together, separate the manifolds and detach the gasket.

Inspection and Reconditioning

1. Temporarily assemble the manifolds together and, with the exhaust flanges in contact with the surface plate, check the clearance between the intake manifold attachment faces and the surface plate (Fig. B.19). If the clearance is in excess of the specified limit, check for bent intake-to-exhaust manifold studs. If the studs are satisfactory, the stud holes in the intake manifold may be opened out slightly to allow repositioning of the manifold.

2. Check the exhaust manifold valve for free movement, and the shaft for excessive slackness in the bushes. Renew the thermostat if its condition is doubtful.

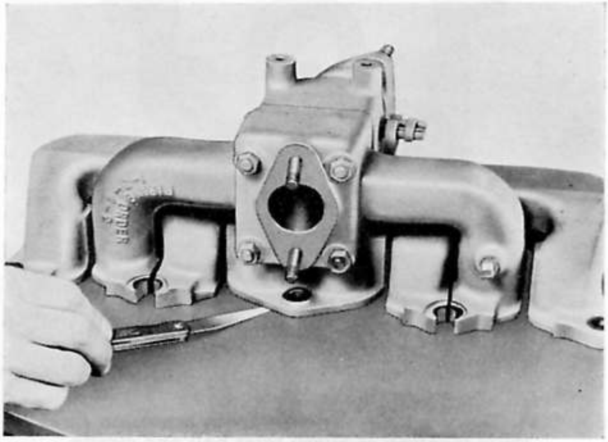


Fig. B.19. Checking the intake manifold flanges for correct relationship with those of the exhaust manifold

3. To renew the manifold valve, proceed as follows:

(*a*) Remove the spring stop and thermostat.

(*b*) Position the valve as shown in Fig. B.20 and scribe on the manifold a line projected from the centre line of the slot in the end of the valve shaft. This line will be a location during the installation of new components.

(*c*) Free the valve from the welds, tap out the shaft and lift away the valve.

(*d*) Remove the bushes, taking care not to damage the bores in the manifold.

(*e*) Install the new bushes flush with the outer ends of the manifold bores. Ream the bushes to the diameter specified to provide adequate clearance under operating conditions.

(*f*) Locate the shaft shoulder ·18 in. from the manifold, with the valve positioned as shown at 'A' in Fig. B.20.

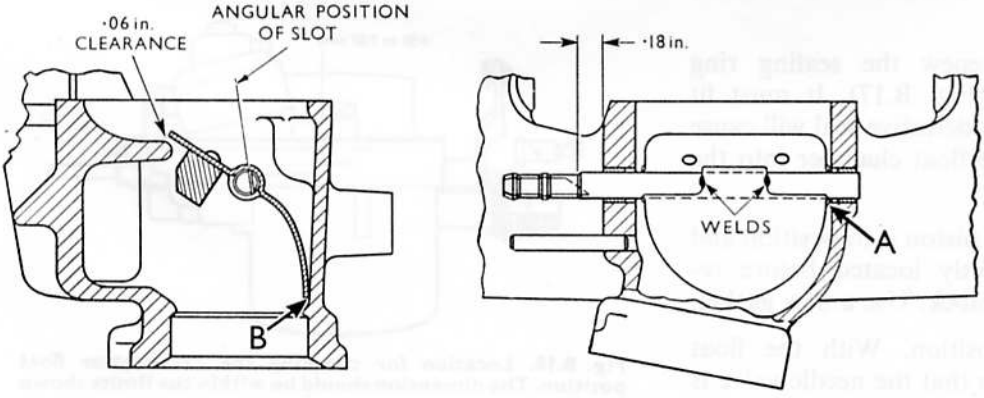


Fig. B.20. Exhaust manifold valve installation details

(*g*) Line up the shaft slot—short side uppermost—with the mark scribed on the manifold during disassembly, and position the bottom of the valve against the manifold as at 'B'. In this position the maximum clearance between the top of the valve and the manifold should be as shown.

If the valve is installed in a new manifold the slot should be positioned a few degrees from the vertical as indicated.

(*h*) Maintaining the foregoing assembly locations, arc-weld the valve to the shaft at the points indicated.

(*i*) Where necessary, set the free end of the stop so that it contacts the spindle just before the valve has reached its fully open position.

Reassembly

Note the following:

1. Use a new gasket when assembling the intake and exhaust manifolds together; the narrow flange of the gasket should contact the intake manifold. The nuts should be fully tightened and then slackened just sufficiently to allow the manifolds to take up their correct relationship with one another when installed on the cylinder head.

2. Fit a new gasket on each side of the carburetter heat insulator. Avoid excessive force when tightening the carburetter flange nuts.

Installation

Note the following:

1. Be sure the collars are positioned in the cylinder head intake ports, and that a new gasket is located on each collar.

2. When installing the manifolds, check that the intake manifold is engaged with all the collars. The bolts attaching the manifolds to the head must be tightened evenly, after which the intake-to-exhaust manifold nuts must be retightened.

3. Check the tightness of the manifold bolts after the engine has warmed up.

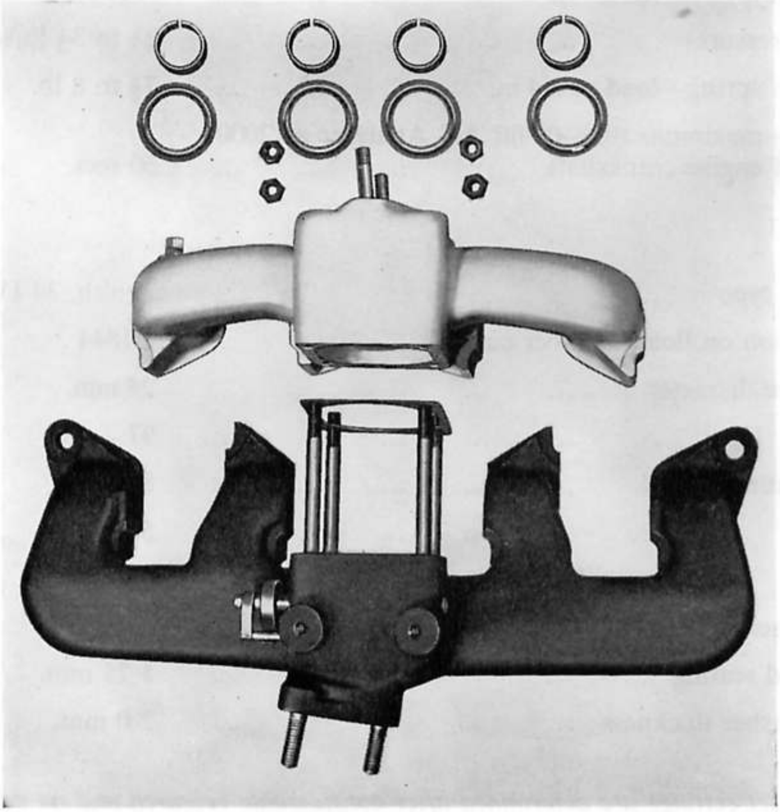


Fig. B.21. Exploded view of intake and exhaust manifolds

SECTION C—COOLING
(Gasoline Engine)

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Have you read the General Notes on page vii ?

DESCRIPTION

The cooling system is pressurized, incorporating a water pump, fan, thermostat and film type radiator. The system has two water drain taps.

Water Pump

The pump (Fig. C.1), is a belt driven centrifugal type. The pump body is bolted to the cylinder head, and has a rotor chamber communicating with a water distributor tube located longitudinally in the head. This tube directs cooled water to the areas of the exhaust valve seats and spark plug bosses. A shaft and bearing assembly, secured by a retainer, carries a self-adjusting seal and a rotor at the rear, and a pulley flange at the front.

Thermostat

A bellows type unit is used on vehicles without a heater; where a heater is installed a capsule type unit is required. A by-pass drilling connecting the thermostat housing to the pump rotor chamber, relieves the thermostat valve of coolant pressure when closed during the warming-up period.

Radiator

The radiator has a copper film type cooling element and is attached to a support frame located behind the grille. This support frame is rubber-mounted on the chassis frame front crossmember. A detachable cowling is provided for the four-bladed fan.

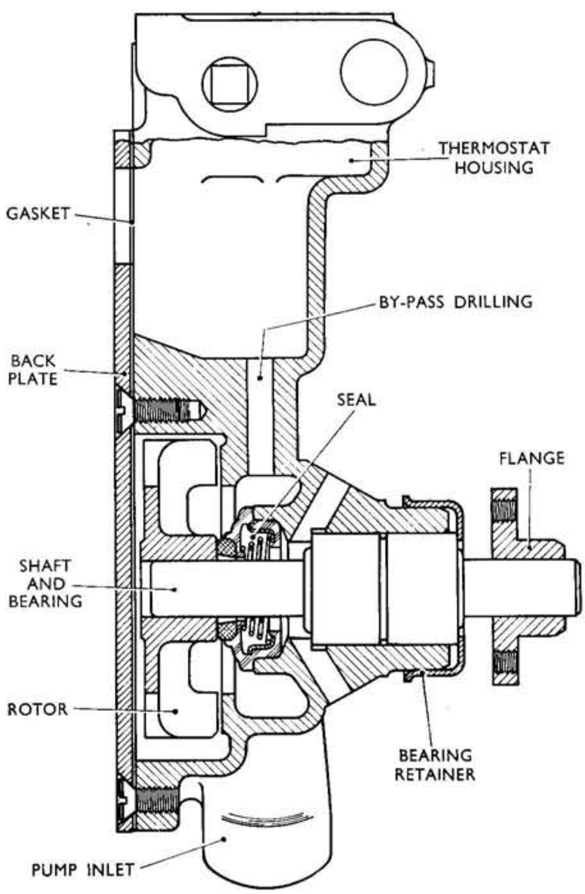


Fig. C.1. Sectioned view of water pump

A pressure vent type filler cap (Fig. C.2), creates a pressurized cooling system and, by raising the boiling point of the coolant, gives additional protection against overheating. The pressure is limited by the pressure valve which allows steam and water to escape through the overflow pipe whenever the pressure exceeds specified limits. Excess loss of coolant through the overflow pipe is prevented by a baffle in the radiator top tank. Any depression within the system as the engine cools down is relieved by the vacuum valve which admits air from the overflow pipe.

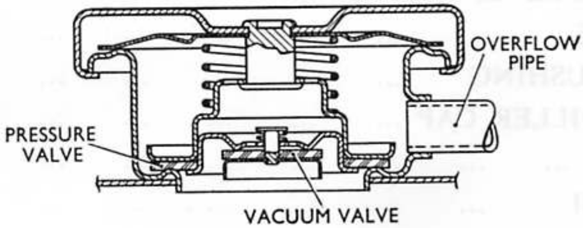


Fig. C.2. Sectioned view of radiator filler cap

DRAINING AND REFILLING THE COOLING SYSTEM

Draining

The cooling system incorporates two drain taps; one in the radiator bottom tank and the other in the cylinder block with a handle accessible between the generator and fan pulleys (Fig. C.3). The radiator tap does not drain the cylinder block.

To prevent the formation of an air lock it is essential that the radiator filler cap is removed, and where necessary, the control lever of the heater moved to the 'MAX' position prior to draining. To completely drain the cylinder block and radiator, the vehicle must be on level ground when draining.

Refilling

Close both drain taps and refill the cooling system, using warm water for a warm engine. It is preferable to use hard water from public supplies, as with this, corrosion is less likely to occur than with soft water. *Rain water should not be used.* The coolant level should be one inch below the bottom of the radiator filler neck.

WARNING: *Where a heater is fitted, ethylene glycol type anti-freeze solution must be used during the winter months or in cold climates, as water in the heater is not completely drained with the cooling system.*

Run the engine for a few minutes with the heater control lever on 'MAX' then top-up the radiator coolant level.

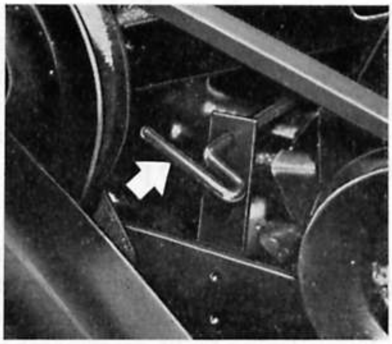


Fig. C.3. Radiator and cylinder block drain taps

CORROSION PREVENTATIVE

To prevent corrosion of the interior of the cooling system, and consequent silting up of the radiator element, a quantity of soluble oil type corrosion preventative is added to the cooling system before the vehicle leaves the factory. This forms an emulsion with the water and deposits an anti-corrosive film. Addition of Vauxhall Corrosion Preventative should be made whenever the cooling system is refilled after draining, to maintain the system in a clean condition. The quantity to be added to the cooling system is $\frac{1}{8}$ pint.

IMPORTANT: *Vauxhall Corrosion Preventative can safely be used with Vauxhall (ethylene glycol) Anti-freeze. It must not be used with other types of anti-freeze having an ethylene glycol base, because they may not be specially treated to mix with the Vauxhall Corrosion Preventative and there may be a danger of precipitation of a soapy sludge and possible trouble due to foaming.*

ANTI-FREEZE

It is important that 'permanent' (ethylene glycol) type of anti-freeze is used in the cooling system. The engine is designed to operate at a relatively high temperature which will cause an alcohol type of anti-freeze to evaporate rapidly.

The process of protecting the cooling system against frost by adding anti-freeze is well known. What is not so generally known is the degree of frost protection afforded by a specific quantity of anti-freeze (page C-10).

When adding anti-freeze it must be appreciated that the quantity will depend upon the degree of low temperature protection required. The various degrees of protection are classified under the following three headings. In addition, the specified data gives the lowest approximate temperature at which each of the various degrees of protection are provided by the different quantities and percentage solutions of anti-freeze.

Complete Protection Temperature

This is the lowest temperature at which the entire cooling system will remain free from ice crystals so that the vehicle can be driven immediately from cold without risk of freezing or boiling.

Safe Limit Temperature

This is the lowest temperature at which the coolant, containing ice crystals, will remain mushy. With this condition the engine can be safely rotated but the vehicle must not be driven immediately from cold. To prevent any risk of boiling, the engine must be run at a fast **idling** speed for at least five minutes with the radiator covered before the vehicle is driven.

When the temperature is below the 'Safe limit' it will be necessary to raise the temperature of the coolant before the engine can be safely rotated. The method to adopt in raising the coolant temperature will depend on the facilities available, but where possible it is preferable to allow the coolant to thaw naturally by parking the vehicle in a warm atmosphere.

Lower Protection Limit Temperature

This is the lowest temperature which can be withstood without serious risk of cracked castings.

Preliminary Operations for Anti-Freeze

Before adding anti-freeze, the cooling system should be reverse flushed.

Remember to use warm water for flushing or filling the cooling system of a warm engine.

After reverse flushing and before filling with anti-freeze mixture, inspect the condition of the water hoses, and check the hose connections for tightness.

Adding the Anti-Freeze

Mix the required quantity of anti-freeze (page C-10) with an equal quantity of clean warm water, pour the mixture into the cooling system and top up with water. Hard water is preferable, as corrosion is less likely to occur with hard water than with soft water. *Rain water should not be used.* Overfilling the radiator will cause loss of anti-freeze mixture through the overflow. To avoid wastage, water should be added to bring the level to one inch below the bottom of the filler neck.

NOTE: *When using anti-freeze with Corrosion Preventative observe the 'Important Note' under the heading 'Corrosion Preventative'.*

To prevent dilution and so maintain frost protection in service, it is important that only anti-freeze mixture of the correct strength is used when topping up.

The strength of the anti-freeze solution in the cooling system can be established by means of the Vauxhall Anti-Freeze Tester. The tester records the strength of the solution on a percentage scale and also provides temperature compensation on a thermometer correction scale.

When warm weather returns, the anti-freeze mixture should be drained and the process of reverse flushing repeated. Add corrosion preventative to the water when refilling.

REVERSE FLUSHING

The advantage of reverse flushing is that the cooling system is flushed in the direction contrary to that of normal circulation, and sludge or deposits in the radiator can be forced out more readily. Similarly, by reverse flushing the cylinder block and head it is possible to remove sludge and deposits from the base of the water jackets.

To obtain the best results from reverse flushing, it is necessary to introduce water and compressed air into the cooling system with the aid of a flushing gun (Fig. C.4). *Where possible use warm water for flushing a warm engine. Alternatively, ensure that the engine has cooled before using cold water.*

1. Drain the cooling system (page C-2). Connect the appropriate hoses of the flushing gun to water and air supplies.

2. Connect the flushing gun and discharge hose to the radiator as shown in Fig. C.4.

3. Turn on the water and, when the radiator is full, inject air in very short bursts. Keep the water running to enable the radiator to fill between the bursts of air. Flush in this manner until the water from the discharge hose runs clean. *Inject air very carefully as there is danger of building up excessive pressure if the radiator element is badly clogged.* If it is suspected that the radiator is partially blocked, it should be flow tested (page C-8).

4. Remove the thermostat and refit the water outlet and hose. Where necessary, disconnect the heater hoses from the engine and plug the connections. Connect the flushing gun and discharge hose to the engine (Fig. C.4), and proceed as for the radiator.

5. Upon completion, refit the thermostat. Refit the hoses, and where applicable, remove the plugs and reconnect the heater hoses.

6. Refill the cooling system.

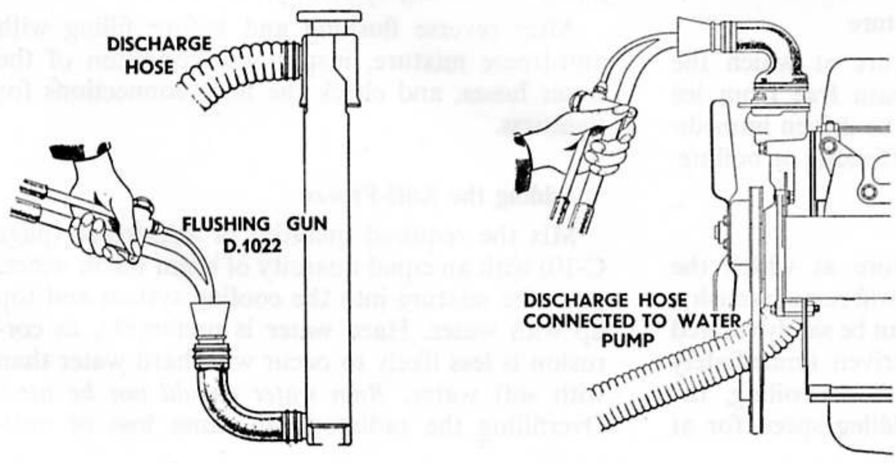


Fig. C.4. Diagrammatic sketches showing reverse flushing of the radiator and the cylinder block and head

RADIATOR FILLER CAP

Pressure Test

When investigating cooling system complaints, or reconditioning a radiator, a test must be made to ensure that the pressurized cooling system is operating within the specified limits.

This test involves a check on the operation of the filler cap valves, and a pressure check on the valve seating face of the radiator filler neck (Fig. C.5).

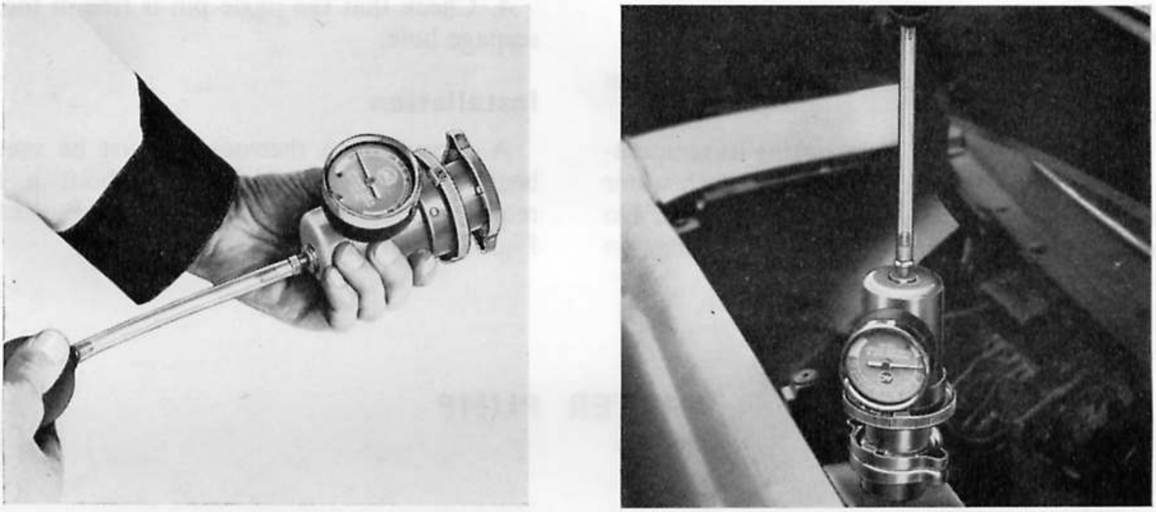


Fig. C.5. Pressure testing the radiator filler cap and the seating in the radiator filler neck

FAN BELT

Adjustment

1. Slacken the generator pivot bolts, also the bolts securing the slotted brace (Fig. C.6).

2. Pivot the generator in the required direction to obtain the specified belt tension, checked at a point midway between fan and generator pulleys.

The adjustment requires care. A belt too tight will overload the generator and water pump bearings. A slack belt will slip and wear, and also cause the engine to overheat.

3. When belt tension is correct, tighten all bolts.

Removal and Installation

Slacken the generator pivot bolts, also the brace bolts, and move generator towards engine as far as possible before removing the belt.

Adjust the belt tension as under previous heading. Remember to tighten the pivot bolts and the brace bolts. When a new belt is installed, recheck the tension after 1000 miles of service.

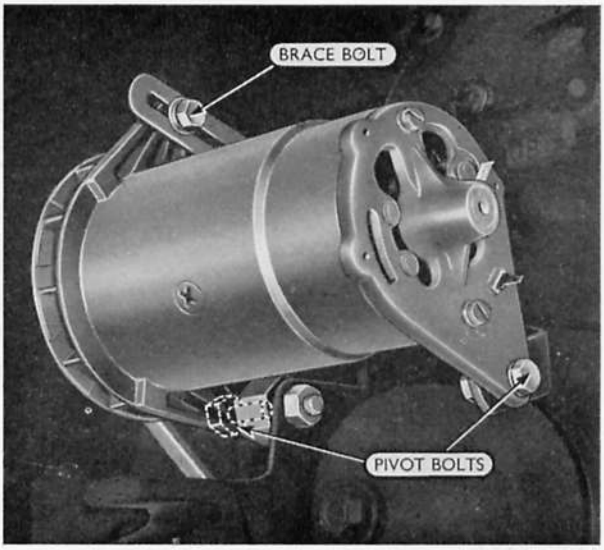


Fig. C.6. Generator mounting. The pivot bolts and brace bolts must be slackened when adjusting the fan belt tension

THERMOSTAT

Removal

1. Drain the cooling system (page C-2).

2. Remove the water outlet and gasket, and withdraw the thermostat.

Inspection

1. Suspend the thermostat and a thermometer in a container of water.

2. Gradually heat the water, noting its temperature. Agitate the water to ensure that both water and thermostat are at a uniform temperature. Do not allow the thermometer or thermostat to rest on the bottom of the container, as this will result in a false temperature reading.

3. Check that the thermostat valve commences to open, and is fully open at the specified temperatures. The valve lift should be as specified.

4. Check that the jiggle pin is free in the valve seepage hole.

Installation

A capsule type thermostat must be used if a heater is installed. Vehicles without a heater require one of the bellows type thermostats (see Fig. C.13 on page C-11).

WATER PUMP

Removal

1. Drain the cooling system (page C-2).

2. Disconnect the radiator hoses, also the heater hoses where installed, from the pump.

3. Disconnect the wire from the water temperature gauge engine unit, and unclip the fuel pipe from the thermostat housing flange.

4. Remove the radiator cowling.

5. Remove the fan belt.

6. Remove the four securing bolts and lock-washers, and lift away the pump and fan assembly also the radiator cowling.

Disassembly

1. Remove the fan, distance piece and pulley.

2. Remove the water outlet and gasket, and lift out the thermostat.

3. Remove the pump back plate and gasket.

4. Withdraw the rotor, using a three-legged drag (Fig. C.7).

5. Withdraw and discard the seal.

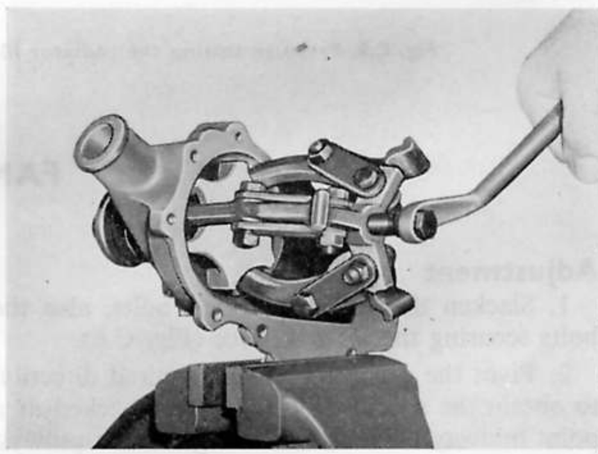


Fig. C.7. Use a three-legged drag to remove the rotor

6. Inspect the condition of the shaft and bearing. If renewal is necessary, tap the shaft and bearing, complete with flange, out of the pump body. This will also remove the bearing retainer.

Reassembly

1. Using a sleeve with an external diameter equal to that of the bearing, press the shaft and bearing assembly, long end of shaft first, into the pump body until the bearing contacts the shoulder at the end of the body bore.

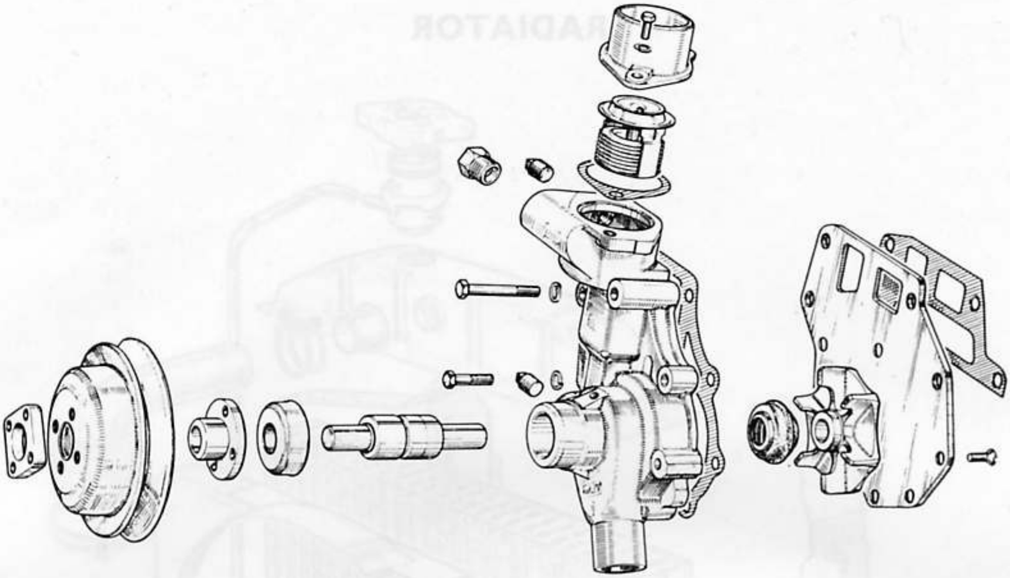


Fig. C.8. Exploded view of water pump

2. Locate a new bearing retainer squarely on the end of the pump body. Press on the retainer, using a sleeve as shown in Fig. C.9.

3. With the rear end of the shaft supported, press on a new flange to the position indicated in Fig. C.10.

4. Smear recommended grease on the seal rear face and around the body bore, and install the seal.

5. Press on the rotor to the position shown in Fig. C.10.

6. Using a new gasket smeared each side with sealing compound, refit the back plate. Check that the screws do not project above the plate.

7. Install the thermostat and water outlet. Use a capsule type thermostat where a heater is installed; a vehicle without a heater requires a bellows type thermostat (see Fig. C.13 on page C-11).

8. Reassemble the pulley, distance piece and fan.

Installation

Note the following:

1. Smear sealing compound each side of a new gasket.

2. Adjust the fan belt tension (page C-5).

3. Check hose connections for leaks.

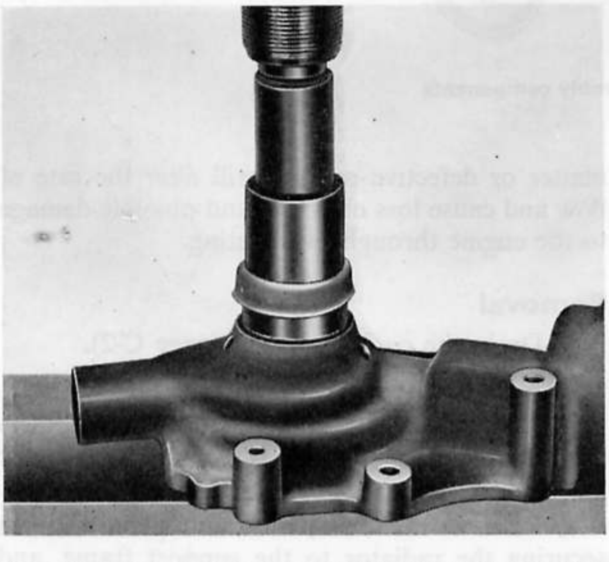


Fig. C.9. Pressing on a bearing retainer, using a sleeve of similar outside diameter

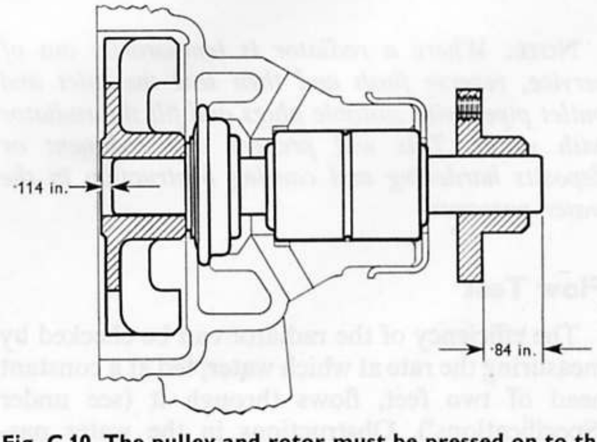


Fig. C.10. The pulley and rotor must be pressed on to the pump shaft to the locations shown

RADIATOR

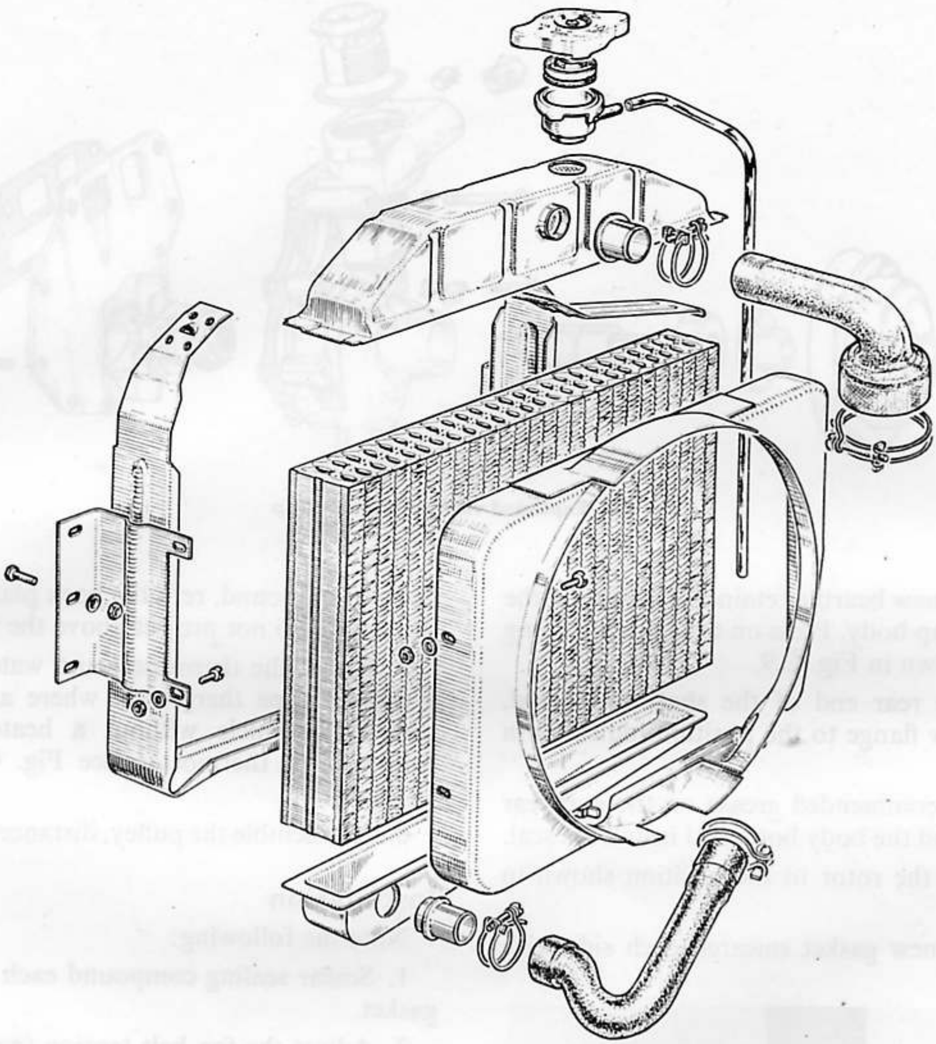


Fig. C.11. Radiator assembly components

NOTE: *Where a radiator is temporarily out of service, reverse flush and then seal the inlet and outlet pipes with suitable plugs and fill the radiator with water. This will prevent any sediment or deposits hardening and causing obstruction in the water passages.*

Flow Test

The efficiency of the radiator can be checked by measuring the rate at which water, fed at a constant head of two feet, flows through it (see under 'Specifications'). Obstructions in the water passages of the element, due to accumulated foreign matter or defective repairs, will alter the rate of flow and cause loss of power and possible damage to the engine through overheating.

Removal

1. Drain the cooling system (page C-2).
2. Disconnect the hoses from the radiator.
3. Remove the screws, nuts and plain washers securing the fan cowl, and rest the cowl over the fan.
4. Remove the bolts, nuts and plain washers securing the radiator to the support frame, and lift out the radiator.

Inspection and Reconditioning

1. Check the operation of the filler cap and the seal face of the radiator filler neck (page C-5).

2. Flow test the radiator.

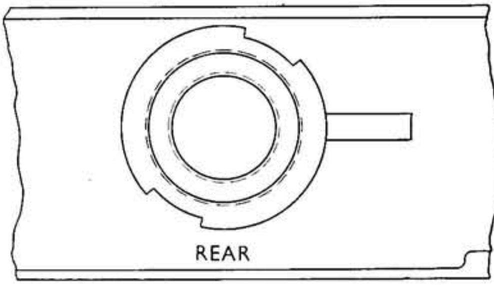


Fig. C.12. Radiator filler neck location

3. Minor repairs to the cooling element or tanks should be carried out as follows:

(*a*) Seal the filler neck and the inlet and outlet pipes with plugs.

(*b*) Connect the air supply to the overflow pipe adaptor, and completely submerge the radiator in a tank.

(*c*) Gradually increase the air pressure in the radiator to within the specified limits. *Do not exceed the maximum*. Check carefully for rising air bubbles from the radiator and trace the source of the leakage.

(*d*) Seal the leak with solder and repeat the test.

4. Where major repairs are necessary, note the following:

(*a*) The rear bottom edge of the top tank should project ·26 in. beyond the rear face of the element.

(*b*) When a new filler neck assembly is installed, it must be located as shown in Fig. C.12.

(*c*) If the radiator is to be placed in stock, the necessary anti-corrosion precautions must be taken, using Shell Ensis 254 fluid.

Installation

Note the following:

1. Check that the radiator bottom hose has clearance with the lower nut of the engine front mounting.

2. To avoid wastage of anti-freeze mixture during the winter months, the coolant level should not be less than one inch below the bottom of the filler neck. Overfilling will cause loss through the overflow.

3. Check for leaks from the hose connections.

SPECIFICATIONS

GENERAL DATA

Cooling System Capacity—Nominal

Without heater	$11\frac{1}{4}$ Imp. pints (6·7 U.S. quarts)
With single heater	$12\frac{3}{4}$ Imp. pints (7·6 U.S. quarts)
With dual heaters	$14\frac{1}{4}$ Imp. pints (8·5 U.S. quarts)

Radiator Flow Test	5 Imp. gal. (6·0 U.S. gal.) in 21 secs. maximum, with a constant 2 ft. head of water through a pipe of 1·50 in. bore.
Radiator Test Pressure	7 to 10 lb/sq. in.

ANTI-FREEZE

The following table gives the quantity of Vauxhall (ethylene glycol) Anti-Freeze required for protecting the cooling system within the temperature quoted.

ANTI-FREEZE			PROTECTION TEMPERATURE (APPROX.)					
% SOLUTION (VOLUME)	QUANTITY		*COMPLETE PROTECTION		*SAFE LIMIT		*LOWER PROTECTION LIMIT	
	IMP. PINTS	U.S. PINTS	°C.	°F.	°C.	°F.	°C.	°F.
25	†3	†3½	–11	12	–18	0	–28	–18
30	†3½	†4¼	–14	6	–23	–10	—	—
35	‡4	‡5	–19	–2	—	—	—	—
40	‡4½	‡5½	–23	–10	—	—	—	—
45	‡5	‡6	–29	–20	—	—	—	—
50	‡5¾	‡7	–35	–31	—	—	—	—

* *For definitions see page C-3.*
† *Add ¼ pint for single heater, ½ pint for dual heaters.*
‡ *Add ½ pint for single heater, 1 pint for dual heaters.*

FAN BELT

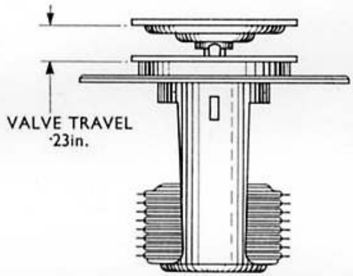
Belt Tension ... ... Belt should depress ·50 in. midway between fan and generator pulleys, under load of 8 to 10 lb.

RADIATOR FILLER CAP

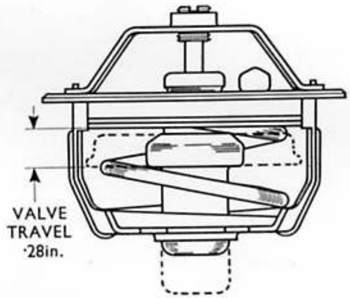
Pressure Valve Opening Pressure... ... ... 3¼ to 4½ lb/sq. in.

THERMOSTAT

	STANDARD BELLOWS TYPE	LOW TEMPERATURE OPENING BELLOWS TYPE	CAPSULE TYPE (FOR HEATER)
Opening Temperature	77° to 83°C. (170° to 182°F.)	69° to 76°C. (156° to 168°F.)	80° to 84°C. (177° to 188°F.)
Fully Open Temperature	93°C. (199°F.)	85°C. (185°F.)	98°C. (208°F.)
Valve Travel—Minimum	·23 in.	·23 in.	·28 in.



BELLOWS TYPE



CAPSULE TYPE

Fig. C.13. Cooling system thermostat identification. The capsule type is installed where a heater is fitted

WATER PUMP

Rotor and Pulley Flange

Fit on shaft:	
·0015 to ·0030 in. interference	Shaft dia. ·6262 to ·6267 in. Rotor and flange bore ·6237 to ·6247 in.
Assembled positions on shaft	See Fig. C.10 page C-7.

SECTION D—DIESEL ENGINE (including Lubrication, Fuel and Exhaust, and Cooling)

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See also reference to Perkins Manual on page D - 2

Have you read the General Notes on page vii ?

DESCRIPTION

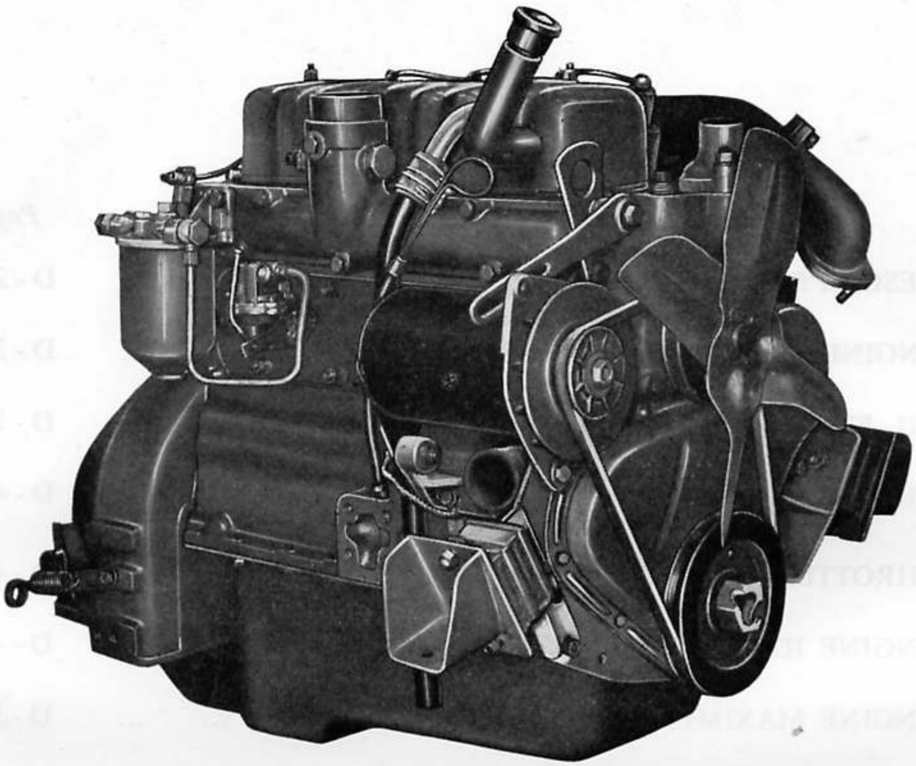


Fig. D.1. Diesel engine assembly

General service information on the Perkins Series 4·99 diesel engine is covered in Publication No. 7292 available direct from the Service Department, Perkins Engines Limited, Peterborough, Northants. The information given in this section covers the differences in the engine assembly in its application to the Bedford CA.

Engine

The engine front mountings (see Fig. D.3), are of the shear type. The mountings are attached to brackets bolted to the crankcase front plate, and to supports bolted to brackets on the chassis frame sidemembers. The chassis frame brackets are the same as those for the gasoline-engined model. The rear mounting is as shown on page A-12.

A full flow type oil filter with detachable element is bolted to a filter head attachment on the crankcase and a drain plug is provided in the filter head. An oil pressure switch is screwed into the main oil gallery and wired in circuit with an oil warning lamp.

Fuel and Exhaust

An oil bath type air cleaner is used and is supported by a bracket attached to the cylinder head.

The fuel tank is similar to the tank of the gasoline-engined vehicle but is provided with a connection for a fuel return pipe.

A primary fuel filter (Fig. D.7), is mounted on a bracket bolted to the chassis frame right-hand side-member and connected by pipe lines to the fuel tank and feed pump inlet port.

The fuel feed pump does not incorporate a filter screen and no periodical attention is required.

The exhaust system, except for the front pipe is similar to that of the gasoline-engined vehicle. The exhaust manifold outlet is at the front and is provided with an elbow secured by studs and nuts and sealed with a flange type gasket. The joint between the elbow and the front exhaust pipe is sealed with a packing.

Cooling

Different hoses, and different locations for the connections to the radiator tanks, are used to suit the diesel engine. The top tank does not incorporate a baffle, nor is there a fan cowling. A drain tap is provided in the radiator bottom tank, and at the right-hand rear of the cylinder block (Fig. D.2).

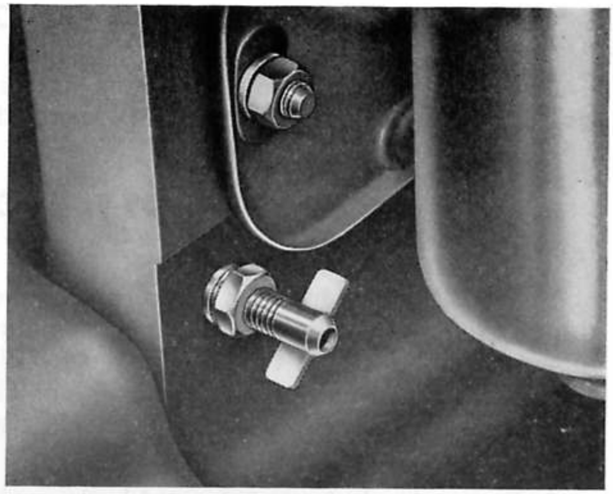


Fig. D.2. Cylinder block drain tap

ENGINE FRONT MOUNTINGS

Renewal

Either front mounting can be renewed provided the front of the engine is supported.

When installing, secure the mountings to the engine and chassis frame brackets before removing the support. Check the engine bracket bolts for tightness. Reconnect the radiator hose support clip to the right-hand mounting engine bracket.

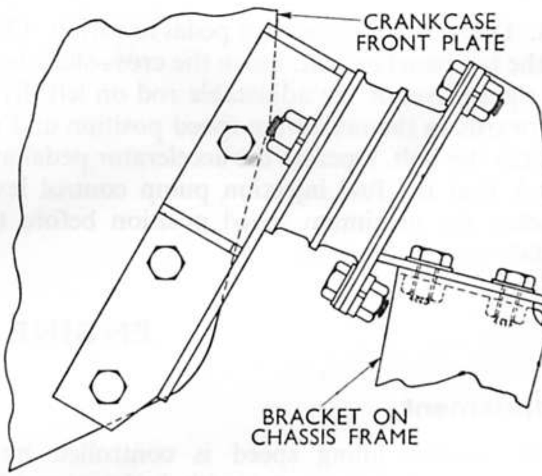


Fig. D.3. Left-hand front engine mounting. The right-hand mounting is similar

OIL FILTER

Element Renewal

Access to the full flow type filter is from beneath the left-hand front wing, after removing the cover plate from the splashguard panel. Before withdrawing the casing for element renewal, drain the filter by removing the drain plug (Fig. D.4).

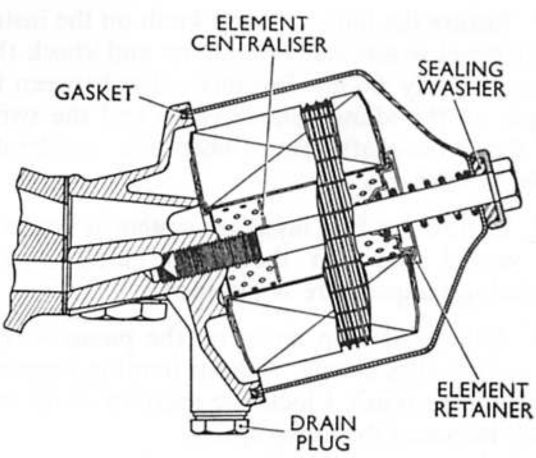


Fig. D.4. Sectioned view of oil filter

OIL PAN

Removal of the oil pan entails lowering the front axle assembly (see Section K of TS.674), to provide clearance necessary for lowering the oil pan clear of the crankcase.

THROTTLE CONTROL LINKAGE

Adjustment

1. Ensure the fuel injection pump control lever is correctly positioned on its spindle, i.e. pointing upwards to the rear at the specified angle (Fig. D.5) when in the maximum speed position. The lever can be adjusted in steps of $22\frac{1}{2}°$, after slackening its securing bolt.

2. Ensure the clevis pin is located in the centre hole of the control lever as shown.

3. Slacken the cross-shaft lever clamp bolt on right drive, or the adjusting nipple bolt on left drive.

4. Depress the accelerator pedal to within ·12 in. of the toe panel or mat, move the cross-shaft lever on right drive, or the adjustable rod on left drive, rearwards to the maximum speed position and re-tighten the bolt. Operate the accelerator pedal and check that the fuel injection pump control lever reaches the maximum speed position before the pedal reaches the floor.

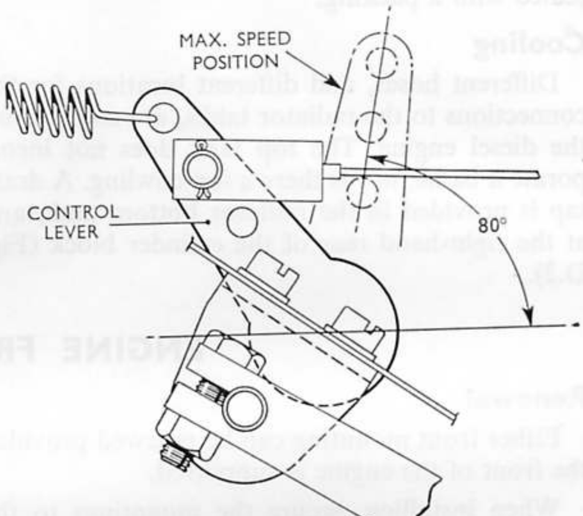


Fig. D.5. Correct location of injection pump control lever. Note that the cable is connected to the centre hole of the lever

ENGINE IDLING SPEED

Adjustment

The engine idling speed is controlled by a hexagon-head stop screw, with locknut, on the governor control housing of the fuel injection pump (Fig. D.6).

1. Ensure the idling control knob on the instrument panel is screwed fully home and check that approximately ·06 in. clearance exists between the nipple on the idling control cable and the swivel on the cross-shaft lever, when the accelerator pedal is released.

2. Ensure the fuel injection system is correctly air vented and run the engine until normal operating temperature is attained.

3. Adjust the stop screw on the pump so that the engine idles evenly, without hunting (approximately 625 r.p.m.). Clockwise rotation of the stop screw increases the idling speed.

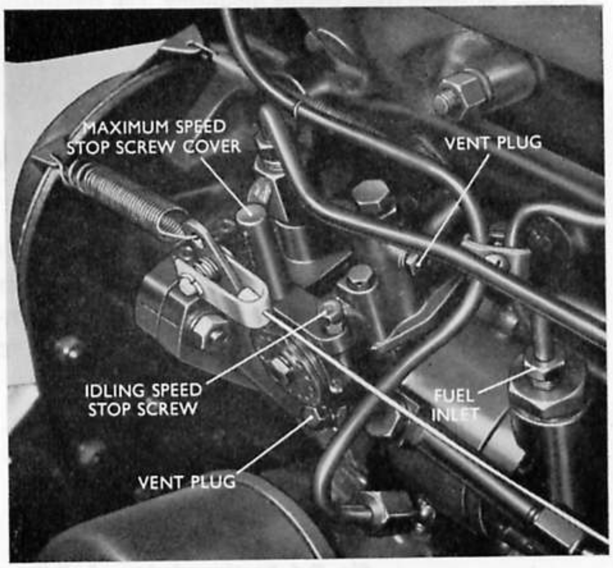


Fig. D.6. Fuel injection pump, showing idling and maximum speed stop screws and venting points

ENGINE MAXIMUM SPEED

Adjustment

The engine maximum speed is set by a hexagon-head screw, with locknut, on the governor control housing of the fuel injection pump. The screw is enclosed by a cover and sealed (Fig. D.6), against unauthorized interference.

To adjust the maximum speed, proceed as follows:

1. Run the engine until normal operating temperature is attained.

2. Move the control lever on the fuel injection pump by hand to the maximum speed position and check the engine speed with a tachometer and Extension D.1038. The maximum speed should be as specified.

3. If necessary, break the seal and remove the cover from the maximum speed stop screw. Adjust the engine speed by turning the stop screw, anti-clockwise to increase speed and clockwise to reduce speed.

4. Refit the cover and re-seal.

5. Check, and if necessary adjust the throttle control linkage.

PRIMARY FUEL FILTER

Cleaning

1. To prevent fuel leakage, raise the front of the vehicle approximately 12 in. before removing the bowl.

2. Remove exterior dirt from the filter head and bowl.

3. Slacken the bail nut and remove the bowl, gasket and gauze screen. Clean these parts in clean paraffin or fuel, and blow dry with compressed air.

4. Inspect the gauze screen for damage, and the bowl for cracks. Check the condition of the gasket and renew as necessary.

5. Assemble the gauze screen to the filter head, refit the gasket and bowl, and tighten the bail nut.

6. Slacken by two or three turns, the two vent plugs on the fuel injection pump (see Fig. D.6). Operate the priming lever of the fuel feed pump until fuel, free of air bubbles, is discharged, then tighten the vent plugs.

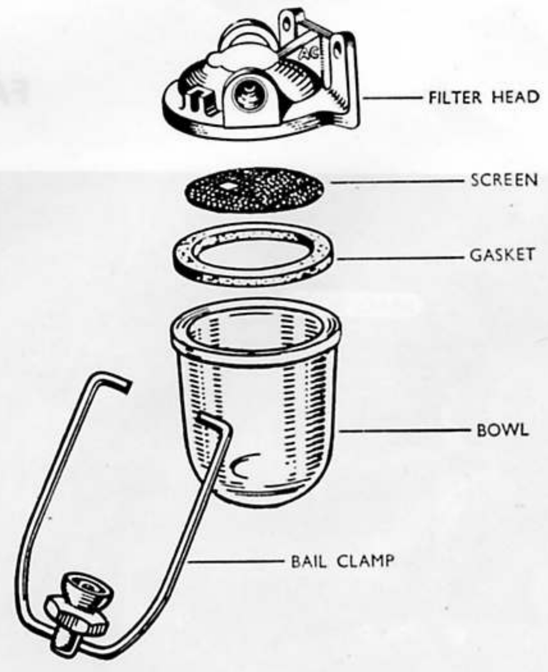
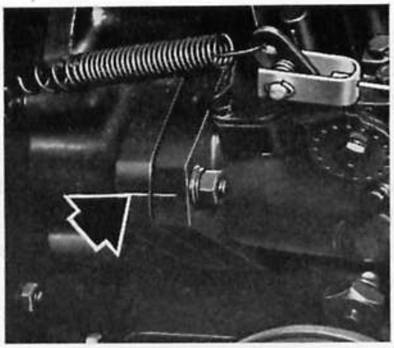


Fig. D.7. Details of primary fuel filter

FUEL INJECTION PUMP



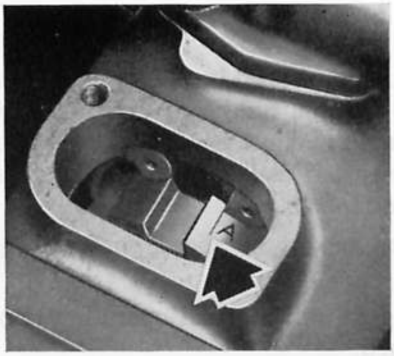


Fig. D.8. DPA pump timing. The flange marks must be aligned as shown on the left. On the right, the scribed line marked 'A' on the pump rotor must be aligned with the squared end of the preset timing circlip

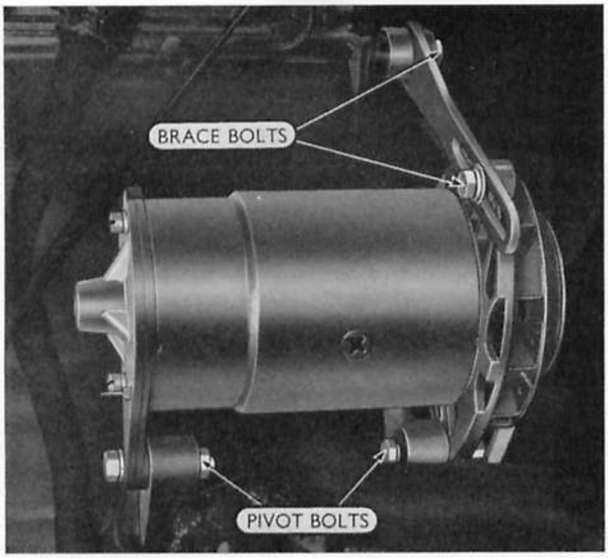
Timing

When installing a fuel injection pump after removal, or fitting a new pump, correct timing will be obtained by aligning the scribed line on the pump mounting flange with the line on the cylinder block (Fig. D.8).

Should it be necessary to make a detailed check of the pump timing, follow the procedure as recommended in Perkins Publication No. 7292 and observe the following points which are applicable to the Bedford CA.

The static timing point of the engine is 26° B.T.D.C. At this setting No. 1 piston will be in a position ·226 in. B.T.D.C. The scribed line marked 'A' on the fuel pump rotor must be aligned with the squared end of the preset timing circlip (Fig. D.8). On early model pumps, the scribed line marked 'A' must be aligned with the scribed line on the circlip.

FAN BELT



Adjustment

1. Slacken the generator pivot bolts (Fig. D.9), also the bolts securing the slotted brace.

2. Pivot the generator in the required direction to obtain the specified belt tension checked at a point midway between fan and generator pulleys.

The adjustment requires care. A tight belt will overload the generator bearings and also result in early belt failure. A slack belt will slip and wear and, also cause the engine to overheat.

3. When belt tension is correct, tighten all bolts.

Fig. D.9. Generator mounting. The pivot bolts and brace bolts must be slackened when adjusting the fan belt tension

FLYWHEEL

The friction face of the flywheel, if scored, may be machined provided the thickness of the flywheel is not reduced below that shown in Fig. D.10, see below.

ENGINE ASSEMBLY

Removal

Whilst the removal procedure in general is as described for the gasoline engine on page A-31, the following items should also be noted:

1. Remove the engine cowl centre and left-hand side panels.

2. Remove the air cleaner.

3. Before disconnecting the cables from the starter, note their position on the starter terminals.

4. Disconnect the throttle control cable from the fuel injection pump.

5. Disconnect the stop control cable.

6. Disconnect the flexible pipes from the fuel pump, igniter and supply tank.

7. The engine is provided with two lifting eyes for attachment of a suitable jib crane adaptor.

Installation

Note the following:

1. Connect the earth strap and the black earth wire to the inner (large) terminal of the starter.

2. After connecting the flexible pipes, air vent the fuel system (see Perkins Publication No. 7292).

3. Install the air cleaner so that the air intake tube points forward at approximately 30° to the left. Ensure the tube clears adjacent components.

4. Connect the stop control wire so that there is approximately ·06 in. clearance between the end of the outer cable and the nipple when the stop control is pushed fully in and the stop control lever is in the normal running position.

5. Run the engine until normal operating temperature is attained. Tighten the cylinder head nuts and adjust the valve clearances (see Perkins Publication No. 7292).

6. Check and if necessary adjust the idling and maximum speed settings (pages D-4 and D-5).

SPECIFICATIONS

ENGINE

Oil Pan Capacity—Nominal

Total—dry engine	7½ Imp. pints (9·0 U.S. pints)
Refill	6 Imp. pints (7·2 U.S. pints)
Refill—with filter element change	6½ Imp. pints (7·8 U.S. pints)

Oil Filter

Make	AC
Series	F730
Element type	AC73

Flywheel—Minimum thickness after refacing ... ... 2·114 in. (Fig. D.10)

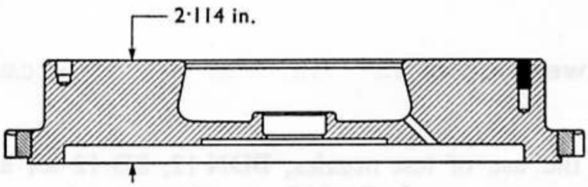


Fig. D.10. Flywheel machining data diagram

FUEL AND EXHAUST

Fuel Tank Capacity	7½ Imp. gal. (9·0 U.S. gal.)
Fuel Feed Pump	
Make	AC
Series	YJ
Delivery Pressure	4 to 7 lb/sq. in.
Diaphragm Spring	
Load at ·46 in.	8 lb. 10 oz. to 9 lb. 6 oz.
Identification colour	Green
Flow Test	
Maximum time to fill AC Analyser at 2000 r.p.m. of engine crankshaft	90 secs.
Main Fuel Filter	
Make	AC
Series	DOE
Element type	FF23
Fuel Injection Pump	
Make	C.A.V.
Type	DPA 3246697
Engine Governed Speed	
Idling	625 r.p.m.
Maximum (full load)	3600 r.p.m.
*Maximum (no load)	4100 r.p.m.

* NOTE: *Final adjustment must be made on the engine and not on the test equipment.*

***Maximum Fuel Output Setting**	5·2 c.c. per 200 strokes at 1000 r.p.m. (averaged over four lines)
***Maximum Spread between Lines**	·4 c.c.

*This test data relates to the use of test nozzles, BDN 12, SD 12 set at 175 atmospheres, with 6×2×865 mm. pipes

Injectors

Make	C.A.V.
Type	Pintle
Nozzle Holder Number	BKB 40S5146V
Nozzle:	
Number	BDN 12SD6236
Seat angle	59° 25′
Valve seat angle	60°
Valve lift	·60 to ·75 mm.

Testing and Setting Data

Back leakage	Pressure to drop from 100 to 75 atmospheres at a temperature of 10° to 21°C. (50° to 70°F.) in not less than 6 seconds
Pressure setting	120 atmospheres
Seat tightness	Nozzle bottom face to be substantially dry at sustained pressure of 110 atmospheres
Spray form	Spray to be finely atomized, equally distributed around the axis of the nozzle and, with the exception of a white centre core, free from coarse or solid streaks

COOLING

Cooling System Capacity—Nominal

Without heater	11 Imp. pints (6·6 U.S. quarts)
With single heater	12½ Imp. pints (7·5 U.S. quarts)
With dual heaters	14 Imp. pints (8·4 U.S. quarts)

Radiator Flow Test **Radiator Test Pressure** **Radiator Filler Cap**	As for gasoline (see page C-9)

Anti-Freeze

Refer to the table given in the specifications of Section C which provides information related to the usage of Vauxhall (ethylene glycol) Anti-Freeze.

Fan Belt

Belt Tension	Belt should depress ·50 in. midway between fan and generator pulleys, under load of 5 to 6 lb.

CLUTCH

Clutch Assembly and Disc	See Section E

Torque Wrench Data

Clutch to Flywheel Bolts	*14 lb.ft.

* *Clean dry threads*

PRE-FOCUS HEAD LAMPS

Bulb Renewal

1. Remove the head lamp rim.

2. Remove the light unit by pressing it firmly inwards and turning anti-clockwise. Do not disturb the lamp beam trim screws (Fig. S.3) otherwise the alignment of the lamp will be altered.

3. On head lamps other than Unified European:

(*a*) Press in and turn the bulb holder in an anti-clockwise direction until it can be withdrawn from the unit. Remove the bulb.

(*b*) Install the new bulb and replace the bulb holder. The bulb is located by a slot in the bulb flange and a projection in the light unit. The bulb holder is positively located by offset tabs.

Fig. S.5. Installing the bulb in a pre-focus head lamp (not Unified European type). A slot in the bulb flange locates in a projection on the light unit

4. On Unified European head lamps:

(*a*) Remove the bulb after releasing the clips securing it to the light unit.

(*b*) Install the new bulb which is located by a projection on the flange and a slot in the light unit flange (Fig. S.6).

5. Install the light unit and rim.

Light Unit Renewal

1. Remove the head lamp rim.

2. Remove the light unit by pressing it firmly inwards and turning anti-clockwise.

3. Remove the bulb (see under previous heading)

4. Remove the three screws securing the clamp rings to the light unit.

5. Locate the new light unit on the inner clamp ring so that the seating brackets on the light unit engage the slots in the ring.

6. Place the outer clamp ring in position and secure with the three screws.

Beam Alignment

Carry out the procedure given on page S-4. The beam trim screws are indicated in Fig. S.3 on page S-4.

Removal and Installation

Proceed as described for sealed beam head lamps on page S-4.

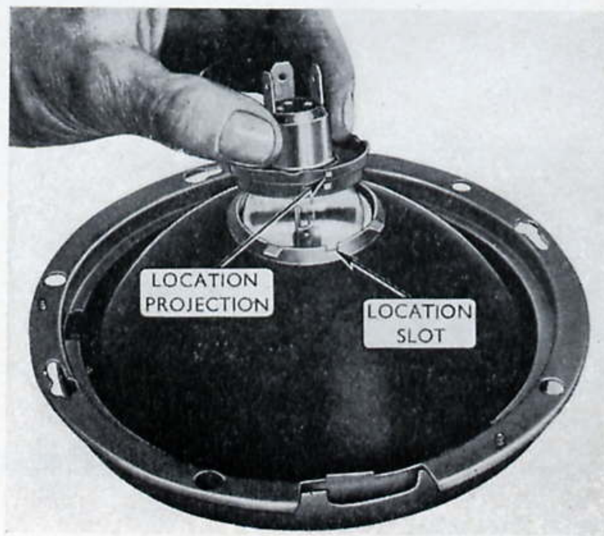


Fig. S.6. Installing a bulb in a Unified European head lamp

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Have you read the General Notes on page vii ?

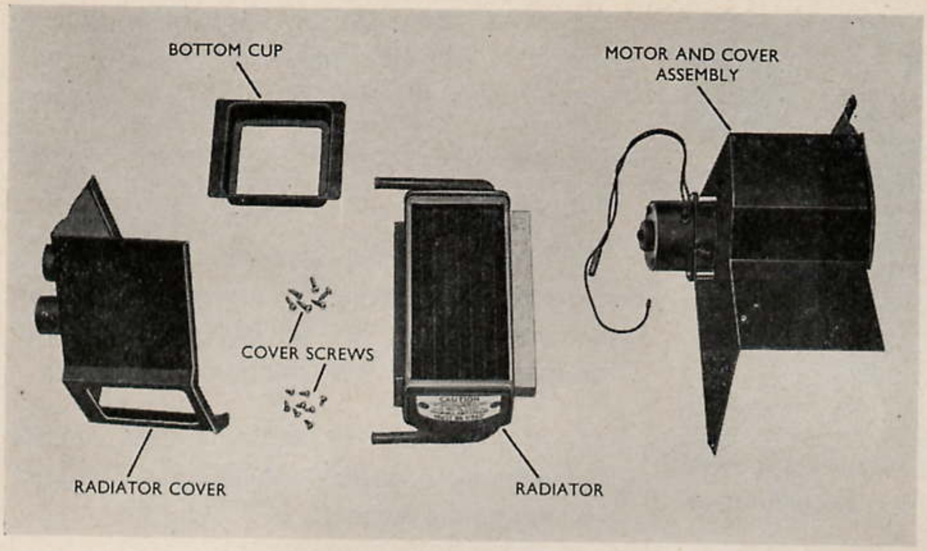

Fig. X.2. Layout of heater units

Disassembly

1. Remove the runner (fan) end cover from the motor cover.

2. Slacken the runner clamp nut and withdraw the runner.

3. Unscrew the three bolts securing the motor to its cover and remove the bolts, spacers and washers.

Reassembly

Note the following:

1. Assemble the motor attaching bolts, spacers and washers as shown in Fig. X-4.

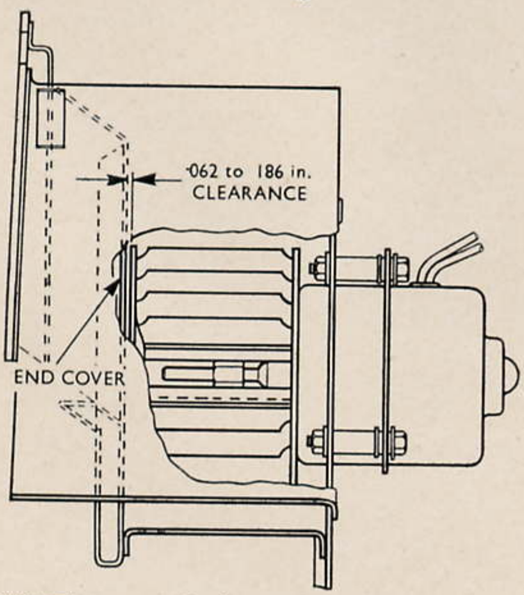

Fig. X.3. The runner (fan) must be positioned to give the clearance shown before tightening the nut securing it to the motor spindle

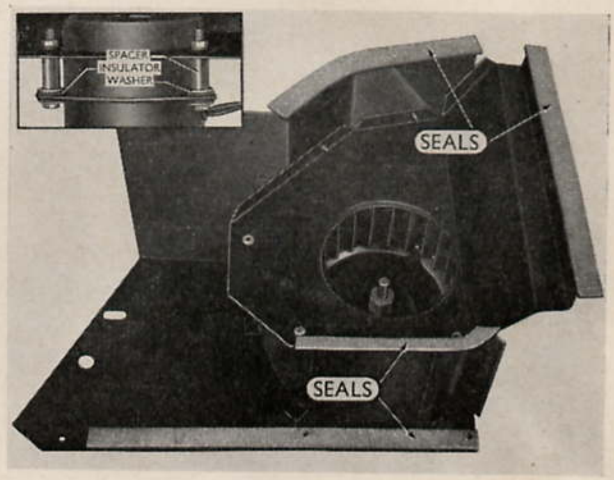

Fig. X.4. View showing location of seals on motor covers. Inset shows details of motor attachment

2. After installing the end cover, position the runner in relation to the cover (Fig. X.3) and tighten the clamp nut.

3. Check the seals along the flanges of the motor covers. If new seals are required, install as shown in Fig. X.4 and secure with a rubber adhesive.

Installation

Note the following:

1. Before installing the radiator, check that the rubber insulator is located on the splashguard, and the seals on the splashguard cup are secure.

Fig. X.5. Installing heater radiator cover. Location of seals is indicated

2. Ensure that seals are fitted to the radiator cover (Fig. X.5). New seals, if required, are secured with a rubber adhesive.

3. Reconnect the hoses in their original positions.

4. If the water valve control has been detached, reconnect with the valve lever in the closed position (see Fig. X.1 on page X-1) and the control lever in the 'OFF' position.

5. After refilling the cooling system, run the engine for a few minutes with the control on 'MAX' then top-up the radiator.

RECOMMENDED LUBRICANTS

OVERSEAS

USAGE	S A E VISCOSITY NO.	GM SPECIFICATION NO.
Battery Battery Terminals Earthing Points	—	4544—M
Distributor Mainshaft Bushes and Reservoir Centrifugal Advance Mechanism Circuit Breaker Cam Felt	20 or 20—W	4603—M or 4501—M
Circuit Breaker Cam	—	4544—M
Generator Drive End Bearing	—	4733—M
Commutator End Bush	20 or 20—W	4603—M or 4501—M
Instruments Speedometer Cable	—	4733—M
Starter Armature Shaft Bushes	20 or 20—W	4603—M or 4501—M
Windshield Wipers Wiper Motor Bushes	20 or 20—W	4603—M or 4501—M
Wiper Motor Gear Casing Wiper Link Bushes	—	4733—M
Doors Front Door Locks, Rollers, Slide Channels, Handle Rubbing Surfaces Back Door Hinges, Check Links, Locking Rods	—	4733—M

RECOMMENDED LUBRICANTS

UNITED KINGDOM

USAGE	BP	CASTROL	DUCKHAM'S	ESSO	GULF	MOBIL	REGENT	SHELL
Battery Battery Terminals Earthing Points	Petroleum Jelly							
Distributor Mainshaft Bushes and Reservoir Centrifugal Advance Mechanism Circuit Breaker Cam Felt	Engine Oil							
Circuit Breaker Cam	Petroleum Jelly							
Generator Drive End Bearing	Energrease L.2	Castrolease LM	LB.10 Grease	Esso Multi-purpose Grease H	Gulflex A	Mobilgrease MP	Marfak Multi-purpose 2	Retinax A
Commutator End Bush	Engine Oil							
Instruments Speedometer Cable	Energrease L.2	Castrolease LM	LB.10 Grease	Esso Multi-purpose Grease H	Gulflex A	Mobilgrease MP	Marfak Multi-purpose 2	Retinax A
Starter Armature Shaft Bushes	Engine Oil							
Windshield Wipers Wiper Motor Bushes	Engine Oil							
Wiper Motor Gear Casing Wiper Link Bushes	Energrease L.2	Castrolease LM	LB.10 Grease	Esso Multi-purpose Grease H	Gulflex A	Mobilgrease MP	Marfak Multi-purpose 2	Retinax A
Doors Front Door Locks, Rollers, Slide Channels, Handle Rubbing Surfaces Back Door Hinges, Check Links, Locking Rods	Energrease N.3	Castrolease WB	LB.10 Grease	Esso High Temperature Grease	Gulflex A	Mobilgrease No. 5	Marfak Multi-purpose 2	Retinax A

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BEDFORD CA Mark 2

Training Manual

TS 964

SUPPLEMENT

Electrical Equipment and Instruments

VAUXHALL MOTORS LTD

LUTON – ENGLAND

INTRODUCTION

This Supplement provides information on changes in design and servicing procedure introduced since publication of Training Manual TS 675.

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RITEWAY SERVICE TOOLS

Tools which carry a 'Z', 'D' or 'VR' prefix to the tool number are available from the following sources:

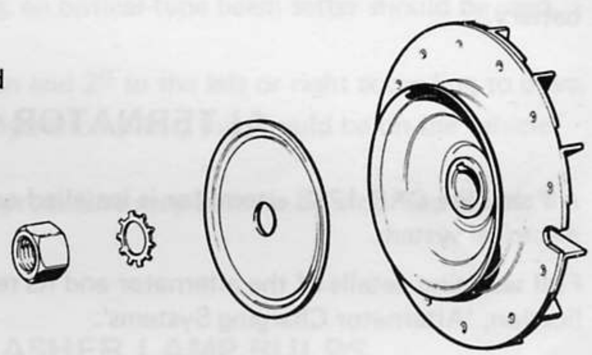
All territories except Continental Europe, Kent-Moore Tools Ltd, Bow Street, Birmingham 1, England.

Continental Europe, Kent-Moore International AG, Altgasse 6340, Baar-Zug, Switzerland.

Drawings of 'SE' tools are still obtainable from Service Department, Vauxhall Motors Ltd.

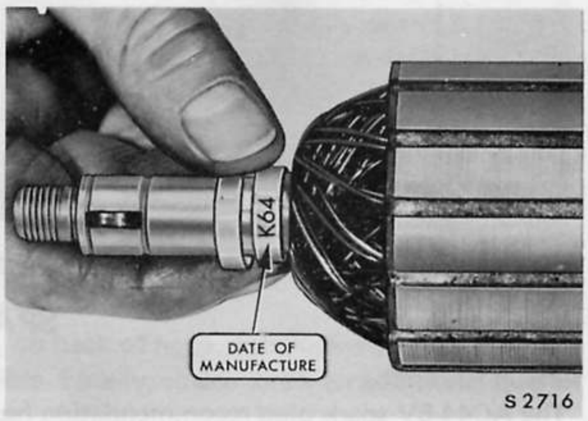
GENERATOR PULLEY REINFORCEMENT

The generator pulley was reinforced by a preshaped spring plate washer on later models. The washer is held against the pulley outer flange, under tension by the armature shaft nut, which must be tightened to a torque of 28 lb ft.
Washer is installed with convex side to pulley.



GENERATOR COMMUTATOR DIAMETER

Moulded commutators in Lucas C40 generators manufactured after October 1964 can be skimmed to a minimum diameter of 1.430 in.
The minimum diameter for C40 fabricated commutators is 1.385 in.
The month and year of manufacture of a commutator are stamped on the armature bearing collar. The month is indicated in alphabetical sequence (omitting the letter I), and each year is denoted by its last two figures. The date shown is October 1964.



CURRENT-VOLTAGE CONTROLLER

On later models, the generator controller cover is secured by plastic rivets which are heat-sealed to discourage interference with the controller settings.

Removal of the cover is not necessary for the purpose of checking the controller settings. The four tests should be carried out in a complete sequence, without attempting any adjustments.

For maximum accuracy of the open circuit voltage check, the engine speed should slowly be increased from idling to 2000 rpm (gasoline engine) or 1500 rpm (diesel engine). At this engine speed, voltage reading should be 14.5 to 15.5 volts when the ambient temperature is below 25°C, or 14.25 to 15.25 volts above 25°C.

If the reading is steady but outside the limits by no more than 0.5 volt, the electrical setting can be adjusted after completing all tests. If, however, the error exceeds 0.5 volt, it is unlikely that it is due to maladjustment, and the controller should be renewed.

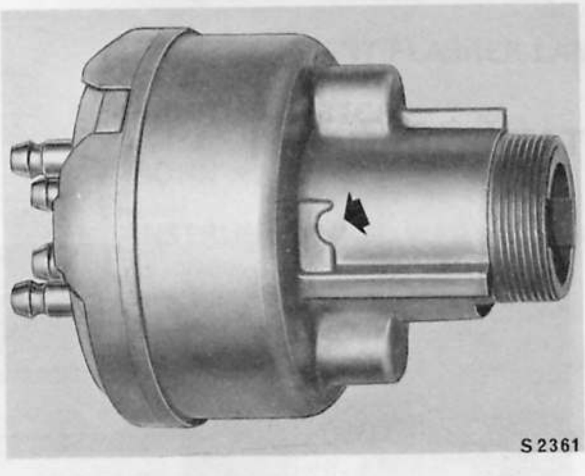
To check the current regulator on-load setting without removing the cover, connect a 0.5 ohm resistor with a rating of not less than 30 amps across the battery terminals. This has a similar effect to shorting out the voltage regulator contacts with a spring clip. It is essential that this check is carried out as quickly as possible to prevent overheating of the resistor and excess discharge of the battery.

ALTERNATOR CHARGING SYSTEM

A Prestolite CAB 1235 alternator is installed on some later models equipped with a negative-ground electrical system.

Full servicing details of the alternator and its regulator and relay are contained in a separate publication, 'Alternator Charging Systems'.

KEY START SWITCH



S 2361

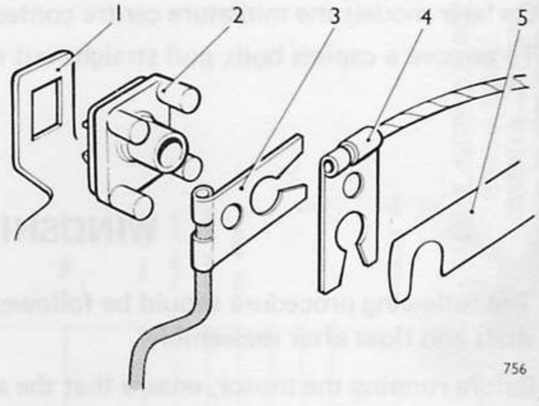
The switch barrel plunger release hole was deleted from the key start switch on later models, to prevent ingress of water. Access to the plunger is made by drilling through the thin casting at the location shown. After reinstalling the barrel the hole should be sealed with wax.

SPARK PLUGS

The AC44-5V spark plug recommendation has been revised to AC43 for standard usage.

CIRCUIT BREAKER CONTACTS

On later engines the method of securing the feed and capacitor wire terminals (3 and 4) to the circuit breaker (1), was modified. The terminals are now located by a nylon clip (2) and retained in position by the pressure of the circuit breaker arm spring blade (5).



HEAD LAMP AIMING

To achieve maximum accuracy in head lamp aiming, an optical-type beam setter should be used, and the lamps aimed whilst on dipped beam.

The lamps should be set so that the beam is 2° down and 2° to the left or right according to drive.

If the vehicle normally carries a fixed load, e.g. refrigeration plant, this should be on the vehicle when the head lamp aim is checked.

In some European countries, the head lamp aiming procedure may have to be modified to suit the regulations of the country concerned.

PARKING/FRONT FLASHER LAMP BULBS

On later models the sealed beam headlamp units were replaced by pre-focus units incorporating a 12 volt, 6 watt MCC parking lamp bulb.

To gain access to parking lamp bulb, light unit must be withdrawn.

The flasher lamp bulbs are 12 volt, 21 watt SCC.

LIGHTING SWITCH

A redesigned lighting switch was introduced at Chassis No. 6316689. Where this switch is fitted it is important that none of the bulbs used in the instrument panel lamps should exceed 3 watts rating or the rheostat may be overloaded.

HORN

To prevent corrosion at the horn terminals on vehicles with negative-ground electrical system, a new type horn, located behind the radiator grille, was introduced.

The horn tone should be adjusted by rotating screw, on back of horn, anticlockwise until there is no note from horn, then clockwise until horn is audible. Finally, rotate screw an additional quarter turn clockwise.

INSTRUMENT AND WARNING LAMP BULBS

On later models the miniature centre contact bulbs were replaced by 3 watt wedge base capless bulbs. To remove a capless bulb, pull straight out of holder.

WINDSHIELD WIPER MOTOR

The following procedure should be followed when adjusting the windshield wiper motor armature shaft end float after reassembly.

Before running the motor, ensure that the armature is free and that some end float is present.

Having aligned the spherical bearing to reduce current consumption to a minimum, screw in the thrust screw until consumption increases by not more than 0.1 amp. This will provide the correct end float setting.

NEGATIVE-GROUND ELECTRICAL SYSTEM

A negative-ground electrical system was introduced on later models. It is important that the ground polarity of the vehicle is noted before connecting polarity sensitive units such as alternators, electric clocks and radios.

With the negative-ground system, the ignition coil cold start resistor is fitted to the positive terminal of the coil. Generator output tests, field coil tests, and current-voltage controller settings should be carried out with voltmeter negative terminal connected to ground.

WIRING DIAGRAMS

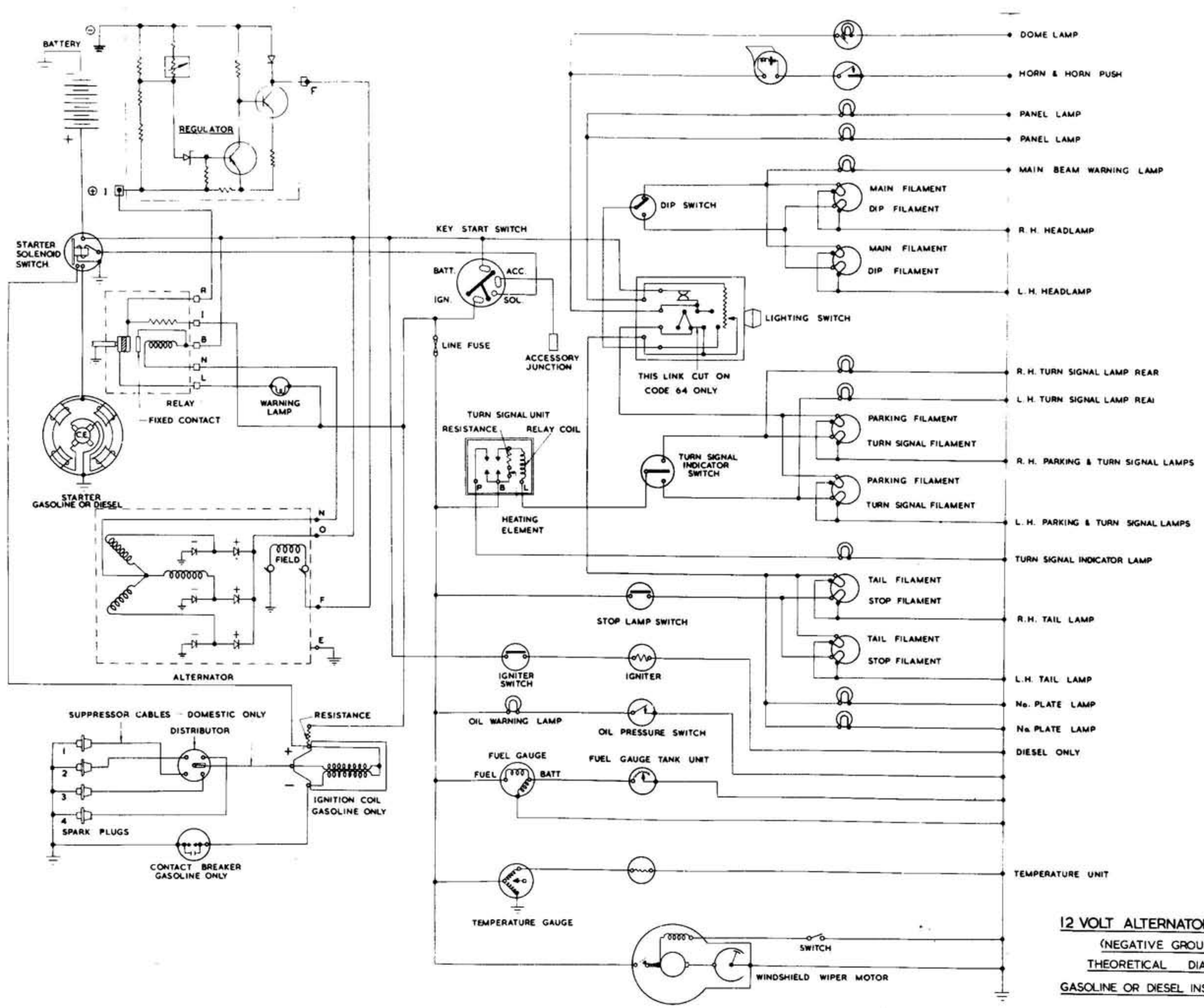
The wiring diagrams in the Manual show positive-ground polarity. These diagrams can be applied to negative-ground vehicles with a generator charging system if the points included in the preceding paragraphs are noted.

A theoretical wiring diagram for vehicles with a negative-ground alternator charging system is given on the next page.

RECOMMENDED LUBRICANTS

In addition to the lubricants listed in the manual, Fina Marson HTL2 grease is also recommended for the following usages:

- Generator drive end bearing
- Speedometer cable
- Windshield wiper motor gear casing
- Windshield wiper link bushes



12 VOLT ALTERNATOR SYSTEM
(NEGATIVE GROUND)
THEORETICAL DIAGRAM
GASOLINE OR DIESEL INSTALLATION