Section 9

FUEL SYSTEM

CONTENTS

SUBJECT

FUEL SYSTEM: PETROL

OVERHAUL PROCEDURES

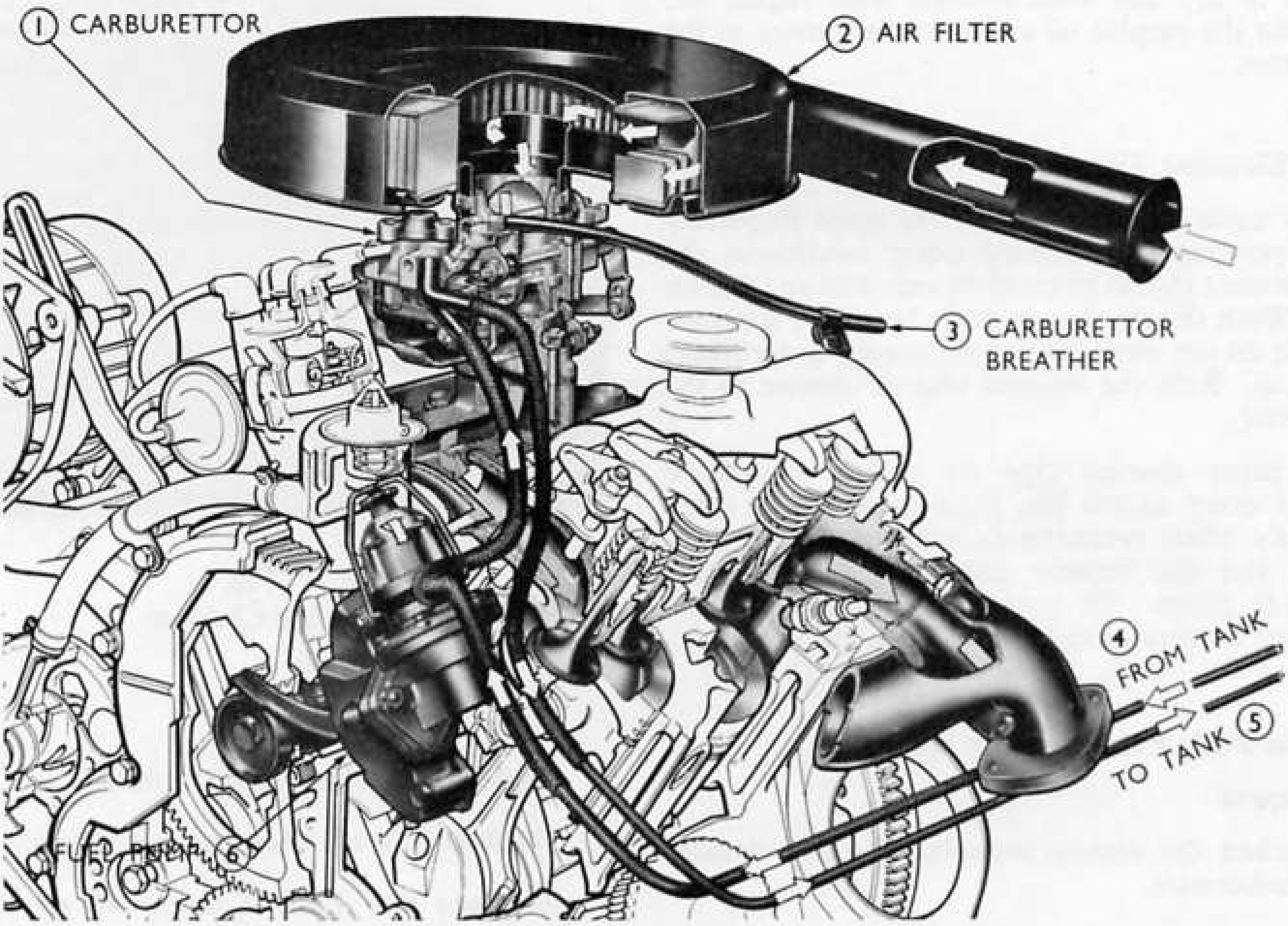


Fig. 1
Fuel System (Prior to September 1968)

Introduction

The fuel system of all standard and de-luxe models consists of a fuel tank, a mechanical fuel pump operated by the engine camshaft and a downdraught carburettor, with the necessary fuel lines.

A standard rectangular fuel tank is located at the left-hand side of the vehicle beneath the floor. The fuel pump is supplied from the tank by means of a rigid fuel line which runs beneath the floor of the vehicle, having flexible connector hoses to tank and engine.

A fuel tank vent pipe is fitted to the top of the tank adjacent to the fuel supply pipe, and the filler cap is also vented. A fuel return pipe is fitted to the tank from a tee piece in the fuel feed pipe adjacent to the carburettor, enabling a continuous flow fuel system to be employed.

The carburettor is of the single-venturi, downdraught type. An accelerator pump, to assist acceleration, and an economy device controlled by manifold depression are incorporated, together with a choke valve of the strangler type for cold starting.

The fuel gauge is designed to eliminate needle fluctuation whilst the vehicle is in motion. With this type of gauge the needle moves slowly, taking about 30 seconds to indicate the true reading after switching on the ignition.

Routine Maintenance

Routine maintenance for the fuel system consists of the following:

The fuel pump sediment bowl, gauze filter and sediment chamber should be cleaned every 8,000 km. (5,000 miles.)

Adjust the carburettor slow-running every 8,000 km. (5,000 miles) as described on pages 9 and 14.

The paper type air cleaner element should be renewed every 24,000 km. (15,000 miles) (see page 4). Should the vehicle be operated in dusty conditions it may be necessary to occasionally remove the element, shake it clean and refit.

AIR CLEANER

Wire Gauze Type

The wire gauze type air cleaner should be removed every 8,000 km. (5,000 miles), or more frequently when operating in extremely dusty conditions, and the element and body washed in petrol. Allow the element to dry and then saturate with engine oil. Shake out the surplus oil and refit the cleaner to the carburettor.

Paper Element Type

Every 8,000 km. (5,000 miles) or more frequently when operating in extremely dusty conditions, the paper element should be carefully removed and shaken clean. Wash the air cleaner body in petrol, if necessary, but do not wash the paper element or shrinkage will occur. Refit the element and air cleaner to the carburettor.

The paper element type air cleaner should be removed every 24,000 km. (15,000 miles), or more frequently when operating in extremely dusty conditions, and the element discarded and the body washed in petrol. Fit a new element and refit the cleaner to the carburettor.

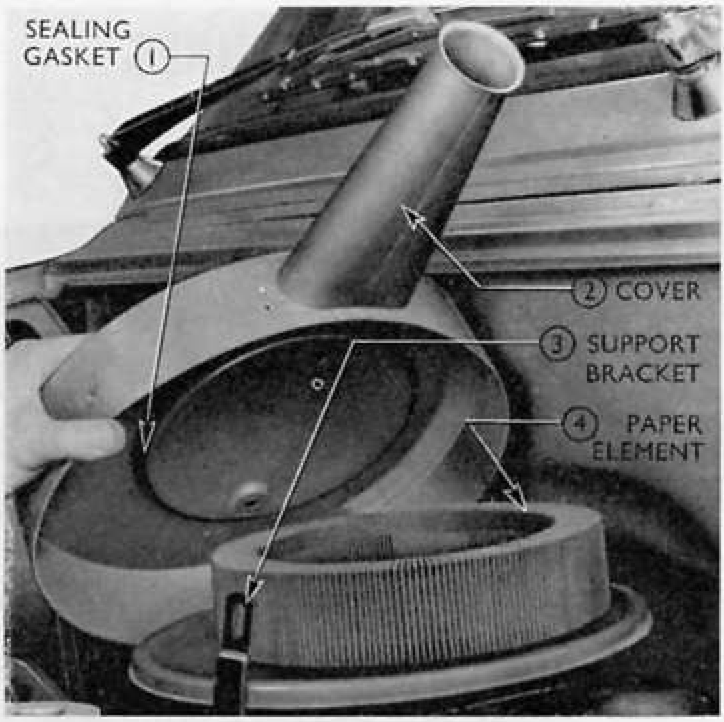


Fig. 2
Air Cleaner

Vehicles Built Prior to May 1967

To Remove

1. **Slacken the clamp securing the air cleaner** to the carburettor.

2. **Remove the bolt from the air cleaner support bracket** and pull off the breather pipe from the rocker cover.

3. **Remove the air cleaner.**

4. **Unscrew the two bolts** in the dished section of the air cleaner.

5. **Lift out and discard the paper element** and two rubber sealing rings.

6. **Thoroughly clean the body** in petrol and allow to dry.

To Replace

1. **Fit two new rubber sealing rings,** one round the boss inside the top cover, shown in Fig. 2, the other locating at the bottom, inside the body of the cleaner.

2. **Place the new paper element** in the centre of the body so that it seats on the lower sealing ring.

3. **Carefully replace the top cover** ensuring that the upper sealing ring remains in place on the boss.

4. **Tighten the two screws** securely.

5. **Replace the air cleaner** and breather pipe.

6. **Replace the bolt** retaining the air cleaner to the support bracket.

7. **Tighten the air cleaner clamp.**

Vehicles Built from May 1967 Onwards

To Remove

1. **Unscrew the hexagon-headed bolt** and steady bracket and lift the air cleaner assembly off the carburettor.

2. **Remove the cover** from the body.

3. **Remove the element** from the body.

To Replace

1. **Locate the body** on the carburettor with the spout facing towards the left-hand front cover of the engine compartment.

2. **Place the element** into the body and centralise it on its seat.

3. **Position the cover** on the body with the alignment arrow pointing along the spout and retain with the hexagon-headed bolt and steady bracket.

CARBURETTOR
(Prior to May 1967)

The carburettor is of the single venturi down-draught type. It incorporates an accelerator pump to ensure smooth and rapid acceleration, an economy unit, and a choke valve of the semi-automatic strangler type.

Description and Operation

The cold starting device consists of a choke plate which is connected by means of a flexible cable to a friction locking type control on the facia panel. Pulling the control closes the choke plate and at the same time, by means of an interconnecting rod opens the throttle plate a pre-determined amount; the degree of throttle opening allowing depression created by the induction strokes to reach the mixture chamber and choke tube areas, and ensuring a fast idle speed after starting.

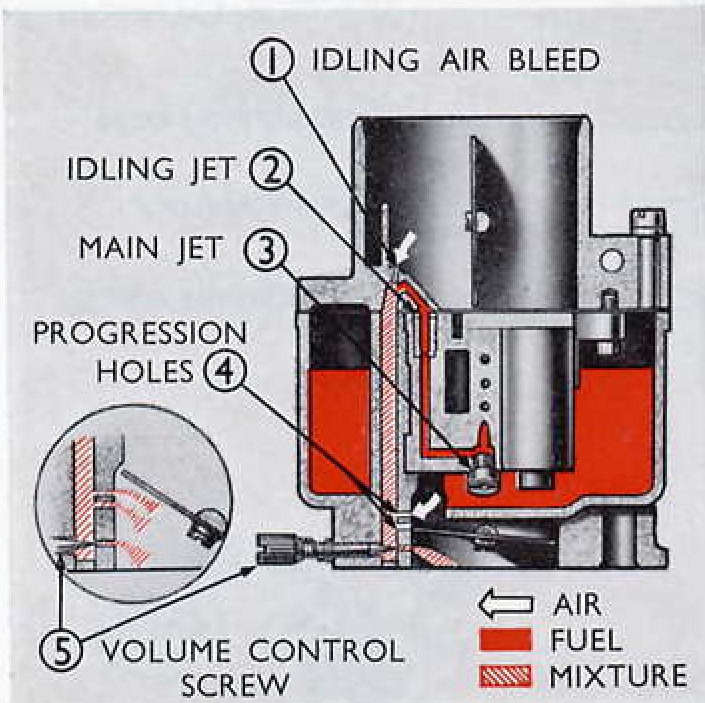


Fig. 3
Idling and Progression

As the engine is rotated by the starter motor, a high depression is created upon the emulsion block discharge beak, and fuel is thus drawn from the capacity well in the emulsion block. When the engine is running with the choke shut, the depression created in the manifold at low speed acts on the largest portion of the spring-loaded choke plate, this being offset on its spindle, thereby causing the choke plate to open admitting sufficient air to keep the engine running.

Idling Supply (Fig. 3)

With the accelerator released and the throttle plate in the idling position, petrol is supplied by the slow-running or idling jet which obtains fuel from the metered side of the main jet, located in the base of the emulsion block. The fuel is emulsified by air admitted through the idling air bleed hole in the main air intake. The resulting mixture is drawn down the vertical channel in the carburettor body to the idling discharge hole just below the throttle plate, and thence into the induction manifold. The quantity of mixture passing through the idling discharge hole is regulated by the needle-type volume control screw.

The two small holes above the idling discharge hole in the carburettor body also connect to the vertical channel supplying the idling mixture. These progression holes provide a smooth and progressive supply of mixture as the throttle plate is gradually opened.

Main System—Full Load (Fig. 4)

On opening the throttle further, the engine depression is imposed on the emulsion block beak. This depression draws fuel from the channels above the main and compensating jets and from the enrichment jet. Air is supplied simultaneously by the "full throttle" air bleed and the enrichment air bleed, which remains open under all conditions, and also, providing the economy device is operative, by air regulated through the larger "part throttle", or main air bleed. This fuel/air mixture is then drawn from the emulsion block beak into the induction manifold.

As the petrol level drops in the main jet channel, a number of small holes are progressively exposed. These admit more air, thus emulsifying the mixture, and maintaining a balanced fuel/air ratio.

Economy Device Main System—Part Load (Fig. 6)

This is incorporated in a small casting secured by three screws to the top of the carburettor body. A diaphragm inside this casting is held in a flexed

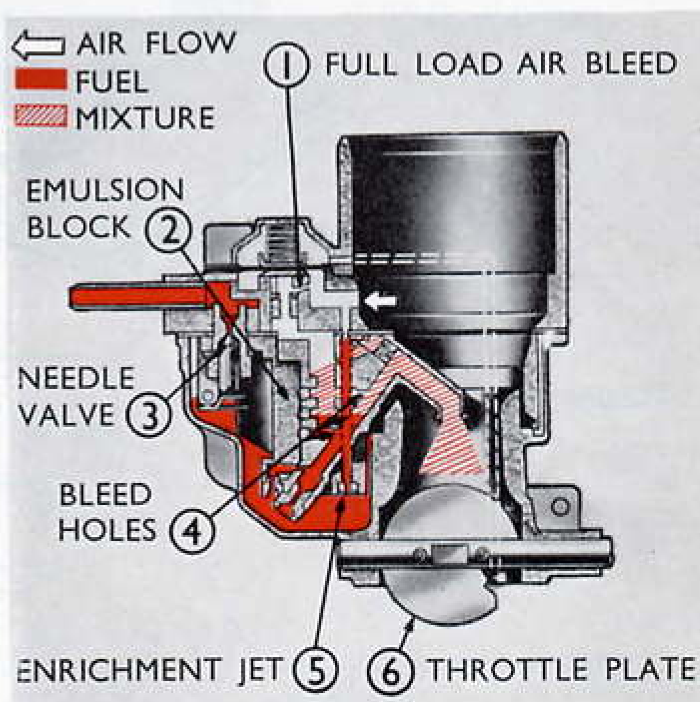


Fig. 4
Main Supply — Full Load

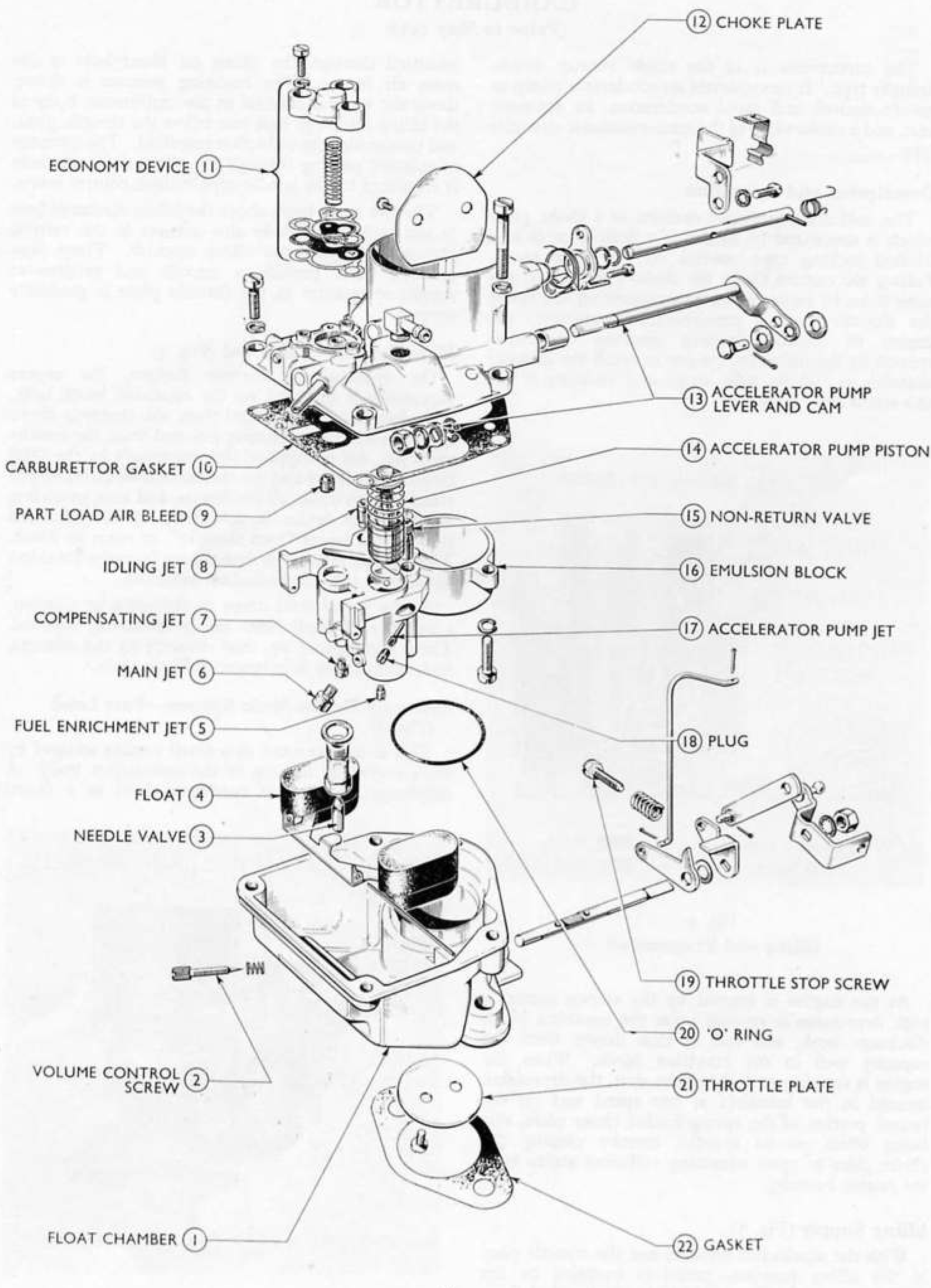


Fig. 5
Carburettor (prior to May 1967)—Exploded

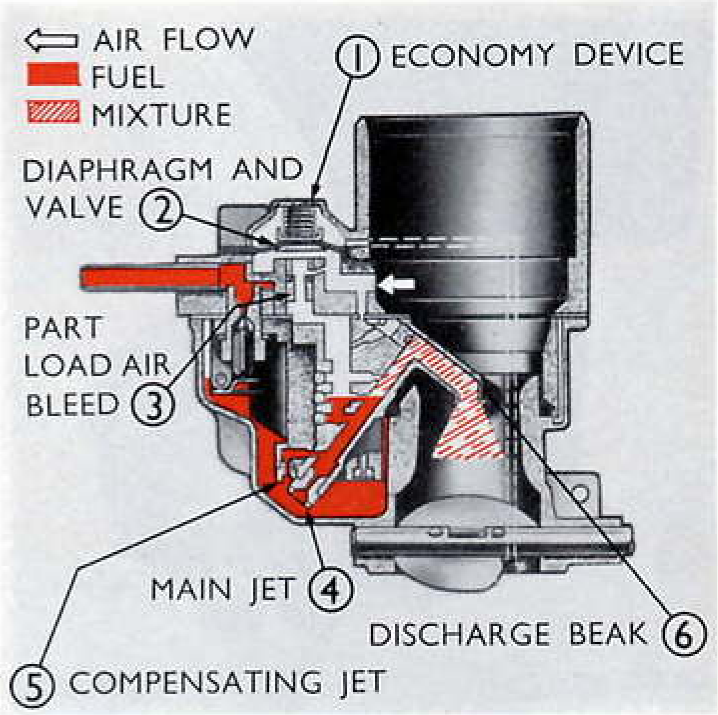


Fig. 6
Main Supply — Part Load

condition by spring pressure. The back of the diaphragm and valve (i.e. on the same side as the spring) is directly connected by an internal passage to the engine side of the throttle plate (see dotted lines Fig. 4).

On acceleration and "full throttle" conditions, when the manifold depression is low, the spring retains the valve attached to the diaphragm on its seating. The only air supply to the jets is through the "full throttle" air bleed.

Under part throttle conditions when the manifold depression is high, this depression is felt on the spring-loaded side of the diaphragm, drawing the diaphragm back and lifting the valve from its seat. Air is allowed past this valve, the quantity of air being controlled only by the "part throttle" air bleed, therefore increasing the degree of air bleeding to the emulsion well and consequently reducing the depression on the compensating and main jets, resulting in a weaker mixture being supplied by the carburettor.

The action of the economy device is completely automatic, being controlled by the demands of the engine.

Accelerator Pump System

The purpose of the accelerator pump is to ensure smooth acceleration, and prevent any hesitation when the throttle is suddenly opened. The richer mixture required to fulfil these conditions is provided by a controlled and metered supply of fuel from the accelerator pump into the carburettor venturi coincident with the sudden opening of the throttle plate.

When the pump piston is at the top of its stroke, the pump chamber is charged with fuel admitted from the float chamber through the check valve, (lower ball valve) at the base of the chamber. When the throttle is suddenly opened, a lever and cam connected to the throttle linkage, forces the pump piston down, discharging the fuel in the accelerator pump well through the discharge valve (upper ball valve) and the horizontal accelerator pump jet discharge nozzle into the air stream. The pump piston is returned to the charged position by the piston spring ready for the next stroke.

The travel of the piston and, consequently, the volume of fuel discharged at each stroke can be set in one of two positions (see Carburettor Maintenance, page 9).

To Remove

1. **Remove the air cleaner.**

2. **Disconnect the inner choke cable** and remove the outer cable retaining clip.

3. **Disconnect the throttle linkage** from the carburettor.

4. **Detach the fuel pipe union.**

5. **Disconnect the distributor vacuum pipe** at the rubber connection.

6. **Unscrew the carburettor flange nuts** and remove the spring washers, carburettor and gasket.

To Dismantle

1. **Disconnect the accelerator pump** control arm by removing the split pin retaining the arm to the accelerator pump operating lever.

2. **Disconnect the choke link rod** from the choke control lever by removing the split pin.

3. **Unscrew the four screws** retaining the two halves of the carburettor and separate the assembly.

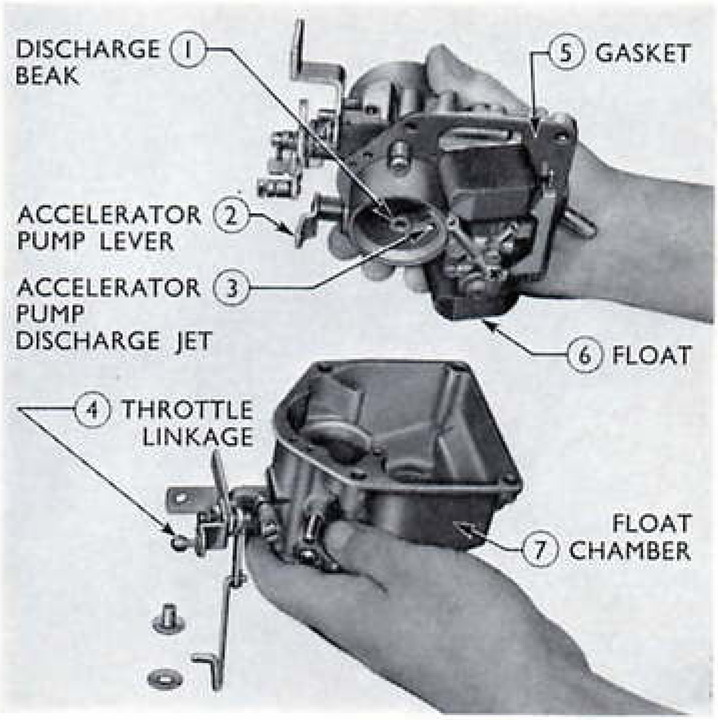


Fig. 7
Dismantling the Carburettor

4. Withdraw the float pivot pin and remove the float assembly, allowing the needle valve to be withdrawn.

5. Remove the emulsion block. Unscrew the needle valve housing and washer, and the screw either side of the choke tube. Remove the emulsion block and gasket.

6. Withdraw the accelerator pump piston assembly.

7. Remove the following jets from the emulsion block, using suitable screwdrivers, (**do not** damage the jet with an unsuitable or badly worn screwdriver), the main jet, compensating jet and enrichment jet from the lower section, and the idling fuel jet and accelerator pump non-return valve from the upper face. The accelerator pump jet can be removed after unscrewing the brass plug. The other non-return valve ball can be removed after hooking out the spring from the bottom of the accelerator pump bore. Do not scratch the bore.

8. Remove the economy valve housing by unscrewing the three retaining screws. Remove the housing, diaphragm and two gaskets and spring. The part throttle air bleed screw can be unscrewed from the opposite face of the carburettor body.

9. Unscrew the two screws retaining the choke plate to the spindle and withdraw the spindle and return spring assembly and washer.

10. Remove the accelerator pump operating lever. Unscrew the brass nut and shakeproof washer from the accelerator pump shaft, and withdraw the operating cam. Remove the circlip and withdraw the shaft and brass collar.

11. Remove the volume control screw and spring from the lower half of the carburettor body. Unscrew the throttle stop screw and spring.

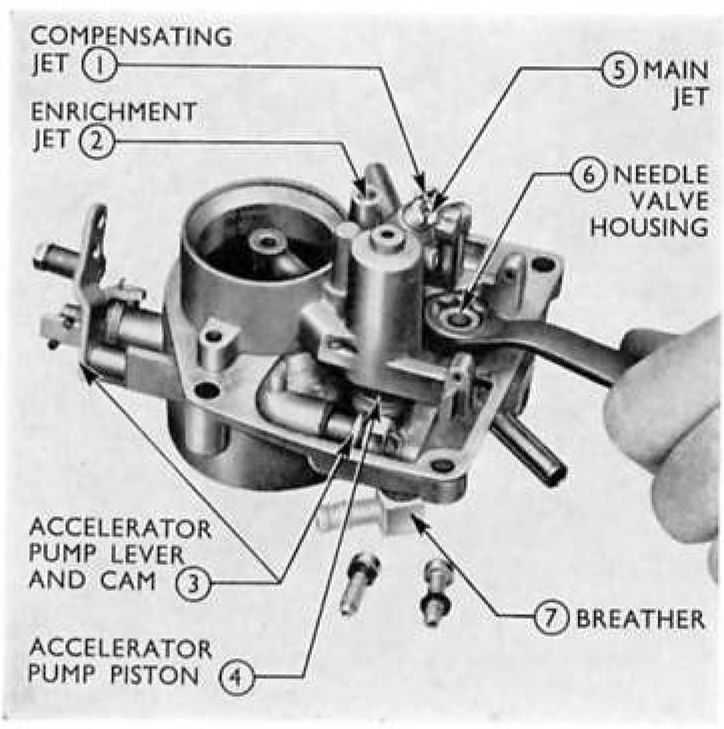


Fig. 8
Removing the Emulsion Block

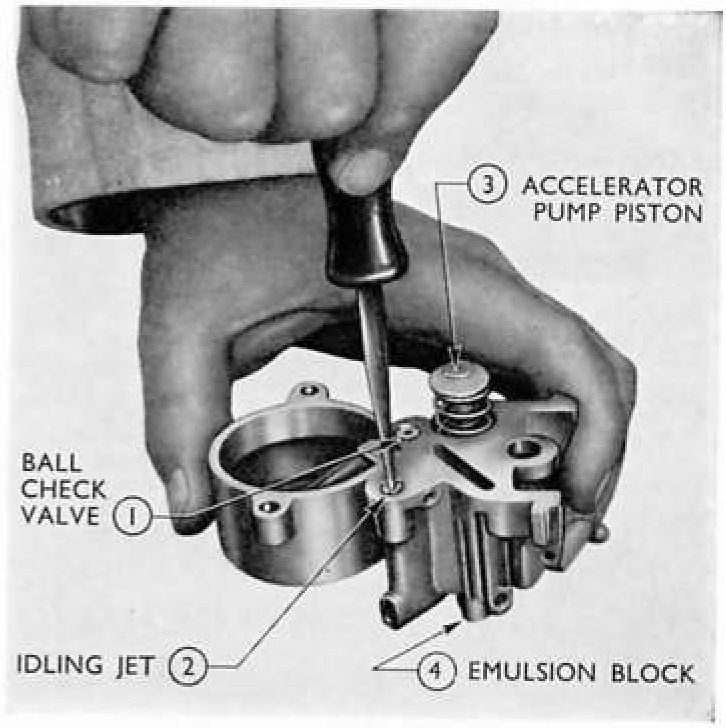


Fig. 9
Removing the Idling Jet

12. Unscrew the throttle plate retaining screws and remove the plate from the spindle. Withdraw the spindle assembly.

13. Remove and inspect the rubber 'O' ring around the choke tube.

To Reassemble

1. Replace the rubber 'O' ring around the choke tube in the lower half of the carburettor body.

2. Insert the throttle spindle assembly and replace the throttle plate and the two retaining screws. The larger flat on the spindle must face the lower flange when the throttle is closed. Lightly centre-punch the screw threads to retain the screws in position.

3. Replace the volume control screw and throttle stop screw with their respective springs.

4. Replace the accelerator pump operating lever. Slide the brass collar on the shaft and fit the shaft to the carburettor body. Replace the cam whilst holding the operating lever vertical. The cam must face the accelerator pump piston when assembled. Replace the shakeproof washer and nut and finally fit the circlip to the shaft.

5. Replace the choke spindle assembly and refit the choke plate and two retaining screws. The spindle flat should face towards the air cleaner when the choke is closed. Ensure that the choke plate return spring is correctly tensioned and fitted.

6. Replace the economy valve assembly. Locate the diaphragm, with a gasket either side, on the three spigots, ensuring that the air port is in alignment with the hole in the casting. Locate the spring in the diaphragm cup and refit the valve cover and retaining screws. The lug on the valve housing must cover the air port. Replace the part throttle air bleed jet in the opposite face of the carburettor cover.

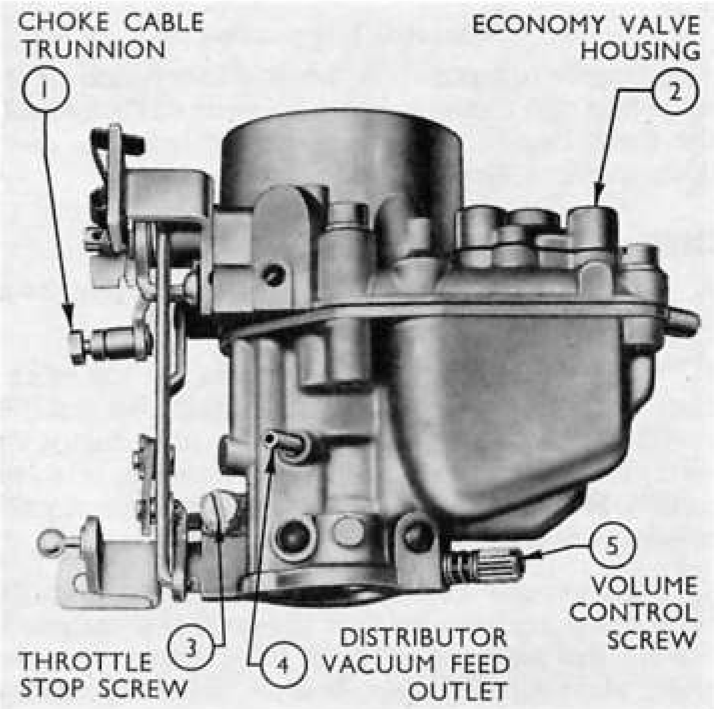


Fig. 10
Adjusting Screws

7. **Replace the jets** in the emulsion block. Replace the ball valve and spring in the accelerator pump bore, (do not scratch the bore). Refit the main jet, compensating jet and enrichment jet in the lower face and the idling fuel jet and accelerator pump non-return valve in the upper face. Replace the accelerator pump jet and plug and insert the accelerator pump piston assembly.

8. **Reassemble the emulsion block to the carburettor** body, locating a new gasket on the upper half of the body. Replace the screw and washer either side of the choke tube and the needle valve housing and washer. Check the movement of the accelerator pump piston.

9. **Locate the needle valve** and float assembly and refit the float pivot pin.

10. **Assemble the carburettor** together and replace the retaining screws, the longer screws fitting either side of the choke tube.

11. **Connect the choke link rod** to the choke control lever and fit a new split pin. Check the operation of the choke and ensure that the throttle is opened slightly by the link rod when the choke is closed.

12. **Connect the accelerator pump** control arm to the operating lever. Use the lower hole in temperate climates and the upper hole, which supplies more fuel, in cold climates. Ensure that a washer is fitted on the inside and outside of the clevis pin with the levers between the washers.

To Replace

1. **Fit the carburettor and a new gasket** to the inlet manifold. Replace the spring washers and nuts on the mounting studs and tighten them securely.

2. **Reconnect the distributor vacuum pipe** to the rubber connection.

3. **Reconnect the fuel supply pipe.**

4. **Locate the choke cable** and pass the inner cable through the choke lever trunnion and tighten the clamping screw. Replace the outer cable retaining clip and check the operation of the choke.

5. **Reconnect the throttle linkage.**

6. **Refit the air cleaner.**

CARBURETTOR MAINTENANCE

Cleaning the Carburettor

At periodic intervals the float chamber should be swilled in clean petrol to remove all sediment. The jets should occasionally be removed and cleared, using compressed air supply. Never use wire or anything which may enlarge the jets.

Carburettor Adjustments

Certain adjustments may be required from time to time, and these are detailed under the following headings:—

Choke Adjustments

The choke control cable is adjusted at the choke operating lever so that there is approximately 3 mm. (⅛ in.) free play in the cable when the control is pushed in fully.

Slow-Running Adjustment

To obtain the best slow-running adjustment, the engine should be tuned against a vacuum gauge connected to the inlet manifold. This connection can be made by removing the blanking plug from the inlet manifold and fitting the appropriate adaptor and gauge.

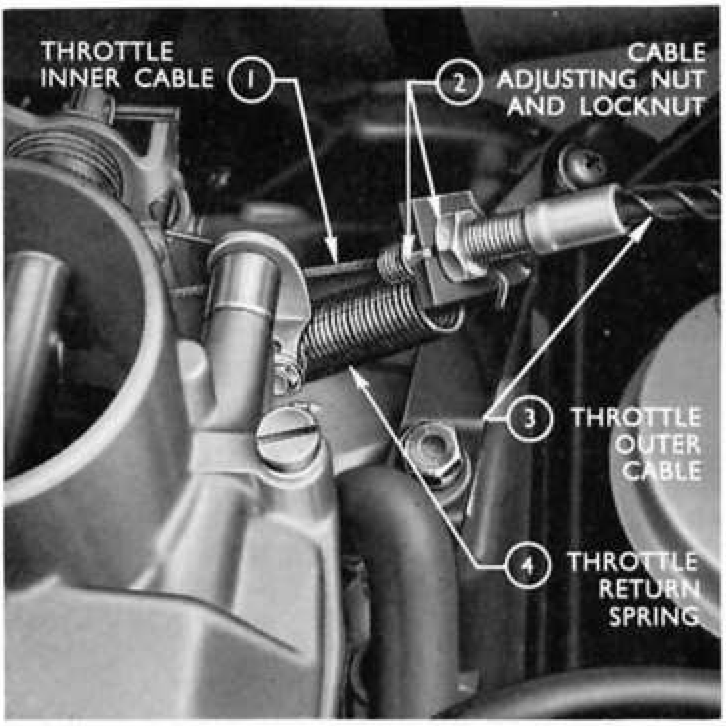


Fig. 11
Throttle Cable Adjustment

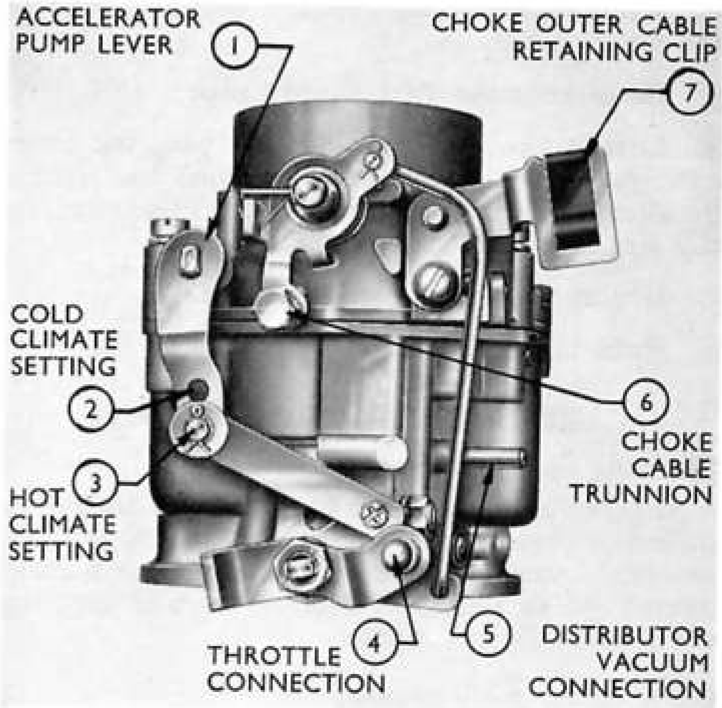


Fig. 12
Accelerator Pump Setting

Before commencing adjustment, check the air cleaner to ensure that the element is clean and remove any excessive free play from the throttle cable.

Run the engine allowing it to warm up. To adjust the slow-running, screw in the throttle stop screw (see Fig. 10) until a fast idling speed is obtained, then turn the volume control screw, illustrated in Fig. 10, either clockwise or anti-clockwise to obtain the maximum vacuum reading. Readjust the idling speed as necessary and continue the adjustment until the maximum possible vacuum reading is obtained with a reasonable slow-running speed. It may be necessary to adjust the ignition setting, see Section 10.

When a suitable vacuum gauge is not available, the engine should be warmed up and the throttle stop screw turned clockwise so that the engine is running at a fast idling speed. Screw the volume control screw in or out until the engine runs evenly. Readjust the throttle stop screw if the engine is running too fast, followed by a further readjustment of the volume control screw.

These operations should be repeated until the idling speed is satisfactory and, if necessary, followed by a readjustment to the ignition setting.

Accelerator Pump Stroke Adjustment

The accelerator pump stroke can be adjusted by altering the position of the accelerator pump link to the accelerator pump operating lever (Fig. 12). In warm or temperate climates set the link to the outer hole in the lever to give a short pump stroke. In cold climates set the link to the inner hole, thus allowing a longer pump stroke. To adjust the setting, remove the split pin and the clevis pin and washers. Refit the clevis pin in the desired position, ensuring that a washer is fitted either side of the arm and link before replacing the split pin.

General Diagnosis

If engine operation is unsatisfactory and it is suspected that the fault is due to **poor carburation,** the items listed under the following headings may, when checked, help to locate the cause.

Difficult Starting from Cold

1. **Ensure first that fuel is being supplied** from the fuel pump.

2. **Check that the needle valve** at the top of the float chamber is free to operate and that fuel is supplied through this valve when the engine is rotated. If the needle sticks on its seating, this can usually be overcome by washing the valve assembly in methylated spirit.

3. **Remove air cleaner** and check that the choke plate closes completely when the control is operated. Should this plate fail to close fully, ensure that the choke plate spindle is not bent or the return spring broken, also check that the spindle bearings are free from dirt, thus preventing full movement of the choke plate.

4. **Check the operation of the choke** and cable as described under the heading "Choke Adjustments."

Difficult Starting of a Warm Engine

This is usually due to an over-rich mixture which may normally be cleared by fully opening the throttle and turning the engine over on the starter motor. However, should this condition be recurrent, check the following items to determine the actual cause.

1. **Ensure that the air cleaner is serviceable,** cleaning as described on page 4 if necessary.

2. **Check the fuel pump delivery pressure** as described on page 22.

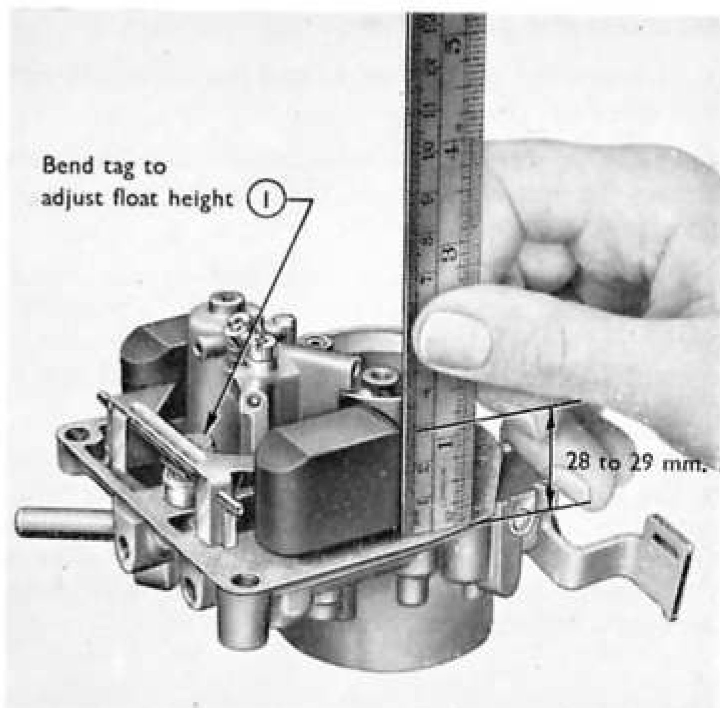


Fig. 13
Checking Float Level

3. **Ensure that the needle valve and seating** at the top of the float chamber are not damaged or dirty, and are screwed tightly in place.

4. **Examine the float,** ensuring that it has not been punctured, and the float arm to see that this is not damaged or bent. Check petrol level in the float chamber as indicated in Fig 13 – checking Float Level.

Stalling and Irregular Slow-Running

1. **Check adjustment of volume control and idling control screws** as described under the heading "Slow-Running Adjustment."

2. **Clean the idling jet,** and check that the internal drilling is free from obstruction. Ensure that the idling air bleed is free from obstruction.

3. **Check that the slow-running** and progression outlet holes are clear.

4. **Remove the volume control screw** and inspect to ensure that the tapered end has not been damaged and that the coil spring on the screw is in good condition, spring-loading the screw to prevent it from vibrating out of the set position.

Poor Acceleration

1. **Ensure that fuel is emitted into the venturi** when the accelerator pump lever is operated.

2. **Clean the accelerator pump jet,** remove the pump piston and check valves and wash in methylated spirit.

3. **Check the economy device** to ensure that the diaphragm and spring are in good condition, inspect the gaskets and evenly tighten the three screws retaining the casting to the carburettor.

Excessive Fuel Consumption

1. **Check that the air cleaner is serviceable** and, if necessary, clean as described on page 4.

2. **Ensure that the choke plate returns to the open position** when the control is released. Failure to do this may be caused by dirty spindle bearings or a broken return spring.

3. **Thoroughly clean all jets and passages,** making sure that the accelerator pump discharge valve is free to operate, and the valve ball falls onto its lower seat.

4. **Inspect the economy device diaphragm** and gaskets, and also ensure that the spring is in good condition, located on the metal seating in the centre of the diaphragm on reassembly.

5. **Examine the gasket between the emulsion block and float chamber body,** tightening the screws retaining the emulsion block securely when replacing.

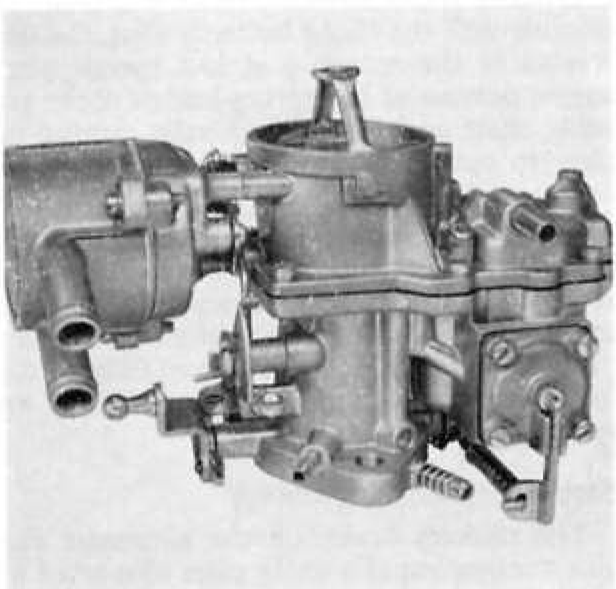
CARBURETTOR
(May 1967 onwards)

A Ford manufactured carburettor has been fitted in production from May 1967.

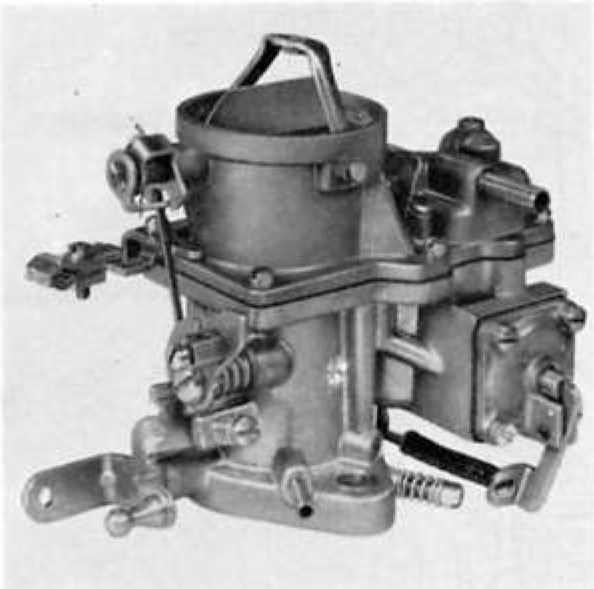
A later type Ford carburettor with a single and larger inlet pipe and revised settings has been fitted since September 1968.

All carburettors are of the single venturi, down-draught type and in addition to the usual idling and main jet systems an accelerator pump is incorporated. This ensures smooth and rapid acceleration when the throttle valve is opened quickly.

The carburettors consist of two castings forming the upper and lower bodies. On automatic choke carburettors a casting containing the thermostatic spring and choke mechanism is fitted. This is screwed to the upper body corresponding to the choke linkage. The upper body incorporates the float chamber cover,



AUTOMATIC CHOKE



MANUAL CHOKE

Fig. 14
The Carburettors

float pivot brackets, fuel inlet connection tube, needle valve, air intake, choke plate, the complete main system and discharge beak, idling jet and first idle air bleed of the idling system and the accelerator pump discharge nozzle. The lower body incorporates the float chamber, throttle barrel and integral choke tube, throttle plate, idling discharge orifices and adjustment screws, the accelerator pump, the distributor vacuum and the choke and throttle linkages.

POWER VALVE

Incorporated in these carburettors is a power valve. It consists of a piston, piston rod, adjusting spring and washers, valve, valve spring and valve body (Fig. 15). The piston is retained in its upper body by a washer staked to the upper body, and the valve body is closely fitted and pinned to the lower portion of the main well. The nylon adjusting washers are split to facilitate calibration.

The power valve provides a supply of additional fuel to meet increased power demands.

Under normal operating conditions with the engine running at part load, manifold depression holds the piston and rod in a raised position against the force of the adjusting spring, with the valve spring holding the valve against its seat.

When the power demand increases and the engine is working at full load the manifold vacuum decreases. The adjusting spring is allowed to expand, moving the piston and rod down and dislodging the valve from its seat. Fuel then passes through the valve body into the main well, increasing the supply of fuel to meet the increased power demand.

Fuel Supply

Fuel is supplied to the carburettor float chamber by a mechanical fuel pump. Fuel in the float chamber is automatically maintained at a pre-determined level by the slight rise and fall of the float, closing or opening the needle valve to cut off or admit fuel from the pump as required.

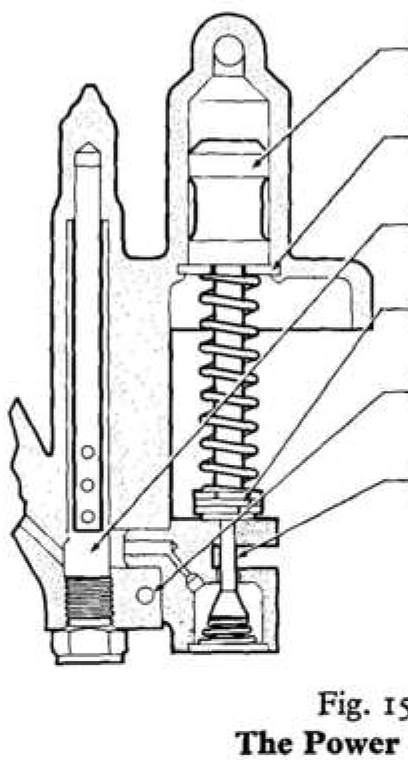


Fig. 15
The Power Valve

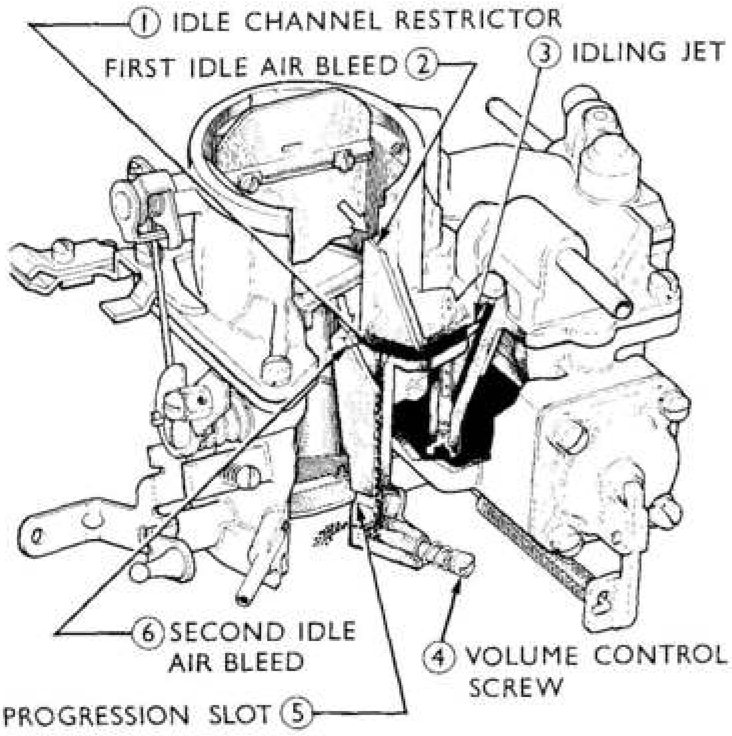


Fig. 16
Idling

OPERATION

Starting (Manual Choke)

The starting device on the manual choke carburettor consists of a choke plate which is connected by means of a link to the choke lever on the carburettor body. A flexible cable connects the choke lever to a friction locking type control on the facia panel. Pulling the control closes the choke plate and opens the throttle a pre-determined amount, the degree of throttle opening allowing depression created by the induction strokes to reach the mixture channels and choke tube area, ensuring a fast idle speed after starting.

As the engine is rotated by the starter motor, a high depression is created upon the emulsion block discharge beak and fuel is drawn from the capacity well situated in the emulsion block. When the engine is running with the choke butterfly shut, the depression created in the manifold at low speeds acts on the largest portion of the spring-loaded choke plate, this being offset on its spindle, thereby causing the choke plate to open, admitting sufficient air to keep the engine running.

As the temperature rises the control knob should be gradually pushed towards the 'off' position in accordance with the requirements of the engine. Once the normal operating temperature has been reached the control knob should be pushed fully in, the engine fuel requirements at idling being met by the idling system only.

Starting (Automatic Choke)

The starting device on the automatic choke carburettor consists of a choke plate connected by means of a link to the thermostatic spring housed in a casting screwed to the upper body of the carburettor. This is connected in series with the engine cooling system by-pass. As the engine coolant heats up the spring expands. This movement is transmitted by a link to

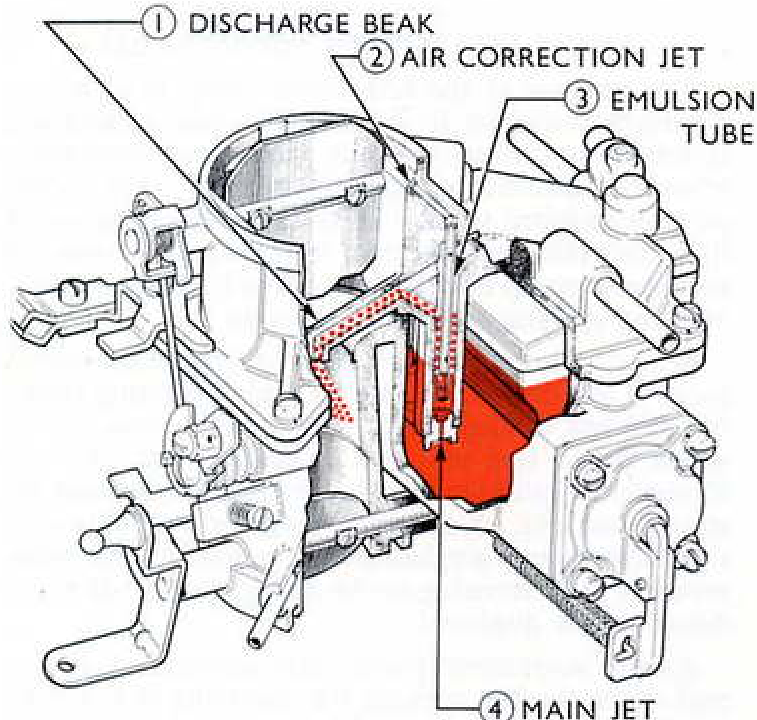


Fig. 17
Main System

the choke plate which opens, weakening the fuel/air mixture as required.

A vacuum piston connected by a rod to the crank operates in a bore in the choke housing and is connected by internal drillings to the throttle barrel below the butterfly.

A stepped fast idle cam and choke lever assembly is fitted between the lower body and the automatic choke housing. The choke lever is attached to the cam by a pin locating in a slot in the cam. This allows the choke plate to open without the throttle setting altering. The cam has three steps on it, giving different degrees of choke plate opening depending upon the temperature of the engine.

A rich mixture is required for starting. Prior to starting the accelerator pedal should be fully depressed once. This has the effect of releasing the fast idle cam so that it is free to return to the starting position, and returning the choke plate to the closed position.

When the engine is rotated by the starter motor a high depression is created upon the emulsion block discharge beak and fuel is drawn from the main system, in addition to the idling system, to start the engine. Immediately the engine starts to run increased depression in the choke tube acts, through the internal drillings, upon the underside of the vacuum piston. The piston is pulled down and, through the action of the crank, the choke plate is opened a pre-determined amount against the tension of the thermostatic spring. This admits sufficient air to weaken the mixture and keep the engine running without flooding. The throttle plate is also held open slightly. This is the automatic choke plate pull down, the measurement of which should be, for carburettors fitted from May 1967 to September 1968, 4.2 mm. (0.165 in.) for the 1700 c.c. engine and 3.4 mm. (0.135) for the 2000 c.c. engine.

From September 1968 onwards the measurement should be 3.94 to 4.45 mm. (0.155 to 0.175 in.) for the 1700 c.c. engine and 3.18 to 3.69 mm. (0.125 to 0.145 in.) for the 2000 c.c. engine.

Immediately after starting the engine, the throttle should be eased open a little and released. This releases the cam which, under its own weight, moves and brings the first fast idle notch to rest on the throttle lever.

As the engine warms up, the thermostatic spring is heated by the engine coolant circulating through the choke water chamber, causing the spring to expand. This has the effect of gradually rotating the crank and, through the linkage, moving the choke plate to the open position. During the warming up period the vehicle should be driven or the throttle blipped occasionally to allow the fast idle cam to move through its arc bringing the remaining two notches, in turn, into line with the throttle lever. When the engine has reached normal operating temperature the choke plate will be fully opened and the cam will have rotated clear of the throttle lever.

NOTE.—As the cam rotates and the three notches in turn line up with the throttle lever, the choke plate opens and the throttle plate closes ensuring a good and even tick-over.

IDLING AND PROGRESSION SUPPLY

With the engine running and the choke control pushed fully home, the throttle plate returns to the normal idling position. Manifold depression acting on the volume control screw orifice draws fuel up to the idling jet via the main jet. The fuel discharging through the idling jet is now emulsified by air drawn through the first idle air bleed situated in the carburettor air intake. The resulting mixture is drawn through the idle channel restrictor into the vertical duct in the carburettor body and is further emulsified by air bleeding in through the second idle air bleed and a small progression slot, before it finally reaches the idling discharge aperture just below the throttle plate (see

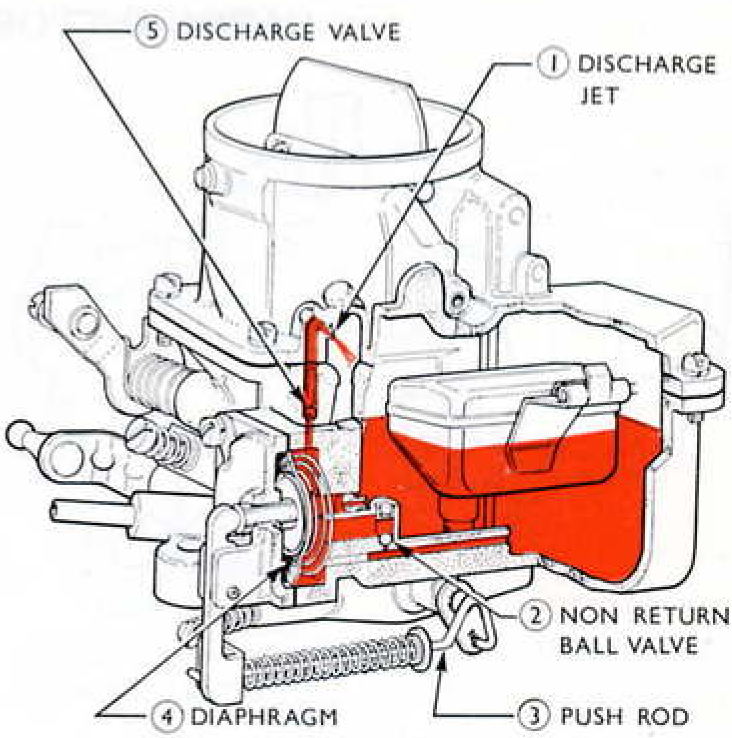


Fig. 18
Accelerator Pump System

Fig. 16). It will be noted that the progression slot is situated in a slightly offset horizontal position along the closed throttle plate line. The effect being to provide a more accurate progressively controlled delivery.

The quantity of fuel entering the inlet manifold of the engine is regulated by a needle-type volume control screw operating within the idling discharge orifice.

As the accelerator pedal is gradually depressed to increase the speed, the small air bleed or progression slot is covered by the throttle plate to cut off the air bleed at this point. The richer mixture, now supplied by the idling system, mixes with the greater volume of air flowing past the partially opened throttle plate to give the correct mixture strength for the engine. As the progression slot is uncovered by the throttle plate, mixture discharges from it into the inlet manifold, thus providing a smooth and progressive transition from the idling to the main system.

MAIN SYSTEM

On opening the throttle plate further, increased depression is created around the main discharge beak by the air passing through the choke tube. This depression on the discharge beak draws fuel from the main jet well, which is supplied with fuel by the main jet. The fuel is emulsified by air drawn into the system through the air correction jet and through lateral holes in the emulsion tube (see Fig. 17). As the engine speed increases, the depression is increased and the fuel level drops in the main jet well, progressively exposing the holes in the emulsion tube to maintain a balanced emulsified fuel/air ratio regardless of the engine speed.

ACCELERATOR PUMP SYSTEM

The purpose of the accelerator pump is to ensure a smooth transition from the idling and progression system on to the main system, without any hesitation, when the throttle is suddenly opened. The richer mixture required to fulfil these conditions is provided by a controlled and metered supply of fuel from the accelerator pump into the carburettor barrel coincident with the opening of the throttle plate.

When the accelerator pedal is depressed the movement of the throttle spindle actuates the pump push-rod and link to displace the pump diaphragm. This action forces fuel past the discharge valve and out through the calibrated discharge jet into the main air stream (see Fig. 18), thereby ensuring a condition of rapid and smooth acceleration. A non-return ball valve prevents fuel returning to the float chamber when the diaphragm is displaced.

As the accelerator pump only operates during a part of the throttle opening the operating link is connected to the push rod with a compression spring thus allowing full throttle opening after completing the pump operating stroke. This action also prevents a partial hydraulic lock occurring during very rapid throttle opening and provides a progressive feed at the start of acceleration. During very slow throttle opening the fuel in the pump chamber bleeds back through a small jet into the float chamber without any discharge into the carburettor barrel.

When the throttle plate is closed, and the push rod and link are in the released condition the diaphragm is returned by its spring to the 'charged' position ready for the next stroke. The travel of the diaphragm and, consequently, the volume of fuel discharged at each stroke, can be set by adjustment to the push-rod as outlined in the following maintenance chapters.

CARBURETTOR MAINTENANCE

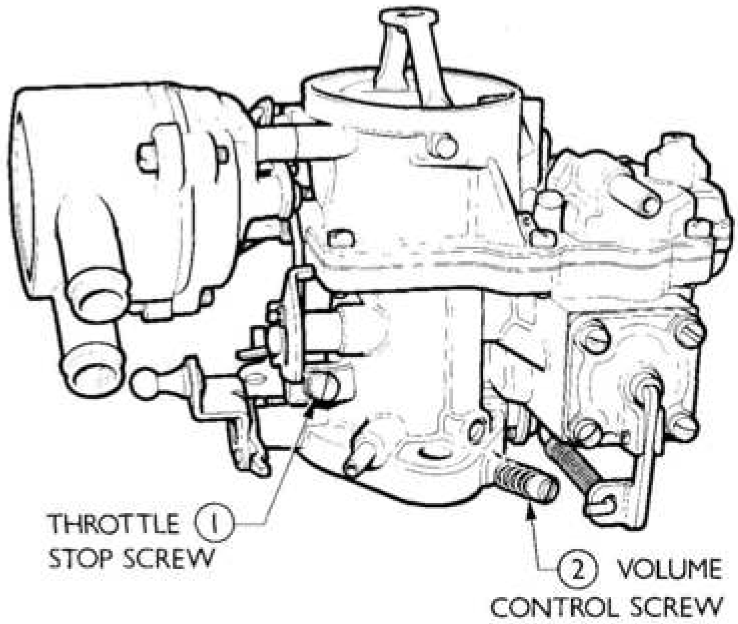


Fig. 19
Slow-Running Adjustments

1. Slow-Running Adjustment

After 800 km. (500 miles) and thereafter every 8,000 km. (5,000 miles) the carburettor slow-running should be checked and adjusted if necessary. Before commencing adjustment check that all other direct influences on engine behaviour, e.g. electrical system, valve clearances, etc., are correct and in working order. Check the air cleaner to ensure that the element is clean; also check that the throttle operation is free and unrestricted.

If the engine or carburettor has been disturbed, it will be necessary to check that the throttle and choke operations are correctly synchronised prior to effecting any slow-running adjustments.

To obtain the best slow-running adjustment, the engine should be tuned against a vacuum gauge connected to the inlet manifold. This connection can be made by removing the blanking plug from the inlet manifold and fitting the appropriate adaptor and gauge.

Run the engine until it has reached normal operating temperature. To adjust the slow-running, screw in the throttle stop screw until a fast idling speed is obtained then turn the volume control screw, illustrated in Fig. 19, either clockwise or anti-clockwise to obtain a maximum vacuum reading. Readjust the idling speed as necessary and continue the adjustment until the maximum possible reading is obtained, compatible with a reasonable slow-running speed.

When a vacuum gauge is not available, the engine should be warmed up as previously described and the throttle stop screw turned clockwise so that the engine is running at a fast idling speed. Screw the volume control screw in or out until the engine runs evenly. Readjust the throttle stop-screw if the engine is running too fast, followed by a further readjustment of the volume control screw. These operations should be repeated until the idling speed is satisfactory—this should be approximately 600 rev./min.

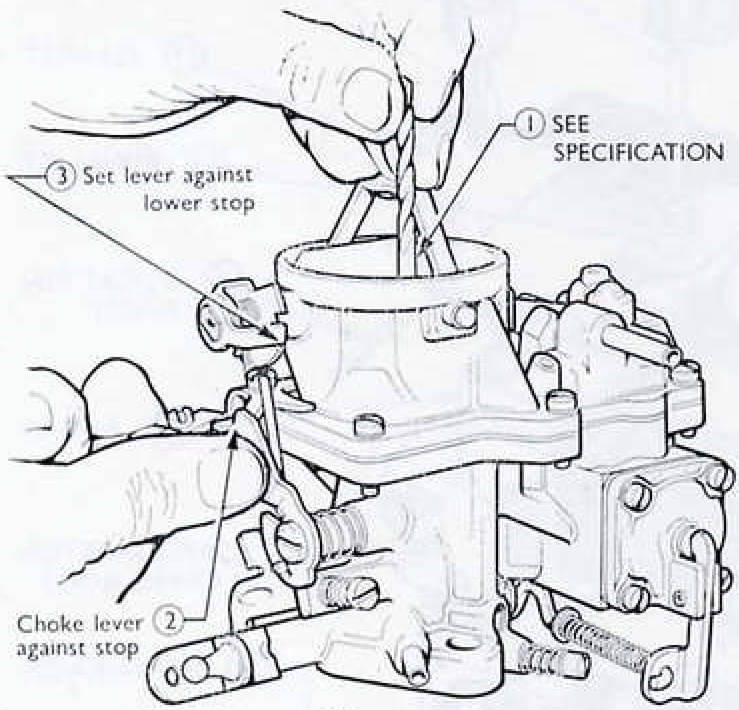


Fig. 20
Choke Pull Down Setting

2. Choke Adjustment

Choke Plate Pull-down (Manual choke carburettor)

Remove the air cleaner and rotate the choke lever to its stop. With the lever in this position the choke plate should now be depressed and the clearance between the lower edge of the choke plate and the inside of the carburettor air intake should be checked.

For carburettors fitted from May 1967 to September 1968 this measurement should be 2.8 mm. (0.110 in.) for the 1700 c.c. engine and 4.0 mm. (0.150 in.) for the 2000 c.c. engine.

From September 1968 onwards the measurement should be 2.54 to 3.05 mm. (0.100 to 0.120 in.) for the 1700 c.c. engine and 3.56 to 4.06 mm. (0.140 to 0.160 in.) for the 2000 c.c. engine.

It is suggested that a suitable drill or gauge rod be used in this operation and inserted between the choke plate and the inside of the carburettor air intake. The tab on the choke spindle should be bent to achieve this result (see Fig. 26).

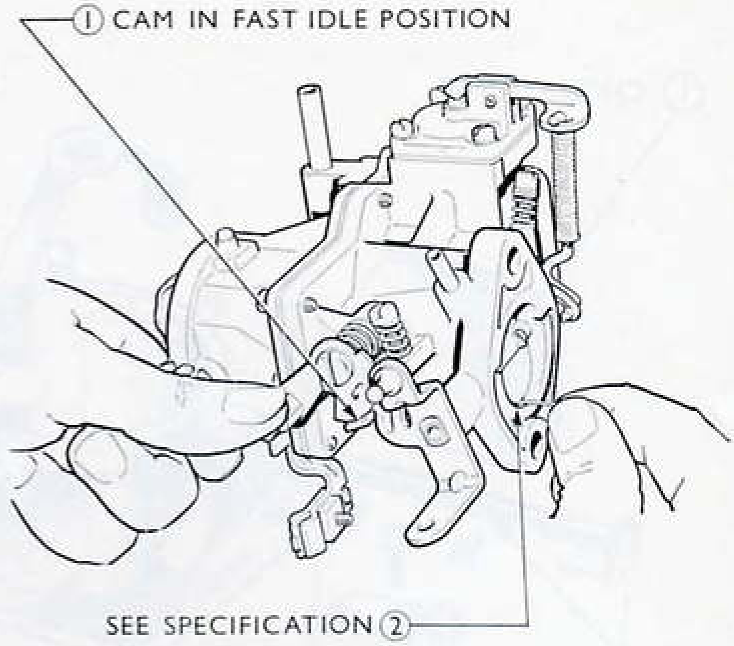


Fig. 21
Fast Idle Adjustment

Fast Idle

The fast idle adjustment can only be checked on the engine after first checking and adjusting (if necessary) the choke pull-down. If a tachometer is available this should be connected to the ignition. Run the engine until it reaches its normal operating temperature and idling speed (600 rev./min.). With the engine still running, hold the choke plate in the fully opened (vertical) position and rotate the choke lever until it is stopped by the choke linkage. With the choke lever in this position the fast idle cam will be opening the throttle plate a small amount and the engine speed should now rise to 750 to 850 rev./min. with manual choke, 2,000 to 2,200 rev./min. with automatic choke for carburettors fitted from May 1967 to September 1968.

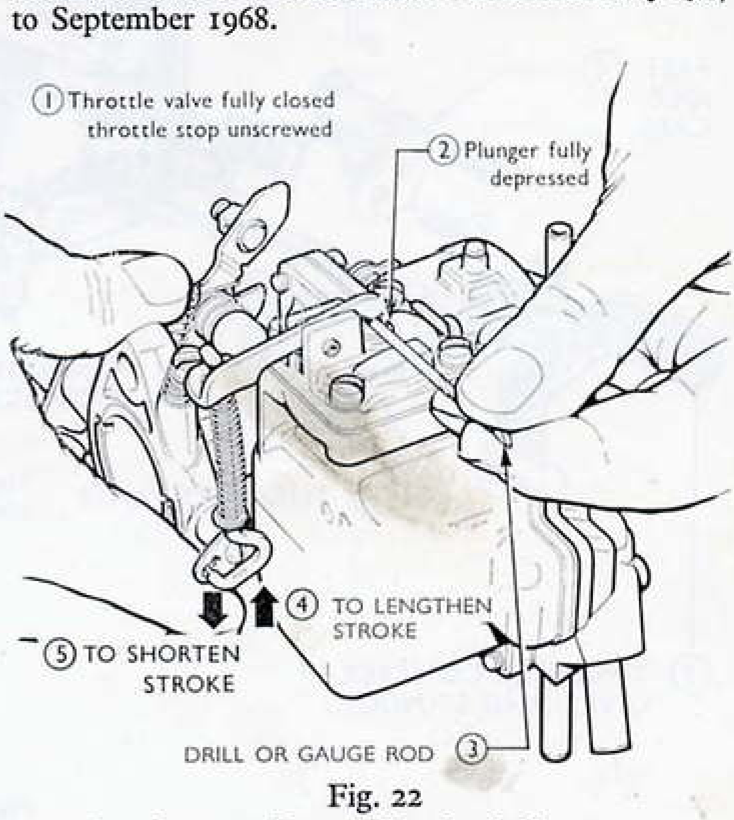


Fig. 22
Accelerator Pump Stroke Adjustment

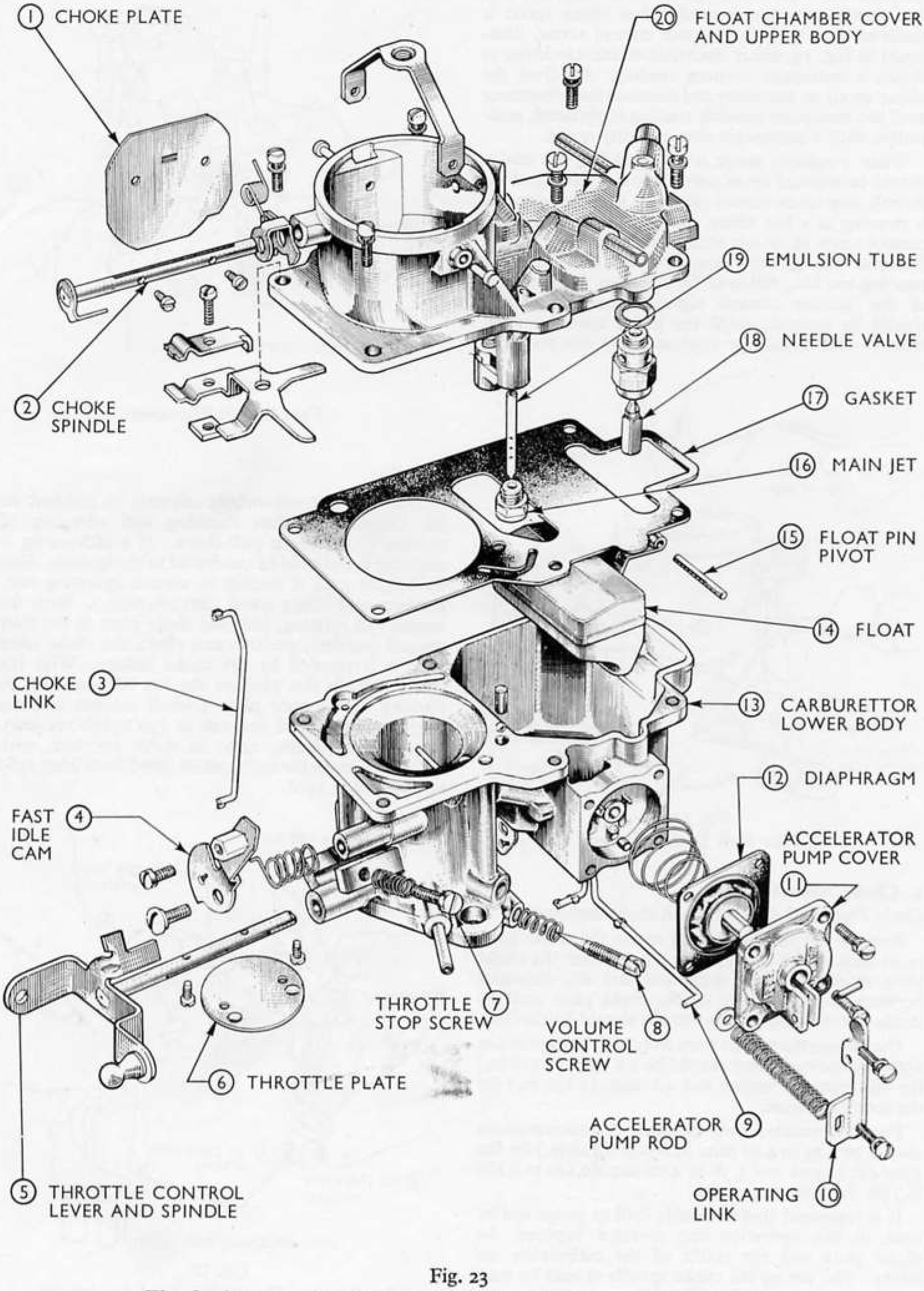


Fig. 23
The Carburettor (Manual) May 1967 to September 1968—Exploded

For carburettors fitted from September 1968 the engine speed should now rise to 750 to 850 rev./min. with manual choke, with automatic choke 2,000 to 2,200 rev./min. on the 1700 c.c. engine and 1,800 to 2,000 rev./min. on the 2,000 c.c. engine.

Ascertain the amount of radial movement required on the throttle lever to achieve this result and turn off engine. Clamp the throttle lever fully open with a pair of grips on the stop portion of the casting boss and bend up the tab to increase the fast idle or down to decrease. Repeat the operation and check as necessary.

If this operation is done off the engine, rotate the choke lever to its stop and check the clearance between the lower edge of the throttle plate and the inside of the carburettor barrel. This clearance should be 0.9 mm. (0.035 in.) for the manual choke (a number 64 drill may be used), and 3.8 to 4.3 mm. (0.15 in. to 0.17 in.) for the automatic choke carburettors fitted from May 1967 until September 1968. Check the clearance with a suitable drill or gauge rod (see Fig. 21).

If necessary adjust the throttle lever tab (as described previously) to obtain the correct clearance.

3. Accelerator Pump Adjustment

The accelerator pump has been set on manufacture for optimum requirements under normal operating conditions giving a pre-determined stroke and delivery of fuel at normal ambient temperatures.

The only adjustment to check is the stroke.

With the throttle stop screw backed off so that the throttle plate is fully closed, depress the diaphragm plunger. Check the clearance between the operating lever and the plunger which should be 4.5 mm. (0.175 in.) for the 1700 c.c. engines and 3.4 mm. (0.135 in.) for 2000 c.c. engines. This clearance can be checked with a drill or gauge rod (see Fig. 22). Bend the gooseneck of the pump push rod to adjust the stroke. Close the gooseneck to lengthen the stroke or expand it to shorten the stroke.

4. Float and Fuel Level Setting

To check the float or set the fuel level it is necessary to remove the air cleaner and the float chamber cover.

Release the outer choke cable from its clamped position to the carburettor top by undoing the clamp screw.

Remove the idling cam locating screw on the automatic choke carburettor.

Undo the six screws and spring washers retaining the upper body to the lower part of the carburettor body (one of these screws retains the choke cable bracket) lift off the upper body carefully, unlatch the choke link and at the same time observe that the gasket is not adhering to the lower body. Examine the float, ensuring that it has not been punctured, and the float arm to see that this is not damaged or bent.

With the carburettor upper body vertical, the distance from the bottom of the float to the mating surface of the gasket, distance 'A', (see Fig. 24), for carburettors fitted from May 1967 to September 1968, must be 28.5 mm. to 29.0 mm., (1.12 in. to 1.14 in.), for carburettors fitted from September 1968, 30.73 mm. to 31.24 mm. (1.21 in. to 1.23 in.). The position of the float is determined by the tab resting on the fuel inlet needle valve. Bend as necessary to achieve the desired measurement. Turn the upper body upright when the same measurement, distance 'B', (see Fig. 24), for carburettors fitted from May 1967 to September 1968, must be 35.1 mm. to 35.6 mm. (1.38 in. to 1.40 in.), for carburettors fitted from September 1968, 35.81 mm. to 36.32 mm. (1.41 in. to 1.43 in.), this can be adjusted by bending the tab resting on the needle valve housing.

Before replacing the carburettor upper body it is advisable to swill the chamber out with clean fuel to remove all sediment and to check on the correct functioning of the needle valve in the upper body.

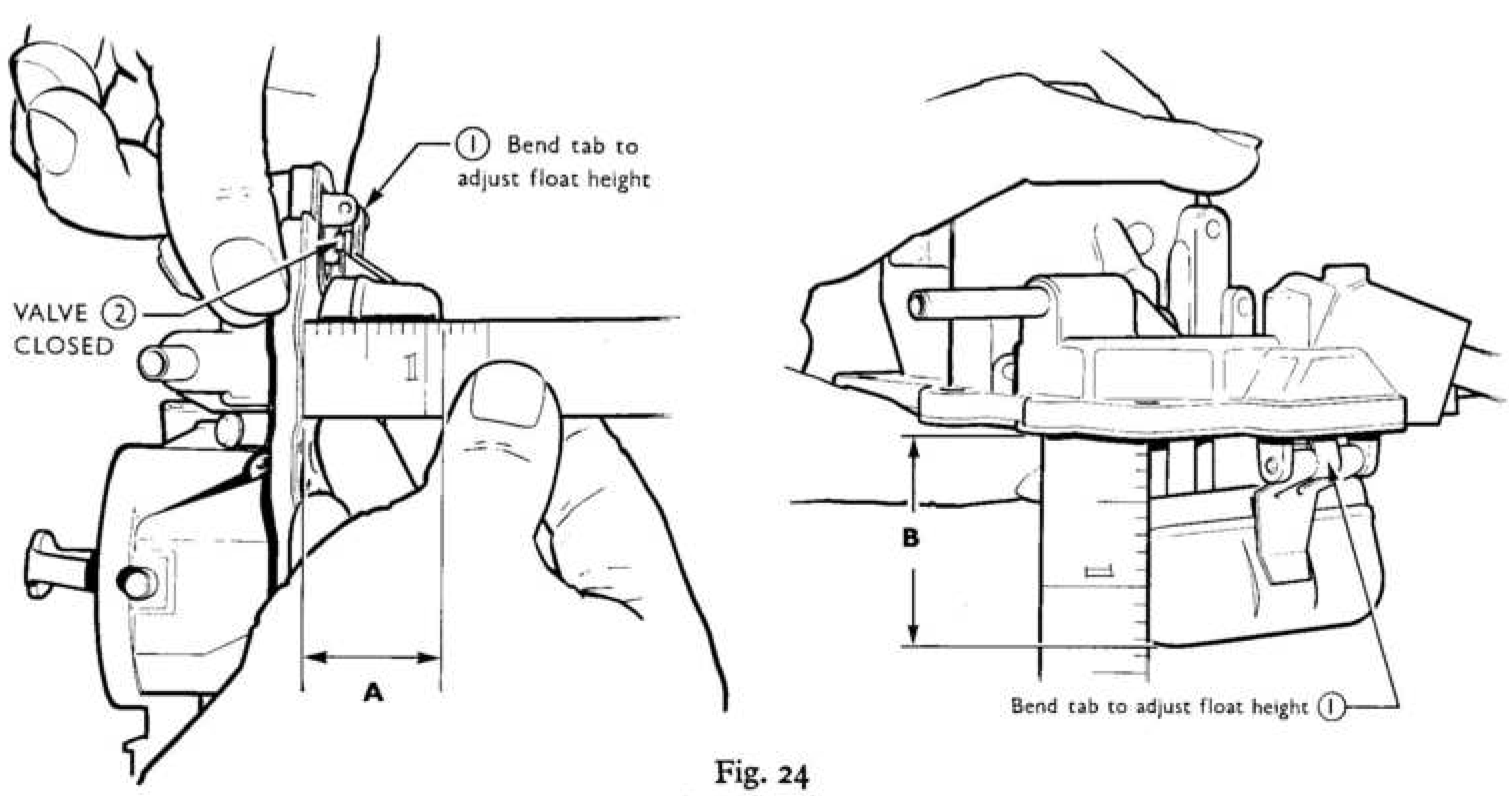


Fig. 24
Float Settings

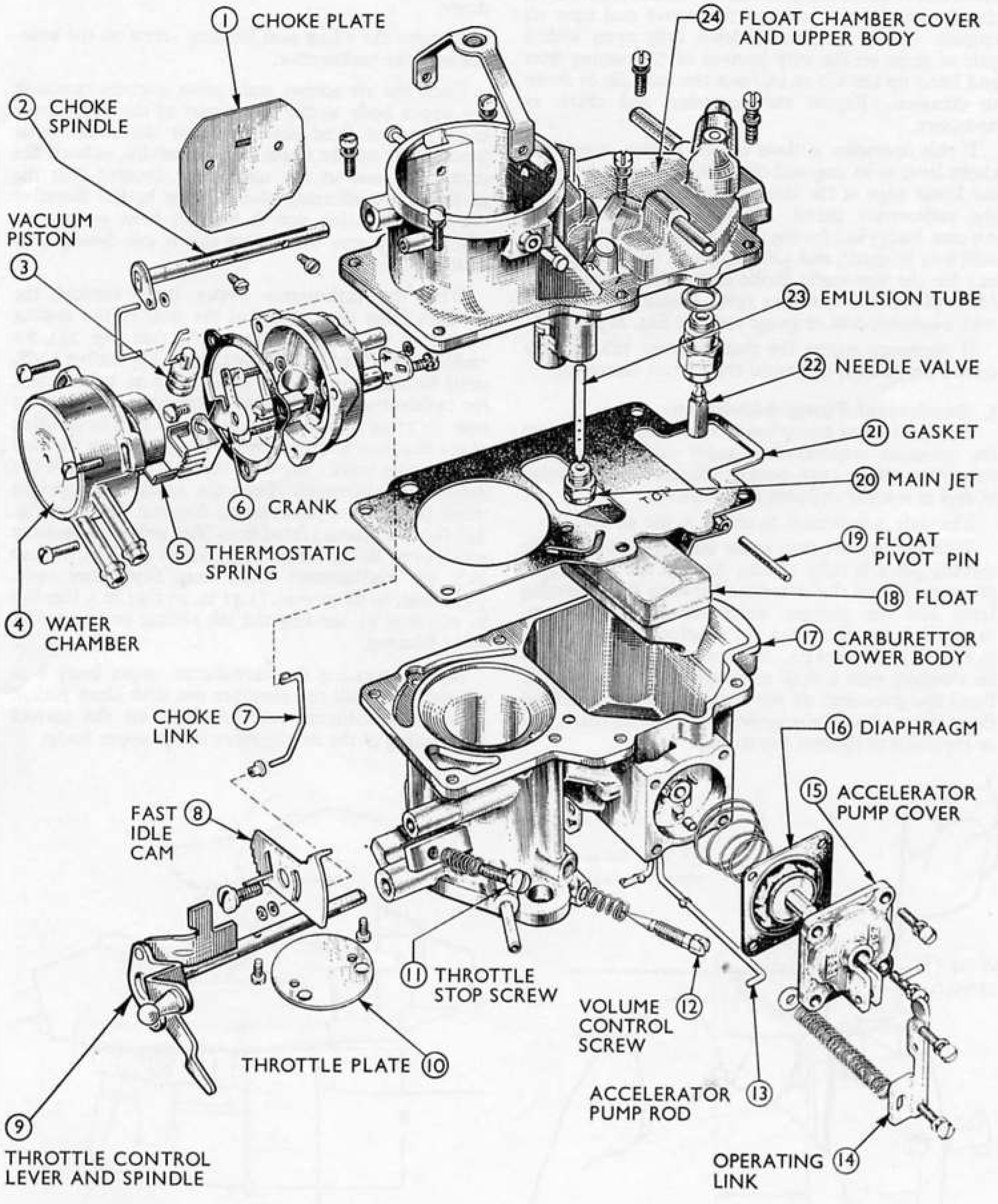


Fig. 25

The Carburettor (Automatic) May 1967 to September 1968—Exploded

REPAIR OPERATIONS

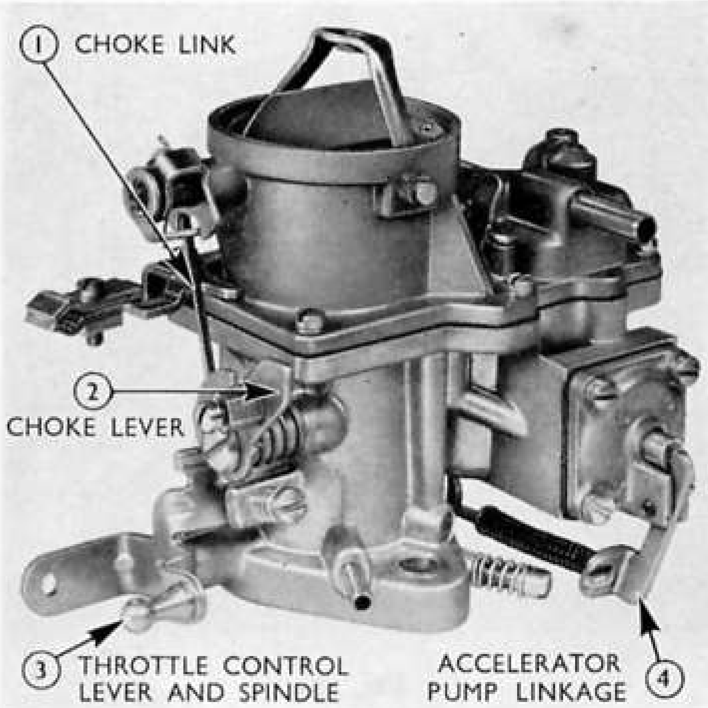


Fig. 26
Carburettor Linkages (Manual)

To Remove

1. Remove the air cleaner.

2. Disconnect the fuel feed pipe and the distributor vacuum pipe at the carburettor.

3. Disconnect the choke cable control by undoing the screw of the trunnion on the choke lever and releasing the inner cable. Undo the screw clamping the outer cable to the upper carburettor body cable bracket and withdraw the cable.

4. Disconnect throttle linkage.

5. Remove the two nuts and spring washers securing the carburettor to the manifold and lift off the carburettor.

6. Remove the carburettor to manifold gasket.

To Dismantle (Manual Choke)

1. Remove the six screws and spring washers securing the carburettor upper body to the lower body. Carefully lift off the upper body (see Fig. 27) and unlatch the choke link at the same time. The gasket should come away with the upper component and care should be exercised to see it is not adhering to the lower body.

2. Withdraw the float arm pivot pin and remove the float. This will allow the needle valve to be withdrawn.

3. Lift off the gasket from the upper body.

4. Remove the air cleaner retainer pins and retainer from the upper body.

5. Undo the two screws clamping the choke plate within its spindle and remove the plate.

6. Withdraw the choke spindle and slide the choke pull-down stop and spring off the spindle.

7. Undo the needle valve housing using a suitable socket or box spanner.

8. Unscrew the main jet using a $\frac{5}{16}$ in. AF socket.

9. Undo the screw and lockwasher retaining the accelerator pump push rod arm to the throttle spindle. Remove the arm and detach the push rod and spring.

10. Unscrew the four screws securing the accelerator pump in position and remove the accelerator pump body and operating arm, diaphragm and return spring.

11. Unscrew the cheese head pivot screw and remove the choke lever and return spring.

12. Undo the two screws clamping the throttle plate within its spindle and remove the plate.

13. Withdraw the throttle spindle from the body and remove the return spring.

14. Undo the volume control needle screw and remove the spring.

To Reassemble

1. Slide the pull-down spring and stop on to the choke spindle and insert the spindle into the carburettor body. Refit the choke plate.

It will be observed that there is a small rectangular stamping on the choke plate itself. This should be situated adjacent to the spindle, the indentation side upwards, i.e. alongside the screw head recesses of the spindle with the plate in the closed position.

2. Refit the air cleaner retainer and pins to the upper body.

3. Refit the main jet.

4. Replace the needle valve housing.

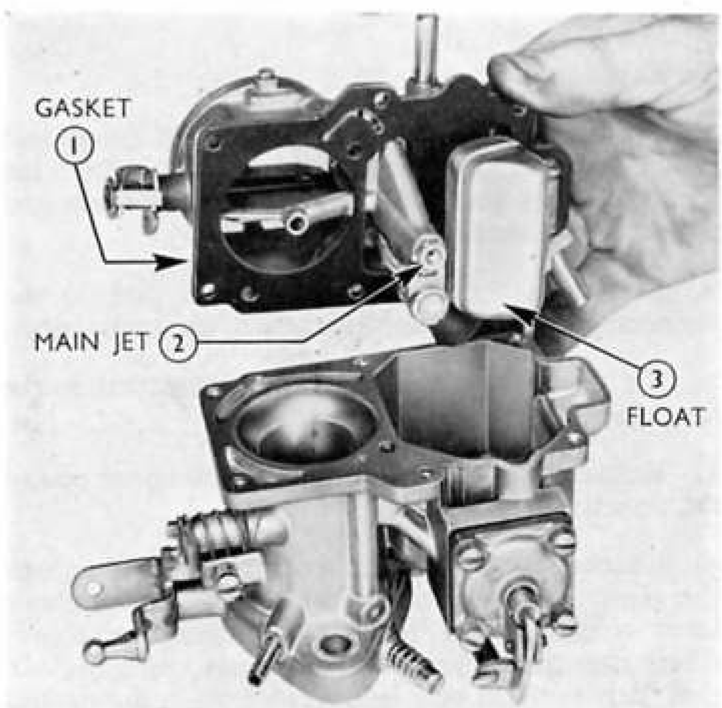


Fig. 27
Separating the Upper and Lower Bodies

5. Position a new gasket on the upper body.

6. Install the needle in the needle valve housing, needle end inwards.

7. Replace the float assembly, sliding the pivot pin into position.

8. Place the return spring on the bearing abutment of the body and refit the choke lever with its pivot screw.

9. Insert one end of the choke link into the pull-down stop and the other into the fast idle cam, hold the choke butterfly in the closed position and carefully refit the upper body to the lower body.

10. Secure the upper body with five screws and spring washers, the sixth screw and spring washer serving to retain the choke cable abutment bracket.

11. Refit the throttle return spring onto the bearing abutment of the body and slide the throttle spindle into the body.

12. Refit the throttle plate ensuring that the recessed sides of the two small indentations are adjacent to the screw head recesses with the throttle plate in the closed position.

13. Refit the diaphragm and plunger into the cover of the accelerator pump.

14. Replace the spring, locating its larger diameter over the three abutments within the pump housing and carefully replace the cover, securing it with the four screws and spring washers.

15. Connect the spring and push rod to the accelerator pump lever and attach the gooseneck end to the throttle arm. Secure this arm to the throttle spindle and with the screw and lockwasher.

16. Refit the volume control screw and spring.

To Replace

1. Locate a new gasket on the manifold flange and position the carburettor over the studs. Refit the spring washers and nuts on the mounting studs and tighten them securely.

2. Reconnect the distributor vacuum pipe to the connection on the right-hand side of the carburettor.

3. Fit the fuel pump line to its connection at the float chamber.

4. Refit the throttle control rod to the upper end of the throttle lever.

5. Connect the choke control outer cable and tighten the clamp. Pass the inner cable through the choke lever trunnion and tighten the clamping screw. Check that the choke opens and closes correctly, and that there is slight play in the cable when the control is pushed fully home.

6. Refit the air cleaner.

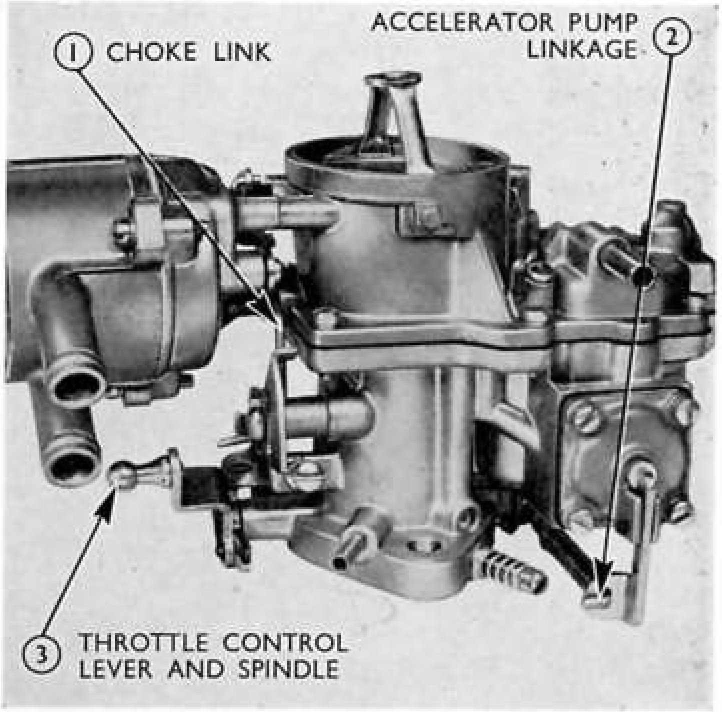


Fig. 28
Carburettor Linkages (Automatic)

Extra Operations for Automatic Choke (To be carried out before previous dismantle operations)

To Dismantle

1. Remove the idling cam locating screw.

2. Remove the three screws securing the thermostatic spring cover.

3. Undo the two screws holding the automatic choke cover to the carburettor body.

4. Remove the screw holding the automatic choke assembly to the cover.

5. Remove the vacuum piston and crank assembly from the choke housing.

6. Remove the remaining choke linkage arms.

To Reassemble

1. Pre-assemble the choke linkage arms.

2. Reassemble the vacuum piston, linkage and crank with the piston link in the inner crank arm hole, to the choke housing.

3. Reassemble choke housing to carburettor upper body.

4. Replace the screw holding the choke assembly to cover.

5. Relocate thermostatic spring into the centre slot in the choke crank.

6. Secure the spring cover to the choke housing

7. Locate and replace the idling cam screw.

THE FUEL TANK

The position of the fuel tank varies, depending on the type of vehicle and is usually retained in position by two straps secured at one end by adjustable hooks and, at the other, by brackets attached to the floor pan. Anti-squeak pads are fitted between the tank and the support straps, and also between the upper surface of the tank and the floor pan.

To Remove

1. **Disconnect the fuel line** and hose connectors from the pipes and detach the hoses from the clip under the floor.

2. **Disconnect the vent pipe** from the filler pipe connection and detach hose. Remove the fuel drain plug and drain the fuel from the tank.

3. **Disconnect the fuel filler pipe** by slackening the rubber pipe clamps.

4. **Disconnect the lead** connected by the terminal to the fuel gauge sender unit.

5. **Suitably support the fuel tank,** and unscrew the nuts on the threaded clamps. Unhook the straps from the holes on the floor member and lower the tank towards the ground.

To Replace

1. **Raise the fuel tank** sufficiently to connect the lead to the fuel gauge sender unit.

2. **Position the tank in its location** and engage the hooks on the end of each support strap in their respective holes on the floor member, ensuring that these support straps have the anti-squeak pads attached. Do not fully tighten the nuts on the hook clamps.

3. **Connect the fuel feed hose** and return hose to the rigid fuel pipes. Connect the vent hose to the filler pipe connection. Re-insert fuel hoses and vent hose in their respective clips.

4. **Tighten up the nuts on the hook clamps** until the fuel tank is firmly located.

5. **Reconnect the fuel filler pipe** and tighten the clamps. Refill the tank with fuel.

Maintenance

In course of time, sediment may collect in the fuel tank, its presence usually being denoted by sediment deposits on the fuel pump screen.

If it is suspected that either excessive deposits, or water, are present in the tank, the tank should be removed and throughly flushed with clean petrol.

When repairs involving the application of a flame or heat are necessary to a fuel tank, this should be flushed, "steamed" and allowed to stand for at least 24 hours to evaporate all fumes from the tank.

THE FUEL LINE

The fuel pipe is clipped to the underside of the floor pan. Occasionally, the unions and securing clips should be checked for tightness, and the pipe inspected to ensure that no chafing against the floor has occurred.

FUEL PUMP

Description and Operation

The fuel pump is a self-priming unit operated through a spring-loaded arm from an eccentric on the camshaft.

As the engine camshaft revolves, the eccentric moves the pump rocker arm upwards, causing the diaphragm to be moved downwards against the pressure of the diaphragm spring, by means of the diaphragm pull rod. This creates a partial vacuum in the pump chamber sufficient to open the inlet valve and draw fuel from the tank, entering at the inlet port and thence to the sediment chamber.

The fuel is then drawn through the filter screen and down past the non-return valve into the pump chamber immediately above the diaphragm.

Further movement of the engine camshaft allows the spring loaded-rocker arm to move downwards, allowing the diaphragm spring to push the diaphragm upwards. This forces the fuel in the pump chamber past the outlet valve into the outlet pipe connecting the pump to the carburettor float chamber.

When the carburettor bowl is full, the floats will close the needle valve, thus preventing further petrol supply from the fuel pump. The pressure thus created will hold the fuel pump diaphragm downwards against the pressure of the diaphragm spring and it will remain in this position until the carburettor requires more fuel and the needle valve opens.

The operating linkage of the pump is such that idling movement of the rocker arm is allowed when there is no movement of the fuel pump diaphragm. A spring holds the rocker arm in constant contact with the eccentric to minimise operating noise.

The fuel pump incorporates valve assemblies which are serviced as complete units. Each unit consists of a small brass cage holding the valve and spring which can be fitted in either inlet or outlet position.

Every 8,000 km. (5,000 miles)

Cleaning the Fuel Pump

The filter screen, glass sediment bowl and the sediment chamber should be cleaned with petrol every 8,000 km. (5,000 miles), and the flange screws checked with a hand screwdriver for tightness. If any screws are found to be loose the pump assembly must be removed, the diaphragm located and the flange screws torqued as in part 6 of the reassemble instructions on page 24.

To Remove the Filter Screen

1. Unscrew the sediment bowl retainer clamp and lift off the bowl and filter screen.

2. Carefully wash the screen in petrol and flush all traces of sediment from the sediment chamber and bowl.

To Refit

1. Refit the screen to the fuel pump body.

2. Ensure that the gasket is in good condition and will make an airtight joint. Refit the sediment bowl and tighten the clamp to retain the sediment bowl in position.

Testing the Fuel Pump

Providing there are no leaks or obstructions in the fuel line, a quick check of the fuel pump efficiency can be made as follows:

1. Disconnect the fuel pump to carburettor pipe at the pump outlet.

2. Crank the engine by means of the starter motor, when a well-defined spurt of fuel should be apparent for each revolution of the camshaft. If the pump does not operate correctly, check the inlet depression and delivery pressure using suitable gauges. (The gang gauge set (Tool No. 500) or a Diagnosis Test Set have suitable gauges and adaptors for this work.)

Fuel Pump Inlet Depression Test

1. Fill the carburettor float chamber with petrol.

2. Disconnect the fuel line from the fuel tank at the pump inlet, suitably plugging the end of the pipe to prevent loss of fuel from the tank or the ingress of foreign matter. Sharp plugs i.e. screws should not be used.

3. Connect the vacuum gauge to the inlet union, start the engine and allow it to run at idling speed, when a vacuum reading of at least 21.59 cms. (8½ in.) mercury should be obtained.

4. Stop the engine, when the gauge needle should take at least one minute to return to zero.

Fuel Pump Delivery Pressure Test

1. Fill the carburettor float chamber with petrol.

2. Disconnect the fuel pump to carburettor pipe at the carburettor and connect the pressure gauge to the pump outlet. Leave the return flow pipe in the circuit (if fitted).

3. Start the engine and observe the pressure when running at idling speed. Momentarily race the engine and observe the pressure. This should not be less than 0.070 kg. per sq. cm. (1 lb. per sq. in.) and should be between 0.25 and 0.35 kg. per sq. cm. (3.5 and 5 p.s.i.) at idle with needle seat valve closed.

Low fuel pump outlet pressure may limit engine performance. An excessive pressure may result in a high float chamber level, with possible flooding. High fuel pump pressure may also cause the engine to stall, due to an over-rich mixture.

4. Disconnect the pressure gauge from the pump and reconnect the fuel pump to carburettor pipe.

Overhauling the Fuel Pump

To Remove

1. Disconnect the fuel pump to carburettor pipe and remove the pipe.

2. Detach the fuel supply pipe from the petrol tank. The pipe should be suitably plugged to prevent loss of fuel or the ingress of foreign matter. Sharp plugs i.e. screws should not be used.

3. Unscrew and remove the two bolts and spring washers securing the fuel pump to the cylinder block and detach the fuel pump, lifting the operating lever to clear the eccentric and the slotted hole in the block. Remove the gasket.

4. Slacken the clamp and remove the sediment bowl and gasket.

5. Pull off the filter gauze and wash thoroughly in clean petrol.

6. Mark the position of the tab on the side of the body and unscrew the upper body retaining screws and remove the body.

7. Carefully remove the valve assemblies and gaskets if they require a replacement. These assemblies are staked in position.

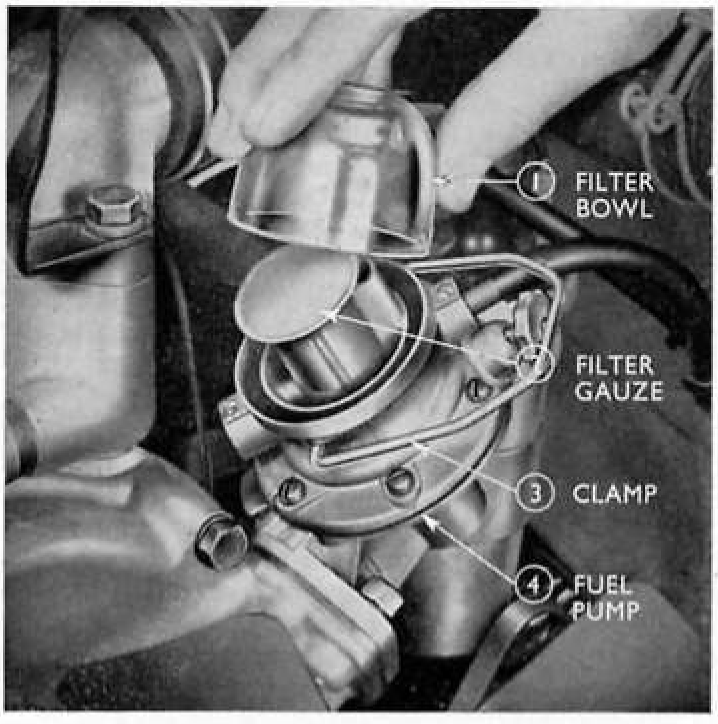


Fig. 29
Removing the Sediment Bowl

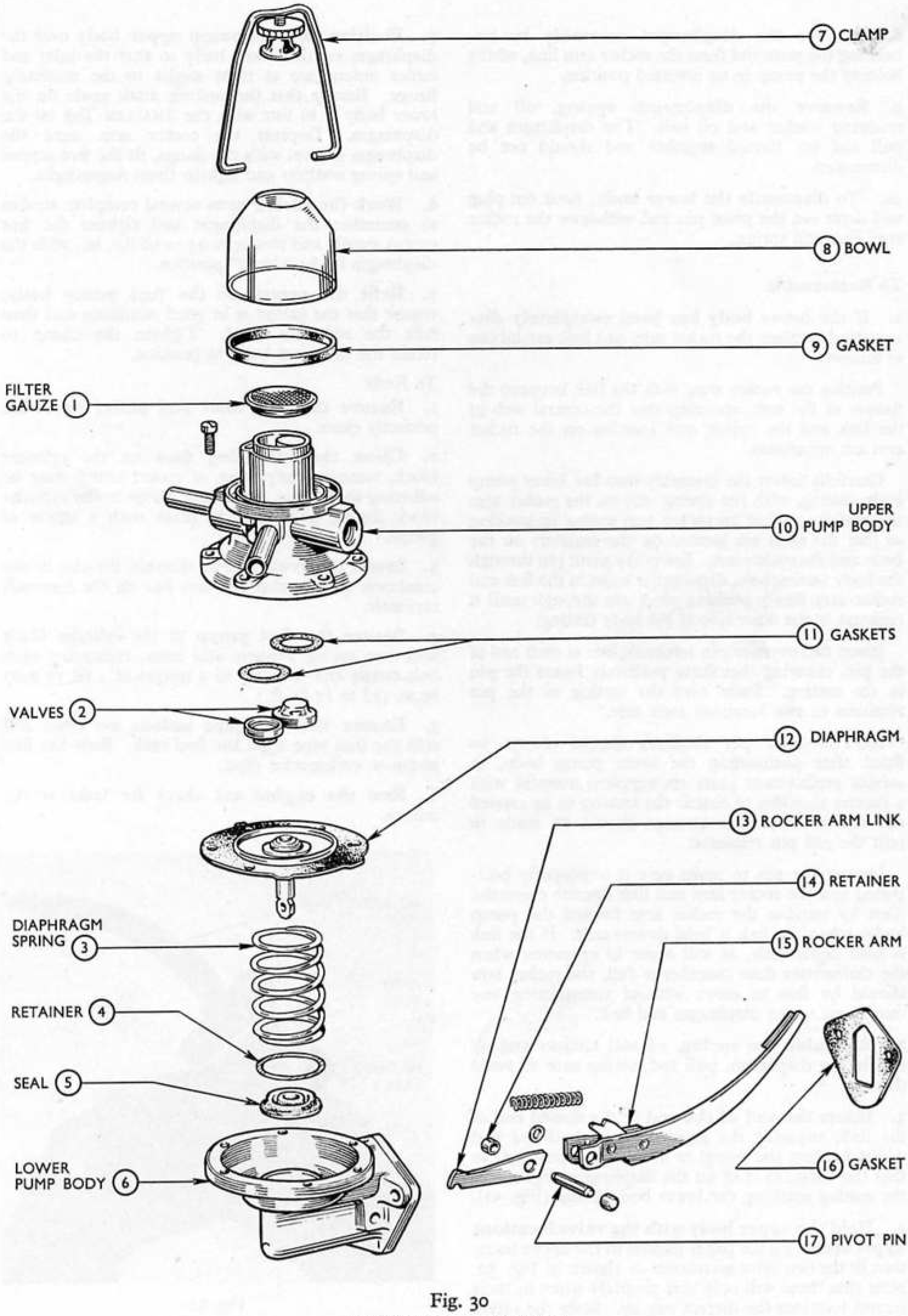


Fig. 30
Fuel Pump — Exploded

8. **Remove the diaphragm assembly** by unhooking the push rod from the rocker arm link, whilst holding the pump in an inverted position.

9. **Remove the diaphragm spring,** oil seal retaining washer and oil seal. The diaphragm and pull rod are riveted together and should not be dismantled.

10. **To dismantle the lower body,** hook out plug and drive out the pivot pin and withdraw the rocker arm, link and spring.

To Reassemble

1. **If the lower body has been completely dismantled,** replace the rocker arm and link assemblies as follows:

Position the rocker arm, with the link between the flanges of the arm, ensuring that the central web of the link and the spring seat location on the rocker arm are uppermost.

Carefully insert the assembly into the lower pump body casting, with the spring seat on the rocker arm uppermost, placing the rocker arm spring in position so that the ends are located by the registers on the body and the rocker arm. Insert the pivot pin through the body casting hole, aligning the holes in the link and rocker arm, finally pushing pivot pin through until it registers in the other side of the body casting.

Insert two oversize pin retainers, one at each end of the pin, ensuring that these positively locate the pin in the casting. Stake over the casting to the pin retainers in two locations each side.

NOTE.—New pin retainers should always be fitted after dismantling the lower pump body, as service replacement parts are supplied oversize with a shorter shoulder to enable the staking to be carried out satisfactorily. No attempt should be made to refit the old pin retainers.

Inspect the pin to make sure it is properly positioned and the rocker arm and link operate correctly. Test by moving the rocker arm toward the pump body, when the link is held downwards. If the link is held downwards, as will occur in operation when the carburettor float chamber is full, the rocker arm should be free to move without transmitting any movement to the diaphragm and link.

2. **Assemble the spring,** oil seal retainer and oil seal to the diaphragm pull rod, taking care to avoid damage.

3. **Insert the end of the rod** in the slotted end of the link, engaging the groove in the pull rod end whilst holding the pump in an inverted position, so that the SMALLER TAB on the diaphragm aligns with the mating mark on the lower body flange (Fig. 31).

4. **Hold the upper body with the valve locations uppermost.** Fit the paper gaskets in the upper body, then fit the two valve assemblies as shown in Fig. 30. Note that these will only seat properly when in their correct locations the correct way up. Stake the valves in position.

5. **Position the fuel pump upper body** over the diaphragm on the lower body so that the inlet and outlet unions are at right angles to the mounting flange. Ensure that the mating mark made on the lower body is in line with the SMALLER TAB on the diaphragm. Depress the rocker arm until the diaphragm is level with the flange, fit the five screws and spring washers and tighten them finger-tight.

6. **Work the rocker arm** several complete strokes to centralise the diaphragm and tighten the five screws evenly and torque to 25 to 30 lbs. in., with the diaphragm in the "down" position.

7. **Refit the screen to the fuel pump body,** ensure that the gasket is in good condition and then refit the sediment bowl. Tighten the clamp to retain the sediment bowl in position.

To Refit

1. **Ensure that the inlet and outlet ports** are perfectly clean.

2. **Clean the mounting face** on the cylinder block, removing any trace of gasket which may be adhering to the face. Fit a new gasket to the cylinder block flange, holding it in place with a smear of grease.

3. **Insert the rocker arm** through the slot in the crankcase wall so that the arm lies on the camshaft eccentric.

4. **Secure the fuel pump** to the cylinder block with two spring washers and bolts, tightening each bolt evenly and securely to a torque of 1.66 to 2.07 kg.m. (12 to 15 lb. ft.).

5. **Ensure that the pipe unions** are clean and refit the fuel pipe from the fuel tank. Refit the fuel pump to carburettor pipe.

6. **Run the engine** and check for leaks at the unions.

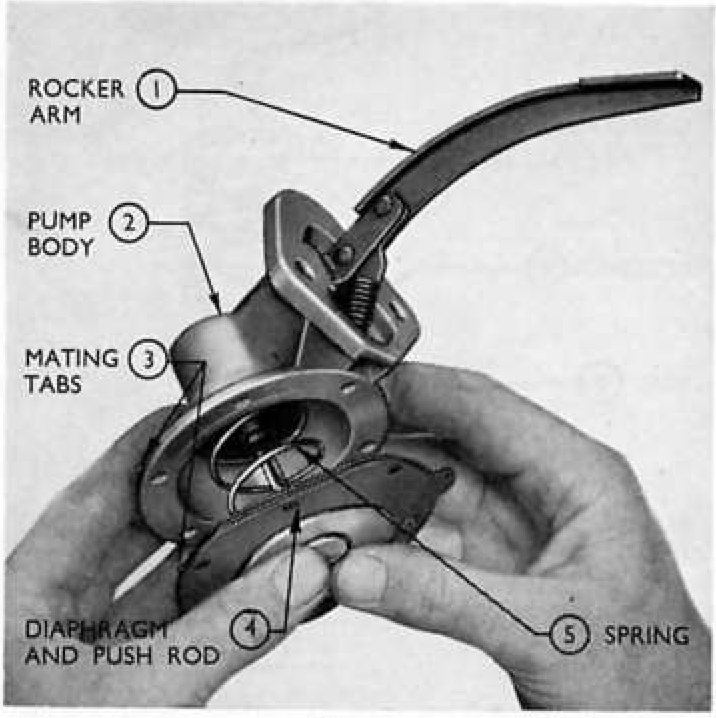


Fig. 31
Assembling Fuel Pump

FUEL SYSTEM: DIESEL

OVERHAUL PROCEDURES

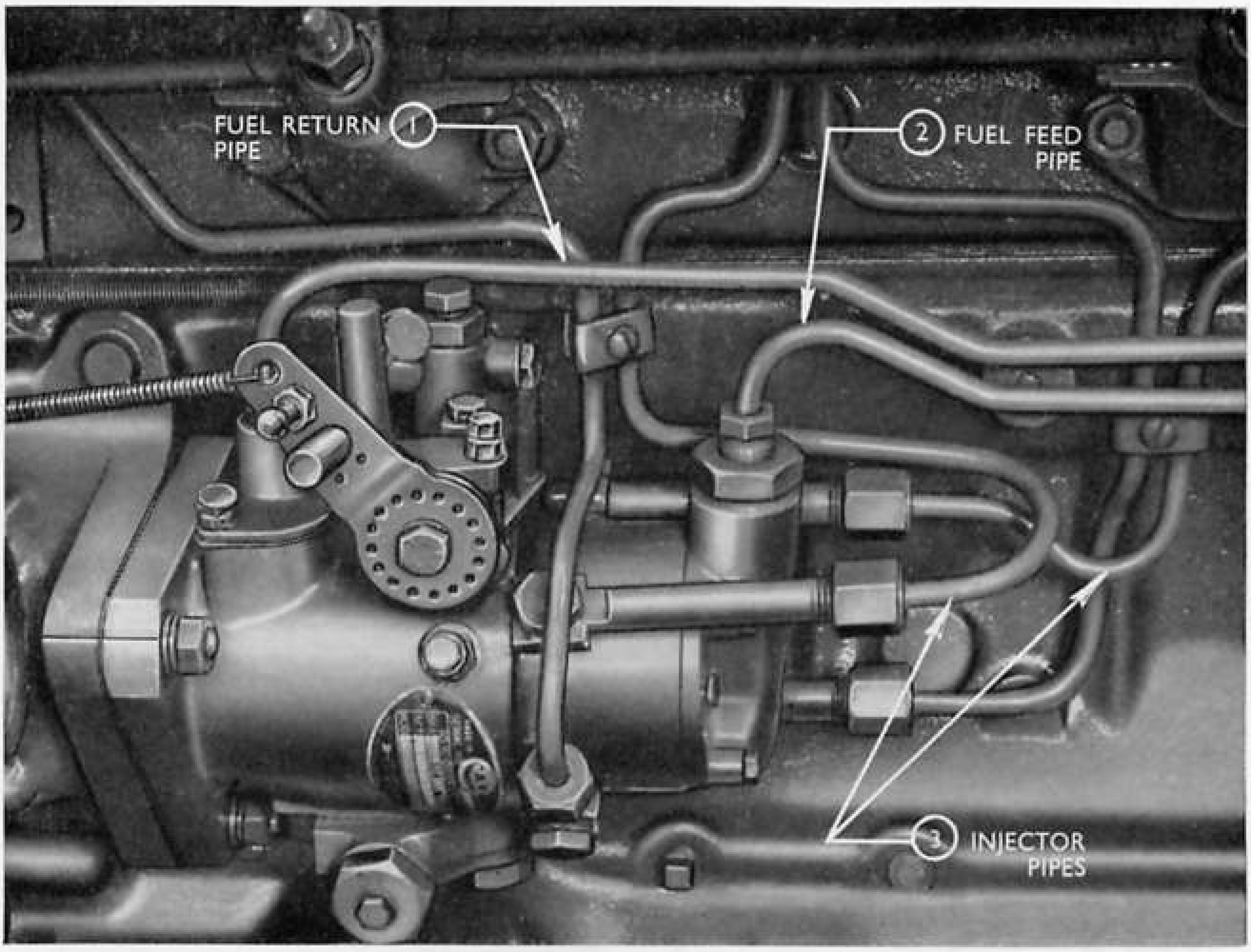


Fig. 32
The Fuel Injection Pump (4/99)

Introduction

The Fuel System consists of a fuel tank, sediment bowl, lift pump, filter, injection pump and injectors. There is also a small reservoir mounted behind the engine to provide a gravity feed to the cold starting device in the manifold.

The fuel lift pump is of the diaphragm type mounted on the engine tappet chamber cover and operated by a push rod from an eccentric on the engine camshaft. This pump incorporates a hand priming lever to enable the fuel system to be bled. The lift pump draws fuel from the fuel tank through a sediment bowl mounted inside the engine compartment.

From the fuel lift pump the fuel passes through a replaceable element-type filter to a distributor-type fuel injection pump. Fuel at high pressure is then passed, in turn, to each of the four delay-type pintle nozzle injectors mounted in the cylinder head. The injectors are lubricated by fuel oil leaking back past the needle valve stems. This fuel is returned to the fuel tank, via the starting device reservoir, by a "leak-off" pipe.

Service Precautions

It should be stressed that as the fuel injection equipment is extremely accurate and finely finished, it is essential that every care be exercised to prevent damage when carrying out repairs or overhauls.

Special equipment must be used when carrying out the pump test procedures and re-setting injector pressures. For all operations a dust-proof room should be provided.

To protect the pump and injectors when they are removed prior to servicing, and to protect them before refitting to an engine, special dust caps and plugs from the pump repair kit should be used for blanking fuel connections.

For cleaning and testing an odourless kerosene, or a special substitute test fuel must be used, see Specification and Repair Data.

The mechanic should protect his hands with a good quality barrier cream prior to commencing any work

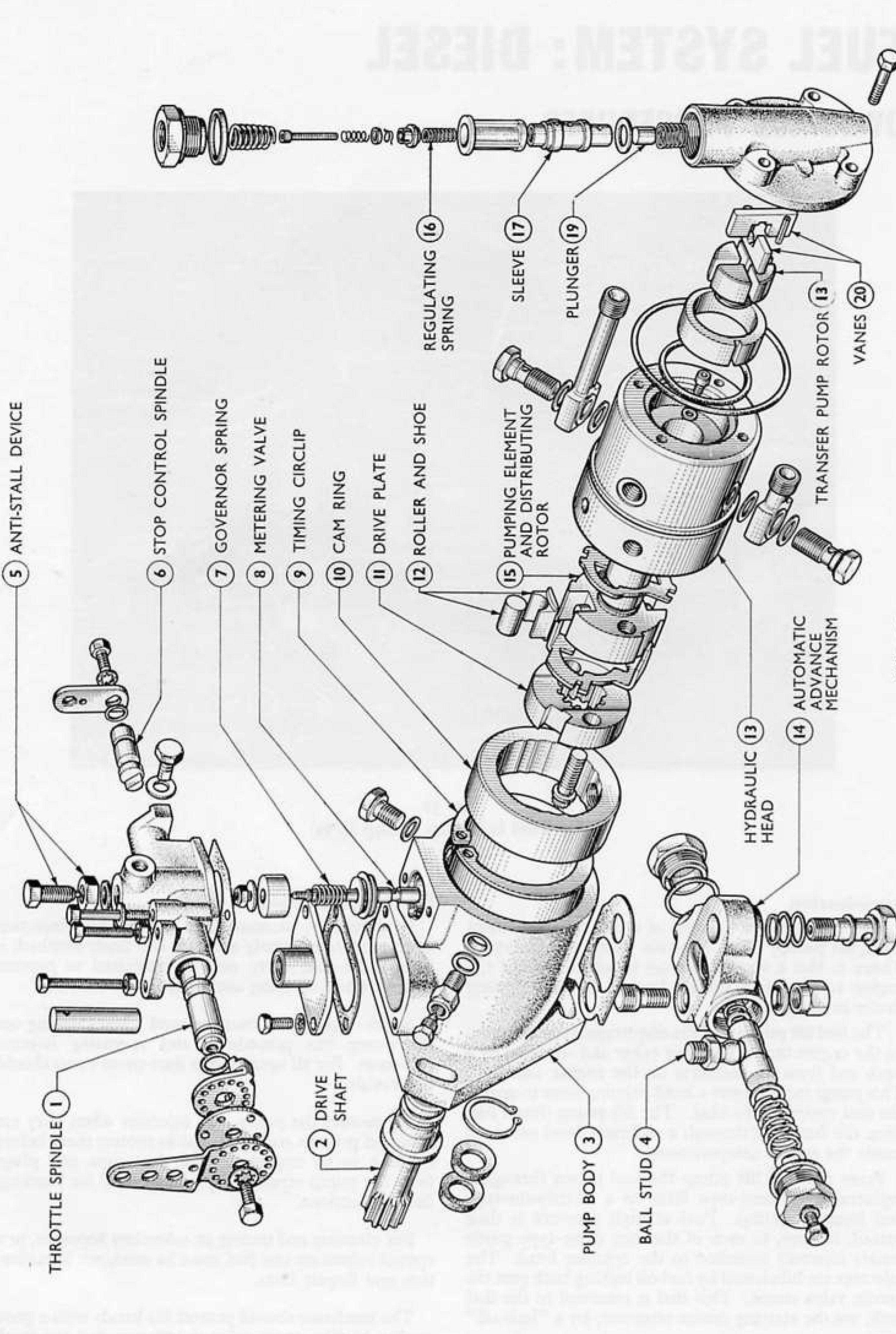


Fig. 33
Fuel Injection Pump — Exploded

of this nature, as a certain amount of fuel oil is bound to be present in pumps and injectors which have been in service.

Care should also be taken when testing injectors to prevent spray from the injectors coming into direct contact with the hands, as the working pressure is such that it will easily penetrate the skin.

Remember ! Cleanliness is essential.

THE DISTRIBUTOR TYPE INJECTION PUMP

Description

The distributor type injection pump consists of a single pumping element (two opposed plungers, revolving in a cam ring). This pumping element delivers fuel at high pressure to all injectors in turn by means of a distributing rotor integral with the pump rotor. A vane type transfer pump at the end of the distributing rotor supplies fuel to the pumping element via an annular groove in the distributing rotor, the metering valve and port. Transfer pressure is determined by a regulating valve in the end cover. The maximum fuel delivery is controlled by the stroke of the pumping element plungers which is determined by stop plates attached to either side of the pump rotor.

The hydraulic governor consists of the governor spring, control sleeve damper and metering valve. As the accelerator is depressed or released the throttle shaft increases or decreases the pressure on the control sleeve and governor spring.

A stop plate, attached to the throttle shaft and two adjusting screws limit the movement of the shaft and set the maximum and idling speeds.

The injection pump is mounted horizontally on the left-hand side of the engine and is driven at half engine speed by a timing gear in mesh with an idler gear driven by the engine crankshaft.

Operation

Injection Pump

Fuel from the fuel pump is filtered by a replaceable element-type filter and enters the injection pump at the fuel inlet connection (see Fig. 36). After passing through a nylon filter an eccentric sliding vane-type transfer pump increases the pressure. This pressure increase is proportional to the engine speed and is controlled by a regulating valve. The regulating valve is a spring-loaded plunger in a sleeve situated beneath the inlet connection between the inlet and outlet side of the transfer pump. The fuel pressure lifts the plunger up against the regulating spring until the regulating port is partially open and fuel bleeds back to the inlet side of the transfer pump, thus regulating the transfer pressure.

Fuel at transfer pressure flows through a drilling in the hydraulic head and then, via an annular groove in the distributor rotor to the metering valve. The metering valve is controlled by a hydraulic governor which is operated by fuel at transfer pressure acting on one side of the metering valve and is balanced on the other side by a governor spring. The governor spring load is varied by a cam, machined on the inner end of the throttle spindle. A throttle lever attached to the end of the spindle is connected to the accelerator pedal. At low engine speeds the action of the governor spring is compensated by an idling spring.

An increase in the governor spring load, by depressing the accelerator pedal, moves the metering valve downwards to uncover more of the metering port and increase the fuel delivery. As the engine speed increases the transfer pressure increases, until it is sufficient to move the metering valve upwards to a reduced fuel position and balance the increased spring load, thus effectively governing the engine speed.

To prevent the engine stalling when decelerating from high to idling speed, an anti-stall device is fitted in the top of the governor housing. This device is a spring-loaded adjustable stop which limits the movement of the metering valve upwards, ensuring that fuel delivery is not completely cut off during deceleration.

A metered quantity of fuel flows to the pumping element each time one of the four inlet ports in the distributor rotor is in alignment with the metering port. The single pumping element consists of opposed plungers in a radial bore machined through the pump rotor. Rollers located in shoes sliding in the rotor are displaced by internal lobes in a stationary cam ring and operate the plungers as the rotor revolves at half engine speed. The metered quantity of fuel flowing into the pumping element moves the plungers apart. Different quantities of fuel, depending on operating conditions, will cause different displacements. At full load the maximum quantity of fuel is limited by a stop restricting the outward movement of the shoes.

As the rotor revolves the inlet port, which has communicated with the metering port, moves away and injection commences as each roller rides up the flank of diametrically opposed lobes to force the plungers together (see Fig. 36). At this instant, the distributing port will be in alignment with one of the four delivery ports and fuel at high pressure will be delivered to the appropriate injector. Each cam lobe has two peaks and injection ceases when the roller reaches the first, which is the highest. The valley between the two peaks ensures a rapid reduction in pressure in the injector pipe line preventing dribble and carbon formation at the injector nozzle at the end of injection. The second, lower, peak maintains residual pressure in the pipe lines. The cam ring between the lobes is relieved and the rollers do not at any time contact this surface which, therefore, is not ground.

Advance Mechanism

The cam ring is not fixed to the injection pump body but is attached by a ball stud to the advance and retard mechanism (see Fig. 33). This consists of inner and outer pistons located in a transverse bore machined through a housing attached to the underside of the injection pump body. Fuel at transfer pressure acting on the outer piston crown is opposed by a spring. The ball pin is located in the inner piston, which is also spring-loaded, and transmits any movement of the outer piston to the cam ring. As transfer pressure increases with speed, the piston moves, compressing the spring and advancing the injection pump timing. A decrease in speed causes the transfer pressure to drop and the spring pressure moves the piston back, retarding the injection pump timing.

At full load the pumping element plungers are operated by the rollers earlier than at light loads, when the reduced quantity of fuel restricts outward movement of the plungers and, therefore, plunger operation does not commence until the rollers are nearer to the cam peaks. If the cam ring were fixed this would result in the injection pump timing being retarded. However, at light loads the inner spring-loaded piston (Fig. 33) holds the cam ring in an advanced position to compensate for this. At full load the increased plunger displacement causes a higher torque to be applied to the cam ring. This torque, transmitted to the inner piston by the ball pin, overcomes the spring pressure and retards the cam ring to give correct injection pump timing advance characteristics.

The injection pump is lubricated by fuel oil which is permitted to bleed past the rotating parts and completely fills the pump body.

Surplus fuel oil is returned to the inlet side of the fuel filter from the low pressure outlet.

Regulating Valve

The regulating valve performs an additional function to transfer pressure regulation, described previously. Provision is made in the regulating valve for by-passing the sliding vane type transfer pump to enable the injection pump to be primed or bled. When the injection pump is not operating the regulating plunger is in the lower part of the regulating sleeve bore and rests on a priming by-pass spring (see Figs. 33, 36 and 39). Operation of the lift pump priming lever forces fuel at lift pump pressure through the inlet connection and into the regulating sleeve bore. This pressure forces the plunger downwards compressing the priming by-pass spring and uncovering the priming port in the sleeve (see Figs. 33, 36 and 39). The transfer pump is then by-passed and the injection pump may then be primed and bled. The regulating plunger returns to its normal position after bleeding has been completed.

Stop Control

To stop the engine, the stop lever is turned, by pulling the control in the cab, moving the metering valve upwards against the governor and anti-stall device spring pressures to close the metering port completely.

Cold Starting Device

As there is no excess fuel device incorporated in this injection pump a cold starting device is fitted in the inlet manifold. The "Thermostart" is described on page 51.

Lubrication

The body of the injection pump is completely filled with fuel oil, which is continuously being re-circulated, and requires no additional lubrication.

OVERHAUL PROCEDURES

Fig. 34
Timing the Injection Pump (4/99)

The injection pump has a timing mark scribed on the mounting flange that aligns with a similar mark on the cylinder block (see Fig. 34).

The injection pump may be removed and/or replaced regardless of the engine's rotational position, providing the engine timing gears are not disturbed.

The pump drive shaft has a master spline, which locates in a corresponding spline in the engine timing gear hub. When fitting an injection pump, maintain the correct injection timing by engaging the master splines and aligning the timing marks on the injection pump mounting flange and the cylinder block.

To Remove

1. **Raise the bonnet** and secure with the stay.

2. **Unscrew the exhaust pipe clamp bolts** and remove the clamp and circular steel insert (4/99 only).

3. **Remove the exhaust manifold clamp bolts,** and remove the manifold (4/99 only).

4. **Disconnect the four injector pipes.**

5. **Remove the inlet and outlet pipes** from the injection pump and filter.

6. **Disconnect the stop and throttle controls.**

7. **Unscrew the nuts** securing the injection pump to the engine. Remove the pump.

NOTE.—The 4/108 pump is secured by two studs and a bolt.

Preliminary Checking

Before the injection pump is dismantled or a replacement unit fitted to an engine, the pump that has been removed should be thoroughly cleaned and its operation checked on a calibrating machine. It is also advisable to remove and check the operation of the fuel injection pump whenever the engine is undergoing major attention. Even pumps that have seen very extensive service should be checked for general performance to ascertain (*a*) if any faults exist, and (*b*) whether a complete overhaul is necessary.

To check the operation of the pump it is only necessary to complete the operations marked thus † on the test procedure on page 41.

To Replace or Refit a Fuel Injection Pump

1. **Locate the injection pump** on the mounting studs on the cylinder block, at the same time engaging the master spline on the pump drive shaft with a corresponding spline on the engine timing gear hub.

2. **Align the timing mark** scribed on the injection pump mounting flange with the timing mark on the cylinder block (see Fig. 34). Fit the nuts (and the bolt on the 4/108), then tighten securely.

3. **Connect the throttle and stop controls,** adjusting the throttle lever position, if necessary. Locate the throttle linkage in **the lever inner hole.**

4. **Refit the inlet and outlet pipes** to the fuel pump and filter. Ensure that the inlet pipe to the injection pump is connected to the connection marked " OUT " on the filter.

5. **Fit the fuel injector pipes** to their respective connectors on the fuel injection pump.

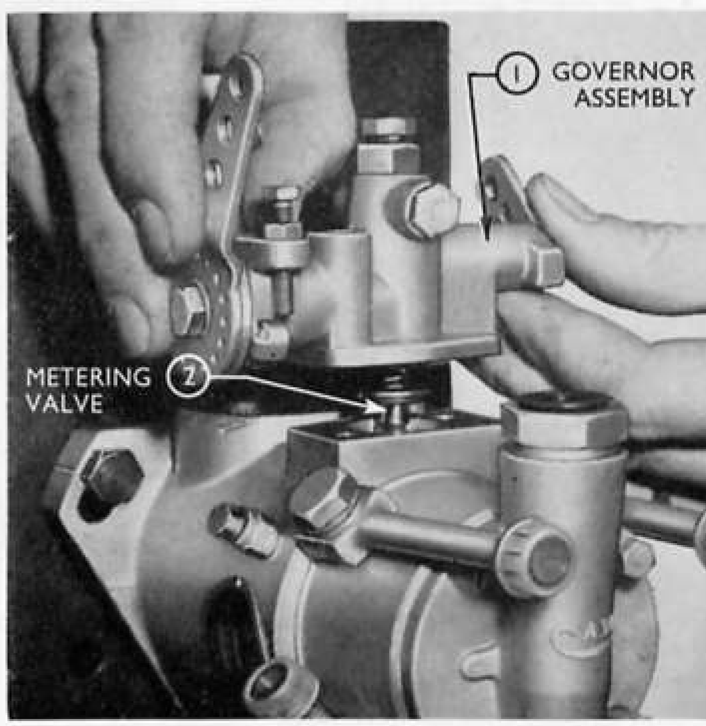


Fig. 35
Removal of Governor Assembly

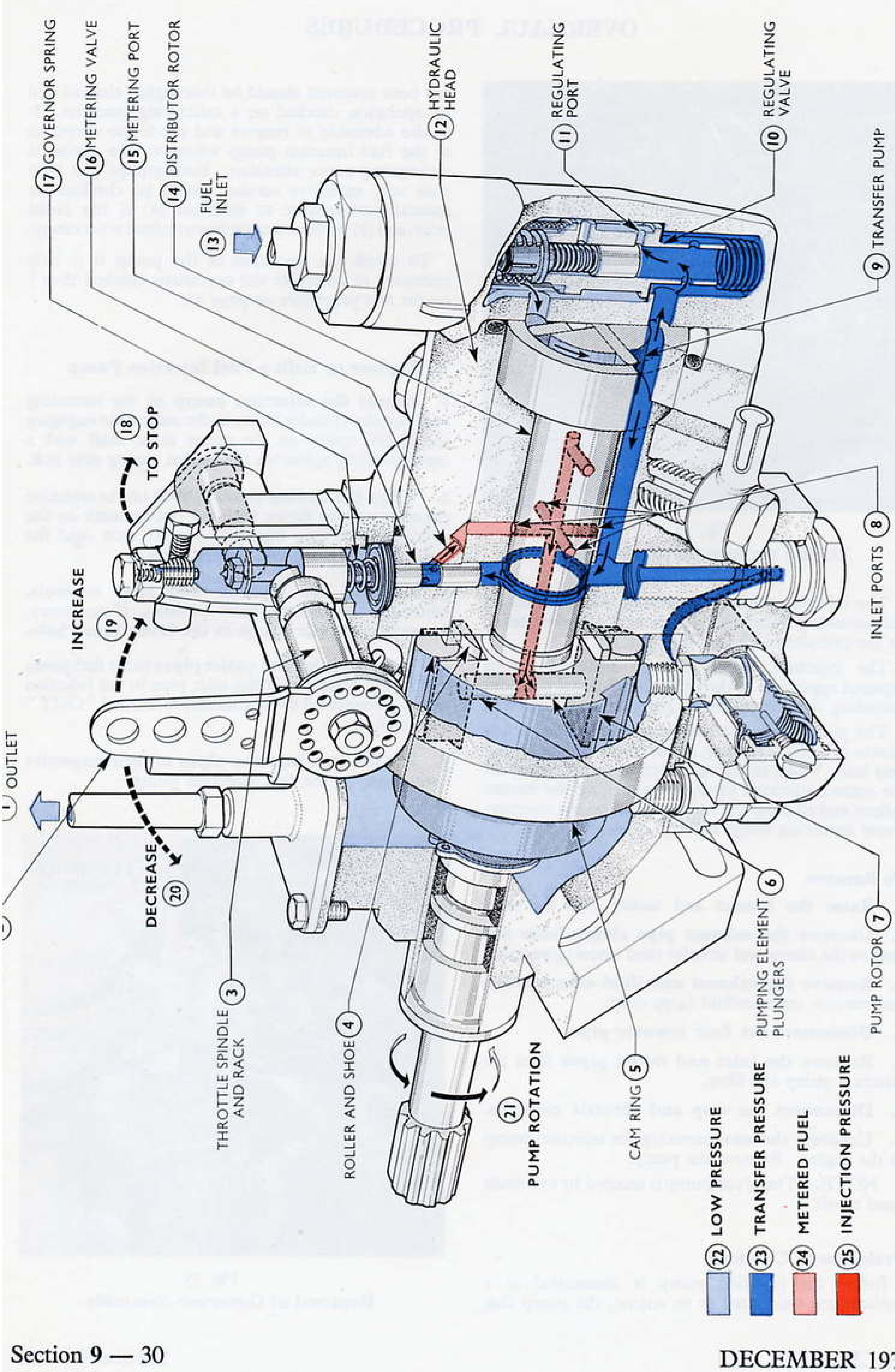


Fig. 36
Operation of Fuel Injection Pump (Metering)

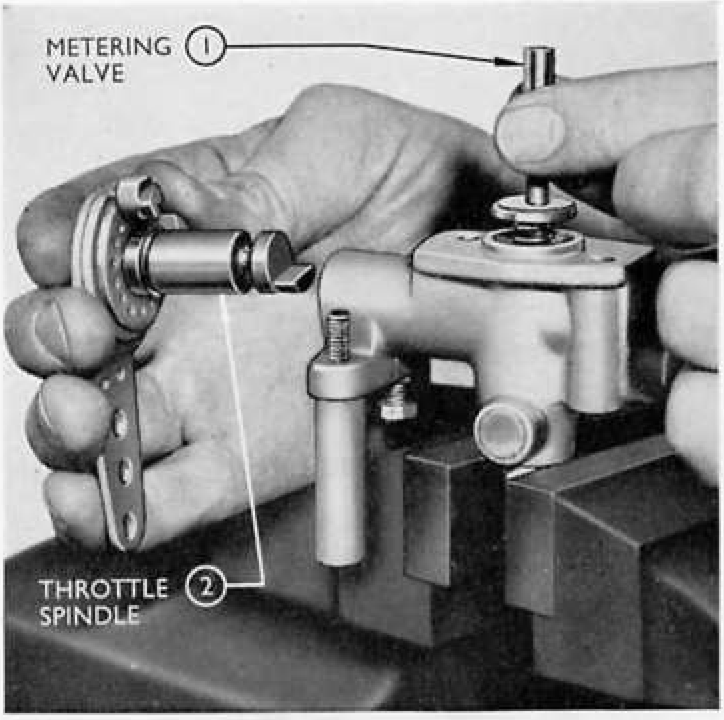


Fig. 37
Removing the Metering Valve

6. **Locate the exhaust manifold** on its mounting flanges and fit the clamp. Secure each clamp with two nuts (4/99 only).

7. **Fit the circular steel insert** between the exhaust manifold and exhaust pipe, fit the clamps and secure in position (4/99 only).

8. **Bleed the fuel injection pump** (see page 51).

9. **Adjust the engine idling speed** (see page 40).

10. **Lower the bonnet** and secure.

To Dismantle

1. **Break the seal,** unscrew the two screws and remove the pump inspection cover plate.

NOTE.—This seal should only be removed by experienced personnel authorized by the pump manufacturers who can reseal the pump with identifiable seals. Unauthorized breaking of the fuel pump seals may render the guarantee void.

2. **Drain the fuel oil from the pump housing.**

3. **Mount the pump with the governor uppermost on a dismantling jig** Tool No. CA.62. Three nuts and bolts are provided with the jig for this purpose.

4. **Unscrew and remove the two bolts securing the governor assembly** to the pump body. This must be carried out without applying any side thrust, as it is possible to damage or break the metering valve (see Fig. 35).

5. **Dismantle the governor assembly as follows:**

(*a*) Remove the anti-stall device from the governor housing.

(*b*) Pull the stop control spindle out of the governor housing.

(*c*) Pull the throttle spindle out of the governor housing.

(*d*) Withdraw the metering valve from the housing (see Fig. 37).

6. **Unscrew the four banjo bolts** and remove the four injector pipe banjos.

7. **Slacken the inlet union** on the end cover.

8. **Unscrew the four bolts retaining the end cover to the pump body.** Remove the end cover assembly.

9. **Dismantle the regulating valve.** Remove the inlet union and placing your hand over the inlet union recess, invert the end cover assembly to carefully remove the filter and regulating valve assembly (see Fig. 43). Care should be taken not to lose the regulating spring and plunger located in the sleeve.

10. **Remove the transfer pump 'O' ring** from the pump body using the assembly rod Tool No. CA.60.

11. **Holding the carbon vanes in position,** withdraw the transfer pump eccentric liner (see Fig. 38) and carefully remove the carbon vanes.

NOTE.—These carbon vanes are very brittle and may chip or break if not handled with care.

12. **Remove the two hydraulic head locking screws.**

13. **Invert the dismantling jig in the vice.**

14. **Slacken the advance mechanism end plugs.**

15. **Remove the advance mechanism** by unscrewing the securing nut and banjo bolt.

16. **Dismantle the advance mechanism** by unscrewing the end plugs. Remove the pistons and springs.

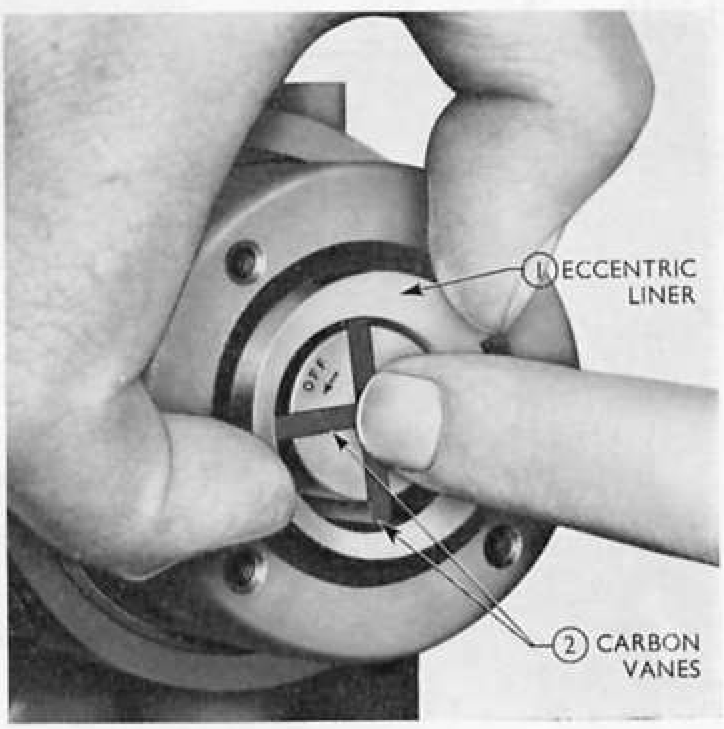


Fig. 38
Removing the Transfer Pump Eccentric Liner

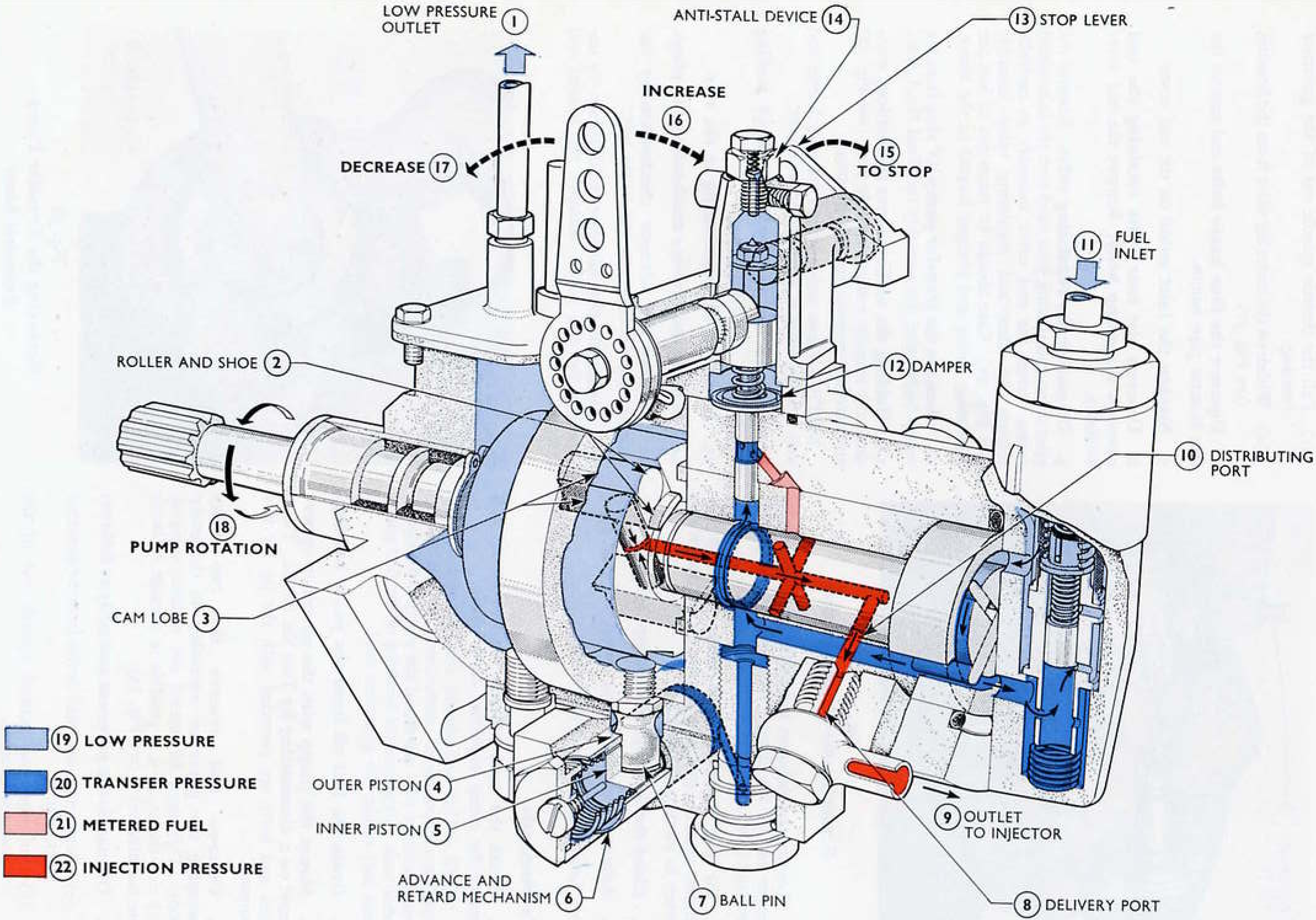


Fig. 39
Operation of Fuel Injection Pump (Injecting)

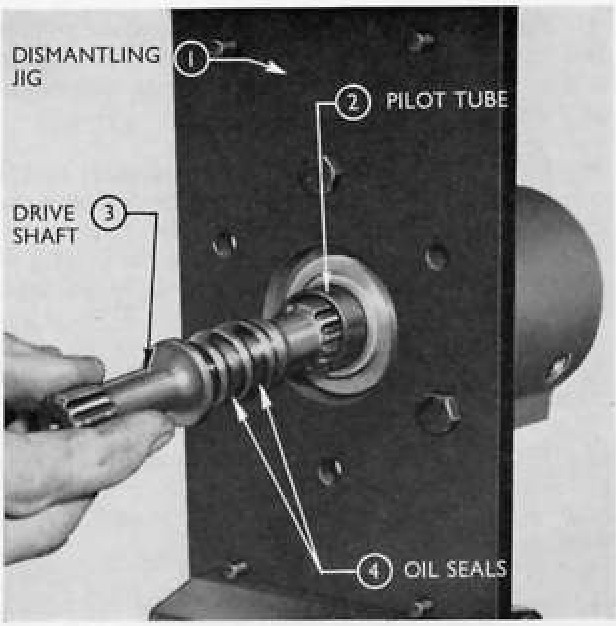


Fig. 40
Fitting the Splined Drive Shaft

17. **Remove the inner piston and spring** from the outer piston. Note the number of adjusting shims.

18. **Slacken the transfer pump rotor** in the direction of rotation, using rotor socket Tool No. CA.58 and drive shaft ring key Tool No. CA.61. Ensure that the socket is fully home to prevent damage to the rotor.

19. **Withdraw the hydraulic head assembly.**

20. **Unscrew the advance ball stud** and remove the cam ring.

21. **Using circlip pliers, compress and remove the timing circlip.**

22. **Using circlip pliers, expand and remove the driveshaft circlip.**

23. **Withdraw the driveshaft** from the pilot tube in the pump body.

24. **Dismantle the hydraulic head assembly:—**

(*a*) Remove the ' O ' ring from the annular groove in the periphery of the hydraulic head.

(*b*) Hold the drive plate with Tool No. CA.59 and unscrew the drive plate bolts. Adaptor Tool No. CA.57 can be used for this operation.

(*c*) Remove the drive plate and the outer fuel adjusting plate.

(*d*) Withdraw the rollers and shoes keeping them in their respective positions.

(*e*) Retain the twin pumping plungers in position with corks.

(*f*) Unscrew the transfer pump rotor and remove the pump and distributor rotor from the hydraulic head.

(*g*) Remove the inner fuel adjusting plate from the distributor rotor.

To Reassemble

Wash all components, ensure that they are clean and leave them in the cleaning fluid until they are required for assembly. All components should be fitted " wet " and not dry, to provide initial lubrication.

1. (*a*) Inspect the pump body machined surfaces for wear or damage.

(*b*) Check governor mounting and inspection window surfaces for flatness and scoring.

(*c*) Check the hydraulic head locating bore for damage. Inspect all threaded holes to ensure that no threads are damaged or stripped.

(*d*) Inspect the advance mechanism locating pad to ensure that it is free from burrs or other damage that would affect its normal operation.

(*e*) Check the pilot tube for wear or scoring.

(*f*) Inspect the mounting flange for cracks. Any part or parts that are worn or damaged and which in any way appear unserviceable should be replaced. Wash both existing and replacement parts thoroughly.

2. **Inspect the driveshaft,** and if serviceable, fit two new oil seals, using Tool No. CA.55. The seals are separated from each other by the flange machined on the shaft (see Fig. 40). Both seals are fitted with the lip towards the pump body.

3. **Insert the short splined end of the driveshaft into the pilot tube** from the rear of the dismantling jig (see Fig. 40). Special pliers Tool No. CA.56 should be used to fold these seals to facilitate assembly and prevent damage.

4. **Retain the driveshaft by fitting a new circlip.** This circlip is located inside the pump body.

5. **Compress the timing circlip** with circlip pliers (see Fig. 41) and seat it against the shoulder in the

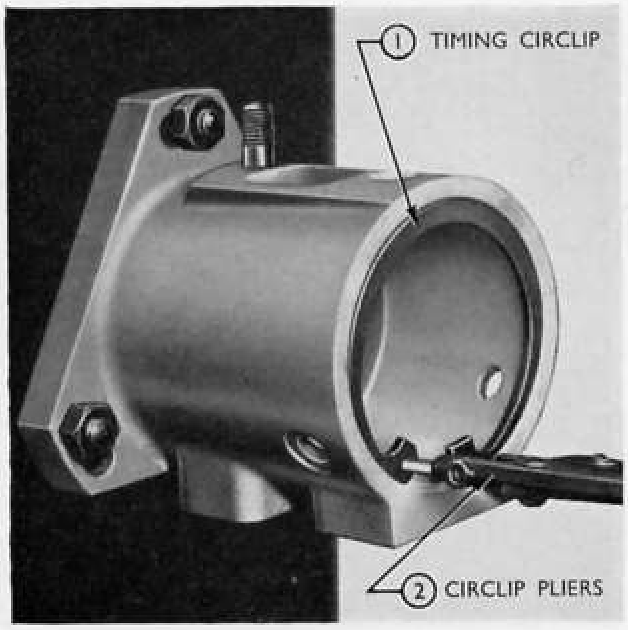


Fig. 41
Installing the Timing Circlips

pump body so that the square end of the circlip is in the centre of the inspection window.

6. **Inspect the cam ring.** The cam lobes and outer surfaces of the cam ring must be free from any dirt, corrosion and wear, or any other defects. Fit the cam ring into the pump body so that the arrow is in the same direction as the arrow on the injection pump name plate.

It is important that the cam ring is fitted the correct way round. Check this by seeing if, in the normal direction of rotation, the rollers will rise up the steepest ramp to the highest peak of the cam lobe first.

Check that the cam ring is quite free to turn in the injection pump body.

7. **Fit the advance ball pin** to the cam ring and tighten to a torque of 345 kg.cm. (300 lb. in.). Again check that the cam ring is free to rotate the limited amount permitted by the ball pin.

8. **Inspect the distributor rotor for wear.** Any bore wear in the hydraulic head will be reproduced on the rotor. Wash and fit the inner fuel adjusting plate so that the locating slots and roller shoe locations line up with the slots in the pump rotor. Wash the hydraulic head and insert the distributor rotor.

9. **Fit the transfer pump rotor.**

10. **Check the rollers for wear,** fine circumferential lines may be ignored. Remove the corks retaining the twin pumping plungers in position and fit the rollers and shoes to the injection pump rotor with the wide end of the lug to the wide end of the slot in the fuel adjusting plate.

11. **Fit the outer fuel adjustment plate** so that the scribed line in the injection pump rotor is adjacent to the centre of the small adjusting slot. (Approximate maximum fuel setting.)

12. **Fit the drive plate** with the channel to the rollers and shoes, and the slot to correspond with the scribed line in the injection pump rotor. Secure the drive plate with two new high tensile bolts and tighten to a torque of 185 kg.cm. (160 lb. in.), holding the drive plate with Tool No. CA.59.

13. **Wash the hydraulic head assembly** and ensure that it spins freely on the distributor rotor.

14. **Fit a new 'O' ring to the hydraulic head.** Lubricate the pump body and install the hydraulic head with the bolt holes and drive master splines lined up (see Fig. 42).

15. **Fit the bleed screw to the side of the pump** bearing the direction of rotation plate and a transfer pressure adaptor to the other. Do not tighten until the advance and retard mechanism is fitted.

16. **Tighten the transfer pump rotor,** using the drive shaft spanner Tool No. CA.61 and the rotor socket Tool No. CA.58 to a torque of 75 kg.cm. (65 lb. in.). Check pump movement.

17. **Assemble the advance mechanism.** Place the inner piston and spring in the outer piston together with any adjustment shims removed. Insert the outer piston in the housing bore with the piston crown to the same end as the drilling from the banjo bolt. Fit the plain end plug to the housing, adjacent to the piston crown.

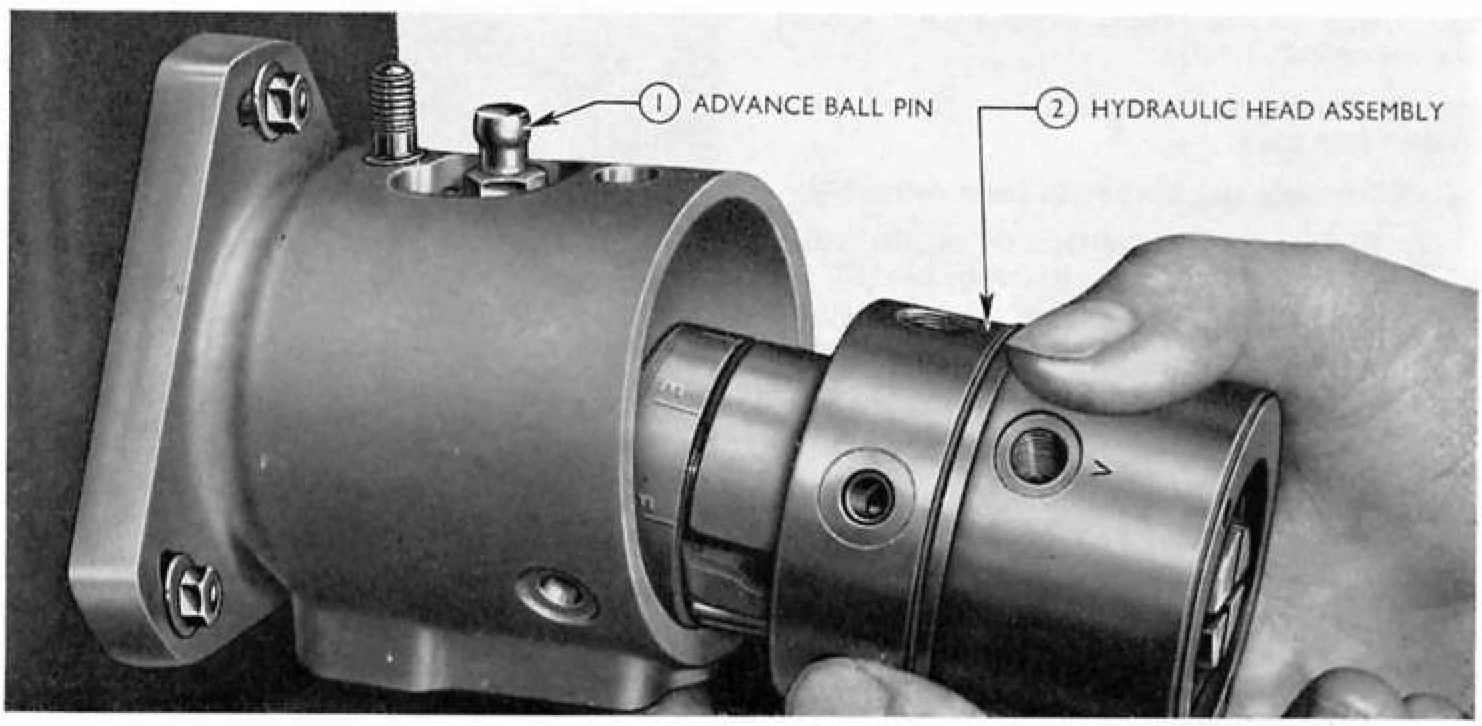


Fig. 42
Fitting Hydraulic Head Assembly

Should either end plug " O " ring be unserviceable a new " O " ring should be fitted, using Tool No. CA.52.

18. Place the spring seat washer on the step machined in the outer piston and then insert the outer piston spring. Fit the end plug incorporating the stop pin, together with any adjustment shims removed, to the housing.

NOTE.—A 0.5 mm. thick assembly shim must be fitted in this end plug to prevent damage by the spring end.

19. Fit the advance mechanism to the pump body with a new gasket on the mating faces. Assemble two 'O' sealing rings to the banjo bolt, one under the head and one under the flange. Use Tool No. CA.53 for the head seal and Tool No. CA.54 for the flange. Ensure that the advance mechanism is a snug fit on the body and install the banjo bolt with the steel washer under the inner " O " ring. Tighten the banjo bolt to a torque of 403 kg.cm. (350 lb. in.) and the securing nut to 127 kg.cm. (110 lb. in.).

Fit the hydraulic head alignment tool No. CA.79 in the metering valve location and ensure that it is seated fully.

Tighten the hydraulic head locking screw and the transfer pressure adaptor to 195 kg.cm. (170 lb. in.) torque.

Raise the hydraulic head alignment tool and allow it to fall. It should seat fully without binding.

Check that the pump is free to rotate.

20. Invert the dismantling jig and fit the inspection cover plate with a new gasket.

21. Assemble the governor assembly as follows:

(*a*) Fit an ' O ' sealing ring to the throttle spindle, using Tool No. CA.50.

(*b*) Insert the metering valve into the governor housing. Fit the throttle spindle into the governor housing with the eccentric cam above the control sleeve and below the shut off washer.

(*c*) Fit an ' O ' sealing ring to the stop control spindle, using Tool No. CA.51 and insert in the governor housing. Ensure that the stop control spindle eccentric cam is beneath the shut off washer. If this shaft is assembled with the cam above the washer the pump will be set in the maximum fuel position with no means of shut off.

(*d*) Fit the throttle adjustment plate to the throttle spindle and place the throttle lever on the shaft so that it is vertical with the throttle adjustment plate in the mid position.

NOTE.—This is only a provisional setting for test purposes and will have to be reset to suit the throttle linkage on the vehicle.

22. Fit the governor assembly to the injection pump body with a new gasket. The metering valve must be entered squarely into the hydraulic head as this component may be easily broken. Guide the large damping washer into its bore with a suitable probe.

Tighten the bolts securely and use copper washers under the heads to prevent oil leaks.

23. Fit the anti-stall device to the governor housing and screw in three or four turns before tightening the locknut. Final adjustment of this device will, of course, be carried out on the engine.

24. Install the transfer pump eccentric liner.

25. Fit the carbon vanes to the rotor. These vanes must be perfectly free and must not pick up on the eccentric liner when the pump is rotated. Fit new vanes if the old ones are not satisfactory.

26. Assemble the regulating valve and filter (see Fig. 43) to the end plate as follows:—

(*a*) Insert the priming by-pass spring in the end plate bore. Ensure that the spring is correctly located.

(*b*) Place the regulating plunger in the regulating sleeve. This plunger must be free to slide easily under its own weight.

(*c*) Locate a new gasket on the regulating sleeve and insert the sleeve and plunger in the end plate bore so that the plunger does not fall out. Check the plunger operation on the priming spring, with the assembly rod Tool No. CA.60.

(*d*) Fit the regulating spring to the sleeve bore. This may be done by threading the spring onto the assembly rod Tool No. CA.60.

(*e*) Push the nylon filter onto its seating on the upper end of the sleeve.

(*f*) Place the sleeve retaining spring seat onto the sleeve with the smaller spigot located in the bore.

(*g*) Place the sleeve retaining spring inside the filter and locate on the spring seat.

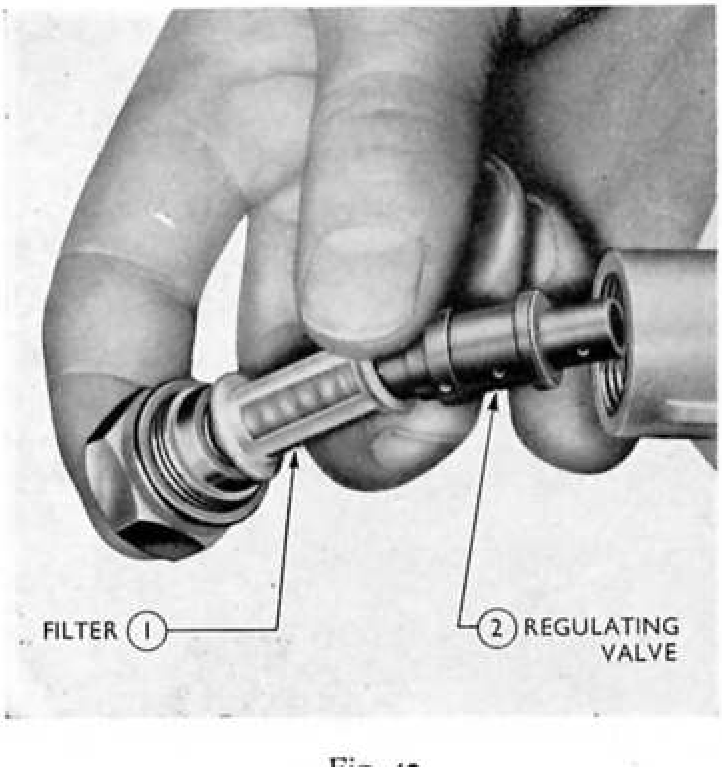


Fig. 43
Regulating Valve and Filter

(*h*) Secure the regulating valve assembly by screwing the fuel inlet valve connection in.

27. Fit an 'O' ring to the transfer pump groove.

28. Fit the end plate to the hydraulic head, locating the dowel in the slot in the periphery of the eccentric liner.

The dowel is fitted to the hole marked with a letter ' C ' on the outer face.

Tighten the bolts diagonally to a torque of 52 kg.cm. (45 lb. in.).

29. Tighten the inlet connection to 415 kg.cm. (360 lb. in.) torque.

30. For test purposes fit radial connections, with copper washers, in place of the four injector pipe banjos.

TESTING AND ADJUSTING THE FUEL INJECTION PUMP

The distributor type pump has only one pumping element, thus each injector receives an equal volume of fuel when the engine is operating at constant speed and load. Also, injection will occur at regular intervals as the cam lobes which operate the single pumping element (two opposed plungers) are evenly spaced and accurately machined in the cam ring. Phasing and calibration, operations which are essential when a conventional multi-element type injection pump is overhauled are, therefore, not required. Pre-set timing marks are also accurately machined on the cam ring and drive plate and, as these are fixed, no timing adjustment is necessary.

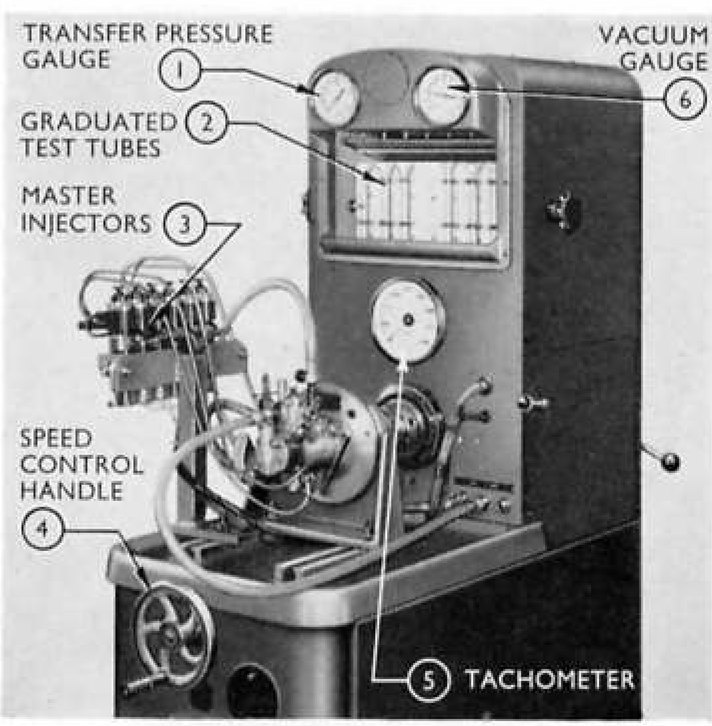


Fig. 44
A Typical Variable Speed Test Bench

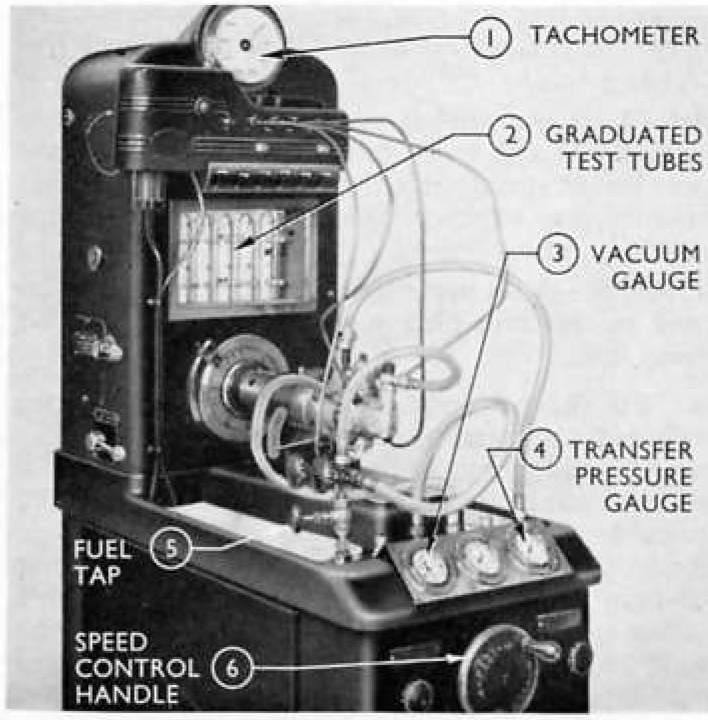


Fig. 45
A Typical Variable Speed Test Bench

It is necessary, however, to check and adjust the maximum fuel delivery and also to check the operation of the injection pump on a calibrating machine. As this injection pump has to be tested at varying speeds, the calibrating machine used must have a variable speed drive (see Figs. 44 and 45).

Where it is only necessary to check the operation of the pump, i.e. when a fault is suspected or prior to overhaul, complete the operations on the test procedure on page 41, but do not make any adjustments.

Test Bench Adjustments

Fuel injection pumps must be accurately tested and to ensure this, it is essential that the master injectors fitted to the calibrating machine are maintained as an accurately balanced set. To ensure maximum life and efficiency from master injectors the following points should be strictly observed:—

1. The calibrating machine should be housed in a dustproof room, and suitably covered when not in use.

2. The fuel tank should be drained and cleaned out frequently, and after testing 200 pumps, the filter element renewed.

3. Where testing is not carried out frequently, an injection pump should be mounted on the machine and test fuel passed through the master injectors at least once a week.

NOTE.—It is advisable to use only a substitute test fuel in the calibrating machine as the variation of this fuel is less than that of diesel fuel so that more accurate readings can be obtained. Also the test fuel gives better protection to the master injectors.

Master Injectors

The master injectors must be checked regularly for balance. To carry out this test, mount an in-line

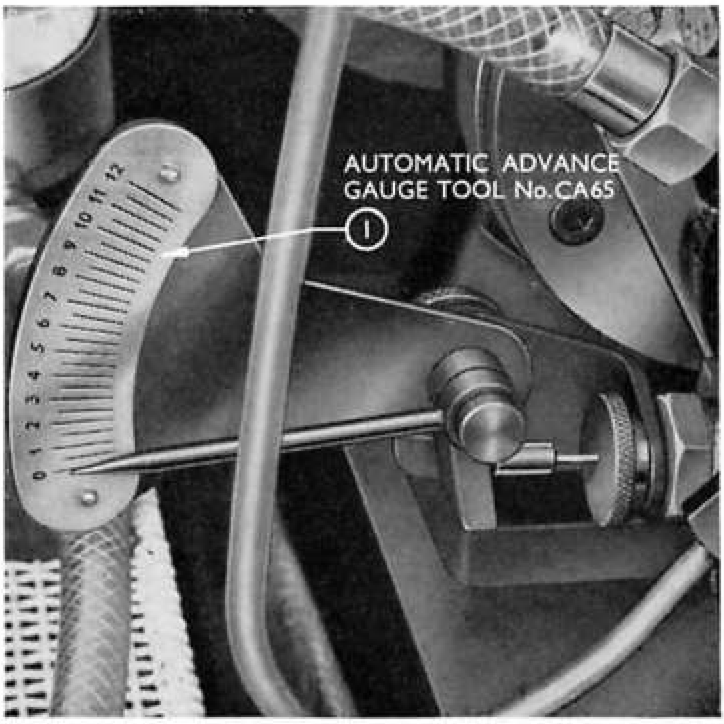


Fig. 46
The Automatic Advance Gauge

injection pump on the calibrating machine, connect all pipes and run the machine for at least 15 minutes to allow everything to reach normal operating temperature. It is essential that this is strictly observed when carrying out this test.

Adjust one pump element to deliver 15 c.c. for three consecutive readings, running at 600 rev./min. for 300 shots of fuel. **Note: All readings must be taken from the bottom of the meniscus.** Connect this pump element to each master injector in turn, using the same pipe and test tube throughout this test. Running at 600 rev./min. collect 300 shots of fuel, allowing 15 seconds after delivery has ceased for the fuel to settle before taking the readings, and 30 seconds for the tube to drain when emptying. Take the mean of three readings from each injector in turn and the variation between the highest and lowest readings should not exceed 0.3 c.c. If the variation exceeds this figure a fresh set of master injectors should be fitted. Do not attempt to balance master injectors by cleaning or pressure adjustment.

Injector Pipes

After a prolonged period of use on the calibrating machine it may be found that the ends of the injector pipes have closed up slightly thus reducing the bore. This condition will affect the pump delivery and if it is found to exist, the pipes should be renewed. As an emergency measure the ends of the pipes can be cleared by using a 2 mm. diameter drill to a depth of 20 mm. (¾ in.) and then the pipe bore thoroughly cleaned (preferably with pressure equipment) before refitting.

(a) **Test Equipment Specification**

Master injectors fitted with BDN12SD12 nozzles set at 175 atmospheres opening pressure. Nozzle back leakage must not be less than 10 secs. for a drop from 150 to 100 atmospheres.

High pressure pipes 6 mm. by 2 mm. by 86.4 cm. (34 in.) long with special radial connections identified by a drilling through a corner of the hexagon.

Gravity to 0.07 kg./sq. cm. (1 lb./sq. in.) feed with a minimum flow of 1,000 c.c./min.

Special substitute fuel oil, see Specification and Repair Data.

Oil temperature 15.6 to 48.9°C (60 to 120°F).

(b) **Basic Specification of Fuel Injection Pump**

(1) Pump Rotation: Clockwise, looking on drive end.

(2) Combined speed and light load advance mechanism and anti-stall device fitted.

(3) Transfer pressure adjuster in the end plate assembly.

(4) Hydraulic governor.

(c) **Mounting the Fuel Injection Pump on the Test Equipment**

(1) Mount the fuel injection pump on the test equipment, using the distributor type pump mounting adaptor and drive. (This is usually supplied with the test equipment.)

(2) Align the master spline on the injection pump drive shaft with the corresponding spline of the test equipment drive. Secure the pump in position with three bolts fitted through the pump mounting flange.

(3) From the base of the injection pump remove the stop pin located in one of the end plugs fitted to the advance and retard mechanism. In place of the stop pin fit an automatic advance gauge Tool No. CA.65. Zero the gauge before commencing any test as described in section (*d*) General Data.

(4) Unscrew the hydraulic head locking screw that does not incorporate a vent screw, if a pressure adaptor has not already been fitted. In its place fit a pressure adaptor. Couple up the test pressure gauge pipe to this adaptor.

(5) Connect up the pipe line from the back leakage measuring cylinder of the test equipment to the outlet port on the fuel injection pump.

(6) If the banjo unions are fitted to the four injector outlet ports on the pump, (i.e. on a pump just removed from a vehicle) remove these banjo unions and fit radial connectors in their place. Couple up the radial connectors to the four pipes leading to the test equipment injectors.

(7) Fit the fuel supply pipe from the test equipment to the inlet union on the regulating valve connection of the fuel injection pump with a transfer pressure adjusting Tool No. CA.113. Prime all test bench fuel lines, including the line to the vacuum gauge.

(d) **General Data**

Test the injection pump in accordance with "Test Procedure" detailed on page 41. The throttle and stop control levers to be fully opened except where otherwise stated.

Where marked thus * use 30 seconds glass draining time and allow fuel to settle for 15 seconds before taking a reading.

Leaks. All pumps must be completely free from leaks both while running and when stationary.

Delivery values. All calibration and setting values are for 200 strokes except where otherwise stated.

Unscrew the maximum stop screw and idling stop screw to allow full movement of the throttle arm before commencing tests.

Screw out the transfer pressure adjusting screw fully and then screw in 1½ turns before commencing test.

Do NOT run the pump for long periods with the shut-off lever closed.

Do NOT run the pump for long periods at high speed with small delivery.

Zero the advance gauge Tool No. CA.65, before commencing any tests, by pressing the pin fully inwards and adjusting the scale to zero. Upon release, the inner piston should cause the indicator to show 4° to 4½° advance.

Unscrew the anti-stall device and lock so that it does not interfere with movement of the metering valve before commencing the test. Adjustment of the anti-stall device must be made on the engine.

Note the points in the test procedure where priming and venting is required.

(e) **Priming and Venting**

With this pump, correct and consistent operation of the auto-advance is dependent upon the exclusion of air from the auto-advance housing.

Venting should be carried out at the vent screws whilst running the injection pump at 100 r.p.m.

Operate the throttle lever and press inwards and release the automatic advance gauge Tool No. CA.65 indicator pin several times to ensure venting.

(f) **Automatic Advance**

The automatic advance mechanism is adjusted by shimming the inner and outer piston springs (see Fig. 33) as follows :—

Speed Advance

(1) Remove the automatic advance gauge Tool No. CA.65 and the end plug into which it is screwed.

(2) If the advance is low remove shims to rectify. NOTE.—A 0.5 mm. shim is fitted to this end plug on assembly. This must NOT be removed.

(3) If the advance is high add shims to rectify. NOTE.—The amount of shimming, in addition to the 0.5 mm. assembly shim, that may be added to meet the test requirements may vary from 0 to 2.4 mm. Shims 0.2, 0.5, 1 and 2 mm. thick are available.

(4) Replace the end plug and the advance gauge Tool No. CA.65, zero if necessary. Prime and vent the injection pump as described previously.

Light Load Advance

(1) Remove the automatic advance gauge Tool No. CA.65 and then unscrew the banjo bolt and securing nut to remove the advance mechanism.

(2) Unscrew the end plug incorporating the tapped hole and carefully remove the inner and outer pistons and springs. Do not disturb the outer piston adjustment shims.

(3) Remove the inner piston from the outer and remove shims if the fuel delivery is too high. Add shims if the fuel delivery is too low. NOTE.—The amount of shimming that may be added to meet the test requirements may vary from 0 to 1.2 mm. Shims 0.2, 0.5 and 1 mm. thick are available.

(4) Reassemble the advance mechanism and replace on the injection pump body. Tighten the banjo bolt to 403 kg.cm. (350 lb. in.) torque and the securing nut to 127 kg.cm. (110 lb. in.). Fit the advance gauge Tool No. CA.65 to the end plug and zero if necessary. Prime and vent the injection pump as described previously.

(g) **Transfer Pressure**

The transfer pressure is adjusted by means of an adjusting screw in the end plate assembly, accessible through the inlet connection. This can be adjusted with the pump running with adjuster Tool No. CA.113 (see Fig. 47). Screw the adjuster in to increase pressure and out to reduce the pressure.

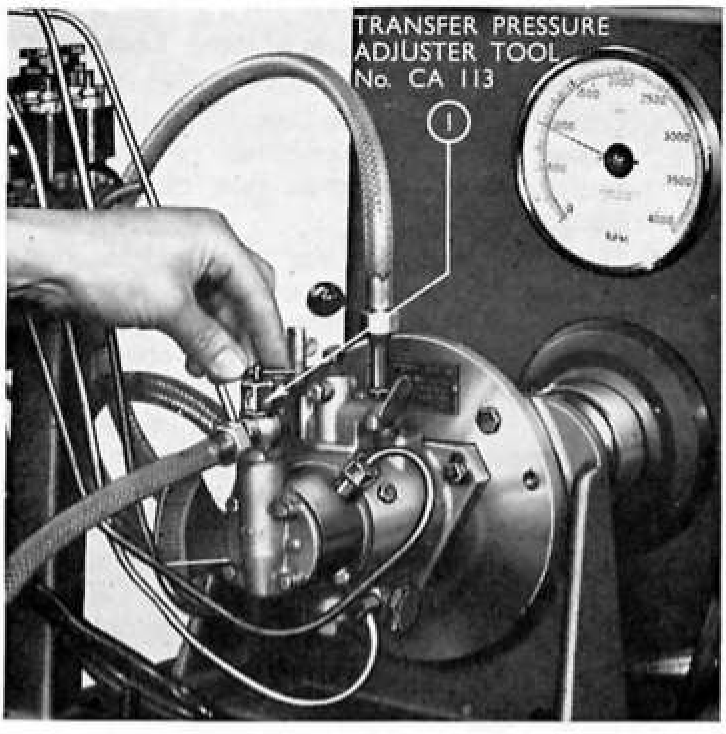


Fig. 47
Adjusting Transfer Pressure

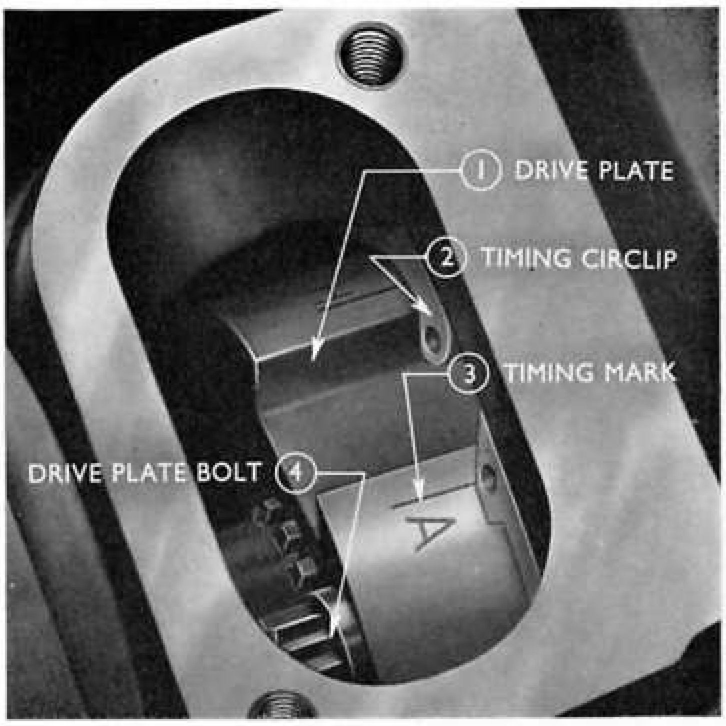


Fig. 48
Injection Pump Timing

(h) **Maximum Fuel Delivery**

The maximum fuel delivery is controlled by the stroke of the pumping element plungers. The plunger stroke is limited by lugs, on the roller shoes, which protrude into slots cut in the inner edge of annular adjustment plates situated on either side of the pump rotor. The base of these slots are curved to form a small section of a spiral so that one side is longer than the other. The lugs are machined to follow the contour of this curve. Any movement of the adjustment plates relative to the pump rotor will vary the maximum plunger stroke and hence the maximum fuel delivery. The outer adjustment plate (i.e. the one nearest to the drive end) is clamped between the drive plate and the pump rotor and is connected to the inner plate by two connecting bars. The outer adjustment plate has a small slot in its outer edge in which a suitable lever is engaged when making adjustments. A slot is provided in the drive plate to facilitate this.

To adjust the maximum fuel delivery, slacken the drive plate bolts, using adaptor Tool No. CA.57 and using a suitable lever move the adjustment plates clockwise to increase the fuel delivery and anti-clockwise to decrease. Tighten the drive plate bolts using the adaptor Tool No. CA.57 and a torque wrench. A torque reading of 144.0 kg.cm. (125 lb. in.) will ensure that a torque of 185 kg.cm. (160 lb. in.) is applied to the bolt.

NOTE.—The torque wrench and adaptor must be in line.

Replace the inspection cover plate and refill the pump body. Re-test the maximum fuel delivery and readjust if not within the specified limits.

When the maximum fuel delivery is within the specified limits repeat operations Nos. 5, 6, 8 and 9 in the test procedure and then re-check operation No. 11 (Maximum Fuel Delivery).

(i) **Timing**

The injection pump drive shaft has a master spline which locates in a corresponding spline in the engine timing gear hub. Accurate timing of the injection pump in relation to the engine is ensured by setting timing marks within the pump and externally by scribing a line on the pump mounting flange during testing. This scribed line aligns with a similar mark on the cylinder block. It is, therefore, possible to replace the injection pump or fit a new one and maintain the correct timing by engaging the master splines and aligning the timing marks on the injection pump mounting flange and the cylinder block (see Fig. 34), providing the engine timing gears are not disturbed (relative to each other).

Set the injection pump timing by connecting a stirrup pipe Tool No. CA.64 to outlets U and W on the hydraulic head with pressure relief valve Tool No. CA.71 to an injector tester. Turn the pump clockwise until the scribed line marked with a letter " B " on the drive plate is visible in the inspection window. Apply a pressure of 30 atmospheres with an injector tester to expand the plungers to their limit. The use of a stirrup pipe across diametrically opposed delivery ports balances the pressure applied to the distributor rotor. Hold the inner advance piston in the fully retarded position by pressing the advance gauge pin and continue turning the pump clockwise until the plunger rollers contact the cam lobe when resistance to further movement will be encountered. At this point align the square end of the circlip with the scribed line marked with a letter "A," (see Fig. 48).

The timing mark on the pump mounting flange is also made with the pump held in this position. Mount a flange marking gauge Tool No. CA.63, set to 300°, onto the drive shaft and scribe a line on the pump mounting flange.

Fuel Injection Pump Removal from the Test Equipment

1. Disconnect all pipes and remove the automatic advance gauge Tool No. CA.65 from the injection pump. Replace the stop pin in the advance mechanism end plug.

2. Unscrew the transfer pressure adjuster Tool No. CA.113 and remove the adjuster assembly and banjo connection.

3. Remove the transfer pressure adaptor and replace the hydraulic head locking screw. Tighten to 196 kg.cm. (170 lb. in.) torque.

4. Unscrew the radial connections from the hydraulic head and refit the long banjo unions, with the pipes horizontal, to outlet ports U, V and X. Fit the short banjo union, with the pipe upwards, to outlet W. Use new copper washers and tighten securely to prevent leaks.

5. Fit dust caps or plugs to all connections.

6. Unscrew the three bolts through the injection pump mounting flange and remove the pump from the test equipment.

Idling Adjustment

The idling adjustment can only be made when the injection pump is on the engine.

Fit the injection pump to the engine, as described previously (see page 29), and adjust the idling speed, with the engine and gearbox at normal working temperature as follows :—

1. Ensure that the idling control knob is screwed fully home.

2. Slacken the lock nut and unscrew the anti-stall device until it is out of contact with the metering valve.

3. Start the engine and, when running at the normal operating temperature adjust the idling speed to 625 rev./min. with the idling stop screw (see Fig. 49).

4. Screw in the anti-stall device slowly until a slight increase in engine speed is noticed and then slacken by approximately one third of a turn. Lock in this position with the lock nut.

5. Run up the engine and gently throttle back to the idling position to check for stalling or slow deceleration.

(a) If the engine stalls the anti-stall device should be screwed in slightly.

(b) If the rate of deceleration is too slow the anti-stall device should be screwed out slightly.

After adjustment (a) or (b) run the engine up and recheck for stalling or slow deceleration. Re-adjust the anti-stall device if necessary.

Note: After every adjustment check that the engine is not idling directly on the anti-stall device. If it is, it must be readjusted immediately.

6. Pull the stop control knob to check that the engine stops.

Fig. 49
Idling Stop Screw and Anti-Stall Device (4/99)

CHECKING INJECTION PUMP TIMING

1. Disconnect the fuel return pipe from the injection pump.

2. Remove the inspection cover to expose the injection pump drive plate.

3. Turn the engine until the scribed line "A" is in alignment with the squared end of the timing circlip (see Fig. 49).

4. Unscrew the timing pin located in the timing cover backplate. The pin should locate in one of the two holes in the rear face of crankshaft pulley. This is the point of injection, 26° (4/99) or 19° (4/108) before top dead centre static advance, for No. 1 cylinder. The second hole in the back of the crankshaft pulley indicates top dead centre for No. 1 piston when the notch in the pulley rim is uppermost.

5. After checking the timing, screw home the timing pin, refit the inspection cover to the injection pump and reconnect the fuel return pipe.

INJECTION PUMP TEST PROCEDURE—4/99

	Description	R.P.M.	Requirements
†(1)	Operation	100 max.	Prime and vent the injection pump, see Note (*e*), to ensure fuel delivery from all nozzles.
(2)	Transfer pump vacuum	100	Turn the two-way tap, in the fuel feed pipe, to connect the vacuum gauge. 16 in. Hg. must be reached within 60 seconds. Prime the pump after this test.
(3)	Transfer pressure	100	0.8 kg./sq.cm. (11 lb./sq. in.) minimum.
(4)	Transfer pressure	1,000	2.55 to 3.4 kg./sq. cm. (36 to 48 lb./sq. in.).
†(5)	Transfer pressure	1,900	Set end plate pressure adjuster to give 2.9 kg./sq. cm. (41 lb./sq. in.). higher than (4).
†(6)	Advance position	1,600	$3\frac{1}{2}°$ to $4\frac{1}{2}°$
†(7)	Advance position	1,900	$5\frac{1}{2}°$ to $6\frac{1}{4}°$
†(8)	Advance position	1,000	$1\frac{1}{2}°$

N.B.—If adjustment is required to obtain the correct advance characteristics shim the OUTER PISTON spring only, see Note (*f*) Speed Advance. Prime and vent the injection pump after adjustment, see Note (*e*), before continuing the test.

	Description	R.P.M.	Requirements
†(9)	Light Load Advance		
(*a*)	Set throttle by adjustment of idling stop screw to give a minimum of 3° advance	250	Delivery to be 2.6 c.c. minimum average.
(*b*)	Set throttle by adjustment of idling stop screw to give a minimum of 4° advance	650	Delivery to be 2.0 c.c. minimum average.
(*c*)	Set the throttle by hand to give a maximum of 2° advance	1,100	Delivery not to exceed 3.6 c.c. average.

N.B.—If adjustment is required to obtain the correct fuel delivery, shim the INNER PISTON spring only, see Note (*f*) Light Load Advance. Prime and vent the injection pump after adjustment, see Note (*e*), before continuing test.

	Description	R.P.M.	Requirements
(*d*)	Reset idling stop screw to position 9 (*a*) above		
†(10)	Maximum fuel delivery*	1,000	Average delivery to be 5.0 ± 0.1 c.c. Spread between lines not to exceed 0.4 c.c. Adjust if incorrect, see Note (*h*). If alteration required re-test 6, 7 and 8 and then re-check Test 10.
†(11)	Maximum fuel delivery*	100	Average delivery to be not less than average at (10) minus 0.5 c.c.
†(12)	Stop control operation with the throttle fully open	200	With stop control lever closed, average delivery not to exceed 0.4 c.c.
(13)	Back leakage	1,000	5 to 35 c.c. in the same time as 100 strokes.
(14)	Fuel delivery check	1,700	Minimum average delivery to be average at (10) plus 0.8 c.c.
†(15)	Governor setting	2,000	Set delivery by adjusting maximum speed screw to 1.0 to 1.6 c.c.
†(16)	Fuel delivery check	1,700	Average delivery to be not less than average at (14) plus 0.4 c.c. with throttle as set at (15).
†(17)	Timing	—	Using outlet 'W,' (30 atmospheres pressure) press inner advance piston to full retard position by means of advance gauge pin, and set the circlip to letter 'A' on the drive plate. With the pump in this position scribe a line on the housing flange using Tool No. CA.63, see Note (*i*).

INJECTION PUMP TEST PROCEDURE — 4/108

Pump Type: 3246960-3246969 (with setting code on nameplate)

Fit auto-advance measuring device and set scale to zero before commencing test.

Where marked thus* use 30 seconds glass draining time and allow fuel to settle for 15 seconds before taking reading.

Screw back transfer pressure adjuster in end plate to the maximum extent and then screw in 1½ turns before commencing test.

Shimming of Automatic Speed Advance Device

(a) A 0.5 mm. shim is fitted to the piston spring cap on assembly. This must NOT be removed.

(b) The amount of additional shimming that may be added to meet test requirements may vary from 0 to 3.0 mm.

Test No.	*Description*	*R.P.M.*	*Requirements*
1	Priming	100 max.	Fuel delivery from all injectors.
2	Transfer pump vacuum	100	Note time to reach 406 mm. (16 in.) Hg. Max. time allowed 60 seconds.
3	Transfer pressure	100	0.8 kg./cm.² (11 lb./in.²) min.
4	Transfer pressure	1,200	3.2 to 4.0 kg./cm.² (45 to 57 lb./in.²).
5	Transfer pressure	2,000	Set end plate pressure adjuster to give 1.8 kg./cm.² (26 lb./in.²) higher than (4).
6	Advance position	1,200	1½° to 2°.
7	Advance position	1,700	3¾° to 3¼°.
8	Back leakage	1,200	5 to 70 c.c. for 100 stroke time cycle.
9	Maximum fuel delivery check ..	*	Set to code shown on pump nameplate. Delivery tolerance +0 —0.2 c.c. Spread between lines not to exceed 0.8 c.c.
10	Maximum fuel delivery check ..	100*	Average delivery to be not less than average at (9) minus 3.2 c.c.
11	Cut-off operation with throttle lever open	200	Average delivery not to exceed 0.6 c.c.
12	Fuel delivery check	1,640	Record average delivery.
13	Governor setting	2,140	Set throttle by maximum speed adjustment screw to give maximum average delivery of 1.0 c.c. No line to exceed 1.5 c.c.
14	Fuel delivery check	1,640	With throttle set as (13) average delivery to be not less than average at (12) minus 0.4 c.c.

Final transfer pressure and governor setting are related to the engine no load r.p.m. shown on the pump name plate.

Engine no load r.p.m. shown on pump nameplate	Test 15 Transfer pressure difference	Test 16 Governor setting r.p.m.
	1.8 kg./cm.² (26 lb./in.²)	2140

15	Transfer pressure	2,000	Unscrew maximum speed adjustment screw and set end plate pressure adjuster to give (see table) higher than (4).
16	Governor setting	See table	Set throttle by maximum speed adjustment screw to give maximum average delivery of 1.0 c.c. No line to exceed 1.5 c.c.
17	Timing	—	Using outlet 'W', (30 atmospheres pressure) press inner advance piston to full retard position by means of advance gauge pin, and set the circlip to letter 'A' on the drive plate. With the pump in this position scribe a line on the housing flange using Tool No. CA 63, see Note (i).

NOTE: THE GOVERNOR SETTING SPEED QUOTED IN THIS TEST PLAN IS FOR TEST PURPOSES ONLY. THE GOVERNOR MAXIMUM SPEED SCREW MUST BE FINALLY SET ON ENGINE ACCORDING TO THE MANUFACTURER'S INSTRUCTIONS FOR THE PARTICULAR APPLICATION.

INJECTION PUMP TEST PROCEDURE—4/108

Pump Type: **3246990 – 3246999 (With setting code on nameplate).**

Test Procedure

Fit auto-advance measuring device and set scale to zero before commencing test.

Where marked thus* use 30 seconds glass draining time and allow fuel to settle for 15 seconds before taking reading.

Screw back transfer pressure adjuster in end plate to the maximum extent and then screw in 1½ turns before commencing test.

Shimming of Automatic Speed Advance Device

(a) A 0.5 mm. shim is fitted to the piston spring cap on assembly. This must NOT be removed.

(b) The amount of additional shimming that may be added to meet test requirments may vary from 0 to 3.0 mm.

Test No.	*Description*	*R.P.M.*	*Requirements*
1	Priming	100 max.	Fuel delivery from all injectors.
2	Transfer pump vacuum	100	Note time to reach 406 mm. (16 in.) Hg. Max. time allowed 60 seconds.
3	Transfer pressure	100	0.8 kg./cm.² (11 lb./in.²) min.
4	Transfer pressure	1,200	3.2 to 4.0 kg./cm.² (45 to 57 lb./in.²).
5	Transfer pressure	2,000	Set end plate pressure adjuster to give 2.0 kg./cm.² (29 lb./in.²) higher than (4).
6	Cambox pressure	2,000	0.3 to 0.5 kg./cm.² (4 to 7 lb./in.²).
7	Advance position	1,200	1½° to 2°.
8	Advance position	1,700	2¾° to 3¼°.
9	Back leakage	1,200	5 to 70 c.c. for 100 stroke time cycle.
10	Maximum fuel delivery	*	Set to code shown on pump nameplate. Delivery tolerance +0 —0.2 c.c. Spread between lines not to exceed 0.8 c.c.
11	Maximum fuel delivery check ..	100	Average delivery to be not less than average at (10) minus 3.2 c.c.
12	Cut off operation throttle lever fully open	200	Average delivery not to exceed 0.6 c.c.
13	Fuel delivery check	1,640	Record average delivery.
14	Governor setting	2,140	Set throttle by maximum speed adjustment screw to give maximum average delivery of 1.0 c.c. No line to exceed 1.5 c.c.
15	Fuel delivery check	1,640	With throttle set as at (14) average delivery to be not less than average at (13) —0.4 c.c.

Final transfer pressure and governor settings are related to the engine no load r.p.m. shown on the pump nameplate and must be obtained from the following table.

Engine no load r.p.m. shown on pump nameplate	Test 16 Transfer pressure difference	Test 17 Governor setting r.p.m.
	2.0 kg./cm.² (29 lb./in.²)	2140

16	Transfer pressure	2000	Unscrew maximum speed adjustment screw and set End plate pressure adjuster to give (see table) higher than (4).
17	Governor setting	See Table	Set throttle by maximum speed adjustment screw to give maximum average delivery of 1.0 c.c. No line to exceed 1.5 c.c.
18	Timing	—	Using outlet 'W' (30 atmospheres pressure), press inner advance piston to full retard position by means of advance gauge pin, and set the circlip to letter 'A' on the drive plate. With the pump in this position scribe a line on the housing flange using Tool No. CA.63, see Note (i)

THE GOVERNOR SETTING SPEED QUOTED IN THIS TEST PLAN IS FOR TEST PURPOSES ONLY. THE GOVERNOR MAXIMUM SPEED SCREW MUST BE FINALLY SET ON ENGINE ACCORDING TO THE MANUFACTURER'S INSTRUCTIONS FOR THE PARTICULAR APPLICATION.

Injection Pump—Fault Finding

Incorrect Vacuum

(1) Loose or damaged inlet connections.
(2) Unserviceable copper washer on inlet adaptor to end plate.
(3) Damaged gasket or regulating sleeve.
(4) Regulating spring missing or broken.
(5) End plate not tightened square to hydraulic head.
(6) Faulty transfer pump seal.
(7) Worn or damaged transfer pump blades.
(8) Transfer pump liner not located by dowel pin.
(9) Air in pipe to vacuum gauge.
(10) Priming spring missing or broken.

Low Transfer Pressure

(1) Incorrect adjustment.
(2) Regulating spring or piston missing.
(3) Regulating sleeve gasket damaged.
(4) Incorrect regulating spring.
(5) Worn or damaged transfer pump blades.
(6) Faulty transfer pump seal.
(7) Loose or incorrectly tightened end plate.
(8) Faulty washers on head locking and head locating screws.
(9) Damaged seals on head locating fitting.

High Transfer Pressure

(1) Incorrect adjustment.
(2) Sticking regulating plunger.
(3) Incorrect regulating spring—too strong.
(4) Test equipment operating on pressure feed.

Low and Fluctuating Transfer Pressure

(1) One transfer pump blade chipped or broken.

Low Advance Reading

(1) Low transfer pressure.
(2) Too many shims fitted.
(3) Spring too stiff, incorrect type fitted.
(4) Sticking advance piston.
(5) Sticking cam ring.
(6) Excessive clearance between piston and housing.

High Advance Reading

(1) High transfer pressure.
(2) Insufficient shims fitted.
(3) Incorrect spring, too weak.

Incorrect Maximum Fuel Delivery

(1) Throttle not fully open.
(2) Incorrect maximum fuel setting.
(3) Faulty washer on rotor plug screw.
(4) Loose rotor plug screw.
(5) Sticking metering valve.
(6) Air in the fuel system.
(7) Sticking plungers or roller shoes.
(8) Damaged washers on radial connections.
(9) Incorrect transfer pressure.
(10) Stop control spindle fouling metering valve.
(11) Cam ring reversed.
(12) Cam ring worn.

Low Fuel Delivery at 100 R.P.M.

(1) Low transfer pressure.
(2) Throttle not fully open.
(3) Rotor plug screw washer damaged.
(4) Rotor plug screw loose.
(5) Sticking metering valve.

Low fuel Delivery at 100 R.P.M. — contd.

(6) Sticking plungers and roller shoes.
(7) Damaged washers on radial connections.
(8) Plungers scored.
(9) Outlet ports scored.
(10) Excessive clearance, rotor to hydraulic head
(11) Air in the fuel system.
(12) Scored metering valve.

Stop Control Not Working

(1) Stop control lever incorrectly fitted to spindle.
(2) Stop control lever not turning spindle.
(3) Sticking metering valve.
(4) Slack metering valve nut.

Low Delivery during Fuel Delivery Check at Maximum Speed

(1) Maximum speed stop screw incorrectly adjusted.
(2) Faulty or incorrect governor spring.
(3) Sticking metering valve.

Difficulty in Setting Delivery by Maximum Speed Stop Screw

(1) Governor spring damaged or of wrong type.
(2) Sticking metering valve.

THE INJECTORS

Fuel from the distributor-type injection pump enters the injector inlet adaptor and passes through the injector body before reaching the delay-type pintle nozzle. The injectors are lubricated by fuel oil leaking back past the needle valve stems. This fuel is returned to the fuel tank by a 'leak-off' pipe.

Each injector flange is secured to two studs on the cylinder head by means of two nuts. The joint between the injector and the cylinder head is made by a copper washer between the lower face of the nozzle cap nut and the recess provided.

Under normal operating conditions, the injectors should be removed from the engine and cleaned at every 8,000 km. (5,000 mile) service. When the vehicle is operating continuously under stop-start conditions or in regular use on short journeys, it may be necessary to clean the injectors more frequently. Operating conditions and subsequent engine performance will be the best guide to individual service requirements.

To ensure that the injectors and other fuel system components have a long and efficient life, absolute cleanliness of the fuel and handling are most essential.

Diagnosis

In service a faulty injector will usually give one or more of the following symptons:—

(*a*) Knocking in one or more cylinders.

(*b*) Lack of power.

(*c*) Black smoke emission from exhaust.

(*d*) Overheating.

(*e*) Misfiring.

(*f*) Increased fuel consumption.

To detect a "missing" injector, remove an injector pipe, connect a serviceable injector and run the engine. Repeat this procedure for the other cylinders. Using this method systematically it will be possible to identify the "missing" injector. It is not advisable to run the engine with an injector removed as the air noise and uneven compression will make diagnosis very difficult. The normal method of slackening an injector pipe union will usually cut out two cylinders and give misleading results.

To Remove an Injector

1. **From the top of the injector** unscrew the banjo bolt securing the leak-off banjo union to the injector body.

2. **Remove the two washers** located one either side of the leak-off banjo union.

3. **Unscrew the two pressure pipe union nuts,** one at either end of the injector pressure pipe.

4. **Unscrew the two injector retaining nuts** and remove the injector.

5. **Remove and discard the copper washer** which provides a gas-tight joint between the injector and the cylinder head.

6. **Blank off the delivery** and leak-off connections and thoroughly clean the injector externally.

To Test

Care should be taken when testing injectors to ensure that the fuel spray does not come into contact with the hands of personnel operating the test equipment.

The characteristics of this delay-type pintle nozzle differ from the normal in that the spray, with slow hand pumping, presents rather an inefficient appearance in comparison, and is inclined to be more "ragged," "wet," or "soft," than with the normal pintle-type injector.

The nozzle can only be completely and satisfactorily tested with expensive and special stroboscopic equipment, but a good general test can be applied with a nozzle testing machine as follows:—

(1) Depress the Nozzle Testing Machine lever at about 20 strokes per minute, when a serviceable nozzle should emit a soft "buzzing" noise or a series of "grunts." Atomization will, however, appear to be streaky and generally unsatisfactory, at the same time there should be no appreciable wetness at the orifice.

(2) Raise and maintain the pressure at 110 atmospheres, when no fuel seeping or leaking should occur at the orifice

(3) It is difficult to obtain fuel "atomization" with these nozzles on a normal testing machine, and the spray will always appear to be streaky. Fast operation of the lever (about 100 strokes per minute) should give a reasonable spray.

(4) Back leakage should not be less than six seconds for a natural fall of 100 atmospheres to 75 atmospheres.

If any of the above checks show that the injector is faulty, it should be cleaned internally, re-adjusted and re-tested. If the injector again fails the tests, a serviceable replacement must be fitted.

To Dismantle

1. **Fit the injector** to a dismantling jig.

2. **Remove the injector cap nut** and the tab washer, then, with a screwdriver, unscrew the spring adjusting nut. Lift off the spring seat, injector spring and spindle, taking care not to lose the small steel washer located between the spring and spring seat.

3. **Unscrew the nozzle nut,** and remove the nozzle and the needle valve.

NOTE.—As nozzles and needle valves are a lapped fit, **they should never be interchanged.**

4. **Wash all the injector parts** in clean fuel or substitute fuel oil and using a soft brass wire brush remove all carbon from the nozzle and needle valve.

Inspect the Injector Parts

1. If the tip of the needle is blued from overheating, or if the seat is seriously scored or damaged, the nozzle and needle valve are unfit for further service.

2. Check that the spring is not broken or rusty and that the ends are perfectly square.

3. Inspect all the components for wear or damage and check joint faces for scratches or trapped foreign particles.

4. Ensure that the needle is free to fall under its own weight in the nozzle, when wet with substitute fuel oil, and falls freely from the nozzle seat when inverted.

If any of the components are faulty the injector must be renewed.

To Clean

Use the tools in the injector cleaning kit, Tool No. CT.9014, to remove all carbon from the interior of the nozzle.

When a hard carbon deposit is formed, it may be softened by immersing the nozzle in "Acetone" for a short period. Up to half an hour is normally sufficient.

WARNING.—"Acetone" is a highly inflammable liquid and must not be brought near a naked flame.

NOTE.—It is important that immediately the nozzle is removed from the fluid, it must be rinsed in clean fuel or substitute fuel oil to prevent corrosion on the highly-finished surfaces.

Alternatively, the nozzles may be treated as follows:—

1. Dissolve 55 gm. (2 oz.) of caustic soda in 0.5 litre (1 pint) of water. Also add 14 gm. (½ oz.) of detergent.

2. Place the nozzles in the liquid and boil for a minimum period of 1 hour and not more than 1½ hours.

NOTE.—The concentration of caustic soda must not exceed 15% and water should be added to replace that lost by evaporation. Should the concentration of caustic soda exceed 15%, then the needle valve bore and joint face on the nozzle body may be roughened, making the injector unserviceable.

3. Remove the nozzles, after treatment, and wash in running water to remove all traces of caustic soda. After washing, immerse the nozzle in a de-watering oil, remove surplus oil by draining.

4. The carbon can now be easily removed with a wire brush and a standard pricker wire.

5. Flush out the interior of the nozzle using a suitable reverse wash adaptor fitted to the injector testing machine. When all particles of carbon have been removed, enter the needle valve into the nozzle and ensure that it is quite free.

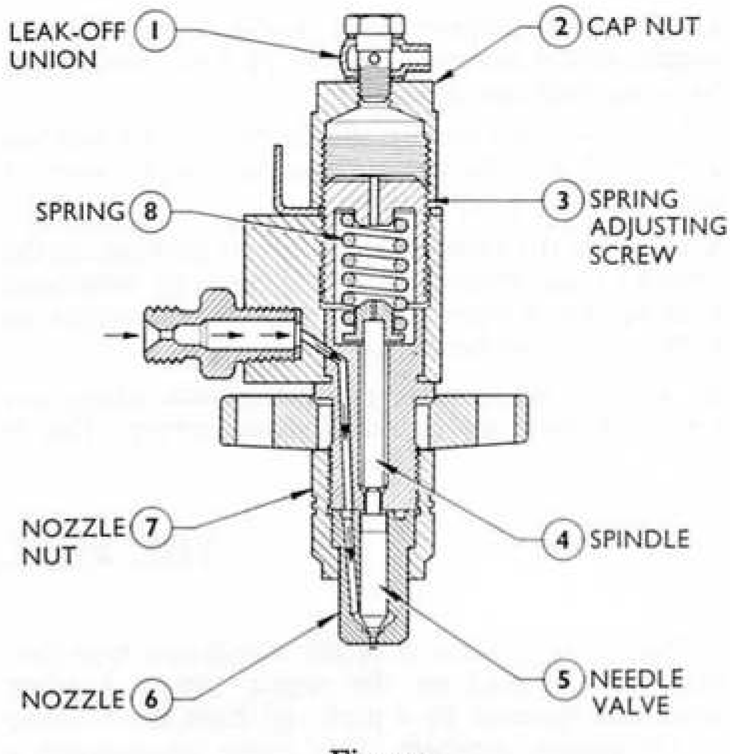


Fig. 50
Fuel Injector—Sectioned

To Reassemble

All injector parts should be reassembled wet, after rinsing in clean fuel or substitute fuel oil. *Do not use rag to clean any of the internal parts.*

1. **Fit the nozzle and the needle valve to the injector body.** Screw on the nozzle nut and tighten securely to a torque of 6.22 to 6.91 kg.m. (45 to 50 lb. ft.).

NOTE.—*It is essential that this figure is not exceeded otherwise serious distortion of the nozzle assembly may occur.*

2. **Fit the injector spindle, spring, upper spring disc and spring adjusting nut.** Screw down the adjusting nut until pressure can be felt on the spring.

3. **Connect the injector to the testing machine pipe.** Adjust the nozzle opening pressure to 150 atmospheres (4/108), 130 atmospheres (4/99).

4. **Fit the injector cap nut** and the tab washer. Tighten securely and recheck the nozzle opening pressure.

5. **Test the injector** as previously outlined on page 46.

NOTE.—If, after cleaning, the injector fails to pass these tests it should be replaced by a serviceable injector and the faulty one reconditioned. On no account should attempts be made to reclaim injector nozzles and valves through hand-lapping with metal polish or any other abrasive.

To Replace

1. **Clean the mating faces** of the recess in the cylinder head and the corresponding mating face on the injector nozzle cap nut.

2. **Fit a new copper joint washer** on the injector nozzle, always ensuring that the previous washer has been removed and discarded.

NOTE.—This washer should be an easy but not a loose fit on the injector nozzle. On no account use a spark plug type washer.

3. **Locate the injector** in the recess provided in the cylinder head, ensuring that it is correctly positioned to allow the injector pressure pipe to be coupled up without stress or bending.

4. **Fit the two injector retaining nuts,** taking care that these nuts are tightened down evenly. This is most important and failure to observe this often results in a gas leak past the copper joint washer and the injector.

5. **Position the injector pressure pipe** between the fuel injection pump and the appropriate injector and tighten the two union nuts evenly. When fitting these pressure pipes, tighten the unions alternately a little at a time, first one end then the other until both are tight.

6. **Fit a washer** either side of the leak-off pipe banjo union, fit the banjo union bolt and tighten securely.

THE FUEL LIFT PUMP

The fuel lift pump is of the diaphragm type (see Fig. 51), mounted on the engine tappet chamber cover and operated by a push rod from an eccentric on the engine camshaft. This pump incorporates a hand priming lever to enable the fuel system to be primed and bled.

On rotation of the engine, the eccentric on the camshaft lifts the push rod which in turn pivots the fuel lift pump rocker arm and link and pulls the diaphragm downwards against the pressure of the return spring. This creates a partial vacuum in the pump chamber, causing the inlet valve to open and draw fuel from the tank, through the pipe line, into the diaphragm chamber.

Further movement of the camshaft eccentric allows the rocker arm to return and the diaphragm is pushed up by the return spring, causing the inlet valve to close and the outlet valve to open. The fuel is then forced through the replaceable element filter to the injection pump.

When the filter and injection pump are filled with fuel, surplus fuel bleeds through a restricting orifice from the filter to the thermostart reservoir. Any back pressure created in the diaphragm chamber, by this restricting orifice, holds the diaphragm down and damps the action of the return spring.

Until the back pressure has fallen, the push rod and rocker arm idle on the camshaft eccentric without operating the link. As the pressure drops the diaphragm and link move upwards until the link makes contact with the rocker arm when the cycle will be repeated.

To Test

Providing there are no air leaks or obstructions in the fuel system, a quick check on the pump efficiency can be made as follows:—

1. Remove the air bleed screw from the fuel filter.

2. Operate the hand priming lever in the normal manner when there should be a well defined surge of fuel for each working stroke of the pump.

If there is no resistance of the diaphragm spring it is likely that the diaphragm is held down, due to the push rod being on the high point of the eccentric, and it will be necessary to rotate the engine approximately one turn.

If the pump does not operate correctly, check the inlet depression and delivery pressure, using the Diagnosis Test Set, the Gang Gauge Set No. 500-X or a suitable vacuum/pressure gauge.

Fuel Lift Pump Inlet Depression Test

1. Operate the lift pump hand priming lever to fill the injection pump and filter.

2. Disconnect the fuel inlet pipe from the lift pump and connect the vacuum gauge to the pump inlet union.

3. Connect a gravity feed supply of clean fuel to the inlet connection of the filter.

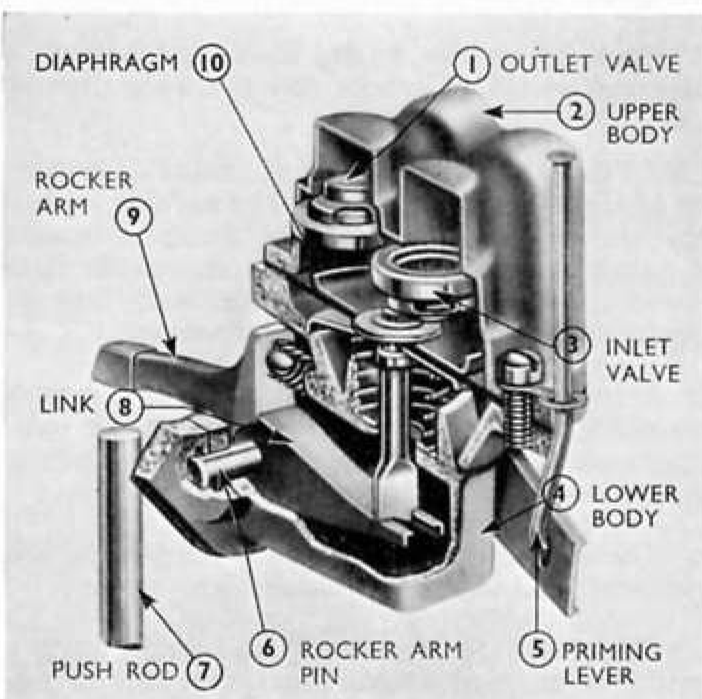


Fig. 51
Sectioned View of Fuel Lift Pump

4. Start the engine and allow it to run at idling speed. The vacuum reading should be at least 8½in. of mercury.

5. Stop the engine and the needle should take at least a minute to drop from 8½ in. of mercury to zero. Should the reading drop quicker than this, it indicates an air leak or faulty outlet valve.

6. Disconnect the vacuum gauge and gravity feed, replace the fuel inlet pipe and bleed the fuel system as described on page 51.

NOTE.—This test can be carried out at any point between the lift pump and fuel tank to check for air leaks in the fuel system as a whole. By starting the tests at the fuel tank and working towards the fuel lift pump, it will be possible to determine the faulty component.

Fuel Lift Pump Delivery Pressure Test

1. Operate the lift pump hand priming lever to fill the injection pump and filter.

2. Disconnect the fuel outlet pipe from the lift pump and connect the pressure gauge to the pump outlet union.

3. Connect a gravity feed supply of clean fuel to the inlet connection of the filter.

4. Start the engine and observe the pressure at idling speed. Increase the speed and check throughout the speed range that the pressure is between 0.42 to 0.70 kg./sq. cm. (6 and 10 lb./sq. in.).

NOTE.—Low fuel pump pressure may affect engine performance due to lack of fuel.

5. Disconnect the pressure gauge and gravity feed, replace the fuel outlet pipe and bleed the system as outlined on page 51.

To Remove

1. **Disconnect the fuel inlet and outlet pipes** from the fuel lift pump.

2. **Unscrew the two nuts securing the pump to the engine tappet cover** and detach the pump. Remove the pump gasket.

To Dismantle

1. **Mark the upper and lower body flanges to facilitate their correct reassembly** and remove the five screws securing the fuel pump upper body to the lower body. Remove the upper body, taking care not to damage the diaphragm when separating these parts.

2. **Push down the diaphragm and turn it 90°** in either direction when the diaphragm pull rod will be disconnected from the operating link and the diaphragm can then be detached.

3. **Remove the fabric oil seal from the diaphragm pull rod.** Turn the oil seal washer through 90° and detach the washer and diaphragm return spring. The diaphragm and pull rod are riveted together and should not be dismantled.

4. **The inlet and outlet valve assemblies** are retained by a plate secured by two round-headed screws. Remove the two screws, lift off the plate, valve assemblies and gasket.

Should it be necessary to dismantle the lower half of the pump body, remove the staking from around the rocker arm pin retainers and pull them from the slots in the body. The rocker arm pin, rocker arm, link, spring and thrust washers will then be freed and may be removed, leaving the priming lever in position.

To Reassemble

If the lower body has been dismantled, replace the rocker arm and link as follows:—

1. **Insert the rocker arm pin, rocker arm, link, spring** and thrust washers into the lower pump body, replace the rocker arm pin retainers in their slots, and securely stake them in position.

Test the operation of the rocker arm and link by moving the rocker arm towards the body when the link should be moved downwards. Depress the link, and the rocker arm should move freely without transmitting movement to the link. Ensure that the priming lever operates correctly and returns freely to the normal position.

2. **Locate the diaphragm return spring on the pull rod,** fit the oil seal washer, depress the washer and turn it through 90° to lock it on the pull rod. Fit a new fabric oil seal washer.

3. **Enter the diaphragm pull rod in the slotted end of the link** and turn it through 90° to lock it in position. Check that when assembled the small tab on the diaphragm is located directly below the outlet port in the top body.

4. **Inspect the valve assemblies** to see that the valves are seating properly. Locate a new gasket in the upper body and replace the valve assemblies. Secure the valves in position with the retaining plate and two round-headed screws. The retaining plate fits with the bowed centre towards the diaphragm.

5. **Fit the upper body to the lower** so that the mating marks, previously made, line up. Fit the five securing screws and spring washers, operate the rocker arm to compress the spring and tighten the screws evenly and securely.

To Replace

1. **Ensure that the lift pump mounting faces are clean,** fit a new gasket, and secure the pump with two nuts and spring washers.

2. **Reconnect the fuel inlet and outlet pipes.**

3. **Bleed the fuel system** as described on page 51.

THE FUEL FILTERS

It must be emphasised that fuel oil must be kept clean at all times. Contamination by dirt and/or water will result in premature wear and possible failure of finely machined components in the injection pump and injectors.

When filling the fuel tank, the fuel must not be poured from or have been stored in a dirty container.

Even when operating under the most favourable conditions a certain amount of dirt may be present in the fuel oil and, to prevent this reaching the injection pump and injectors, filters are provided in the fuel system.

Fuel is drawn from the fuel tank through a sediment bowl, mounted on the engine compartment bulkhead, by a mechanical lift pump on the engine tappet chamber cover.

Fuel from the lift pump passes through a replaceable element-type filter bolted below the rear of the exhaust manifold. A permanent fuel bleed, from the inlet side of this filter, flows through a restricting orifice to the cold starting device reservoir, which is mounted at the rear of the engine compartment.

Sediment Bowl

Every 8,000 km. (5,000 miles) or sooner if required, the fuel sediment bowl and filter screen should be removed and cleaned.

To Clean the Filter Screen

1. Unscrew the retaining nut and move the retainer to one side.

2. Remove the sediment bowl and gauze filter screen. Thoroughly wash the bowl and filter screen in clean fuel oil or substitute test fuel. **Do not wipe with cloth.**

3. Ensure that the gasket fitted to the body is in good condition. Refit the filter screen and bowl and tighten the retaining nut.

4. Bleed the fuel system, see page 51.

The Element Type Fuel Filter

This fuel oil filter fitted to the diesel engine has a renewable paper element which should be changed every 24,000 km. (15,000 miles).

Renewing the Filter Element

1. **Unscrew the filter securing bolt** and withdraw the filter body and element (see Fig. 52). Remove the rubber sealing ring from the filter head.

2. **Clean the interior of the body** using a brush and clean fuel oil.

On no account use rag for this operation.

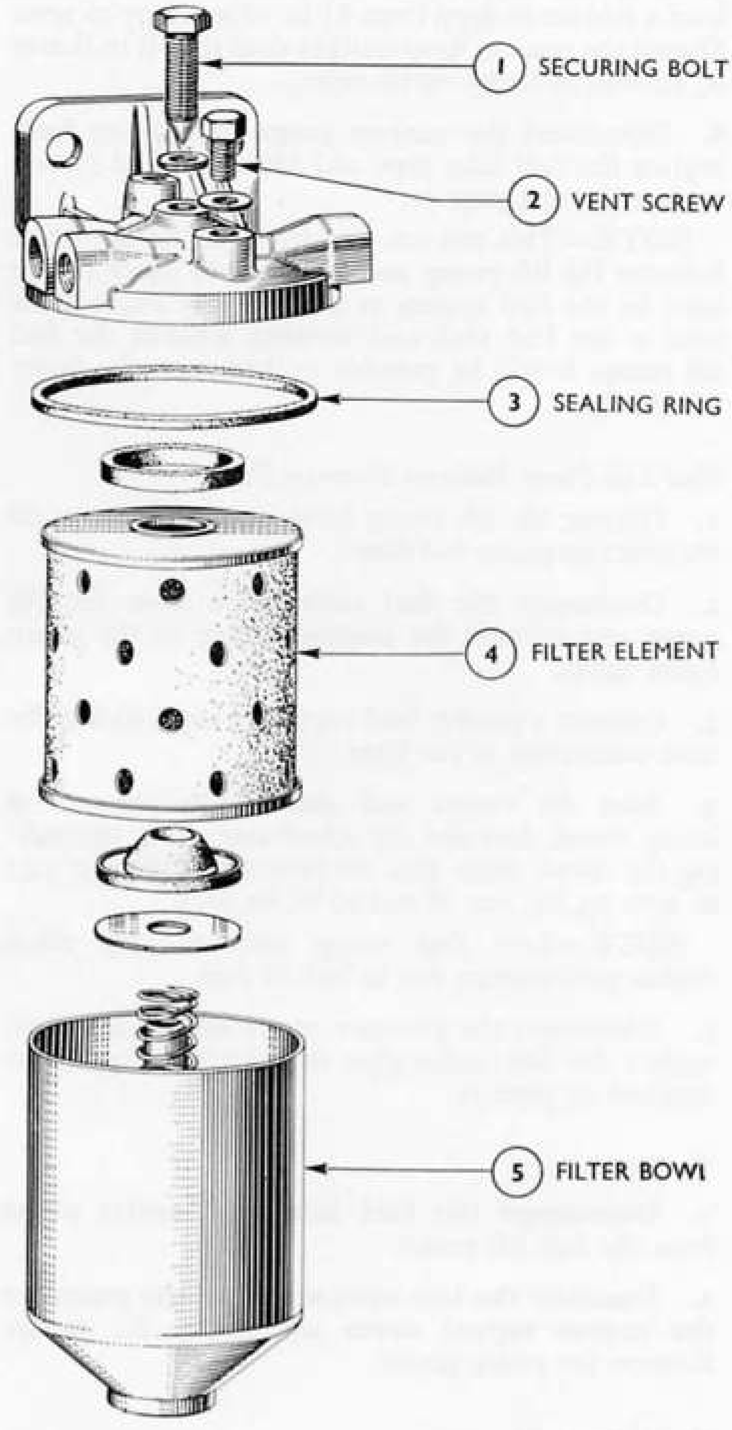


Fig. 52
The Fuel Filter

3. **Unpack the new element and fit it into the filter body.**

The element must not be removed from its packing until it is required for fitting to the filter body, otherwise it may become contaminated by foreign matter, which may pass to the fuel injection pump.

4. **Fit the rubber sealing ring,** supplied with each new filter element, to the filter head and refit the filter body.

5. **Tighten the filter securing bolt firmly.**

6. **Bleed the fuel system,** see page 51.

THE FUEL TANK

The position of the fuel tank varies, depending on the type of vehicle and is usually retained in position by two straps secured at one end by adjustable hooks and, at the other, by brackets attached to the floor pan. Anti-squeak pads are fitted between the tank and the support straps, and also between the upper surface of the tank and the floor pan.

To Remove

1. **Disconnect the fuel line** and return pipe from the tank.
2. **Disconnect the vent pipe** also from the tank, adjacent to the fuel line.
3. **Drain the fuel** from the tank via the drain plug and replace the plug.
4. **Disconnect the fuel supply pipe** by slackening the rubber supply pipe clip.
5. **Disconnect the lead** connected by the terminal to the fuel gauge sender unit.
6. **Suitably support the fuel tank,** and unscrew the nuts on the threaded clamps. Unhook the brackets from the slots on the floor pan and lower the tank towards the ground.

To Replace

1. **Raise the fuel tank** sufficiently to connect the lead to the fuel gauge sender unit.
2. **Position the tank in its location** and engage the brackets on the end of each support strap in their respective slots on the floor pan, ensuring that these support straps run over the anti-squeak pads attached to the underside of the tank. Do not fully tighten the nuts on the hook clamps.
3. **Connect the fuel pipe line** and return pipe and vent pipe to the tank.
4. **Tighten up the nuts on the hook clamps** until the fuel tank is firmly located.
5. **Reconnect the supply pipe** and tighten the clip. Refill the tank with fuel.

Maintenance

In course of time, sediment may collect in the fuel tank, its presence usually being denoted by sediment deposits on the fuel pump screen.

If it is suspected that either excessive deposits, or water, are present in the tank, the tank should be removed and thoroughly flushed with clean petrol.

When repairs involving the application of a flame or heat are necessary to a fuel tank, this should be flushed, "steamed" and allowed to stand for at least 24 hours to evaporate all fumes from the tank.

THE FUEL LINE

The fuel pipe is clipped to the underside of the floor pan. Occasionally, the unions and securing clips should be checked for tightness, and the pipe inspected to ensure that no chafing against the floor has occured.

COLD START AIDS

The fuel injection pump does not incorporate an excess fuel device and, therefore, to facilitate cold engine starting a cold starting device is fitted in the inlet manifold. This device, known as the "Thermostart" consists of a coil of wire heated electrically and controlled by the switch key. A valve, incorporated in the thermostart allows fuel to flow onto the coil. The valve is opened when the coil reaches its operating temperature, by expansion of the valve body. Fuel flowing onto the coil ignites, to facilitate cold starting on subsequent operation of the starter motor. The level of the fuel reservoir is maintained by a permanent bleed from the inlet side of the fuel filter. Surplus fuel drains through a leak-off pipe to the fuel tank.

If the device has not been used for a long period or the feed pipe has been disturbed, the system must be bled. When bleeding, ensure that there is adequate fuel in the reservoir, slacken the feed pipe union at the thermostart and when fuel flows freely, tighten the union.

For extreme climatic conditions, an alternative cold start aid is available. This is known as a "start pilot" and consists of an ether pump controlled from the dash. A disposable cartridge is used and ether is injected directly into the inlet manifold via a nozzle when the pump is operated.

BLEEDING THE FUEL SYSTEM

If any part of the fuel system is disconnected or air has entered the system, it will be necessary to remove all air from the fuel and to prime the injection pump by bleeding.

To enable the injection pump to be primed or bled provision is made in the regulating valve for by-passing the sliding vane type transfer pump which only passes fuel when the rotor is turning. When the injection pump is not operating the regulating plunger is in the lower part of the regulating sleeve bore and rests on a priming by-pass spring, see Figs. 33, 36 and 39. Operation of the lift pump priming lever forces fuel at lift pump pressure through the inlet connection and into the regulating sleeve bore. This pressure forces the plunger downwards compressing the priming by-pass spring and uncovering the priming port in the sleeve, see Figs. 33, 36 and 39. The transfer pump is then by-passed and the injection pump may then be primed and bled. The regulating plunger returns to its normal position after bleeding has been completed.

Bleed the Fuel System as follows:—

1. **Fuel injection pump—**
   - (*a*) Slacken the governor vent screw located at the top of the governor housing (see Fig. 53).
   - (*b*) Slacken the hydraulic head vent screw, on the side of the pump body, again see Fig. 53.

2. **Fuel filter**—Slacken, by two or three turns, the fuel filter vent screw on the top of the filter cover (see Fig. 52). Do not slacken the return pipe to the tank.

3. **Operate the priming lever** on the lift pump, and when fuel, free from air bubbles, appears from each venting point, tighten the vent screws in the following sequence:—

(*a*) Fuel filter vent screw. (Fig. 52.)

(*b*) Hydraulic head vent screw. (Fig. 53.)

(*c*) Governor vent screw. (Fig. 53.)

4. **Slacken the pump inlet union nut** and operate the lift pump priming lever, retighten when fuel, free from air bubbles, issues from around the threads.

5. **Slacken the unions** at the injector ends of two of the high pressure pipes. Set the accelerator at the fully open position and ensure that the "stop" control is in the "off" (or "run") position.

Turn the engine over until fuel oil, free from air bubbles, issues from both high pressure fuel pipes, then tighten the unions.

The fuel system has now been bled, and the engine is ready for starting.

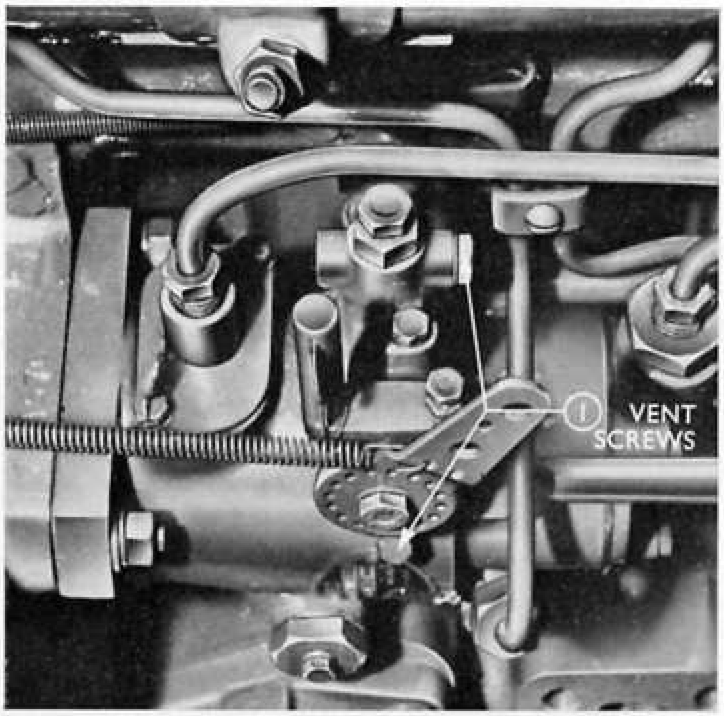


Fig. 53
Injection Pump Bleed Points

NOTE.—If the cam on the engine camshaft is on maximum lift, it will render the fuel lift pump priming lever inoperative. If this occurs, rotate the engine until the priming lever can be operated.

AIR CLEANER

An oil bath-type air cleaner is fitted to these vehicles and in normal operating conditions this should be cleaned and the oil changed every 4,000 km. (2,500 miles). However, should the vehicle be operating in a heavily dust-laden atmosphere it should be cleaned more frequently.

To Remove

1. **Slacken the hose clamp** securing the air cleaner trunk to the inlet manifold.

2. **Unscrew the wing bolt** from the top of the air cleaner and remove the top cover.

3. **Remove the oil bath reservoir.**

To Clean

1. **Wash the gauze element,** incorporated in the top cover, with paraffin or petrol. Dip the element in clean engine oil and allow to drain.

2. **Empty the oil bath reservoir** and wash with paraffin or petrol.

3. **Clean the air cleaner casing** thoroughly with a non-fluffy rag moistened with paraffin or petrol.

4. **Place the oil bath reservoir** on a level surface and fill with clean engine oil to the level mark indicated by the arrow inside the reservoir.

To Replace

1. **Place the oil bath reservoir** (filled to the correct level) in the air cleaner casing.

2. **Fit the air cleaner top cover,** ensuring that the trunk locates in the hose on the inlet manifold.

3. **Refit the wing bolt.**

4. **Tighten the wing bolt** and hose clamp.

Section 10

ELECTRICAL SYSTEM

CONTENTS

SUBJECT

ELECTRICAL SYSTEM

MAINTENANCE AND OVERHAUL PROCEDURES

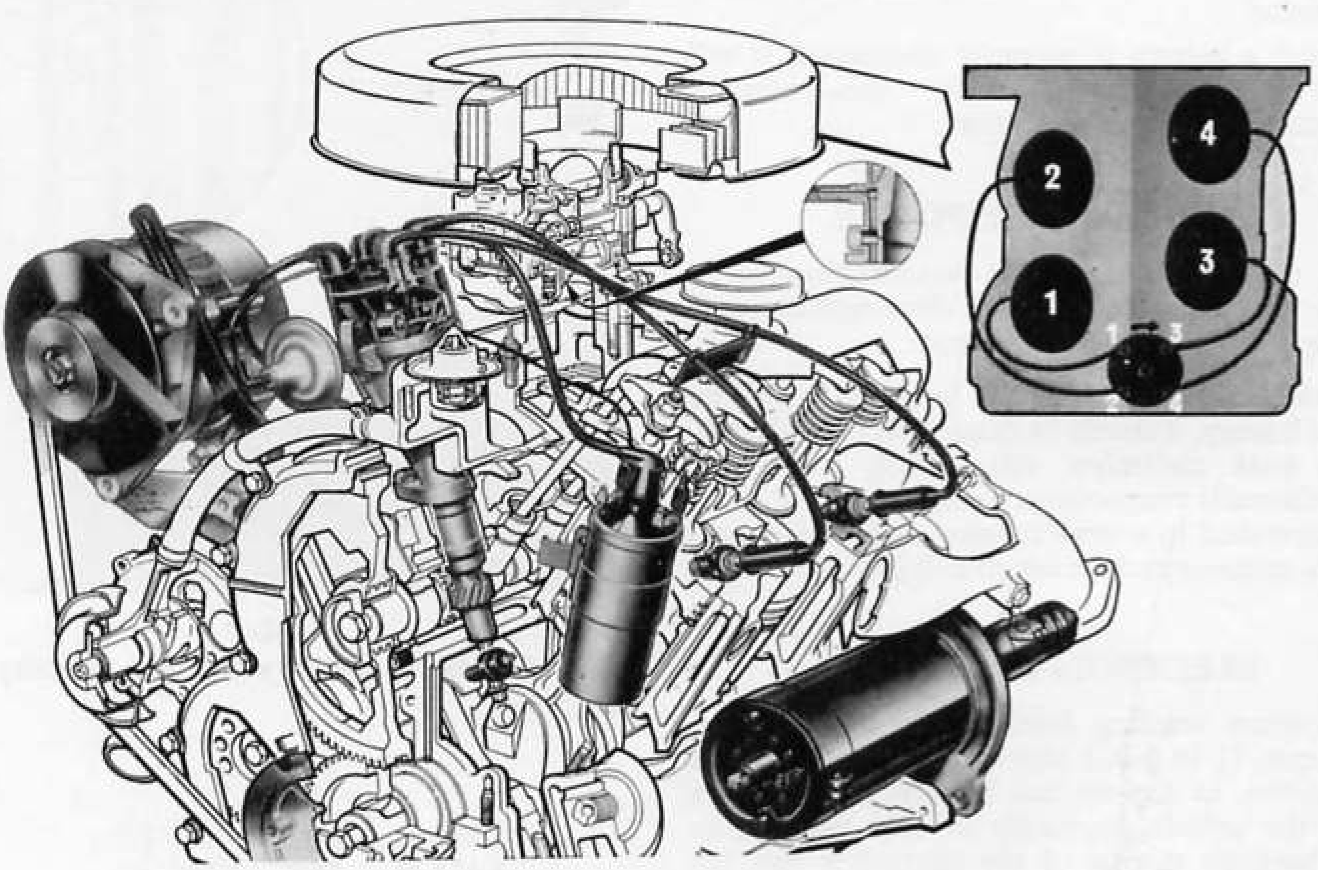


Fig. 1
Electrical System

ELECTRICAL SYSTEM PRECAUTIONS

The "Transit" Range of vehicles is fitted with an Alternator Charging System instead of the more commonly known generator.

Certain precautions must be observed to avoid serious damage to the alternator, battery, or vehicle wiring on vehicles fitted with this charging system.

When carrying out work the precautions are as follows:—

1. Always disconnect the battery earth lead before removing the alternator output lead as this is live at all times.

2. Disconnect both battery and alternator leads when electric arc welding is being carried out on a vehicle.

3. Check battery polarity before installing, as it may be reverse charged. (Use a voltmeter for this check.)

4. Ensure that the battery is connected to the vehicle correctly, i.e. Negative lead to Negative post, and Positive lead to Positive post.

5. Always connect a booster battery in parallel, i.e. Negative to Negative and Positive to Positive.

6. Disconnect the earth battery cable from the battery before connecting a battery charger.

7. Do not attempt to polarize or motor an alternator.

8. Never operate the alternator on open circuit with the rotor (field) coil energised.

9. When adjusting the fan belt always apply the tightening lever to the front mounting bracket and not to the stator or rear housing.

10. Do not use a high voltage source to test diodes. (Use a maximum of 12 volts.)

11. Do not disconnect battery cables from the battery, charging or control circuit, while the engine is running.

12. Do not "flash" any charging or control cables to earth.

13. Do not use a high voltage resistance tester for testing alternator circuits.

THE BATTERY

The electrical system is of the 12 volt earth-return type, the negative terminal of the battery being earthed.

The battery is located in the nearside of the engine compartment.

Provided a battery is properly maintained it will function satisfactorily between the extreme temperatures of summer and winter.

GENERAL MAINTENANCE

Keep the battery and the surrounding parts, particularly the tops of the cells, clean and dry, and brush away any dirt or dust present.

If distilled water or electrolyte has been spilled on top of the battery, it should be cleaned off immediately, as even weak electrolyte will quickly attack and corrode the cable connections, clamp plates and bolts. Use a rag soaked in a weak solution of hot water and ammonia, to counteract the action of spilled electrolyte.

ELECTROLYTE LEVEL

The correct working level of the electrolyte is 6 to 10 mm. ($\frac{1}{4}$ to $\frac{3}{8}$ in.) above the separators. It is good practice to top-up the battery just prior to running the vehicle, especially in cold weather, to ensure thorough mixing of the electrolyte and the water and so prevent freezing.

When topping-up use distilled water from a clean lead, glass or earthenware container, and a funnel.

If the battery is found to need frequent topping-up, steps should be taken to determine the reason. For example, the battery may be receiving an excessive charge, in which case the regulator setting should be checked. If one cell in particular needs topping-up more than another, check the condition of the battery case. If there are signs of an electrolyte leak, trace the fault and take corrective action. The battery tray should then be cleaned and repainted.

SPECIFIC GRAVITY

The specific gravity reading indicates the state of charge of the battery and should be checked with a hydrometer.

If the level of the electrolyte is so low that a hydrometer reading cannot be taken, no attempt should be made to take a reading after adding distilled water until the battery has been on charge for at least one hour.

Table "A" gives the specific gravity of the electrolyte at various electrolyte temperatures when the battery is fully charged.

Table "B" gives the approximate low limits of specific gravity at various electrolyte temperatures when the battery has been fully discharged at the normal rate.

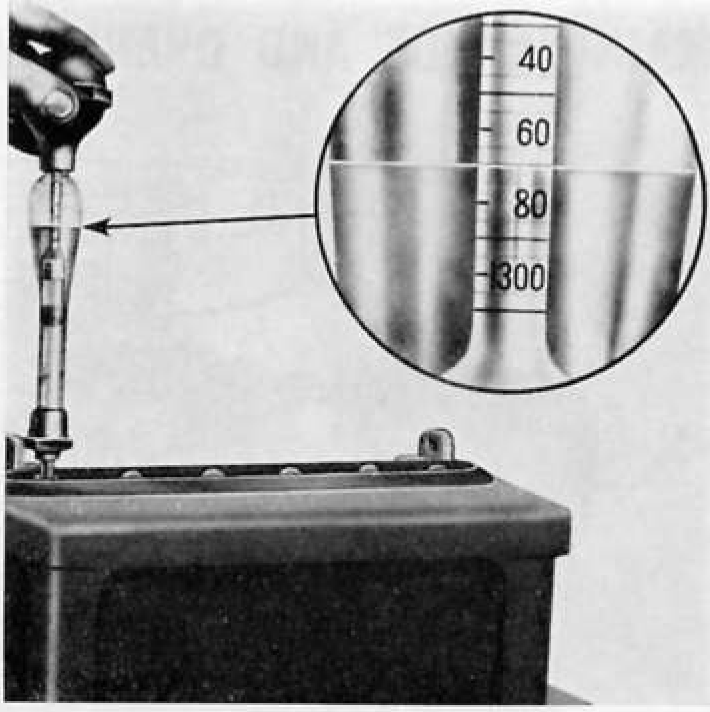


Fig. 2
Checking Battery Specific Gravity

Table "A"

1.259 at	43°C.	(110°F.)	
1.263 at	38°C.	(100°F.)	
1.267 at	32°C.	(90°F.)	
1.271 at	27°C.	(80°F.)	
1.275 at	**21°C.**	**(70°F.)**	**(normal)**
1.279 at	16°C.	(60°F.)	
1.283 at	10°C.	(50°F.)	
1.287 at	4°C.	(40°F.)	
1.295 at	— 7°C.	(20°F.)	
1.303 at	—18°C.	(0°F.)	
1.311 at	—29°C.	(—20°F.)	

Table "B"

1.089 at	43°C.	(110°F.)	
1.093 at	38°C.	(100°F.)	
1.097 at	32°C.	(90°F.)	
1.101 at	27°C.	(80°F.)	
1.105 at	**21°C.**	**(70°F.)**	**(normal)**
1.109 at	16°C.	(60°F.)	
1.113 at	10°C.	(50°F.)	
1.117 at	4°C.	(40°F.)	
1.126 at	— 7°C.	(20°F.)	
1.133 at	—18°C.	(0°F.)	
1.142 at	—29°C.	(—20°F.)	

There should be little variation in the specific gravity readings from cell to cell on any battery in reasonably good condition. If the variation is greater than 0.025, then the reason should be investigated.

If electrolyte has been spilled at any time, or lost owing to a leak, topping-up the level with distilled water will lower the specific gravity.

This can be corrected when next charging the battery by adding a dilute solution of sulphuric acid which has a specific gravity approximating to the values tabulated below, until the specific gravity of the electrolyte is again standard.

1.255 (29.5° Baumé) temperate climates
1.239 (28° Baumé) tropical climates*

*A tropical climate may be taken as one in which water will never freeze and where the air temperature is frequently above 32°C. (90°F.) in the shade.

Never use concentrated acid alone for this purpose. Always add the acid to the water when preparing the electrolyte: it is dangerous to add water to acid.

A large variation, which is not the result of electrolyte loss, is probably an indication of an internal short circuit and an early inspection of the battery by a competent electrician is advisable.

Temperature Correction

When the electrolyte temperature varies from the standard of 21°C. (70°F.), the specific gravity will also vary—see Tables "A" and "B".

The equivalent hydrometer reading at 21°C. (70°F.) can be determined by applying the following correction:—

Add four points (0.004 specific gravity) for every 5½°C. (10°F.) above 21°C. (70°F.).

Subtract four points (0.004 specific gravity) for every 5½°C. (10°F.) below 21°C. (70°F.).

CHECKING BATTERY CONDITION

There are three methods of checking battery condition: (*a*) open circuit voltage test, (*b*) high rate discharge test, and (*c*) checking the specific gravity.

(*a*) The open circuit voltage of a 12 volt battery should be above 12.6 volts (2.1 volts per cell) for a battery in good condition.

However, the voltage reading on open circuit is liable to be misleading. If the voltage is low then the cells are definitely in poor condition, but a high voltage reading on open circuit does not necessarily indicate that the cells are in good condition.

(*b*) The high rate discharge test gives an indication of the condition and capacity of the battery. On test, the battery should maintain 100 amp. flow for 10 seconds with no appreciable fall in voltage.

Where a hand instrument (incorporating a low resistance device) is used for checking the individual cells of a battery, the actual reading obtained will depend upon the exact type of instrument used, but the cell voltage on a 5 to 6 seconds test should remain steady between 1.2 and 1.7 volts.

Variations in individual cell readings can indicate faults, but if all cells in any one battery fall below standard, re-charge and again test before rejecting the battery.

Never make a high rate discharge test on a battery known to be low in charge.

c) A further method of checking the state of charge of a battery is by means of a specific gravity reading, taken on a suitable hydrometer. A fully charged battery should give specific gravity readings of:—

1.272 to 1.283 (31° to 32° Baumé) temperate climates

1.239 to 1.255 (28° to 29½° Baumé) tropical climates

checked with a hydrometer and corrected to 21°C. (70°F.).

CHARGING FROM AN EXTERNAL SOURCE

Before starting the charge, the electrolyte level should be topped-up with distilled water to 6 to 10 mm. (¼ to ⅜ in.) above the separators.

NOTE:—When a battery is on boost charge the ignition must always be switched off to avoid damaging the vehicle charging system.

The normal charge rates are shown in the table below.

Battery	*Bench Charge Normal Rate*	*Initial Charge Rate (converting uncharged batteries)*	
		Rate	*Hours*
38 amp hr.	3 amps	2.25 amps	48 to 60
57 amp hr.	3.5 amps	2.5 amps	48 to 60

The charge should be continued until the specific gravity and cell voltage in each cell show no further rise during five hours on continuous charging and all cells gas freely. If the specific gravity of the electrolyte in any cell or cells fails to rise while on charge and gassing does not take place, the cells should be tested for internal short circuits.

The maximum permissible temperature of electrolyte during external charging is 43°C. (110°F.) and, if this is exceeded, the charge should be suspended or reduced to one-half to allow the temperature to fall.

If, at the end of the charge, the specific gravity varies by more than 10 points (i.e. 0.010), from the figures given in table "A" (see page 4), the specific gravity must be adjusted, either raised by adding fresh electrolyte, the S.G. of which should be 1.343 (37° Baumé), or lowered by the addition of distilled water. The specific gravity of any two cells of a battery should not vary more that 0.015.

To test a cell suspected of being short circuited, take the individual voltage of each cell of the battery while it is on charge and when charged, carry out a high rate discharge test. The cell voltage between individual cells should not vary more than 0.15 volt. The voltage of a faulty cell on high rate discharge will fall rapidly. If it is confirmed that a cell is internally shorted, the battery must be renewed or suitable repairs made.

SPECIAL INSTRUCTIONS

Cold Climates

In cold climates, the electrolyte of a partially discharged battery (specific gravity approximately 1.151, 19° Baumé) will be frozen at temperatures below —18°C. (0°F.), and a fully discharged battery (specific gravity approximately 1.111, 14½° Baumé) will freeze at —9°C. (16°F.). For this reason, special precautions should be taken when operating in cold climates to prevent the battery state from falling below the conditions indicated by the following specific gravities:—

1.198 (24° Baumé) specific gravity at −18°C. (0°F.)
1.245 (28½° Baumé) specific gravity at −29°C. (−20°F.)
1.266 (30½° Baumé) specific gravity at −35°C. (−30°F.)

The electrolyte level in each cell should be frequently checked and adjusted to 6 to 10 mm. (¼ to ⅜ in.) above the separators. When topping-up, use clean distilled water. This should be done only during charging and preferably when the cells are gassing freely, so that the water becomes mixed with the electrolyte before it has time to freeze.

Tropical Climates

A topical climate may be taken as one in which water will never freeze, or where the air temperature is frequently above 32°C. (90°F.) in the shade.

Wet batteries supplied with new vehicles or as service replacements have an electrolyte specific gravity of 1.272 to 1.283 (31° to 32° Baumé) when in a fully charged condition. These readings are corrected to 21°C. (70°F.).

The specific gravity of the electrolyte in batteries to be used under tropical conditions should, however, be between 1.239 and 1.255 when corrected to 21°C. (70°F.) (Baumé equivalent—28° to 29½°). It will, therefore, be necessary to adjust the specific gravity of all wet batteries supplied in service or with vehicles, on arrival at their destination.

Methods of Adjusting Specific Gravity in Tropical Climates

1. Immediately the battery arrives at its destination, check and top-up the electrolyte level with distilled water. Then place the battery on charge at its normal rate (see table).

2. Continue the charge until the specific gravity has reached its maximum, i.e. until the gravity of each cell remains constant for a period from 2 to 5 hours and all cells are gassing freely.

3. Discontinue the charge. turn the battery upside down and allow it to drain.

4. Turn the battery back to its normal upright position and clean the exterior surface of the casing thoroughly, using a cloth moistened with ammonia. This will counteract the effect of spilled electrolyte.

5. Immediately refill each cell with electrolyte of 1.142 specific gravity (18° Baumé).

If the cells are not refilled directly after draining, the negative plates will tend to oxidise.

6. Again place the battery on charge at its normal rate and continue the charge for 4 to 6 hours.

7. If the specific gravity following the charge is above 1.255 (29½° Baumé) when corrected to 21°C. (70°F.), adjust by withdrawing the electrolyte from the cells with a squeeze ball and restoring the level with distilled water.

If the specific gravity is below 1.239 (28° Baumé) when corrected to 21°C. (70°F.), adjust by adding electrolyte of specific gravity greater than 1.250.

8. Following an adjustment to the electrolyte specific gravity, replace the battery on charge at the normal rate until the specific gravity of the electrolyte in each cell has stabilised.

9. Before putting the battery into service again, check the electrolyte levels, adjusting if necessary to 6 to 10 mm. (¼ to ⅜ in.) above the separators. Remove electrolyte if the levels are too high or add electrolyte of the correct specific gravity if too low.

Always give idle batteries a freshening charge at least once a month.

THE LIGHTING SYSTEM

The Headlamps

Each headlamp is a sealed beam unit, consisting of a filament, lens and reflector. It is replaceable only as a complete unit.

To Replace a Headlamp

1. **Remove the headlamp surround retaining screw.** Insert a screwdriver through the hole in the bottom of the headlamp surround, and remove the crosshead retaining screw. Remove the surround.

2. **Unscrew the three crosshead screws** retaining the inner rim and remove the rim.

NOTE.—Do not disturb the two slot-head screws as these control headlamp alignment.

3. **Lift forward the sealed beam unit** and detach the plug from the three contacts on the rear of the unit.

Fig. 3
Headlamp Adjustment

4. **Refit a new sealed beam unit.**

5. **Replace the inner rim** and secure with the three crosshead screws.

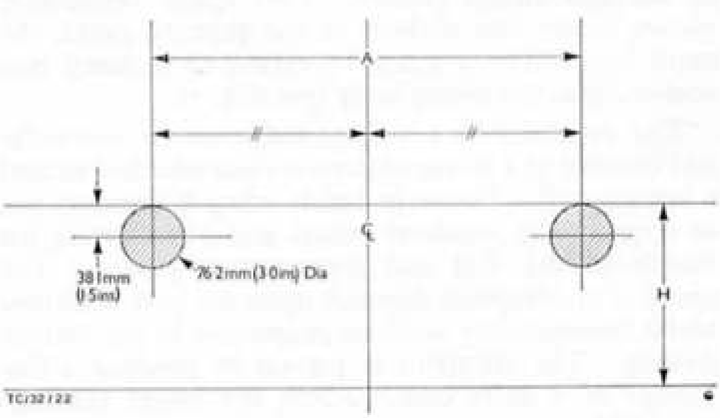
6. **Press the headlamp surround into position** over the retaining clips and refit the screw through the hole in the bottom of the surround.

Headlamp Alignment

The headlamps can be aligned with any suitable alignment equipment, but if this is not available, the following procedure should be carried out:

1. Position the vehicle on level ground 3 m. (10 ft.) in front of a suitable darkened board which is marked with a vertical and horizontal line.

This board must be at right-angles to the vehicle centre-line.



Centre of main beam hot spot to be within the 76.2 mm. (3 in.) dia. shaded arc shown above.

Fig. 3a

2. Measure the height 'H' from the ground to the centre of the headlamps.

3. **Position the board** so that the vertical line is exactly in line with the vehicle centre-line.

Position the board, also, so that the horizontal line is parallel to the ground and at a height 'H' from the ground.

4. **Remove the headlamp** surrounds and switch on the main beam.

5. **By means of the horizontal** and vertical adjusting screws, adjust each headlamp in turn so that the centres of brightest illumination lie on the horizontal dividing line 161 cm. (63.5 in.) apart (A) and equidistant from the vertical dividing line (see Fig. 3a).

It is advisable to cover one headlamp whilst adjusting the other.

6. **Switch off the headlamps** and refit the surrounds.

Side Lamps and Front Direction Indicator Lamps

To renew a side lamp or front direction indicator bulb, unscrew the three crosshead screws securing the combined lens, and remove the lens, bezel and gasket.

The bulbs are the normal bayonet type.

When refitting a lens, ensure that the gasket is located evenly behind the lens so that the assembly is completely watertight.

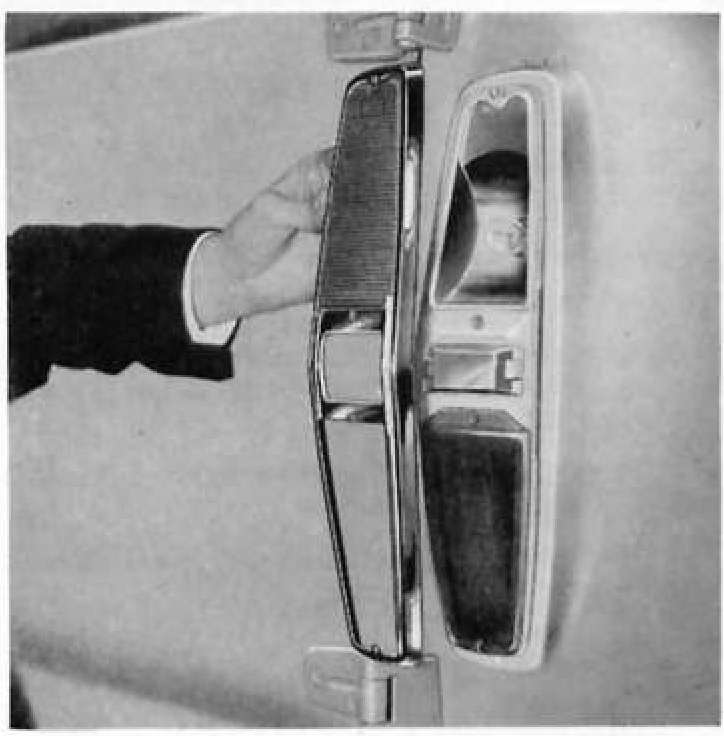


Fig. 4
Replacing a Rear Bulb

Rear, Stop and Rear Direction Indicator Lamps

To renew either a rear and stop lamp bulb (dual filament), or a direction indicator bulb (single filament) remove the two screws retaining the rubber door stop, and then the two screws retaining the lens bezel. This will enable the two lenses and the gasket to be removed (Fig. 4).

Replace the faulty bulb, position the gasket and lenses, and replace the bezel and two outer screws. Replace the door stop and secure it with the two inner screws.

When replacing the lenses, ensure that the gasket is evenly located.

Stop Light Switch (*pre-September* 1970)

The stop light switch is hydraulically operated and is located in a four-way union mounted on the bulkhead below the regulator.

(*September* 1970 *onwards*)

The stop light switch is mounted on top of the pedal box assembly, and is operated directly by an extension of the brake pedal.

To replace the stop light switch, remove the two wires from the unit and unscrew it. Refit the new switch and connect the two wires to their respective terminals. Bleed the braking system (pre-September 1970 models only).

THE INSTRUMENT PANEL

The instrument panel assembly incorporates the central instrument cluster, and other instruments such as a vacuum gauge, where fitted.

To Remove

1. **Unscrew the four panel retaining screws** and ease the panel rearwards.

2. **Disconnect the speedometer cable** and vacuum pipe (where fitted).

3. **Pull the multi-connector plug** from the panel socket.

4. **If necessary,** the instrument cluster can be removed by unscrewing the two retaining clamps.

To Replace

1. **Replace the instrument cluster.**

2. **Reposition the multi-connector plug.** The locating keyway on the plug ensures it can only be replaced in one position.

3. **Reconnect the speedometer drive cable** and vacuum gauge pipe (where fitted).

4. **Present the panel into its location** and retain it with the four crosshead screws.

THE INSTRUMENT CLUSTER

The electrical supply to the instrument cluster is provided by a thirteen-pin multi-connector plug, which, due to a locating keyway, can only be fitted in one position.

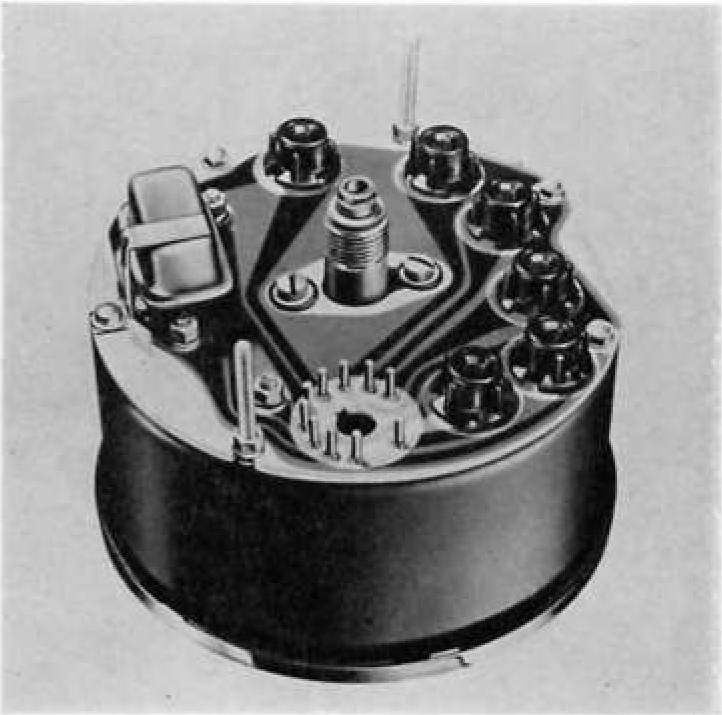


Fig. 5
Instrument Cluster

The circuit fed by each multi-connector pin is shown in the wiring diagrams.

The rear face of the instrument cluster incorporates a printed circuit which is coated with a protective plastic film.

The cluster consists of the speedometer, fuel gauge, temperature gauge, main beam warning light, direction indicator light, generator warning light and oil pressure warning light.

Panel Light Bulbs

The instrument illumination, direction indicator and warning bulbs are housed in plastic holders with metal inserts which contact the printed panel.

To remove a bulb, simply turn the holder a quarter-of-a-turn anti-clockwise after which the holder and bulb can be removed. Each is a normal bayonet fitting in its respective holder.

Instrument Regulator and Gauges

The instrument regulator is located on the rear face of the instrument cluster. Two spade connection blades locate into sockets in the printed panel, the earth connection is made by means of a clamp bolt screwed into the casing body (see Fig. 5).

The regulator is a voltage/temperature controller and consists of a bi-metal strip around which is wound a heating coil. The strip bends when it becomes hot so opening the regulator points and interrupting the circuit to the fuel and temperature gauges. The speed of interruption depends upon the heat produced and is consequently in direct proportion to the current flowing. The regulator is pre-set to produce a line voltage of 5 volts consequently the gauge readings will still be accurate even when the battery is in a low state of charge.

Both the petrol and temperature gauges also incorporate a bi-metal strip which bends when it becomes hot thus producing the needle deflection.

A theoretical layout of the instruments and regulator is shown in Fig. 6.

When the petrol tank is empty, the tank unit float arm falls to its lowest position inserting the whole of the unit resistance in the fuel gauge circuit. This reduces the current flowing and the gauge will read "empty".

When the tank is full the tank unit resistance is "shorted out" causing maximum current flow and the gauge to read "Full".

The temperature sender unit is also a variable resistance, but this takes the form of tightly packed discs of a material which has a high resistance when cold and a low resistance when hot.

When the ignition is first switched "on" it takes approximately 30 seconds for the bi-metal strips to attain their static temperature. During this period the needles of both gauges slowly rise to the correct reading on their respective dials.

Fault Finding

If **both** gauges record what is known to be an incorrect reading then a **common** fault is indicated, these are:—

(*a*) Battery—poor condition, loose or dirty connections.

(*b*) Electrical Wiring—loose connections or poor earthing.

(*c*) Voltage Stabiliser—faulty or poorly earthed.

If **one** gauge only registers an incorrect reading then the fault is confined to the gauge, its sender unit or its wiring.

Do not remove any components until tests on the vehicle have been completed.

General Check

Check that all the wiring connections are clean and secure and that all the components are well earthed. Also check that the battery open circuit voltage is greater than 11 volts.

Both Gauges register incorrectly

Voltage Stabiliser earth test

Provide an alternative good earth for the stabiliser and observe the gauge readings. If they are still incorrect then renew the stabiliser.

Fuel Gauge only registers incorrectly

1. *Tank Unit earth test*

Provide an alternative good earth for the tank unit and observe the gauge reading. If the reading is now correct then a poor tank unit earth is indicated.

2. *Wiring Continuity test*

Connect a lead between the tank unit terminal and the fuel gauge (tank unit) terminal and observe the gauge reading. If the reading is now correct then faulty wiring or connection are indicated.

3. *Tank Unit test*

Remove the tank unit from the vehicle and reconnect the feed wire to the tank unit terminal. Earth the tank unit to the vehicle chassis. Switch on the ignition and slowly move the float arm between its limits of travel. Check the gauge readings for correct response.

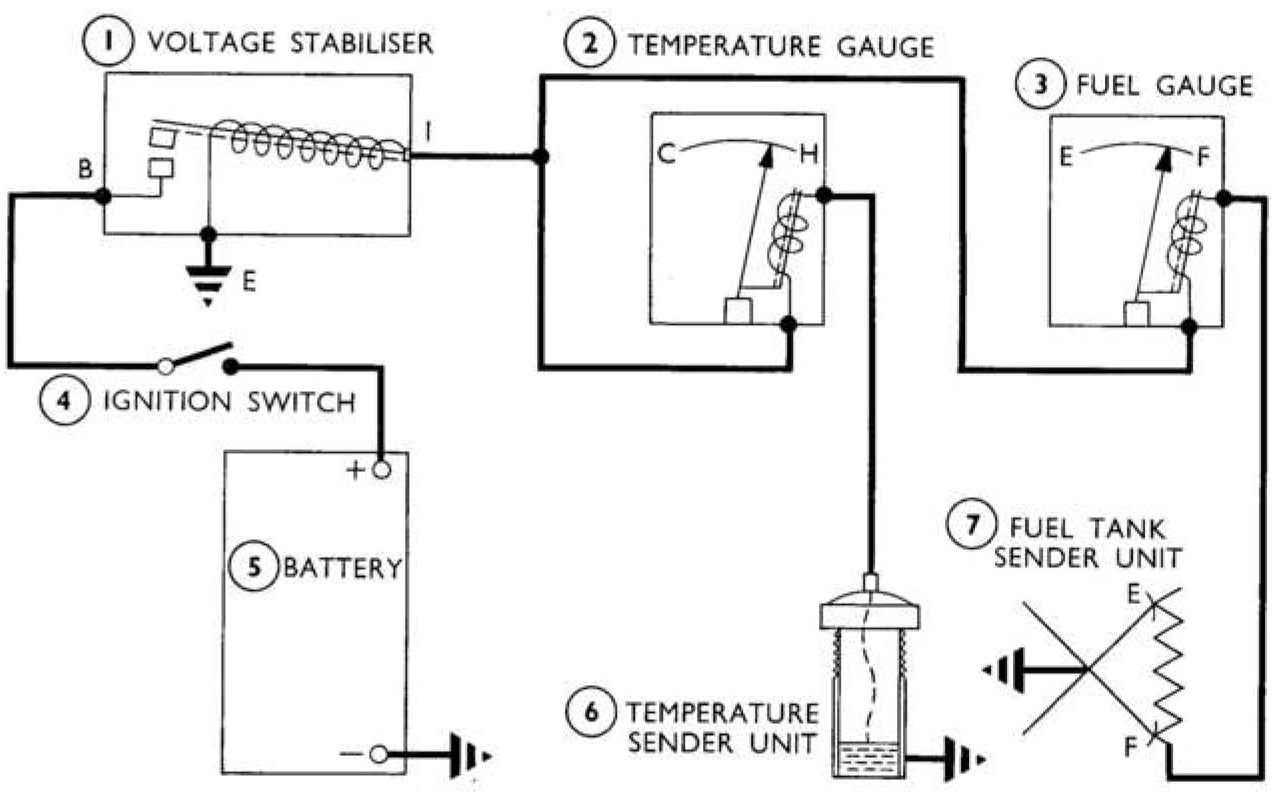


Fig. 6
Theoretical Layout of Instruments and Regulator

4. *Tank Unit substitution test*

If the readings from test 3 are incorrect, connect up a new tank unit and repeat test 3. If incorrect readings are still obtained then a faulty gauge is indicated.

Temperature Gauge only registers incorrectly

1. *Wiring Continuity test*

Connect a wire between the sender unit terminal and the temperature gauge (sender unit) terminal and observe the gauge reading with the engine at normal running temperature. If the reading is now correct then faulty wiring or connections are indicated.

2. *Sender Unit substitution test*

Replace the sender unit with a new one and observe the gauge reading. If the reading is still incorrect then renew the temperature gauge and replace the original sender unit.

HEADLAMP FLASHER, DIRECTION INDICATOR, DIP SWITCH AND HORN BUTTON ASSEMBLY

This assembly is mounted on the right-hand side of the steering column.

The self-cancelling direction indicators operate only when the ignition is switched on. The lever is pressed downwards for right-hand turns (Fig. 7, position 2) and upwards for left-hand turns (Fig. 7, position 1).

To change the headlamp main beam from "low" to "high" beam, push the lever away from the steering wheel (Fig. 7, position 4). The lever should be returned to its original position when "low" (dipped) beam is required.

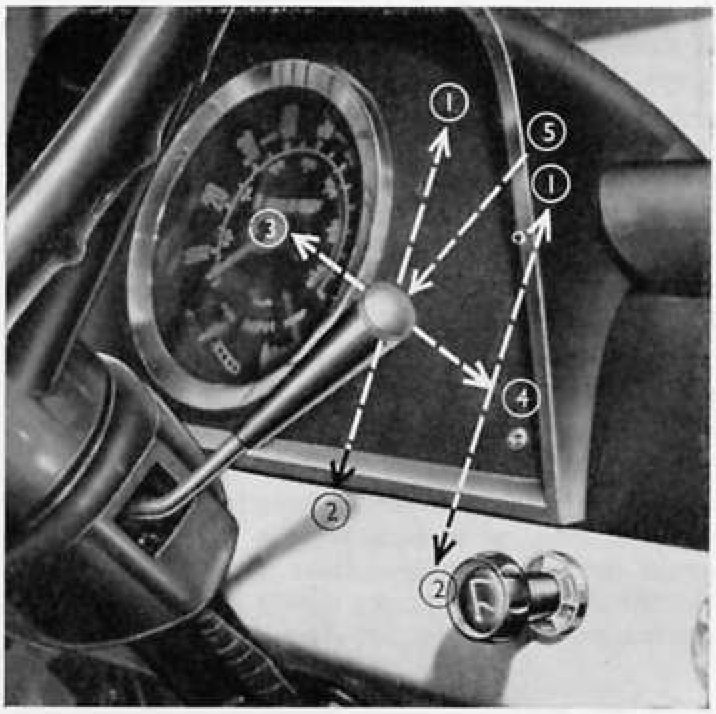


Fig. 7
Switch Positions

To flash the headlamps at any time, pull the lever towards the steering wheel (Fig. 7, position 3). When released the lever will return to its original position.

To operate the horn, press the end of the control towards the steering column (Fig. 7, position 5).

To Remove

1. **Disconnect the battery.**

2. **Remove the left-hand half of the casing.** This is a press fit, locating on two ball-ended studs. Carefully insert a small screwdriver in the point between the two halves of the casing and prise off.

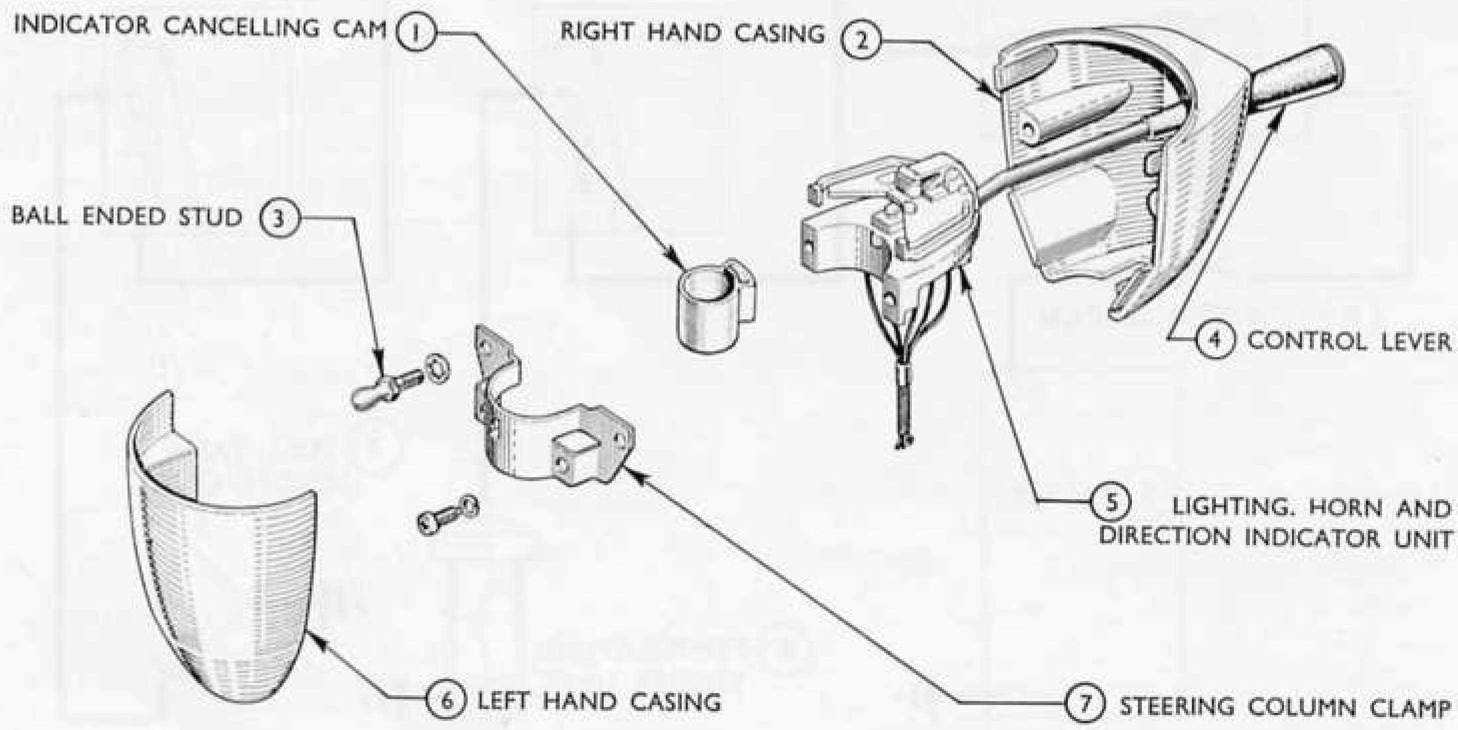


Fig. 8
Exploded View of Switch Assembly

3. **Remove the two ball-ended locating studs,** using a 2 B.A. spanner. Remove the right-hand half of the casing.

4. **Remove the two crosshead screws** securing the unit to the steering column.

5. **Disconnect the wiring** from the unit, noting the positions and colours of the wires for reassembly.

To Reassemble

1. **Reconnect the wiring.**

2. **Position the clamp** around the steering column and refit the unit using the two crosshead screws. Ensure that the lugs locate in the slots in the steering column tube.

3. **Refit the right-hand half of the casing** over the operating arm, and secure with the two ball-ended studs.

4. **Press the left-hand half of the casing** into position.

5. **Reconnect the battery,** switch on the ignition and test the action of the switch, checking all exterior lights.

THE INERTIA STARTER MOTOR

The starter is mounted on the front of the flywheel housing on the R.H. side of the engine.

The motor has four pole pieces and four sets of field coils. Four commutator brushes are fitted, two of which are earthed, the other two being insulated and connected to the ends of the field coils.

A square is machined on the end of the armature shaft, beneath a small metal cap. This will assist in freeing the pinion if, at any time, it jams in mesh with the flywheel ring gear.

TO TEST THE STARTER MOTOR ON THE ENGINE

If the starter does not operate, check the condition of the battery and the battery connections.

If the battery is in good condition, check the starter switch. If the starter still does not operate, the motor should be removed for examination.

To Remove

1. **Disconnect the battery** and the cable at the terminal on the starter motor end plate.

2. **Unscrew the three starter motor securing bolts** evenly and detach the starter motor.

To Replace

1. **Pass the drive end of the starter motor into the flywheel housing aperture** and locate the motor on the mounting flange with the cable terminal to the R.H. side of the vehicle.

2. **Replace the three bolts** and spring washers and tighten securely.

3. **Reconnect the cable to the starter motor terminal,** ensure that the cable does not foul the exhaust pipe and reconnect the battery.

4. **Check that the starter motor turns** the engine when the starter switch is operated.

STARTER BRUSHES

To Examine the Brushes

1. **Remove the starter motor.**

2. **Loosen the screw** and slide the brush cover away from the brush apertures.

3. **Lift the brush springs** using a piece of wire shaped into a hook and check the movement of the brushes in the holder.

4. **If the brushes are sticking,** clean them with a petrol moistened cloth and, if necessary, ease the sides of the brushes by polishing on a smooth file. When satisfactory, replace the starter motor.

NOTE.—If the brushes are worn so that they do not bear on the commutator or the brush lead is exposed on the wearing face, new brushes must be fitted.

If the commutator is blackened or dirty, clean by holding a petrol moistened cloth against it while the armature is rotated.

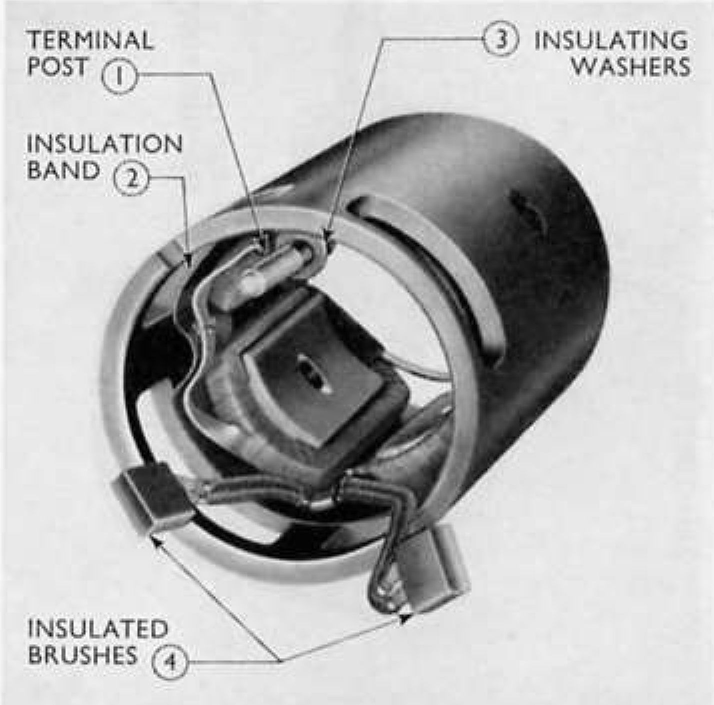


Fig. 9
Position of Starter Field Coils

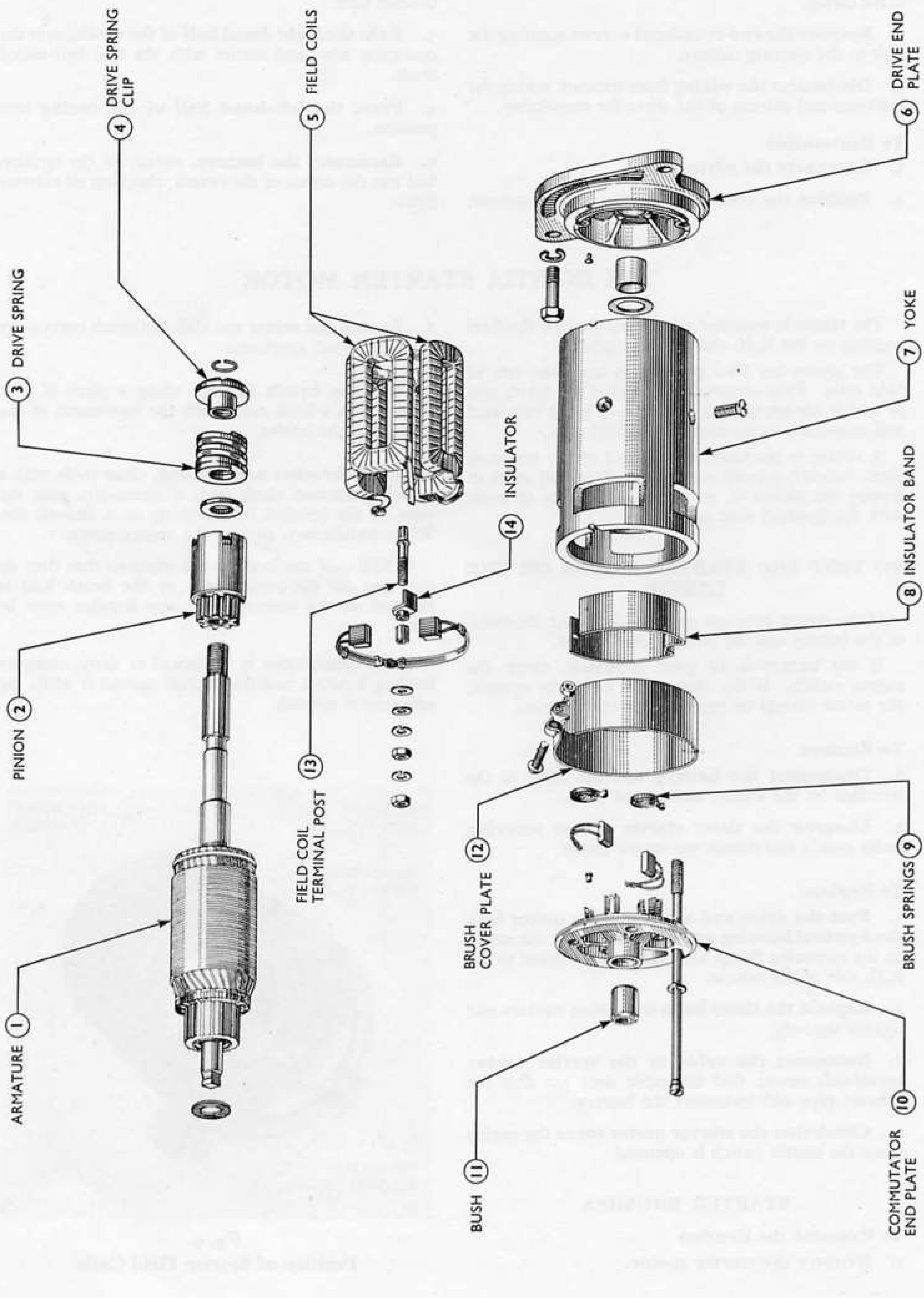


Fig. 10
Starter Motor — Exploded View

COMMUTATOR END PLATE AND BRUSHES

To Remove

1. **Remove the starter motor.**

2. **Slacken the cover band screw** and slide the cover band away from the brush apertures.

3. **Lift the brush springs** and pull the brushes out of their holders.

4. **Unscrew the starter cable terminal nuts** and detach the spring, flat and fibre washers.

5. **Unscrew the two through-bolts** and carefully pull the commutator end plate from the starter motor, together with the earth brushes. Remove the armature if necessary.

6. **Unsweat the earthed brush leads** from the connections and detach the brushes.

To Replace

1. **Check the brushes for freedom of movement** in the brush holders (see previously) and then resolder the brush leads to the field coils and earthed brush holders.

The field coil or insulated brushes are longer than the earthed brushes and have a braided covering. Fit these brushes so that they both point towards the field coil terminal, when the starter motor yoke is viewed from the commutator end as shown in Fig. 9.

2. **Before fitting the end plate, check the brush springs** and renew if necessary. Take care to close the ends of the brush spring posts after fitting new springs.

It is also advisable to check the insulated brush holders to ensure that they are not earthing. Use a battery and bulb for this test.

3. **Check that the fibre washers are fitted** on the field coil terminal post and a fibre sleeve is located in the terminal post hole in the commutator end plate.

4. **Check that the insulator band is located** between the yoke and the end of the field coils, and pass the insulated brushes through the apertures in the yoke.

5. **Replace the commutator end plate** on the starter motor yoke, passing the earthed brushes through the other apertures in the yoke and engage the dowel pin in the end plate with the notch in the yoke end.

6. **Replace a fibre washer, flat washer, spring washer, nut,** spring washer and nut (in that order) on the field coil terminal post and tighten the inner nut securely.

7. **Replace the armature and drive end plate,** if removed, engaging the dowel pin on the plate in the notch at the drive end of the yoke.

Replace the two through-bolts and tighten securely.

8. **Lift the brush springs** and insert the brushes into their holders, ensuring that they slide freely. (The field coil brushes locate in the insulated brush holders.)

9. **Slide the brush cover band over the brush apertures** and tighten the screw securely.

10. **Replace the starter motor** as described earlier in this Bulletin.

STARTER COMMUTATOR

The commutator should be inspected when the starter motor is dismantled. A commutator in good condition should be smooth and free from pitting or burned spots.

Clean the commutator with a petrol-moistened cloth. If this is ineffective, carefully polish with a strip of fine glass paper, *not emery cloth*, while the armature is rotated.

If the commutator is badly worn or scored, remove the starter drive as described previously in this Bulletin and detach the drive end plate. Mount the armature in a lathe, rotate at high speed, and take a light cut with a very sharp tool.

Polish the commutator with very fine glass paper.

Do not undercut the mica insulation between the segments as is the normal practice with generators.

Check that the commutator segments are not earthing to the armature shaft and core by checking with a battery and bulb.

STARTER ARMATURE

The armature can be inspected after it has been removed from the starter motor yoke. Visual examination will, in many cases, reveal any cause of failure, i.e., conductors lifting away from the commutator due to the starter pinion being jammed in the engaged position while the engine is running.

A damaged armature must be replaced in all cases. No attempt should be made to machine the armature core or to true a distorted armature shaft.

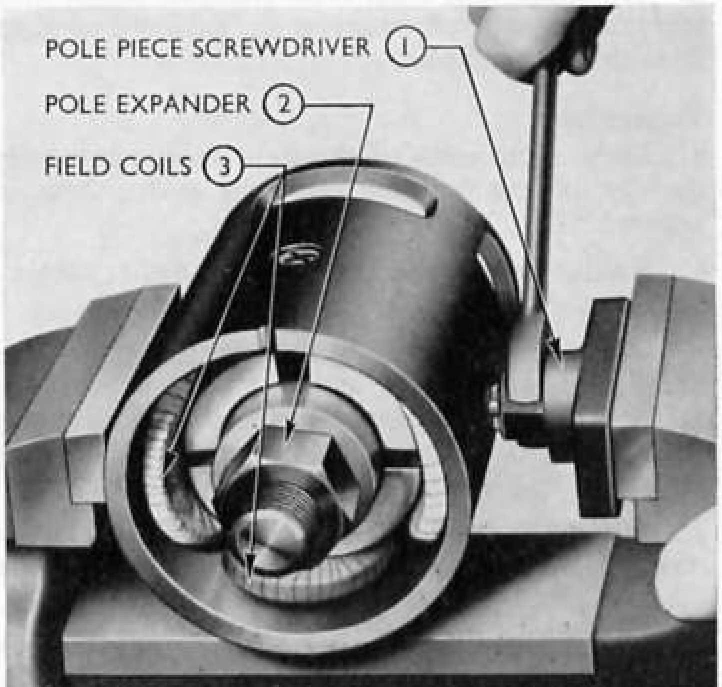


Fig. 11
Removing Starter Field Coils

STARTER FIELD COILS

To Test

1. Remove the commutator end plate as described previously, and withdraw the armature and drive end plate.

2. Test the field coils for continuity and earth as follows:—

Check for continuity between the two ends of the field coils, using a mains operated line tester, having a suitable bulb in circuit. Alternatively, the test prods on a Diagnosis Test Set can be used.

If the lamp does not light, there is an open circuit in one of the field coils. If the lamp lights, it does not necessarily mean that the field coils are in order, as it is possible that one of the coils may be earthing to the pole pieces or starter yoke.

This may be checked by touching one of the test prods on the starter yoke and the other onto one of the field coil tappings. If the bulb now lights, the coils are earthed.

NOTE.—The field coils are not serviced separately, as invariably it is found that if one fails the others are affected.

To Remove

1. **Mark the yoke and pole shoes** so that the shoes can be refitted in their original positions.

2. **Detach the fibre insulating washers** and sleeve from the field coil terminal post and the insulation band from the commutator end of the yoke.

3. **Locate the pole piece expander** CP.9509 in the starter yoke and tighten the nut to expand the tool against the pole pieces. Mount the starter yoke and pole piece screwdriver CP.9504 in a vice as shown in Fig. 11, and slacken the pole piece screws one at a time. Finally, remove the screws with a crosshead screwdriver.

4. **Withdraw the field coils** and pole pieces from the yoke and carefully unsweat the field coil tappings from the terminal post.

To Replace

1. **Locate the ends of the field coil tappings** in the slot of the terminal post and solder them in position.

2. **Solder new brush leads** to the smaller connections on the field coils as previously described.

3. **Temporarily replace the commutator end plate** on the starter yoke and note the position of the field coil terminal in relation to the yoke. Reassemble the pole pieces to the field coils so that the mating marks on the yoke and pole pieces are together.

4. **Insert the field coils and pole pieces** into the starter yoke, align the securing screw holes and locate the pole pieces with the cross-head screws.

5. **Insert the pole piece expander** and tighten the nut to press the pole pieces against the yoke.

6. **Place the starter yoke** and pole piece screwdriver in a vice and tighten the screws securely.

7. **Slacken off the nut and remove the expander.**

8. **Replace the insulator band** around the commutator end of the field coils between the coil tappings and the yoke.

9. **Replace the insulator sleeve** and washers on the field coil terminal post and check that the post is pointing along the axis of the yoke.

10. **Replace the armature** and commutator end bracket.

STARTER END PLATE BUSHES

The bushes in the drive and commutator end plates are serviced and should be renewed if the bushes are found to be excessively worn or scored.

The bushes can be removed and replaced with suitable drivers.

After reassembling the starter motor, check that the armature shaft is free to rotate in the bushes without binding.

Starter Motor Drive

The starter drive is of the outboard drive type, the pinion moving towards the body of the starter motor when the switch is operated.

When a starter motor is removed, it is important that the drive is thoroughly cleaned and is checked for freedom of action. If necessary, wash the parts in paraffin to remove any grease, oil or dirt present.

Do not lubricate the components as this may eventually cause the pinion to stick.

The front face of the pinion sleeve is cut-away at four points and the rear face of the pinion is correspondingly machined to act as a ratchet.

If the pinion fails to engage or the engine kicks back when the starter control is operated, the pinion sleeve is screwed rearwards against the tension of the main spring until it disengages from the pinion and rotates independently of it. This prevents any excessive strain being imposed on the armature shaft.

When the starter control is released the pinion re-engages the sleeve and returns to the disengaged position under the influence of the spring.

To Dismantle

1. **Compress the drive spring cup and drive spring,** using a suitable press and spring compressor, and remove the retaining circlip.

2. **Release the press** and remove the drive spring cup, drive spring and retaining washer. Pull the drive pinion barrel assembly from the armature shaft.

NOTE.—The pinion barrel assembly cannot be dismantled, it is serviced as a complete assembly.

To Reassemble

1. **Refit the pinion barrel assembly** on the armature shaft with the pinion teeth towards the armature windings.

2. **Locate the drive spring retaining washer** and drive spring on the shaft and refit the drive spring cup. Compress the cup and drive spring and refit the circlip, ensuring that it is fully seated.

THE PRE-ENGAGED STARTER MOTOR WITH PARALLEL SOLENOID

Description and Operation

The starter motor is mounted at the side of the flywheel housing on the left-hand side of the engine. It is of the pre-engaged type and incorporates an externally mounted parallel solenoid.

The purpose of the pre-engaged feature of this starter is to protect the flywheel ring gear and the starter pinion gear teeth, by the self-indexing operation.

When the ignition key is operated, current flows from the battery to the solenoid. The solenoid plunger moves inwards and operates a pivoted drive engaging lever which pushes the drive pinion into mesh with the flywheel ring gear. As the solenoid plunger reaches the end of its travel it closes an internal contact and full starting current flows to the starter field coils. The armature then revolves and drives the engine.

The starter drive pinion is fitted with a one-way clutch so that when the engine starts it does not drive the starter motor. The drive pinion will remain in mesh with the flywheel ring gear as long as the ignition key is held on. Therefore, release the key as soon as the engine is running.

To Test the Starter Motor on the Engine

If the starter does not operate, check the condition of the battery and the battery connections.

If the battery is in good condition, check the starter switch. If the starter still does not operate, the motor should be removed for examination.

To Remove the Starter Motor

1. Disconnect the battery earth cable and the heavy duty solenoid cable. Disconnect the ignition switch-to-solenoid wires at the solenoid end.

2. Unscrew the three starter motor securing bolts and detach the starter from the engine.

To Replace the Starter Motor

1. Pass the drive end of the starter motor into the flywheel housing aperture and locate the motor on the mounting flange with the solenoid uppermost.

2. Replace the three securing bolts and spring washers and tighten securely.

3. Reconnect the solenoid wiring and the battery earth lead.

4. Check that the starter motor turns the engine when the ignition key is operated.

THE SOLENOID

The solenoid has two sets of windings; a main series winding and a parallel shunt winding. Both of these windings are energised when the ignition key is turned and the solenoid plunger is drawn inwards, engaging the drive pinion in the starter ring gear. At the end of its travel the plunger closes a contact switch and the series winding is cut out; the current flows to the starter motor and it revolves at high speed. The parallel shunt winding, however, remains energised and holds the pinion gear in mesh until the ignition key is released.

In the event of the pinion gear meeting the flywheel ring gear tooth to tooth and not engaging, the solenoid plunger can still move inwards against a spring and close the contact switch. The starter then revolves slowly and the teeth engage.

To Test the Solenoid

1. It is first necessary to set the pinion gear travel (see Fig. 12), using the eccentric pivot pin as follows: first energise the solenoid with a 12 volt supply. Slacken the eccentric pivot pin locknut and turn the pin until the correct setting of 1.27 mm. (0.050 in.) is obtained between the pinion and thrust washer. Note that the arc of adjustment is 180° as indicated by arrows on the casing.

2. Remove the connection from the solenoid to the starter body terminal.

Connect, through a switch, a 6 volt supply between the solenoid small unmarked terminal and the large terminal "STA". Connect a separately energised test lamp circuit across the solenoid main terminals (see Fig. 14.)

3. Insert a stop of $\frac{1}{8}$ in. thickness between the pinion and drive end bracket to prevent the pinion moving fully outwards.

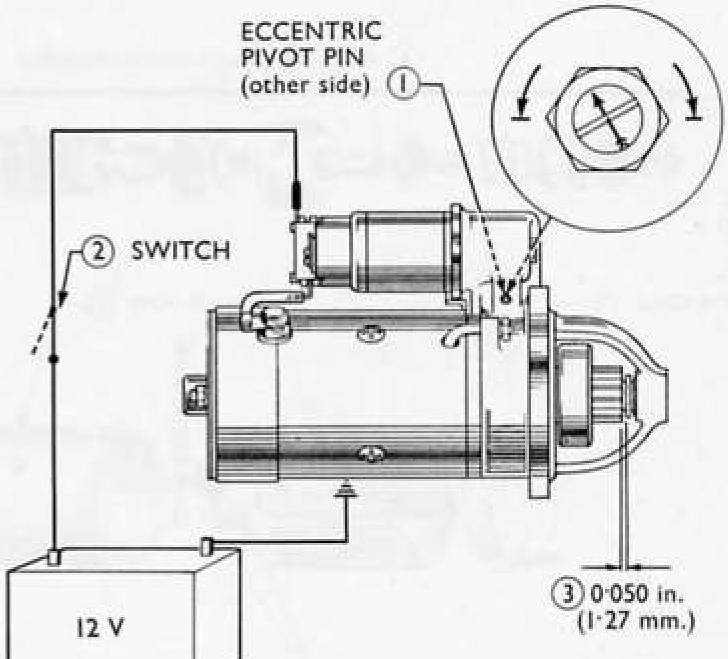


Fig. 12
Pinion Clearance Setting

4. Close the switch, thus causing the 6 volt supply to energise the shunt winding. The test lamp should now light, indicating the solenoid contacts have closed satisfactorily.

5. Switch off and remove the 0.32 cm. (⅛ in.) stop restricting the pinion movement.
Switch on again and hold the pinion in the fully engaged position by hand.

6. Switch off and observe the test lamp which should go out, indicating that the solenoid contacts have opened satisfactorily.

To Remove the Solenoid

1. Remove the starter motor as previously described.
2. Disconnect the solenoid to starter motor yoke terminal connection.
3. Unscrew the two solenoid securing bolts.
4. Withdraw the solenoid body from the solenoid plunger.

To Replace the Solenoid

1. Reposition the solenoid body over the solenoid plunger with the terminal "STA" against the starter motor yoke.
2. Replace the two securing bolts and spring washers and tighten securely.
3. Replace the starter motor as previously described.

STARTER BRUSHES

To Examine the Brushes

1. Remove the starter motor as described previously.
2. Loosen the screw and slide the brush cover away from the brush apertures.
3. Lift the brush springs using a piece of wire shaped into a hook and check the movement of the brushes in the holder.
4. If the brushes are sticking, clean them with a petrol-moistened cloth and, if necessary, ease the sides of the brushes by polishing on a smooth file.
NOTE.—Brushes should be renewed when they are worn to 7.5 mm. (0.3 in.) in length.

To Remove the Brushes

1. Remove the starter motor.
2. Loosen the screw and slide the brush cover away from the brush apertures.
3. Lift the brush springs with a wire hook and pull the brushes out of their holders.
4. Prise back the through bolt locking tabs and unscrew the two through bolts and carefully pull the commutator end plate from the starter motor, together with the earth brushes. Remove the armature if necessary.
5. Cut the brush leads and discard the brushes.

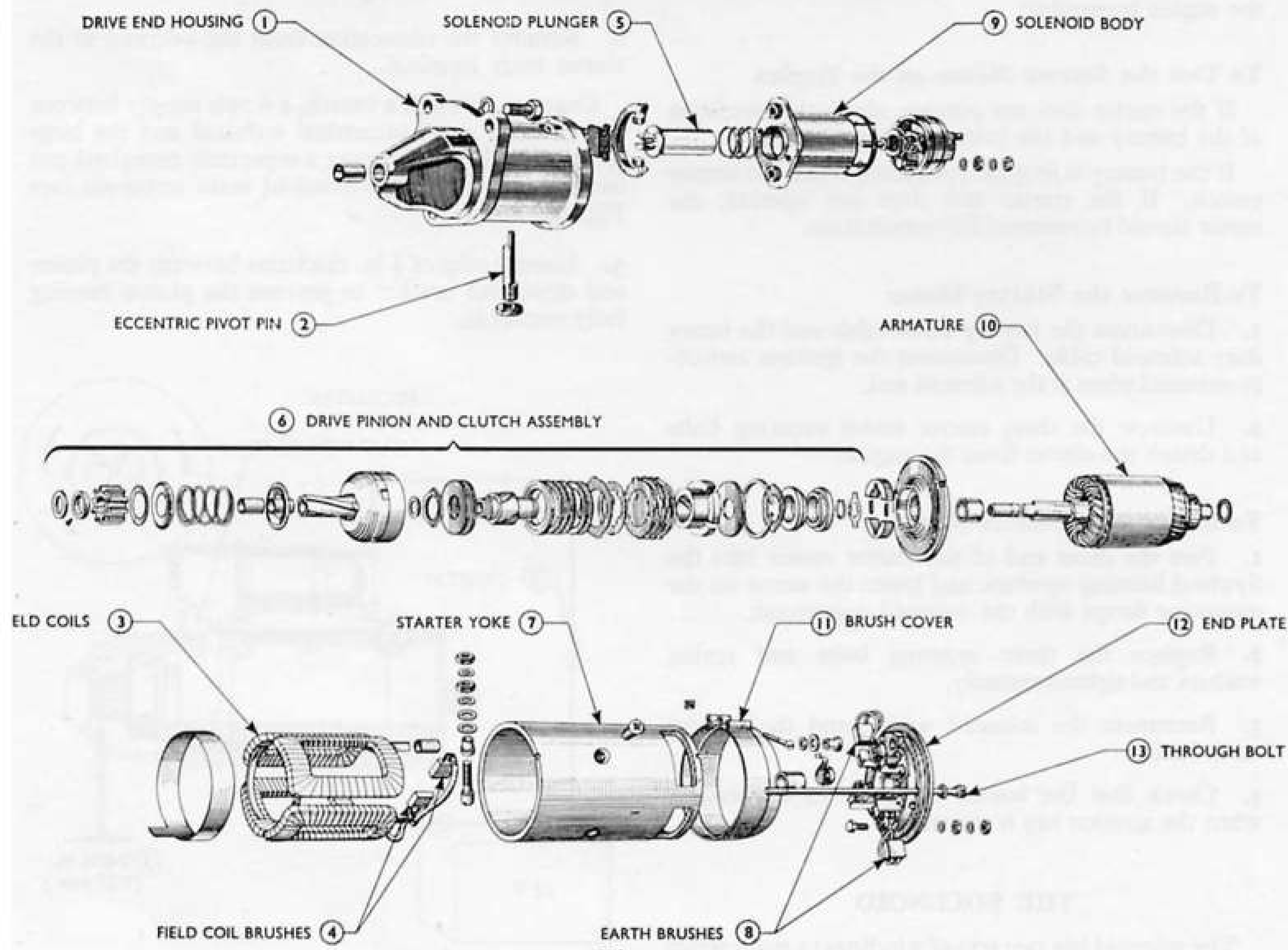


Fig. 13a
Pre-engaged Starter Motor — Diesel

Do not attempt to unsolder the brushes because, as aluminium field coils are fitted, difficulty will be experienced unless special equipment is used.

To Replace the Brushes

1. Check the brushes for freedom of movement in the brush holders (see previously) and then solder the new brushes to the old leads. If necessary trim the new brush leads to the required length.

The field coil or insulated brushes have a braided covering. Fit these brushes so that they both point towards the field coil terminal, when the starter motor yoke is viewed from the commutator end.

2. Before fitting the end plate, check the brush springs and renew if necessary.

It is also advisable to check the insulated brush holders to ensure that they are not earthing. Use a battery and bulb for this test.

3. Check that the insulator band is located between the yoke and the end of the field coils, and pass the insulated brushes through the apertures in the yoke.

4. Replace the commutator end plate on the starter motor yoke, passing the earthed brushes through the other apertures in the yoke and engage the dowel pin in the end plate with the notch in the yoke end.

5. Refit the through bolts, tab washers and spring washers. Tighten to 0.83 kg.m. (6 lb. ft.) and bend up the tab washers against the through bolts.

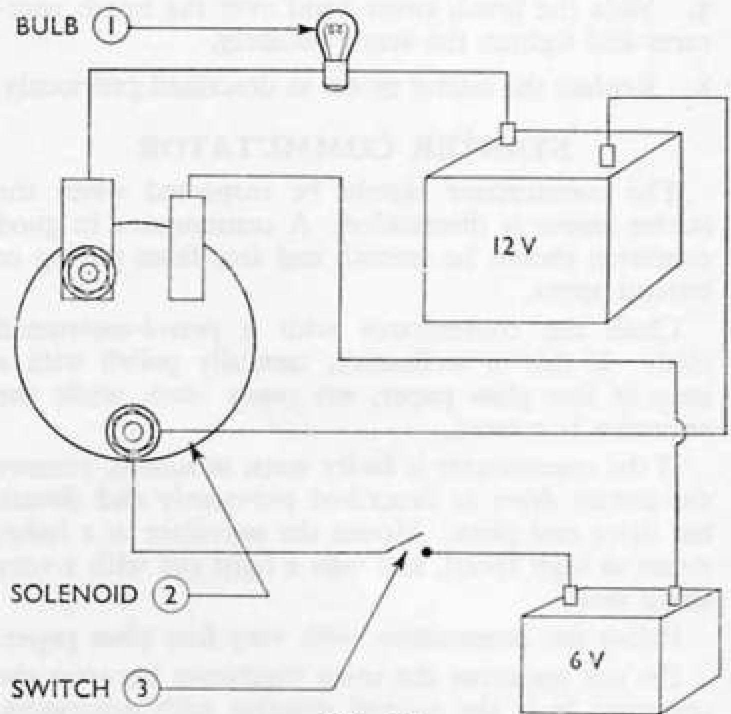


Fig. 14
Testing the Solenoid Operation

6. Lift the brush springs and insert the brushes into their holders, ensuring that they slide freely. (The field coil brushes locate in the insulated brush holders.)

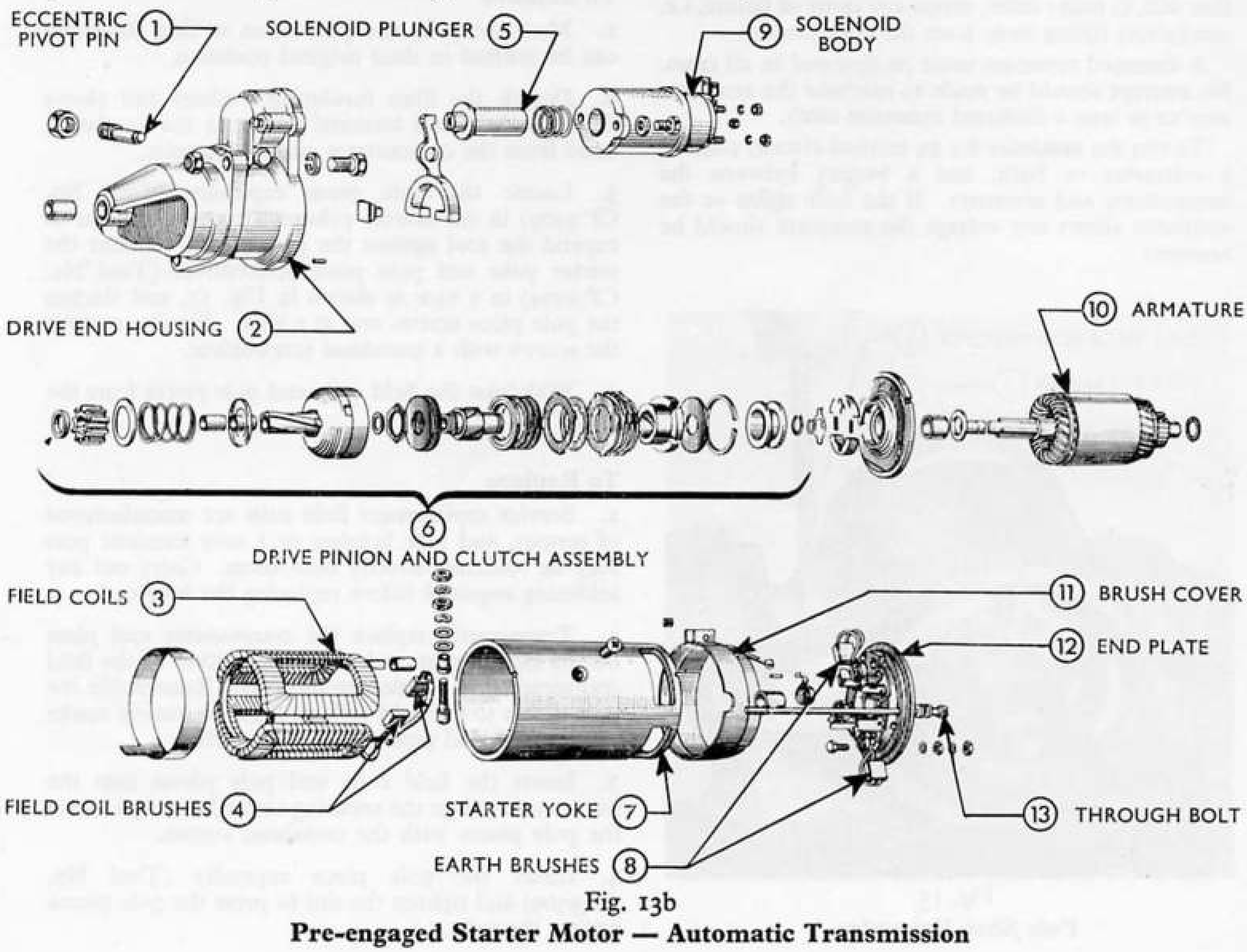


Fig. 13b
Pre-engaged Starter Motor — Automatic Transmission

7. Slide the brush cover band over the brush apertures and tighten the screw securely.

8. Replace the starter motor as described previously.

STARTER COMMUTATOR

The commutator should be inspected when the starter motor is dismantled. A commutator in good condition should be smooth and free from pitting or burned spots.

Clean the commutator with a petrol-moistened cloth. If this is ineffective, carefully polish with a strip of fine glass paper, *not emery cloth*, while the armature is rotated.

If the commutator is badly worn or scored, remove the starter drive as described previously and detach the drive end plate. Mount the armature in a lathe, rotate at high speed, and take a light cut with a very sharp tool.

Polish the commutator with very fine glass paper.

Do not undercut the mica insulation between the segments as is the normal practice with generators.

Check that the commutator segments are not earthing to the armature shaft and core by checking with a battery and bulb.

STARTER ARMATURE

The armature can be inspected after it has been removed from the starter motor yoke. Visual examination will, in many cases, reveal any cause of failure, i.e. conductors lifting away from the commutator.

A damaged armature must be renewed in all cases. No attempt should be made to machine the armature core or to true a distorted armature shaft.

To test the armature for an earthed circuit, connect a voltmeter or bulb, and a battery between the commutator and armature. If the bulb lights or the voltmeter shows any voltage the armature should be renewed.

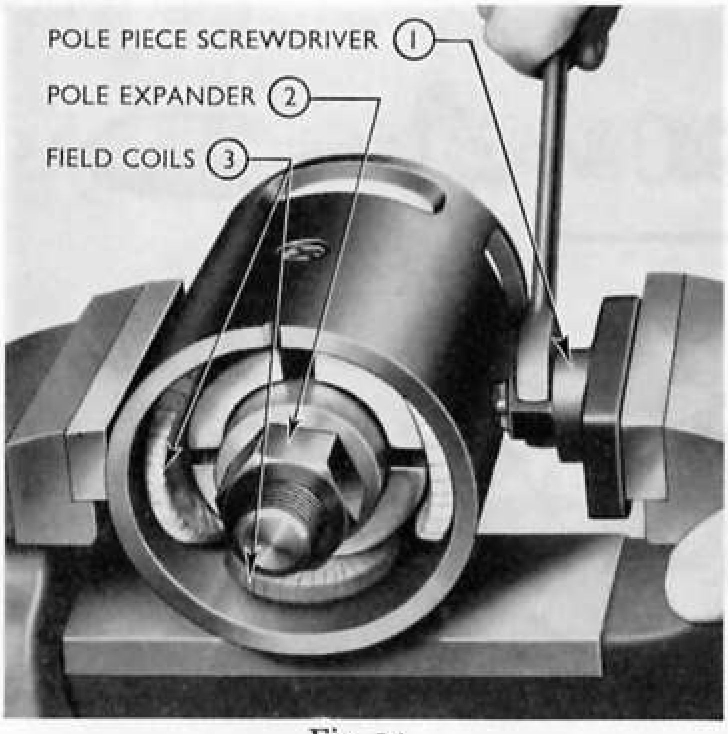


Fig. 15
Pole Shoe Expander

STARTER FIELD COILS

To Test

1. Remove the commutator end plate and solenoid as described previously.

Slacken the eccentric pivot locknut and remove the eccentric pivot, housing, armature, pinion gear and drive engaging lever.

2. Test the field coils for continuity and earth as follows:—

Check for continuity between the two ends of the field coils, using a mains operated line tester, having a suitable bulb in circuit. Alternatively, the test prods on a Diagnosis Test Set can be used.

If the lamp does not light, there is an open circuit in one of the field coils. If the lamp lights, it does not necessarily mean that the field coils are in order, as it is possible that one of the coils may be earthing to the pole pieces or starter yoke.

This may be checked by touching one of the test prods on the starter yoke and the other onto one of the field coil tappings. If the bulb now lights, the coils are earthed.

NOTE.—The field coils are not serviced separately, as invariably it is found that if one fails the others are affected.

To Remove

1. Mark the yoke and pole shoes so that the shoes can be refitted in their original positions.

2. Detach the fibre insulating washers and sleeve from the field coil terminal post and the insulation band from the commutator end of the yoke.

3. Locate the pole piece expander (Tool No. CP.9509) in the starter yoke and tighten the nut to expand the tool against the pole pieces. Mount the starter yoke and pole piece screwdriver (Tool No. CP.9504) in a vice as shown in Fig. 15, and slacken the pole piece screws one at a time. Finally, remove the screws with a crosshead screwdriver.

4. Withdraw the field coils and pole pieces from the yoke.

To Replace

1. Service replacement field coils are manufactured of copper, and new brushes or a new terminal post may be soldered directly onto them. Carry out any soldering required before replacing the field coils.

2. Temporarily replace the commutator end plate on the starter yoke and note the position of the field coil terminal in relation to the yoke. Reassemble the pole pieces to the field coils so that the mating marks on the yoke and pole pieces are together.

3. Insert the field coils and pole pieces into the starter yoke, align the securing screw holes and locate the pole pieces with the crosshead screws.

4. Insert the pole piece expander (Tool No. CP.9509) and tighten the nut to press the pole pieces against the yoke.

5. Place the starter yoke and pole piece screwdriver (Tool No. CP.9504) in a vice and tighten the screws securely.

6. Slacken off the nut and remove the expander.

7. Replace the insulator band around the commutator end of the field coils between the coil tappings and the yoke.

8. Replace the insulator sleeve and washers on the field coil terminal post and insert it through the aperture in the starter yoke.

9. Reassemble the starter motor. Refit the solenoid and set the pinion clearance as described previously.

STARTER END PLATE BUSHES

The bushes in the drive and commutator end plates are serviced and should be renewed if the bushes are found to be excessively worn or scored.

The bushes can be removed and replaced with suitable drivers.

NOTE.—Before fitting a new porous bronze bush it should be completely immersed for 24 hours in clean thin engine oil.

Porous bushes must not be opened out after fitting, or their porosity will become impaired.

After reassembling the starter motor, check that the armature shaft is free to rotate in the bushes without binding.

THE STARTER DRIVE PINION ASSEMBLY

To Remove

1. Remove the starter motor from the vehicle and dismantle it as described previously.

2. Locate the armature in a soft jawed vice, remove the circlip and detach the drive pinion assembly.

3. Remove the spring from the pinion assembly after removing the retaining circlip.

NOTE.—Do not grip the one-way clutch in a vice whilst carrying out this operation as it will be damaged.

The drive pinion and clutch are serviced as a complete unit as repairs to the unit are impractical.

To Replace

1. Refit the spring and retainer plate to the drive pinion and clutch unit; secure them with the circlip.

2. Reassemble the starter motor and refit it to the engine.

3. Check the operation of the starter motor on the vehicle.

THE PRE-ENGAGED STARTER MOTOR WITH MOVING POLE SHOE SOLENOID

Description and Operation

The starter motor is mounted at the side of the flywheel housing on the left-hand side of the engine. It is of the pre-engaged type incorporating a moving pole shoe solenoid (see Fig. 16).

The purpose of the pre-engaged feature of this starter is to protect the flywheel ring gear and the starter pinion gear teeth, by the self-indexing operation of the starter.

When the ignition switch is operated a current flows from the battery to the solenoid switch, which becomes energised and its plunger moves inwards, closing an internal switch. The battery is then connected directly to the starter terminal via the solenoid.

The starter terminal is joined to the field coils, one of which is directly earthed through a pair of contact points. Therefore, this field coil receives a large current and the magnetic field induced in the windings pulls down a pole shoe that is pivoted above it. A lever is attached to one side of the pole shoe and is engaged with the drive pinion. The movement of the pole shoe is thus transmitted to the drive pinion which slides along the armature shaft and into engagement with the starter ring gear.

When the pinion is fully in mesh and the pole shoe is fully seated it opens the earthing contact points and full starting current flows through all four field coils. The armature then rotates and turns the engine.

The starter drive pinion is fitted with a one-way clutch so that when the engine starts it does not drive the starter motor. The drive pinion will remain in engagement with the starter ring gear as long as the ignition key is held on. Therefore, release the ignition key as soon as the engine is running.

TO TEST THE STARTER MOTOR ON THE ENGINE

If the starter motor does not operate, check the condition of the battery and the battery connections.

If the battery is in a good condition, check the starter switch and solenoid. If the starter motor still does not operate, it should be removed for examination.

To Remove

1. Disconnect the battery and the starter cable at the terminal on the side of the starter.

2. Unscrew the two bolts securing the starter to the engine and detach the starter.

To Replace

1. Enter the starter into the aperture in the flywheel cover and locate it with the pole shoe cover uppermost.

2. Replace the two retaining bolts and spring washers and tighten securely.

3. Reconnect the cable to the starter motor and reconnect the battery.

4. Check that the starter motor turns the engine when the starter switch is operated.

STARTER BRUSHES

To Examine

1. Remove the starter motor.

2. Loosen the brush cover band clamp screw and slide the band from the starter.

3. Lift off the moving pole shoe cover and the brush cover insulation strip.

4. Lift the brush springs with a piece of wire shaped into a hook and check the movement of the brushes in their holders.

5. If the brushes are sticking, clean them with a petrol moistened cloth and, if necessary, ease the sides of the brushes with a smooth file.

NOTE.—Brushes should be replaced when they are worn to 6.4 mm. (0.25 in.).

To Remove

1. Remove the starter motor from the vehicle.

2. Loosen the brush cover band clamp screw and slide the band from the starter.

3. Lift off the moving pole shoe cover and brush cover insulation strip.

4. Lift the brush springs with a piece of wire shaped into a hook and pull the brushes from their holders.

5. Remove the two through bolts from the commutator end of the starter and carefully remove the end plate.

6. Remove the drive end housing and the return spring from the starter.

7. Push out the moving pole shoe pivot pin and lift off the pole shoe (see Fig. 16).

8. Withdraw the armature, complete with drive pinion, from the starter body.

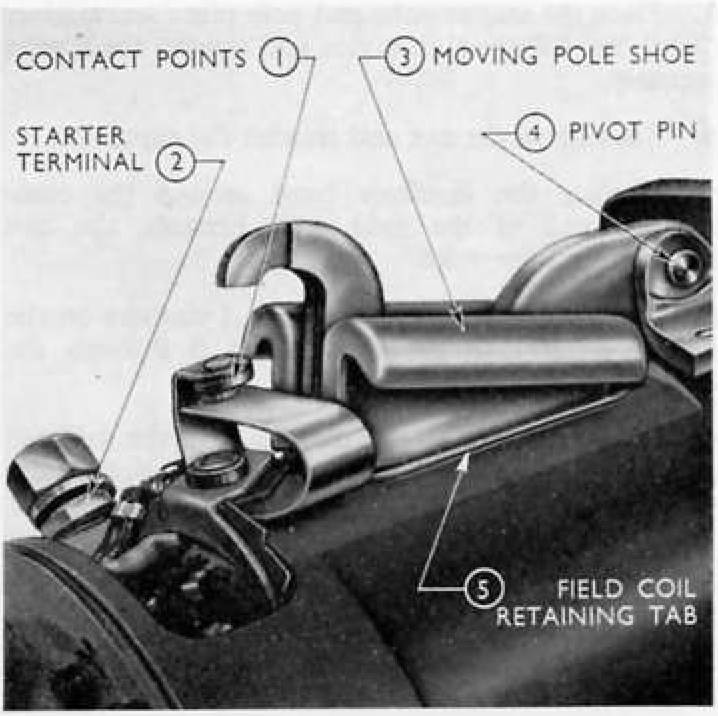


Fig. 16
Moving Pole Shoe and Pivot

9. Unscrew the two screws retaining the earth leads to the starter yoke. One lead is also soldered to one side of the contact points and this lead should be cut as near to the connection as possible. Remove the brushes (see Fig. 17).

10. Cut the insulated field coil brush leads as near to the field coil connections as possible and remove these brushes.

To Replace

1. Pull the insulated copper field coil connecting strip from behind the field coil brush terminal to prevent damage during subsequent soldering operations.

2. Position the leads of the new insulated brushes on the field coil terminal and solder them securely to it. Push the insulated copper connecting strip back down behind the exposed copper strip and ensure that the exposed strip is not touching the starter yoke.

3. Solder the new earth brush lead to the contact point connection and screw both earth brush leads to the starter yoke.

4. Slide the armature into the starter yoke, ensure that the fibre washer is fitted at the commutator end, and fit the commutator end plate.

5. Install the moving pole shoe on the starter yoke, engaging the forked end with the arms on the drive pinion (see Fig. 18) and replace the pivot pin.

6. Partially engage the drive end housing on the shaft. Fit the return spring between the arm on the moving pole shoe and the recess in the drive end housing. Push the drive end housing fully home.

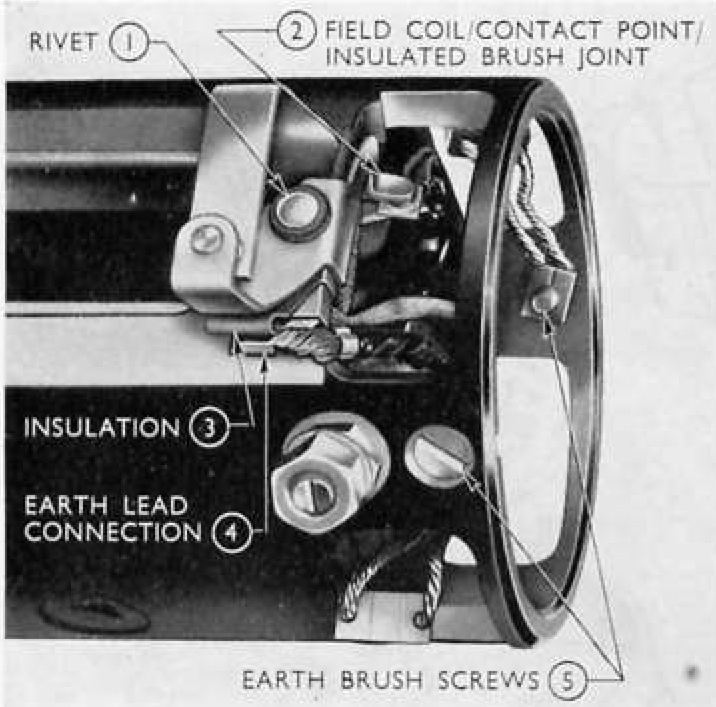


Fig. 17
Brush Lead Connections

7. Fit the two through bolts and spring washers from the commutator end and tighten securely.

8. Lift the brush springs with a hook-shaped piece of wire and slide the brushes into their holders. Ensure that the insulated brushes are fitted in the insulated brush holders.

9. Fit the brush cover insulating strip around the brush apertures, position the moving pole shoe cover on the starter, and slide on the brush cover band. Tighten the clamp screw.

10. Before refitting the starter motor, check its operation as follows:—

Securely clamp the starter motor in a vice. Connect the positive terminal of a battery to the starter terminal and the negative terminal of the battery to the starter motor yoke.

11. Replace the starter on the vehicle and check its operation.

STARTER COMMUTATOR

The commutator should be inspected when the starter motor is dismantled. If it has a rough surface or is burned, it should be cleaned with very fine glass paper, *not emery cloth*, whilst the armature is rotated.

If the commutator is badly worn or its run-out exceeds 0.127 mm. (0.005 in.) it should be mounted in a lathe, rotated at high speed and a light cut taken with a sharp tool. Re-polish it with fine glass paper.

The mica insulation should not be under-cut as is the normal practice with generators.

Check that the commutator segments are not earthing to the armature shaft and core by checking with a battery and bulb.

THE ARMATURE

The armature should be inspected when the starter is dismantled.

An open circuit may sometimes be detected by examining the commutator for excessive burning, the burned spot being caused by an arc formed every time the commutator segment, which is connected to an open circuit armature winding, passes under a brush.

To test the armature for an earthed circuit, connect a voltmeter or bulb, and a battery between the commutator and armature. If the bulb lights or the voltmeter shows a voltage, the armature should be renewed.

FIELD COILS

To Remove

1. Remove the starter from the vehicle and dismantle it as described previously.

2. The field coil that operates the moving pole shoe is retained in the starter by a metal tab. Bend up the tab and remove the retainer (see Fig. 16).

3. Unscrew the three pole shoe retaining screws with a square-headed pole shoe screwdriver (Tool No. CP.9504, see Fig. 15) and remove the pole shoes.

4. The contact points are connected to the field coils by a soldered joint. Unsweat this joint and break the connection.

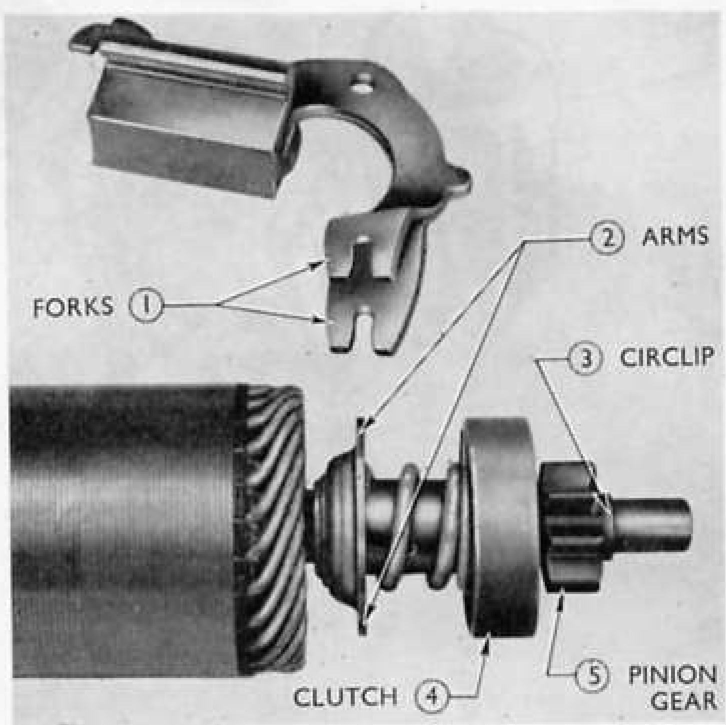


Fig. 18
Drive Pinion and Pole Shoe Lever

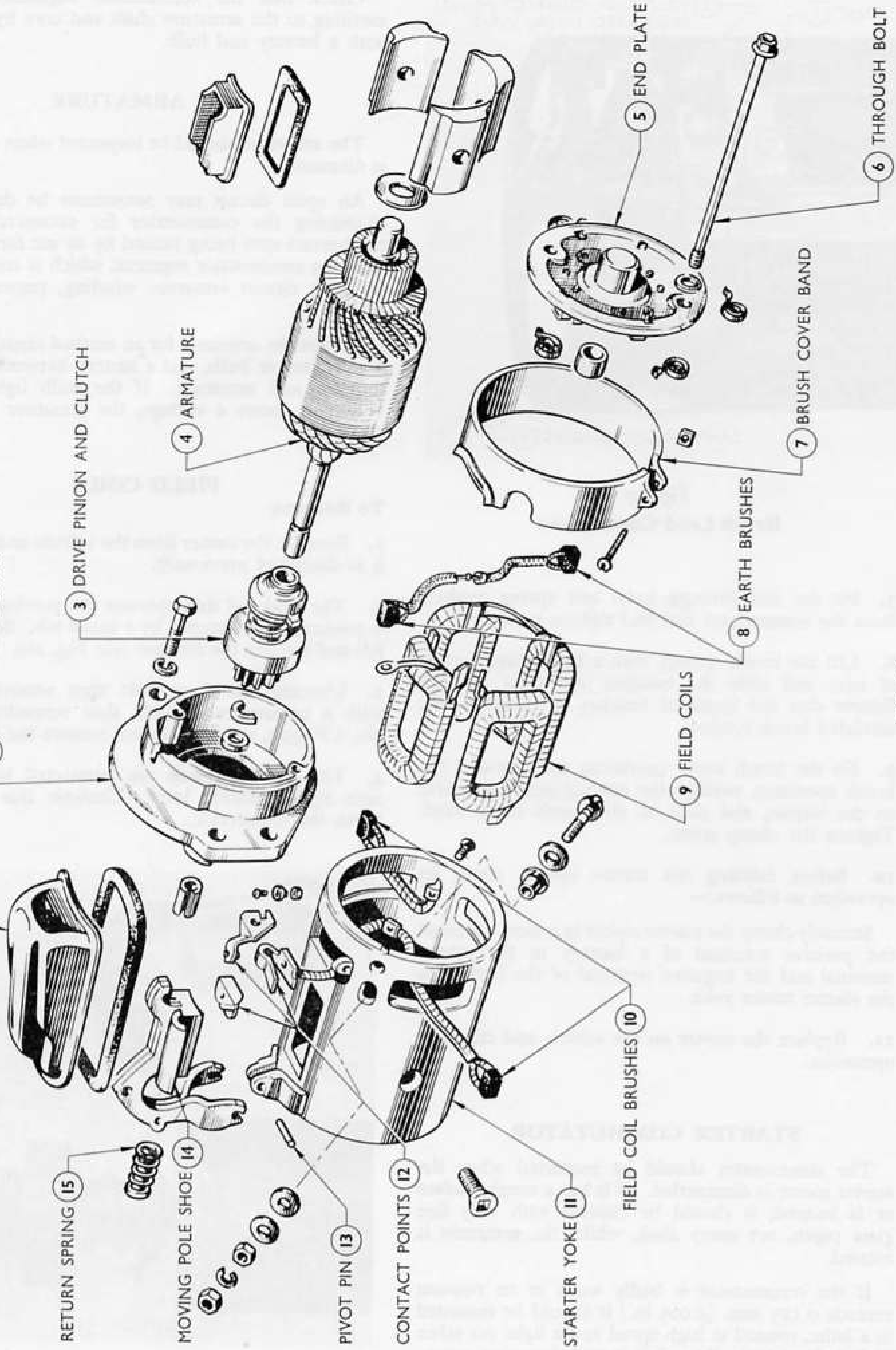


Fig. 19
Moving Pole Shoe Starter Motor

5. Unsweat the starter terminal from the field coils and remove the field coils from the starter.

6. If desired, the insulated brushes can be cut off from the field coils, for re-use.

To Replace

1. Solder the insulated brushes to the field coils as required.

2. Insert the field coils into the starter body, and solder to the starter terminal.

3. Resolder the connection between the field coils and the contact points.

4. Replace the three pole shoes and retain them with their screws. Replace the moving pole shoe field coil and retain it with the metal tab.

Fit the pole shoe expander (Tool No. CP.9509) inside the starter and expand the segments (Fig. 15). Fully tighten the pole shoe screws with the square-headed driver (Tool No. CP.9504).

5. Reassemble the rest of the components as previously described.

6. Before refitting the starter, check its action as previously described.

7. Refit the starter and check its action on the vehicle.

CONTACT POINTS

To Remove

1. Remove and dismantle the starter motor as previously described.

2. Unsweat the connection joining the field coils to the earth brush lead and the contact points (see Fig. 17).

3. Drill out the rivet fixing the contact points to the starter body. Remove the points.

To Replace

1. Install the contact points on the starter body with the insulating strip in position between the two halves of the points.

2. Position the insulation washer on top of the outer points and rivet the assembly to the starter body.

3. Re-solder the field coil terminal to the earth brush lead and the contact points.

4. Reassemble the starter and refit it to the engine.

5. Check the action of the starter on the vehicle.

THE STARTER DRIVE PINION ASSEMBLY

To Remove

1. Remove the starter motor from the vehicle and remove the drive end housing as described previously.

2. Remove the circlip retaining the drive pinion assembly to the armature shaft and then slide off the pinion.

3. Dismantle the drive pinion assembly by removing the circlip behind the spring retainer plate.

NOTE.—Do not grip the one-way clutch in a vice whilst carrying out this operation as it will be damaged.

The drive pinion and clutch are serviced as a complete unit as repairs to the unit are impractical.

To Replace

1. Refit the spring and retainer plate to the drive pinion and clutch unit; secure them with the circlip.

2. Replace the assembly on the armature shaft with the spring retainer nearest the starter, and retain it with the circlip.

3. Ensure that the retaining ring is fitted over the circlip before refitting the drive end housing as described previously.

4. Refit the starter to the vehicle and check its operation.

THE LUCAS DISTRIBUTOR

(Prior to May 1967)

Description

The distributor is mounted on the front of the inlet manifold and is driven by a skew gear from the camshaft. The ignition advance is mechanically controlled, according to engine speed by governor weights inside the distributor body, and according to engine load by vacuum control acting directly on the contact breaker plate, which is movable in relation to the distributor body.

Correction to spark advance is necessary because of the wide variation in engine speed and load under normal operating conditions. When accelerating or climbing hills, the engine load can be high and the range of spark advance required is not necessarily as much as it would be on level ground at an equivalent constant engine speed.

In the vacuum control mechanism, one side of the diaphragm is linked to the breaker plate and the other side is connected by a vacuum line to the carburettor, just above the throttle plate. A spring is fitted between the vacuum side of the diaphragm and the vacuum unit connection.

The vacuum applied at the diaphragm, combined with the action of the diaphragm spring, gives correct spark advance according to the load placed on the engine. Maximum advance is obtained when manifold depression on the vacuum diaphragm is between 43.2 and 45.7 cm. (17 and 18 in.) of mercury. As the vacuum advance does not operate at idling speed, due to the throttle plate being almost closed, a correctly retarded spark is obtained for starting.

The mechanical governor mechanism consists of two weights pivoted so that they move outwards from the distributor shaft as the engine speed rises. As the weights move outwards they turn the cam relative to the distributor shaft and thus advance the firing point. The weights are restrained by two springs of different tension thus giving a progressive advance action, and the amount the weights move outwards is in direct proportion to the distributor shaft speed. To maintain a smooth operation throughout the engine speed range the weights follow the contours of fixed cam segments as they move outwards, and this system has the advantage of reducing the number of moving parts to a minimum.

Remember that, in practice, the total advance provided by the distributor at a constant engine speed is determined by a combination of both engine speed and manifold depression, according to engine load.

Lubrication

The cam (and contact breaker plate pivots and bushings when assembling after overhaul) should be lubricated with petroleum jelly and the cam spindle, governor weights and breaker arm pivot lubricated with engine oil every 8,000 km. (5,000 miles). To lubricate the cam spindle remove the rotor and apply two drops of oil to the centre of the spindle, and to lubricate the governor weights apply a few drops of oil through the apertures in the breaker plate. Only a film of engine oil should be applied to the breaker arm pivot, ensuring that none contaminates the distributor points (see Fig. 20).

CAUTION: Do not over-lubricate any part of the distributor, otherwise lubricant may reach the breaker contacts, resulting in burning and difficult starting.

CONTACT BREAKER POINT ADJUSTMENT

To Adjust

1. **Remove the distributor cap and rotor arm.**

2. **Turn the engine** so that the heel of the contact breaker is on the highest point of the cam.

3. **Slacken the one locking screw** and by means of the slot in the end of the adjustable contact bracket, adjust the points gap to 0.356 to 0.406 mm. (0.014 to 0.016 in.) (see Fig. 21). If necessary, align the breaker points to make full face contact by bending the adjustable contact bracket. Do not bend the breaker arm.

4. **Tighten the screw securing the adjustable contact breaker** in position and re-check the gap.

5. **Refit the rotor arm** squarely on the distributor cam boss with the slot and lug in line. Press the rotor into position so that the lower face abuts the cam.

6. **Check that the high tension leads are securely retained** and then refit the distributor cap.

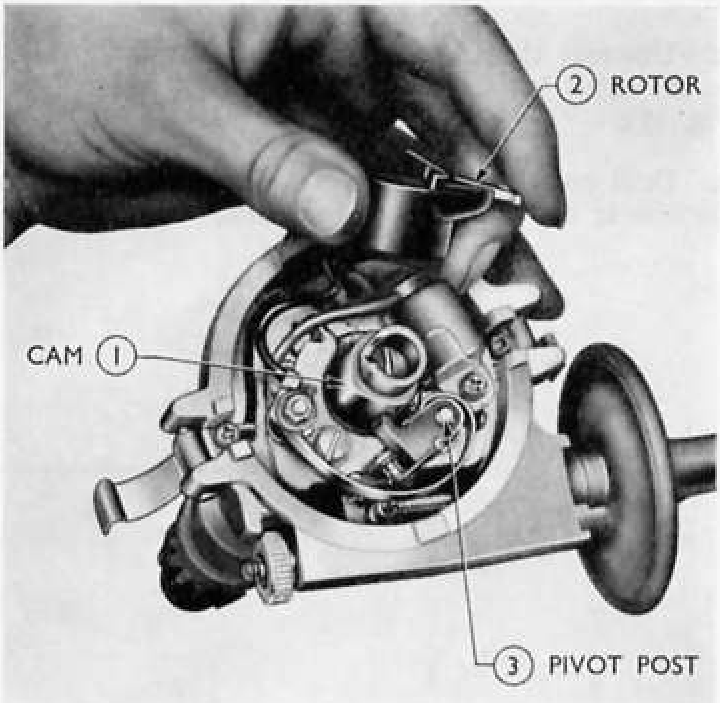


Fig. 20
Distributor Lubrication

To Remove

1. **Detach the distributor cap** and rotor from the distributor cam.

2. **Remove the breaker arm** after unscrewing the terminal nut and detaching the flanged nylon bush, together with the primary and condenser leads. The breaker arm and spring assembly can now be lifted off followed by the fibre washers from the terminal and pivot posts.

3. **Detach the adjustable contact** after removing the one locking screw.

To Replace

Check the condition of the points and fit new parts if the contacts are worn or burnt. Contacts showing a greyish colour and only slightly pitted need not be renewed. If necessary, contacts can be smoothed with a very fine emery stone and then thoroughly cleaned with carbon-tetrachloride.

1. **Secure the adjustable contact to the breaker plate** (see Fig. 22) with one flat washer, lockwasher and screw, but do not tighten the screw fully at this stage.

2. **Locate the fibre washer on the pivot post** and breaker arm terminal post and refit the breaker arm assembly so that the contact points are together (see Fig. 23).

3. **Locate the primary and condenser leads** on the shouldered bush and pass this over the terminal post and through the looped end of the breaker spring. Replace the terminal nut on the post and tighten the nut securely.

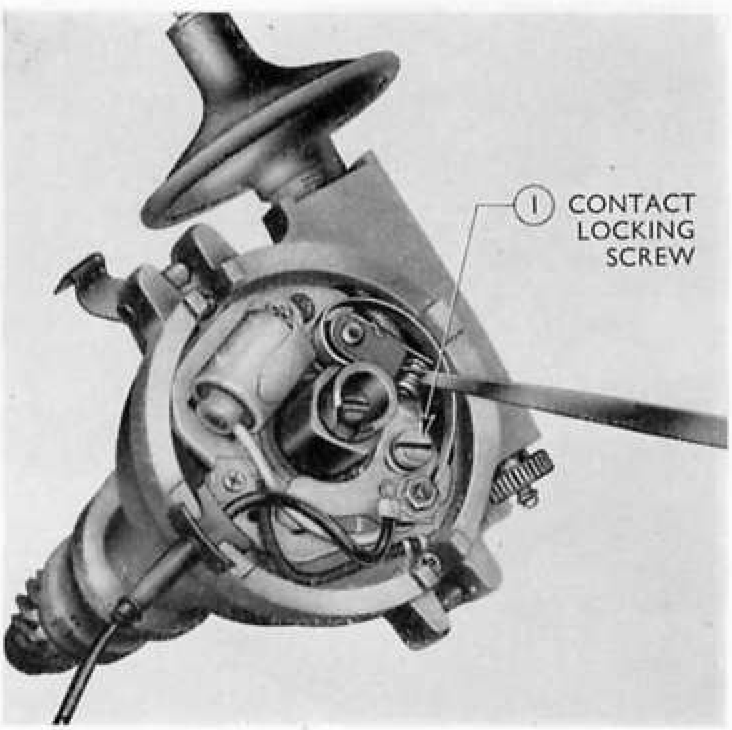


Fig. 21
Checking Contact Breaker Points Gap

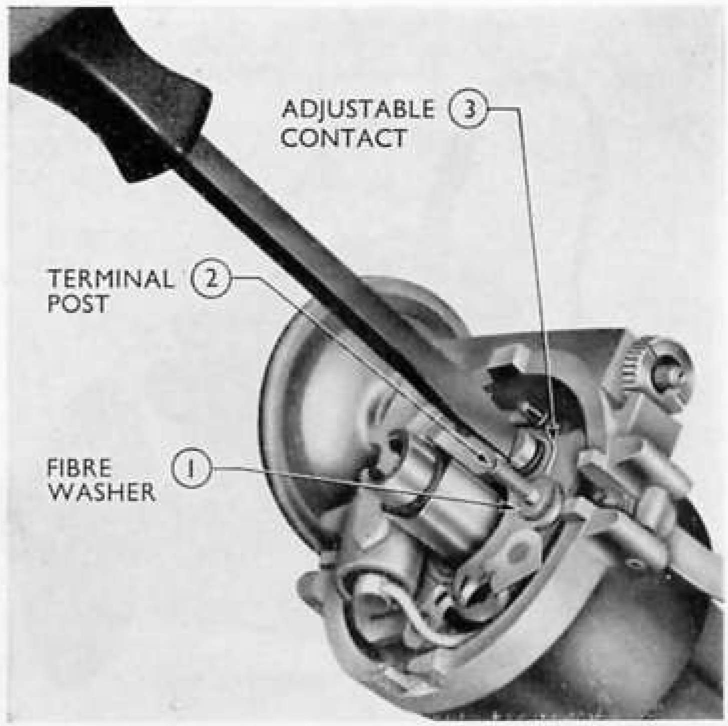


Fig. 22
Replacing Adjustable Contact

4. **Ensure that the contact points abut squarely** and check the breaker arm spring tension with the spring scale (see page 30).

5. **Adjust the contact breaker points** as described previously.

6. **Refit the rotor** squarely on the distributor cam boss with the slot and lug in line. Press the rotor into position so that the lower face abuts the cam. Replace the distributor cap.

DISTRIBUTOR CONDENSER

The condenser is fitted in parallel across the contact breaker points and a short circuit in the condenser will cause ignition failure as the points will no longer interrupt the low tension circuit. In such cases the condenser will have to be renewed.

An open circuit, however, cannot readily be checked without the use of specialised equipment, such as a Diagnosis Test Set. The usual signs of this are excessively burnt contact breaker points and difficult starting.

The capacity of the condenser is 0.18 to 0.22 microfarad.

To Remove the Condenser

1. **Remove the distributor cap and rotor,** unscrew the breaker arm terminal nut and detach the nylon bush, condenser and primary leads.

2. **Unscrew the screw retaining the condenser** to the breaker plate and remove the condenser.

To Replace

1. **Locate the condenser in the slot on the breaker plate** and refit the securing screw and lockwasher.

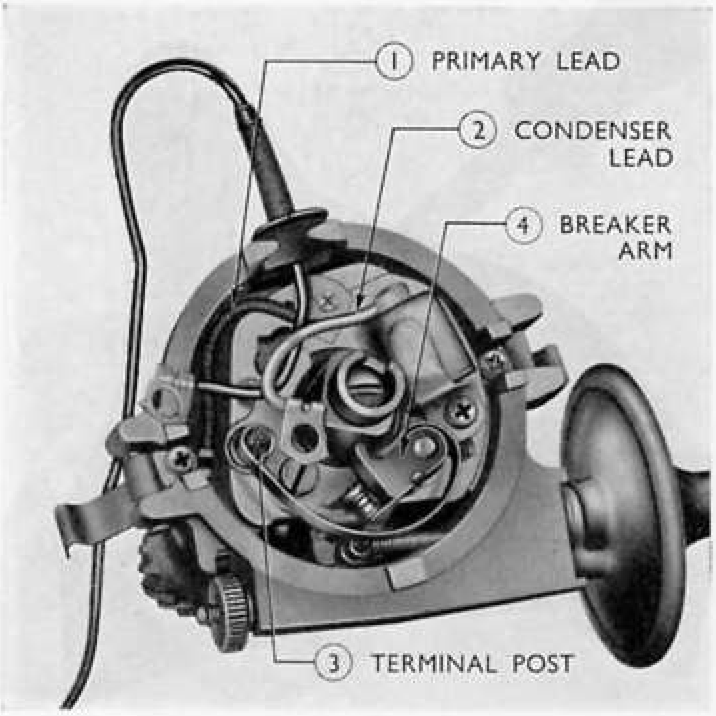


Fig. 23
Fitting the Breaker Arm Assembly

2. **Refit the condenser and primary leads on the breaker arm terminal** and refit the nylon bush and retaining nut, tightening it securely.

3. **Check that there is no possibility of a short circuit** between the condenser lead and the breaker plate and refit the rotor and distributor cap.

OVERHAULING THE DISTRIBUTOR

To Remove

1. **Disconnect the spark plug leads** from the plug terminals, taking care not to pull the leads, but pull the terminals from each plug.

2. **Disconnect the low tension lead** from the coil primary terminal and the high tension lead from the coil.

3. **Disconnect the vacuum line** from the distributor vacuum housing.

4. **Remove the distributor body clamp bolt** and remove the distributor assembly.

To Dismantle (refer to Fig. 25)

1. **Remove the distributor cap.**

2. **Lift the rotor** straight up from the distributor cam.

3. **Remove the contact breaker points** as described on page 25.

4. **Unscrew the condenser retaining screw** and detach the condenser.

5. **Remove and dismantle the contact breaker plate assembly.**

(*a*) Unhook the vacuum unit spring from its mounting pin on the breaker plate assembly.

(*b*) Remove the two screws and lockwashers securing the assembly to the distributor body sides (note that the screw opposite to the vacuum unit retains the other end of the contact breaker plate earth wire).

(*c*) Remove the low tension rubber block and wire by sliding the assembly up from its location on the distributor body.

(*d*) Lift out the breaker plate assembly.

(*e*) Twist the breaker plate fully anti-clockwise until the locating peg enters the opening at the end of the slot in the breaker bearing plate. Separate the breaker plate and breaker bearing plate by disengaging the spring clip (see Fig. 24).

6. **Unhook the governor weight springs** from the pegs on the cam plate.

7. **Remove the screw retaining the cam** to the distributor shaft, and carefully lift the cam clear of the governor weights.

8. **Disconnect the springs from the pegs on the action plate** and lift off the weights.

9. **If it is necessary to remove the distributor driving shaft** due to wear or excessive end-float (see Specification section), drive out the driving gear retaining pin through the collar with a suitable thin punch. Remove the collar and washer.

10. **Remove the distributor shaft and action plate** from the distributor body together with the nylon spacing washer beneath the action plate.

11. **To remove the vacuum unit,** detach the small circlip securing the advance adjustment nut and unscrew the nut, when the vacuum unit may be pulled out of the distributor body.

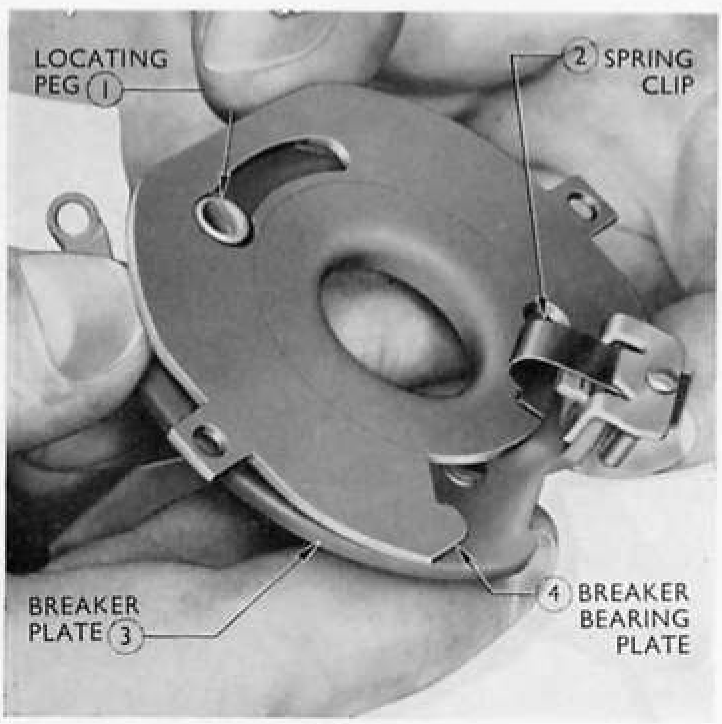


Fig. 24
Separating the Breaker Plate and Bearing Plate

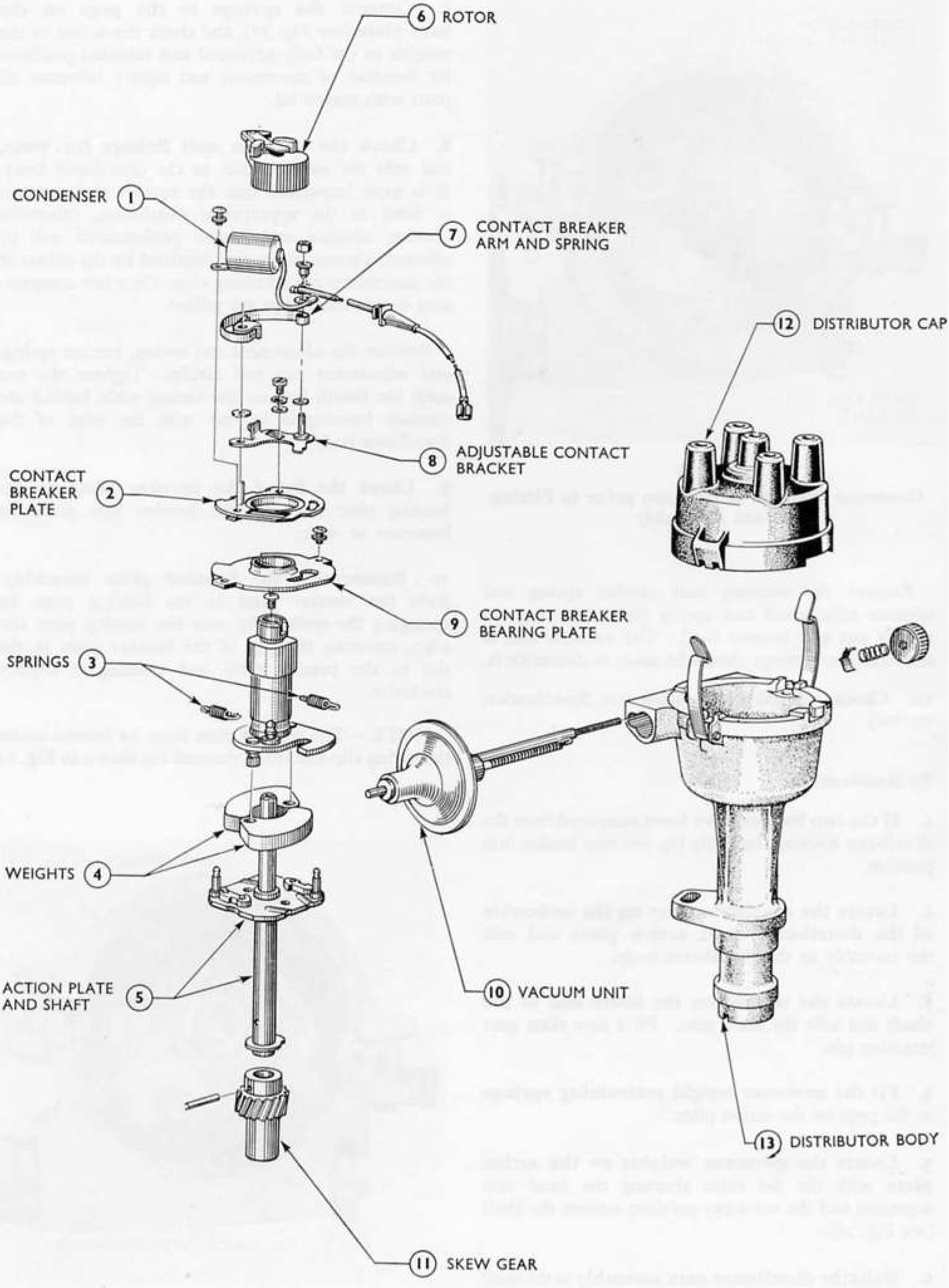


Fig. 25
Distributor—Exploded View

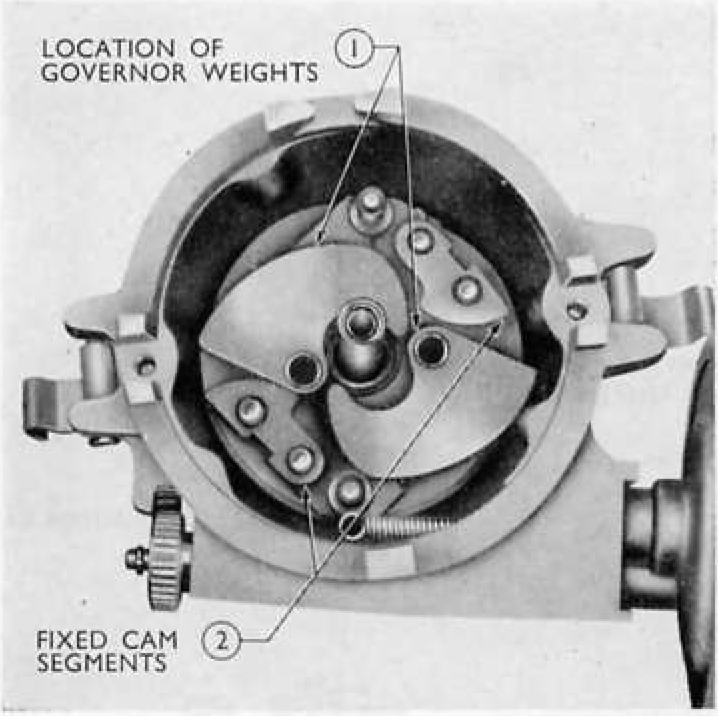


Fig. 26
Governor Weights in Position prior to Fitting Cam Assembly

Remove the vacuum unit ratchet spring and advance adjustment nut spring (take care they do not fly out and become lost). The vacuum unit is sealed and no attempt should be made to dismantle it.

12. **Check all parts for wear** (see Specification section).

To Reassemble

1. **If the two bushes have been removed** from the distributor housing, carefully tap two new bushes into position.

2. **Locate the spacing washer on the underside of the distributor shaft action plate** and refit the assembly in the distributor body.

3. **Locate the washer on the lower end of the shaft** and refit the skew gear. Fit a new skew gear retaining pin.

4. **Fit the governor weight restraining springs** to the pegs on the action plate.

5. **Locate the governor weights on the action plate** with the flat sides abutting the fixed cam segments and the cut-away portions nearest the shaft (see Fig. 26).

6. **Refit the distributor cam assembly** to the shaft and ensure that it turns smoothly without tightness. Engage the cam pegs in the governor weight holes and refit the securing screw.

7. **Connect the springs to the pegs on the cam plate** (see Fig. 27), and check the action of the weights in the fully advanced and retarded positions for freedom of movement and lightly lubricate all parts with engine oil.

8. **Check the vacuum unit linkage for wear,** and refit the vacuum unit to the distributor body. It is most important that the correct vacuum unit is fitted to the appropriate distributor, otherwise ignition advance and engine performance will be affected. Vacuum units are identified by the colour of the distributor cap retaining clips. On a low compression engine these clips are yellow.

Replace the adjustment nut spring, ratchet spring, and adjustment nut and circlip. Tighten the nut until the fourth line on the timing scale behind the vacuum housing is in line with the edge of the distributor body.

9. **Check the fit of the breaker plate** on the bearing plate and also the breaker arm pivot for looseness or wear.

10. **Reassemble the breaker plate assembly.** Refit the breaker plate to the bearing plate by springing the spring clip over the bearing plate slot edge, inserting the peg of the breaker plate in the slot in the bearing plate and twisting it slightly clockwise.

NOTE.—The bearing plate must be located under the spring clip and the horizontal lug shown in Fig. 24

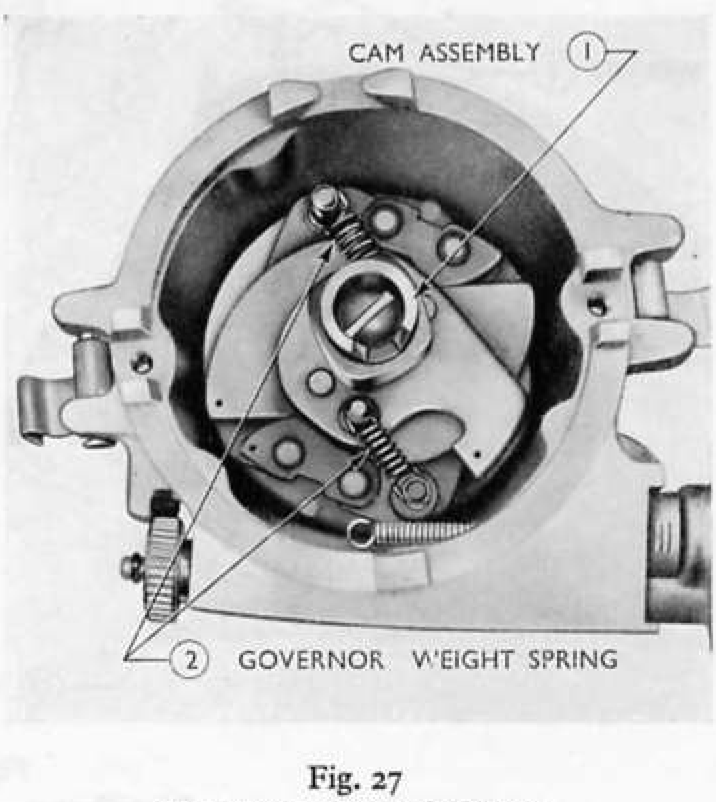
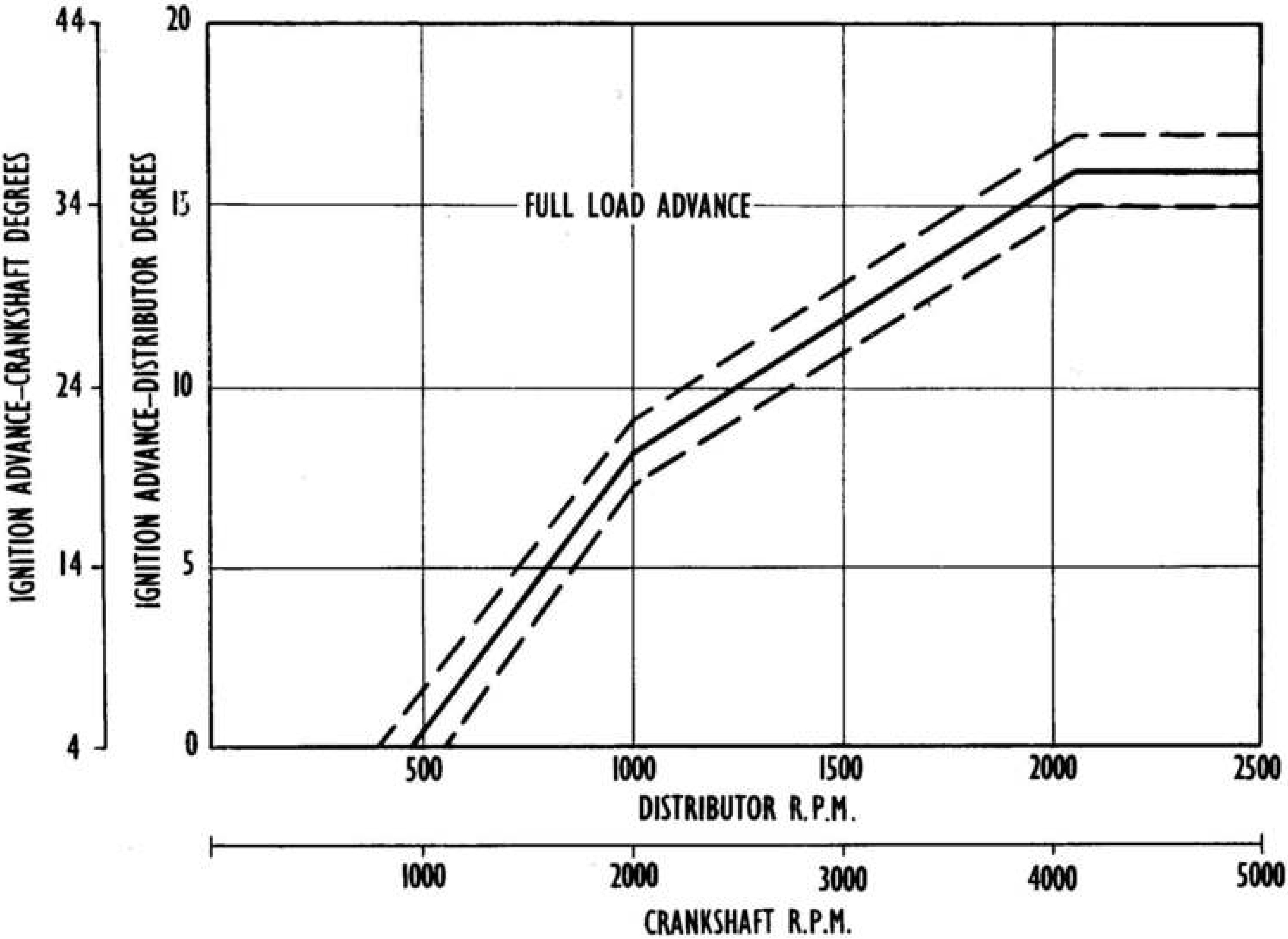


Fig. 27
Cam Assembly in Position

LOW COMPRESSION



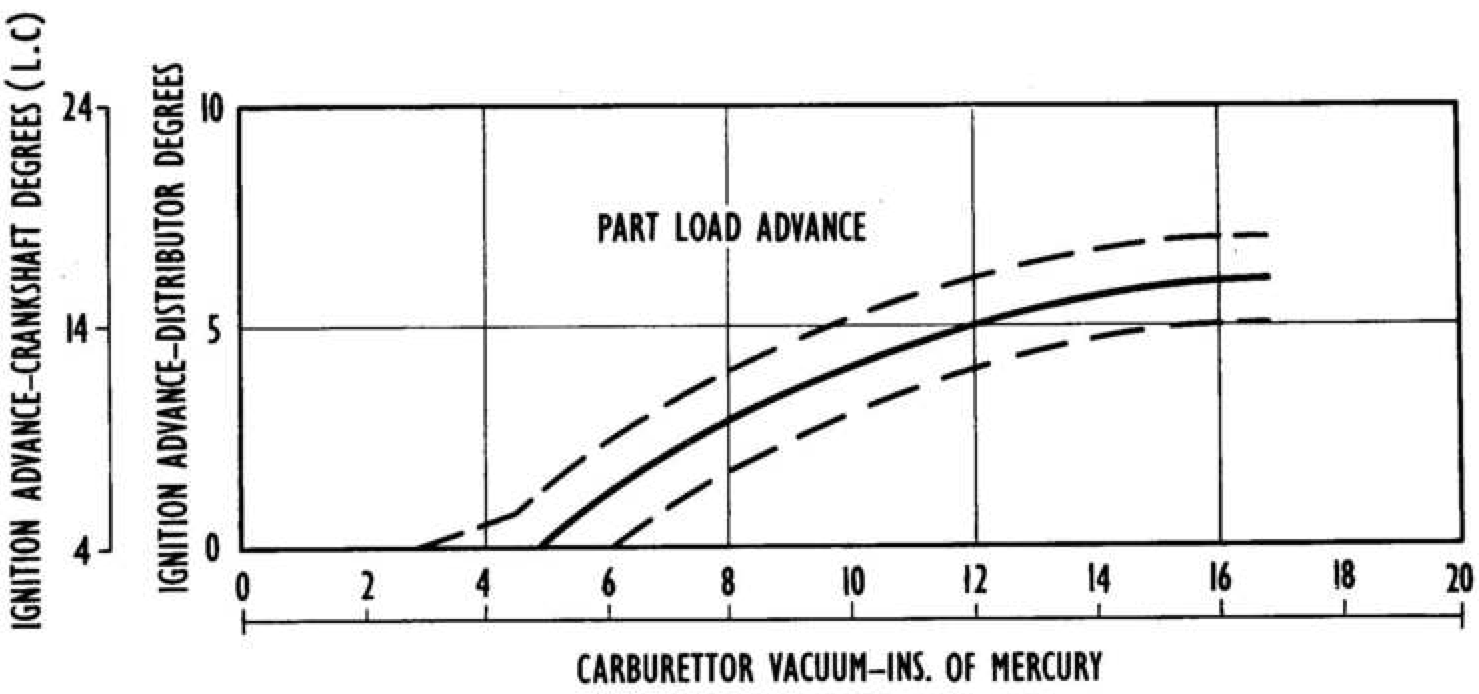


Fig. 28

Mechanical and Vacuum Advance Curves

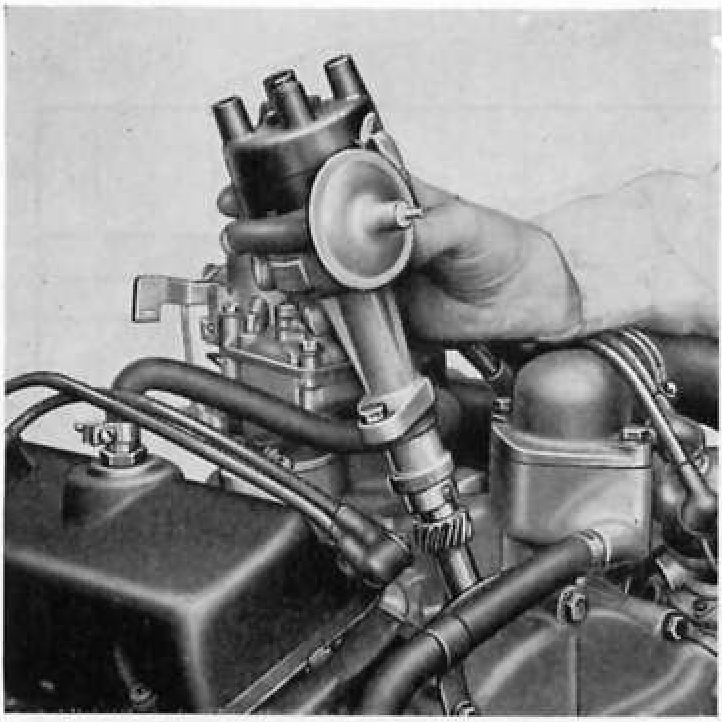


Fig. 29
Locating the Distributor on the Engine

11. **Locate the contact breaker plate assembly in the distributor body,** securing the end of the vacuum unit spring to the post on the breaker plate lug. Secure the plate with two screws and lockwashers to the distributor body, noting that the screw opposite to the vacuum unit retains one end of the contact breaker plate earth wire.

12. **Check the condenser and renew if necessary.** Locate the condenser on the breaker plate and refit the securing screw.

13. **Replace the contact points,** as described on page 16, and initially set the gap to 0.356 to 0.406 mm. (0.014 to 0.016 in.).

Rotate the cam to close the points, then measure the contact breaker arm spring tension by pressing the hook of the scale CP.9501 against the breaker arm, adjacent to the contact point.

The reading should be taken just as the points separate and should be between 510 to 680 gms. (18 to 24 oz.).

14. **Replace the rotor,** locating the tongue in the slot in the distributor cam.

To Replace

1. **Set the engine,** with the upper timing mark on the timing cover in line with the notch in the crankshaft pulley as No. 1 piston comes up on the compression stroke (see Fig. 30).

2. **Line up the recessed end** of the skew gear retaining pin with the groove on the lower part of the distributor body. Position the distributor on the engine so that the vacuum unit faces forward. As the skew gears mesh the rotor arm will rotate until it points towards the H.T. contact in the distributor cap. Verify that this does happen by replacing the cap and noting the position of the rotor arm in relation to No. 1 H.T. contact.

3. **Replace the distributor cap and leads** securing the cap with the two retaining clips.

4. **Reconnect the leads to the spark plug terminals** in the correct firing order (1, 3, 4, 2); noting the direction of rotation of the rotor arm. Connect the high tension lead to the coil and the low tension wire to the coil.

5. **Reconnect the vacuum line to the vacuum housing connector.**

6. **Re-time the ignition** as described below.

IGNITION TIMING

General

(*a*) Prior to adjusting the ignition timing, check the fuel octane rating that is to be used with this engine. Establish that the correct distributor is fitted for this combination of compression ratio and fuel.

(*b*) The static advance of 6° before T.D.C. is "built in" to the engine and when No. 1 cylinder is on the compression stroke and the notch on the crankshaft pulley is midway between the upper and lower timing marks on the timing cover (see Fig. 30) the crankshaft is at the static advance setting and no further adjustment is required at this stage, see operation 5.

(*c*) All reference to degrees (advance or retard) on the distributor are in terms of crankshaft degrees as in 'b' above.

(*d*) If the vehicle is normally operated at a high altitude the distributor settings on the graphs (see Fig. 28) may be **advanced** by 4° (one division on the ignition timing scale).

A. To Adjust the Timing without the use of a Timing Light

1. **If the engine has not been previously set, turn it with No. 1 piston coming up to T.D.C. on the compression stroke** (this can be checked by removing No. 1 spark plug and feeling the pressure developed in the cylinder).

Continue turning the engine until the notch on the crankshaft pulley is midway between the upper and lower timing marks on the timing cover (see Fig. 30).

This will give the initial timing setting of 6° B.T.D.C. (static advance).

2. Check that the fourth line on the ignition timing scale, counting from the vacuum diaphragm housing, is in line with the edge of the distributor body.

At this fourth graduated line the distributor is still at the 6° static advance position. If the octane number of the fuel cuts the horizontal line on the ignition advance graph only correct for high altitudes, see operation 'd' above.

If the octane rating of the fuel falls on the 'slope' of the ignition advance graph **retard** as indicated by the graph (one graduation or division on the distributor is equal to 4°).

Remove the distributor cap.

3. Slacken off the distributor body clamp bolt and move the body until the contact breaker points are just opening when the rotor is adjacent to No. 1 H.T. contact in the distributor cap. Note direction of rotation of arm.

4. Tighten the distributor body clamp bolt and replace the distributor cap.

5. A slight readjustment to the distributor may be necessary and should be carried out on the road in the following manner:—

(*a*) Warm up the engine to normal operating temperature.

(*b*) Accelerate in top gear on wide throttle opening from 32 k.p.h. (20 m.p.h.) to 72 k.p.h. (50 m.p.h.).

(*c*) If heavy pinking occurs, **retard** the ignition (see Fig. 28) until a trace pink can just be heard under these conditions of acceleration.

B. To Adjust the Timing using a Timing Light

1. Complete operations Nos. 1 to 3 inclusive from the previous section, A.

Fig. 30
Correct Engine Timing Position

Octane Number	1662 c.c. L. C. Engine	2000 c.c. L. C. Engine
89	8°	6°
86	4°	4°
80	0°	—2°

Fig. 31
Octane Rating, Compression Ratio and Distributor Setting Chart

2. Replace the distributor cap.

3. Connect the two main leads of the timing light to the battery, using the clips provided. The positive lead clip has a red outer covering and the negative lead clip has a black covering. Connect the third lead, which has a smaller clip, to the L.T. wire from the distributor.

4. Check that the notch on the crankshaft pulley is visible and mark with chalk or paint if necessary.

5. Disconnect the vacuum pipe line and start the engine, allowing it to idle (approx. 550 r.p.m.).

6. Point the timing light at the timing indicator. Check that the upper indicator and the notch on the pulley are in line (see Fig. 30).

If the notch of the pulley is above the indicator, the engine is too far retarded and the distributor body should be turned anti-clockwise slightly to advance the ignition.

Should the notch be below the indicator, the distributor body should be turned clockwise slightly to retard the ignition.

7. Securely tighten the distributor body clamp bolt after the adjustment has been made.

Reconnect the vacuum pipe line.

The operation of the governor weights may be checked by opening and closing the throttle. As the throttle is gradually opened, the notch should move away from the indicator against the direction of engine rotation; and as the throttle is closed the notch will move with the direction of engine rotation.

Any tendency for erratic advance shown by the notch jumping suddenly away from the indicator shows that the governor weights are binding, or that the springs are weak.

NOTE.—As in "A" a slight readjustment to the distributor may be necessary to suit the particular type of fuel in use and this setting should be determined after checking the timing as described in operation 5.

THE AUTOLITE DISTRIBUTOR

(May 1967 onwards)

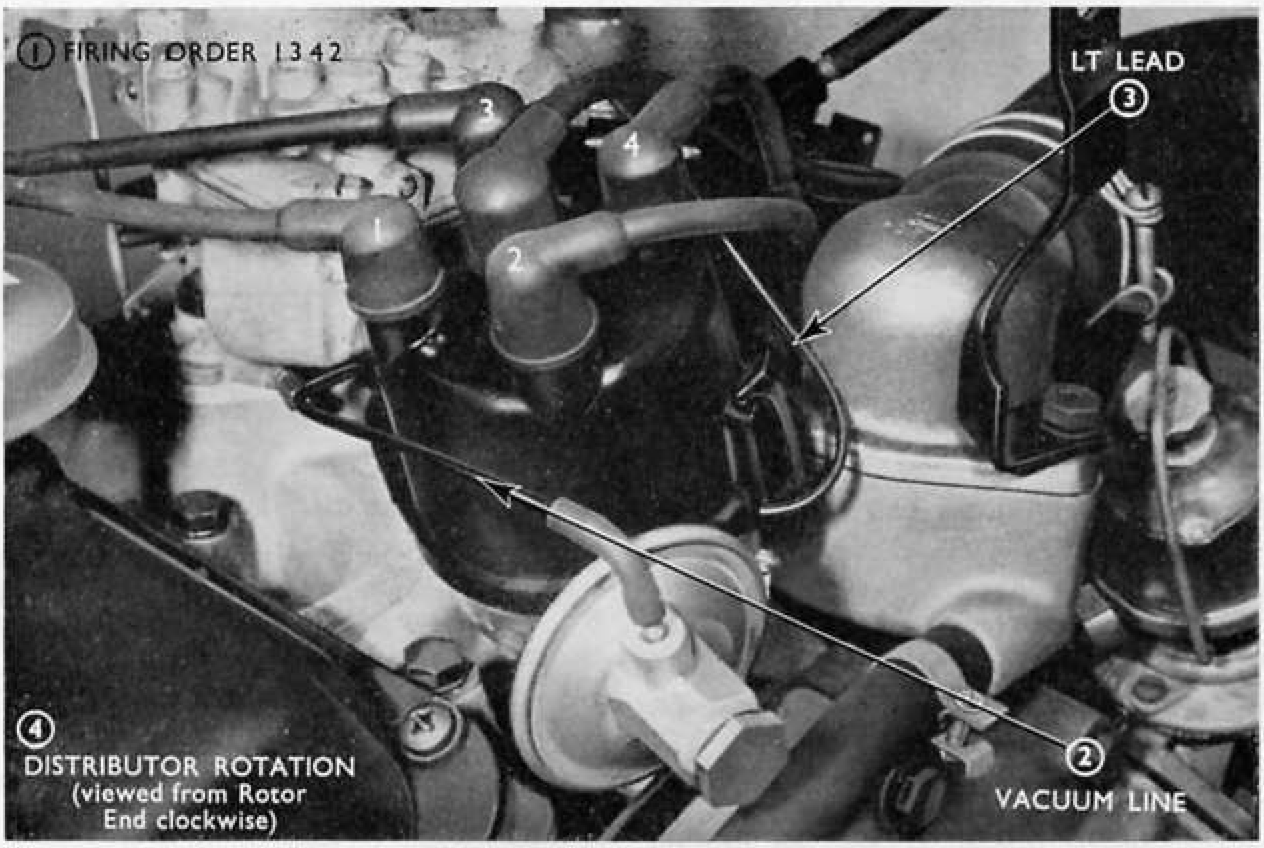


Fig. 32
The Distributor in Situ

A new type of distributor, Part No. C6CH/C8CH-12100-B low compression, (C6CH/C8CH-12100-A high compression) is fitted in production to vehicles manufactured from May 1967 onwards, and is available in both the 1.7 and 2.0 litre engines.

This new distributor is readily identified from its former counterpart by the vacuum advance unit which is mounted on a bracket attached to the distributor body instead of the mounting being cast integrally with the body. There is no advance and retard adjusting screw, and the vacuum line connects to the side of the advance unit housing instead of the end.

The distributor is mounted on the front of the engine between the cylinder heads and is driven by a skew gear from the camshaft. The ignition advance is mechanically controlled, according to engine speed by governor weights within the distributor body, and according to the engine load by a vacuum control acting directly on the contact breaker plate which has a limited arc of movement in relation to the distributor body.

Correction to the spark advance is necessary because of the wide variation in engine speed and load under normal operating conditions. When accelerating or climbing hills, the engine load can be high and the range of spark advance is not necessarily as much as it would be on level ground at an equivalent constant engine speed.

The mechanical advance mechanism consists of two weights pivoted so that they move outwards from the distributor shaft as the engine speed rises. As the weights move outwards they turn the cam relative to the distributor shaft and thus advance the firing point. The weights are restrained by two springs of different tension thus giving a progressive advance action, and the amount the weights move outwards is in direct proportion to the distributor shaft speed.

To maintain a smooth operation throughout the engine speed range the contoured side of the cam plate follows the contours of the weights as they move outwards, and this system has the advantage of reducing the number of moving parts to a minimum.

The maximum advance or radial movement is limited by a stop on the action plate working within a slot in the cam spring plate. Two slots are, in fact, provided so that the cam may be withdrawn, turned 180° and replaced, giving in fact two alternative limits of advance for different applications. It will be seen that these are marked "14R" and "16.5R" adjacent to the slots on either side of the cam base. The number indicating the degree of advance and the letter R right-hand (clockwise) rotation, when viewed from the rotor end.

The distributor is set up in production on the Transit with the stop engaged in the 16.5R position for both high and low compression engines **and on no account must be altered for this vehicle.**

The vacuum advance unit consists of a diaphragm assembly mounted on a bracket attached to the distributor body. The diaphragm is connected to the contact breaker plate by a link and is open to the atmosphere on this side. The other side of the diaphragm has a spring and stop, to control the diaphragm movement, and is connected to the carburettor by a vacuum line. This vacuum line enters the carburettor barrel at a point just above the edge of the throttle plate, and is only sensitive to manifold depression when the throttle plate is opened past the idling position.

The vacuum applied at the diaphragm, combined with the action of the diaphragm spring, gives correct spark advance according to the load placed on the engine. Under part load operation the manifold vacuum is high and the vacuum advance is correspondingly high. At full load there is little or no manifold vacuum and therefore little or no vacuum advance. As the vacuum advance does not operate at idling speed, due to the throttle plate being almost closed, a correctly timed spark is obtained for starting.

Remember that, in practice, the total advance provided by the distributor at a constant engine speed is determined by a combination of both engine speed and manifold depression, according to the engine load.

Lubrication

The cam, weight pivot pins, and cam spindle are lubricated with a suitable high melting point grease. When renewing the contact breaker points assembly, apply a smear of this grease to the cam. Every 8,000 kms. (5,000 miles) remove the rotor and apply a drop or two of engine oil to the felt wick situated within the end of the spindle.

CAUTION: Do not over-lubricate any part of the distributor, otherwise lubricant may reach the breaker contacts, resulting in burning and difficult starting.

CONTACT BREAKER POINT ADJUSTMENT

The contact breaker points should be checked and adjusted every 8,000 kms. (5,000 miles).

Check the condition and alignment (see Fig. 34) of the points and fit a new set if the contacts are worn or burnt. Contacts showing a greyish colour and only slight signs of pitting need not be renewed. Fit a new contact breaker point assembly if the points are badly burnt or excessive metal transfer has occurred. Metal transfer is considered excessive when it equals or exceeds the gap setting of 0.64 mm. (0.025 in.).

Points which have become dirty or contaminated with oil or grease should be cleaned with a stiff brush and carbon tetrachloride.

To Adjust

1. Unclip and detach the distributor cap and remove the rotor arm.

2. Turn the engine so that the heel of the contact breaker arm is on the highest point of the cam.

3. Slacken the two locking screws on the contact breaker bracket and, by means of the vee notch in this component and the adjacent slot in the breaker plate, insert the blade of a screwdriver and adjust the points gap to 0.64 mm. (0.025 in.) (see Fig. 33).

NOTE.—When measuring used points with a feeler gauge, it must be remembered that a pit is usually formed in the face of one point and a corresponding pip on the other. The position of these varies with the capacity of the condenser and has no adverse effect on the functioning of the distributor, as the gap remains practically constant. However, points gap adjustment must be made outside these formations to achieve a correct reading. Under these conditions an oscilloscope or dwell meter should be used to check the points adjustment.

The correct dwell angle is between 38° and 42° at 1,000 rev./min. (crankshaft) with the vacuum pipe disconnected.

Remember that a smaller dwell angle than specified in the test values means too large a breaker point gap, whereas a larger dwell angle means too small a gap.

4. Tighten the screws securing the adjustable contact bracket in position and re-check the gap.

5. Refit the rotor arm squarely on the distributor cam spindle with the slot and lug in line. Press the rotor into position so that the lower face abuts the cam.

6. Check that the high tension leads are securely retained and then refit the distributor cap.

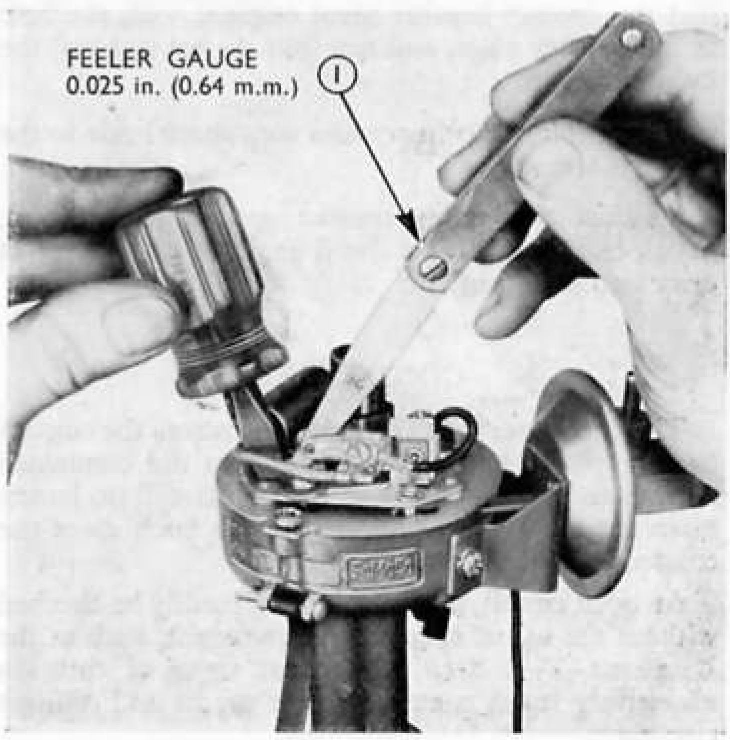


Fig. 33
Adjusting the Contact Breaker Points

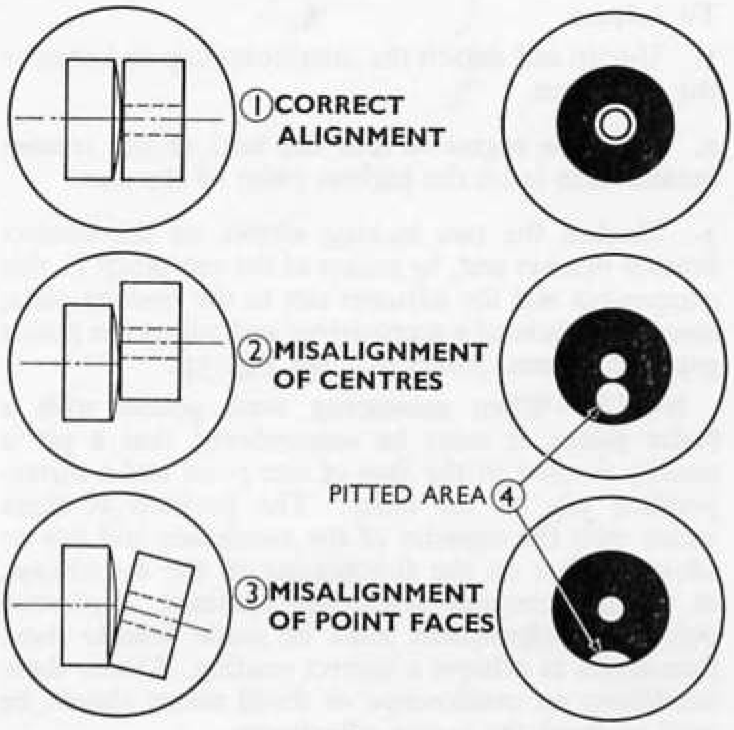


Fig. 34
Contact Breaker Points Alignment

To Remove

1. Unclip and detach the distributor cap and withdraw the rotor arm from the distributor cam spindle.

2. Slacken the terminal screw and detach the primary and condenser leads.

3. Undo the two locking screws and lift out the contact breaker point assembly.

To Replace

1. The contact set is pre-assembled and a new component requires no alignment nor tension check. Position the new set on the breaker plate ensuring that the contact breaker pivot engages with the hole in the breaker plate, and nip (but do not tighten) the locking screws.

2. Assemble the primary and condenser leads to the terminal screw.

3. Adjust the point contact gap to 0.635 mm. (0.025 in.) or to give a dwell angle of 38° to 42° as described previously.

CONDENSER

The condenser is fitted in parallel across the contact breaker points and a short circuit in the condenser will cause ignition failure as the points will no longer interrupt the low tension circuit. In such cases the condenser will have to be renewed.

An open circuit, however, cannot readily be checked without the use of specialised equipment, such as the Diagnosis Test Set. The usual signs of this are excessively burnt contact breaker points and difficult starting.

The capacity of the condenser is 0.21 to 0.25 microfarad.

To Remove

1. Remove the distributor cap and rotor.

2. Slacken the terminal screw and detach the condenser lead.

3. Unscrew the screw retaining the condenser to the breaker plate and remove the condenser.

To Replace

1. Locate the condenser in the hole in the breaker plate and refit the securing screw.

2. Refit the condenser lead to the terminal screw and tighten it securely.

3. Check that there is no possibility of a short circuit between the condenser lead and the breaker plate and refit the rotor and distributor cap.

VACUUM DIAPHRAGM UNIT

To Remove

1. Remove the distributor cap and rotor and disconnect the vacuum line from the vacuum diaphragm.

2. Remove the E-clip retaining the diaphragm pull rod pin to the breaker plate assembly.

3. Remove the two screws that secure the lower breaker plate to the distributor body and lift out the plate assembly.

4. Remove the two diaphragm assembly retaining screws and lift off the diaphragm assembly.

5. Holding the diaphragm by its hexagonal shank in a vice unscrew the 19.0 mm. (¾ in.) plug on the end of the assembly and remove the copper sealing ring. Extract the shim washers, spring and vacuum stop.

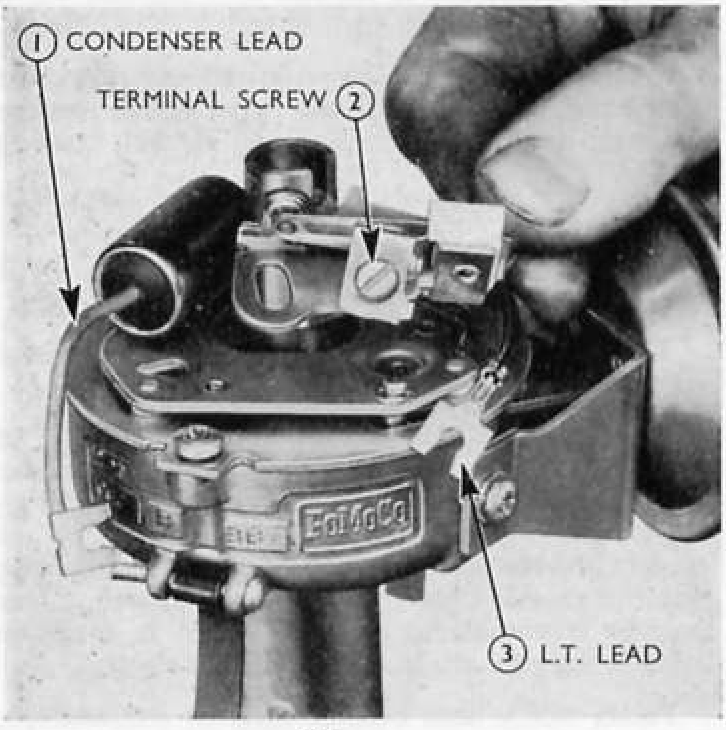


Fig. 35
Replacing the Contact Breaker Points Assembly

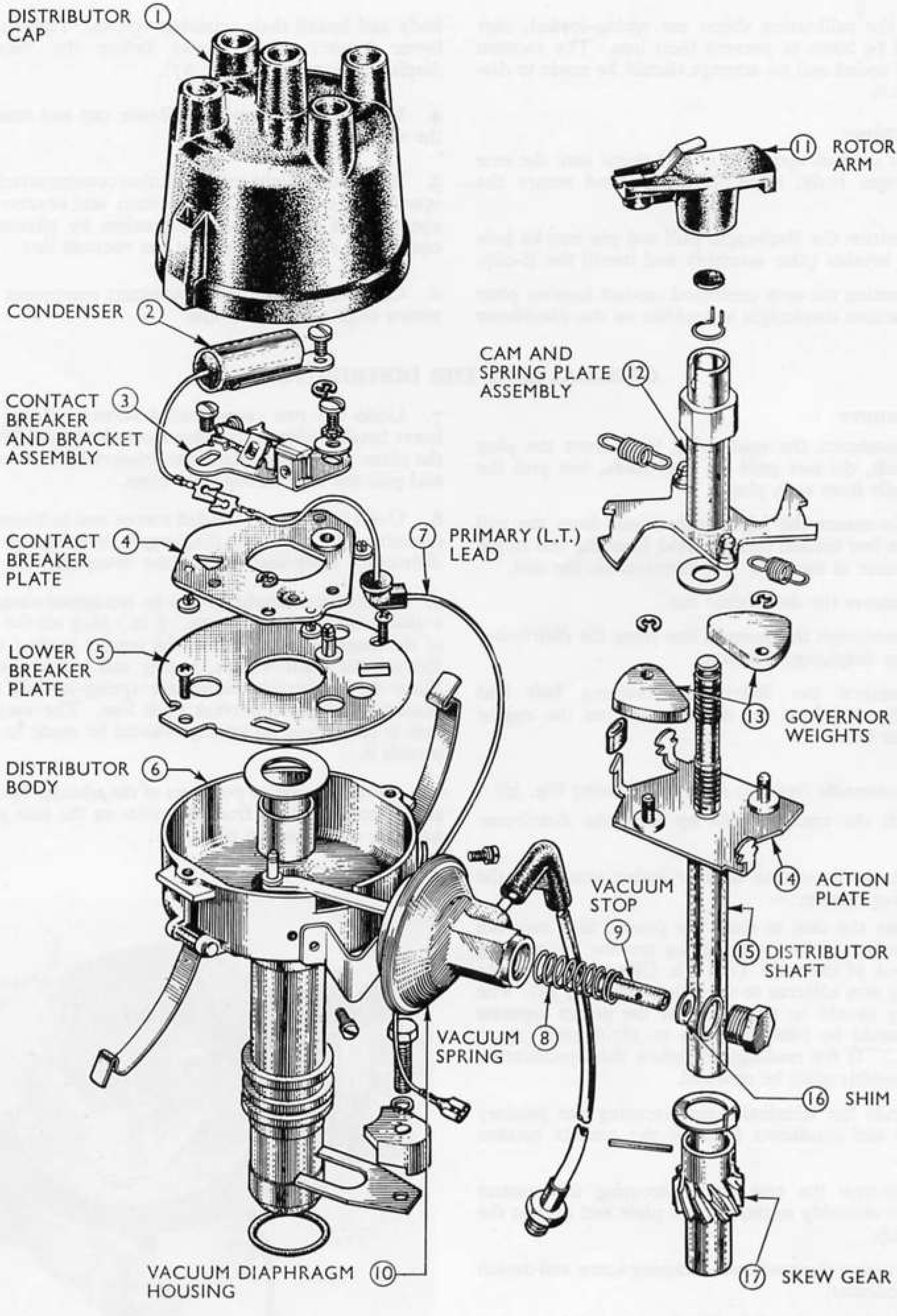


Fig. 36
The Distributor Assembly—Exploded

Since the calibrating shims are spring-loaded, care should be taken to prevent their loss. The vacuum unit is sealed and no attempt should be made to dismantle it.

To Replace

1. Fit original spring, stop and shims into the new diaphragm body, assemble washer and secure the plug.

2. Position the diaphragm pull rod pin into its hole in the breaker plate assembly and install the E-clip.

3. Position the now combined contact breaker plate and vacuum diaphragm assemblies on the distributor body and install their retaining screws. Tighten the lower breaker plate screws before the vacuum diaphragm screws (see Fig. 37).

4. Install the rotor and distributor cap and connect the vacuum line.

5. With timing light and revolution counter attached, operate the engine at 1,000 rev./min. and observe the operation of the vacuum mechanism by alternately connecting and disconnecting the vacuum line.

6. Connect vacuum line, disconnect equipment and return engine setting to idle.

OVERHAULING THE DISTRIBUTOR

To Remove

1. Disconnect the spark plug leads from the plug terminals, **do not pull on the leads,** but pull the terminals from each plug.

2. Disconnect the high tension lead from the coil and the low tension primary lead from the coil to the distributor at the C.B. +ve terminal on the coil.

3. Remove the distributor cap.

4. Disconnect the vacuum line from the distributor vacuum diaphragm housing.

5. Unscrew the distributor retaining bolt and carefully withdraw the distributor from the engine cylinder block.

To Dismantle (refer to exploded drawing Fig. 36)

1. Lift the rotor straight up from the distributor cam.

2. Check the contact breaker spring tension in the following manner:—

Rotate the cam to close the points, then measure the contact breaker arm spring tension by pressing the hook of the scale Tool No. CP.9501 against the breaker arm adjacent to the points (see Fig. 39). The reading should be taken just as the points separate and should be between 481.9 to 567.0 gms. (17 to 21 ozs.). If the readings are below this specification the assembly must be renewed.

3. Undo the terminal screw securing the primary (L.T.) and condenser leads to the contact breaker points.

4. Unscrew the two screws securing the contact breaker assembly to the breaker plate and lift out the assembly.

5. Unscrew the condenser retaining screw and detach the condenser.

6. Carefully prise off the 'E' clip securing the contact breaker plate to the lower breaker plate and lift off the plain and spring thrust washers from the pivot post. Prise off the smaller 'E' clip securing the contact breaker plate to the vacuum diaphragm pull rod, and lift out the breaker plate.

7. Undo the two cross-headed screws holding the lower breaker plate to the distributor body and lift off the plate. Carefully detach the primary lead grommet and pull the lead through the plate.

8. Undo the two pan-headed screws and lockwashers retaining the vacuum diaphragm housing to the distributor body and remove the assembly.

9. Holding the diaphragm by its hexagonal shank in a vice unscrew the 19.0 mm. (¾ in.) plug on the end of the assembly and remove the copper sealing ring. Extract the shim washer, spring and vacuum stop. Since the calibrating shims are spring-loaded, care should be taken to prevent their loss. The vacuum unit is sealed and no attempt should be made to dismantle it.

10. Note the relative positions of the advance springs and disconnect them from the posts on the cam plate and tabs on the action plate.

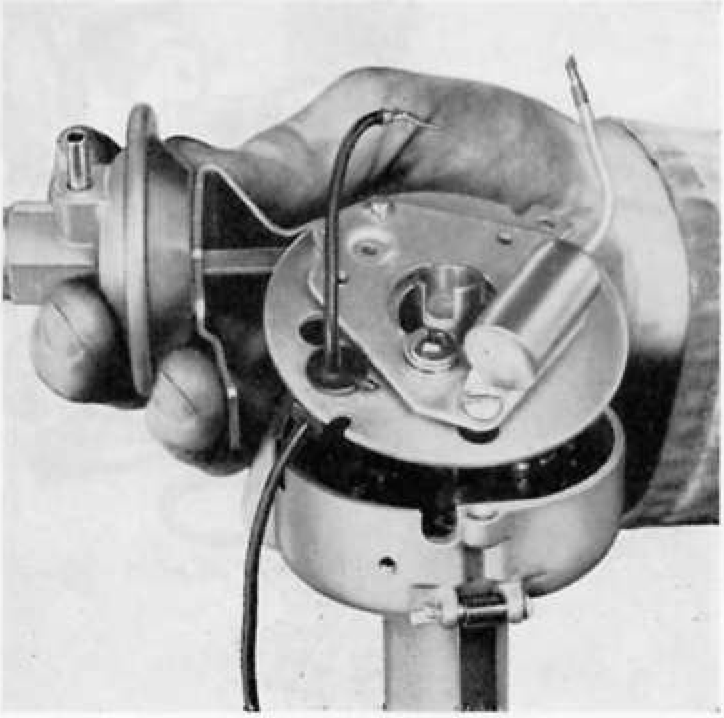


Fig. 37
The Lower Breaker Plate and Vacuum Diaphragm Screws

11. Lift out the felt wick from the counter-bored end of the cam, and extract the wire circlip located within this counterbore around the distributor shaft. Slide off the cam from the distributor shaft.

12. Remove the 'E' clips retaining the governor weights to the action plate.

13. Check all parts for wear, reference should be made to the Specification section, and replace all worn components.

14. If, due to wear, it is necessary to remove the shaft or the thrust washers from the body proceed as follows:—

(*a*) Drift out the 3.18 mm. ($\frac{1}{8}$ in.) roll pin and slide the skew gear, thrust washer, and wave washer from the distributor shaft.

(*b*) Draw out the shaft from the body and remove the washers from beneath the action plate.

To Replace the Skew Gear

When fitting a new skew gear on an old shaft, or a new shaft with the original gear, a new roll pin hole will have to be drilled at right angles to the original roll pin hole and at the same time obtain the correct end-float. This is achieved by assembling the shaft in the body with the correct replacement thrust washers in their top and bottom respective positions, and effecting the desired end-float by temporary shimming, pre-loading the assembled shaft and drilling in the same operation. It will be noted that replacement skew gears are supplied with a pilot drilling for the roll pin hole.

Replacement of gear on original or new shafts

1. Assemble the washers on shaft in their correct sequence beneath the action plate and insert the shaft into the distributor body.

2. Obtain or make a 0.127 mm. (0.005 in.) shim as per illustration.

3. Assemble a new wave washer, thrust washer and the 0.127 mm. (0.005 in.) shim on the distributor shaft (see Fig. 38).

4. When using original shafts, position the new skew gear on the shaft so that the pilot hole is at right angles to the original hole.

5. Using a suitable screw compression clamp, press gear onto shaft until spring washer is compressed and all slack is removed. **Do not over-tighten.**

6. Position the assembly carefully in Vee blocks under a press drill. Drill a 3.18 mm. ($\frac{1}{8}$ in.) hole through gear and shaft using the pilot hole as a guide. When using the original gear with a new shaft, drill the roll pin hole through the gear at right angles to the original hole.

7. Remove drill and install a new roll pin.

8. Release the compression of the clamp and extract the temporary 0.127 mm. (0.005 in.) shim.

To Reassemble

1. Locate the governor weights on the action plate with the flat sides adjacent to the distributor shaft (see Fig. 40).

2. Refit the cam on the distributor shaft with the advance stop on the action plate within the segment slot marked 16.5R.

3. Refit the wire circlip on the distributor shaft within the cam counter-bore and replace the felt oil wick.

4. Reconnect the advance springs to the posts on the cam plate and tabs on the action plate in their original positions (see Fig. 40).

NOTE.—The primary spring tab may be marked with a green paint mark for L.C. The primary spring has a larger coil diameter and a shorter length than the secondary spring.

5. Fit the original spring, stop and shims into the diaphragm body, assemble washer and secure the plug.

6. Insert the primary lead into the lower breaker plate with the breaker terminal connection upwards and locate the lead by pushing the grommet home in the plate.

7. Locate the contact breaker plate over the pivot pin in the lower braker plate, replace the wave washer, plain washer and secure with the 'E' clip.

8. Fit the diaphragm pull rod pin into its hole in the breaker plate assembly and install the E-clip.

9. Position the now combined breaker plate and diaphragm assemblies on the distributor body and install their retaining screws. Tighten the lower breaker plate screws before the vacuum diaphragm screws.

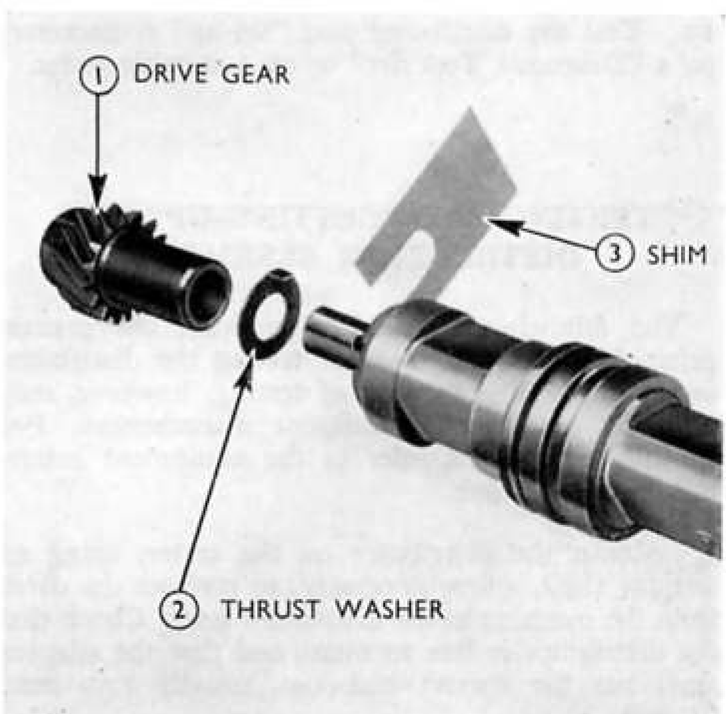


Fig. 38
Setting the Distributor Shaft Pre-Load

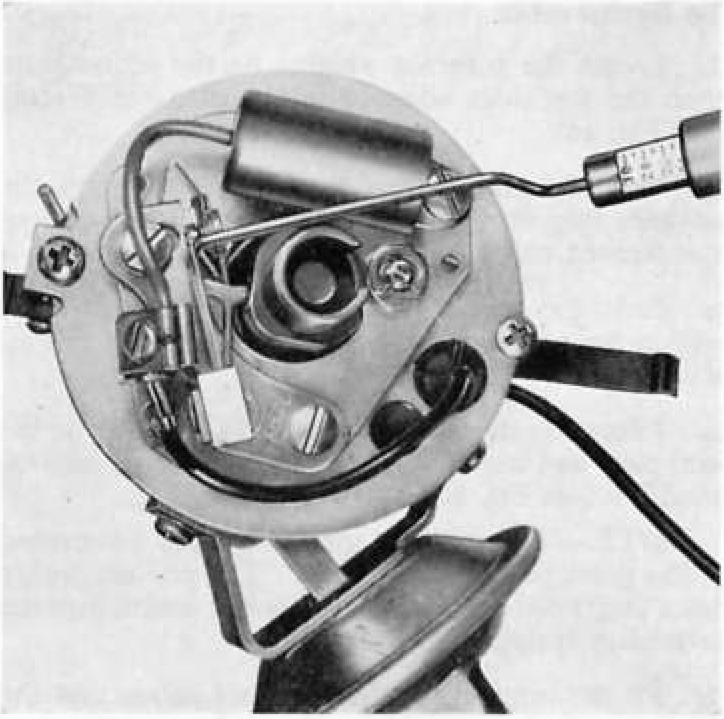


Fig. 39
Checking Contact Breaker Spring Tension

10. Position a new contact breaker and bracket assembly on the breaker plate ensuring that the contact breaker pivot engages with the hole in the breaker plate. Adjust the point contact gap to 0.64 mm. (0.025 in.) as previously outlined within this section.

11. Replace the condenser after checking and re-connect the condenser and primary leads to the terminal screw on the contact breaker.

12. Replace the rotor, locating the tongue in the slot at the top of the distributor cam.

13. Test the distributor and "set-up" if necessary on a "Diagnosis Test Set" or on a suitable tester.

TESTING AND "SETTING-UP" THE DISTRIBUTOR ASSEMBLY

The following instructions indicate the general principles to be followed for testing the distributor on a tester. The method of testing, however, may vary for machines of different manufacture. For specific instructions refer to the equipment manufacturer's handbook.

1. Mount the distributor on the tester, using an adaptor shaft, where necessary, to connect the drive from the machine to the distributor gear. Check that the distributor is free to rotate and that the adaptor shaft has the correct end-float, usually 1.59 mm. ($\frac{1}{16}$ in.).

2. Make the necessary electrical connections and zero the instrument if required.

3. Dwell angle

(*a*) Turn the cylinder selector to the figure corresponding to the number of lobes on the cam of the distributor being tested, in this case four.

(*b*) Turn the test selector switch to the cam angle position and operate the distributor at approximately 1,000 rev./min. (crankshaft).

(*c*) Adjust the distributor breaker point gap to a dwell angle of 42°.

(*d*) Increase the speed up to a maximum of 5,000 rev./min. (crankshaft) and check the dwell reading, which must be between 38° and 42°. If the reading changes more than 3° check for a worn distributor shaft or worn bushings.

4. Mechanical operation

(*a*) Make the necessary connections for the stroboscopic timing light or sparking protractor, refer to equipment manufacturer's handbook.

(*b*) Adjust the speed control to vary the distributor speed between 400 and 5,000 rev./min. (crankshaft). Erratic or thin faint flashes of light preceding the regular flashes as the speed of rotation is increased can be due to weak breaker arm spring tension.

(*c*) Operate the distributor at approximately 2,500 rev./min. (crankshaft).

(*d*) Move the protractor scale with the adjustment control so that the zero degree mark on the scale is opposite one of the neon flashes. The balance of all the flashes should come within plus or minus 1°, evenly around the protractor scale. A larger variation

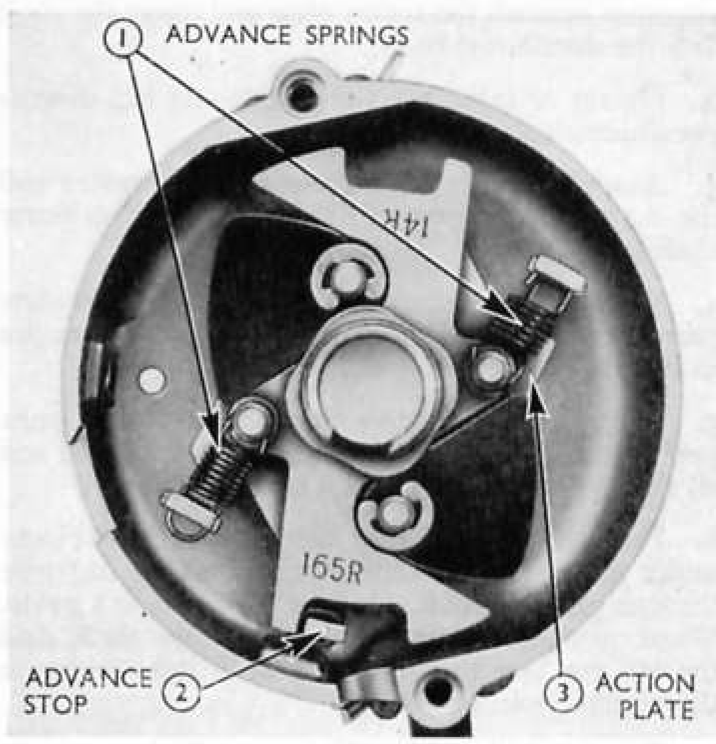


Fig. 40
Assembling the Mechanical Advance Mechanism

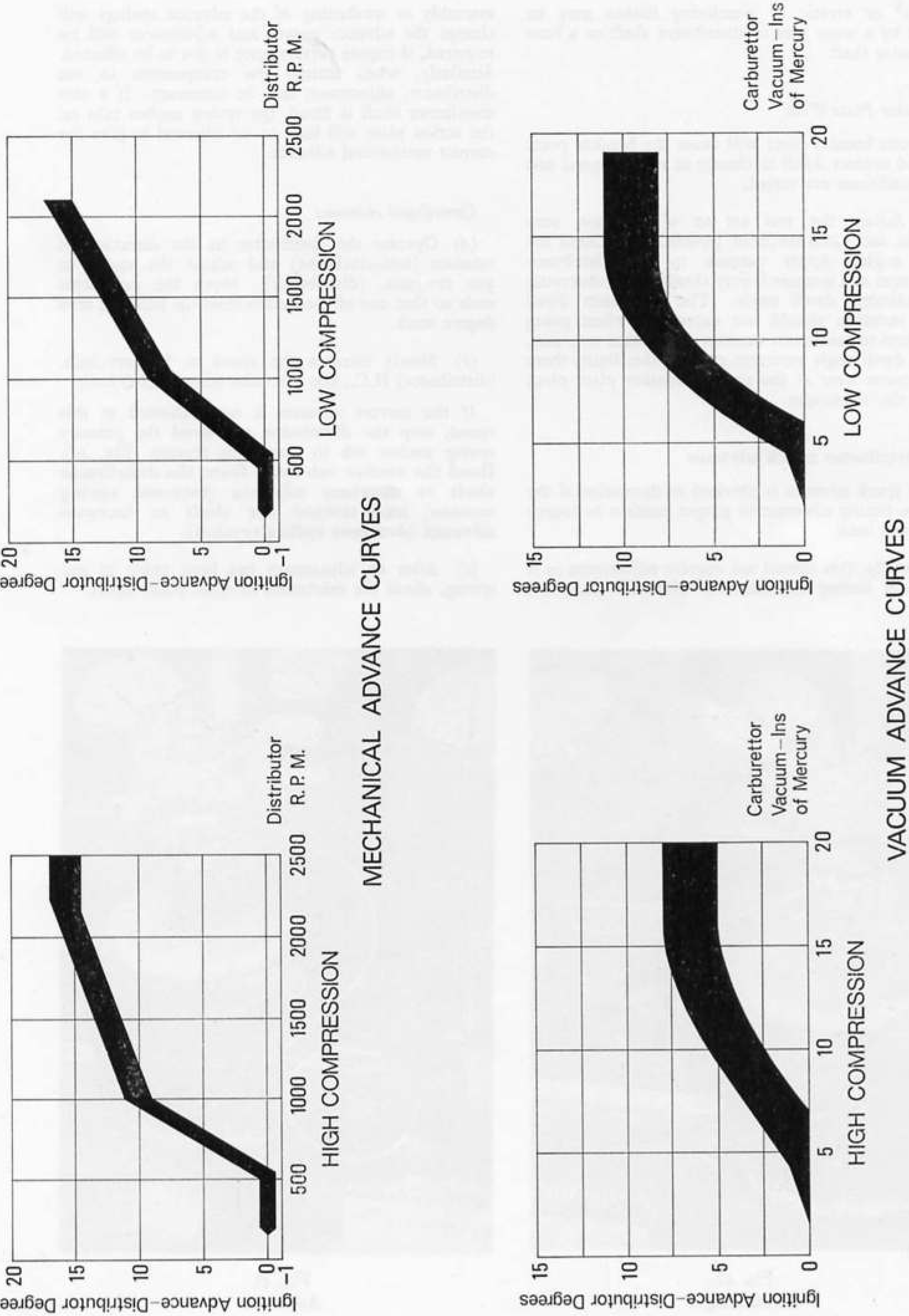


Fig. 41

The Mechanical and Vacuum Advance Curve

than 1° or erratic or wandering flashes may be caused by a worn cam or distributor shaft or a bent distributor shaft.

Breaker Plate Wear

A worn breaker plate will cause the breaker point gap and contact dwell to change as engine speed and load conditions are varied.

(*e*) Adjust the test set to 0° advance, zero vacuum, and 1,000 rev./min. (crankshaft). Check the dwell angle. Apply vacuum to the distributor diaphragm and increase it very slowly while observing the indicated dwell angle. The maximum dwell angle variation should not exceed 6° when going from zero to maximum vacuum at constant rev./min. If the dwell angle variation exceeds this limit, there is excessive wear at the contact breaker plate pivot pin or the diaphragm.

5. Distributor spark advance

The spark advance is checked to determine if the ignition timing advances in proper relation to engine speed and load.

Normally, this should not require adjustment as it is pre-set during manufacture. However, incorrect assembly or weakening of the advance springs will change the advance curves and adjustment will be required, if engine performance is not to be affected. Similarly, when fitting new components in the distributor, adjustment may be necessary. If a new distributor shaft is fitted, the spring anchor tabs on the action plate will have to be adjusted to give the correct mechanical advance.

Centrifugal Advance

(*a*) Operate the distributor in the direction of rotation (anti-clockwise) and adjust the speed to 300 rev./min. (distributor). Move the protractor scale so that one of the flashes lines up with the zero degree mark.

(*b*) Slowly increase the speed to 700 rev./min. (distributor) H.C., 800 rev./min. (distributor) L.C.

If the correct advance is not indicated at this speed, stop the distributor and bend the primary spring anchor tab to change its tension (Fig. 44). **Bend the anchor tab away from the distributor shaft to decrease advance (increase spring tension) and toward the shaft to increase advance (decrease spring tension).**

(*c*) After an adjustment has been made to one spring, check the minimum advance point again.

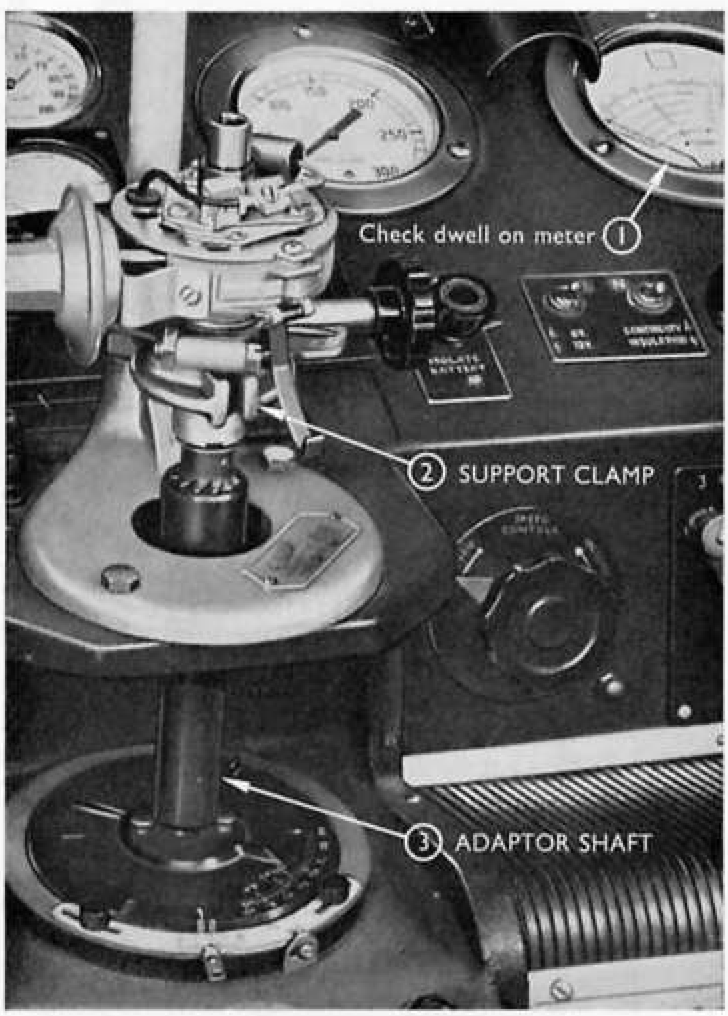


Fig. 42
Dwell Angle

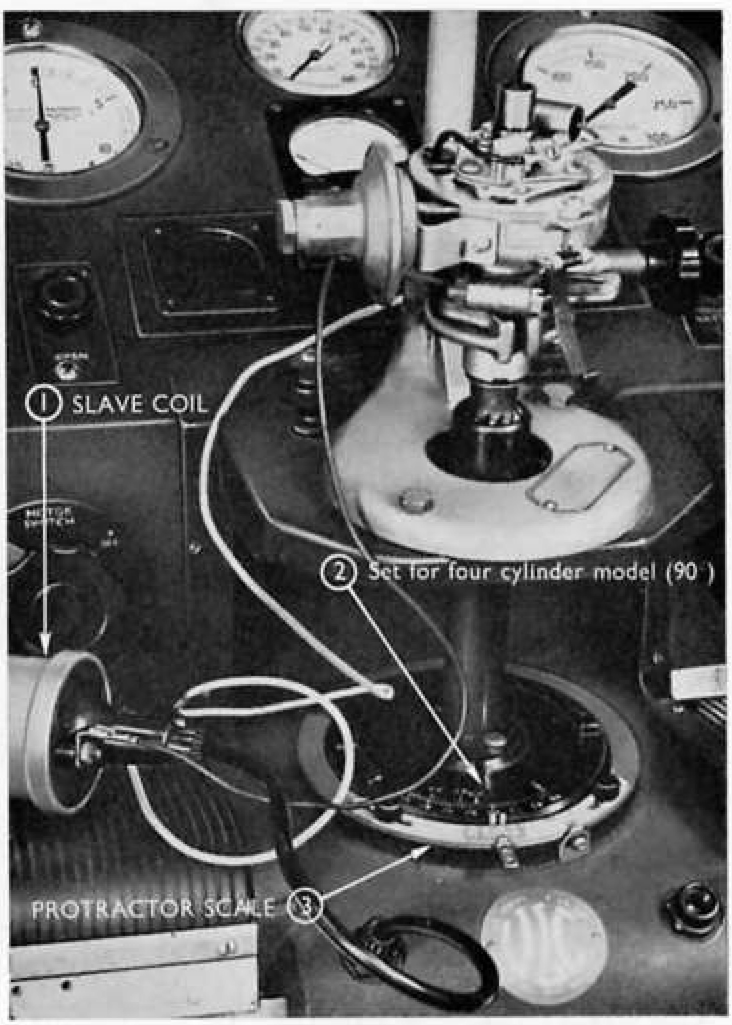


Fig. 43
Advance

(*d*) Operate the distributor at 2,500 rev./min. (distributor). If this advance is not to specifications, stop the distributor and bend the secondary spring anchor tab to give the correct advance.

(*e*) Check the advance at the other speeds tabulated in the Specification section and readjust if necessary. Operate the distributor both up and down the speed range.

Vacuum Advance

(*a*) Connect the test set vacuum line to the fitting on the diaphragm and turn the vacuum supply switch on.

(*b*) Set the test set to 0° advance, zero vacuum, and at 1,000 rev./min. (crankshaft).

(*c*) Check the advance at the vacuum settings tabulated in the Specification section.

(*d*) If the advance is incorrect, change the calibration shims between the vacuum chamber spring and plug (Fig. 45). After installing or removing a shim, position the gasket in place and tighten the plug. **The addition of a shim will decrease advance and the removal of a shim will increase advance.**

(*e*) After one vacuum setting has been adjusted, check the advance at other vacuum settings on the curve. **Do not change the original speed setting when going to a different vacuum setting.** If the other settings are not within limits, it indicates incorrect spring tension, leakage in the vacuum chamber and/or line, or the wrong fibre stop has been installed in the vacuum chamber of the diaphragm housing.

To Replace

1. Set the engine with the upper (inner) timing mark on the timing cover in line with the notch in the crankshaft pulley as No. 1 piston comes up on the compression stroke (see Fig. 46).

2. Point the rotor towards the offside rocker cover in the vicinity of the front rocker cover screw, and insert the distributor into the engine. (It may be necessary to turn the rotor a few degrees clockwise or anti-clockwise for the distributor gear teeth to mesh with those of the cam gear.) Fit the distributor retaining bolt.

3. Connect the primary (L.T.) lead to the coil.

4. Replace the distributor cap and leads securing the cap with the two retaining clips.

5. Reconnect the leads to the spark plug terminals in the correct firing order (1, 3, 4, 2); noting the direction of rotation of the rotor arm. Connect the high tension lead from the coil to the central socket of the distributor cap.

6. Reconnect the vacuum line to the vacuum housing 'push-on' connector.

7. Start engine and adjust the distributor for correct initial advance.

IGNITION TIMING

General

(*a*) Prior to adjusting the ignition timing ascertain the engine compression ratio. This can be readily identified by the letter **"H"** (High Compression 9.1 : 1) or the letter **"L"** (Low Compression 8.0 : 1) stamped on one inlet manifold mounting pad.

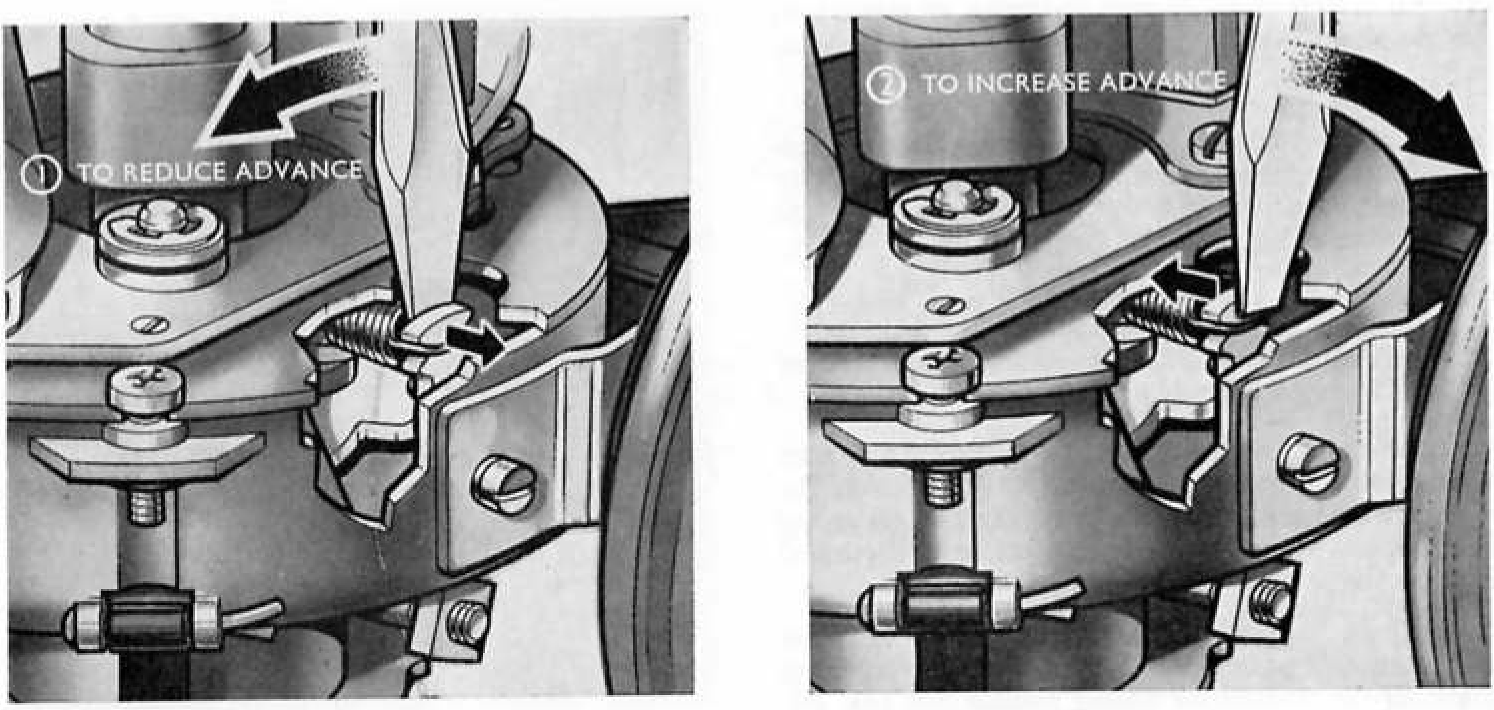


Fig. 44
Adjusting the Mechanical Advance Characteristics

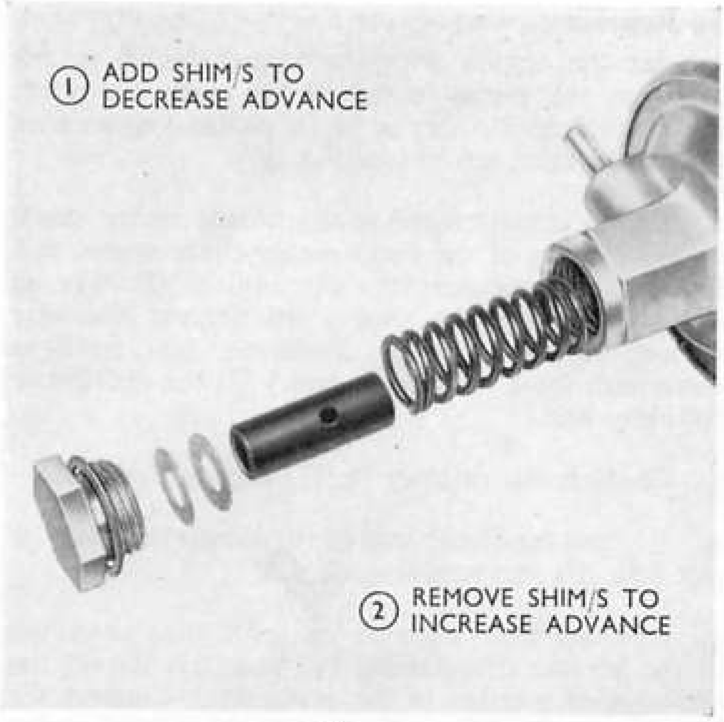


Fig. 45
Adjusting the Vacuum Advance Characteristics

(*b*) Check also the fuel octane rating that is to be used with this engine. Establish that the correct distributor is fitted for this combination of compression ratio and fuel. See page 32.

(*c*) The static advance of 8° H.C. or 6° L.C. before T.D.C. is "built in" to the engine and when No. 1 cylinder is on the compression stroke and the mark on the crankshaft pulley aligns with the appropriate mark on the front cover timing pointer (see Fig. 46) the crankshaft is at the static advance setting and no further adjustment is required at this stage, see operation A5.

(*d*) All reference to degrees (advance or retard) on the distributor are in terms of crankshaft degrees as in 'c'.

(*e*) If the vehicle is normally operated at a high altitude the distributor setting must be **advanced** by 4° for each 609.6 m. (2,000 ft.) above sea level, up to a maximum of 10° from the static setting.

A. To Adjust the Timing without the use of a Timing Light

1. If the engine has not been previously set, turn it with No. 1 piston coming up to T.D.C. on the compression stroke (this can be checked by removing No. 1 spark plug and feeling the pressure developed in the cylinder).

Continue turning the engine until the mark on the crankshaft pulley is in line with the appropriate mark on the front cover timing pointer (see Fig. 46).

This will give the initial timing setting of 6° L.C or 8° H.C. B.T.D.C. (static advance).

2. Remove the distributor cap.

3. Slacken off the distributor body clamp bolt and rotate the body clockwise until the contact breaker points are just opening when the rotor is adjacent to No. 1 H.T. contact in the distributor cap. Note direction of rotation of arm.

4. Tighten the distributor body clamp bolt and replace the distributor cap.

5. A slight readjustment to the distributor may be necessary and should be carried out on the road in the following manner:—

(*a*) Warm up the engine to normal operating temperature.

(*b*) Accelerate in top gear on wide throttle opening from 32 k.p.h. (20 m.p.h.) to 64 k.p.h. (40 m.p.h.).

(*c*) If heavy pinking occurs, **retard** the ignition until a trace pink can just be heard under these conditions of acceleration (see operation B4).

NOTE.—It is not necessary to advance the ignition beyond the static setting (except under high altitude operating conditions previously detailed). Also, there is no need to use a fuel of a higher octane rating (or number) than that specified.

B. To Adjust the Timing using a Timing Light

1. Connect the leads of the timing light, using the clips provided in accordance with the manufacturer's instructions.

2. Check that the mark on the crankshaft pulley is visible and mark with chalk or paint if necessary.

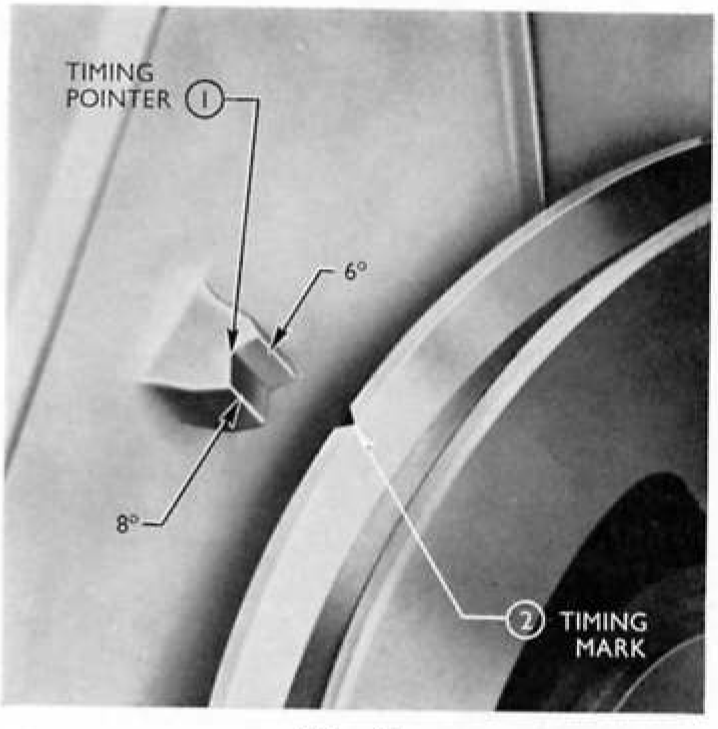


Fig. 46
Engine Positioned for Timing

3. Disconnect the vacuum pipe line and start the engine, allowing it to idle (approx. 600 rev./min.).

4. Point the timing light at the timing pointer. Check that the mark on the crankshaft pulley is adjacent to the appropriate mark on the front cover timing pointer (see Fig. 46).

If the mark of the pulley is above the correct timing mark, the engine is too far advanced. Slacken the distributor body clamp and turn body clockwise slightly to retard the ignition.

Should the mark be below the correct timing mark, the distributor body should be turned anti-clockwise slightly to advance the ignition.

5. Securely tighten the distributor body clamp bolt after the adjustment has been made.

Reconnect the vacuum pipe line.

The operation of the governor weights may be checked by opening and closing the throttle. As the throttle is gradually opened, the mark should move away from the indicator upwards; and as the throttle is closed the notch will move down in line with the indicator.

Any tendency for erratic advance shown by the mark jumping suddenly away from the indicator shows that the governor weights are binding, or that the springs are weak.

NOTE.—As in "A" a slight readjustment to the distributor may be necessary to suit the particular type of fuel in use.

THE LUCAS 11AC ALTERNATOR

(Prior to September 1968)

The alternator is belt-driven from the crankshaft pulley. The mechanical construction of the alternator differs from a generator in that the field rotates (the rotor), and the generating windings are stationary (the stator).

The stator comprises of a 24-slot, 3-phase star-connected output winding on a ring shaped lamination pack, housed between the slip-ring end and drive end brackets. The rotor is of 8-pole construction and carries a slip ring fed field winding. It is supported by a ball bearing in the drive end bracket and a needle roller bearing in the slip ring end bracket.

The brush gear for the field system is mounted on the slip ring end bracket. Two carbon brushes bear against a pair of concentric brass slip rings carried on a moulded disc attached to the end of the rotor.

The slip ring end bracket also carries six silicon diodes connected in a three-phase bridge to rectify the generated alternating current to direct current for use in charging the battery and supplying power to the electrical system.

The diodes and stator windings are cooled by airflow through the alternator induced by the fan at the drive end.

The alternator output is controlled by an electronic voltage regulator unit. In addition a warning light control unit is fitted.

ROUTINE MAINTENANCE

Cleaning

Wipe away any dirt or oil which may collect around the slip ring end cover ventilating apertures.

Belt Adjustment

Inspect the fan belt regularly, for wear and tension. When the belt is pulled and pushed at a point midway between the alternator and fan pulleys, the total movement should not exceed 13 mm. ($\frac{1}{2}$ in.).

Ensure that the alternator pulley is properly aligned with the fan crankshaft and water pump pulleys, otherwise the rotor bearings will be unduly loaded.

Lubrication

The bearings are packed with grease during assembly and do not require attention.

TEST PROCEDURES

In the event of a fault developing in the charging circuit, the following procedure should be followed to locate the cause of the trouble:—

(*a*) Inspect the fan belt for wear and tension.

(*b*) Disconnect the alternator field connections, turn on the ignition and check that battery voltage is being applied to the rotor winding by connecting a voltmeter between the cable ends normally attached to the field terminals. Turn off the ignition.

(*c*) Disconnect the battery earth cable.

(*d*) Disconnect the cables from the alternator output terminal and connect a good quality moving coil ammeter between the output terminal and the disconnected cables.

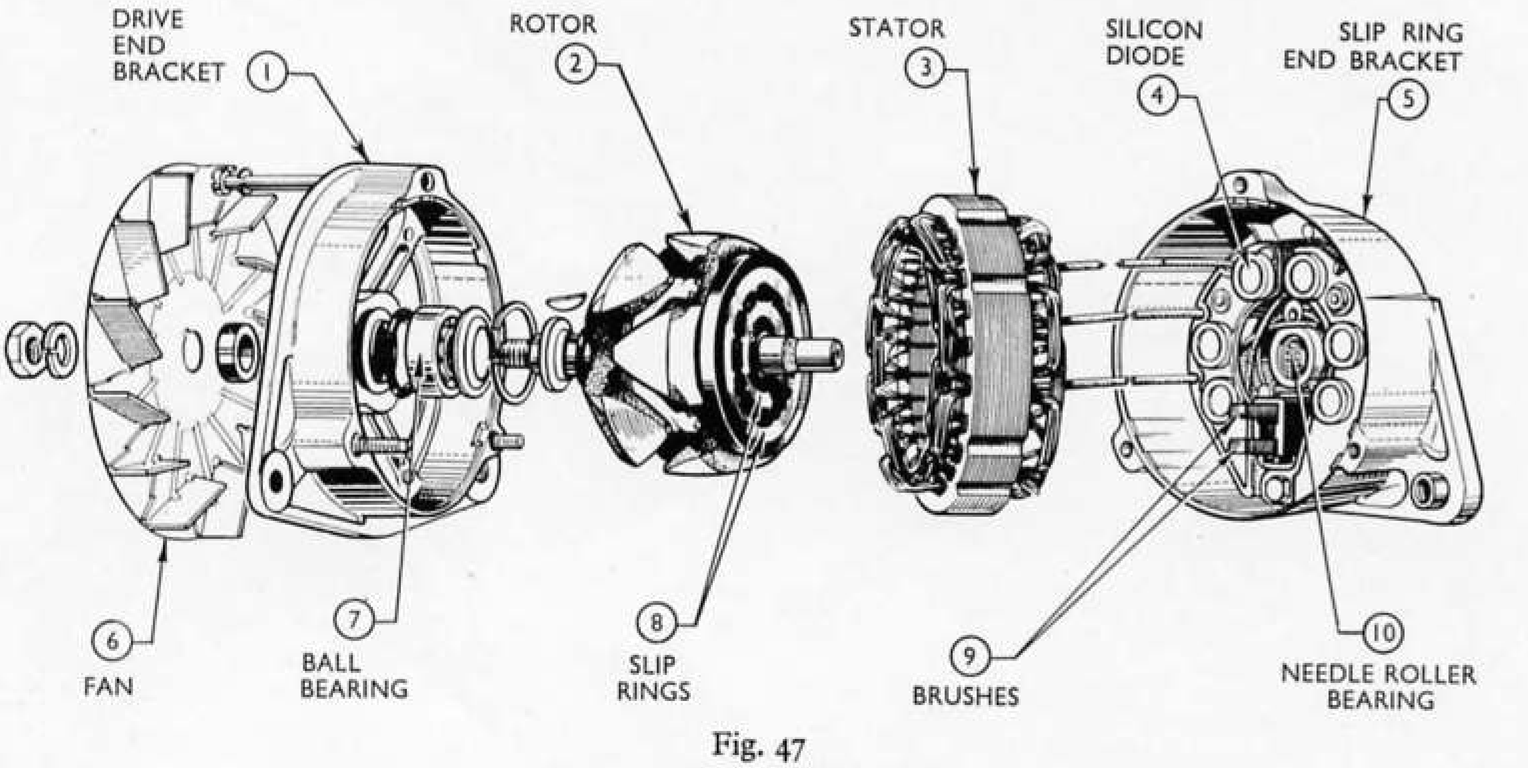


Fig. 47
Alternator — Exploded View

(*e*) Remove the wires from the alternator field terminals and, using a suitable pair of jumper leads, connect these terminals directly to the battery.

For this test polarity matching is unimportant.

(*f*) Reconnect the battery earth lead. Start the engine and slowly open the throttle until the engine speed is approximately 2,200 rev./min. At this speed the reading on the ammeter should be approximately 40 amps.

If a zero reading results, stop the engine and disconnect the cables from the field terminals. Withdraw the two brush box moulding retaining screws and remove the brush gear for examination as described on page 46.

Fit new brush and spring assemblies, if necessary, and re-test the alternator output. If the zero reading persists, the alternator must be removed from the engine and dismantled for detailed inspection (see below).

A low output current reading will indicate either a faulty alternator or poor circuit wiring connections. Check the latter whilst keeping the alternator connected and running as described above; connect a good quality low-range voltmeter between the alternator output terminal and the battery positive terminal and note the voltmeter reading.

Transfer the voltmeter connections to the alternator frame and battery earth terminal and again note the reading.

If either of these readings exceed 0.5 volts there is high resistance in the charging circuit which must be traced and remedied.

If these tests show that there is no undue resistance in the charging circuit, proceed to dismantle the alternator as described below.

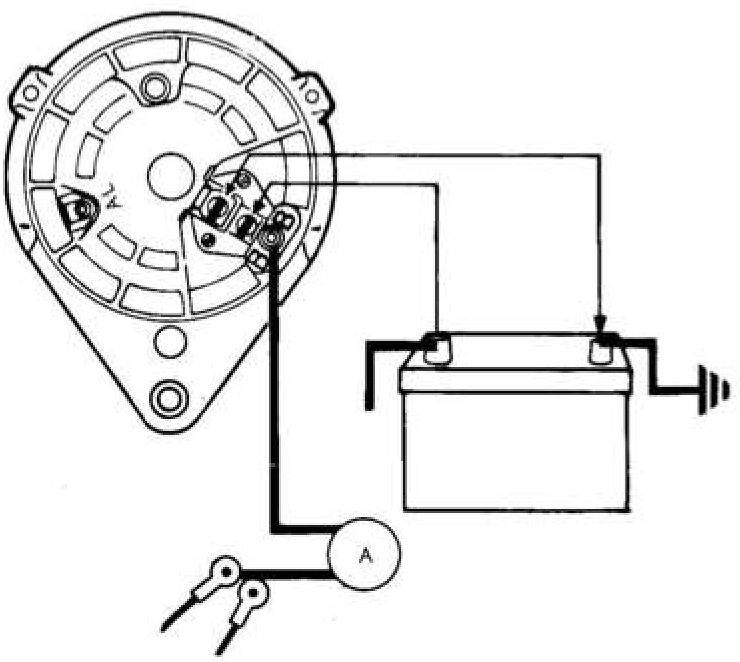


Fig. 48
Alternator Output Test

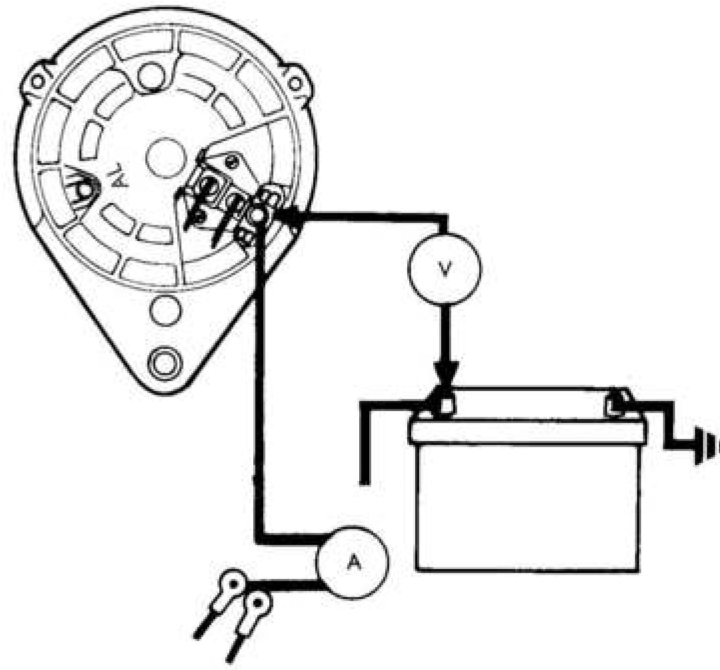


Fig. 49
Charging Circuit Voltage Drop Test Insulated Side

To Remove

1. **Disconnect the battery** and remove the wiring from the alternator.

2. **Remove the alternator adjusting arm bolt,** slacken the alternator mounting bolts and remove the fan belt.

3. **Remove the alternator from the vehicle.**

To Replace

1. **Position the alternator** and fit the mounting bolts.

2. **Refit the fan belt.** Adjust the fan belt tension by moving the alternator. When the tension is correct, refit the adjusting arm bolt and tighten the alternator mounting bolts.

The fan belt tension is correct when the total movement does not exceed 13 mm. ($\frac{1}{2}$ in.) when the belt is pushed and pulled at a point midway between the alternator and fan pulleys.

3. **Connect the wiring** to the alternator and reconnect the battery.

To Dismantle the Alternator

1. **Remove the shaft nut, spring washer, pulley and fan** from the drive end.

2. **Unscrew and withdraw the three 'through' bolts.**

3. **Mark the drive end bracket, lamination pack and slip ring end bracket** so that they may be re-assembled in the correct angular relation to each other.

4. **Withdraw the drive end bracket and rotor** from the stator. The drive end bracket and rotor need

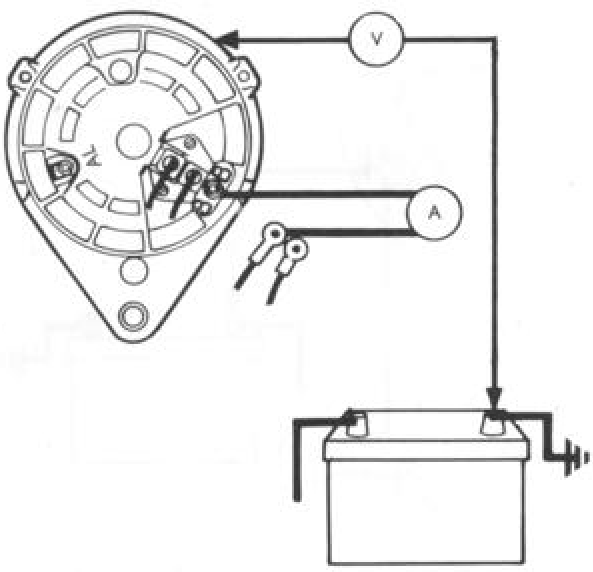


Fig. 50
Charging Circuit Voltage Drop Test Earth Side

not be separated unless the drive end bearing requires examination or the rotor is to be replaced. The rotor can be removed from the drive end bracket by means of a hand press, having first removed the shaft key and bearing collar.

5. **From the slip ring end bracket remove the terminal nuts,** washers, insulating pieces, brush box screws and the 2 B.A. bolt. Take care not to misplace the two washers fitted between the brushbox moulding and the end bracket.

6. **Withdraw the stator** and heat sink assemblies from the slip ring end bracket.

7. **Close up the retaining tongue at the root of each field terminal blade** and withdraw the brush, spring and terminal assemblies from the moulded brush box.

Inspection of Brush Gear

(*a*) Measure brush length. A new brush is 15.9 mm. ($\frac{5}{8}$ in.) long. A fully worn brush is 4 mm. ($\frac{5}{32}$ in.). long and must be replaced at or approaching this length. The new brush is supplied complete with a brush spring and terminal blade and has merely to be pushed in until the tongue registers. To ensure that the terminal is properly retained, carefully lever up the retaining tongue with a small screwdriver blade, so that the tongue makes an angle of about 30° with the terminal blade.

(*b*) Check that the brushes move freely in their holders. If they are at all sluggish, clean the brushes with a petrol-moistened cloth or lightly polish the brush sides on a smooth file. Remove all traces of brush dust before rehousing the brushes in their holders.

NOTE.—The brush which bears on the inner slip ring is always connected to the positive side of the electrical system, since the lower linear speed of the inner ring results in reduced mechanical wear and helps to offset the higher rate of electrical wear peculiar to the positive-connected brush.

Inspection of Slip Rings

The surfaces of the slip rings should be smooth and free from oil or other foreign matter. Clean the surfaces, using a petrol-moistened cloth, or if there is any evidence of burning, very fine glass paper. On no account must emery cloth or similar abrasives be used. No attempt should be made to machine the slip rings, as any eccentricity in the machining may adversely affect the high-speed performance of the alternator.

The small current carried by the rotor winding, and the unbroken surface of the slip rings mean that the likelihood of scored or pitted slip rings is almost negligible.

Rotor

(*a*) Test the rotor winding by connecting either an ohmmeter or a battery and ammeter in series across the two slip rings.

The ohmmeter reading should be 3.8 ohms. If the ammeter was used, the reading should be 3.2 amps.

(*b*) Test for defective insulation between one of the slip rings and one of the rotor poles, using a 110 volt A.C. mains supply and a 15 watt test lamp. If the lamp lights, the coil is earthing and a replacement rotor/slip ring assembly must be fitted.

(*c*) No attempt should be made to machine the rotor poles or to true a distorted shaft.

Stator

(*a*) Unsolder the three stator cables from the heat sink assembly, taking care not to overheat the diodes. Check the continuity of the stator windings by first connecting any two of the three stator cables in series with a 1.5 watt test lamp and a 12 volt battery. Repeat the test, replacing one of the two cables by the third cable. Failure of the test lamp to light on either test indicates that part of the stator winding is open circuit and a replacement stator must be fitted.

(*b*) Test for defective insulation between stator coils and lamination pack with the mains test lamp. Connect the test probes between any one of the three cable ends and the lamination pack. If the lamp lights, the stator coils are earthing and a replacement stator must be fitted.

Diodes

Before resoldering the stator cable ends to the diode pins carry out the following test:—

Each diode can be checked by connecting it in series with the 1.5 watt test bulb across a 12 volt battery and then reversing the battery connections.

Current should flow, and the bulb light, in one direction only. Should the bulb light in both tests or not at all, the diode is defective and the heat sink assembly must be replaced.

Diode Heat Sink Replacement

The alternator heat sink assembly consists of two parts, one of positive polarity and the other negative. The positive portion carries three cathode base diodes marked red, and the negative portion three anode diodes marked black. The diodes are not individually replaceable, but for service purposes, are supplied already pressed into the appropriate heat sink portion.

Great care must be taken to avoid overheating the diodes or bending the diode pins. The diode pins should be lightly gripped with a pair of long-nosed pliers (which act as a thermal shunt) and soldering must be carried out as quickly as possible.

After soldering, the connections must be neatly arranged around the heat sinks, to ensure adequate clearance for the rotor and should be tacked down with a suitable adhesive where indicated in Fig. 52. The stator connections must pass through the appropriate notches at the edge of the heat sink.

Bearings

Bearings which are worn to the extent that they allow excessive side movement of the rotor shaft must be renewed.

1. The needle roller bearing in the slip ring end bracket is not serviced separately. Should this bearing require replacing a complete end bracket assembly must be fitted.

2. The drive end ball bearing retaining plate is secured either by screws, rivets or a circlip.

(*a*) Remove the circlip.

(*b*) Press the bearing out of the bracket, noting the order of assembly of the pressure ring and plate (where fitted).

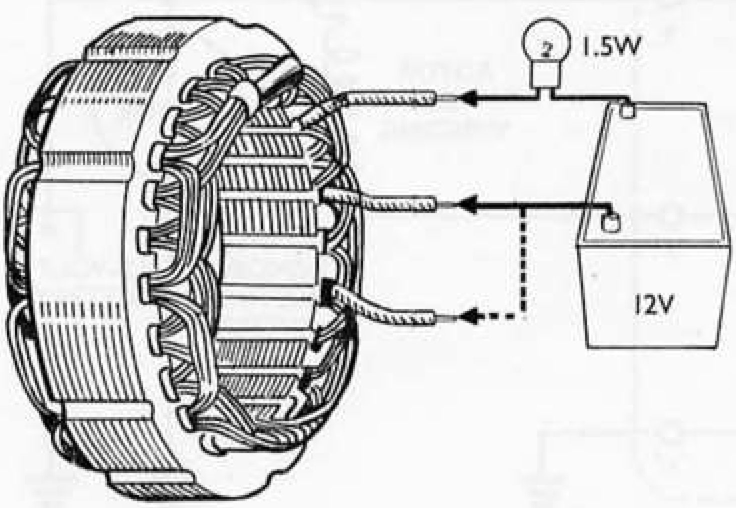


Fig. 51
Stator Winding Continuity Test

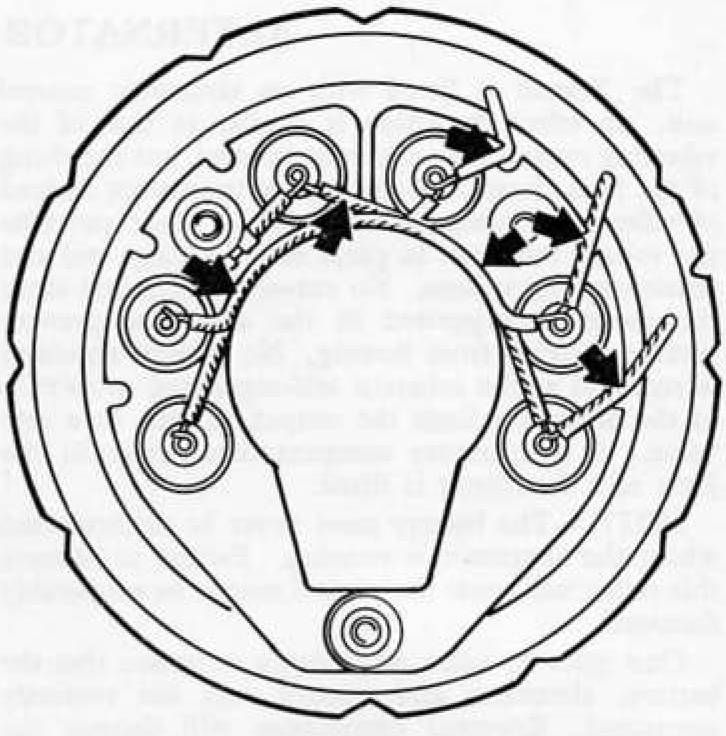


Fig. 52
Heat Sink Cable Securing Points

(*c*) Before fitting the replacement bearing see that it is clean and, if necessary, pack it with a high melting point grease.

(*d*) Locate the bearing in the housing and press it home.

(*e*) Refit the circlip.

To Reassemble the Alternator

1. Fit the brush, spring and terminal assemblies in the moulded brush box. Open out the retaining tongue at the root of each field terminal blade.

2. Replace the stator and heat sink assemblies in the slip ring end bracket.

3. Place the washers over the brush box terminals and replace the brush box in the slip ring end bracket, and secure with the screws and 2 B.A. bolt.

4. Fit the insulating pieces over the terminals and then fit the washers and terminal nuts.

5. Position the drive end bracket and rotor assembly in the slip ring end bracket. Ensure the two end brackets and lamination pack are correctly aligned, using the marks made whilst dismantling.

NOTE.—If the rotor and drive end bracket have been separated, the inner journal of the drive end bracket bearing must be supported by a tube of suitable diameter whilst the rotor is pressed into position. Then refit the key and bearing collar.

6. Replace the three through bolts and tighten to a torque of 0.52 to 0.58 kg.m. (45 to 50 lb. in.).

7. Refit the fan, pulley, spring washer and shaft nut.

ALTERNATOR CONTROL UNIT

The Transit is fitted with an electronic control unit. In effect its action is similar to that of the vibrating contact type of voltage control, but switching of the field circuit is achieved by transistors instead of vibrating contacts, while a Zener diode provides the voltage reference in place of the voltage coil and tension spring system. No cut-out is required since the diodes incorporated in the alternator prevent reverse currents from flowing. No current regulator is required as the inherent self-regulating properties of the alternator limit the output current to a safe value. A temperature compensation device in the form of a thermistor is fitted.

NOTE.—The battery must never be disconnected whilst the alternator is running. Failure to observe this ruling will cause the control unit to be irreparably damaged.

Care must be taken at all times to ensure that the battery, alternator and control unit are correctly connected. Reversed connections will damage the semi-conductor devices used in the alternator and control unit.

No regular maintenance is required, but the moulded cover can be occasionally wiped clean and a check made that the terminal connector is secure.

Checking and Adjusting

Before checking and adjusting the control unit, ensure that the alternator and the charging circuit wiring are in good order. Check also the battery to control unit wiring. To ensure proper working of the control unit, the resistance of this complete circuit must not exceed 0.1 ohms. Any unduly high resistance must be traced and remedied.

Checking

Leave the existing connections to the alternator and control unit undisturbed. Connect a good quality voltmeter between the battery terminals and note the reading with all electrical equipment switched off. If available use a voltmeter of the suppressed-zero type.

Unless an ammeter is fitted to the vehicle, insert one in series with the alternator main output cable.

Switch on an electrical load of approximately 2 amperes, e.g. side and tail lighting.

Start the engine and run at approximately 1650 rev./min. for at least eight minutes. (This will ensure that the system voltage has stabilized.) If the charging current is still greater than 10 amperes, continue to run the engine until this figure is reached. The voltmeter should now give a reading of 13.9 to 14.3 volts.

If the reading is stable but outside these limits the unit can be adjusted to control at the correct voltage.

If, however, the voltmeter reading remains unchanged (at open-circuit battery terminal voltage) or, conversely, increases in an uncontrolled manner, then the control unit is faulty and a replacement unit must be fitted. Component parts are not serviced individually.

Adjusting

Stop the engine and withdraw the control unit mounting screws. Invert the unit and carefully scrape away the sealing compound which conceals the potentiometer adjuster. Check that the voltmeter is still firmly connected between the battery terminals, and that the control unit is earthed. Start the engine and, while running the engine at 1,650 rev./min., turn the potentiometer adjuster slot—clockwise to increase the setting or anti-clockwise to decrease it—until the required setting is obtained. A small movement of the adjuster makes an appreciable difference to the voltage reading.

Recheck the setting by first stopping the engine then starting again and running at 1650 rev./min.

Stop the engine, reconnect the control unit and remove the voltmeter and ammeter.

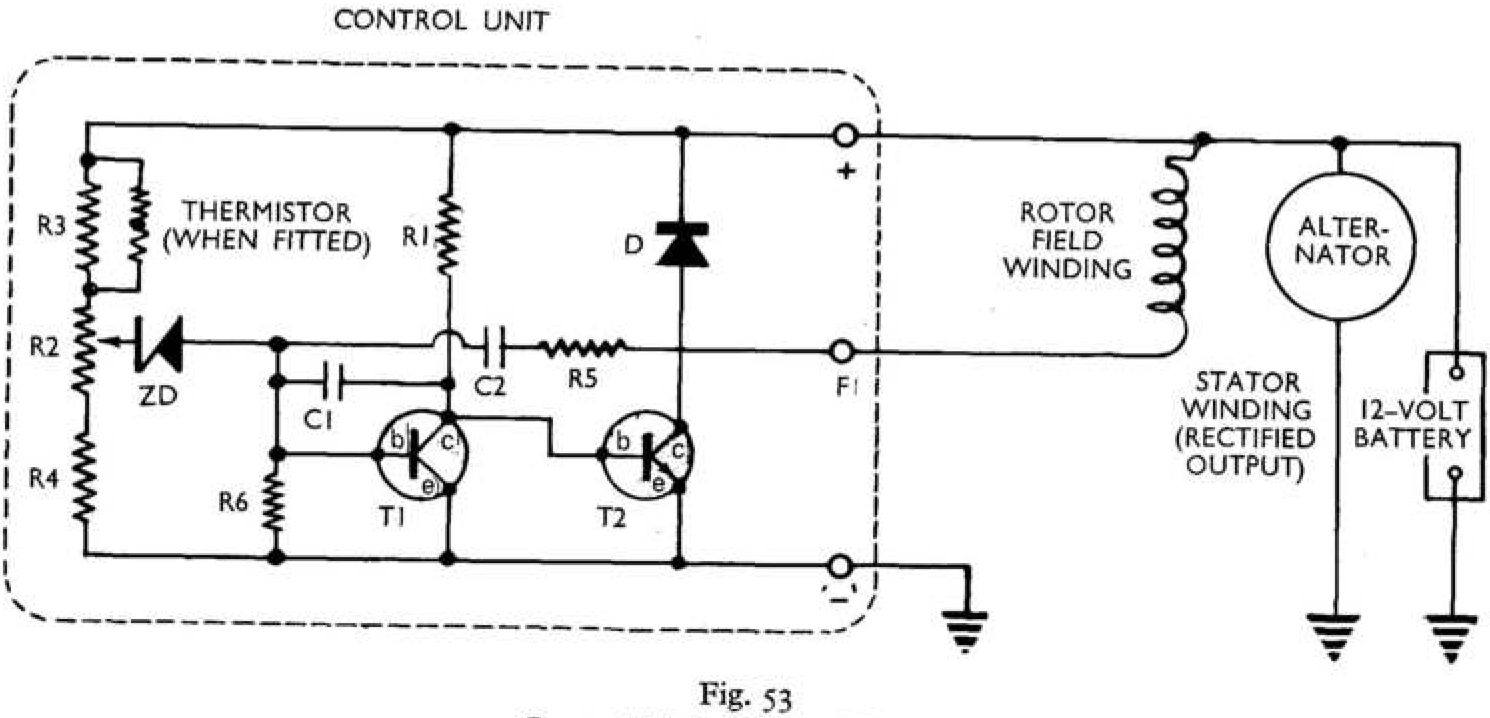


Fig. 53
Control Unit Wiring Diagram

ALTERNATOR WARNING LIGHT CONTROL

Description

The alternator warning light control is a thermally-operated relay for controlling the switching on and off of a facia panel warning light. It is connected, through alternator terminal 'AL', to the centre point of one pair of the six alternator diodes, and to earth. The indication given by the warning light is similar to that provided by the ignition warning light used with generator charging systems. The warning light is illuminated when the alternator is stationary or is being driven very slowly. The light goes out as soon as the alternator voltage begins to rise. If the voltage does not rise for any reason the warning light remains illuminated.

NOTE.—Due to the external similarity of the alternator warning light control unit to the flasher unit, a distinctive green label is applied to the aluminium case of the warning light unit.

Care must be taken to avoid connecting either of these units into a circuit designed for the other.

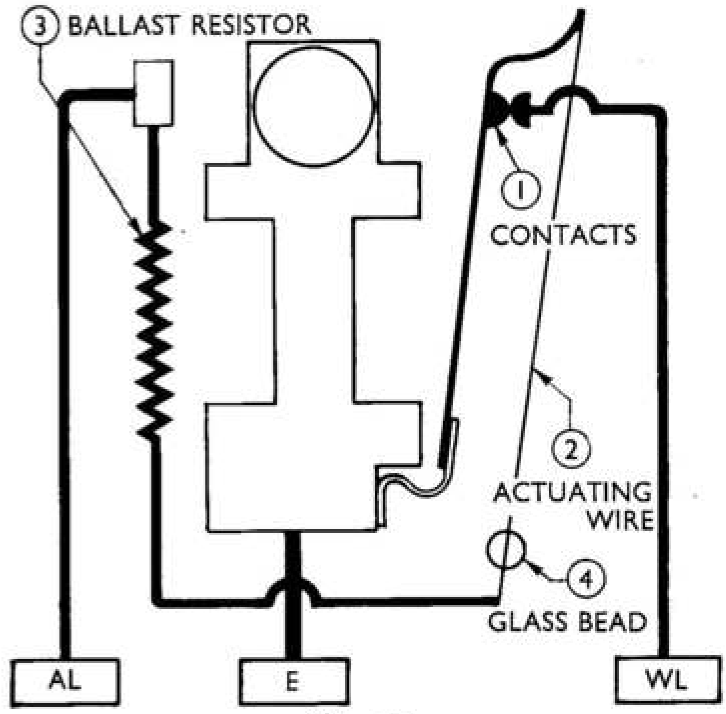


Fig. 54
Theoretical Circuit of Warning Light Control Unit

Operation

The unit consists of a pair of contacts held closed against spring tension by a length of nickel chrome resistance wire. When cold, the wire is in tension: when current flows through the wire, it heats up and lengthens, allowing the contacts to open. The full circuit is shown in Fig. 54.

Servicing

If the warning light unit is shown to be defective by the following tests, it must be replaced:—

NOTE.—A faulty diode in the alternator or an intermittent or open circuit in the alternator-to-battery circuit can cause excessive voltages to be applied to the warning light control. Therefore, to prevent possible damage to the replacement unit, it is important to first measure the voltage between the alternator 'AL' terminal and earth. Run the engine at 1,650 rev./min., when the voltage should be of the order 7 to 7.5 volts, measured on a good quality moving coil voltmeter.

If a higher voltage is indicated, first check all charging circuit connections and then, if necessary, the alternator diodes before fitting a replacement warning light control unit.

11AC ALTERNATOR FAULT DIAGNOSIS

Fault	*Action*
Warning light fails to illuminate when the ignition switch (or equivalent) is turned on	Check the warning light bulb by substitution. Check the warning light control by substitution. Test the continuity of each part of the warning light circuit, i.e. from the alternator to terminal 'AL'; from the ignition switch to terminal 'WL'; and from terminal 'E' to earth.
Warning light fails to go out when the alternator is being driven	Check the warning light control by substitution. Check the continuity of the circuit between the alternator and terminal 'AL' on the warning light control.
Warning light shows intermittent flickering light	Check bulb and circuit connections, and tighten as required. Check warning light control by substitution.

THE LUCAS 15 ACR AND 17 ACR ALTERNATORS

(September 1968 to March 1970)

The Lucas 15 and 17 ACR Alternators are 3 Phase Star Wound Units, giving rated outputs of 28 and 36 amps respectively. A feature of these alternators is the built-in 8 TR voltage regulator which results in a self-contained generating and control unit.

ROUTINE MAINTENANCE

Cleaning

Periodically, clean the outside of the alternator with a petrol-moistened cloth.

Belt Adjustment

Inspect the fan belt regularly, for wear and tension. When the belt is pulled and pushed at a point midway between the alternator and fan pulleys, the total movement should not exceed 13 mm. (½ in.).

Ensure that the alternator pulley is properly aligned with the fan crankshaft and water pump pulleys, otherwise the rotor bearings will be unduly loaded.

Lubrication

The bearings are packed with grease during assembly and do not require attention.

Wiring Connections

Occasionally inspect the connectors to see that they are clean and tight.

Voltage Regulator

This is a sealed unit and does not require any maintenance.

TEST PROCEDURES

Alternator Output Test

(*a*) Check the driving belt for wear and correct tension.

(*b*) Check the connections in the charging circuit.

(*c*) Disconnect the battery earth (—) cable.

(*d*) Remove the two-piece connector from the alternator terminals.

(*e*) Remove the moulded cover, and replace the terminal connectors.

(*f*) Insert a 0–60 scale ammeter in the main (+) cable. (This should be done at the solenoid end of the main cable.)

(*g*) Reconnect the battery earth (—) cable.

(*h*) Using a jumper lead, short together terminals (F) and (—) (Green and Black cables) on the voltage regulator.

(*i*) Switch on all vehicle lighting (headlamps on main beam).

(*j*) Switch on the ignition (auxiliary switch on diesel-engined vehicles) and check that the warning lamp is illuminated. Start the engine and slowly increase speed.

At about 1,500 rev./min. (alternator), the warning light should go out. Increase the engine speed until the alternator is running at 6,000 rev./min. (about half-throttle). If the alternator is satisfactory, the ammeter should indicate the

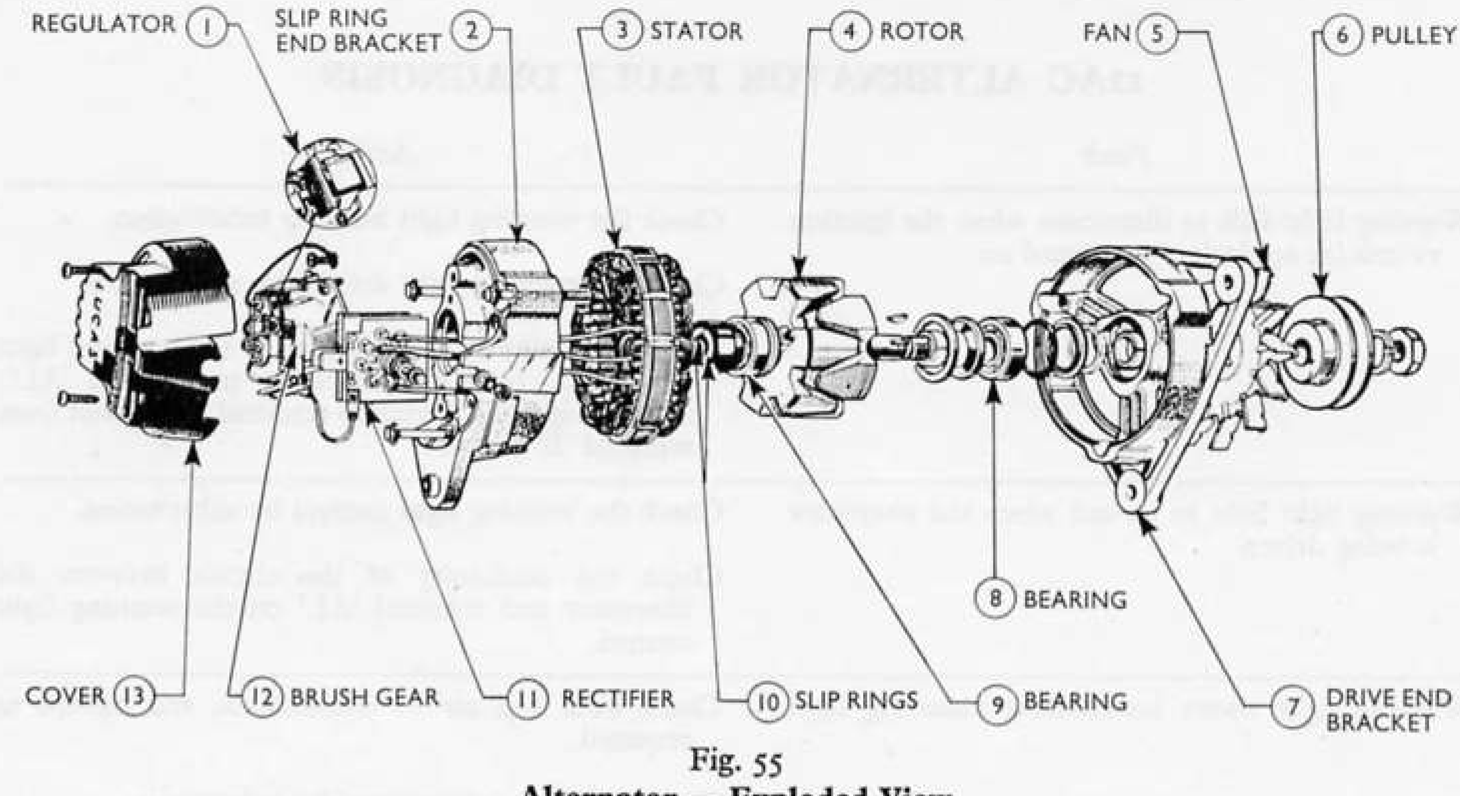


Fig. 55
Alternator — Exploded View

rated output of the machine. 28 Amps (15 ACR) 36 Amps (17 ACR).

NOTE.—The output figures quoted are nominal (hot) values, and may be exceeded if the alternator is tested when cold. To avoid misleading results, the machine should be run for three or four minutes before performing the output test.

If the alternator output is satisfactory, check the voltage regulator setting, see below.

If the alternator output differs appreciably from the specified figure, remove for a detailed bench examination.

The fault-finding chart on page 56 shows how diode failure affects the alternator output. There will also be an increase in the operating temperature and the noise level.

NOTE.—Care should be taken to distinguish between mechanical noises, such as those caused by damaged bearings or loose mounting brackets, and electrical noises caused by short-circuited and open-circuited diodes.

Charging Circuit Voltage Drop Test

A high resistance in the charging circuit (such as a connector which is loose, dirty, or corroded) will affect the alternator output. The following tests should be used to check for a high resistance in the charging circuit. A good quality low-range voltmeter is required, to enable readings to be taken accurately to 0.25 volt. The procedure is as follows:—

(*a*) Connect the voltmeter red lead to the alternator main (+) terminal and the black lead to battery (+) terminal, see Fig. 56.

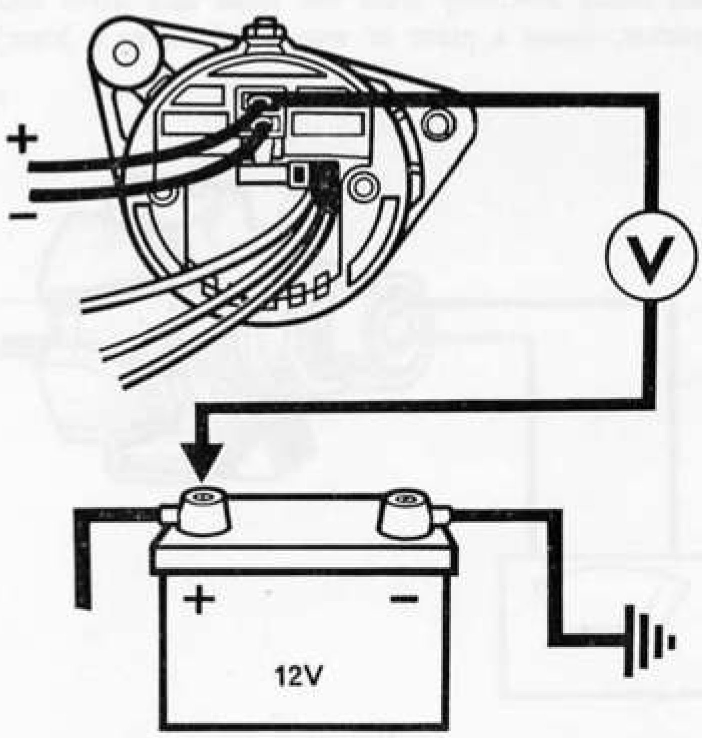


Fig. 56
Charging Circuit Voltage Drop Test (Live Side)

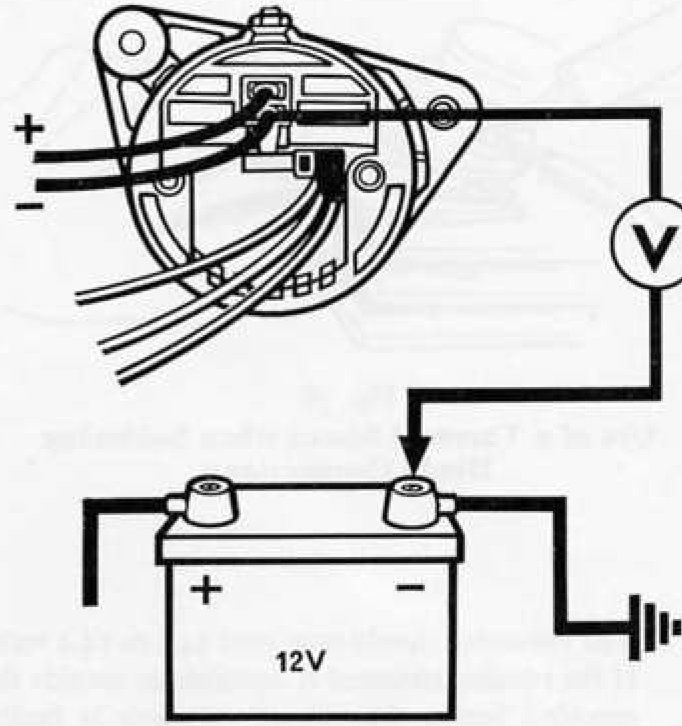


Fig. 57
Charging Circuit Voltage Drop Test (Earth Side)

(*b*) Switch on the headlamps (main beam).

(*c*) Start the engine, and increase the speed until the alternator runs at approximately 6,000 rev./min. Note the voltmeter reading.

(*d*) Transfer the voltmeter connections to the negative (—) terminals of alternator and battery. See Fig. 57 and again note the voltmeter reading. If the reading exceeds 0.5 volt on the positive (live) side, or 0.25 volt on the negative (earth) side, a high resistance in the charging circuit is indicated and this must be traced and rectified.

All cables and connections (including the battery earth cable) should be carefully examined. Rectify any loose, dirty, or corroded connectors.

Checking the Voltage Regulator Setting

Ensure that the wiring and connections in the charging circuit are satisfactory. In particular, the circuit resistance between alternator (—) terminal and battery (—) terminal must not exceed 0.003 ohms. To check the charging circuit the Voltage Drop Test should be performed.

If the battery is discharged, temporarily replace with a similar battery in well-charged state.

(*a*) Connect a good quality voltmeter (a suppressed zero, or extended scale type 12–15 volts) between the main terminals of the battery.

(*b*) Insert an ammeter, scale 0–60 amps, in series with the alternator main output (+) cable at its connection with the starter solenoid.

(*c*) Start the engine and run the alternator at approximately 5,000 rev./min. until the ammeter shows an output current not exceeding 7.5 amps.

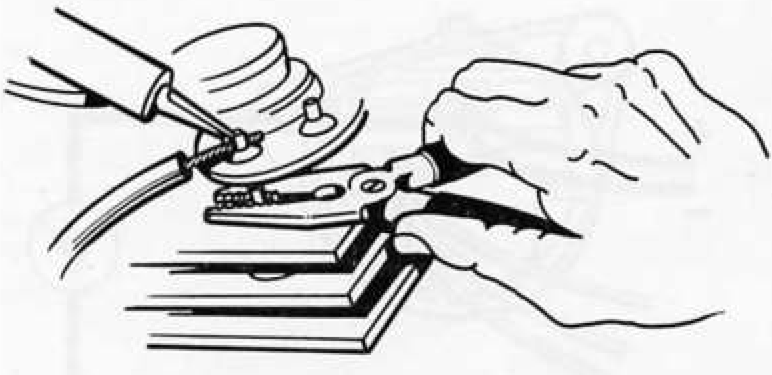


Fig. 58
Use of a Thermal Shunt when Soldering Diode Connections

The voltmeter should now read 14.1 to 14.4 volts. If the reading obtained is unstable or outside the specified limits, the voltage regulator is faulty, and a replacement unit must be fitted. The unit is sealed and is not adjustable.

To Remove

1. Disconnect the battery and remove the wiring from the alternator.

2. Remove the alternator adjusting arm bolt, slacken the alternator mounting bolts and remove the fan belt.

3. Remove the alternator from the vehicle.

To Replace

1. Position the alternator and fit the mounting bolts.

2. Refit the fan belt. Adjust the fan belt tension by moving the alternator. When the tension is correct, refit the adjusting arm bolt and tighten the alternator mounting bolts.

The fan belt tension is correct when the total movement does not exceed 13 mm. (½ in.) when the belt is pushed and pulled at a point midway between the alternator and fan pulleys.

3. Connect the wiring to the alternator and reconnect the battery.

To Dismantle

1. Withdraw the two securing screws and remove the end cover.

2. Disconnect the yellow lead from rectifier terminals.

3. Unscrew the two securing screws for the brush moulding and also the screw which holds the regulator case to the end bracket. Withdraw the brush moulding, complete with the regulator. If required, the regulator can be separated from the brush moulding by removing the top screw which secures the regulator, and also the three screws which secure the regulator yellow, red, and green leads to the brush moulding connectors.

4. Grip the output diode pins in turn with a pair of long-nosed pliers, see Fig. 58. Unsolder the three leads connecting the stator to the diodes. Note the order in which the connections are made.

5. Slacken the rectifier fixing nut sufficiently to allow the assembly to be withdrawn from its moulding.

6. Remove the three alternator through bolts.

7. Separate the slip ring end bracket from the drive end bracket and rotor assembly.

Use of a metal sleeve, having the following dimensions, will assist in this operation.

Length 76.2 mm. (3 ins.)
Outside Diamter 33.52 mm. (1.320 ins.)
Inside Diameter 31.50 mm. (1.240 ins.)

Position the alternator vertically, with the fan underneath. Slide the sleeve over the slip ring moulding, so that it engages with the outer ring of the slip ring end bearing and carefully drive the bearing from its housing.

To get the sleeve to slide smoothly over the slip ring moulding, it may be necessary to file away any surplus solder on the winding terminals.

To simplify separating the slip ring end bracket and stator assembly from the rotor and drive end bracket, insert a piece of wood (to use as a lever)

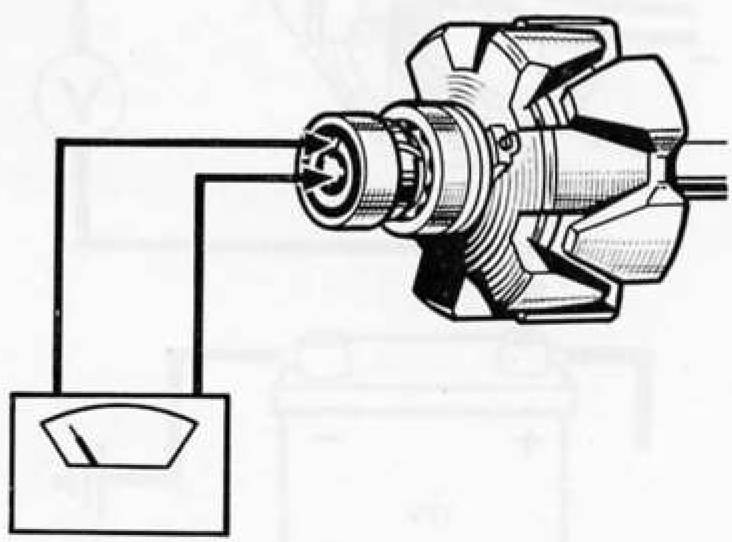


Fig. 59
Measuring Rotor Winding Resistance with an Ohmmeter

between the stator and the drive end bracket. Then, carefully prise the two apart until the clip ring end bearing is clear of its housing.

Inspection of Brush Gear

The length of the brush when new is 12.6 mm. ($\frac{1}{2}$ in.). The serviceability of a brush may be estimated by measuring the amount which protrudes beyond the brushbox moulding when the brush is in the free position. Renew if the brush is worn to less than 5 mm. (0.2 in.). Ensure that the special leaf spring is fitted, when the centre brush is replaced.

Check the brush spring pressures, by means of a push-type spring gauge. The brush should be pushed back against the spring, so that the brush face is flush

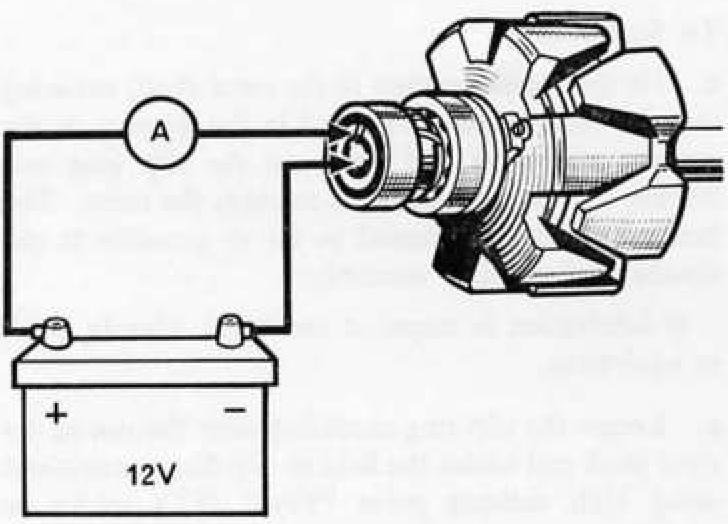


Fig. 60

Measuring Rotor Winding Resistance with a Battery and Ammeter

with the housing. The brush assembly should be replaced, if the reading is appreciably outside the limits 198 to 283 g. (7 to 10 oz.) and the brush is not partially seized. A seized brush should be cleaned with a petrol-moistened cloth or, if necessary, by lightly polishing the brush sides on a smooth file.

Inspection of Slip Rings

The surfaces of the slip ring should be smooth and clean. Remove any contamination with a petrol-moistened cloth. If there is evidence of burning, clean the slip rings with a very fine glass paper. On no account must emery cloth or similar abrasive be used. No attempt must be made to machine (skim) the slip rings, as the high speed performance may be adversely affected.

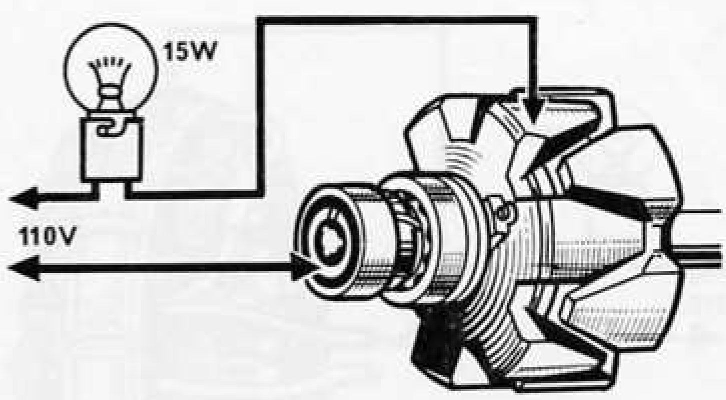


Fig. 61

Rotor Insulation Test

Testing the Rotor

Test the rotor winding by connecting either an Ohmmeter, see Fig. 59, or a 12 volt battery and ammeter, see Fig. 60, between the slip rings. The resistance should be approximately 4.33 ohms (15 ACR), 4.165 (17 ACR) or the value of current approximately 3 amps.

Test for defective insulation between one of the slip rings and the rotor poles, using a 110 volt d.c. mains supply, and a 15 watt test lamp, see Fig. 61. If the lamp lights, the coil is earthed to the rotor core, and a replacement rotor and slip ring assembly must be fitted.

No attempt must be made to machine the rotor poles, or to straighten a distorted shaft.

Stator Tests

Check the continuity of the stator windings by connecting any two of the three stator cables in series with a 12 volt battery and a test lamp of not less than 36 watts, see Fig. 62.

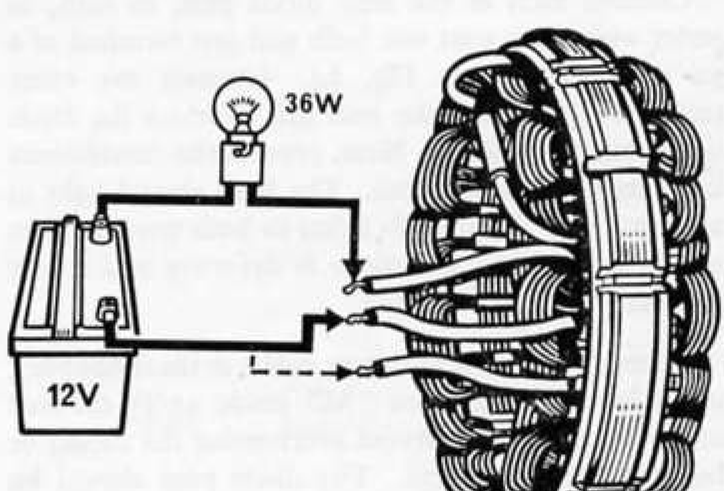


Fig. 62

Stator Winding Continuity Test

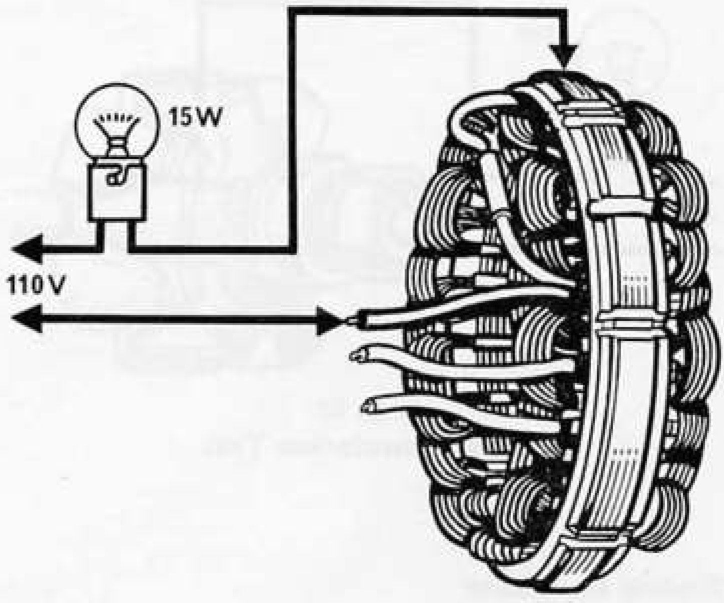


Fig. 63
Stator Winding Insulation Test

Repeat the test, replacing one of the two cables by the third cable. Failure of the test lamp to light on either occasion means that part of the stator winding is open-circuited, and a replacement stator must be fitted.

Test for defective insulation between the stator coils and the lamination pack with the 110 volt d.c. mains supply and a 15 watt test lamp, see Fig. 63. Connect the test probes between any one of the three cable ends and the lamination pack. If the lamp lights, the stator coils are earthing and a replacement stator must be fitted.

Diode Tests

If the alternator output test indicates that one or more of the diodes are faulty, the stator winding connections to the rectifier pack must be unsoldered.

Connect each of the nine diode pins, in turn, in series with a 1.5 watt test bulb and one terminal of a 12 volt battery, see Fig. 64. Connect the other terminal to the particular heat sink to which the diode under test is soldered. Next, reverse the connections to diode pin and heat sink. The bulb should light in one test only. If the bulb lights in both tests, or does not light in either, the diode is defective and a new rectifier pack must be fitted.

When re-soldering the stator cables to the diode pins, use a low melting point "M" grade 45/55 tin-lead solder or equivalent. Avoid overheating the diodes or bending the diode pins. The diode pins should be lightly gripped with a pair of long-nosed pliers, or similar tool (to act as a thermal shunt against overheating) and soldering must be carried out as quickly as possible, see Fig. 58.

Bearings

Bearings which are worn to the extent that they allow excessive side movement of the rotor shaft must be renewed.

If replacement of the drive end bearing is necessary, press the rotor shaft out from the drive end bracket, after having removed the shaft nut, washers, pulley, fan and shaft key.

The drive end bearing assembly can then be withdrawn, after removal of the circlip, see Fig. 55 for details of the bearing assembly.

To remove the slip ring end bearing, first unsolder the field winding connections to the slip ring moulding assembly. The moulding and bearing (and if necessary the grease retainer) may then be withdrawn from the shaft.

To Reassemble

1. Fit the grease retainer to the rotor shaft, ensuring that the rotor leads are located in the grooves in the retainer and shaft and press on the slip ring end bearing with its shielded side towards the rotor. The bearing should be pressed as far as possible in the direction of the field assembly.

If lubrication is required use Shell Alvania 'RA', or equivalent.

2. Locate the slip ring moulding over the slot in the rotor shaft and solder the field to slip ring connections using high melting point "Frys" HT3 solder or equivalent.

3. Locate the seal retainer, seal, bearing and retainer in the drive end bracket and fit the circlip.

4. Fit the spacer and press the rotor shaft into the drive end bracket. Support the inner ring of the

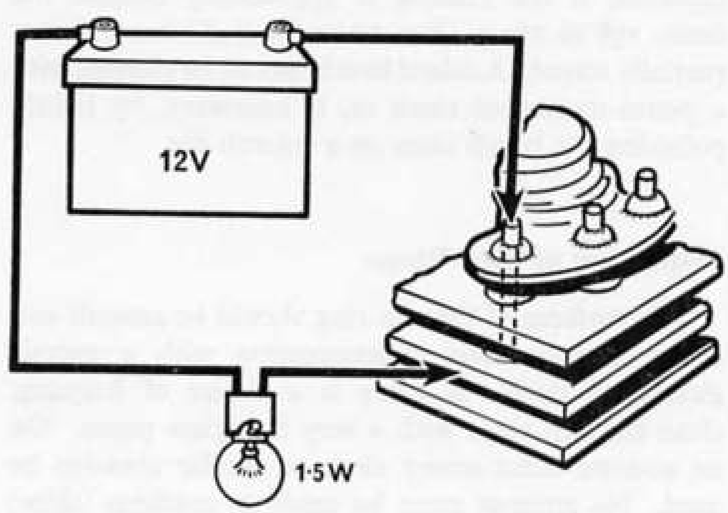


Fig. 64
Diode Test

bearing for this operation and not the drive end bracket.

5. Replace the spacer, key, fan, pulley, washer and nut on the rotor shaft.

6. Locate the stator assembly and the slip ring end bracket on the drive end bracket and rotor assembly and replace the three through bolts, tightening them to a torque of 0.525 to 0.576 kg.m. (45 to 50 lb. in.).

7. Fit the rectifier, locating the step in the rear plate against the slip ring and bracket, and tighten the fixing nut to a torque of 0.420 to 0.460 kg.m. (35 to 40 lb. in.).

8. Resolder the three stator to rectifier leads in the correct order.

9. Position the brushes in their housing, ensuring that the centre brush is fitted with the special leaf spring.

10. Locate the regulator on the brush moulding, fit the regulator top securing screw and secure the yellow, red, and green leads to the brush moulding connectors.

11. Replace the brush moulding and regulator assembly, fit the regulator bottom fixing screw securing the black regulator lead, and fit the two brush moulding screws.

12. Connect the yellow lead to the rectifier.

13. Locate the plastic moulded cover and fit the two securing screws.

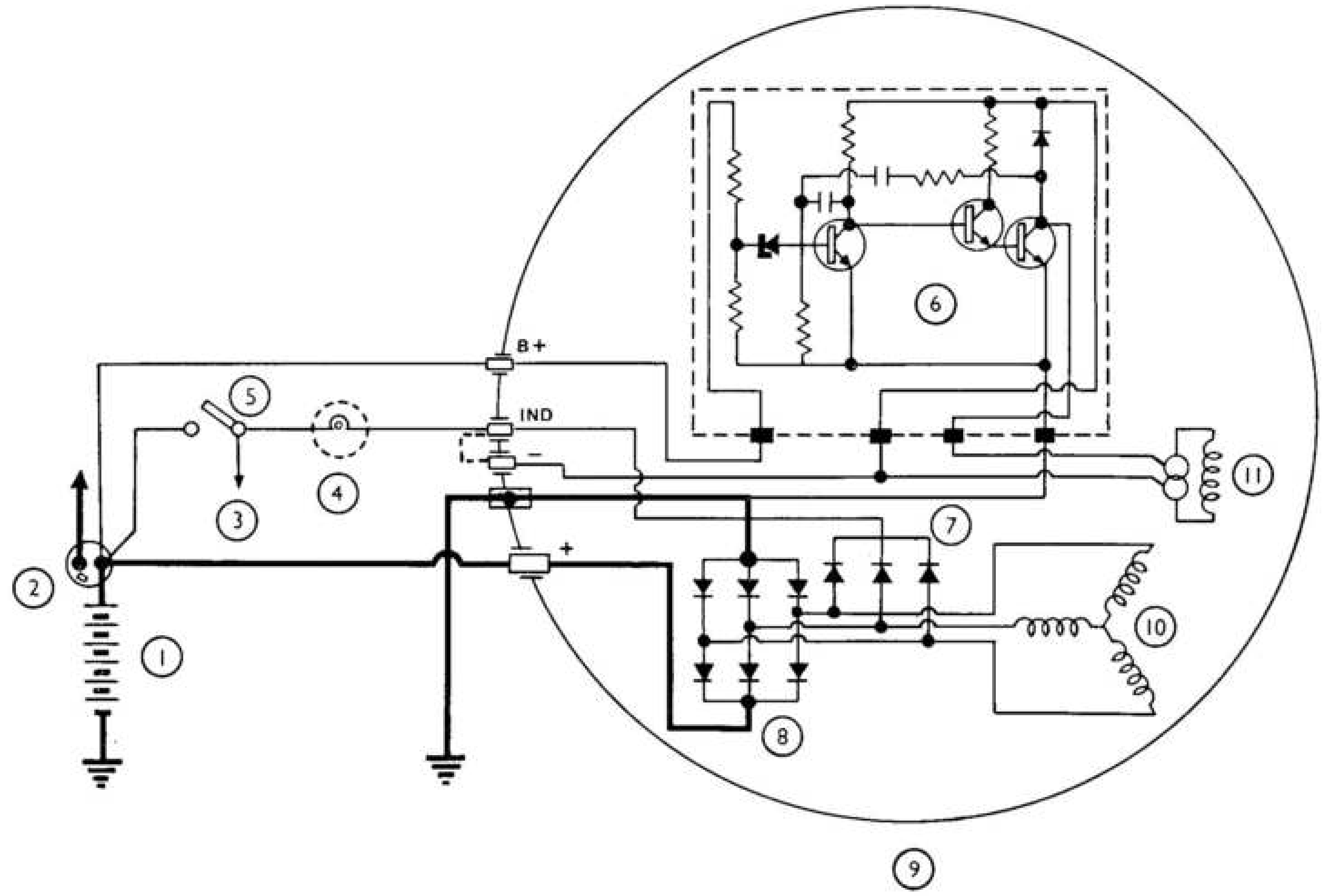


Fig. 65
Charging Circuit

1. Battery
2. Solenoid
3. Ignition loads
4. Charge indicator circuit
5. Ignition switch
6. Regulator
7. Field diodes
8. Output diodes
9. Alternator
10. Stator output windings
11. Fields

15 ACR AND 17 ACR ALTERNATOR FAULT DIAGNOSIS

SYMPTOMS				PROBABLE FAULT
	ALTERNATORS			
WARNING LIGHT	TEMPERATURE	NOISE	OUTPUT	
Normal at standstill. Goes out at cut-in speed. Glows brighter as speed increases.	High	Normal	At 6,000 rev./min. 17 ACR–38 amps. approx. 15 ACR–35 amps. approx.	Output diode open-circuited on supply side.
Light out under all conditions.	High	Excessive	At 6,000 rev./min. 10 amps. approx.	Output diode short-circuited on supply side.
Normal at standstill. Dims at cut-in speed. Gets dimmer or may even be extinguished at higher speeds.	Normal	Excessive	Poor performance at *low speed.* At 6,000 rev./min. 17 ACR–30 amps. approx. 15 ACR–26 amps. approx.	Output diode open-circuited on earth side.
Normal at standstill. Dims at cut-in. Remains dim, or may be extinguished at higher speeds.	Normal	Excessive	Very low at all speeds above cut-in speed. 7 amps. approx.	Output diode short-circuited on each side.
Normal at standstill. Dims at cut-in. Remains dim, or may be extinguished at higher speeds.	Normal	Normal	At 6,000 rev./min. 17 ACR–29 amps. approx. 15 ACR–23 amps. approx.	'Field' diode open-circuited.
Normal at standstill. Dims at cut-in. Remains dim, or may be extinguished at higher speeds.	Normal	Excessive	At 6,000 rev./min. 7 amps. approx.	'Field' diode short-circuited.

THE LUCAS 17 ACR ALTERNATOR

(March 1970 onwards)

A new type of 17-ACR alternator is utilised on all current models of the Transit range. It is a three-phase star wound unit having a built-in 11 TR regulator, which results in a self-contained generating and control unit. The rated output is 36 amps.

Improvements to the internal wiring of the unit have resulted in the elimination of the 'battery sensing' wire (B+) and the separate earth wire (—), used on previous 17-ACR units. The alternator now earths through the casing.

A one-piece connector now connects the remaining two wires to the rear of the alternator (Figs. 67 and 68), these being from the warning light and the starter solenoid.

A relay is now incorporated in the starter switch to solenoid circuit to ensure full voltage reaches the solenoid.

GENERAL PRECAUTIONS

(*a*) NEVER disconnect battery cables from the battery, charging or control circuit, while the engine is running.

(*b*) NEVER "flash" any charging or control cables to earth.

(*c*) NEVER use a high voltage resistance tester ("Megger") for testing alternator circuits.

(*d*) ALWAYS connect a slave battery in parallel, i.e. positive to positive, negative to negative.

(*e*) ALWAYS disconnect the battery earth lead before carrying out any work on the alternator. Note the alternator output lead is live.

(*f*) ALWAYS disconnect the battery leads before connecting a battery charger.

(*g*) ALWAYS disconnect the battery and alternator leads before arc welding on any part of the vehicle.

(*h*) NEVER run an alternator with an open circuit with the rotor fields energised.

(*i*) NEVER use high voltages to test diodes (use 12 volts maximum).

(*j*) NEVER use a lever on the stator or rear housing when adjusting the fan belt.

(*k*) NOTE the polarity of connections to battery, alternator and voltage regulator. Incorrect connections may result in irreparable damage to semi-conductor devices.

ROUTINE MAINTENANCE

(i) **Cleaning**

Periodically, clean the outside of the alternator with paraffin or white spirit moistened cloth.

(ii) **Driving (Fan) Belt**

Occasionally, check that the drive belt is correctly tensioned 12.7 mm. (0.5 in.) total free movement).

If the belt is worn or oily, it should be replaced.

(iii) **Lubrication**

Unnecessary.

(iv) **Cable Terminations**

Occasionally inspect connectors to see that they are clean and tight.

(v) **Voltage Regulator**

Does not require any maintenance.

TESTING THE CHARGING SYSTEM

Alternator Output Test

(i) Check the drive belt for correct tension (12.7 mm. (0.5 in.) total free movement).

(ii) Check all the wiring connections in the charging circuit.

(iii) Remove the connector from the rear of the alternator and switch on the ignition.

Connect a voltmeter between each cable end, in turn, and earth. With the ignition on the voltmeter should read battery voltage. If the reading is incorrect the fault in the wiring must be located and rectified.

(iv) Disconnect the battery earth cable (–) and remove the moulded cover from the rear of the alternator. Refit the cable connector to the alternator.

(v) Insert a 0–60 scale ammeter in the main (+) cable.

(vi) Reconnect the battery earth (–) cable.

Using a "jumper" lead, short together terminals (F) and (–), (Green and Black cables), on the voltage regulator.

(vii) Switch "on" all vehicle lighting (headlamps on main beam).

(viii) Switch "on" the auxiliary switch (ignition) and check that the warning lamp is illuminated.

Start the engine and slowly increase speed.

At about 1,500 rev./min. (alternator) the warning light should go out, increase the engine speed until the alternator is running at 6,000 rev./min. (about half-throttle). If the alternator is satisfactory, the ammeter should indicate the rated output of the machine (36 amp.).

If the alternator output differs appreciably from the specified figure, remove the alternator for a detailed bench examination.

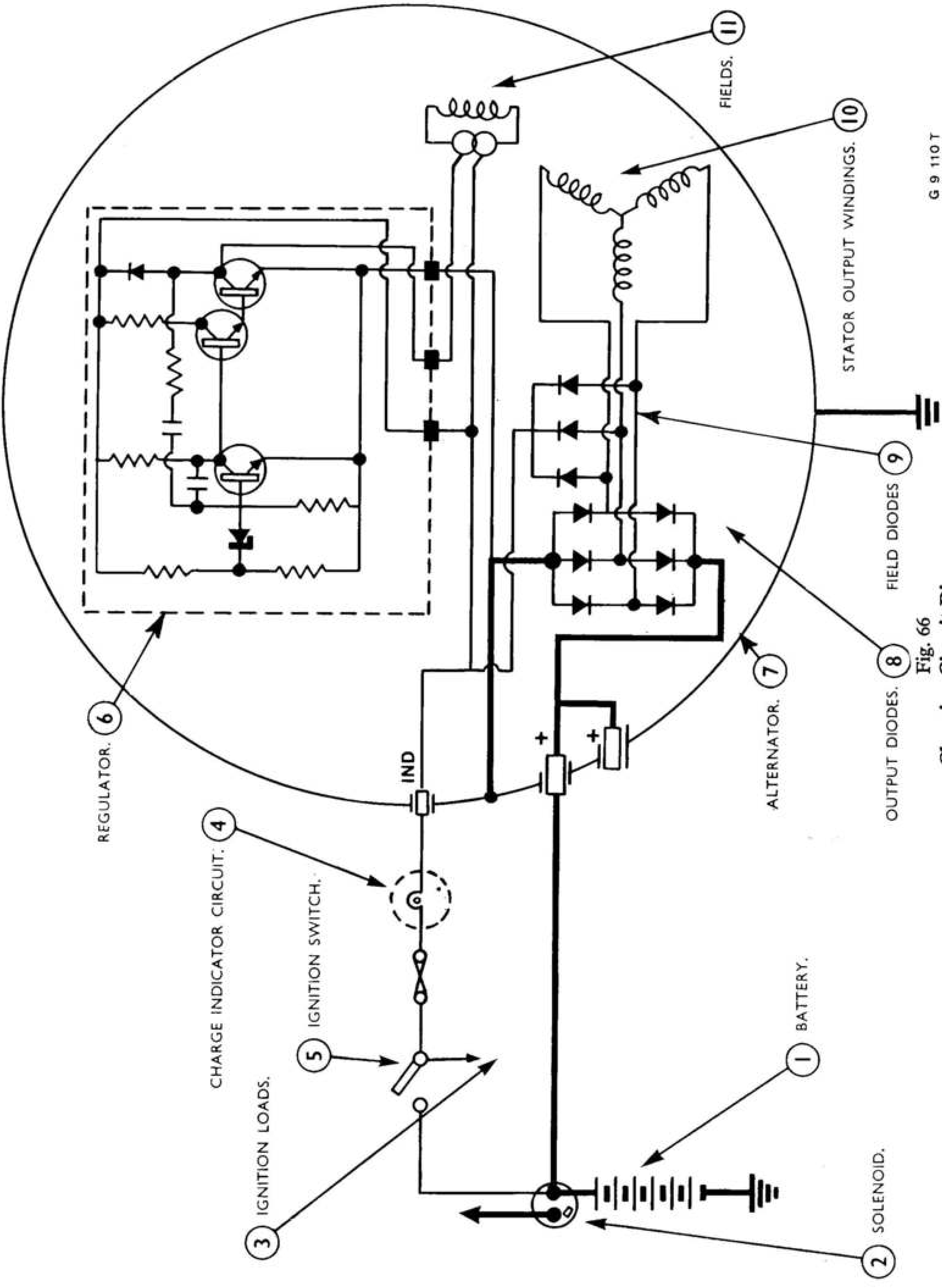


Fig. 66
Charging Circuit Diagram

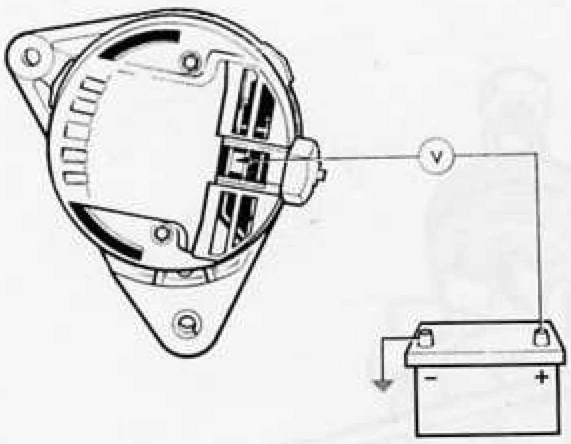


Fig. 67
Volts Drop Test (Live Side)

If the alternator output is satisfactory, check the voltage regulator setting.

NOTE.—The output figures quoted are nominal (hot) values, and may be exceeded if the alternator is tested when cold. To avoid misleading results, the machine should be run for three or four minutes before performing the output test. The diode fault finding chart (see Page 64) shows how diode failure affects the alternator output. There will also be an increase in the operating temperature and the noise level. Care should be taken to distinguish between mechanical noises caused by damaged bearings, loose mounting brackets, etc. and electrical noises caused by short-circuited and open-circuited diodes.

Charging Circuit Volts Drop Test

A high resistance in the charging circuit, such as a connector which is loose, dirty, or corroded, will affect the alternator output. The following tests should be used to check for a high resistance in the charging circuit. A good quality low-range voltmeter is required, to enable readings to be taken accurately to 0.25 volt. The procedure is as follows:

(i) Connect the voltmeter red lead to the alternator main (+) terminal, black lead to battery (+) terminal (see Fig. 67).

(ii) Switch "on" the headlamps (main beam).

(iii) Start the engine, and increase the speed until the alternator runs at approximately 6,000 rev./min. Note the voltmeter reading.

(iv) Transfer the voltmeter connections to the alternator casing (earth) and the negative terminal of the battery (see Fig. 68). Repeat (iii) and again note the voltmeter reading. If the reading exceeds 0.5 volt on the positive (live) side, or 0.25 volt on the negative (earth) side, a high resistance in the charging circuit is indicated.

This must be traced and rectified.

All cables and connections (including the battery earth cable) should be carefully examined. Rectify any loose, dirty, or corroded connectors.

Voltage Regulator Test

Ensure that the wiring and connections in the charging circuit are satisfactory. In particular, the circuit resistance between alternator casing (earth) and battery (–) terminal must not exceed 0.003 ohm. To check the charging circuit the Voltage Drop Test should be carried out.

If the battery is discharged, temporarily replace with a similar battery in a well charged state.

Then proceed as follows:

(i) Connect a good quality voltmeter (a suppressed zero, or extended scale type 12–15 volts) between the main terminals of the battery.

(ii) Insert an ammeter, scale 0–60 amp. in series with the alternator main output (+) cable at its connection with the starter solenoid.

(iii) Start the engine and run the alternator at approximately 5,000 rev./min. until the ammeter shows an output current not exceeding 7.5 amp. The voltmeter should now read 14.1 to 14.4 volts.

If the readings obtained are unstable or outside the specified limits, the voltage regulator is faulty, and a replacement unit must be fitted. The unit is not adjustable and its component parts cannot be serviced individually.

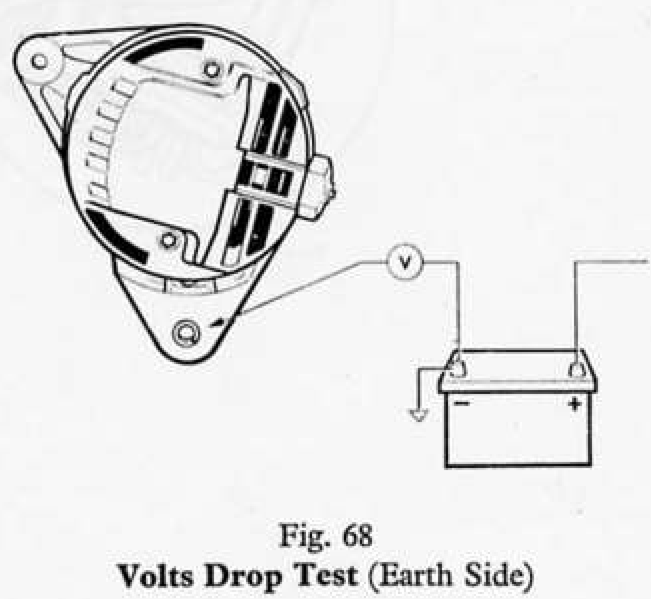


Fig. 68
Volts Drop Test (Earth Side)

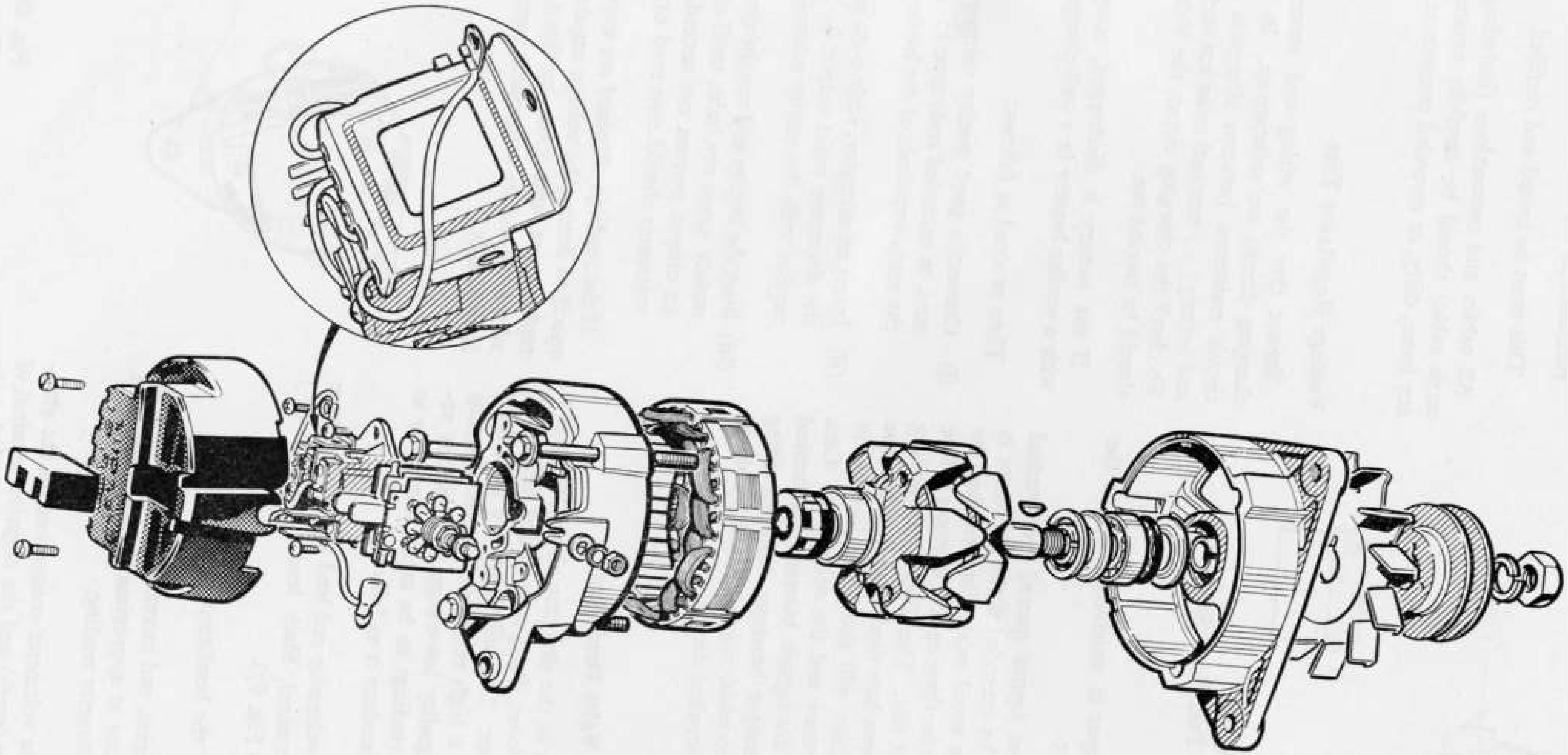


Fig. 69
Alternator — Exploded

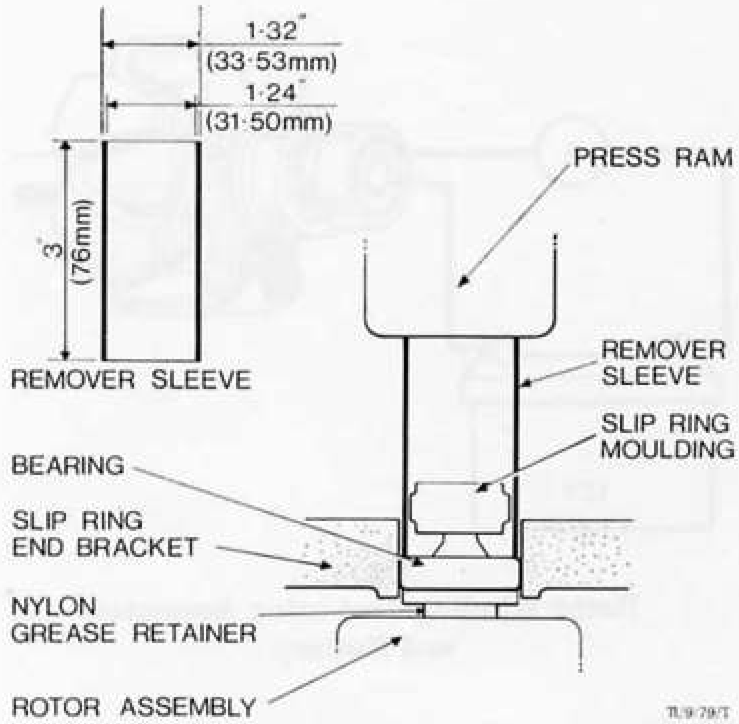


Fig. 70
Remover Sleeve

To Remove the Alternator

1. Disconnect the battery earth wire (–).

2. Disconnect the cable connector from the rear of the alternator.

3. Remove the alternator adjusting arm bolt, slacken the alternator mounting bolts and remove the driving (fan) belt.

4. Remove the mounting bolts and remove the alternator from the vehicle.

To Dismantle

1. Withdraw the two securing screws and remove the alternator end cover.

2. Disconnect the yellow lead from the rectifier terminals.

3. Unscrew the two securing screws for the brush moulding and also the screw which holds the regulator case to the end bracket. Withdraw the brush moulding complete with the regulator. If required, the regulator can be separated from the brush moulding by removing the screws which secure the regulator (top). Also the three screws, which secure the regulator yellow, red and green leads to the brush moulding connectors.

4. Grip the output diode pins in turn with a pair of long-nosed pliers (see Fig. 71). Unsolder the three leads connecting the stator to the diodes. Note the order in which the connections are made (see Diode Tests for re-soldering procedure).

5. Slacken the rectifier fixing nut sufficiently to allow the assembly to be withdrawn from its moulding.

6. Mark end brackets and stator for reassembly. Remove the three through bolts securing the end casings together.

7. Support the slip ring end bracket and press out the rear bearing complete with rotor.

NOTE.—To avoid damaging the slip ring moulding or the end bracket a sleeve with the following dimensions should be used (see Fig. 70).

Length	76.00 mm. (3.00 in.).
Outside Diameter	33.52 mm. (1.32 in.).
Inside Diameter	31.50 mm. (1.24 in.).

Position the sleeve over the slip ring moulding so that it contacts the outer track of the slip ring end bearing. To allow the sleeve to pass freely over the slip ring it may be necessary to file away any surplus solder on the slip ring terminals. Remove the "O" ring.

8. Carefully separate the stator assembly from the end bracket.

9. Remove the nut, washers, pulley, fan and key from the drive end of the rotor.

10. Support the drive bracket and press out the rotor and drive end bearing. Do not lose the spacers located either side of the bearing.

TEST AND INSPECTION

Brush Gear

The length of the brush when new is 12.6 mm. (½ in.). The serviceability of a brush may be estimated by measuring the amount which protrudes beyond the brush-box moulding when the brush is in the free position. Renew if the brush protrusion is less than 5 mm. (0.2 in.). Remove the screws in the rear of the moulding and withdraw the brushes. Ensure that the special leaf spring is fitted, when the centre brush is replaced.

Check the brush spring pressures, by means of a push-type spring gauge. The brush should be pushed back against the spring, so that the brush face is flush with the housing. The brush assembly should be replaced if the reading is appreciably outside the limits 198 to 283 g. (7 to 10 oz.) and the brush is not "partially seized".

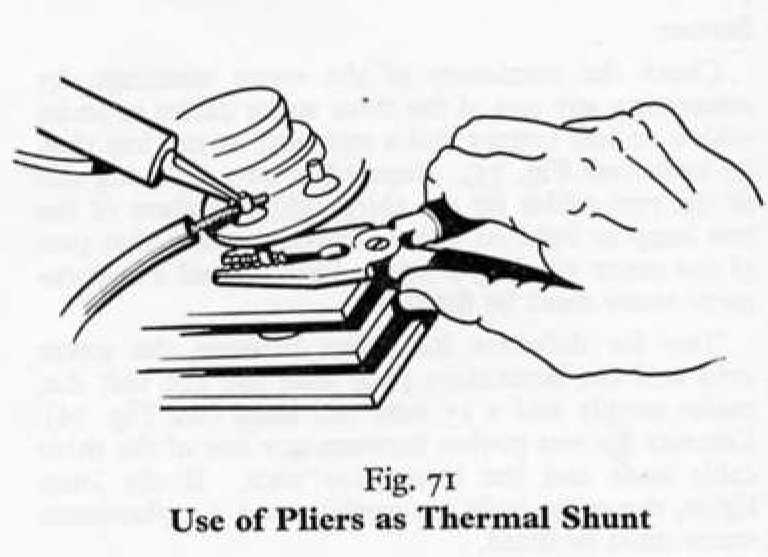


Fig. 71
Use of Pliers as Thermal Shunt

A "seized" brush should be cleaned with a petrol-moistened cloth or, if necessary, by lightly polishing the brush sides on a smooth file.

Slip Rings

The surfaces of the slip ring should be smooth and clean. Remove any contamination with a petrol-moistened cloth. If there is evidence of burning, clean the slip rings with a very fine glass paper. Do not use emery cloth or similar abrasive. No attempt must be made to machine (skim) the slip rings, as the high speed performance may be adversely affected.

Rotor

Test the rotor winding by connecting either an ohmmeter (see Fig. 72) or a 12 volt battery and ammeter (see Fig. 73) between the slip rings. The resistance should be approximately 4.165 ohms or the value of current approximately 3 amp. Test for defective insulation between one of the slip rings and the rotor poles using a 110 volt d.c. mains supply and a 15 watt test lamp (see Fig. 74). If the lamp lights, the coil is earthed to the rotor core, and a replacement rotor/slip ring assembly must be fitted.

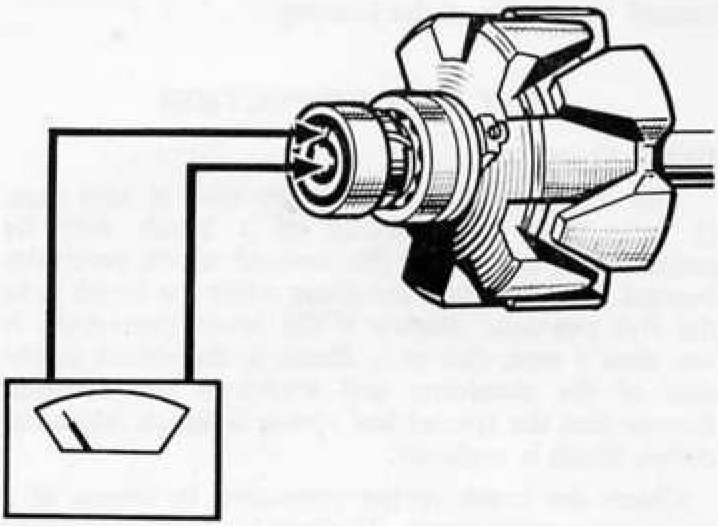


Fig. 72
Rotor Winding Test using Ohmmeter

No attempt must be made to machine the rotor poles, or to straighten a distorted shaft.

Stator

Check the continuity of the stator windings, by connecting any two of the three stator cables in series with a 12 volt battery and a test lamp of not less than 36 watts (see Fig. 75). Repeat the test, replacing one of the two cables by the third cable. Failure of the test lamp to light on either occasion means that part of the stator winding is open-circuited and a replacement stator must be fitted.

Test for defective insulation between the stotor coils and the lamination pack with the 110 volt d.c. mains supply and a 15 watt test lamp (see Fig. 76). Connect the test probes between any one of the three cable ends and the lamination pack. If the lamp lights, the stator coils are earthing and a replacement stator must be fitted.

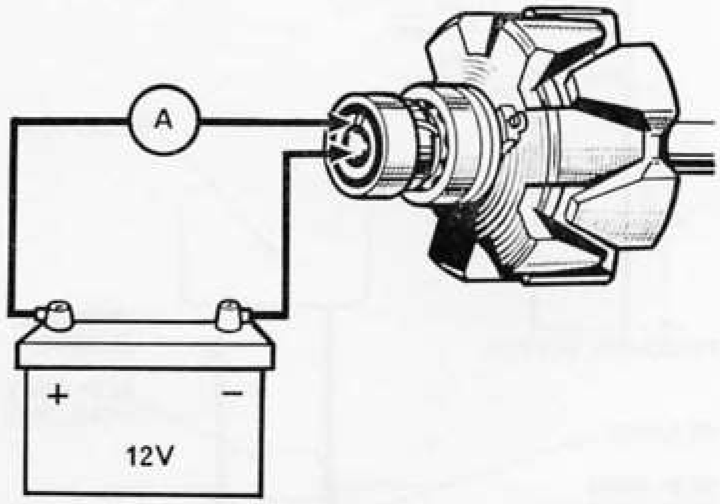


Fig. 73
Rotor Winding Test using Ammeter and Battery

Diodes

Do not attempt to dismantle the rectifier pack.

Connect each of the nine diode pins, in turn, in series with a 1.5 watt test bulb and one terminal of a 12 volt battery (see Fig. 77). Connect the other terminal to the particular heat sink to which the diode under test is soldered. Next, reverse the connections to diode pin and heat sink. The bulb should light in one test only. If the bulb lights in both tests, or does not light in either, the diode is defective and a new rectifier pack must be fitted.

Drive End Bearing

The drive end bearing, grease retainers, "O" ring and the felt seal can be pressed from the end bracket after removal of the circlip. To reassemble, place the felt seal in the bracket followed by a grease retainer, (centre "dish" away from bearing) and the "O" ring. Press in the bearing, position the remaining grease retainer on the bearing (centre dish away from bearing) and insert the circlip.

Slip Ring End Bracket

Unsolder the field windings from the slip ring moulding assembly and withdraw the moulding from the shaft. Press the bearing from the shaft noting that the shielded side faces the slip ring moulding.

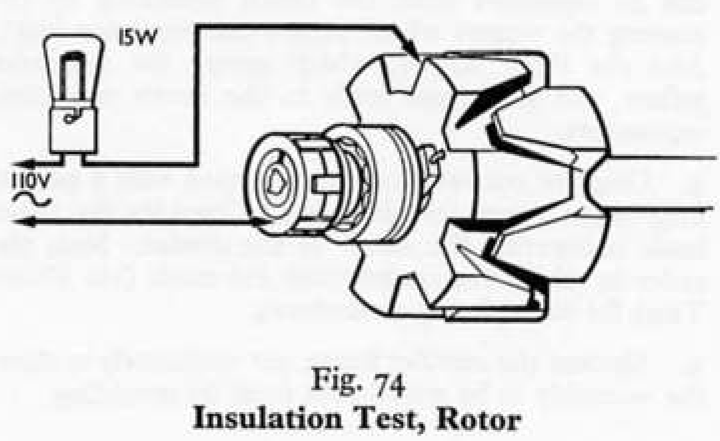


Fig. 74
Insulation Test, Rotor

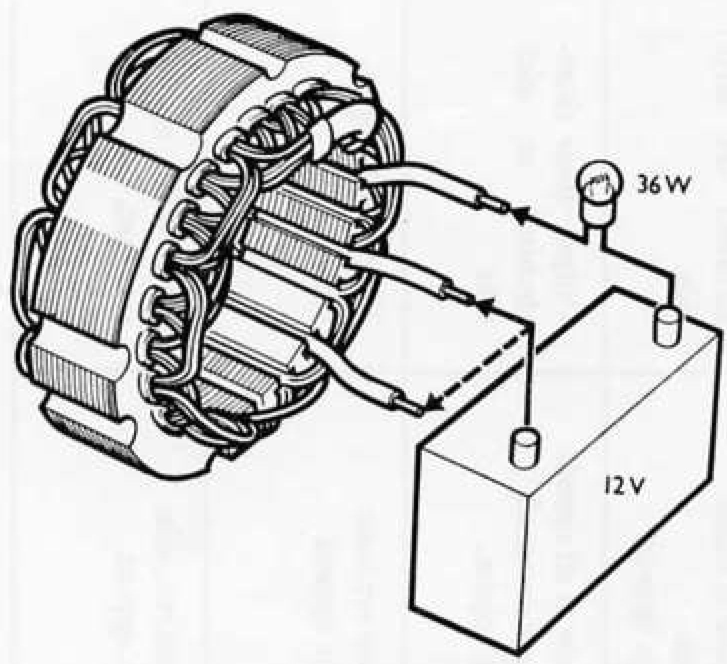


Fig. 75
Stator Winding Continuity Test

Fit the new bearing, and re-engage the slip ring moulding with the slot in the rotor shaft. Finally, remake the field to slip ring connections using a high melting point solder. "Frys" HT3 solder or equivalent.

NOTE.—The correct lubricant for the alternator bearings is Shell "Alvania R.A." or equivalent.

To Reassemble

1. Locate the spacer on the rotor shaft.

Press the rotor shaft into the drive end bearing. Fit the spacer, key, fan, pulley, washers and nut. Tighten the nut to a torque of 8.3 to 11.1 kg.m. (60 to 80 lb. ft.).

2. Fit a new "O" ring to the slip ring and bracket.

Position the stator assembly on the drive end bracket, carefully press the slip ring end bracket over the slip ring end bearing, fit the through bolts and tighten them evenly to a torque of 0.525 to 0.576 kg.m. (45 to 50 lb. in.).

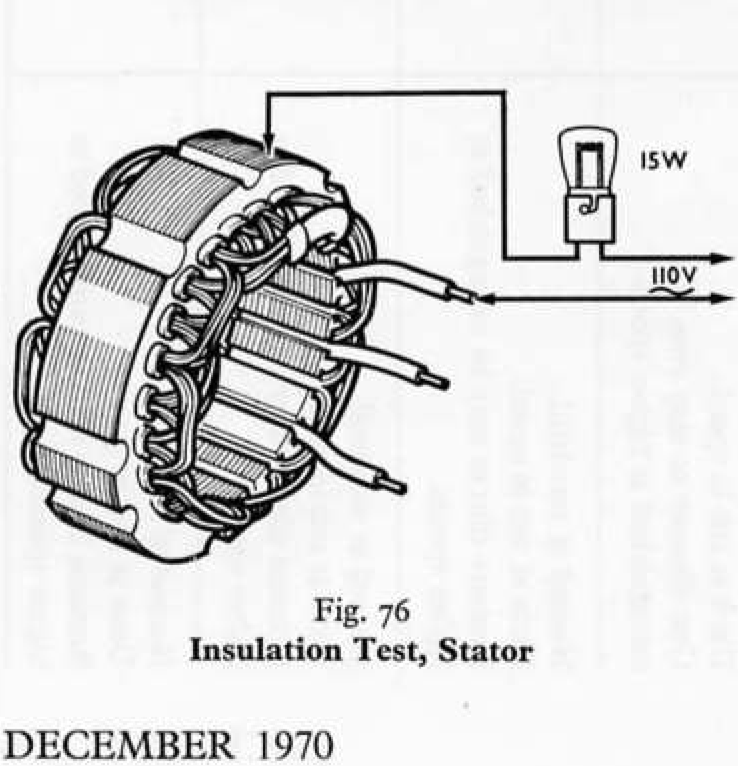


Fig. 76
Insulation Test, Stator

3. Fit the rectifier pack and tighten the nut to 0.42 to 0.46 kg.m. (35 to 40 lb. in.) torque.

When re-soldering the stator cables to the diode pins, use a low melting point solder, "M" grade 45/55 tin-lead solder, or equivalent. Avoid overheating the diodes or bending the diode pins. The diode pins should be lightly gripped with a pair of long-nosed pliers, or similar tool (to act as a thermal shunt against overheating see Fig. 71) and soldering must be carried out as quickly as possible.

4. Fit the regulator to the brush housing and reconnect the wires.

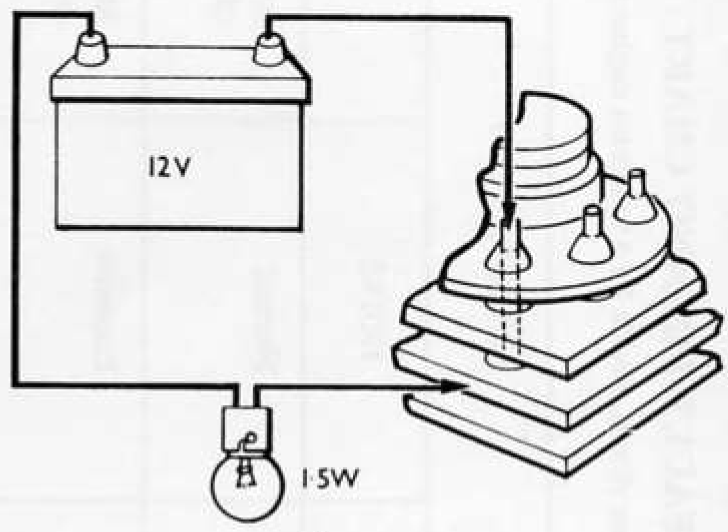


Fig. 77
Diode/Rectifier Pack Test

5. Check the brushes are correctly positioned in their housing (ensure the centre brush is fitted with the special leaf spring) and fit the brush housing to the alternator. Tighten the two screws securely.

6. Connect the yellow lead to the rectifier terminal.

7. Fit the end cover and securing screws.

To Refit

1. Position the alternator on the engine and fit the mounting bolts.

2. Fit the fan and adjust to give 12.7 mm. (0.5 in.) total movement when the belt is pulled and pushed at a point midway between the alternator and water pump pulleys. Tighten the mounting bolts securely.

3. Connect the wiring to the alternator and reconnect the battery.

DIODE FAULT FINDING CHART

(Alternator rev./min. are shown, divide by 2 to obtain engine rev./min.)

SYMPTOMS:

WARNING LIGHT	ALTERNATORS			PROBABLE FAULT
	TEMPERATURE	NOISE	OUTPUT	
Normal at standstill. Goes out at cut-in speed. Glows brighter as speed increases.	High	Normal	At 6,000 rev./min. 38 amp. approx.	Output diode open-circuited on supply side.
Light out under all conditions.	High	Excessive	At 6,000 rev./min. 10 amp. approx.	Output diode short-circuited on supply side.
Normal at standstill. Dims at cut-in speed. Gets dimmer or may even be extinguished at higher speeds.	Normal	Excessive	Poor performance at *Low speed* at 6,000 rev./min. 30 amp. approx.	Output diode open-circuited on earth side.
Normal at standstill. Dims at cut-in speed. Remains dim or may be extinguished at higher speeds.	Normal	Excessive	Very low at all speeds above cut-in speed 7 amp. approx.	Output diode short-circuited on each side.
Normal at standstill. Dims at cut-in speed. Remains dim or may be extinguished at higher speeds.	Normal	Normal	At 6,000 rev./min. 29 amp. approx.	Field diode open-circuited.
Normal at standstill. Dims at cut-in speed. Remains dim or may be extinguished at higher speeds.	Normal	Excessive	At 6,000 rev./min. 7 amp. approx.	Field diode short-circuited.

WIRING DIAGRAMS

(Prior to September 1968)

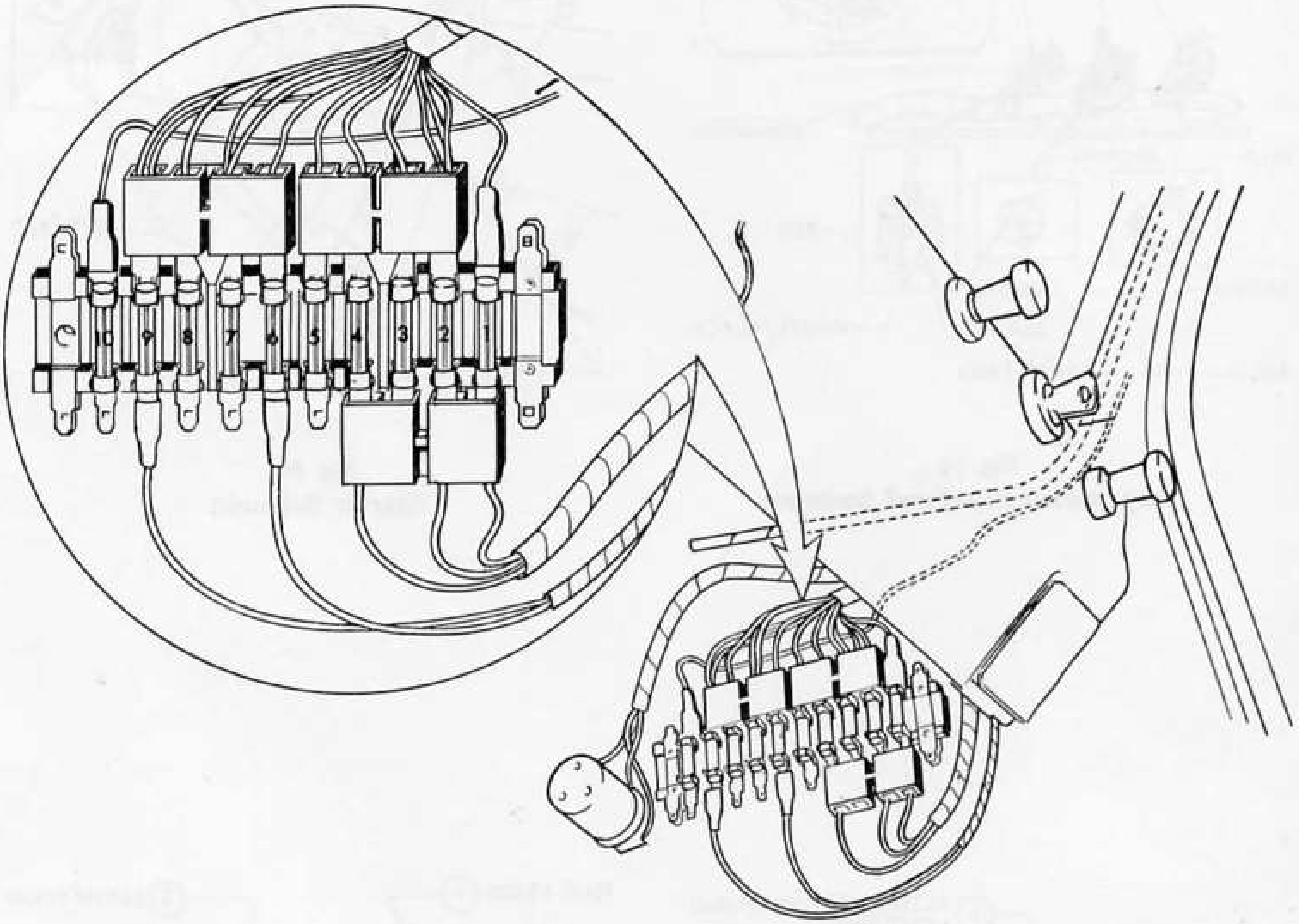


Fig. 78
FUSE BLOCK

Fuse No. 1 10 amp Interior Light

Fuse No. 2 10 amp Instrument Panel Lights, R. H. Side Lights

Fuse No. 3 10 amp L. H. Side Lights

Fuse No. 4 10 amp R. H. Main Beam, Main Beam Warning Light.

Fuse No. 5 10 amp L. H. Main Beam.

Fuse No. 6 10 amp R. H. Dipped Beam.

Fuse No. 7 10 amp L. H. Dipped Beam

Fuse No. 8 10 amp Instrument Panel, Direction Indicator Unit

Fuse No. 9 20 amp Horn, Headlight Flasher Stoplight Switch.

Fuse No. 10 20 amp Alternator Relay, Windscreen Wiper.

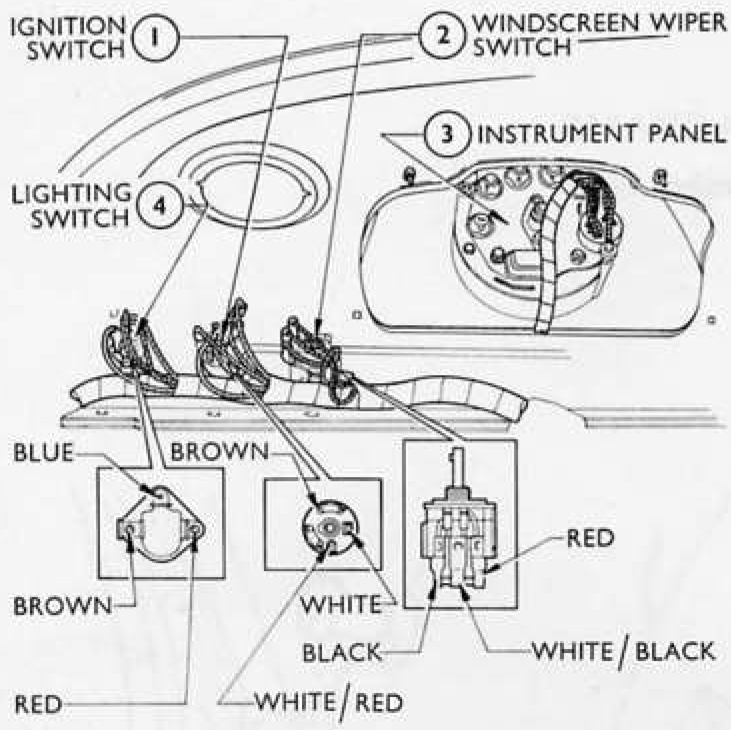


Fig. 79
Instrument Panel and Switches

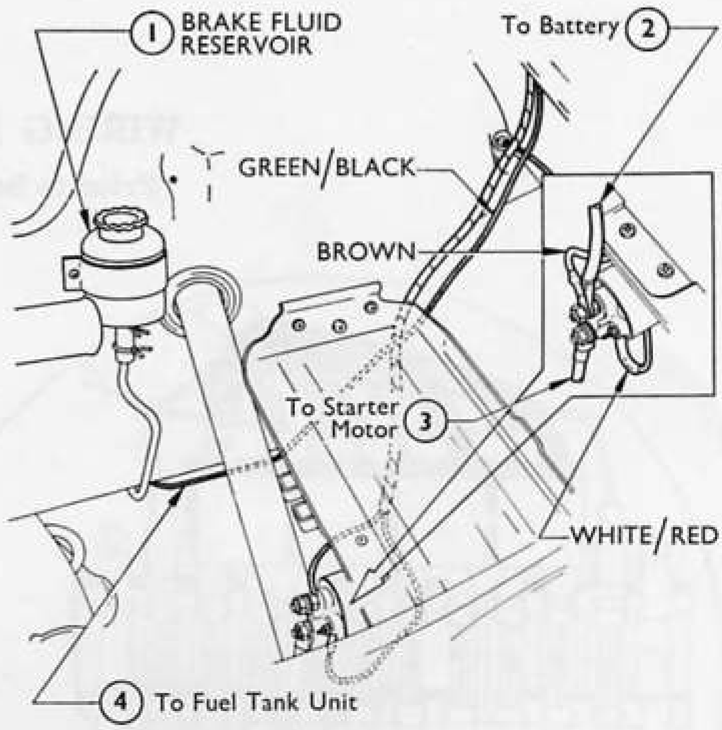


Fig. 80
Starter Solenoid

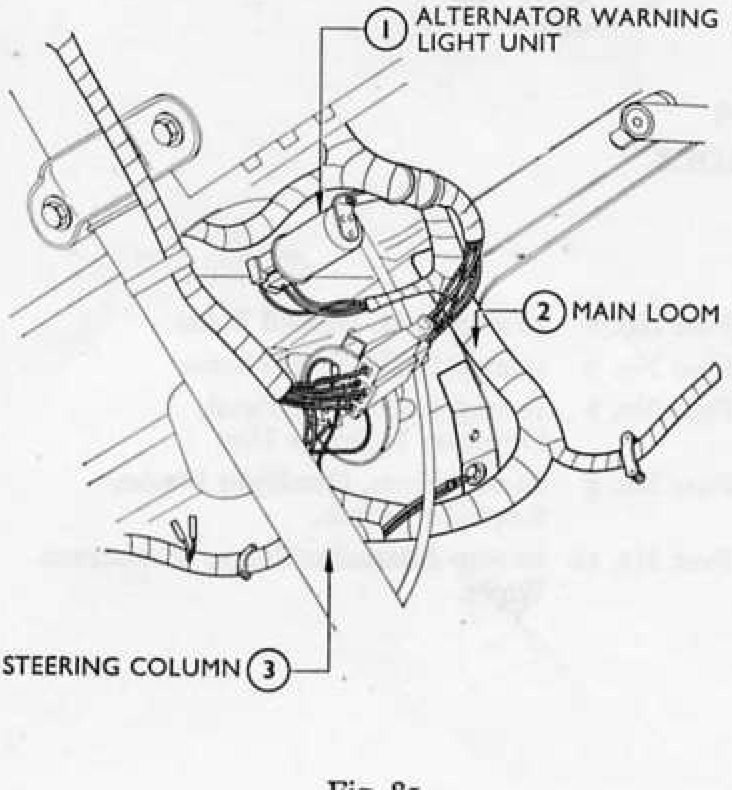


Fig. 81
Alternator Warning Light Unit

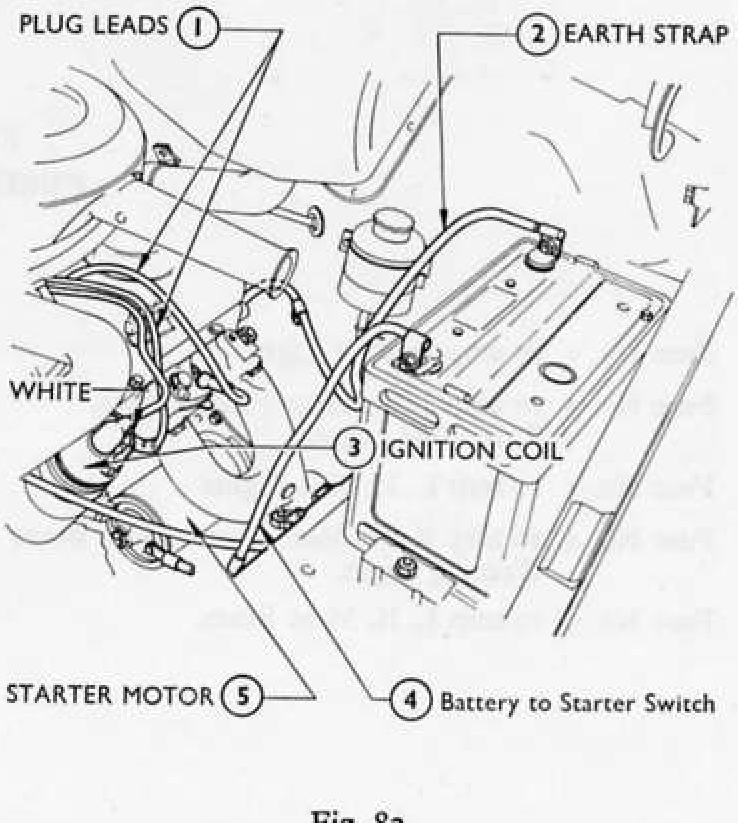
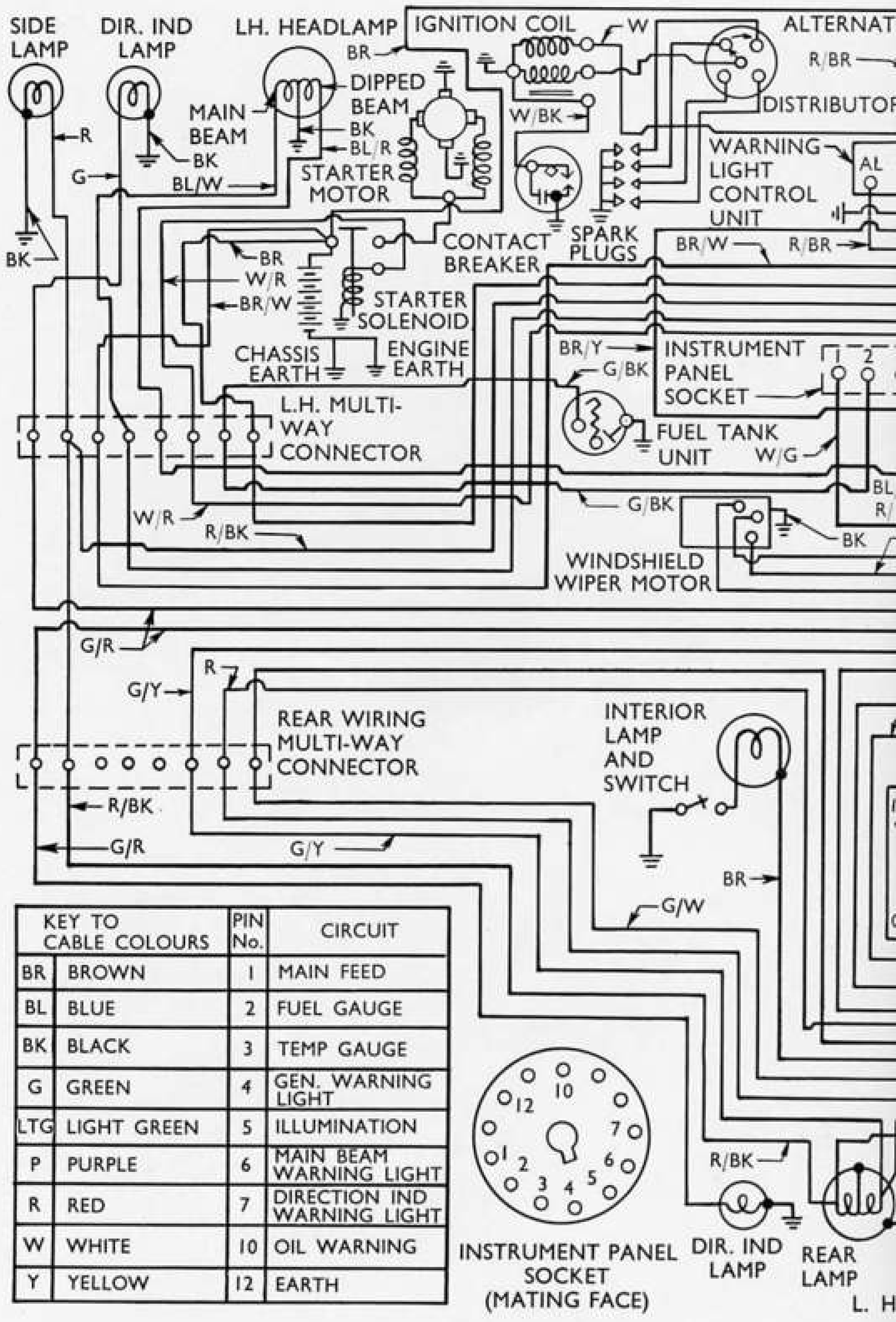


Fig. 82
Engine Compartment



KEY TO CABLE COLOURS		PIN No.	CIRCUIT
BR	BROWN	1	MAIN FEED
BL	BLUE	2	FUEL GAUGE
BK	BLACK	3	TEMP GAUGE
G	GREEN	4	GEN. WARNING LIGHT
LTG	LIGHT GREEN	5	ILLUMINATION
P	PURPLE	6	MAIN BEAM WARNING LIGHT
R	RED	7	DIRECTION IND WARNING LIGHT
W	WHITE	10	OIL WARNING
Y	YELLOW	12	EARTH

Wi

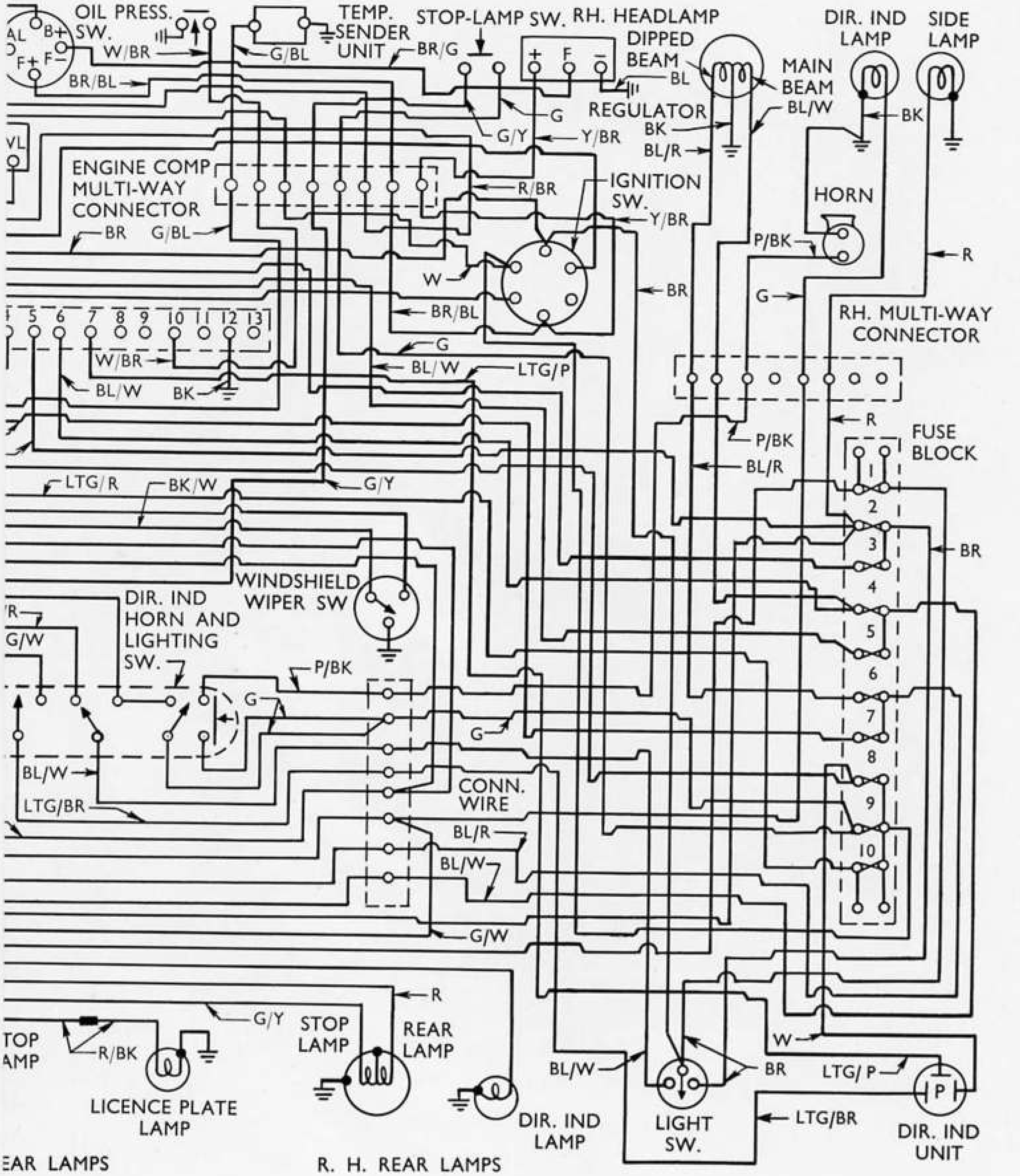
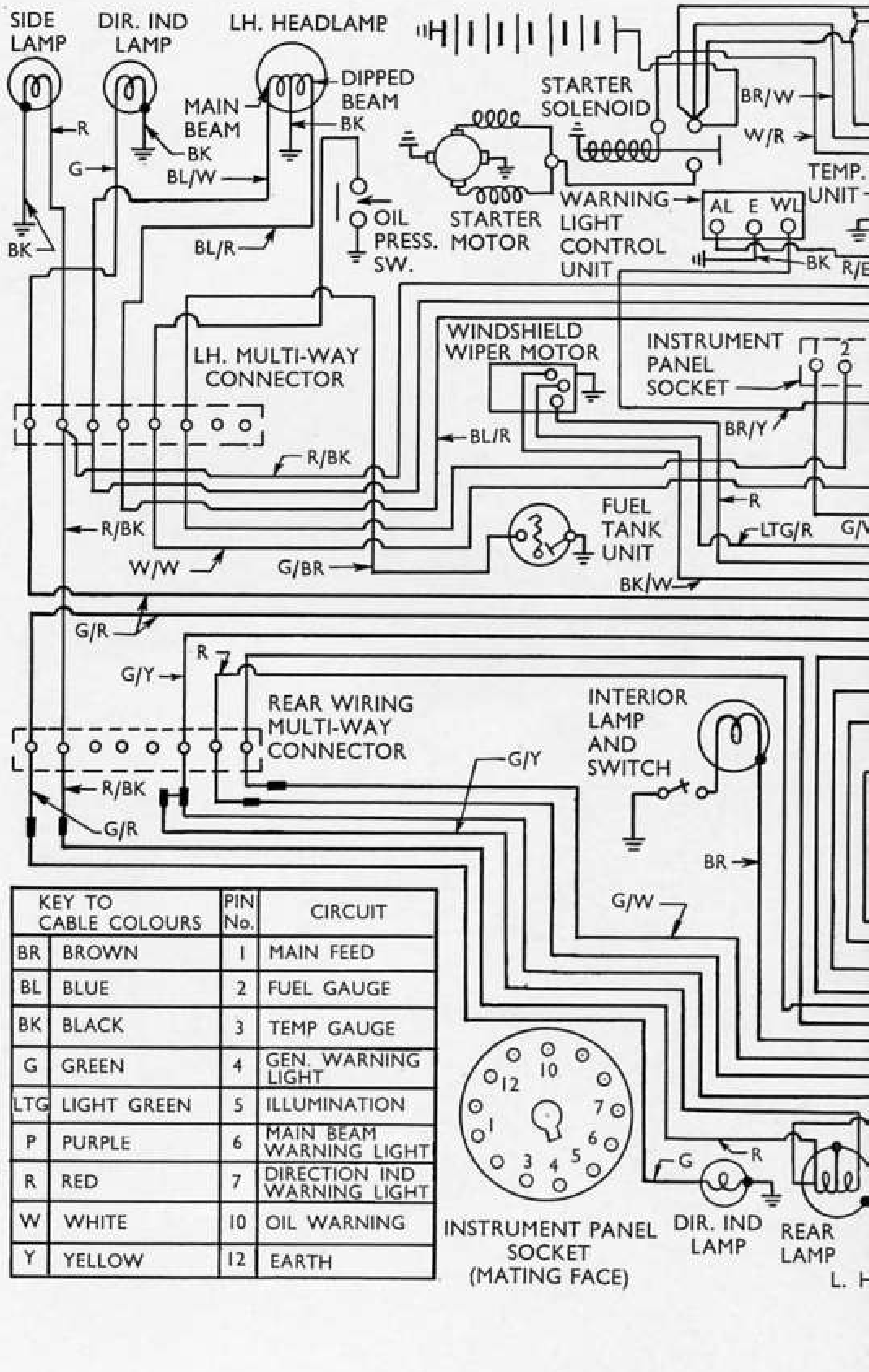


Fig. 83

g Diagram - Petrol



KEY TO CABLE COLOURS		PIN No.	CIRCUIT
BR	BROWN	1	MAIN FEED
BL	BLUE	2	FUEL GAUGE
BK	BLACK	3	TEMP GAUGE
G	GREEN	4	GEN. WARNING LIGHT
LTG	LIGHT GREEN	5	ILLUMINATION
P	PURPLE	6	MAIN BEAM WARNING LIGHT
R	RED	7	DIRECTION IND WARNING LIGHT
W	WHITE	10	OIL WARNING
Y	YELLOW	12	EARTH

Wi

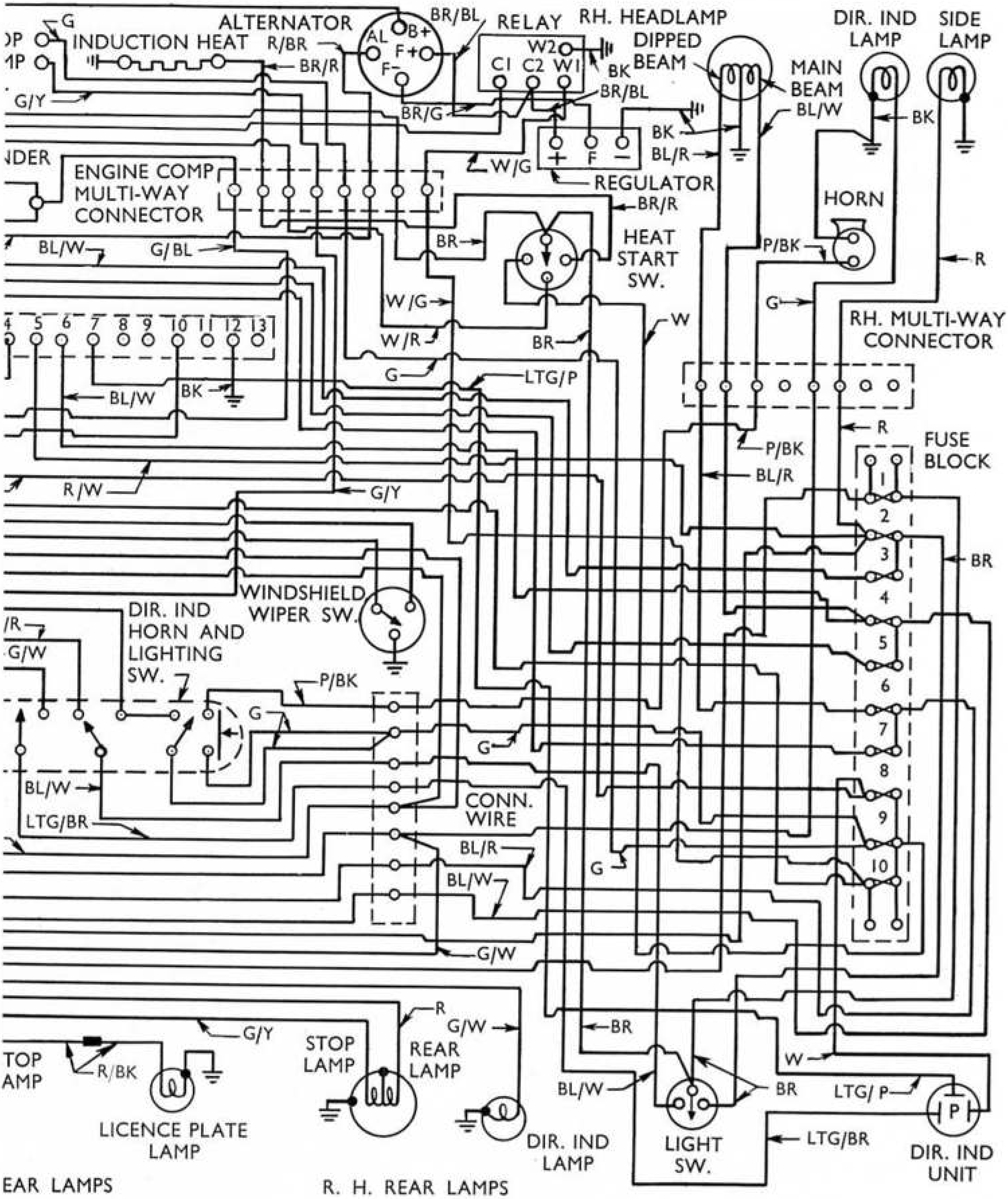


Fig. 84

g Diagram - Diesel

WIRING DIAGRAMS

(September 1968 to September 1970)

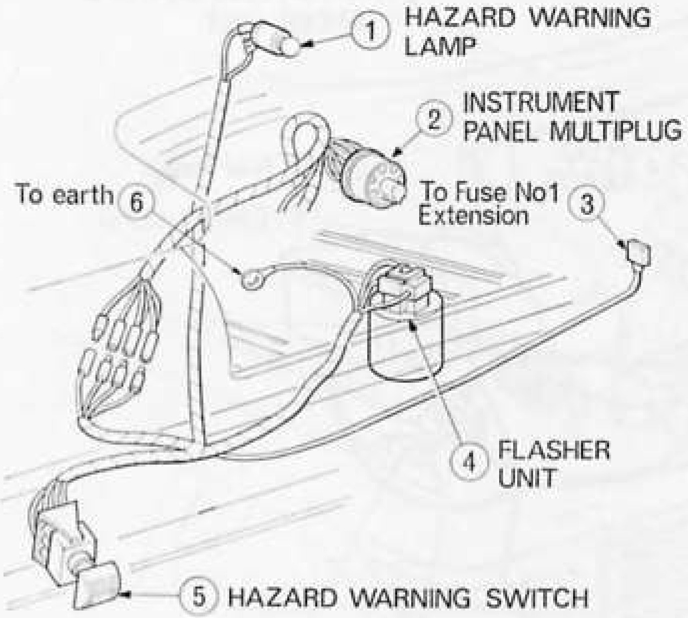


Fig. 85
Hazard Warning

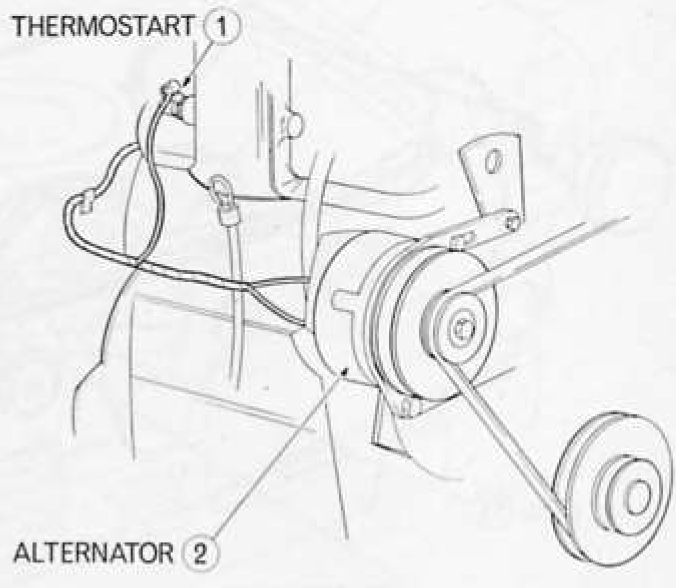


Fig. 86
Thermostart

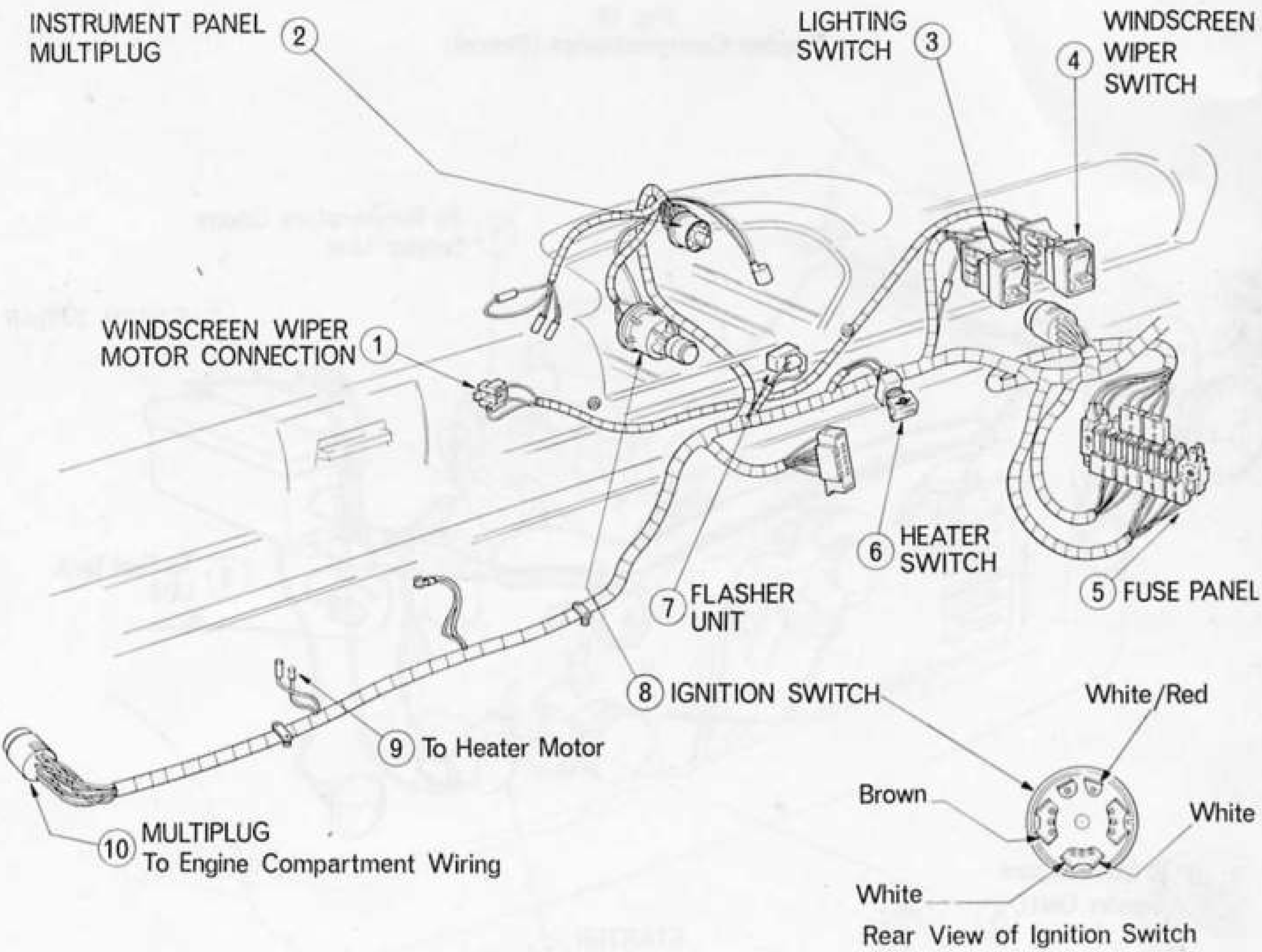


Fig. 87
Dashboard Wiring

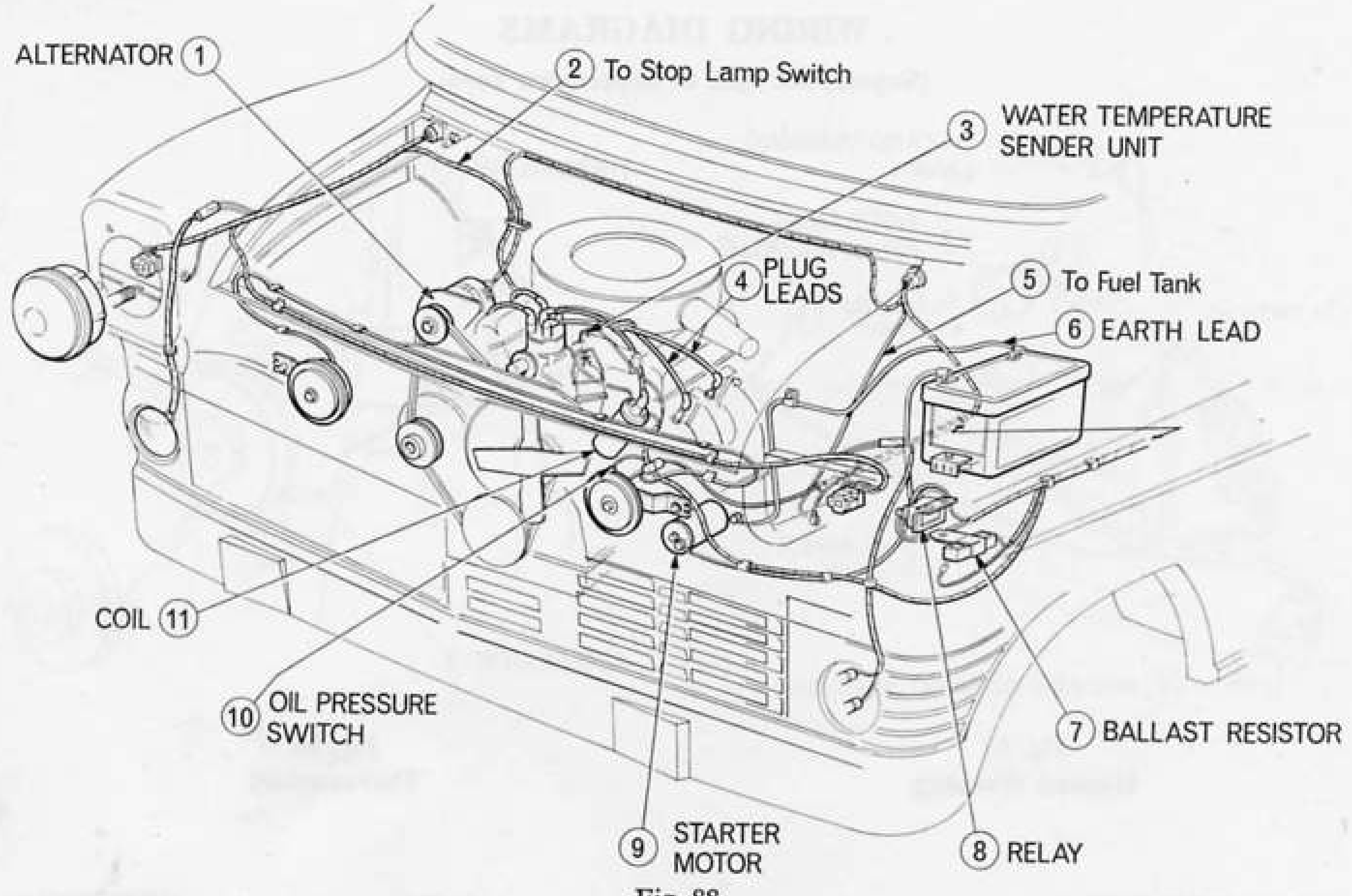


Fig. 88
Engine Compartment (Petrol)

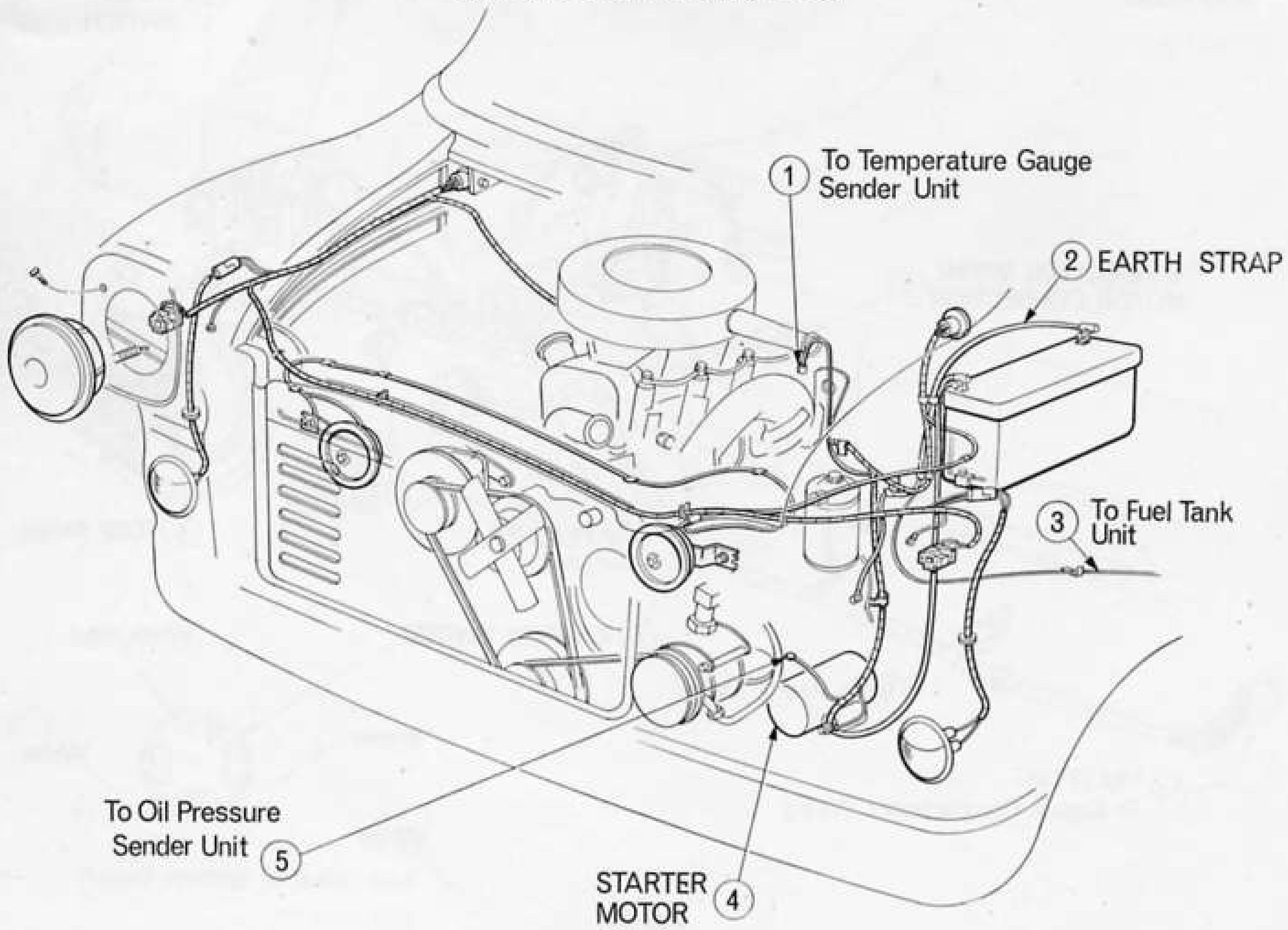


Fig. 89
Engine Compartment (Diesel)

KEY TO WIRING DIAGRAMS — Figures 90, 91 and 92.

1. R/H Side and Flasher Lamp
2. R/H Headlamp
3. Horn
4. L/H Headlamp
5. L/H Side and Flasher Lamp
6. Alternator
7. Distributor
8. Oil Pressure Switch
9. Temperature Sender Unit
10. Starter Motor
11. Ignition Coil
12. Ballast Resistor
13. Starter Solenoid
14. Battery
15. Stop Lamp Switch
16. Lighting Multi-Plug
17. Windshield Wiper Motor
18. Heater Motor
19. Engine Compt. Multi-Plug
20. Fuel Tank Unit
21. Fuse Block
22. Lighting Switch
23. Wiper Switch
24. Hazard Wiring Connection
25. Instrument Wiring Plug
26. Earth
27. Ignition Switch
28. Interior Light
29. Heater Motor Switch
30. Direction Indicator Unit
31. Dipper-Indicator Switch
32. Rear Wiring Multi-Plug
33. R/H Rear Lamp
34. Licence Plate Lamp
35. L/H Rear Lamp
36. Inst. Illum. Vac. Gauge
37. Earth (Accessory)
38. Interior Light Switch
39. Interior Light No. 1
40. Interior Light No. 2
41. Interior Light No. 3
42. Interior Light No. 4
43. Induction Heater Button
44. Induction Heater
45.
46.
47.
48.
49.
50. Side Repeater Flasher Lamp
51. Dual Horn
52. Dual Brake Diff. Valve Switch
53. Auto Trans. Inhibitor Switch
54. Pre-Engage Starter Motor
55. Wiper Motor Switch, Two Speed
56. Wiper Motor, Two Speed
57. Dual Brake Test Switch
58. Dual Brake Warning Ind.
59. Hazard Flasher Indicator
60. Hazard Switch
61. Hazard Flasher Unit
62. Interior Light Switch
63. Interior Light Rear
64. Dipper-Indicator Switch
65. Dip Beam Flasher Relay
66. Ignition Switch Steering Lock

FUSES

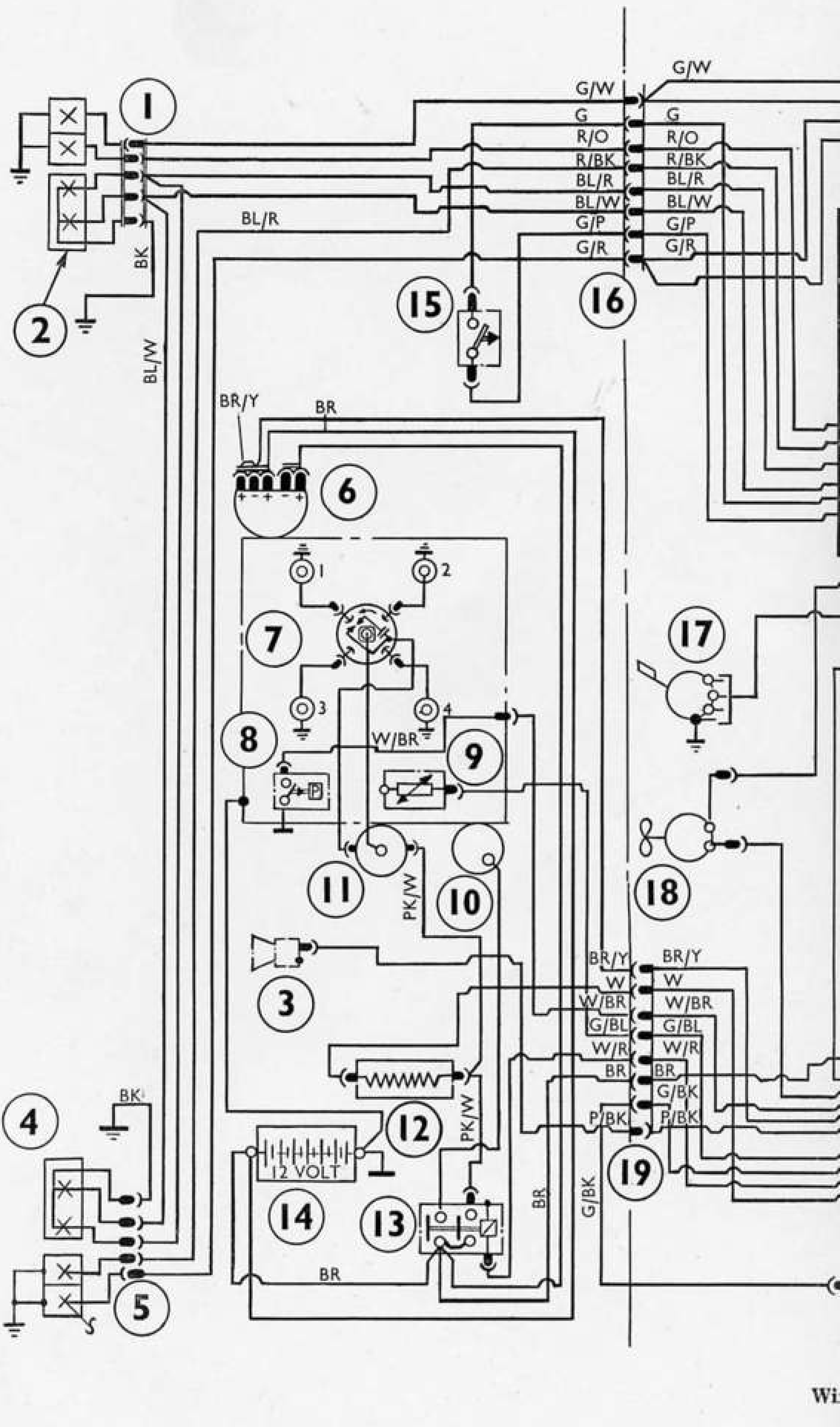
Fuse	1	2	3	4	5	6	7	8
Rating	8	8	8	16	16	16	8	8

INSTRUMENT MULTI CONNECTOR

A Main Feed to Instruments
B Fuel Gauge
C Temperature Gauge
D Alternator Warning Light
E Instrument Panel Lights
F Main Beam Warning Light
G Direction Indicator Warning Light
H Direction Indicator Warning Light
J Oil Pressure Warning Light
K Earth
L Instrument Voltage Stabiliser

CABLE COLOURS

BR – Brown
BL – Blue
BK – Black
G – Green
LTG – Light Green
P – Purple
R – Red
W – White
Y – Yellow


1
2
BK
BL/R
BL/W
G/W
G
R/O
R/BK
BL/R
BL/W
G/P
G/R
15
16
BR/Y
BR
6
7
8
9
W/BR
10
11
PK/W
17
18
3
BR/Y
W
W/BR
G/BL
W/R
BR
G/BK
P/BK
19
4
BK
12
12 VOLT
14
13
5
BR
G/BK
Wi

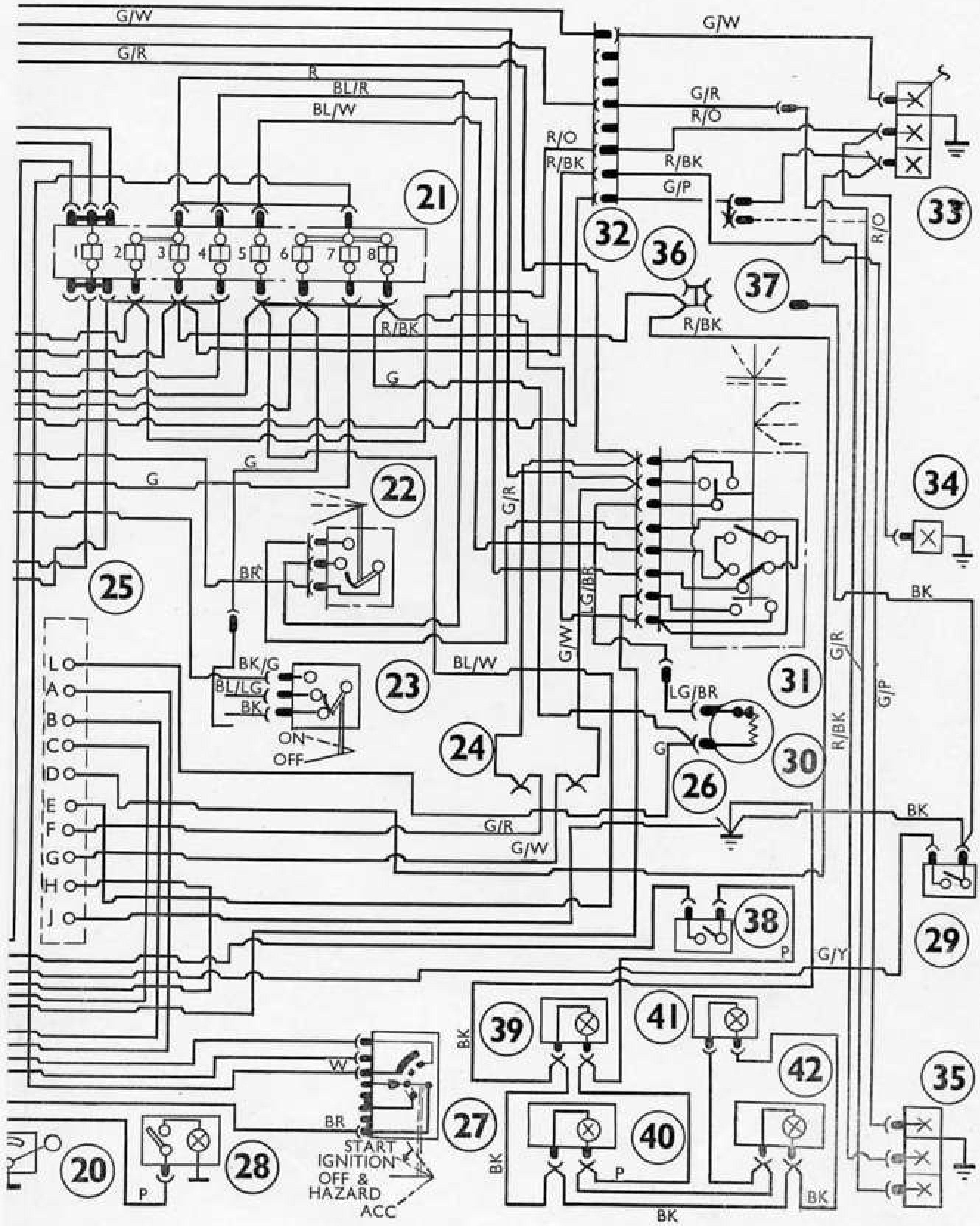
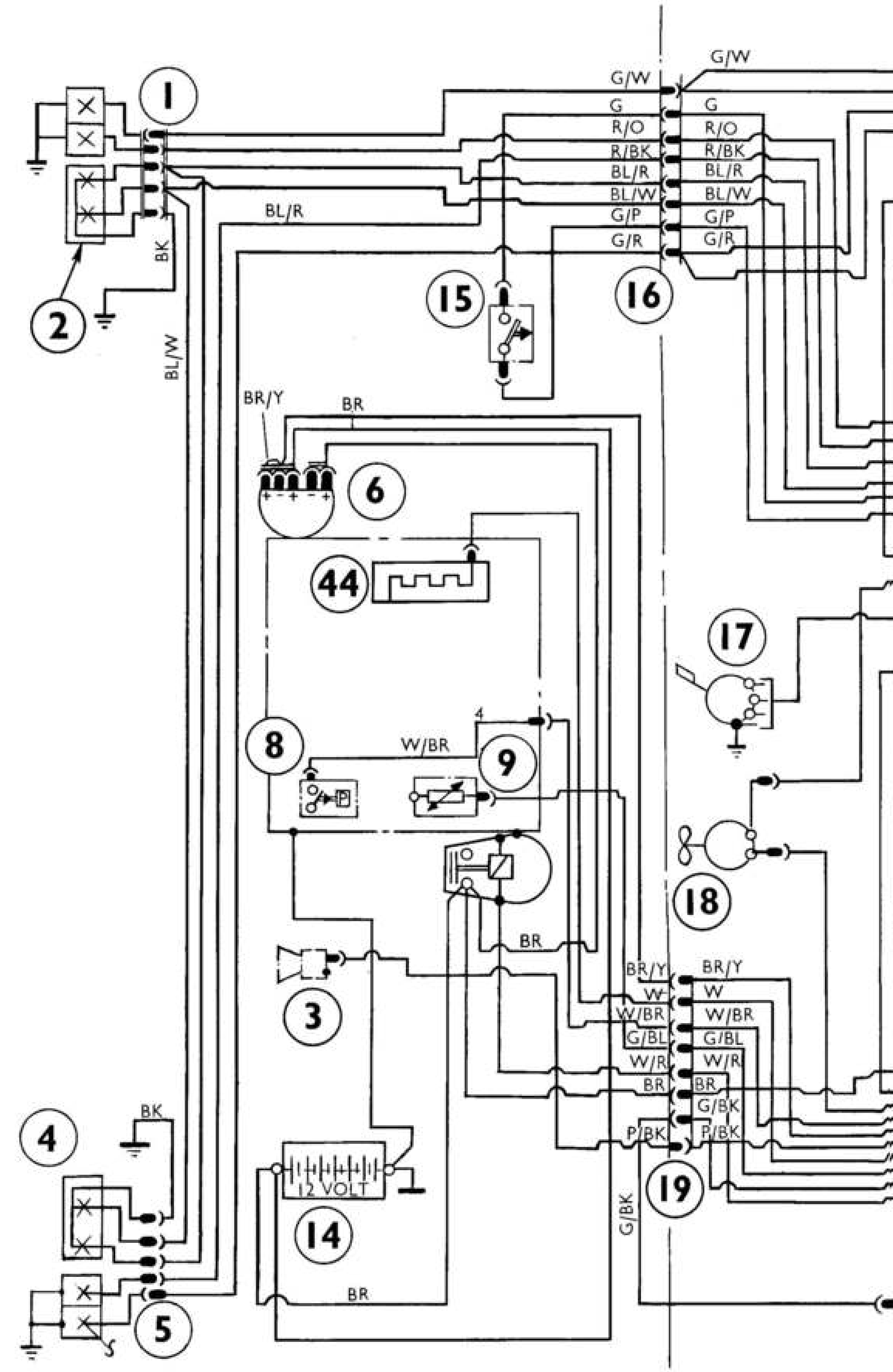


Fig. 90

Diagram - Petrol


G/W
G
R/O
R/BK
BL/R
BL/W
G/P
G/R
BL/R
BK
BL/W
BR/Y
BR
4
W/BR
W
G/BL
W/R
G/BK
P/BK
12 VOLT
1
2
3
4
5
6
8
9
14
15
16
17
18
19
44

Wi

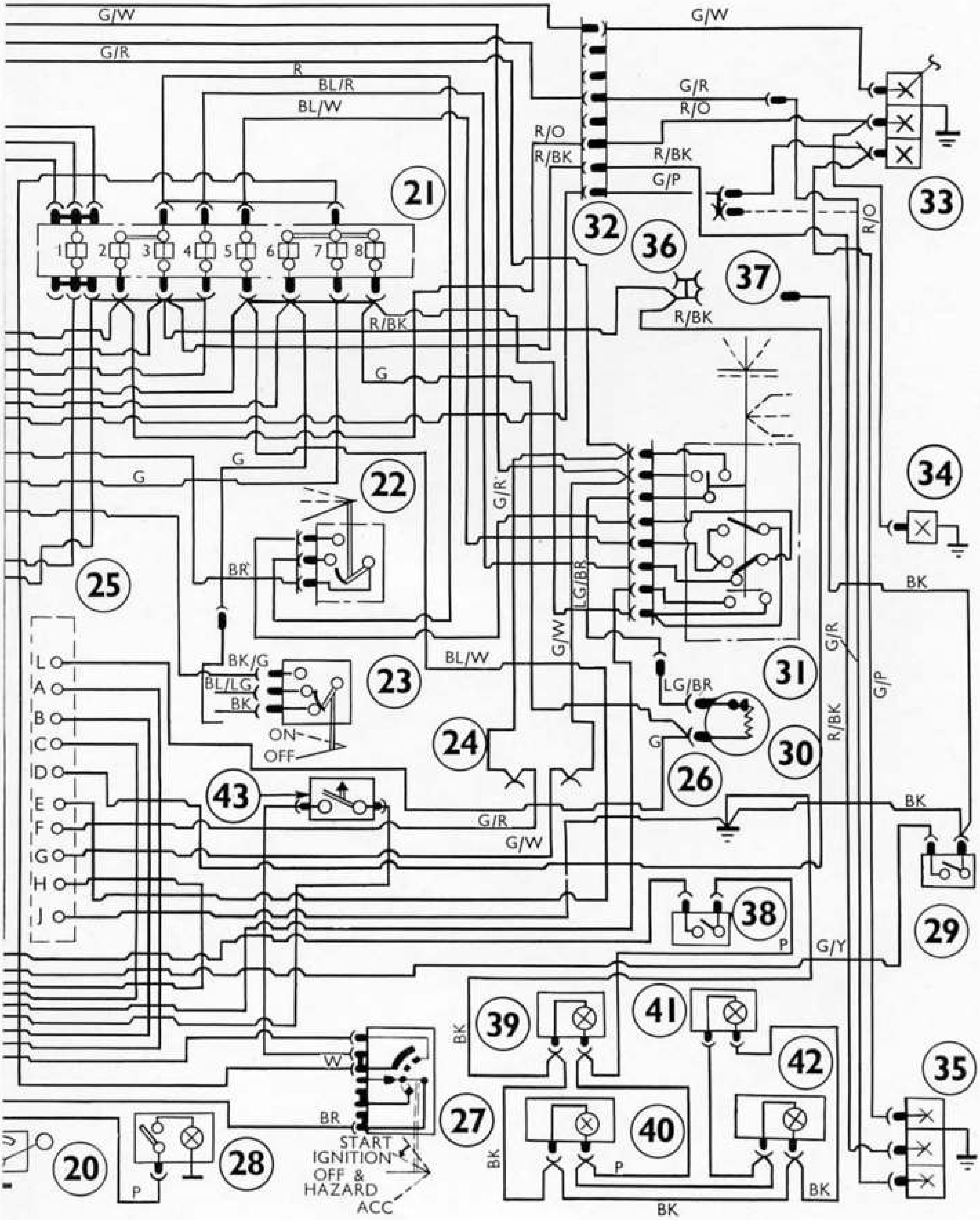
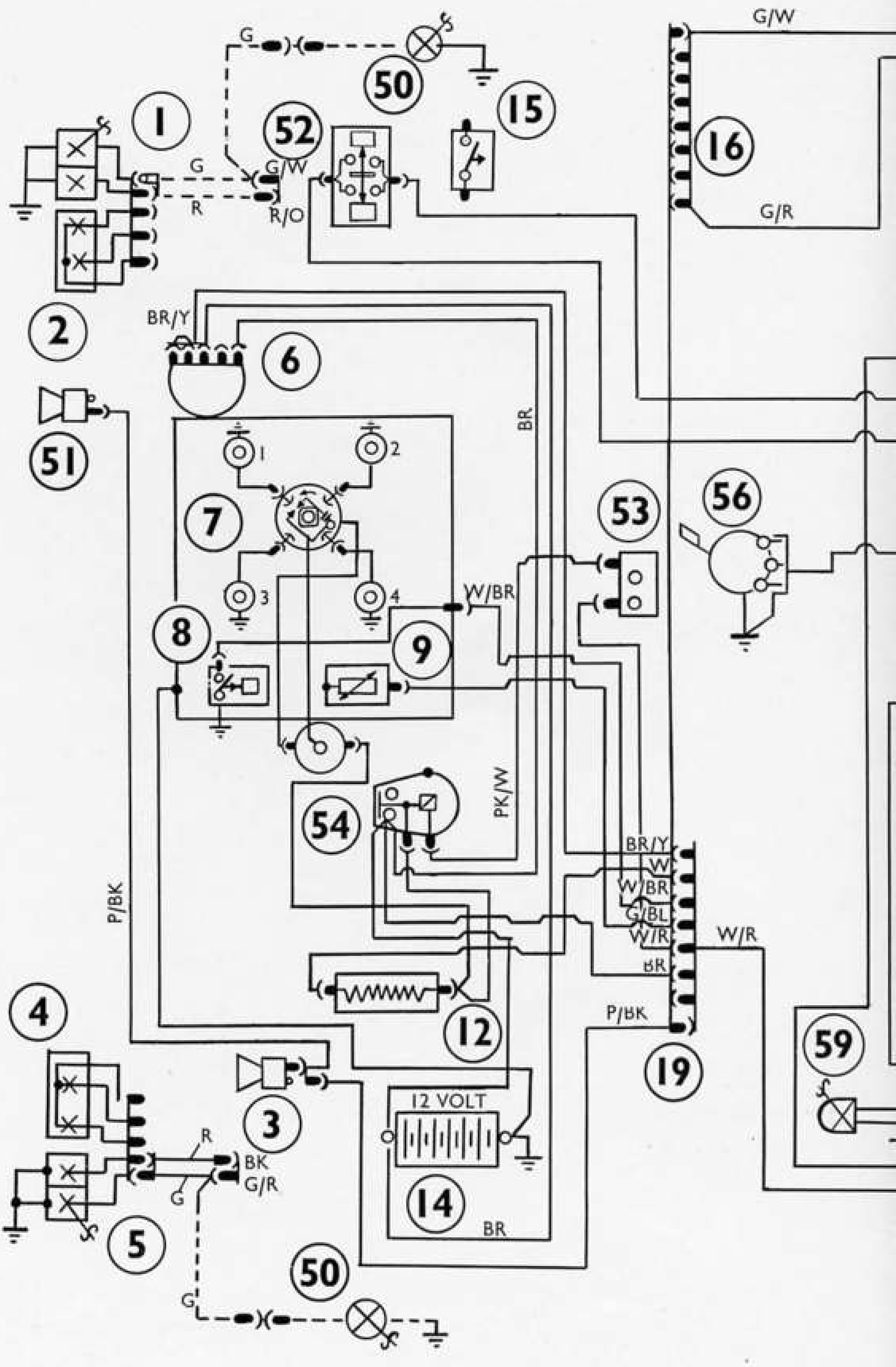


Fig. 91

; Diagram - Diesel



Wiring Diagr

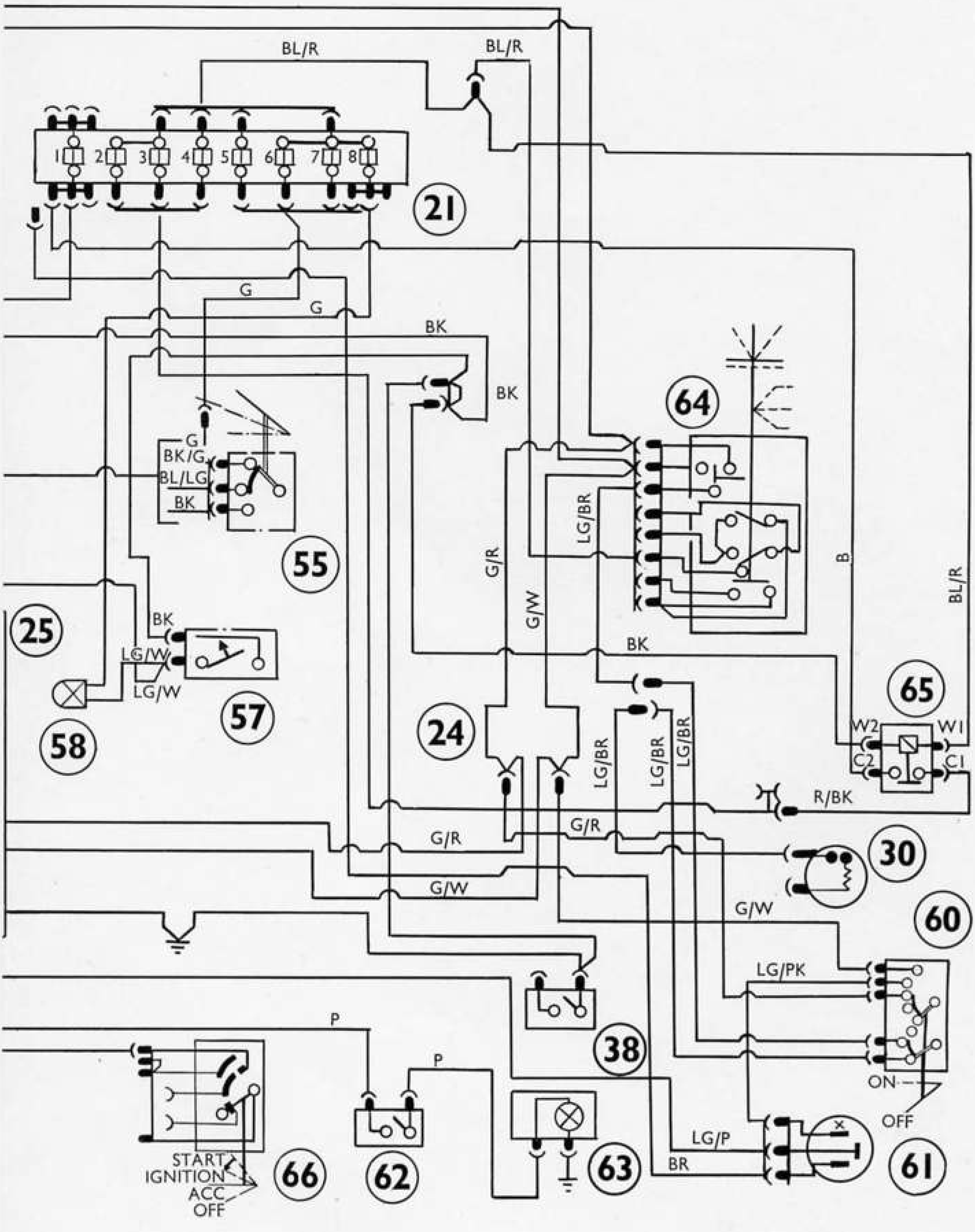


Fig. 92
- Regular Production Options

WIRING DIAGRAMS
(September 1970 onwards)

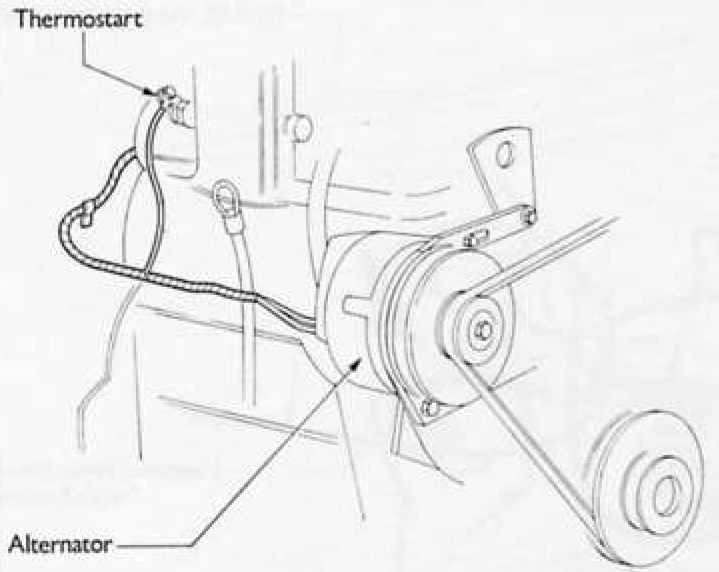


Fig. 93
Thermostart

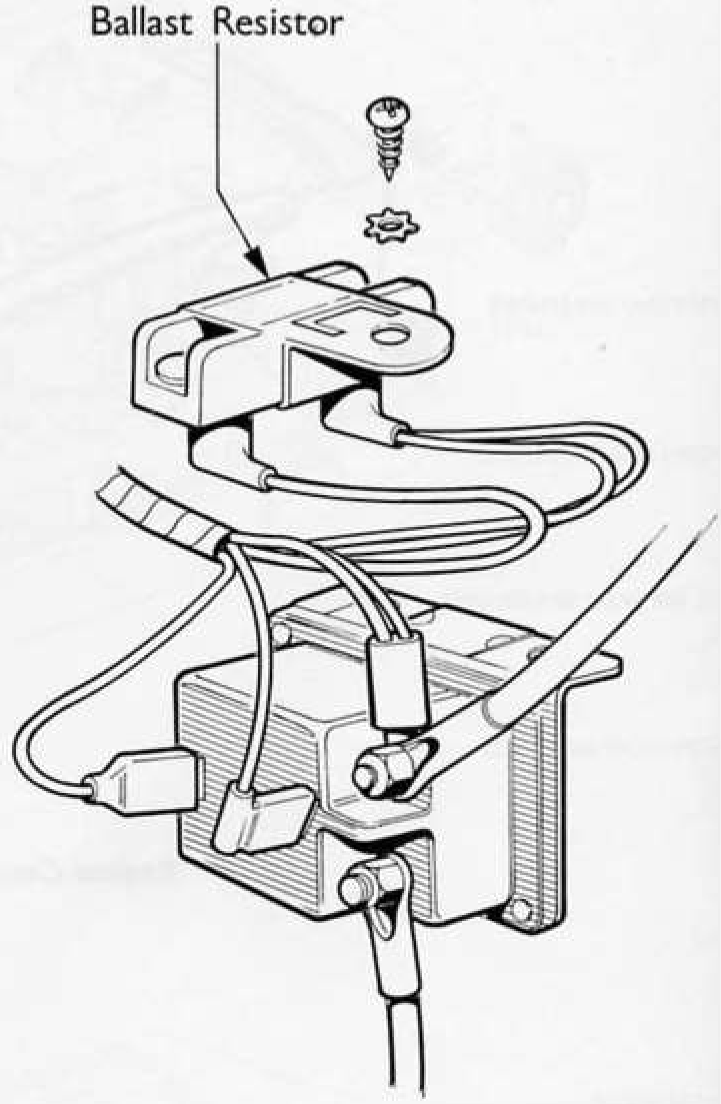


Fig. 94
Ballast Resistor Assembly

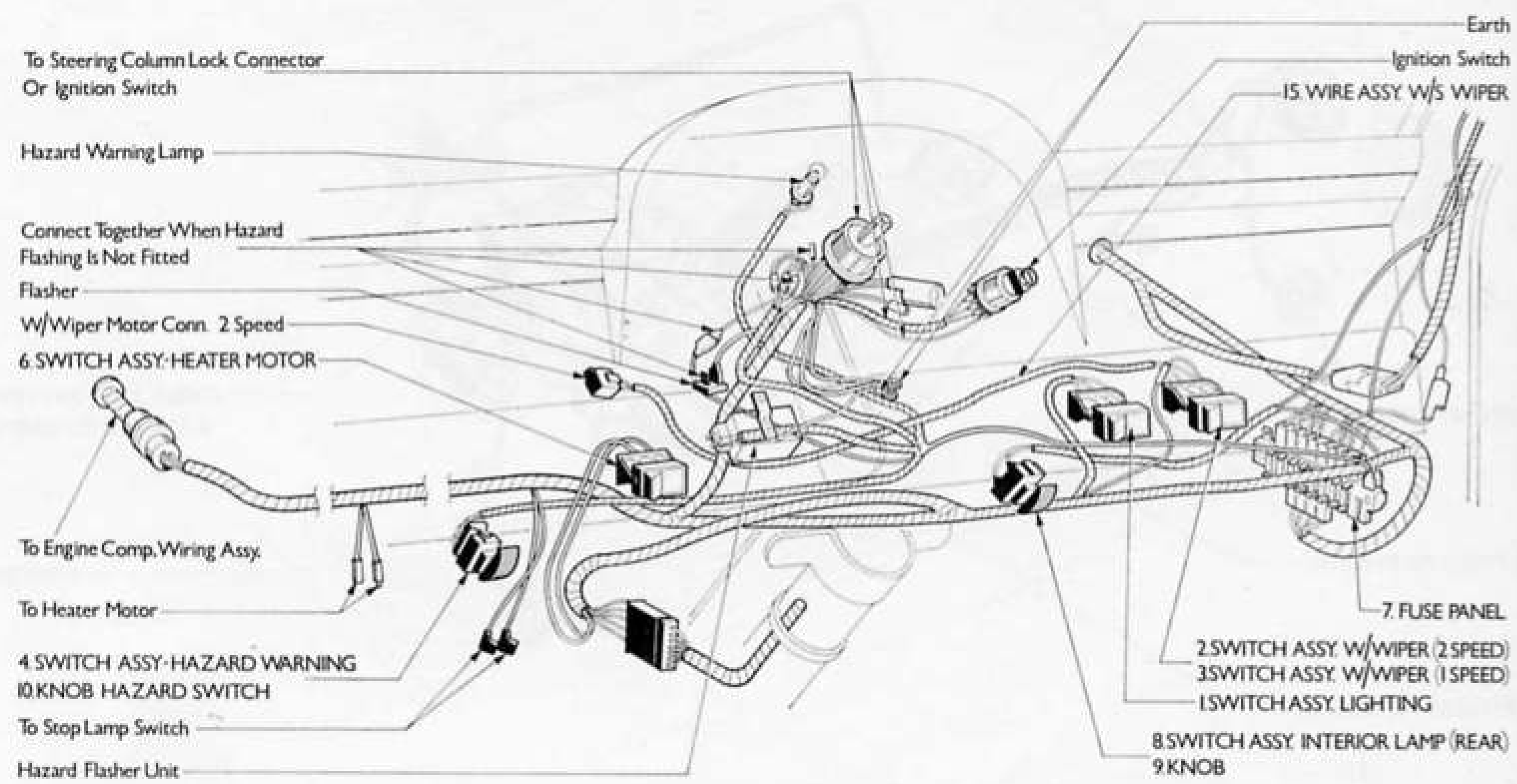


Fig. 95
Dashboard Wiring

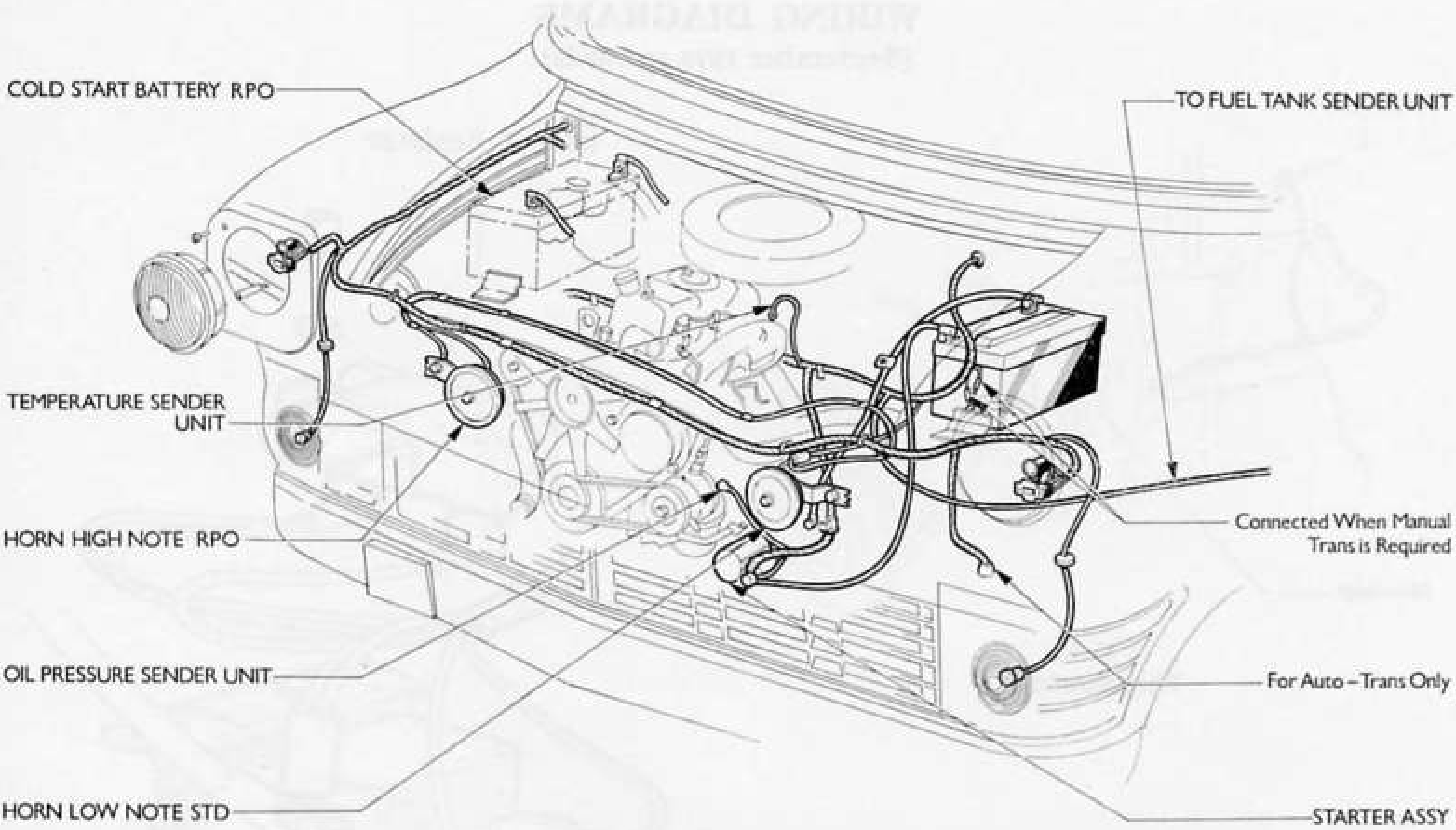


Fig. 96
Engine Compartment (Diesel)

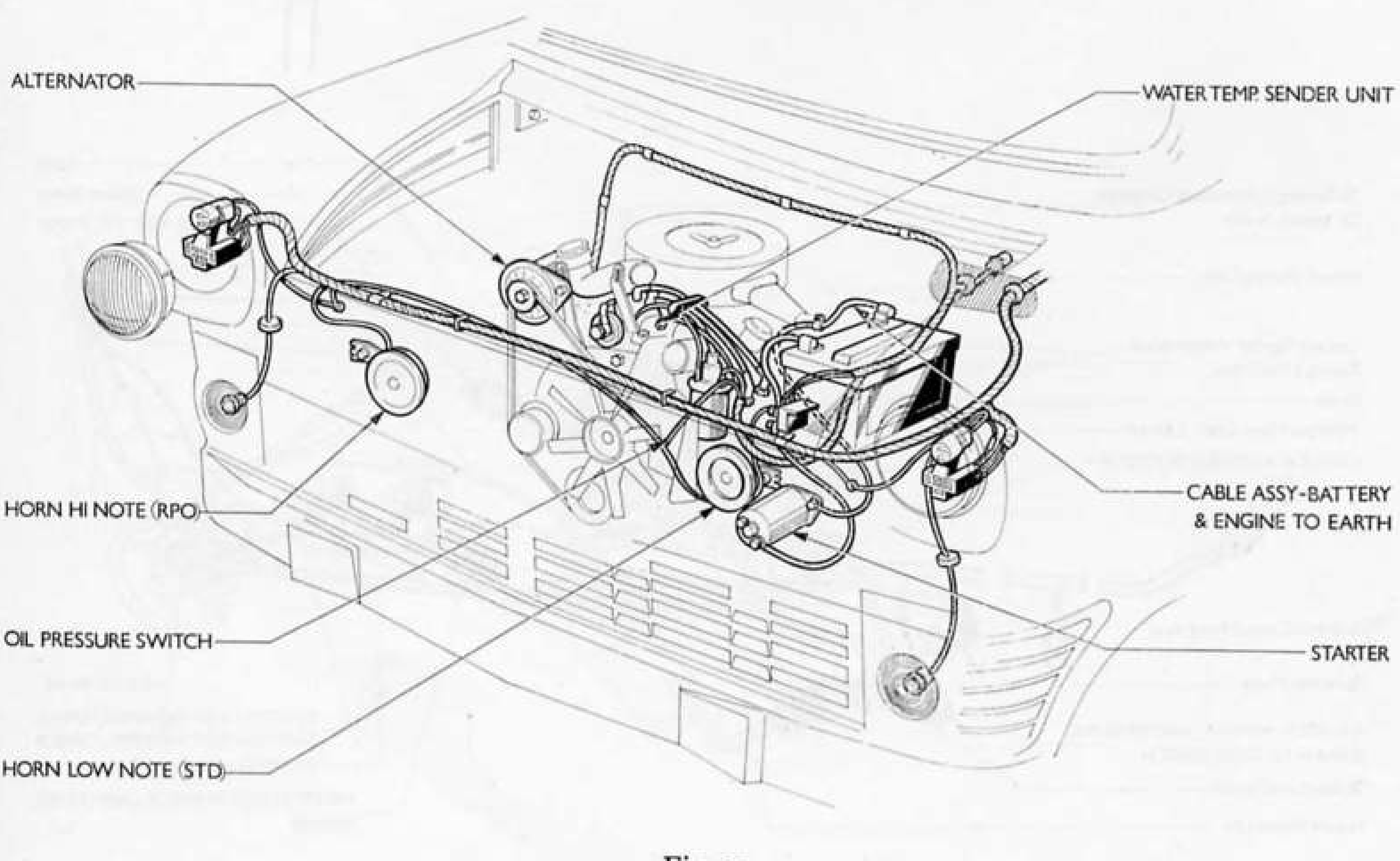


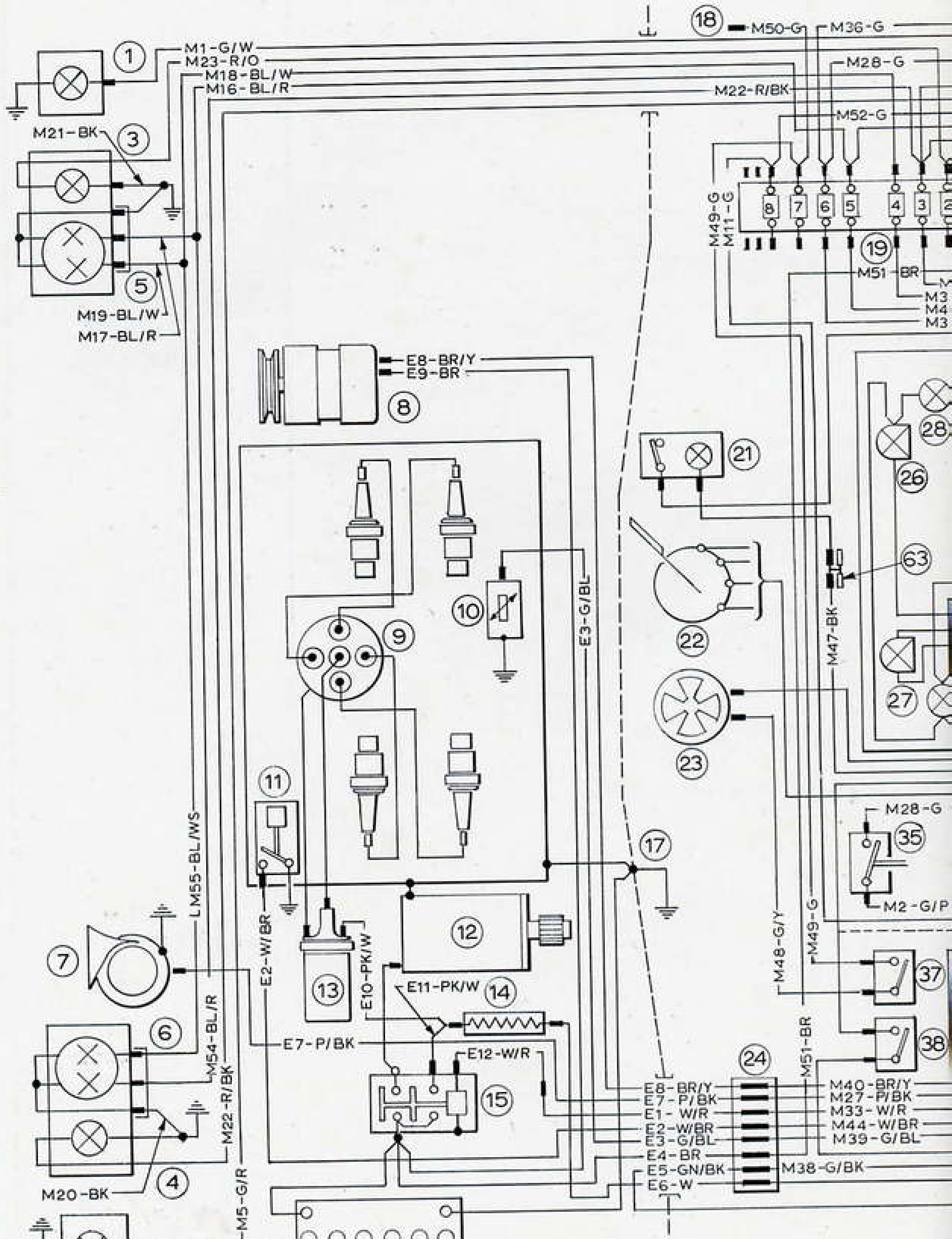
Fig. 97
Engine Compartment (Petrol)

KEY TO WIRING DIAGRAMS (Figs. 98 and 99).

1. R/H Turn Signal Lamp (Front)
2. L/H Turn Signal Lamp (Front)
3. R/H Sidelight
4. L/H Sidelight
5. R/H Headlamp (Main/Dip)
6. L/H Headlamp (Main/Dip)
7. Horn (High)
8. Alternator
9. Distributor
10. Water Temperature Sender
11. Oil Pressure Switch
12. Starter Motor
13. Ignition Coil
14. Ballast Resistor
15. Starter Solenoid
16. Battery
17. Earth (Chassis/Body)
18. Auxiliary Feed
19. Fuse Block
20. Auxiliary Illuminator Feed
21. Interior Lamp
22. Windshield Wiper Motor
23. Heater Motor
24. Main Loom Connector
25. Instrument Cluster
26. Main Beam Warning Light
27. Direction Indicator Warning Light
28. Instrument Illuminator
29. Instrument Connector
30. Alternator Warning Light
31. Oil Pressure Warning Light
32. Fuel Gauge
33. Temperature Gauge
34. Voltage Stabiliser
35. Stop Lamp Switch
36. Instrument Earth
37. Heater Motor Switch
38. Interior Lamp Switch
39. Interior Lamp No. 1
40. Interior Lamp No. 2
41. Interior Lamp Rear
42. Lighting Switch
43. Wiper Switch Feed
44. Windshield Wiper Switch
45. Hazard Connectors
46. Direction Indicator Unit
47. Ignition Switch Connector
48. Steering Lock and Ignition Switch
49. Fuel Gauge Sender Unit
50. Combined D/I Switch Connector
51. Horn Switch
52. Headlamp Flash Switch
53. Headlamp Dip Switch
54. Headlamp Main Beam Switch
55. Direction Indicator Switch
56. R/H Turn Signal Lamp (Rear)
57. L/H Turn Signal Lamp (Rear)
58. R/H Rear Lamp
59. L/H Rear Lamp
60. R/H Stop Lamp
61. L/H Stop Lamp
62. Licence Plate Illuminator
63. Auxiliary Connector
64. Horn (Low)
65. R/H Side Repeater Flasher (Italian requirement)
66. L/H Side Repeater Flasher (Italian requirement)
67. R/H Side Repeater Flasher (Danish requirement)
68. L/H Side Repeater Flasher (Danish requirement)
69. Automatic Transmission Inhibitor Switch
70. Power Wash Motor
71. Fuse Block (Italian requirement)
72. 2-speed A.C. Delco W/Washer and W/Wiper
73. 1-speed A.C. Delco W/Washer and W/Wiper (Parcel Van Only)
74. Dual Brake Differential Valve
75. Vacuum Gauge
76. Foot-switch W/Washer and W/Wiper
77. Power Wash Switch
78. Hazard Warning Light
79. Direction Indicator Unit
80. Hazard Switch
81. Tachograph
82. Fuel Gauge Illuminator
83. Generator Warning Light
84. Temperature Gauge Illuminator
85. 1-speed W/Washer and W/Wiper Switch
86. 2-speed W/Washer and W/Wiper Switch
81. Fuse Unit – Radio – 1·5 amp.
88. Dip Beam Flasher Relay
89. Radio
90. Automatic Transmission Illuminator Dial
91. Dual Brake Warning Indicator
92. Dual Brake Test Switch

CABLE COLOURS

G – Green
R – Red
BL – Blue
BK – Black
W – White
P – Pink
LG – Light Green
O – Orange
BR – Brown



DECEMBER 1970

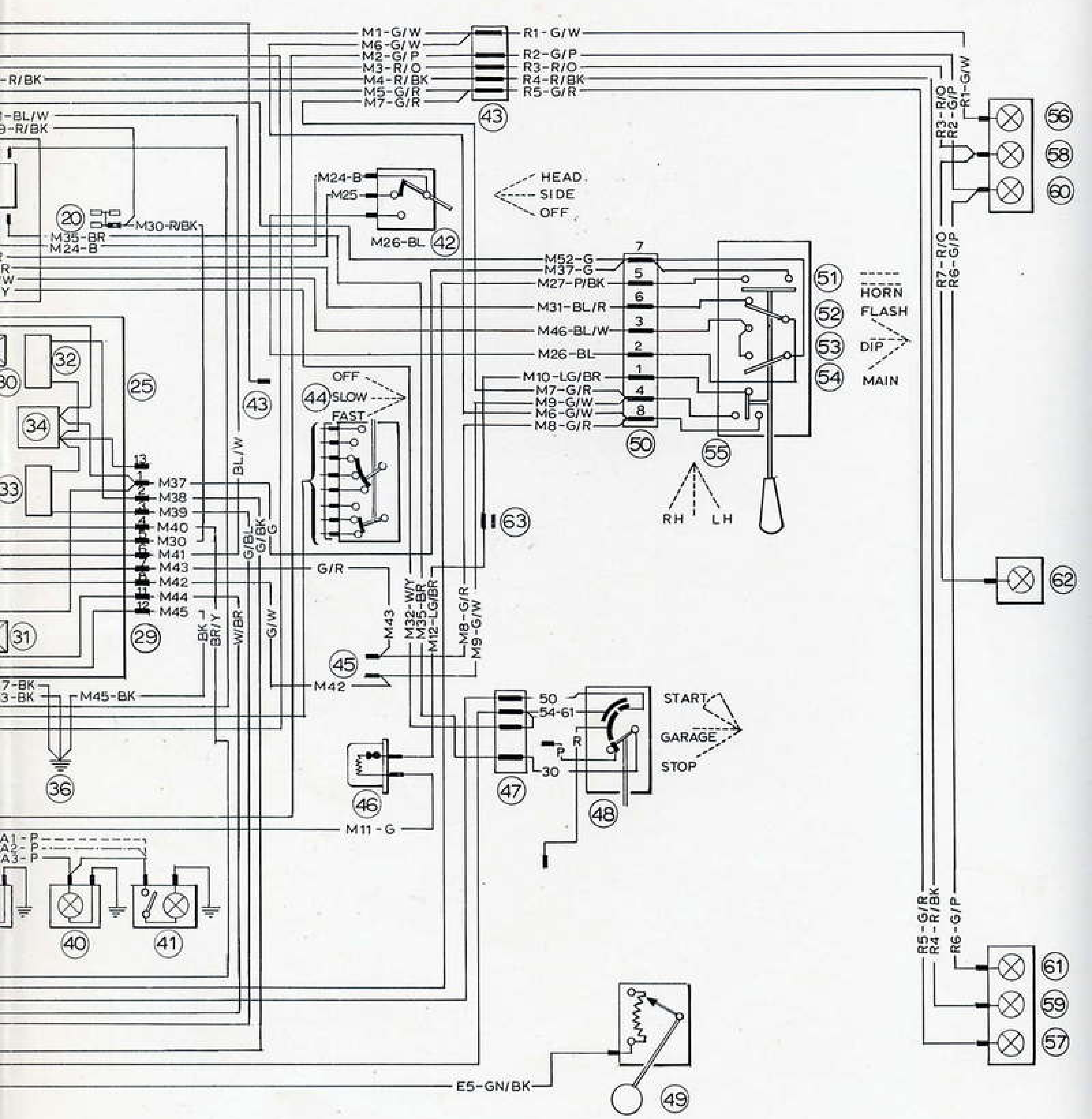
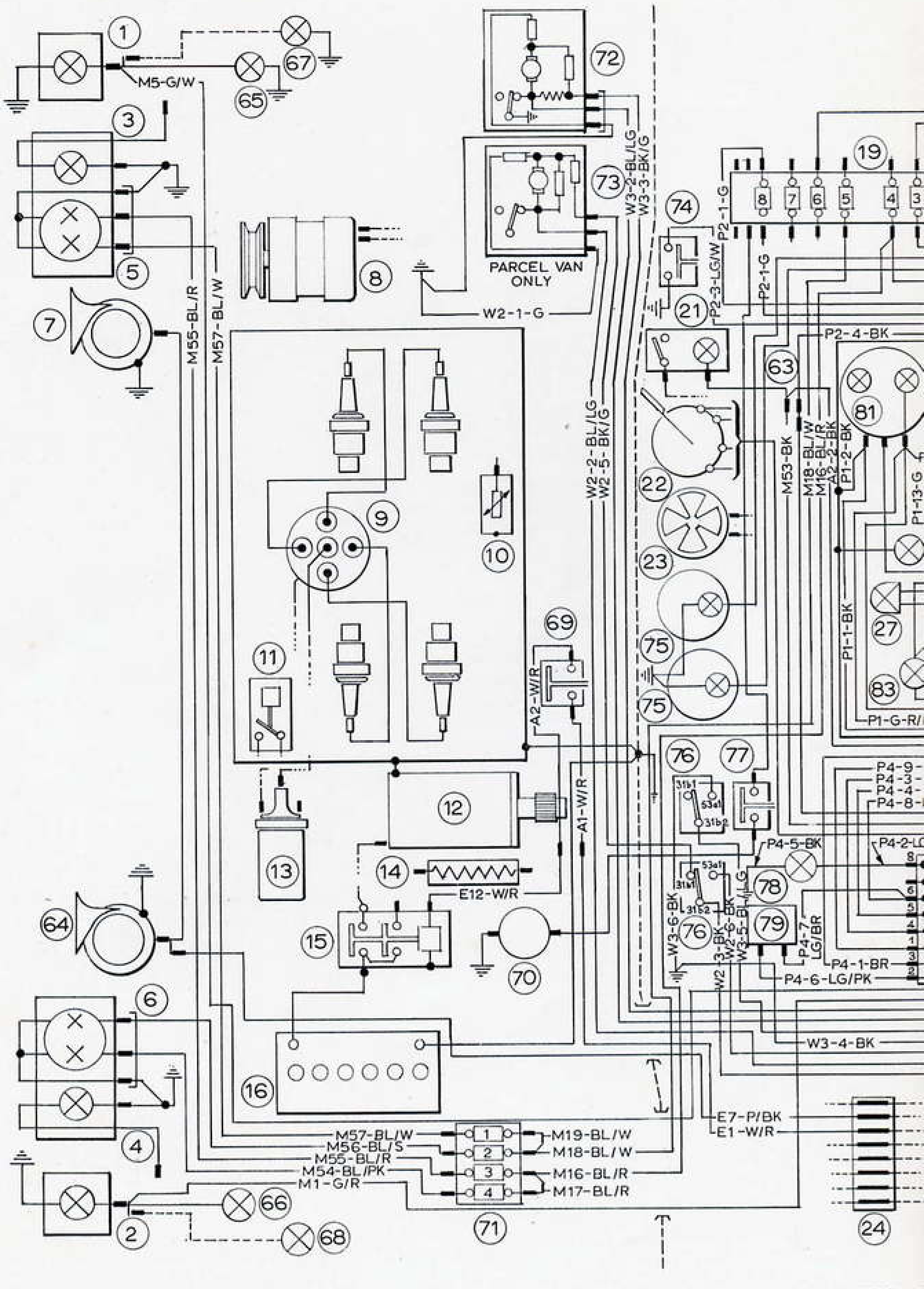


Fig. 98

ring Diagram — All Models


M5-G/W
PARCEL VAN ONLY
W2-1-G
W3-2-BL/LG
W3-3-BK/G
M55-BL/R
M57-BL/W
W2-2-BL/LG
W2-5-BK/G
P2-1-G
P2-3-LG/W
P2-4-BK
M53-BK
M18-BL/W
M16-BL/R
A2-2-BK
P1-2-BK
P1-13-G
P1-1-BK
P1-G-R/
A2-W/R
A1-W/R
E12-W/R
P4-9
P4-3
P4-4
P4-8
P4-5-BK
P4-2-L
P4-7-LG/BR
P4-1-BR
P4-6-LG/PK
W3-6-BK
W3-5-BL/LG
W2-6-BK
3-BK
W3-4-BK
E7-P/BK
E1-W/R
M57-BL/W
M56-BL/S
M55-BL/R
M54-BL/PK
M1-G/R
M19-BL/W
M18-BL/W
M16-BL/R
M17-BL/R
31b1
53a1
31b2

Wiring I

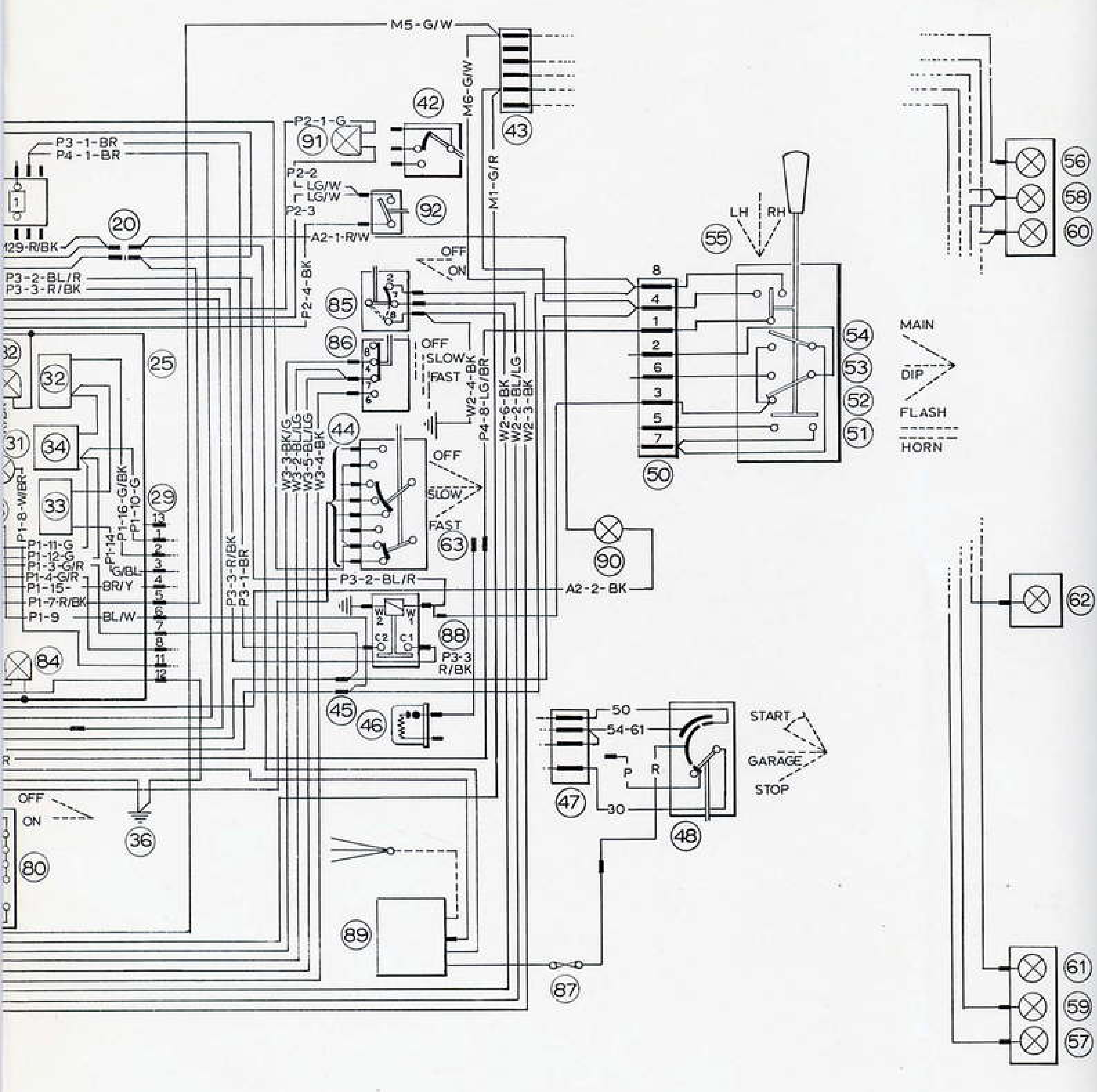


Fig. 99
…gram — Regular Production Options

Section 12

BODYWORK

CONTENTS

SUBJECT

BODYWORK

OVERHAUL PROCEDURES

DRIVER AND PASSENGER DOOR (Hinged) (All Models)

DOOR TRIM PANEL

An interior trim panel covers the access hole to the door interior mechanisms; it can be detached by removing the window winder handle, the remote control handle and pulling the trim panel away from the door frame.

DOOR INTERIOR HANDLES

The interior lock remote control handle and the window winder handle are each secured by a cross-head screw and shakeproof washer located centrally in the handle boss.

To Remove

1. Unscrew and remove the central crosshead screw and shakeproof washer.

2. Remove the handles and escutcheon plates from their respective control shafts.

To Replace

1. Locate each escutcheon plate and handle on its respective control shaft and secure it with a crosshead screw and shakeproof washer.

THE DOOR EXTERNAL HANDLES

The external driver and passenger door handles incorporate a plunger to release the door lock from the outside. The handle may be removed and adjustment carried out in the following manner:

To Remove

1. Close the window and remove the door interior handles and trim panel (see Door Interior Handles—To Remove and Door Trim Panel).

2. Carefully remove the waterproof plastic sheet secured to the door inner frame.

3. Remove the three crosshead screws and shake-proof washers securing the door lock to the door frame.

4. Remove the two crosshead screws, shakeproof and flat washers securing the door handle to the door. Two holes in the door inner panel provide access to the door handle securing screws.

Ensure that the two rubber gaskets are retained for future use when the door handle is removed.

5. Unhook the short wire control rod and disconnect the long wire control rod from the nylon bush.

6. Remove the door handle by turning the front end until the handle is vertical (see Fig. 1). Twist the handle towards the front of the vehicle and withdraw the handle and wire control rods (see Fig. 2).

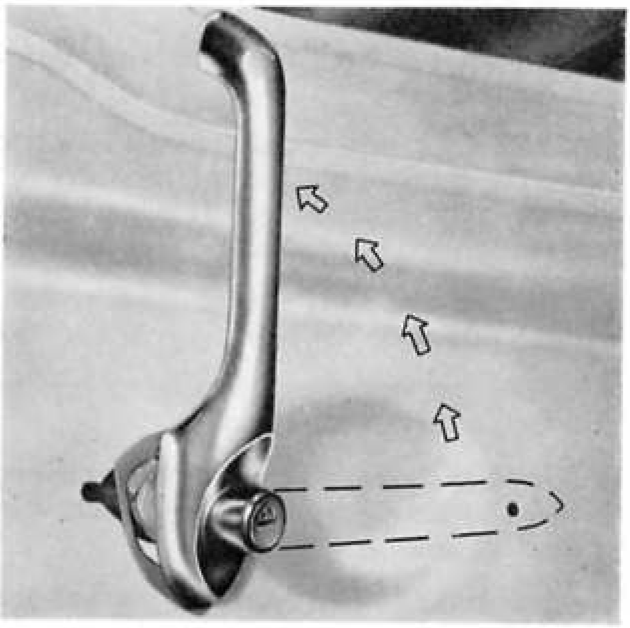


Fig. 1
Removing the Door Handle

Fig. 2
Removing the Door Handle

To Replace

1. With the door handle in the vertical position enter the handle and wire control rods into the door.

2. Rotate the handle until it lines up with the two screw holes in the door outer skin.

3. Reconnect the two wire control rods to the lock mechanism.

4. Replace the two rubber gaskets behind the handle and secure the handle with two crosshead screws, shakeproof and flat washers.

5. Position the door lock and secure it with three crosshead screws and shakeproof washers.

THE DOOR PRIVATE LOCK

An additional control or private lock is fitted to all the exterior doors. Operated by the ignition key, they are located in the centres of the exterior door handles and form the housing for the lock operating plungers (see Fig. 3).

To Remove

1. Remove the door handle (see Door External Handles—To Remove) and detach the two rubber sealing gaskets.

2. Unhook the short wire control rod and disconnect the long wire control rod from the nylon bush.

3. Tap out the split pivot pin locating the plunger crank arm to the door handle and remove the crank arm (see Fig. 4). Ensure that the crank arm return spring does not fly out when the pivot pin is removed.

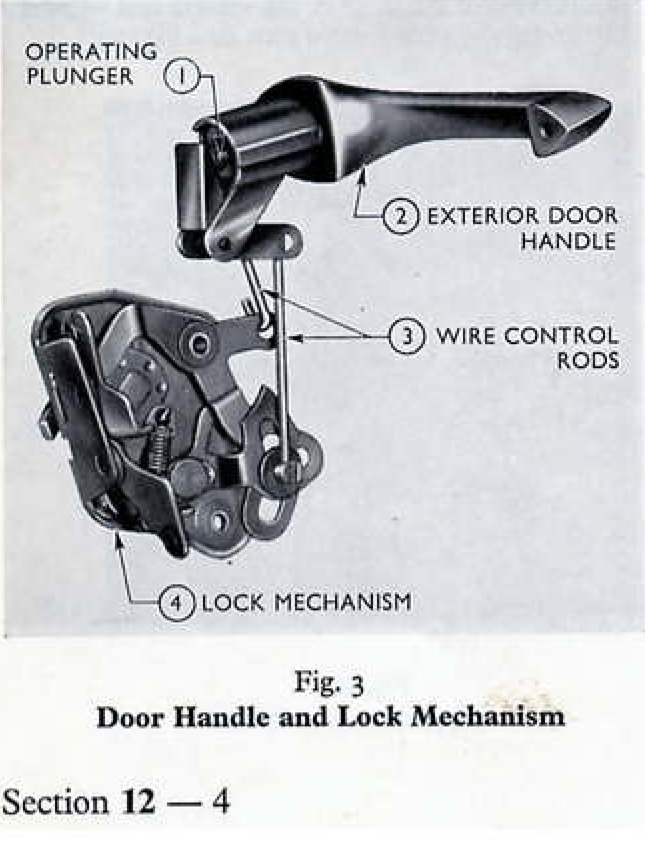


Fig. 3
Door Handle and Lock Mechanism

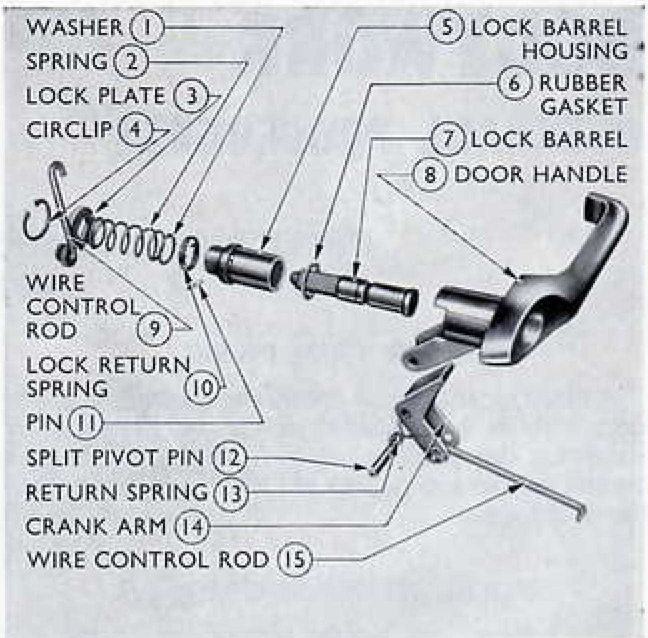


Fig. 4
Door Handle Assembly

4. Remove the circlip locating the lock barrel housing in the door handle and withdraw the lock barrel, lock plate, spring and housing as an assembly (see Fig. 4).

5. Withdraw the steel spacer washers from the lock housing and, using a thin bladed screwdriver, prise the return spring out of the lock barrel and remove the spring (see Fig. 4).

6. Remove the rubber sealing gasket from its groove in the lock housing and drive out the brass pin locating the lock barrel in the housing (see Fig. 4).

7. Withdraw the lock barrel from the housing.

To Replace

1. Slide the lock barrel into the housing and secure it with a brass pin.

2. Replace the rubber gasket in its groove in the lock housing.

3. Slide the return spring into the lock housing and locate the tangs of the spring in the slot provided in the housing and lock barrel. It is important that both tangs are in the same slot.

4. Replace the steel spacer washers on the lock housing and slide the housing into the door handle.

5. Slide the spring and lock plate into the handle and secure them with a circlip.

6. Replace the crank arm and its return spring into position in the door handle and secure them with a split pivot pin.

7. Locate the two wire control rods in their respective positions.

8. Replace the door handle and sealing gaskets (see Door External Handles—To Replace).

THE DOOR LOCKS AND REMOTE CONTROL MECHANISM

The door locks are of a semi-rotary cam type where an external cam, operating in conjunction with a striker plate secured to the door pillar, rotates to give two positions, thus providing a safety catch and a fully closed position.

The remote control operating rod is secured to the remote control mechanism by a spring clip. On early models the operating rod can be detached from the door lock by removing the button, and lowering the remote control mechanism to the bottom of the door after unhooking the rod from the lock mechanism.

On later models the button is not detachable from the operating rod. To remove the rod it must first be unhooked from the lock mechanism and then withdrawn through the door sill.

To Remove

1. Close the window and remove the interior handles, trim panel and plastic sheet (see Door Interior Handles—To Remove and Door Trim Panel).
2. Remove three crosshead screws, spring and cup washers securing the remote control mechanism to the door inner panel (see Fig. 5).
3. Disconnect the remote control operating rod from the door lock mechanism and remove the remote control assembly from the door.
4. Unscrew the door lock interior control knob (see Fig. 5). (Early models only.)
5. Remove the crosshead screw, shakeproof and flat washer securing the lower end of the door rear glass channel, and move the channel to one side.
6. Unscrew and remove the three crosshead screws and shakeproof washers securing the lock mechanism to the door and disconnect the two wire control rods from the lock mechanism (see Fig. 5).
7. Remove the lock mechanism from the door.

To Replace

1. Locate the door lock in the door and reconnect the two wire control rods. Ensure that the interior lock operating rod is correctly positioned through the hole in the top of the door inner panel.
2. Secure the lock with three crosshead screws and shakeproof washers.
3. Position the door glass rear run and secure it at the lower end with a crosshead screw, shakeproof and flat washer.
4. Refit the door lock interior control knob. (Early models only.)
5. Place the remote control mechanism in the door and connect the remote control operating rod to the door lock.
6. Secure the remote control mechanism to the door inner panel with three crosshead screws, spring and cup washers.
7. Replace the plastic sheet, trim panel and interior lock handles (see Door Trim Panel and Door Interior Handles—To Replace).

DOOR ALIGNMENT AND LOCK ADJUSTMENT

The driver's and passenger doors are each hung on two hinges secured to the body hinge pillar and the door inner frame. If necessary, adjustment to the door within the aperture should always be made on the hinges and never on the striker plate. Any adjustments should be carried out in the following sequence:—

1. Carry out a visual examination to determine whether the door will need to be moved within the body aperture.
2. To lift or lower the door, slacken the bolts securing the hinge to the door. Re-locate the door to the desired position and tighten the securing bolts.

STRIKER PLATE ADJUSTMENT

1. Ensure that the rubber weather seal surrounding the lock area is in position.
2. Ensure that the door is correctly aligned in the door aperture.
3. From inside the vehicle, with the door partially open, hold a pencil on the inner surface of the door so that it projects beyond the lock edge just above the striker.
4. Slowly close the door so that the pencil marks a line on the body pillar, ensuring that the pencil does not move relative to the door.
5. Set the top of the striker plate parallel to the pencil line, do not fully tighten the fixing screws.
6. Gently close the door to ease the striker to its correct height. Open the door and check that the striker is still parallel to the pencil line.

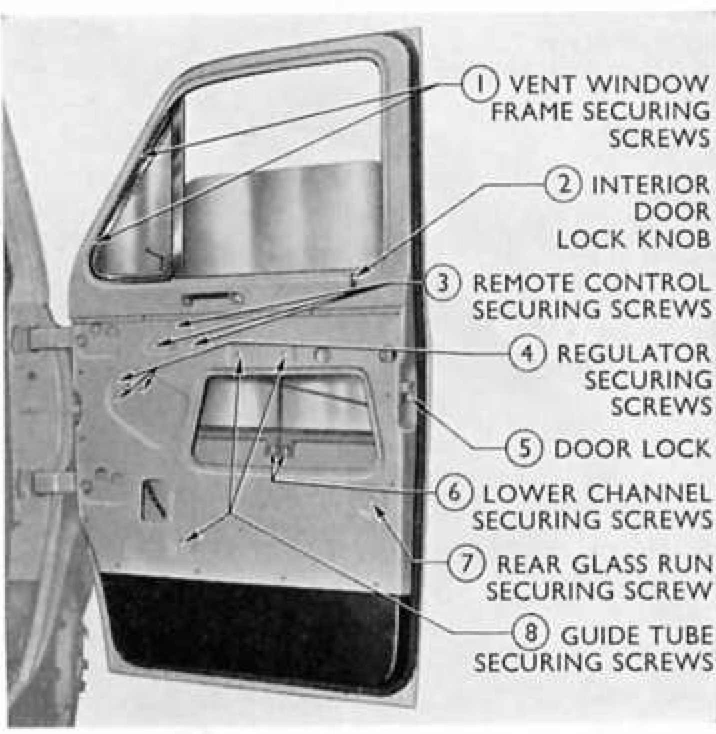


Fig. 5
View of Offside Door

7. Repeat operations 5 and 6 until the lock striker remains parallel to the pencil line. Fully tighten the striker plate fixing screws to 0.97 to 1.24 kg.m. (7 to 9 lb. ft.).

8. Close the door with moderate effort. Two distinct clicks should be heard and the door outer panel should be flush with the outer face of the body pillar. If only one click is heard, move the striker out until door closing gives two clicks and the door panel is flush (ensure that the height and level setting is not disturbed).

THE DOOR VENT WINDOW ASSEMBLY

The door vent window assembly can be removed without removing the door window glass.

To Remove

1. Lower the window and remove the interior handles, trim panel and plastic sheet (see Door Interior Handles—To Remove and Door Trim Panel).

2. Remove the bolt securing the bottom of the vent window dividing channel.

3. Open the vent window fully and remove the two self-tapping screws, securing the vent window outer frame to the door frame (see Fig. 5).

4. Remove the vent window assembly by pulling the top edge towards the rear of the door and withdrawing the assembly through the window aperture (see Fig. 6).

To Dismantle

1. Drill out the two rivets securing the upper pivot hinge.

2. Remove the vent window lower pivot stud clamp bolt and prise off the clamp (see Fig. 6).

3. Remove the vent window and inner frame from the outer frame.

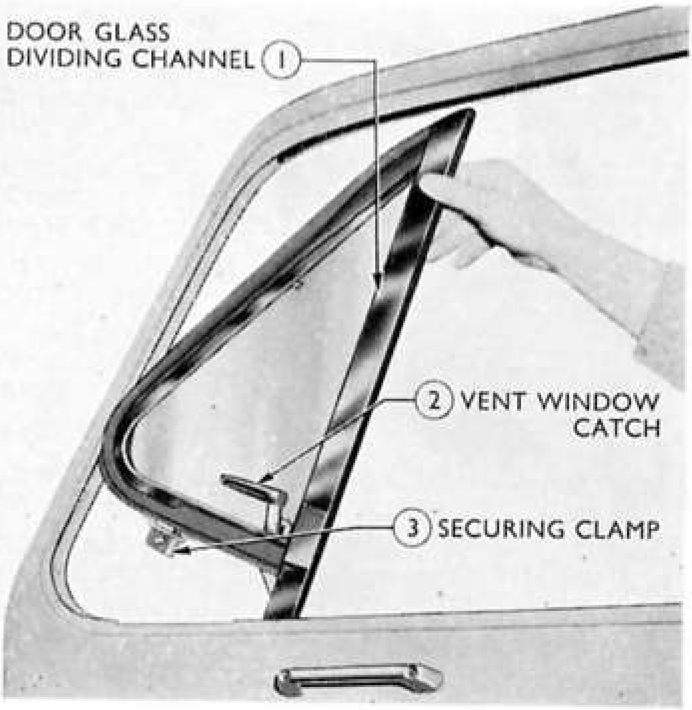


Fig. 6
Removing the Vent Window Assembly

4. The outer frame weatherstrip may then be pulled out from the retaining channel.

To Reassemble

1. Apply soft soap, glycerine or tallow to the rubber weatherstrip and position it in the channel in the outer frame.

2. Refit the glass and inner frame within the outer frame, passing the lower pivot stud through the hole in the bottom of the outer frame.

3. Refit the window upper hinge and retain it with two pop rivets.

4. Replace the lower pivot clamp and bolt.

To Replace

1. Position the vent window assembly in the door frame, ensuring that the door glass is correctly located in the vent window dividing channel.

2. Tap the top of the vent window assembly into position in the door frame and secure it with two self-tapping screws.

3. Secure the lower end of the vent window dividing channel to the door inner panel.

4. Replace the plastic sheet, trim panel and interior handles (see Door Trim Panel and Door Interior Handles—To Replace).

THE DOOR VENT WINDOW GLASS

The door vent window glass may be changed without removing the vent window assembly from the door.

To Remove

1. Open the vent window and at the top rear corner of the frame insert a screwdriver covered with a piece of soft cloth, between the vent window frame and window glass.

2. Gently prise the glass downwards out of the vent window frame to release the top section of the glass.

3. Holding the glass firmly, insert the covered screwdriver between the vent window frame and glass at the bottom rear corner of the frame.

4. Gently prise the bottom of the glass upwards out of the vent window frame and remove the glass and weatherstrip as an assembly.

To Replace

1. If the glass is being replaced due to accident damage, carefully clean any shattered glass which may be present within the window channel.

2. Assuming that the vent window catch pivot shaft has been retained from the shattered glass, carefully clean any fragments of glass which may be present and using a suitable drift, separate the two parts of the pivot shaft.

3. Locate the pivot shaft in the new window glass and slide the securing washer into position over the shaft. Support the outside face of the shaft on a wooden block covered with soft cloth and using a suitable drift carefully tap the securing washer down the shaft, until the shaft is firmly located in the glass.

4. Fit a length of rubber weatherstrip around the glass, with a thin film of adhesive on both sides, ensuring that it is not buckled or twisted. Place the glass and fitted weatherstrip into the vent window inner frame.

5. Carefully push the glass and weatherstrip into the frame so that the lower portion is correctly located with the upper portion of the frame, tilted inwards towards the body.

6. Place a screwdriver covered with a cloth on the top edge of the glass and beneath the upper end of the window frame and carefully prise the frame upwards. At the same time, align the upper section of the glass and when correctly positioned, allow the frame to return to its normal position.

7. Trim off any excess weatherstrip and clean off any surplus adhesive.

THE DOOR VENT WINDOW CATCH

To Remove

NOTE.—Care must be taken when carrying out the following operations to ensure that the vent window glass is not fractured, as the catch is secured to the glass and not the frame.

1. Shut the vent window and using a suitable pin punch, tap out the pin securing the vent window catch to its pivot shaft in the vent window.

2. Withdraw the catch and wave washer from the pivot shaft.

To Replace

1. Locate the wave washer and catch on the vent window pivot shaft and replace the securing pin.

THE DOOR WINDOW GLASS

To Remove

1. Open the window and remove the interior handles, trim panel and plastic sheet (see Door Interior Handles — To Remove and Door Trim Panel).

2. Remove the vent window assembly (see Door Vent Window—To Remove).

3. Remove the inner and outer weatherstrips from the lower edge of the window aperture.

4. Temporarily replace the window winder handle and wind the window up approximately halfway.

5. Support the window glass and remove the two crosshead screws, spring and flat washers securing the door glass lower channel to the window regulator connecting plate (see Fig. 5).

6. Remove the window glass through the window aperture (see Fig. 7).

To Replace

1. Position the window glass in the door through the window aperture.

Fig. 7
Removing the Door Window Glass

2. Secure the door glass window lower channel to the window regulator connecting plate with two crosshead screws, spring and flat washers.

3. Wind the window down and refit the vent window assembly (see Vent Window—To Replace).

4. Replace the inner and outer weatherstrips in the lower edge of the window aperture.

5. Remove the window winder handle and replace the plastic sheet and trim panel (see Door Trim Panel).

6. Replace the interior handles (see Door Interior Handles—To Replace).

THE DOOR WINDOW REGULATOR

The window regulator consists of a remote control mechanism coupled to a spiral flexible cable drive, running in a split guide tube. The reduction gear in the remote control mechanism acts directly on the spirals of the flexible cable. The flexible cable is connected to the door glass lower channel so that when the remote control handle is rotated the cable raises or lowers the window glass.

To Remove

1. Partly open the window and remove the interior handles (see Door Interior Handles—To Remove).

2. Remove the trim panel and plastic sheet (see Door Trim Panel).

3. Support the door window and remove the two crosshead screws, spring and flat washers securing the door window lower channel to the window regulator connecting plate.

4. Lower the window to the bottom of the door and remove the three crosshead screws, spring and flat washers securing the remote control mechanism to the door inner panel (see Fig. 5).

5. Remove the three crosshead screws, spring and flat washers securing the flexible drive guide tube assembly to the door inner panel (see Fig. 5).

6. Remove the bolt securing the bottom of the vent window dividing channel.

7. Lower the window regulator assembly to the bottom of the door, ensuring that the flexible drive guide tube clears the vent window dividing channel.

8. Remove the window regulator assembly through the door access hole.

To Replace

1. Locate the window regulator in position through the door access hole.

2. Replace the bolt securing the bottom of the vent window dividing channel.

3. Replace the three crosshead screws, spring and flat washers securing the flexible drive guide tube assembly to the door inner panel.

4. Replace the three crosshead screws, spring and flat washers securing the remote control mechanism to the door inner panel.

5. Slide the window glass up the door runs until the door glass lower channel lines up with the window regulator connecting plate. Secure the channel to the connecting plate with two crosshead screws, spring and flat washers.

6. Replace the plastic sheet, trim panel and interior handles (see Door Trim Panel and Interior Handles—To Replace).

THE DOOR PULL HANDLE

The door pull handles are located on the top of the door inner panel and are secured by two crosshead screws and spring washers.

THE REAR DOORS

THE DOOR TRIM PANEL (where fitted)

An interior trim panel covers the access hole to the door interior mechanisms, it can be detached by removing the door interior handle and pulling the trim panel away from the door frame.

THE DOOR INTERIOR HANDLE (where fitted)

The door interior handle can be removed by unscrewing a crosshead screw and spring washer located in the centre of the handle boss.

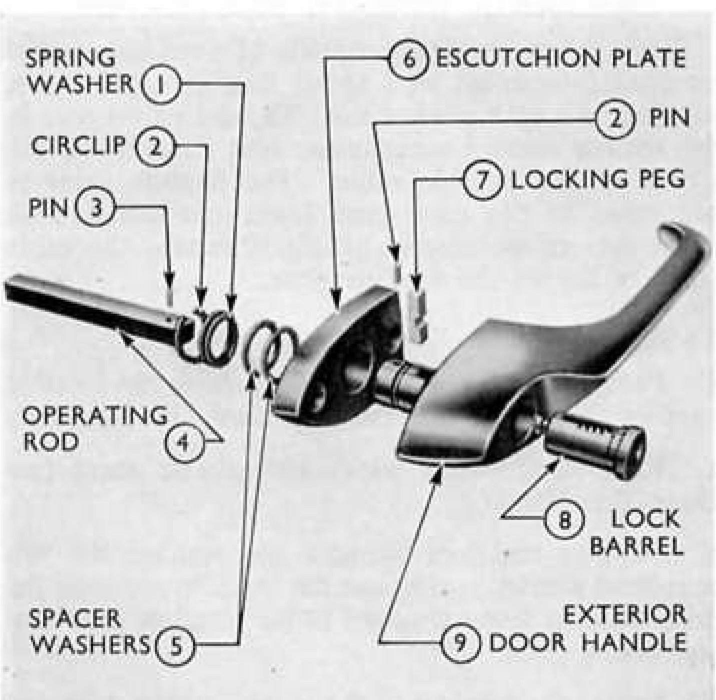


Fig. 8
The Rear Door Handle

THE DOOR EXTERNAL HANDLE

To Remove

1. Where fitted, remove the door interior handle (see Interior Door Handle).

2. Turn the exterior handle into the open position and remove the two crosshead screws securing the handle to the door.

3. Withdraw the handle from the door.

To Replace

1. Engage the door handle spindle into the lock and secure the handle with two crosshead screws.

2. Where fitted, replace the door interior handle and secure it to the exterior handle spindle with a crosshead screw and spring washer.

NOTE.—A change was made in the design of the outside locking handle in May 1967. If it is required to fit a new handle to earlier vehicles, the following modification will be necessary.

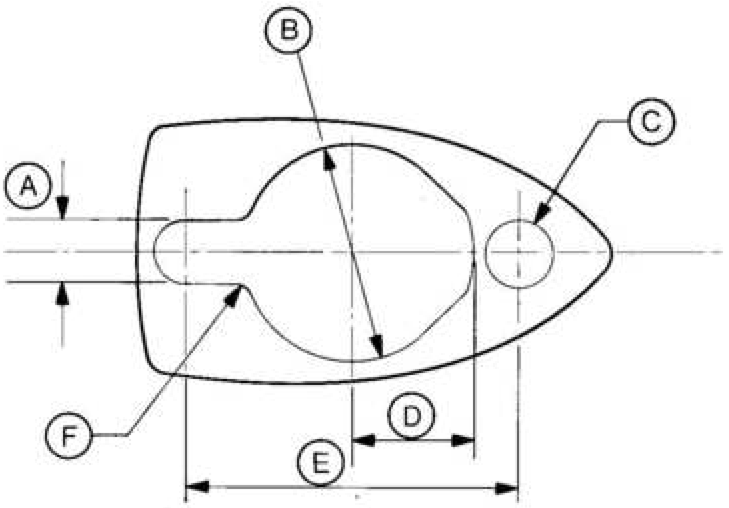
Make up a template as shown in Fig. 9, locate it in position on the door and mark the area to be cut out.

Mask off the surrounding paint area to avoid scratching and, using a rotary drill file, cut the access hole to the new shape. This will involve cutting through the wall of the reinforcing bracket to a depth of 2.54 mm. (0.1 in.).

It may also be necessary to increase the 22.1 mm. (0.87 in.) dia. hole in the reinforcing bracket, to accommodate the increased diameter retaining ring on the handle shaft.

THE DOOR PRIVATE LOCK

An additional control or private lock is fitted to the rear doors. Operated by the ignition key, it is located in the centre of the door exterior handle.



A=7.94 mm. (0.3125 in.) D=17.4 mm. (0.685 in.)
B=31.75 mm. (1.25 in.) dia. E=47.23 mm. (1.860 in.)
C=7.94 mm. (0.3125 in.) dia. F=3.175 mm. (0.125 in.) rad.

Fig. 9

To Dismantle

1. Remove the door exterior handle (see Door Exterior Handle—To Remove).

2. Remove the circlip, spring and spacer washers from the door handle boss and withdraw the escutcheon plate from the handle (see Fig. 8).

3. Tap out the pin securing the square section operating rod and remove the rod.

4. Tap out the pin securing the lock barrel in the door handle and remove the barrel (see Fig. 8).

5. Remove the locking peg from the door handle boss (see Fig. 8).

To Reassemble

1. Replace the locking peg in the slot provided in the door handle boss, ensuring that the slot in the peg faces towards the handle.

2. Slide the lock barrel into the door handle boss, ensuring that the operating pin on the end of the barrel engages in the slot provided in the locking peg.

3. Secure the lock barrel in the handle boss with a pin.

4. Replace the square section operating rod in the handle boss and secure with a pin.

5. Replace the escutcheon plate, spring and spacer washers and secure them with a circlip.

6. Replace the door handle (see Door Exterior Handle—To Replace).

THE DOOR LOCK

To Remove

1. Where fitted, remove the interior handle and escutcheon plate (see Door Interior Handle).

2. Remove the interior trim panel (Bus and Kombi only).

3. Unscrew and remove the three crosshead screws securing the lock assembly to the door inner panel.

4. Unscrew the nylon guide bush located in the bottom edge of the door.

5. Withdraw the lock assembly from the door.

To Replace

1. Locate the lock assembly in the door, ensuring that the top and bottom locking rods are correctly positioned in their respective holes in the door inner frame.

2. Replace the nylon guide bush in the bottom of the door.

3. Secure the lock assembly to the door with three crosshead screws.

4. Replace the interior trim panel (Bus and Kombi only), door handle and escutcheon plate (see Door Interior Handle).

DOOR ALIGNMENT

The rear doors, each hung on two hinges, are secured to the rear body side panel and the door outer frame. If necessary, adjustment to the door within the aperture should always be on the hinges. Any necessary adjustment can be carried out in the following manner:—

1. Carry out a visual examination, to determine whether the door will need to be moved within the body aperture.

2. To lift or lower the door slacken the bolts securing the hinge to the door. Re-locate the door to the desired position and tighten the securing bolts.

DOOR WINDOW GLASS (where fitted)

Removal and fitting procedures for the fixed windows on both the rear doors is identical. In each case the assembly consists of a toughened window glass and a rubber weatherstrip.

To Remove

1. From inside the vehicle, using a lipping tool or screwdriver with all sharp edges removed, force the inner lip of the weatherstrip over the window aperture flange.

2. When approximately two-thirds of the weatherstrip has been treated in this manner, push the glass and weatherstrip out of the door frame as an assembly.

To Replace

1. Fill the groove in the weatherstrip which is to receive the glass with a suitable sealer.

2. Fit the weatherstrip to the glass and insert a cord in the weatherstrip to door groove, so that the cord ends emerge at the bottom centre, allowing a cross-over of approximately 15 cm. (6 in.).

3. Apply a suitable semi-liquid sealer to the rubber to door section of the weatherstrip, if necessary, securing the weatherstrip to the glass with short lengths of masking tape stuck over the rubber and secured to both sides of the glass.

4. From the outside locate the window glass and the weatherstrip assembly centrally in the aperture, ensuring that the two cord ends are hanging loose within the body.

5. Push the assembly up until the groove in the weatherstrip engages the lower transverse lip of the body aperture, and push the window firmly in at the top. From inside the vehicle, pull out the cord, pulling always towards the centre of the glass. Remove any masking tape used to secure the weatherstrip one piece at a time, immediately before the weatherstrip lip is positioned over the aperture flange.

6. On reaching the top centre of the window, start pulling the other end of the cord, repeating the above operations. As the cord is withdrawn, apply pressure to the outside of the window in the immediate area of the cord, to ease the window into position. When the cord has been withdrawn, it may be necessary to work the rubber weatherstrip either side of the glass to obtain even seating of the weatherstrip.

7. Clean off any surplus sealer or lubricant from the glass and weatherstrip.

SIDE LOADING DOOR (Hinged Type)

THE DOOR TRIM PANEL (where fitted)

See Driver and Passenger door (Hinged).

THE DOOR INTERIOR HANDLE (where fitted)

The interior lock remote control handle and escutcheon plate is secured by a crosshead screw and shakeproof washer located centrally in the handle boss.

THE DOOR EXTERNAL HANDLE

See Driver and Passenger door (Hinged).

THE DOOR PULL HANDLE (where fitted)

See Driver and Passenger door (Hinged).

THE DOOR PRIVATE LOCK (where fitted)

See Driver and Passenger door (Hinged).

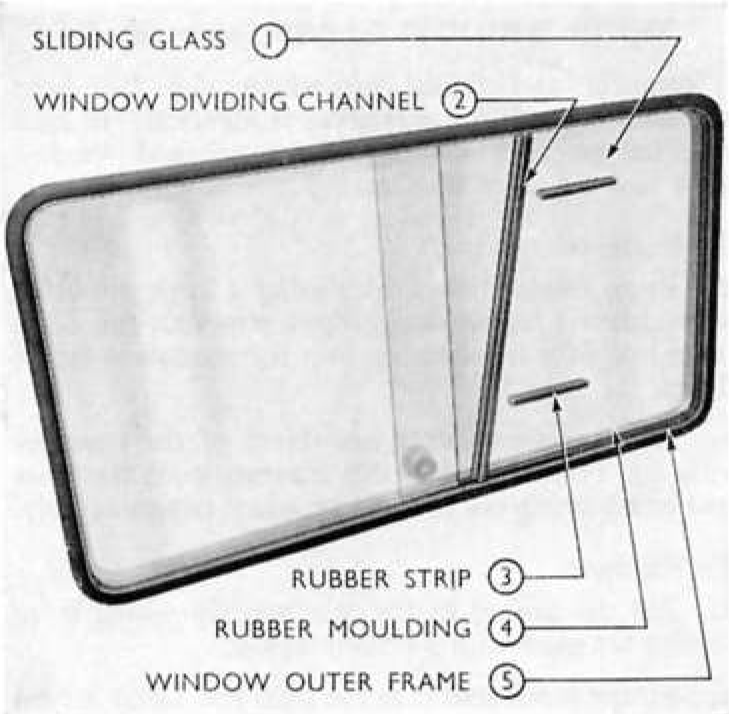


Fig. 10
Sliding Window Assembly

THE DOOR LOCKS AND REMOTE CONTROL MECHANISM

See Driver and Passenger Door (Hinged).

THE DOOR ALIGNMENT AND LOCK ADJUSTMENT

See Driver and Passenger door (Hinged).

FITTING AND ADJUSTING THE STRIKER PLATE

See Driver and Passenger door (Hinged).

THE SLIDING WINDOW (where fitted)

To Remove

1. From inside the vehicle, using a lipping tool or screwdriver with all sharp edges removed, force the inner lip of the sliding window rubber moulding over the window aperture flange.

2. When approximately two-thirds of the moulding has been treated in this manner, from inside the vehicle, push out the sliding window, metal frame and rubber moulding as an assembly.

To Dismantle

1. Pull out two short lengths of rubber strip from the top and bottom inner face of the rubber moulding (see Fig. 10).

2. Using a rubber mallet, gently tap out the window dividing channel (see Fig. 10).

3. Grip the top edge of the outer frame, lift the frame upwards and prise the windows out of their grooves in the frame.

To Reassemble

1. Locate the lower edges of the two windows in their respective grooves in the frame.

2. Grip the top edge of the frame, pull upwards and prise the windows into position.

3. Re-locate the window dividing channel and gently tap into position, using a rubber mallet.

4. Replace the two short lengths of rubber strip in the top and bottom inner face of the frame.

To Replace

1. Apply a suitable semi-liquid sealer to the frame to door groove and insert a cord in the groove so that the cord ends emerge at the bottom centre, allowing a cross-over of approximately 15 cm. (6 in.).

2. From the outside locate the sliding window assembly centrally in the door aperture, ensuring that the cord ends are hanging loose within the body.

3. Push the assembly up until the groove in the weatherstrip engages the lower transverse lip of the door aperture and push the window firmly in at the top. From inside the vehicle pull out the cord, pulling always towards the centre of the glass. Upon reaching the top centre of the window, start pulling out the other end of the cord repeating the above operations. As the cord is withdrawn, apply pressure to the outside of the window in the immediate area of the cord, to ease window into position.

4. Clean off any surplus sealer or lubricant from the glass and weatherstrip.

SIDE WINDOWS, FIXED TYPE (where fitted)

To Remove

1. From the inside of the vehicle, using a lipping tool or a screwdriver with all sharp edges removed, push the inner lip of the weatherstrip under the aperture flange. When approximately two-thirds of the weatherstrip lip has been treated in this manner, apply pressure to the glass from the inside and push out the glass and weatherstrip as an assembly

2. Carefully remove the weatherstrip from the glass.

To Replace

1. Fill the groove which is to receive the glass with a suitable sealer.

2. Fit the weatherstrip to the glass.

3. Fit a length of cord in the weatherstrip groove so that the cord ends emerge at the bottom centre allowing a cross-over of the cord of approximately 15 cm. (6 in.).

4. Apply a suitable sealer to the weatherstrip to door section. If necessary, secure the weatherstrip to the glass with short lengths of masking tape stuck over the weatherstrip and secured to both sides of the glass.

5. From outside offer the assembly to the aperture, top edge first, ensuring that the cord ends are hanging inside the body. Push the assembly firmly from the outside, at the same time pull out the cord, pulling always towards the centre of the glass.

6. Remove any masking tape used to secure the weatherstrip, one piece at a time, immediately before the weatherstrip is positioned over the aperture flange in this location. Upon reaching top centre of the window, start pulling out the other end of the cord, repeating the above operations. It may be necessary to work the weatherstrip either side of the window glass in order to obtain an even seating, for the glass and weatherstrip.

7. Clean off any surplus sealer from the glass and weatherstrip.

THE SIDE WINDOW, HINGED TYPE (where fitted)

The window consists of a window glass and frame pivoting on two rubber inserts secured to the window dividing pillar (see Fig. 11).

To Remove

1. Remove two self-tapping screws securing the window catch to the body.

2. Open the window and place a screwdriver covered with a soft cloth between the window frame and window dividing pillar and carefully prise the frame out of the rubber inserts (see Fig. 11).

3. Remove the window and frame from the vehicle as an assembly.

4. Remove the weatherstrip from the window aperture.

To Replace

1. Apply a suitable semi-liquid sealer to the rubber to body groove of the weatherstrip.

2. Locate the weatherstrip in position around the window flange and press firmly into position.

3. Engage the window frame lugs in the pillar rubber inserts and carefully tap the window assembly into position (see Fig. 11).

4. Position the window catch on the body and secure it with two self-tapping screws.

Fig. 11
Hinged Window and Frame Assembly

DRIVER AND PASSENGER DOOR (Sliding Type)
(All Models)

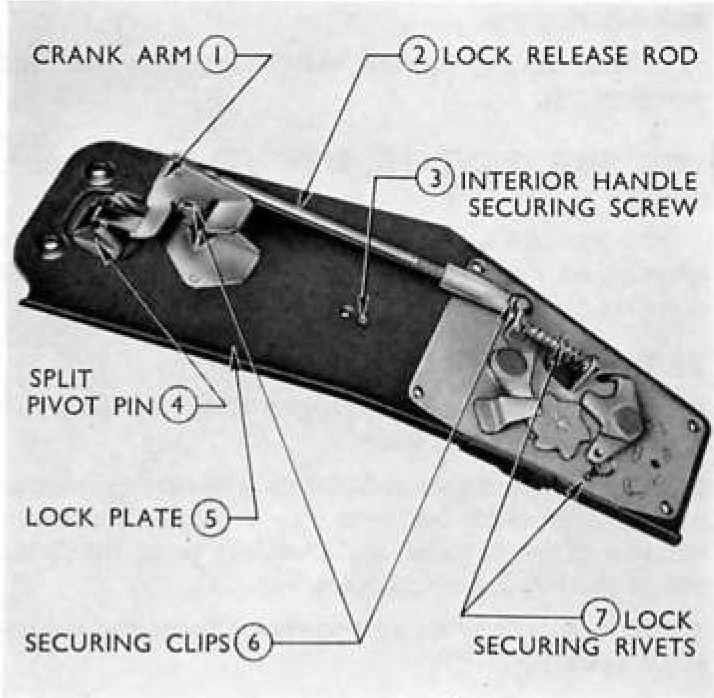


Fig. 12
Sliding Door Lock

THE DOOR EXTERIOR HANDLE

To Remove

1. Remove two crosshead screws and spring washers, four bolts, spring and flat washers securing the lock plate to the door.

2. Remove one crosshead screw and spring washer from the lower end of the door interior handle, remove the interior handle, lock and lock plate as an assembly (see Fig. 12).

3. From inside the door remove three crosshead screws, spring and flat washers securing the door exterior handle and remove the handle.

Ensure that the two rubber gaskets are retained for further use when the door handle is removed.

To Dismantle

1. Remove the circlip from the door handle housing and remove the end plate and spring.

2. Slide the lock barrel, sleeve and adjusting screw out of the door handle housing.

3. Remove the rubber sealing grommet from the lock sleeve.

4. Unscrew and remove the adjusting screw and withdraw the rear section of the lock barrel.

5. Insert the key into the lock and separate the lock barrel and sleeve.

To Reassemble

1. Insert the key in the lock and slide the lock into position in the sleeve.

2. Replace the rear section of the lock and secure with the adjusting screw.

3. Replace the rubber sealing gasket around the lock sleeve.

4. Slide the lock and spring into the door handle housing.

5. Replace the end plate and secure with a circlip.

To Replace

1. Locate the door handle in position, ensuring that the rubber sealing gaskets are correctly located and from the inside of the door secure the handle with three crosshead screws, spring and flat washers.

2. Replace the door interior handle, lock and lock plate as an assembly and secure with one crosshead screw and spring washer in the lower end of the door interior handle.

3. Replace two crosshead screws and spring washers, four bolts, spring and flat washers securing the lock plate to the door.

THE DOOR INTERIOR HANDLE

To Remove

1. Remove two crosshead screws and spring washers, four bolts, spring and flat washers securing the lock plate to the door (see Fig. 12).

2. Remove one crosshead screw and spring washer from the lower end of the door interior handle and remove the interior handle, lock and lock plate as an assembly (see Fig. 12).

3. Remove the clip securing the lock release crank arm to the lock plate (see Fig. 12).

4. Remove the screw from the lower end of the handle and remove the handle from the lock plate (see Fig. 12).

5. Drive out the split pivot pin securing the release lever and return spring to the door handle and withdraw the lever and spring from the handle (see Fig. 12).

To Replace

1. Replace the release lever and return spring in the door handle and secure them with a split pivot pin.

2. Locate the interior handle on the lock plate and secure it with a screw.

3. Replace the lock release crank arm and secure it with a clip.

4. Replace the door interior handle, lock and lock plate in position on the door and secure them with one crosshead screw and spring washer in the lower end of the door interior handle.

5. Replace the two crosshead screws and spring washers, four bolts, spring and flat washers securing the lock plate to the door.

THE DOOR LOCK

To Remove

1. Remove the door interior handle and lock plate (see Door Interior Handle—To Remove).

2. Remove the clips securing the lock interior release rod to the lock mechanism and the crank arm and remove the rod (see Fig. 12).

3. Drill out two pop rivets securing the lock mechanism to the lock plate and remove the lock mechanism (see Fig. 12).

To Replace

1. Locate the lock mechanism on the lock plate and secure it with two pop rivets.

2. Replace the lock interior release rod on the lock mechanism and secure with a clip (see Fig. 12).

3. Replace the door interior handle and lock plate (see Door Interior Handle—To Replace).

THE STRIKER PLATE (FRONT)

To Remove

1. Remove three self-tapping screws securing the striker plate plastic cover to the striker plate mounting bracket and remove the cover.

2. Remove two crosshead screws and spring washers securing the striker plate to the striker plate mounting bracket.

3. Remove the four crosshead screws securing the striker plate mounting bracket to the door front pillar and remove the bracket.

To Replace

1. Locate the striker plate mounting bracket in position on the front pillar and secure it with four crosshead screws.

2. Replace the striker plate on the striker plate mounting bracket and secure it with two crosshead screws and spring washers.

3. Replace the striker plate plastic cover and secure it with three self-tapping screws.

THE STRIKER PLATE (REAR)

To Remove

1. Remove three crosshead screws and spring washers securing the striker plate to the door rear pillar and remove the striker plate.

To Replace

1. Locate the striker plate on the door rear pillar and secure with three crosshead screws.

THE DOOR

To Remove

1. From underneath the door remove four bolts, spring and flat washers securing the two door lower guide brackets.

2. Drill out five pop rivets securing the interior upper draught excluder strip to the upper body framework and remove the strip.

3. Close the door and from the inside of the vehicle slacken the two crosshead screws securing the door front upper guide plate (see Fig. 13).

4. Remove the two screws securing the rear guide tension plate and remove the plate and tension spring (see Fig. 13).

5. Remove the door by lifting upwards and outwards to disengage the door runners from the door upper guide channel.

To Dismantle

1. Remove the two crosshead screws and spacer washers securing the door front upper guide plate and remove the plate (see Fig. 13).

2. Remove two nuts, bolts, spring and spacer washers securing the front upper roller and remove the roller (see Fig. 13).

3. Remove four bolts, spring and flat washers securing the rear upper roller mounting bracket and cover plate and remove the bracket and plate as an assembly (see Fig. 13).

4. Remove one crosshead screw and spring washer securing the cover plate to the rear upper roller mounting bracket and remove the plate (see Fig. 13).

5. Remove two bolts, spring and flat washers securing the rear upper roller to the mounting bracket and remove the roller (see Fig. 13).

6. Drill out five pop rivets securing the lower draught excluder to the door inner panel and remove the draught excluder.

To Reassemble

1. Re-locate the lower draught excluder on the door inner panel and secure it with five pop rivets.

2. Replace the rear upper roller on its mounting bracket and secure it with two bolts, spring and flat washers.

3. Replace the cover plate on the rear upper mounting bracket and secure it with one crosshead screw and spring washer.

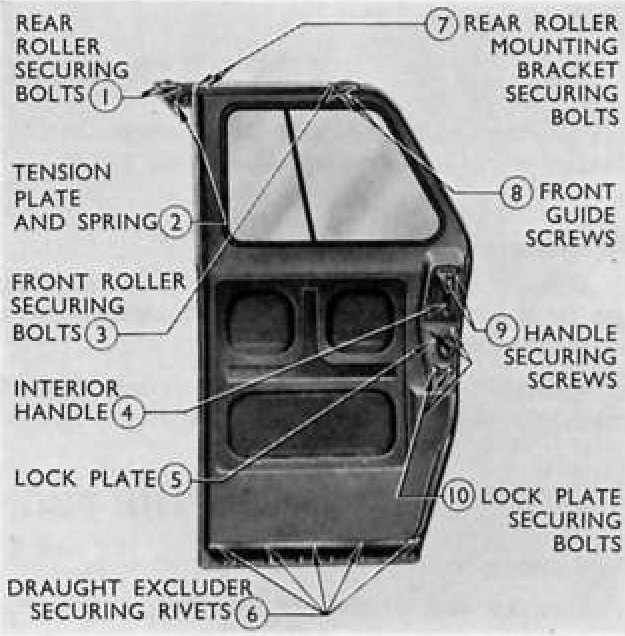


Fig. 13
Sliding Door Off Vehicle

4. Replace the rear upper roller mounting bracket and cover plate and secure them to the door with four bolts, spring and flat washers.

5. Replace the front upper roller on the door frame and secure it with two nuts, bolts, spring and spacer washers.

6. Replace the door front upper guide plate and secure it with two crosshead screws and spacer washers.

To Replace

1. Re-locate the door on the door upper track.

2. Replace the rear guide tension plate and spring and secure it with two screws.

3. Close the door and frcm the inside, tighten the two crosshead screws securing the door front upper guide plate.

4. Replace the interior upper draught excluder strip and secure it with five pop rivets.

5. Replace the two lower guide brackets on the bottom edge of the door and secure them with four bolts, spring and flat washers.

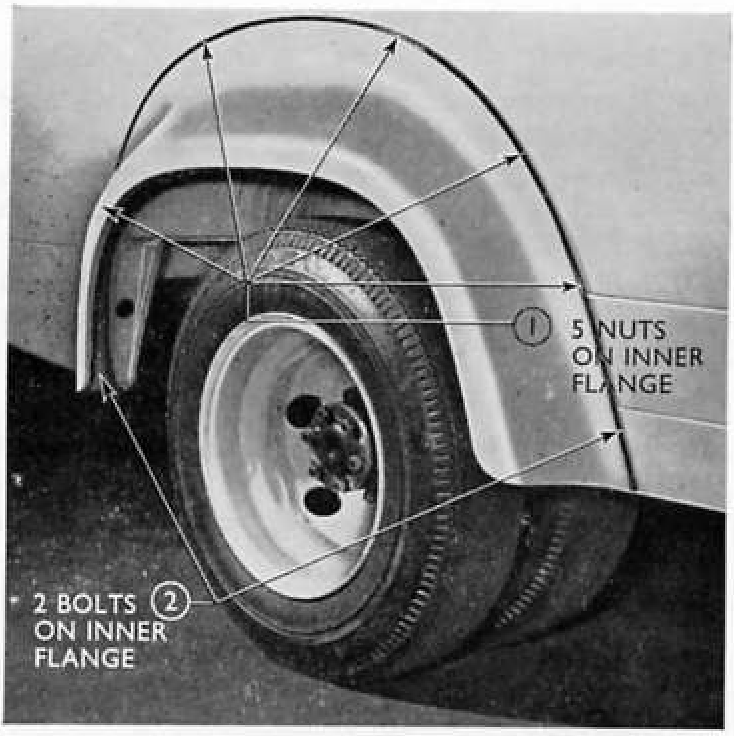


Fig. 14
The Rear Mudguards

THE UPPER TRACK

To Remove

1. Remove three nuts and spring washers securing the front end of the upper track to the body.

2. Remove four bolts and spring washers securing the rear end of the upper track and remove the track from the vehicle.

To Replace

1. Locate the upper track in position on the body and secure the rear end with four bolts and spring washers.

2. Secure the front end of the track with three nuts and spring washers.

THE LOWER TRACK

To Remove

1. Remove six bolts, spring and flat washers securing the lower track to the underbody and remove the track.

To Replace

1. Locate the lower track in position on the underbody and secure it with six bolts, spring and flat washers.

THE RUBBER WEATHERSTRIP

This is a three-piece weatherstrip consisting of a steel and rubber strip and is secured to the rear edge of the door aperture by fifteen pop rivets.

THE REAR MUDGUARDS (where fitted)

The rear mudguard may be removed without disturbing any of the surrounding body panels.

To Remove

1. Remove two bolts, spring and flat washers, one from each lower edge of the mudguard inner flange (see Fig. 14).

2. Remove five nuts, spring and flat washers situated around the mudguard inner panel (see Fig. 14).

3. Pull the mudguard away from the vehicle and remove it and the anti-squeak strip as an assembly.

To Replace

1. Position the anti-squeak strip on the mudguard and locate the mudguard on the vehicle.

2. Replace the two bolts, spring and flat washers securing the lower ends of the mudguard inner flange.

3. Replace the five nuts, spring and flat washers situated around the mudguard inner flange.

THE FRONT BUMPERS

To Remove

1. Unscrew and remove the four nuts, spring and flat washers securing the bumper irons to the vehicle.

2. Remove the bumper and irons from the vehicle as an assembly.

To Replace

1. Locate the bumper and irons in position on the vehicle.

2. Replace the four nuts, spring and flat washers securing the bumper to the vehicle.

THE REAR BUMPERS (where fitted)

To Remove

1. Remove the two nuts, spring and flat washers from each of the two rear bumpers.

2. Remove the bumpers from the vehicle.

To Replace

1. Locate the two rear bumpers on the vehicle.

2. Secure each bumper with two nuts, spring and flat washers.

THE RADIATOR GRILLE PANEL

The radiator grille panel may be removed without disturbing any of the surrounding body panels.

To Remove

1. Remove the four self-tapping bolts from the lower edge of the radiator grille panel (see Fig. 15).

NOTE.—On 125 to 175 diesel engine variants these bolts are replaced by two crosshead screws on the lower grille mounting flange, and are accessible from inside the engine compartment.

2. Remove the pivot bolt securing the bonnet release cable crank arm and disconnect the cable.

Later Models Only

3. Disconnect the wiring loom from the L.H. lamp assemblies.

NOTE.—To disconnect the indicator lamp lead it is necessary to remove the lens and bezel assembly.

4. Remove the loom clips from the radiator grille panel, thread the loom beneath the lock panel and position it aside on the right-hand fender apron. Disconnect the earth location screws at the extreme sides of the grille panel.

5. Pull the horn loom from its locating clips on the upper grille panel, and place to one side. Detach the locating clips.

Early and Later Models

6. Remove the six nuts, spring and flat washers securing the radiator grille panel to the radiator support brackets.

7. Remove the four bolts, spring and flat washers securing the top edge of the radiator grille panel (see Fig. 15).

8. From each side remove two bolts, spring and flat washers securing the radiator grille panel to the front wings (see Fig. 15).

9. From underneath each headlight bezel remove one crosshead screw, spring and flat washer and pull the bezels away from their retaining clips (see Fig. 15).

10. Remove the radiator grille panel from the vehicle.

To Replace

1. Locate the radiator grille panel in position on the front of the vehicle.

2. Replace the two bolts, spring and flat washers securing the grille panel to the front wings.

3. Replace the four bolts, spring and flat washers securing the top edge of the radiator grille panel.

4. Replace the six nuts, spring and flat washers securing the grille panel to the radiator support brackets.

Later Models Only

5. Fit the horn loom retaining clips on the upper grille panel flange, and replace the horn loom.

6. Thread the lighting loom along the top of the grille panel, beneath the lock mounting and reconnect to the L.H. lamp assemblies. Refit the indicator light lens and bezel assembly.

7. Reconnect the earth locating screws at the extreme ends of the grille panel.

Early and Later Models

8. Replace the pivot bolt securing the bonnet release cable crank arm and reconnect the cable.

9. Replace four self-tapping bolts securing the lower edge of the radiator grille panel.

10. Reposition the headlight bezels on their respective retaining clips and secure them with a crosshead screw.

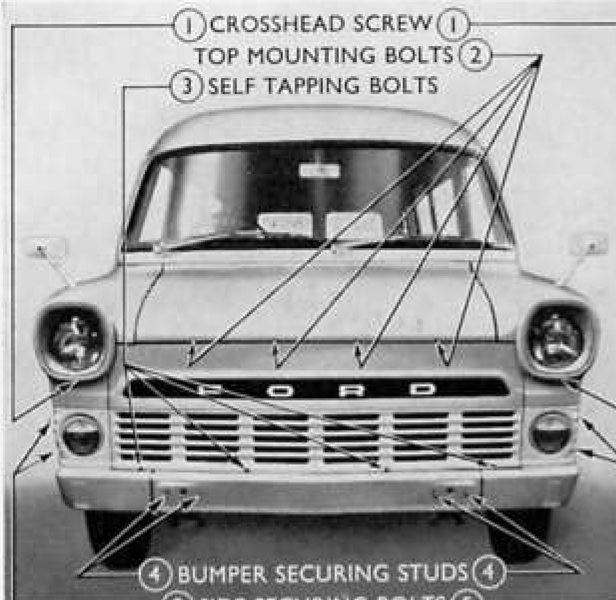


Fig. 15
The Radiator Grille Securing Locations

THE REAR DOOR STEP (where fitted)

To Remove

1. Remove eight nuts, spring and flat washers securing the step support tubes to the underbody.

2. Remove the rear step and support tubes as an assembly.

To Replace

1. Locate the rear step and support tubes in position on the underbody.

2. Secure the step with eight nuts, spring and flat washers.

THE INTERIOR OFFSIDE TRIM PANELS (where fitted)

To Remove

1. Remove the bolts securing the offside seats and remove the seats.

2. Remove the two crosshead screws and cup washers securing the lower edges of the second and third trim panels.

3. Remove the two crosshead screws and cup washers securing the rear edge of the fourth trim panel.

4. Remove the four offside trim panels by pulling the panels away from their securing clips.

To Replace

1. Locate the four trim panels and secure them to the body by pressing the clips into place.

2. Secure the rear edge of the fourth trim panel with two crosshead screws and cup washers.

3. Secure the lower edges of the second and third trim panels with two crosshead screws and cup washers.

4. Replace the four offside seats and secure them to the floor pan with sixteen bolts.

THE INTERIOR NEARSIDE TRIM PANEL (where fitted)

To Remove

1. Remove the bolts securing the nearside seats and remove the seats.

2. Remove the crosshead screw and cup washer securing the front trim panel.

3. Remove the two crosshead screws and cup washers securing the rear trim panel.

4. Remove the two trim panels by pulling them away from their securing clips.

To Replace

1. Locate the trim panels and secure them by pressing the retaining clips into place.

2. Replace the two crosshead screws and cup washers securing the rear trim panel.

3. Replace the two crosshead screws and cup washers securing the front trim panel.

4. Re-locate the seats and secure them to the floorpan.

THE WINDSCREEN

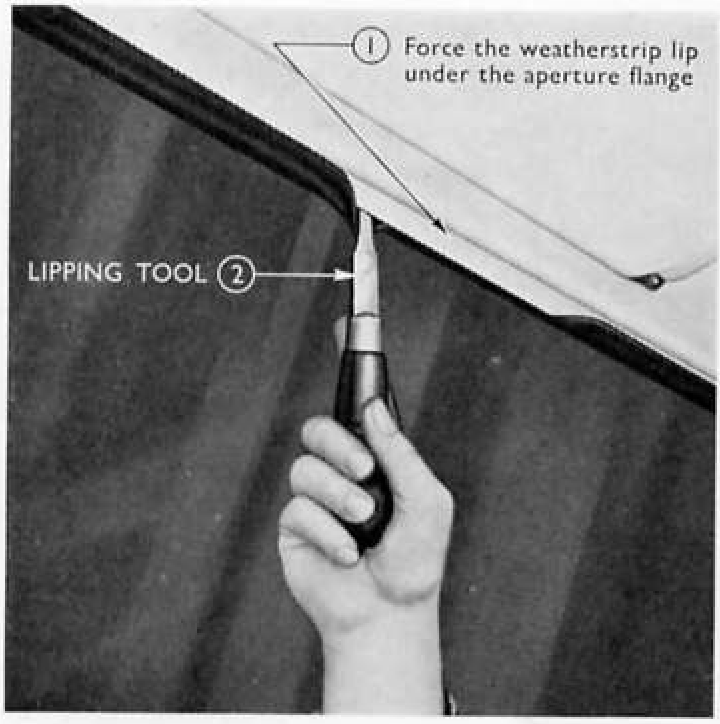


Fig. 16
Removing the Windscreen

The assembly consists of a windscreen glass and weatherstrip. In order that satisfactory sealing against water entry is obtained, it is essential that the correct fitting procedure is adopted.

NOTE 1

Only a suitable permanently flexible sealing material, such as S.R.–51–B manufactured by Expandite Ltd., should be used to seal all fixed windows.

Before removing or refitting windscreen glass, ascertain the type of glass which is being dealt with. Two types are used, "Toughened" or "Laminated", and a close examination of the glass will reveal a distinguishing mark including the words "Toughened" or "Laminated" or 'T' or 'L'. Toughened windscreens have a specially treated zoned area immediately in front of the driver. Since there are different windscreens for Left-Hand and Right-Hand Drive vehicles, the distinguishing mark on the glass incorporates an arrow indicating which side of the windscreen carries the zone.

A rubber mallet can be used to assist in fitting windscreens of toughened glass, but it is essential

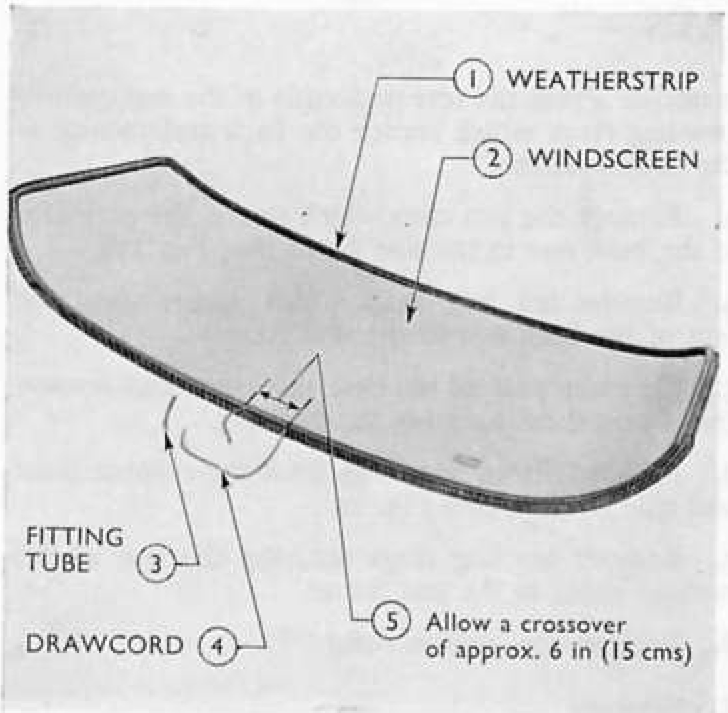


Fig. 17
Fitting the Windscreen Cord

that laminated glass should be treated with extreme care and not subjected to sudden shock or distortion.

To Remove

1. Remove the wiper arms and blades.
2. Using a lipping tool or a screwdriver with all sharp edges removed, from inside the vehicle, force the upper transverse lip of the windscreen weatherstrip under the windscreen aperture flange (see Fig. 16). To accomplish this, it may be necessary to use two or three short flat levers with rounded edges (to avoid damage to the weatherstrip) these may be improvised from lengths of mild steel strip approximately 152 mm. long by 25 mm. wide by 3 mm. thick (6 in. by 1 in. by $\frac{1}{8}$ in.).

Insert the levers behind the upper transverse weatherstrip lip at approximately 5 cm. (2 in.) intervals; when pulled down they will expose the body flange surrounding the windscreen aperture. The weatherstrip then can be forced under this flange until approximately two-thirds of the transverse length has been so treated. From inside the vehicle the glass and weatherstrip can then be pushed out as an assembly.

3. Carefully remove the weatherstrip from the window glass.

To Replace

NOTE 2

If the windscreen glass is being replaced due to accident damage, ensure that the aperture is dimensionally correct and that the aperture flange is free from buckles and protrusions. Carefully clean any shattered glass from the weatherstrip grooves and scrape off any hardened sealer which may be adhering to the weatherstrip or body aperture flange.

1. Fill the groove which is to receive the glass with a suitable sealer (see Note 1).
2. Fit the weatherstrip to the glass.
3. Insert a length of cord into the weatherstrip groove so that the cord ends emerge at the bottom centre, allowing a cross over of approximately 15 cm. (6 in.) (see Fig. 17).

NOTE 3

A short piece of tube, which can be improvised, from a length of petrol feed pipe, can be used to fit the cord. Thread the cord through the tube and insert one end within the weatherstrip groove. Slide the tube along the groove, so feeding the cord into position.

4. Apply suitable sealer to the rubber to body section of the weatherstrip (see Note 1). If necessary secure the weatherstrip to the glass with short lengths of masking tape stuck over the weatherstrip and secured to both sides of the glass.
5. Lubricate the weatherstrip inner lip and the aperture flange with a suitable lubricant such as tallow, glycerine or soft soap.
6. Locate the windscreen and weatherstrip assembly centrally in the aperture, ensuring that the cord ends are hanging loose within the body.

Push the assembly up until the weatherstrip lip engages the lower transverse flange of the body aperture then push the windscreen firmly in at the top.

7. Pull the cord towards the centre of the glass from the inside of the vehicle (see Fig. 18) and remove each piece of masking tape as the weatherstrip is positioned.

As the cord is withdrawn, apply pressure to the outside of the windscreen in the immediate area of the cord to ease the windscreen into position. When the cord has been withdrawn, it may be necessary to work the rubber weatherstrip into position either side of the glass in order to obtain an even seating of the glass and weatherstrip.

8. Clean off any surplus sealer or lubricant from the glass and weatherstrip.

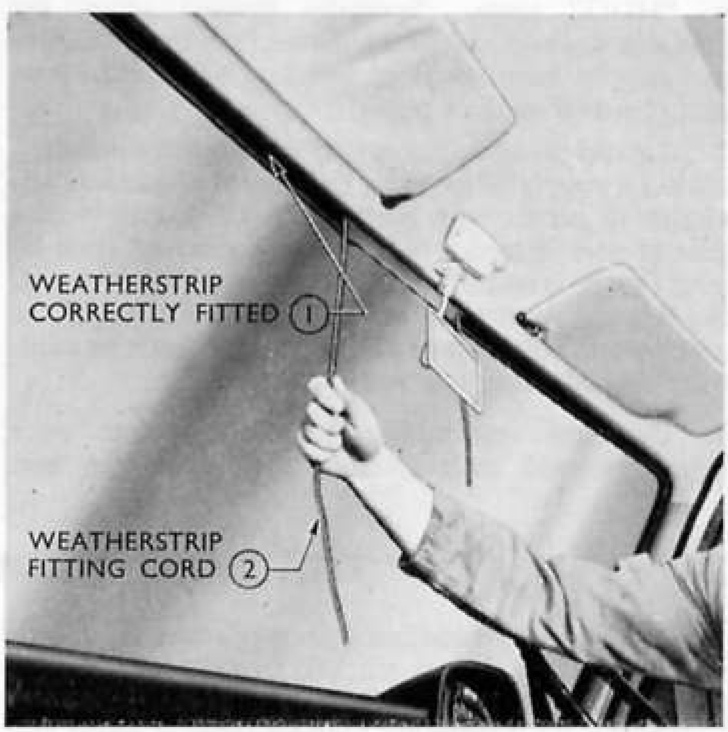


Fig. 18
Fitting the Windscreen

THE SEATS

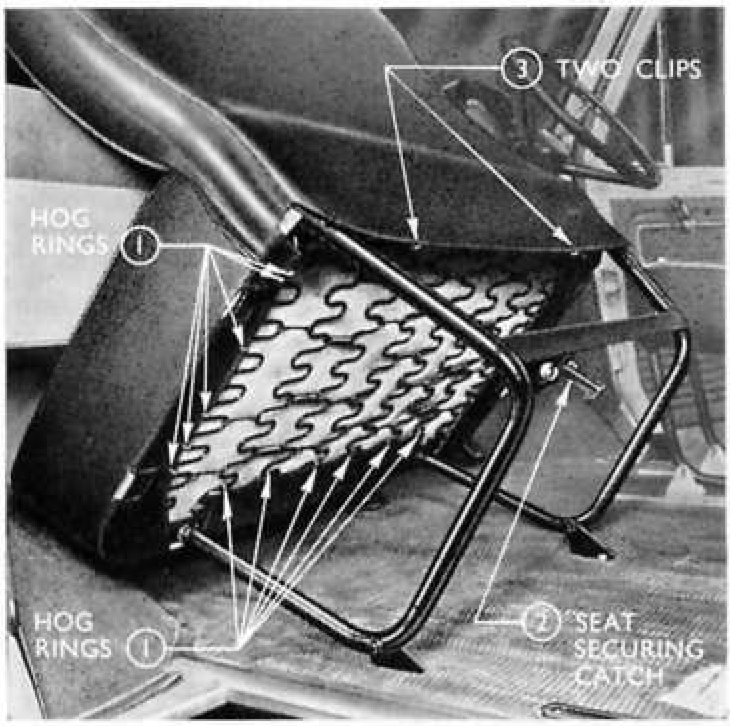


Fig. 19
Seat Cover Securing Clips

As the removal and fitting procedures are similar for all the seats in the range, the only variation being the number of clips and hog rings securing the seat covers to the frames, only one detailed procedure is outlined below.

To Remove

1. Remove the seat from the vehicle.

NOTE 1

The seat covers are secured to the cushion and back rest frame by a number of wire staples known as "HOG" rings. Specially formed pliers are available to close and fasten these clips, but a suitable tool may be improvised by grinding slots in the jaws of a standard type of pliers.

To avoid possible damage to the covering material, should a supply of new hog rings be available it is advisable to cut through each original hog ring with a pair of wire cutters. New hog rings would then be used for the reassembly of the seat cover. However, if the original rings must be retained for further use or wire cutters are not available, each ring must be carefully opened using two pairs of pliers.

2. Place the seat upside down on a clean work bench covered with a cloth to protect the seat material. From the rear underside of the seat remove two hog rings which secure the back rest valance to the cushion frame.

3. Remove the two clips which secure the back face of the back rest to the seat frame (see Fig. 19).

4. Remove ten hog rings which secure the front face of the back rest to the seat frame.

5. Carefully pull off the back rest cover and remove the plastic sheet covering the padding.

6. Remove fifteen hog rings from the cushion front and side borders (see Fig. 19).

7. Remove ten hog rings securing the rear of the cushion cover to the seat frame.

8. Remove the cushion cover.

To Replace

1. Locate the seat cushion cover in position on the seat frame, ensuring that the padding is correctly located and secure the rear edge to the seat frame with ten hog rings.

2. Pull the seat borders down and secure them with eight hog rings, four either side.

3. Pull the material firmly from front to back and secure the front edge of the cover by two hog rings centrally located. Working from the centre, secure the seat cover along the front edge with five more hog rings.

4. Ensure that the back rest padding is correctly located and over the padding place a section of plastic sheeting. Liberally coat the padding corners with liquid soap. Place the back rest cover in position and pull it firmly over the padding.

5. Ensure that the back rest cover is correctly located then tuck the lower edge of the front face of the material behind the seat cushion and secure it to the seat frame with ten hog rings.

6. Secure the back rest cover side valance ends with two hog rings, one either side and the rear face with two clips.

7. Replace the seat.

NOTE 2

If there are any small wrinkles in the material after fitting a new seat cover, they can often be removed by the use of steam iron and a damp cloth on the affected area.

THE FULL HEADLINING (where fitted)

The one-piece headlining is supported by listing wires carried in sleeves stitched to the upper face of the headlining material. Each listing wire locates in a sleeve in the headlining toothed retainer strips and abuts the sound deadener strips secured by adhesive to the underside of the roof panel.

274.3 cm. (108 in.) WHEELBASE (where fitted)

To Remove

1. Remove two self-tapping screws securing the interior rear view mirror.

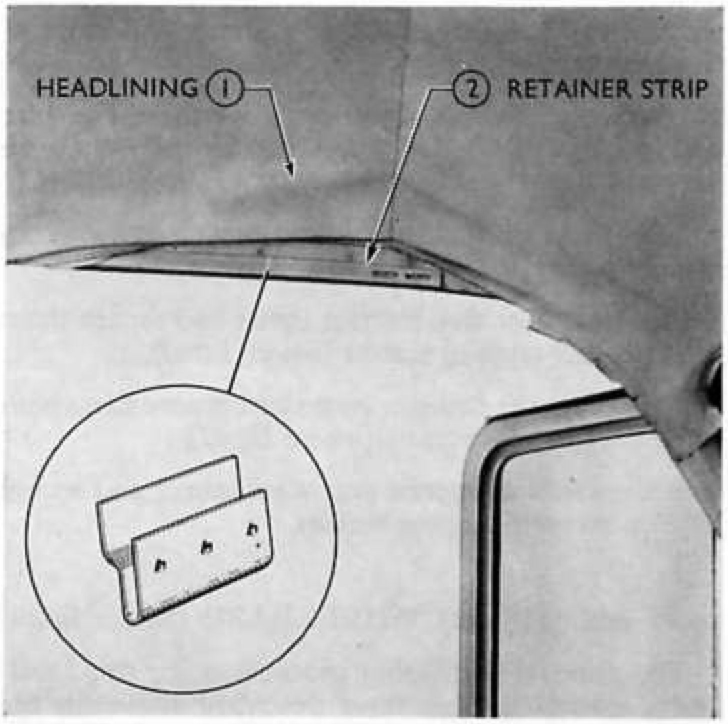


Fig. 20
Headlining Retainer Rail

2. Remove eight self-tapping screws securing the two sun visors (where fitted).

3. Remove ten self-tapping screws securing the five interior lights (where fitted).

4. Remove windscreen and weatherstrip as an assembly (see Windscreen—To Remove).

5. Pull the finish strip away from the door aperture flange and carefully pull the headlining away from the top of the coupe pillars and the windscreen.

6. Insert between the body and the headlining toothed retainer strips, a thin metal blade with all sharp edges removed and gently prise the retainer strips away from the body. (A blunt paint scraper can be used for this operation.) The tool can then be pushed between the retainer strip and body, enabling the headlining to be carefully lifted from the retaining teeth on the back face of the retainer strips (see Fig. 20).

NOTE 1

To avoid damage to the headlining material during this delicate operation, commence to lift the material from the retainer teeth in a location where a sleeve is stitched to the back face. This location can be determined by the stitch join between the panels of the headlining (see Fig. 20) in this manner, detach the headlining along three edges.

The sides and rear edge of the headlining are secured to toothed retainer strips which are spot welded to the upper body framework. The front edge of the headlining is secured by adhesive to the windscreen upper body flange and coupe pillars.

7. The listing wires can then be removed from their sockets in the upper body framework.

8. Remove the headlining and listing wires as an assembly.

To Replace

If the headlining material is to be renewed, ensure that the listing wires are fitted in the correct sleeve. This can be most conveniently carried out by removing the listing wires one at a time from the discarded material and fitting them to the appropriate sleeve of the new. (A generous dusting with powdered chalk will assist in fitting the listing wires to the cotton sleeves.)

The listing wires vary in form and length and are marked with a distinguishing daub of paint. The following list shows the position and colour code of the listing wires, starting from the front of the vehicle.

Position	*Colour*
1	Blue
2	Blue
3	Green
4	Green
5	Yellow
6	Brown
7	Red

NOTE 2

Under cold damp climatic conditions, plastic-covered headlining materials tend to become stiff, making it difficult to obtain a crease and wrinkle-free fitting. To assist in obtaining a satisfactory finish the work should be carried out in a warm 18° to 22°C (65° to 70°F) dry, workshop.

1. Ensure that the listing wires are free to slide within the cotton sleeves and that they are centrally situated, to leave an equal amount of material hanging free at either end. With the material correctly fitted to the listing wires, break the cotton sleeve to allow the ends of the listing wires to protrude with approximately 10 to 15 cm. (4 to 6 in.) of material hanging loose.

2. Locate the first listing wire in its body frame socket, then fit the remaining listing wires in their respective locations.

3. Pull the headlining material from front to back to remove any transverse creases which may exist, and temporarily secure the headlining to the toothed retainer strips with suitable clips or pins. To obtain a crease-free fitting of the material in the corners of the headlining it will be necessary to make short slits from the outside edge of the material. Care must be exercised not to make these slits too long or they will be visible when the headlining is fitted.

4. Liberally coat the top transverse flange of the windscreen aperture flange and coupe pillars with suitable adhesive and temporarily offer the headlining into position on the windscreen and coupe pillars, and thus transfer some of the adhesive to the back face of the material. When both surfaces have thus been primed with adhesive, take down the material and allow a short time to elapse for the adhesive to become tacky.

5. Trim off the surplus material with sharp scissors leaving approximately 5 cm. (2 in.) of material hanging below the retainer strips. Using the tool previously described (a blunt paint scraper) gently push the overhanging material up behind the toothed retainer strips, removing the clips as the operation proceeds. (To avoid possibility of damage to the headlining material this should be commenced at the location where a cotton sleeve is stitched to the back face of the headlining material.) (See Fig. 20). If additional stress is required at any point to remove transverse creases this again should be done by pushing on the headlining material in a position where a cotton sleeve is stitched to the back face of the material.

6. Once the sides and back edges have been secured pull the front edge taut to remove any creases which may exist and secure the front edge of the material to the windscreen upper transverse flange and the coupe pillars. When the headlining is secure, trim off any excess material.

NOTE 3

If there are small wrinkles in the material, after fitting a new plastic-covered headlining, they can often be removed by shrinking the cotton backing in the following manner.

Pierce the material near the wrinkle with a water-filled hypodermic syringe fitted with a fine needle. Whenever possible, insert the needle through a panel joint stitching hole. A small quantity of water can then be ejected on to the upper face of the cotton backing, which will then shrink locally. This shrinkage will usually be sufficient to take out small wrinkles.

7. When the material has been secured along the edges firmly tap the retainer strips to close the locking teeth, using a rubber mallet or hammer and block of wood covered with soft cloth.

8. Refit the finish strip and secure the end under the moulding "pop" rivetted to the door aperture flange.

9. Replace the windscreen and weatherstrip as an assembly (see Windscreen—To Replace).

10. Replace the five interior lights and secure them with ten self-tapping screws (where fitted).

11. Replace the two sun visors and secure them with eight self-tapping screws (where fitted).

12. Replace the interior rear view mirror and secure it with two self-tapping screws.

299.7 cm. (118 in.) WHEELBASE (where fitted)

The removal and fitting procedures for this headlining are identical to those described above for the 274.3 cm. (108 in.) wheelbase (Bus and Kombi), with the exception that there are nine listing wires. The location and colour code on these listing wires is shown below.

Position	*Colour*
1	Blue
2	Green
3	Yellow
4	Yellow
5	Yellow
6	Yellow
7	Brown
8	Red
9	White

PART HEADLINING (where fitted)

This one-piece headlining is supported by two listing wires carried in sleeves stitched to the upper face of the headlining material.

The sides of the headlining are secured to the upper body framework by toothed retainer strips, whilst the front edge is secured by adhesive to the windscreen upper body flange and coupe pillars. The rear edge of the headlining is secured by a steel strip carried in a sleeve in the headlining and screwed to the roof reinforcing panel.

To Remove

1. Remove two self-tapping screws securing the interior rear view mirror.

2. Remove eight self-tapping screws securing the two sun visors (where fitted).

3. Remove the interior lights (where fitted).

4. Remove the windscreen and weatherstrip as an assembly (see Windscreen—To Remove).

5. Pull the finish strip away from the door aperture flange and carefully pull the headlining away from the top of the coupe pillars and the windscreen.

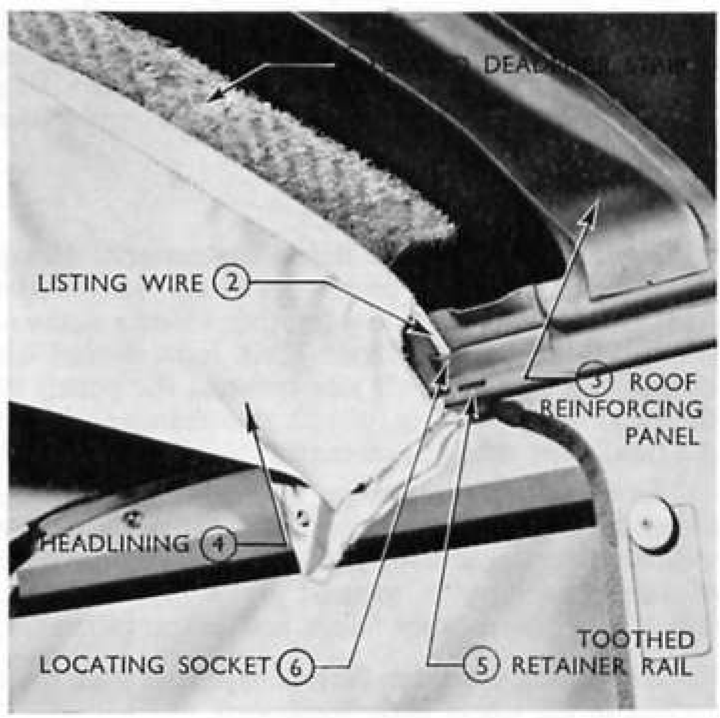


Fig. 21
Part Headlining

6. Unscrew seven self-tapping screws and cup washers securing the rear edge of the headlining to the roof reinforcing panel (see Fig. 21).

7. Insert between the body and the headlining toothed retainer strips, a thin metal blade with all sharp edges removed and gently prise the retainer strips away from the body. (A blunt paint scraper can be used for this operation.) A tool can then be pushed between the retainer strip and body, enabling the headlining to be carefully lifted from the retaining teeth on the back face of the retainer strips.

NOTE 1

To avoid damage to the headlining material during this delicate operation, commence to lift the material from the retainer teeth in a location where a sleeve is stitched to the back face. This location can be determined by the stitch join between the panels of the headlining, in this manner detach the headlining along the sides.

8. The listing wires can then be removed from their sockets in the upper body framework (see Fig. 21).

9. Remove the headlining and listing wires as an assembly.

To Replace

Under cold damp climatic conditions, plastic-covered headlining materials tend to become stiff, making it difficult to obtain a crease and wrinkle-free fitting. To assist in obtaining a satisfactory finish, the work should be carried out in a warm 18° to 22°C (65° to 70°F) dry, workshop.

1. Ensure that the listing wires are free to slide within the cotton sleeves and that they are centrally situated, to leave an equal amount of material hanging free at either end. With the material correctly fitted to the listing wires, break the cotton sleeve to allow the ends of the listing wires to protrude with approximately 10 to 15 cm. (4 to 6 in.) of material hanging loose.

2. Locate the listing wires in their body frame sockets (see Fig. 21).

3. Secure the rear edge of the headlining to the roof reinforcing panel with seven self-tapping screws and cup washers.

4. Pull the headlining material from front to back to remove any transverse creases which may exist, and temporarily secure the headlining to the toothed retainer strips with suitable clips or pins. To obtain a crease-free fitting of the material in the corners of the headlining, it will be necessary to make short slits from the outside edge of the material. Care must be exercised not to make these slits too long or they will be visible when the headlining is fitted.

5. Liberally coat the top transverse flange of the windscreen aperture flange and coupe pillars with suitable adhesive and temporarily offer the headlining into position on the windscreen and coupe pillars, and thus transfer some of the adhesive to the back face of the material. When both surfaces have been primed with adhesive, take down the material and allow a short time to elapse for the adhesive to become tacky.

6. Trim off the surplus material with sharp scissors, leaving approximately 5 cm. (2 in.) of material hanging below the retainer strips. Using the tool previously described (the blunt paint scraper) gently push the overhanging material up behind the toothed retainer strips, removing the clips as the operation proceeds. (To avoid the possibility of damage to the headlining material this should be commenced at the location where a cotton sleeve is stitched to the back face of the headlining material.) If additional stress is required at any point to remove transverse creases, this again should be done by pushing on the headlining material in a position where a cotton sleeve is stitched to the back face.

7. Once the sides and back edges have been secured, pull the front edge taut to remove any creases which may exist and secure the front edge of the material to the windscreen upper transverse flange and the coupe pillars. When the headlining is secure, trim off any excess material.

NOTE 2

If there are any small wrinkles in the material, after fitting a new plastic-covered headlining, they can often be removed by shrinking the cotton backing in the following manner:—

Pierce the material near the wrinkle with a water-filled hypodermic syringe fitted with a fine needle. Whenever possible, insert the needle through a panel joint stitching hole. A small quantity of water can then be ejected onto the upper face of the cotton backing, which will then shrink locally. This shrinkage will usually be sufficient to take out small wrinkles.

8. When the material has been secured along the edges, firmly tap the retainer strips to close the locking teeth, using a rubber mallet or hammer and block of wood covered with a soft cloth.

9. Refit the finish strip and secure the end under the moulding "pop" rivetted to the door aperture flange.

10. Replace the windscreen and weatherstrip as an assembly (see Windscreen—To Replace).

11. Replace the interior lights (where fitted).

12. Replace the two sun visors and secure them with eight self-tapping screws (where fitted).

13. Replace the interior rear view mirror and secure it with two self-tapping screws (where fitted).

BODY AND CHASSIS REPAIR

All Models

The following pages contain dimensional drawings of the various body and chassis versions. These are designed to be of assistance when undertaking repairs to the body or chassis, and should be used in conjunction with suitable stands and a level floor extending the full length of the vehicle (see Note 1). All the bodies are similarly constructed with the chassis members spot welded to the underbody.

An essential first step when checking or repairing extensively damaged vehicles is to ensure correct chassis frame alignment, by carrying out a series of diagonal checks between the various chassis cross-members. The diagonals marked on the plan can be checked by using large callipers or a pair of trammels or, alternatively, by using a plumb bob and line.

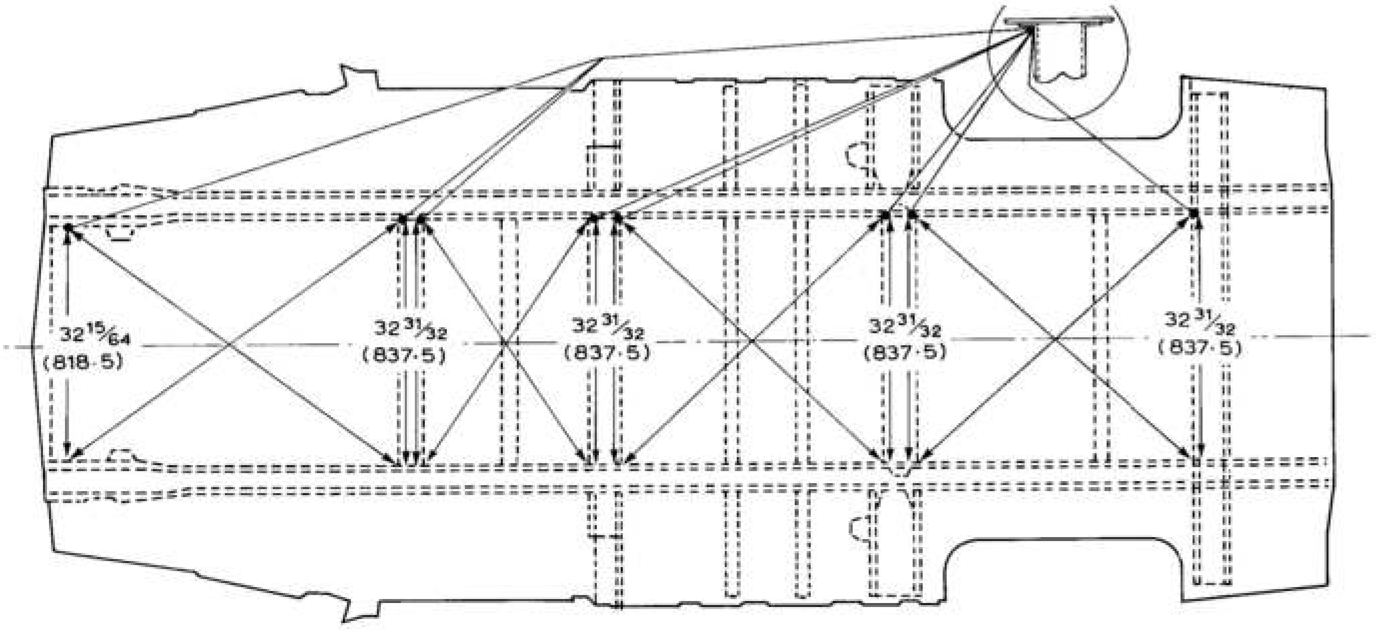
The latter method enables a simple and accurate check to be made. Suspend the plumb bob from the appropriate reference points on the body and carefully mark the floor at each location. Connect these points by a chalk line and draw through the intersecting points of the diagonals. Finally, check the dimensions between the front and rear sidemembers.

NOTE 1:

The vehicle should be supported on four blocks covering the full width of each side member. The blocks should be at least 15.3 cm. (6 in.) long.

The centres of the blocks should be 82.55 cm. (32.5 in.) and 201.9 cm. (79.5 in.) back from the centre line of the front axle on the 75 to 125, and 82.55 cm. (32.5 in.) and 230.1 cm. (90.5 in.) on the 130 to 175.

75 to 125
VAN, BUS and KOMBI



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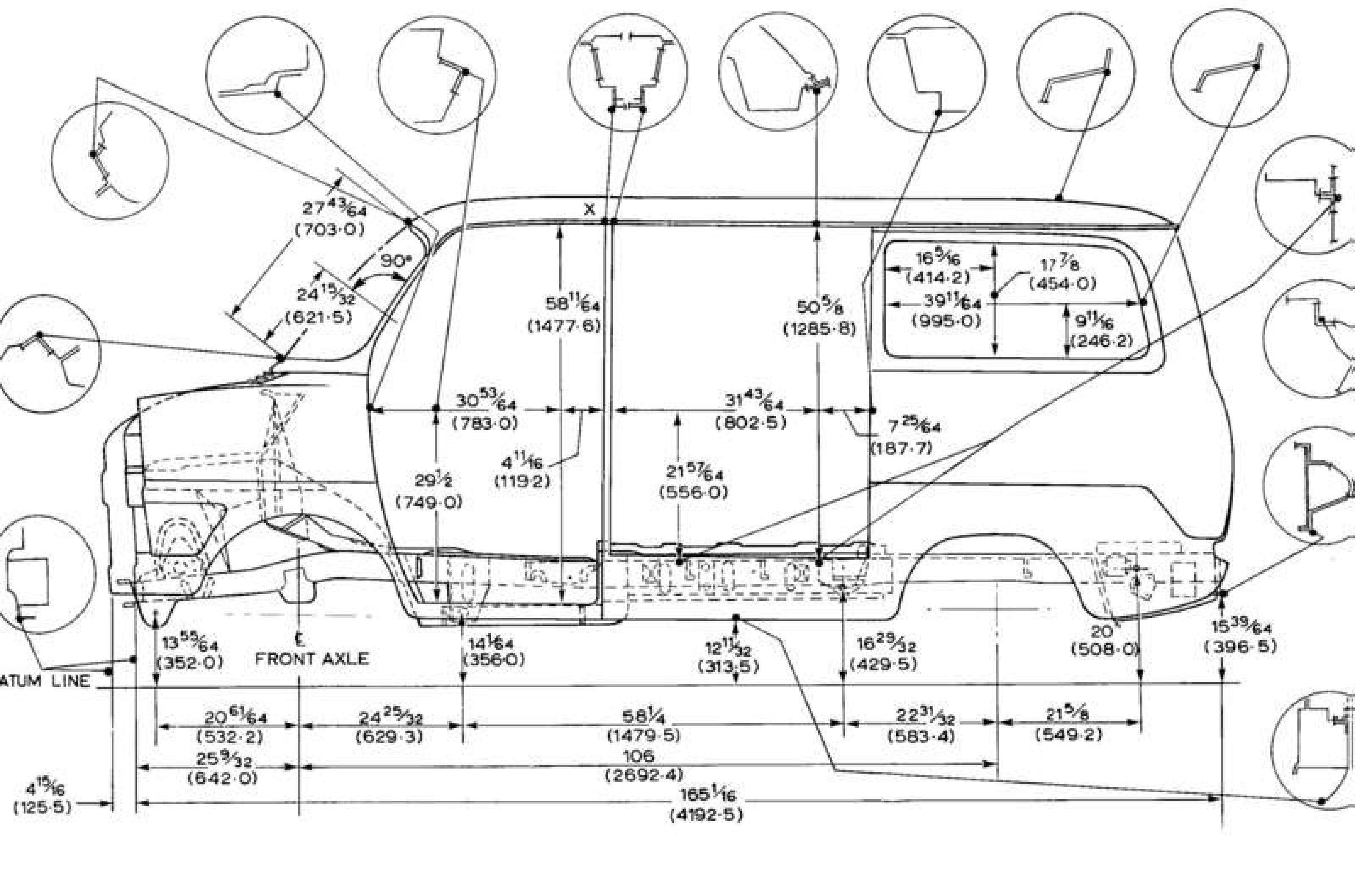

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FRONT AXLE
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12 11/32
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15 39/64
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ATUM LINE
20 61/64
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24 25/32
(629·3)
58 1/4
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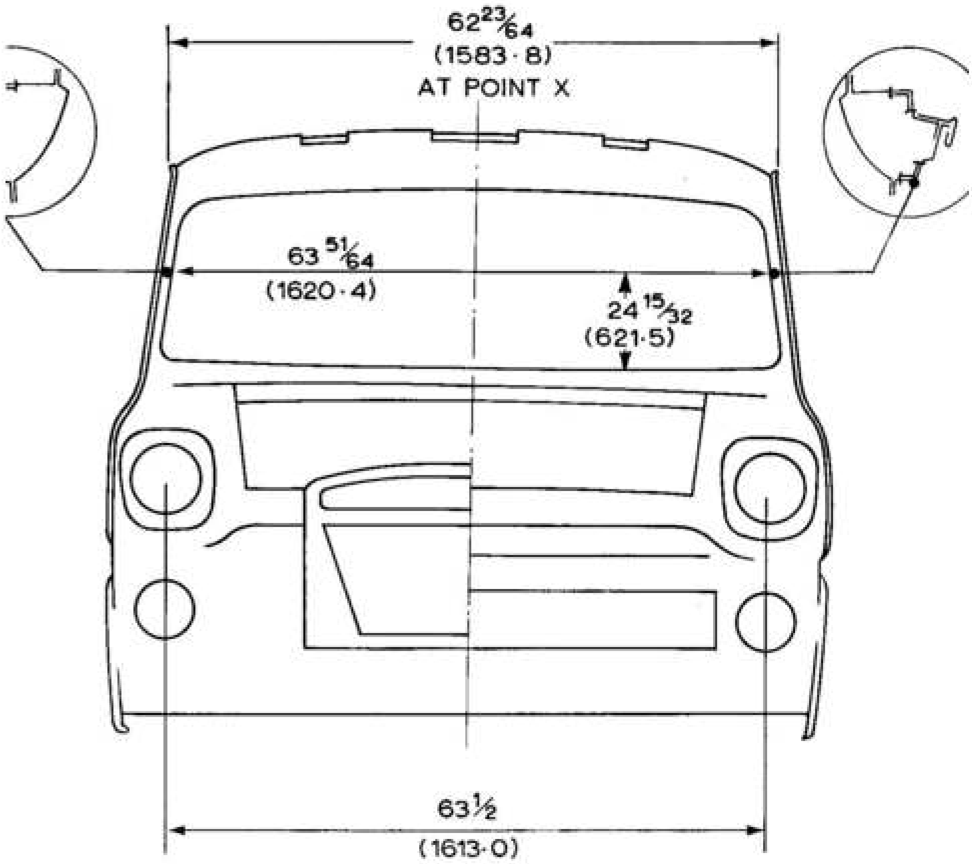
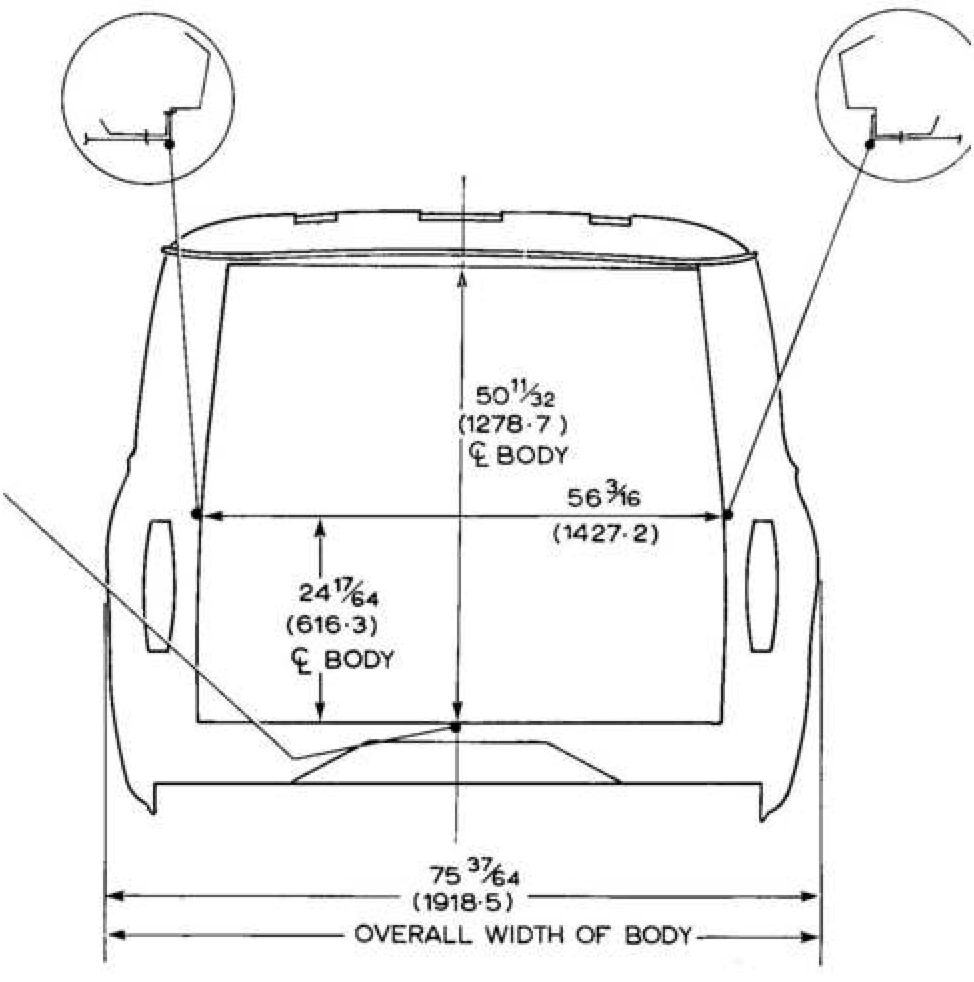
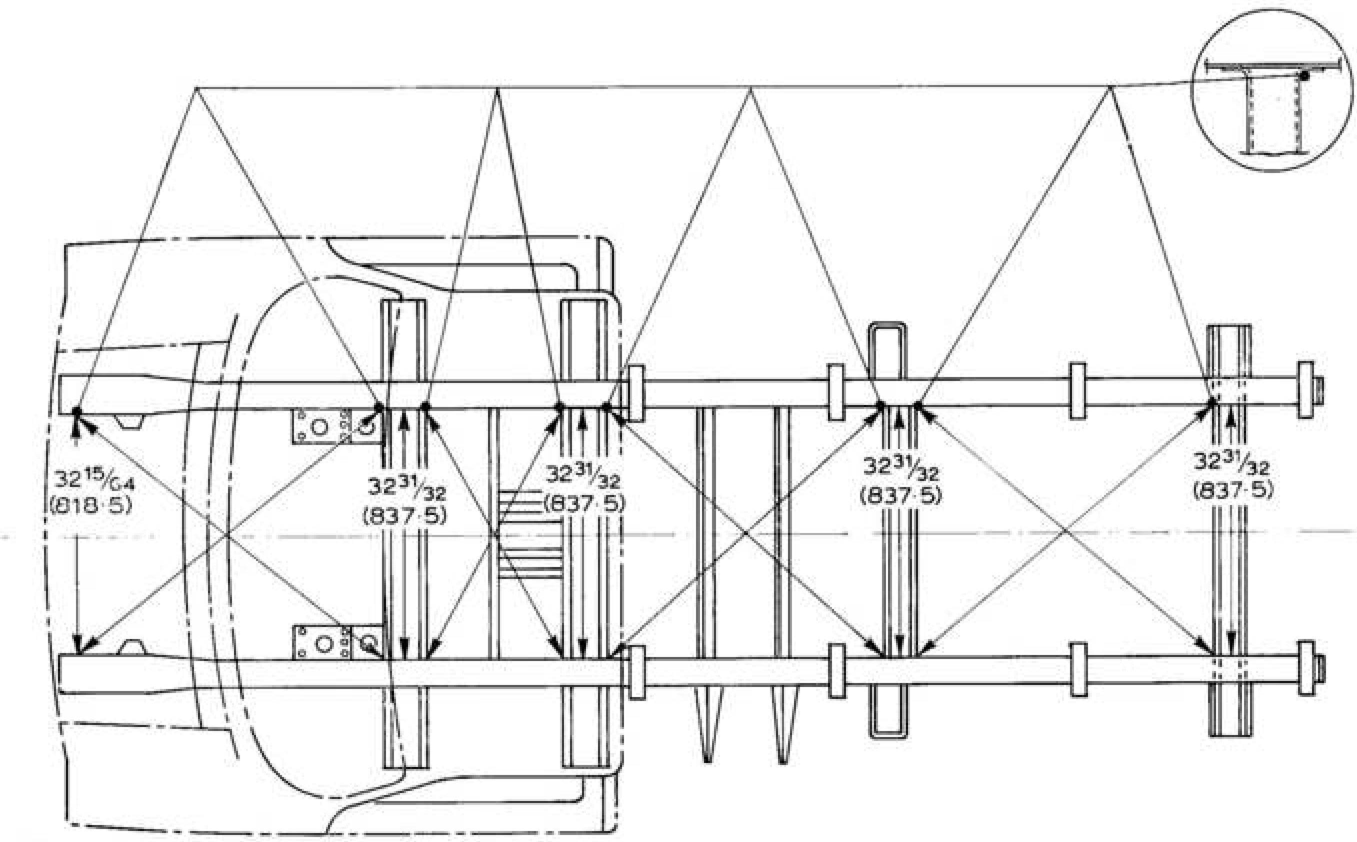




ALL DIMENSIONS IN INCHES (MILLIMETRES)

75 to 125
CHASSIS CAB



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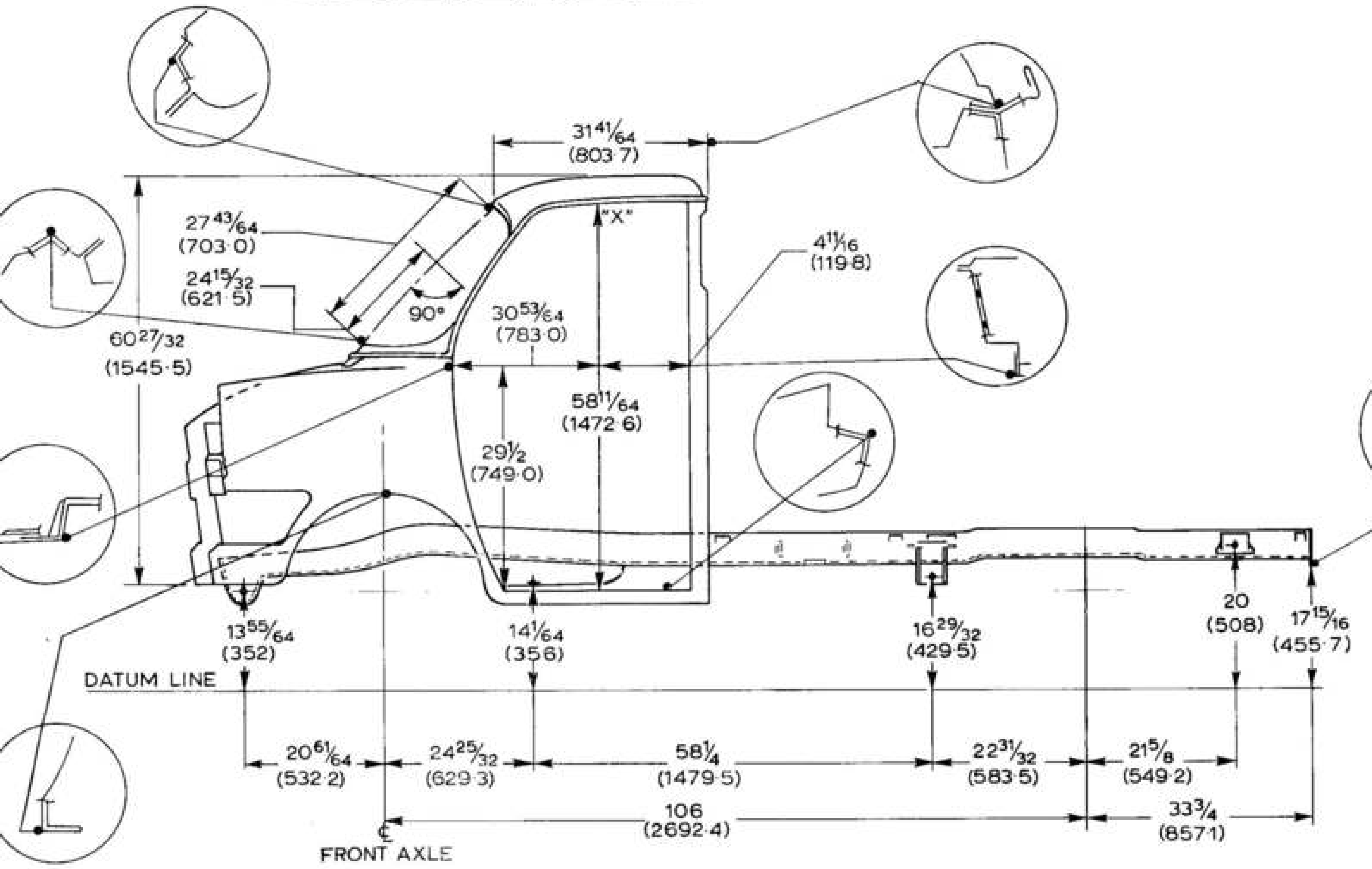

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27 43/64
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24 15/32
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4 11/16
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30 53/64
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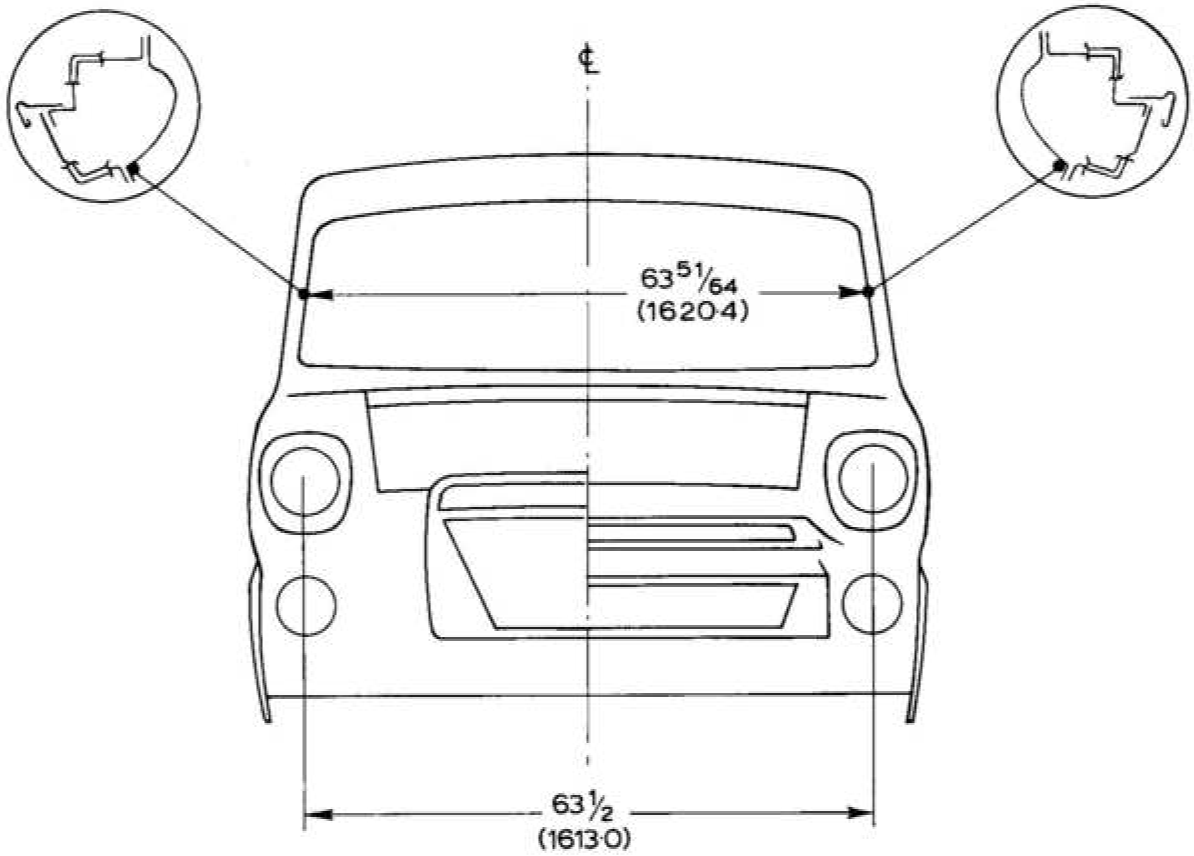
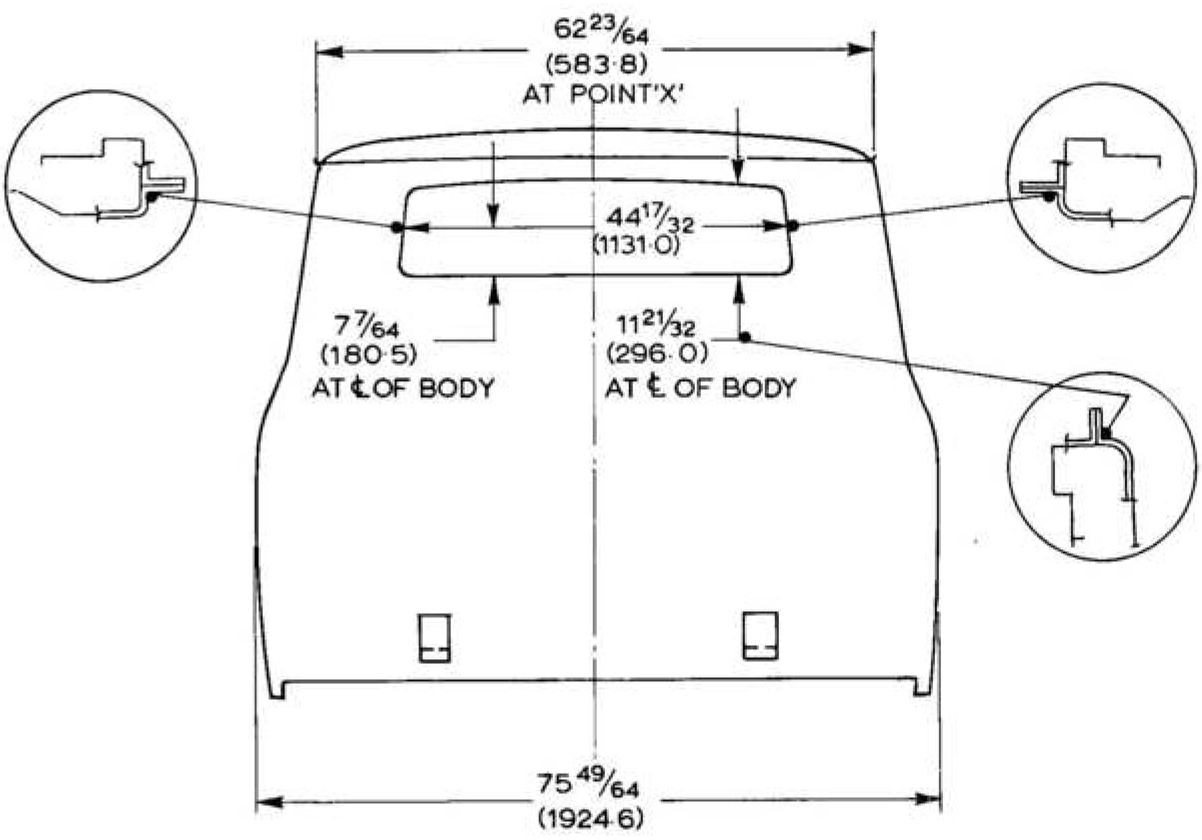
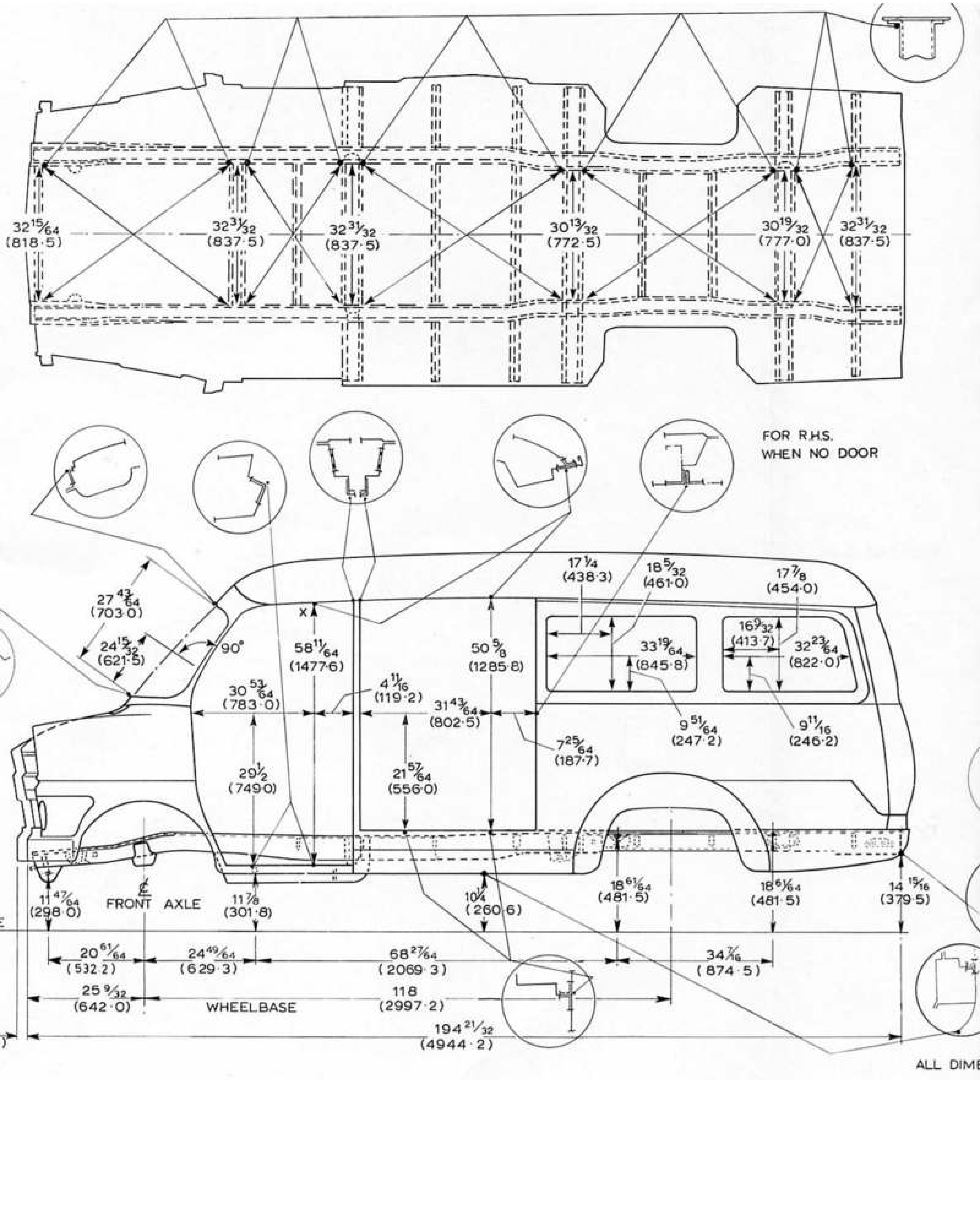
FRONT AXLE





ALL DIMENSIONS IN INCHES (MILLIMETRES)

130 to 175
VAN, BUS and KOMBI



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FOR R.H.S. WHEN NO DOOR
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90°
X
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30 53/64 (783·0)
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50 5/8 (1285·8)
31 43/64 (802·5)
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18 5/32 (461·0)
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17 7/8 (454·0)
16 9/32 (413·7)
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9 51/64 (247·2)
9 11/16 (246·2)
7 25/64 (187·7)
29 1/2 (749·0)
21 57/64 (556·0)
11 47/64 (298·0)
FRONT AXLE
11 7/8 (301·8)
10 1/4 (260·6)
18 61/64 (481·5)
18 61/64 (481·5)
14 15/16 (379·5)
20 61/64 (532·2)
24 49/64 (629·3)
68 27/64 (2069·3)
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WHEELBASE
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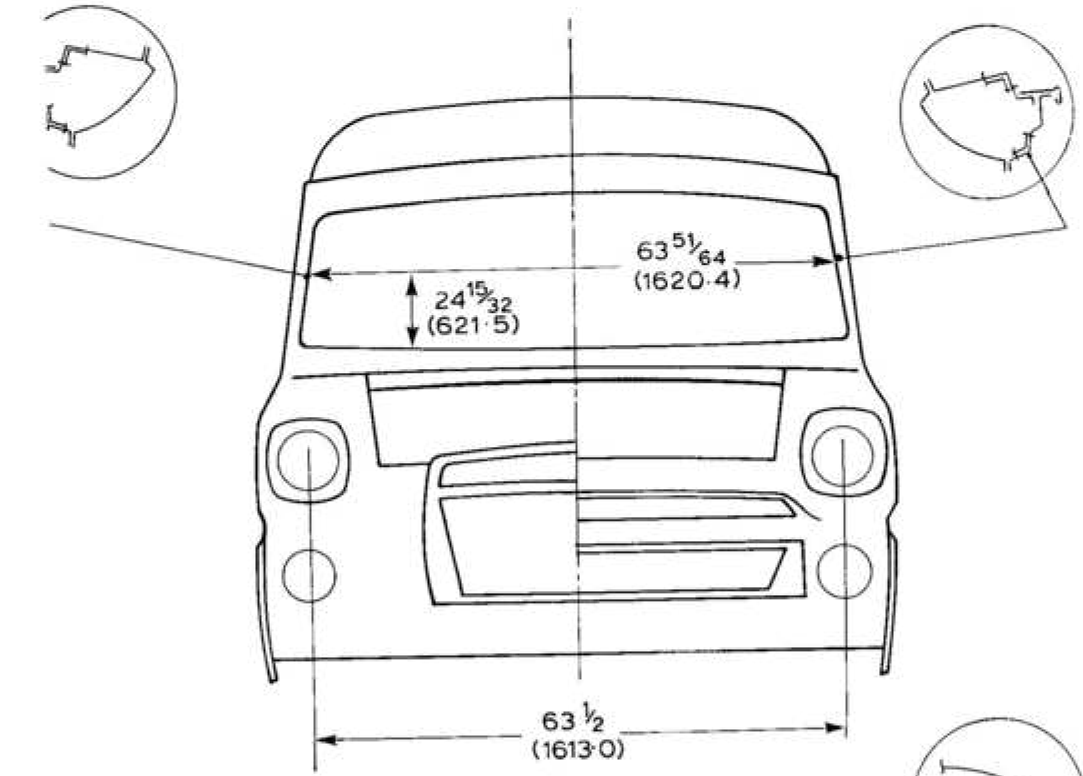
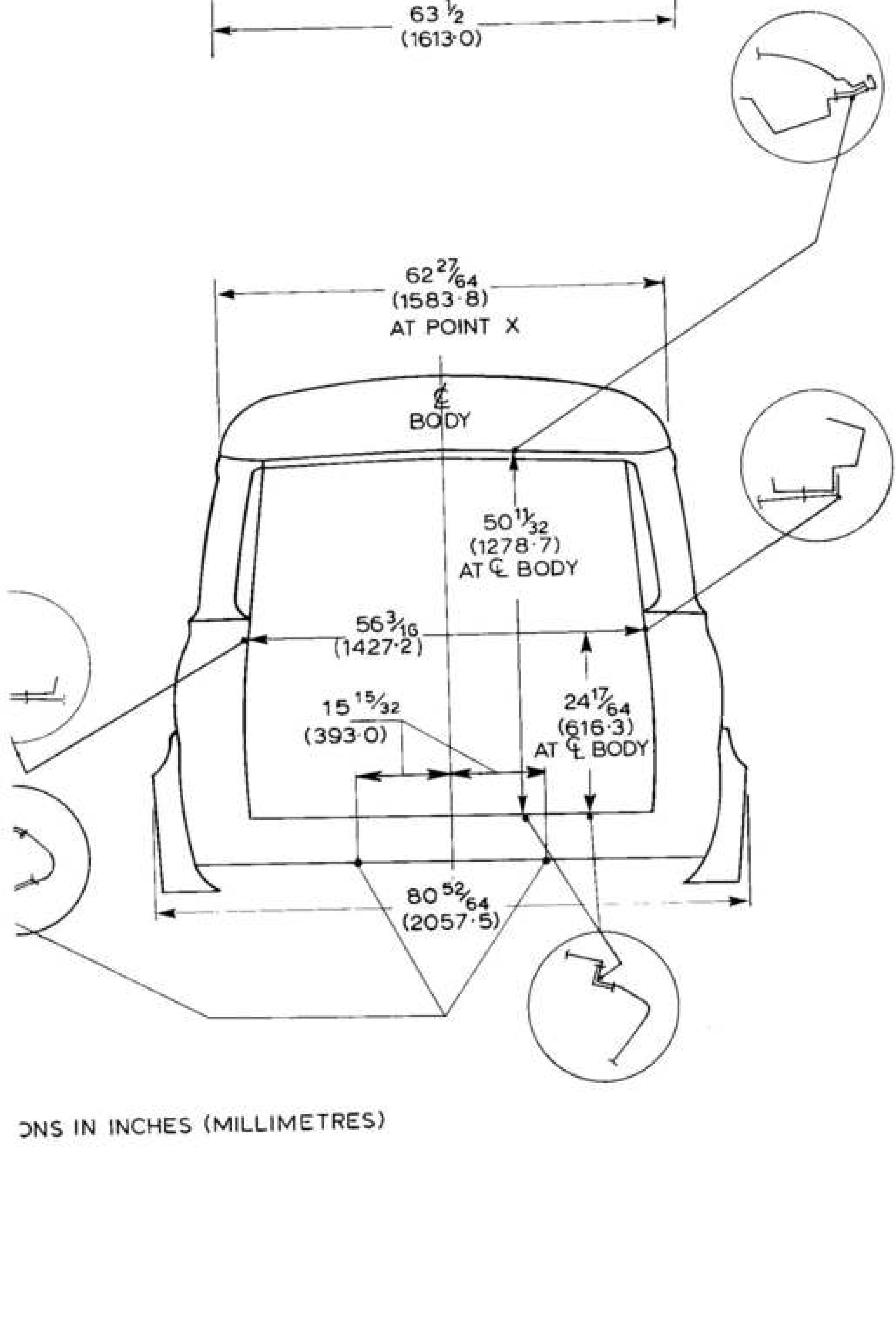
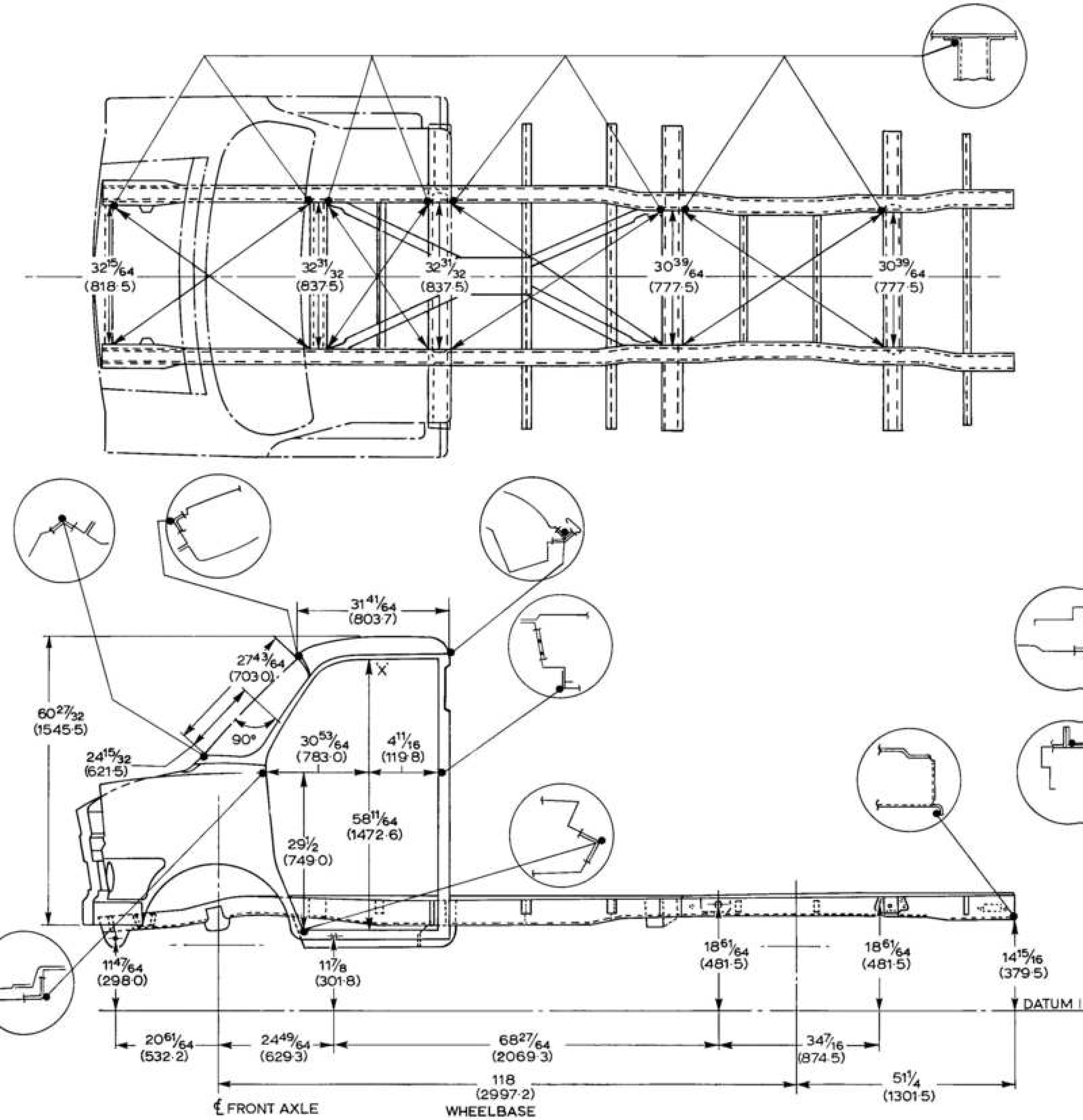
ALL DIME





ONS IN INCHES (MILLIMETRES)

130 to 175
CHASSIS CAB



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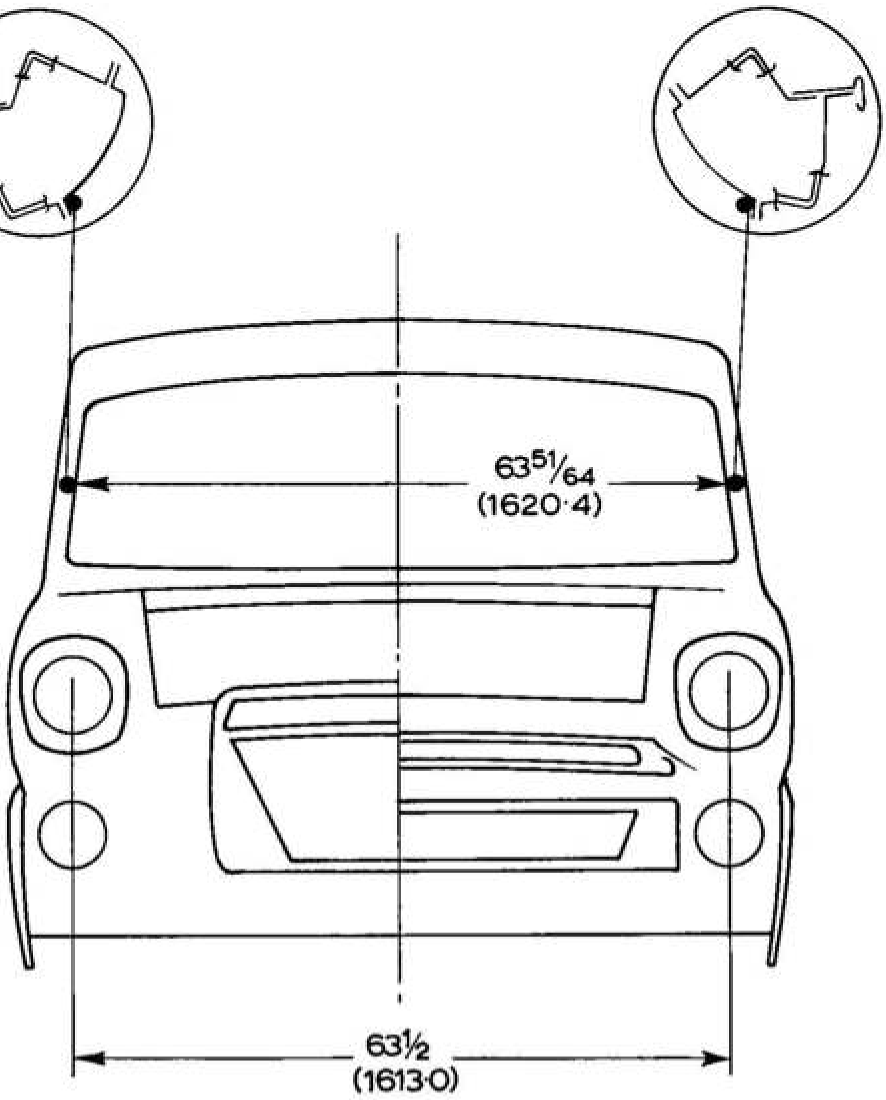
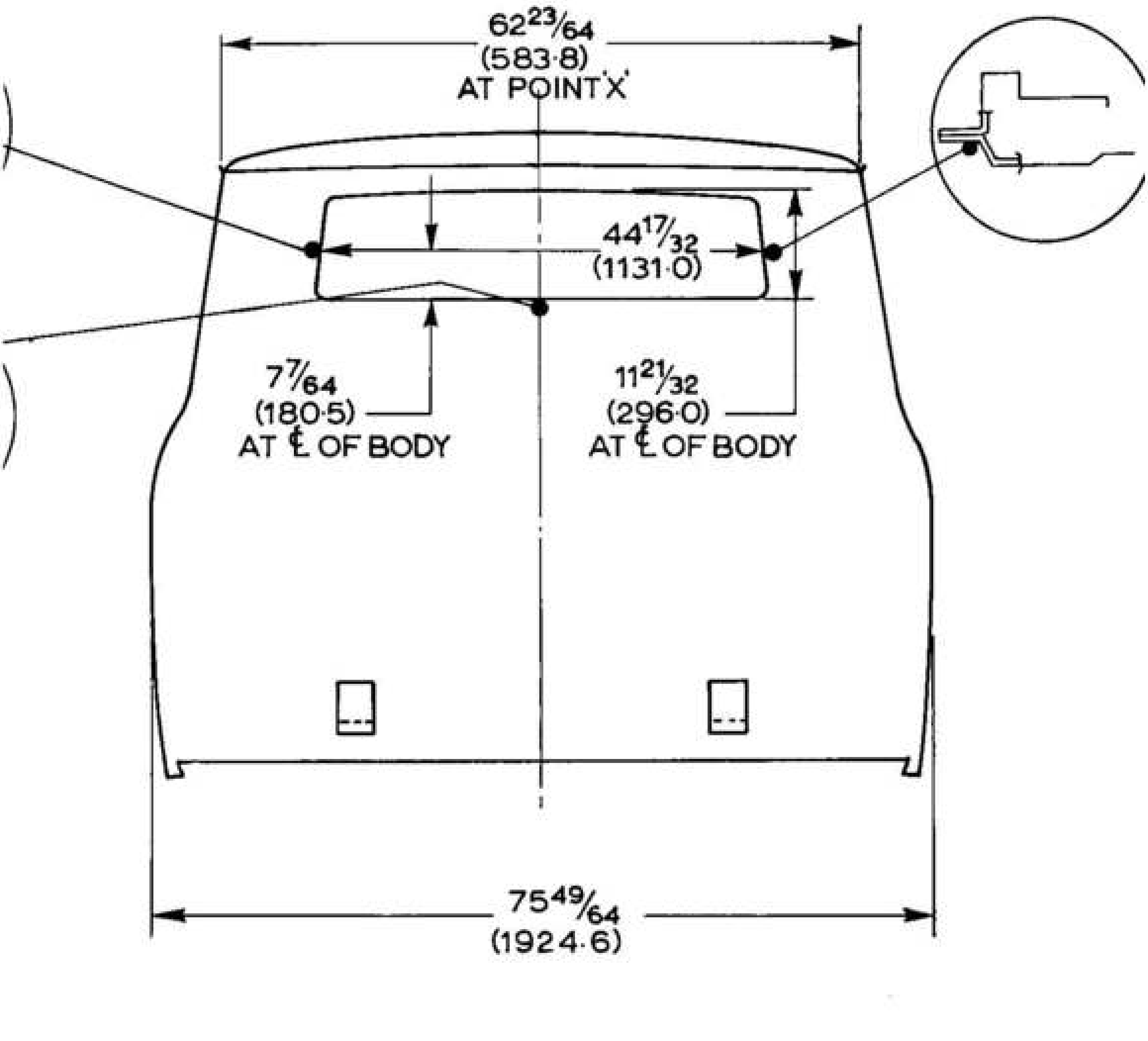
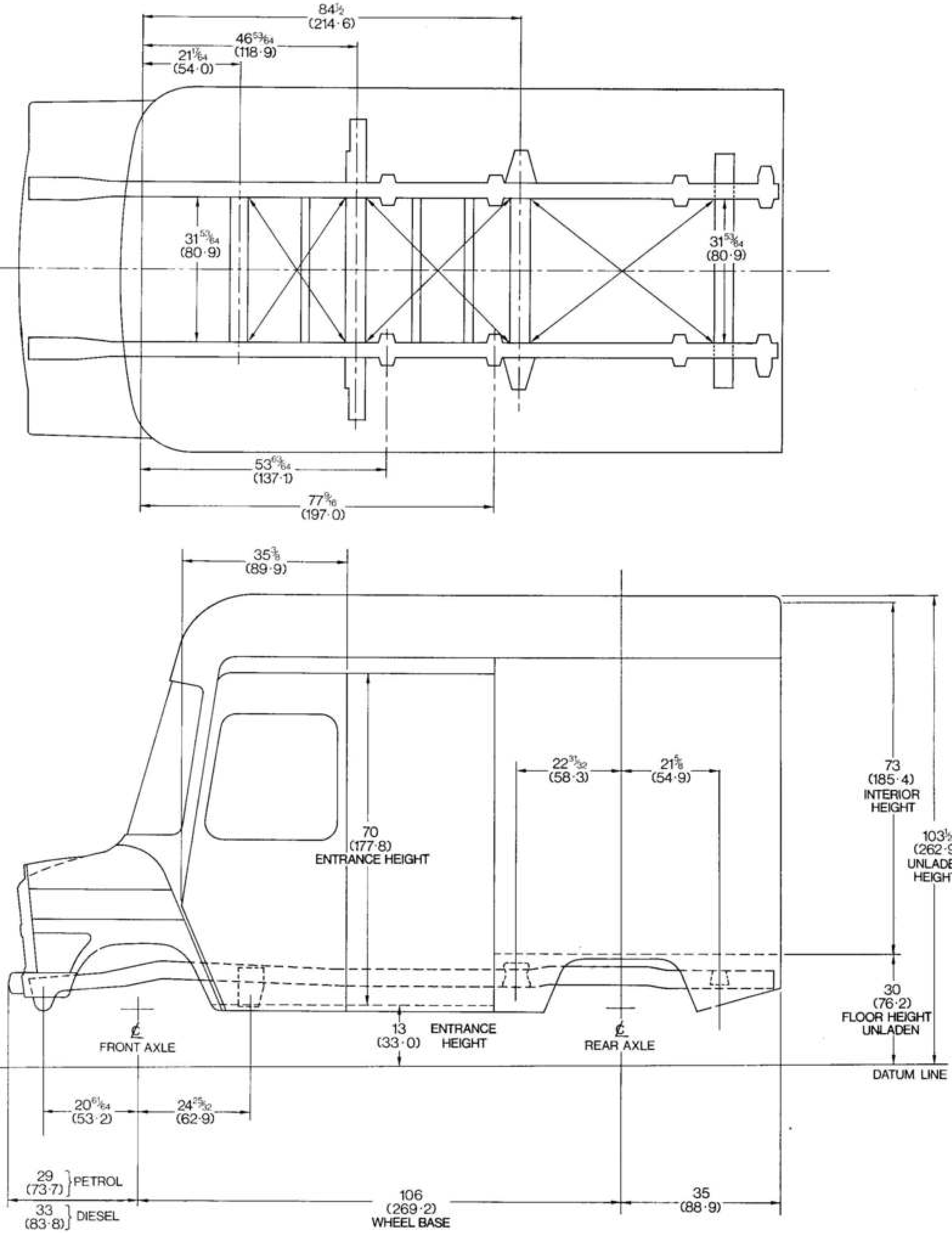
31 41/64
(803·7)
27 43/64
(703·0)
'X'
60 27/32
(1545·5)
90°
24 15/32
(621·5)
30 53/64
(783·0)
4 11/16
(119·8)
58 11/64
(1472·6)
29 1/2
(749·0)
11 47/64
(298·0)
11 7/8
(301·8)
18 61/64
(481·5)
18 61/64
(481·5)
14 15/16
(379·5)
DATUM I
20 61/64
(532·2)
24 49/64
(629·3)
68 27/64
(2069·3)
34 7/16
(874·5)
118
(2997·2)
WHEELBASE
51 1/4
(1301·5)
℄ FRONT AXLE



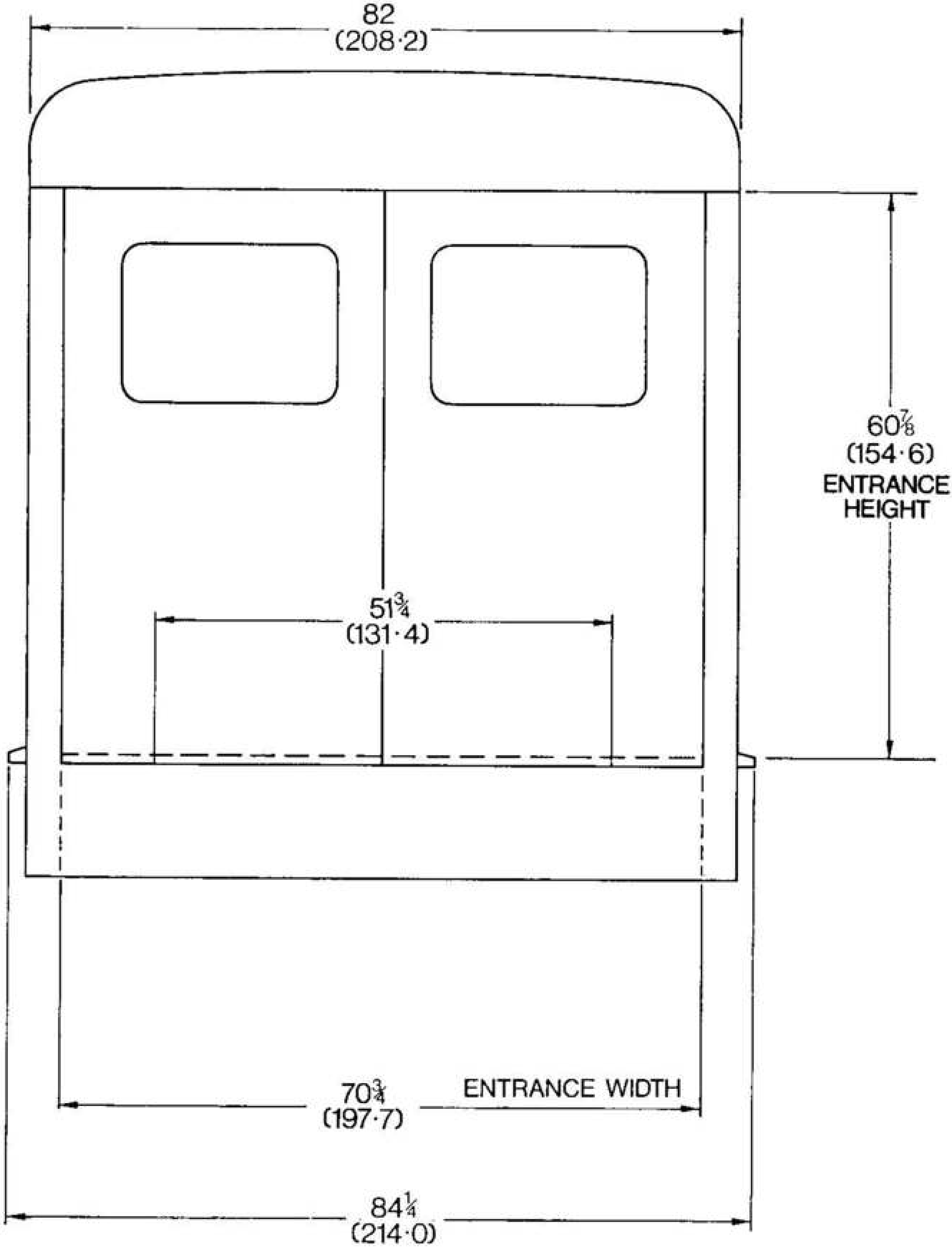


ALL DIMENSIONS IN INCHES (MILLIMETRES)

290 cu. ft.
PARCEL VAN

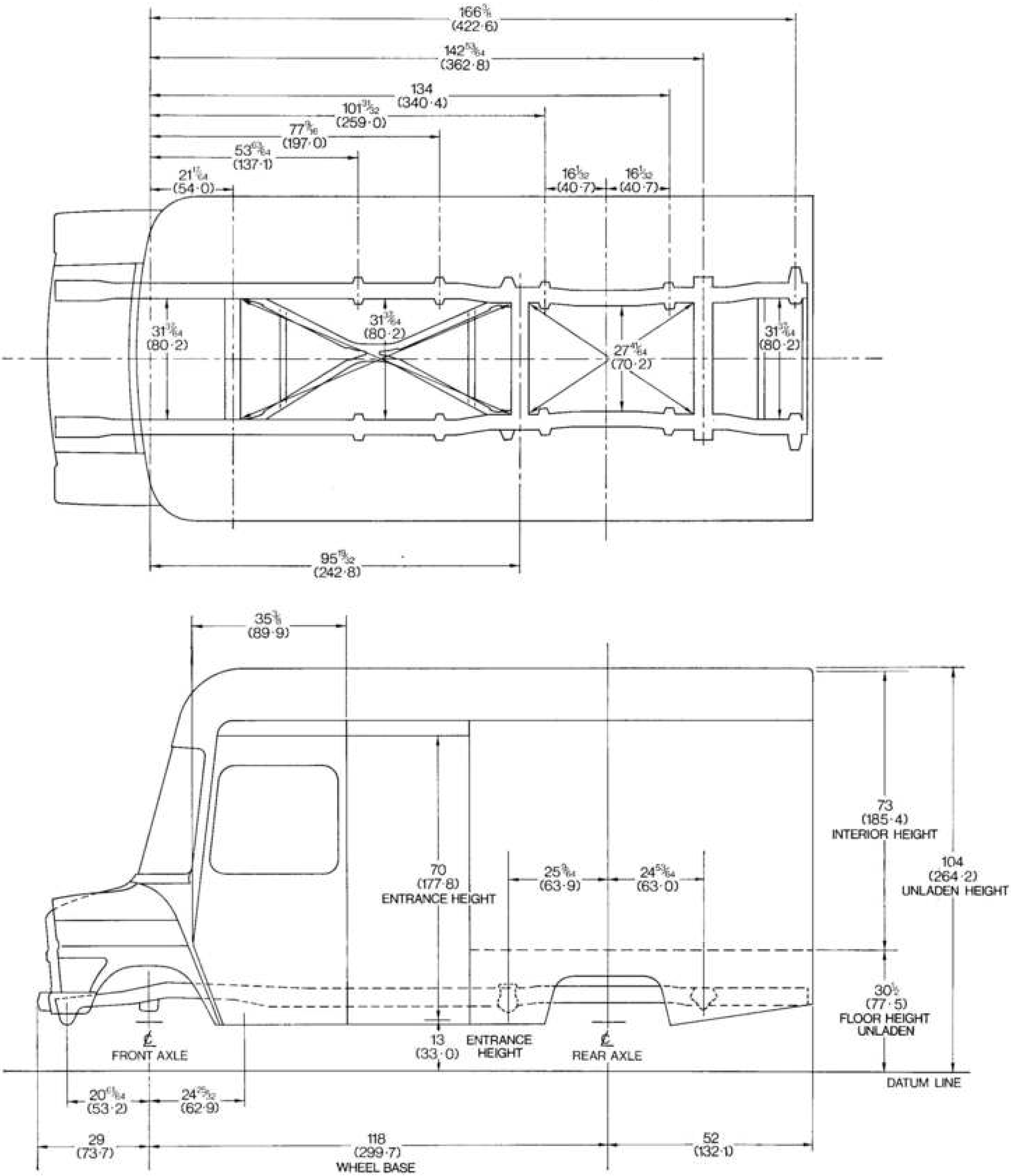


ALL DIMENSIONS IN INCHES (MIL

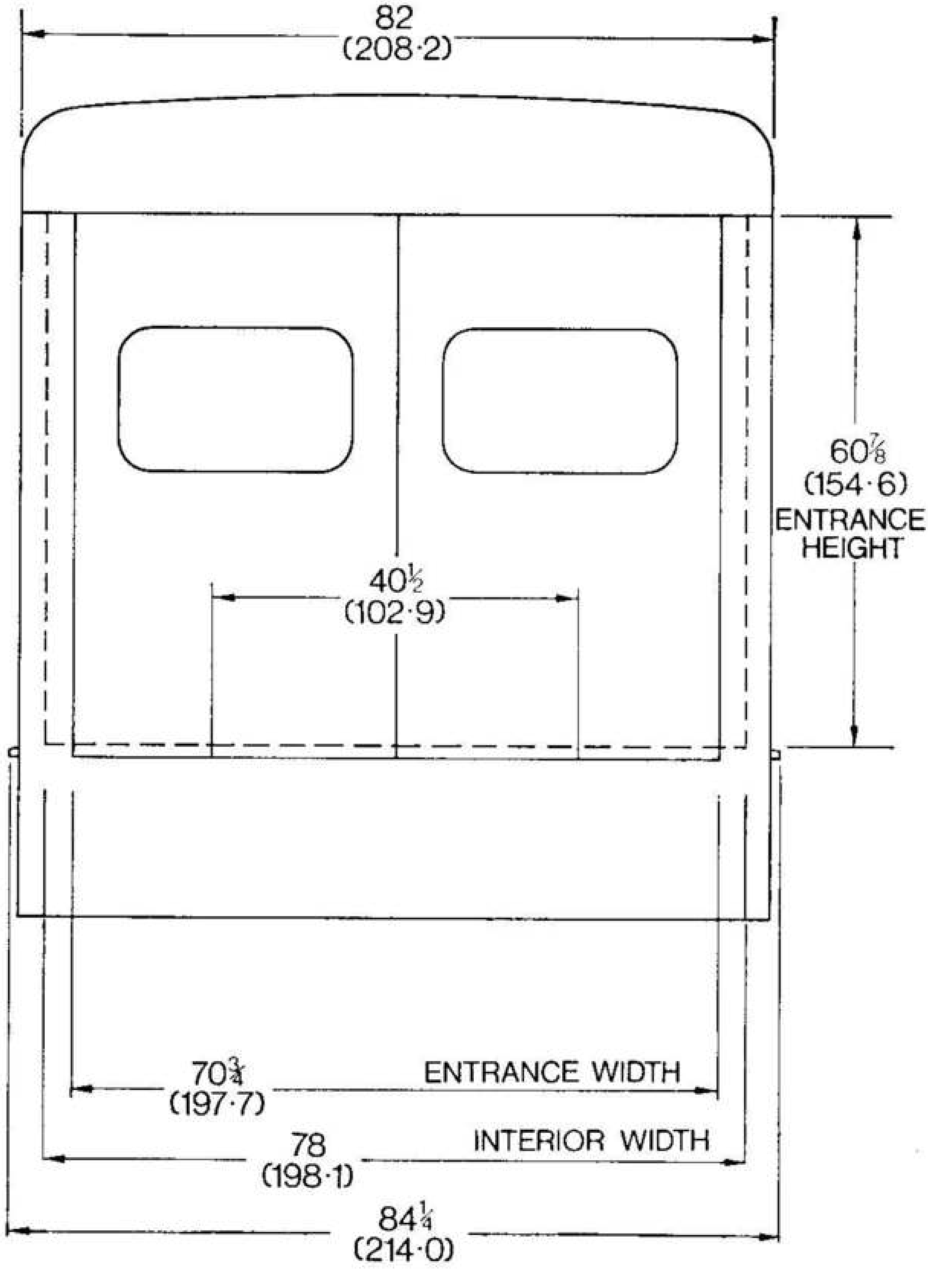

82
(208·2)
60⅞
(154·6)
ENTRANCE
HEIGHT
51¾
(131·4)
70¾
(197·7)
ENTRANCE WIDTH
84¼
(214·0)

TRES)

390 cu. ft.
PARCEL VAN



ALL DIMENSIONS IN INCHES (MILLIM


82
(208·2)
60⅞
(154·6)
ENTRANCE
HEIGHT
40½
(102·9)
70¾
(197·7)
ENTRANCE WIDTH
78
(198·1)
INTERIOR WIDTH
84¼
(214·0)

)

Section 13

SERVICE EQUIPMENT

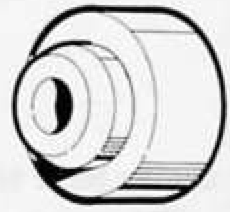
CONTENTS

SUBJECT

WHEELS, HUBS AND DRUMS

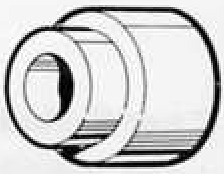
P.1013 Rear Wheel Bearing Grease Seal Replacer

This tool is used with a 550 handle. The lip projecting from the back of the seal locates in the recess in the tool, the front face of the tool abutting the back of the seal, enabling it to be driven into position.



P.1021 Rear Hub Bearing Remover

This tool is used with a 550 handle to assist in easy removal of the hub bearing.

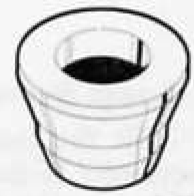


C.1036 Front Hub Grease Seal Replacer

This tool is used with a 550 handle. The lip projecting from the back of the seal locates in the recess in the tool, the front face of the tool abutting the back of the seal, enabling it to be driven into position.

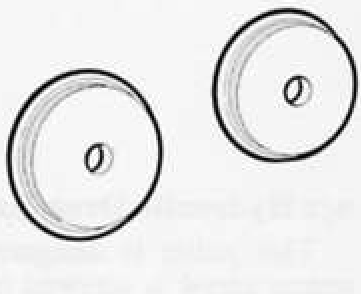
C.1037 Front Hub Bearing Cup Replacer

This tool is used with a 550 handle. The design is such that either the small or large diameter cups may be fitted. Mount the hub on a press and press in the bearing cups.



C.1038 Rear Hub Bearing Cup Replacers

This tool is used with a 550 handle. The tool is made in two sizes, one each for the small and large diameter cups.



3072A Slide Hammer

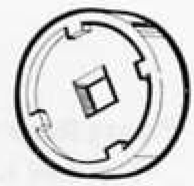
This tool is used with CP.3072-4A Adaptor and C.4107 Hub Nut Spanner. Unscrew the hub nut, fit the tool to CP.3072-4A and the assembly to the hub which can then be removed.

CP.3072-4A Axle Shaft and Hub Remover Adaptor

This tool is used with 3072A Slide Hammer and C.4107 Hub Nut Spanner. The tool fits between the hub and 3072A.

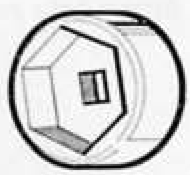
C.4107 Rear Wheel Bearing Nut Socket (75-115)

This tool is specially designed to fit the locating slots on the nut for easy removal.



C.4109 Rear Hub Nut Wrench (125-175)

This tool is in the form of a hexagonal socket with a ½ in. square drive.



BRAKES

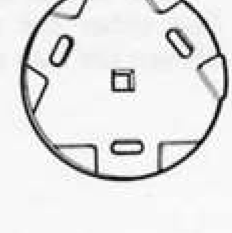
P.2006 Brake Bleeder Tubes

This consists of a set of four clear flexible plastic tubes. One end of a tube is fitted over the bleed nipple of the location being bled, the other end is immersed in a bottle containing brake fluid. When bleeding the brakes, any air bubbling out can be clearly seen through the tube.

P.2012 Brake Line Plugs

This consists of a set of six brass plugs used to seal the open ends of hydraulic lines when dismantling hydraulic brakes.

C.2030 Servo Top Cover Remover and Replacer

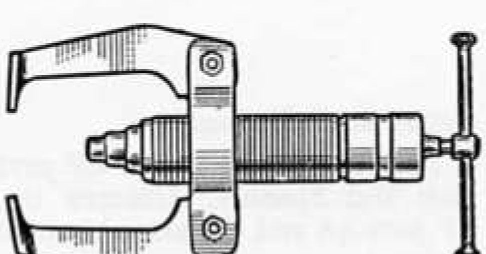


Fit the tool to the servo mounting studs. Grip the slave cylinder in the vice and separate the shell with the aid of a bar fitted to the square hole in the separator. To replace, clamp the slave cylinder in a vice and locate the two halves of the booster shell together. Press down on the tool and rotate until both halves of the shell are securely locked together.

FRONT AXLE AND STEERING

252 Hydraulic Drop Arm Remover

This puller is designed to fit over the drop arm, and the centre screw is screwed in on the steering box shaft until the arm is removed.

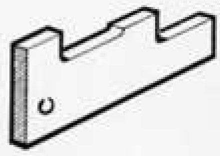


C.3065B Anvil

This is used with C.3103 and C.3104. The tool is used to fit new bushes to spindle body assemblies. Position the Stop Collar C.3104/d and the spindle body on the top face of the anvil. The lip on the stop collar, where fitted, must be facing downwards in the anvil.

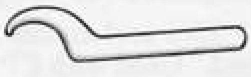
C.3101 Spindle Body Gauge

This is a steel gauge used to check the spindle for distortion.



C.3102 Steering Shaft Bearing Plate Nut Wrench

Bend back the tab of the lockwasher and unscrew, with the use of this tool, the lock ring from the worm shaft bearing housing.

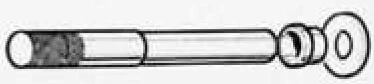


C.3103 Spindle Bush Broaching Kit

This tool is used with C.3065B and C.3104. Press the broach through the spindle assembly, preferably using a hydraulic press.

C.3104 Spindle Bush Remover and Replacer

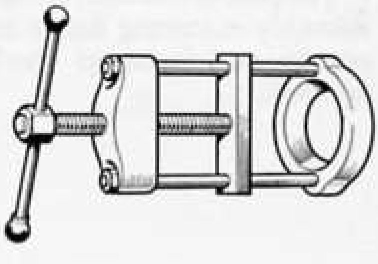
This tool is used with C.3065B and C.3103. The bushes may be pressed out, and in, using the guide bush and a suitable press bed.



REAR AXLE

CP.4000 Hand Press

This tool is used in conjunction with various adaptor sets to remove and replace differential and pinion bearings and related parts.



P.4000-17 Differential Bearing Cone Remover (75-115)

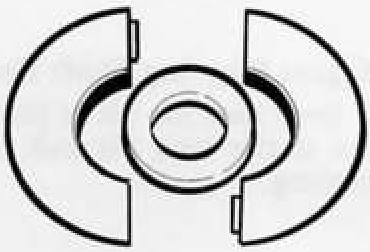
This tool consists of one four-piece split ring adaptor and one thrust block. Used with Main Tool CP.4000. The split adaptors fit around the bearing cone and into the base of the CP.4000 Main Tool. The thrust pad fits into the axle shaft hole and the centre screw of the hand press bears on this whilst withdrawing the bearing cone.

P.4000-18 Pinion Bearing Cone Remover and Replacer

This tool consists of one split ring adaptor and one replacer pad. Used with Main Tool CP.4000. The split adaptors fit around the pinion bearing and are held in place by the base. The pinion is then pressed through the bearing. To replace, the replacer ring is positioned in the split adaptors on the base, the bearing is placed on the ring and the pinion is pressed into the bearing.

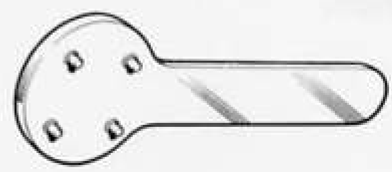
C.4000-36 Pinion Bearing Inner Cone Remover and Replacer (125-175)

This tool consists of one split ring adaptor and one replacer pad. Used with CP.4000 Main Tool. For details of use refer to P.4000-18.



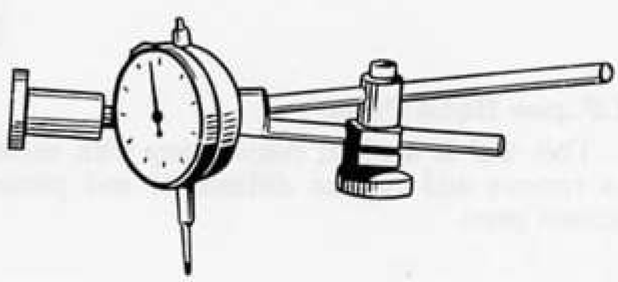
CP.4007 Differential Bearing Adjusting Nut Wrench (75-115)

This tool is a peg style wrench, the pegs of which fit into the differential bearing adjusting nut.



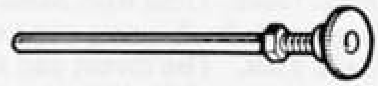
CPT.4008 Crown Wheel and Pinion Backlash Gauge

The post of this tool, CP.4008-1, bolts to one of the differential assembly mounting flange holes and the arm and dial indicator can be positioned to check the crown wheel run-out and backlash.



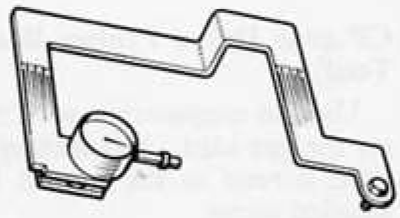
CP.4008-1 Crown Wheel and Pinion Backlash Gauge Adaptor

This tool consists of one mounting post and one locking nut. Used with CPT.4008.



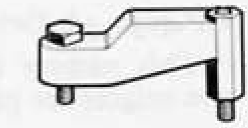
P.4009 Differential Bearing Pre-load Gauge

Secure the tool to the differential bearing cup on one side and then the dial gauge on the opposite side will measure the pre-load.



C.4009-1 Differential Pre-load Gauge Adaptors (125-175)

This tool used with P.4009 measures the pre-load on the 25, 30 and 35 cwt. models.

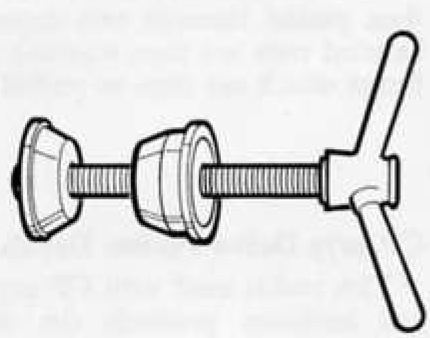


P.4012 Differential Bearing Inner Cone Replacer (75 115)

This tool is used with the 550 handle. The shaft locates in the axle shaft hole whilst the flange abuts the inner track of the bearing cone, enabling the cone to be replaced squarely.

P.4013A Drive Pinion Bearing Cups and Oil Seal Replacer

This tool is used with CP.4013-2 or C.4013-4. Locate the cups. Fit the adaptor to the Replacer and draw into position when the wing nut is turned. By reversing the top pad the oil seal may be replaced.



CP.4013-2 Drive Pinion Bearing Cups and Oil Seal Replacer Adaptor (75-115)

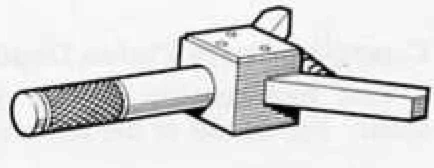
This tool is illustrated with P.4013. The two pads are placed on the outside of the cups which are drawn simultaneously into position.

C.4013-4 Drive Pinion Bearing Cups Replacer Adaptor (125-175)

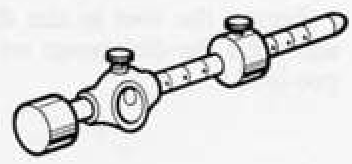
For details of use refer to CP.4013-2.

CP.4015A Drive Pinion Bearing Cups Remover

The spring-loaded legs are placed behind the cup, and the handle struck with a mallet to remove the cup.

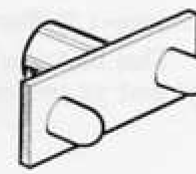


CP.4030 Drive Pinion Bearing Pre-Load Gauge (Main Tool)



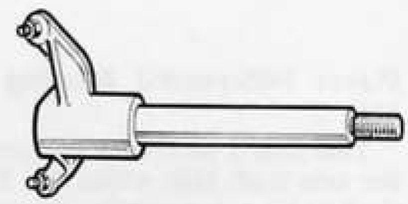
Used in conjunction with Adaptor Tool No. CP.4030-3A to set the pre-load. The sliding weight is moved along the beam until it rests at the correct figure where it is locked by the knurled screw.

CP.4030-3A Drive Pinion Pre-Load Gauge (Adaptor)



This adaptor is attached to the Main Tool CP.4030, the two spigots are pressed into the drive pinion flange bolt holes.

CP.4046 Differential Carrier Bracket (75-115)

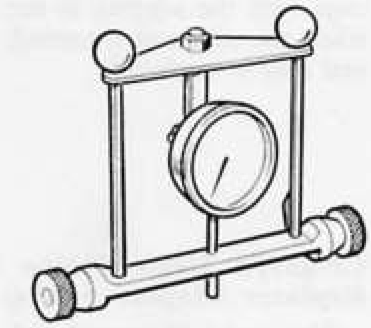


This tool is used with 200A/B Engine Stand, and provides a convenient means of holding the carrier for stripping and rebuilding.

C.4068 Flange Remover

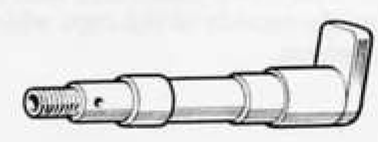
This tool comprises two legs which are used with the 55 Puller. The knurled nuts are removed from the legs which are then passed through two opposed holes in the flange. The knurled nuts are then screwed onto the legs from behind the flange which can then be pulled off.

CP.4075 Drive Pinion Depth Gauge



This tool is used with CP.4075-2, CP.4075-3 and C.4075-5, and indicates precisely the thickness of the spacer shim required when reassembling.

CP.4075-2 Dummy Pinion Adaptor (75-115)

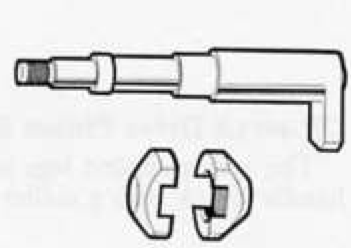


This tool is used with CP.4075. The tool is fitted with the rear pinion bearing cone, and the assembly fitted to the differential carrier. The depth gauge is then fitted and the thickness of shim found.

CP.4075-3 Drive Pinion Depth Gauge Adaptor (75-115)

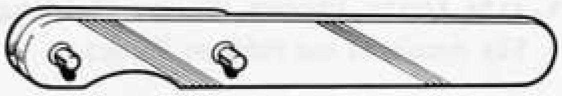
This tool is used with CP.4075 and, together with CP.4075-2, measures the shim thickness required to give the correct pinion depth of mesh in the crown wheel. Add 2.67 mm. (0.105 in.) to the gauge reading to give the thickness of the shim to be fitted between the pinion and the rear bearing cone.

C.4075-5A Drive Pinion Depth Gauge Adaptors (125-175)



This tool consists of one dummy pinion and one split collar. For details of use refer to CP.4075-2 and CP.4075-3.

P.4092 Drive Pinion Flange Wrench (75-115)

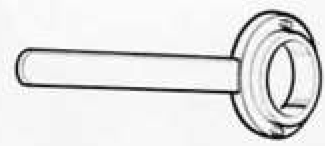


This is a special 2-pegged wrench which locates firmly in the flange. Then the drive pinion nut can be removed or replaced.

C.4106 Differential Bearing Replacer (125-175)

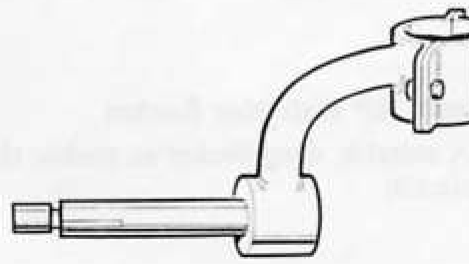
This is used with the 550 handle. The shaft locates in the axle shaft hole whilst the flange abuts with the bearing, enabling the bearing to be replaced squarely.

C.4123 Differential Bearing Adjusting Nut Wrench (125-175)



This tool has two pegs which fit the adjusting nut, and is used with P.4009. For adjustment, fit P.4009 and screw in the bearing adjusting nut on the differential side, until a constant cap spread of 0.12 to 0.16 mm. (0.005 to 0.006 in.) is obtained.

C.4110 Axle Holding Bracket (125-175)



This tool is used with the 200A/B Engine Stand and provides a convenient means of holding the carrier for stripping or rebuilding.

CP.4111A Differential Bearing Cone Remover (125-175)

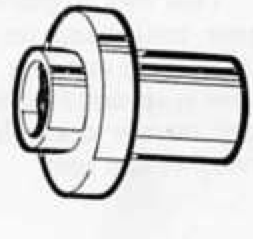
This tool consists of a thrust block and a puller. These are used to enable easy removal of the bearing cone.

C.4112 Drive Pinion Bearing Pre-load Spacer Selector (125-175)

This tool is used with P.4131. The dummy spacer is fitted to the pinion with a ring of soft wire, 2.67 mm. (0.105 in.) diameter, (e.g. solder wire) on its top face. Fit the pinion flange and retaining nut and tighten until only slight end-float can be felt. Fit P.4131, check the running torque. Add this figure to the pre-load, slowly tighten the flange retaining nut until the correct running torque is obtained.

Then dismantle the pinion assembly, the thickness of spacer required is that of the spacer and the flattened wire.

C.4113 Drive Pinion Oil Seal Replacer (125-175)

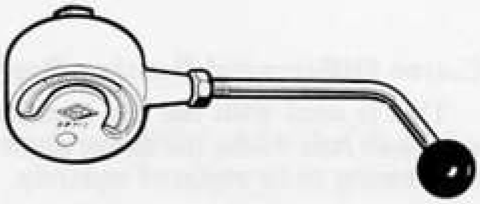


Locate the oil seal in the axle throat with its lip towards the bearing, and drive into position.

C.4114 Drive Pinion Flange Holding Wrench (125-175)

For details of use refer to P.4092.

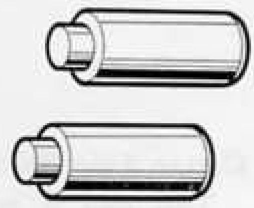
P.4131/547D Pinion Bearing Pre-Load Gauge



This tool, together with a suitable ½ in. drive socket, is fitted to the pinion nut. The tool is then rotated and while turning an accurate running torque reading is obtained.

SPRINGS AND FRAMES

C.5035 Front and Rear Shackle Bush Remover and Replacer



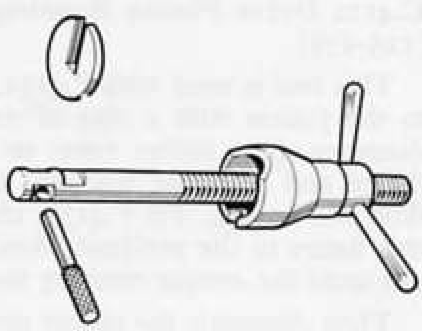
This tool may be used in conjunction with a driver or in a press.

C.5036 'U' Bolt Nut Socket

A suitable deep socket to enable the nuts to be removed or replaced.

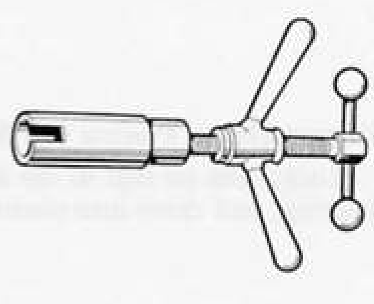
ENGINE

P.6031 Camshaft Bush Remover and Replacer (Main Tool)

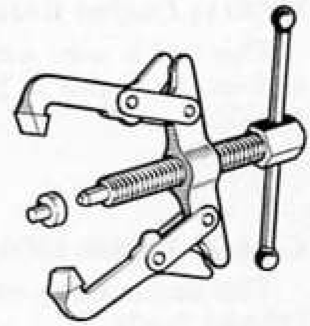


Used with CP.6152 Adaptors to remove the balance shaft bushes.

CP.6032B Crankshaft Gear Replacer



This tool is placed over the end of the crankshaft, with the gear positioned on the reduced diameter. The centre screw is screwed into the crankshaft to locate the tool, and then the gear is screwed home using the handles. Take care to align the key on the crankshaft with the keyway on the gear and the body of the tool.



CP.6041 Crankshaft Pulley Remover

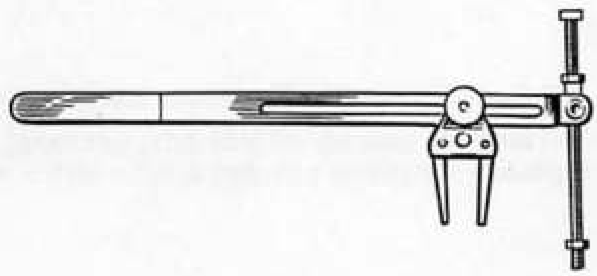
A two-legged puller with specially shaped feet to fit closely to the belt groove of the pulley.

STN.6645 Gear Remover Legs

Consists of two legs used with puller CP.6041 to remove the crankshaft and balance shaft gears.

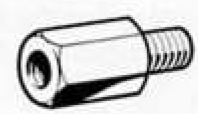
P.6056-015 } Valve Guide Reamers
P.6056-030

This tool enables the valve guide bore to be reamed oversize after wear in order to fit oversize valve stems.



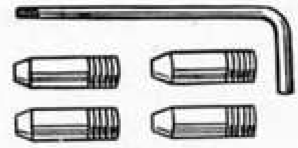
6118B Valve Spring Compressor

One end of this tool screws into CP.6118-1 adaptor. Pivoted at this point is the lever handle along which an adjustable foot can be moved.



CP.6118-1 Valve Spring Compressor, Adaptor

This tool screws into one of the push rod guide plate holes and the post of 6118B screws into this to give a rigid mounting.



C.6135A Cylinder Head Locating Studs

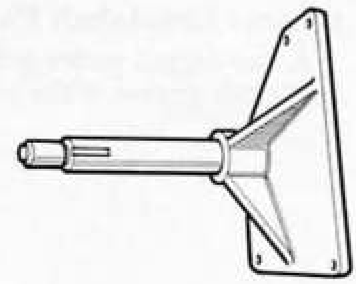
These short studs screw into four cylinder head bolt holes and locate the cylinder head during reassembly. They are removed after the head has been loosely bolted down with the left-hand threaded extracting tool.

CP.6141 Crankshaft Front Oil Seal Aligner

The inside diameter of this tool is an accurate fit on the crankshaft. The plain section of the outside diameter locates on the accurately moulded section of the front cover oil seal. This holds the seal in its correct relation to the crankshaft whilst the front cover is bolted into position.

CP.6144 Engine Bracket

This tool is used with the 200A or 200B Engine Stand and enables the engine to be mounted for ease of strip-down and rebuild.

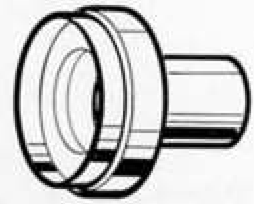


CP.6146 Engine Lifting Eyes

This tool consists of two plates that bolt to the top of the cylinder heads.

CP.6147 Crankshaft Rear Oil Seal Aligner

This tool is fitted into the rear oil seal in the carrier, the inner recess of the tool fits onto the crankshaft flange and holds the seal in its correct relation to the flange whilst the carrier bolts are tightened.

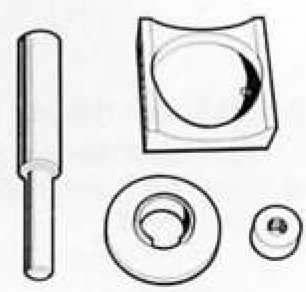


CP.6148 Rocker Stud Reamers

This tool enables the rocker stud holes to be reamed for oversize rocker studs. Two reamers are supplied 0.076 mm. (0.003 in.) and 0.190 mm. (0.0075 in.) oversize.

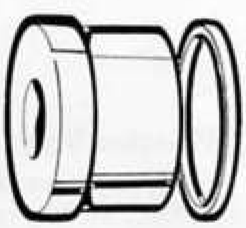
CP.6149 Piston Pin Remover and Replacer

This tool consists of four adaptors used for removing and replacing the piston pin, and is used with a workshop press.



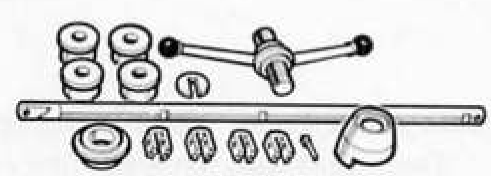
CP.6152 Balance Shaft Bearing Remover and Replacer (Adaptors)

Consists of a set of adaptors used with the 550 Handle for removing the balance shaft bearings or with Tool No. CP.6031 for replacing the bearings.



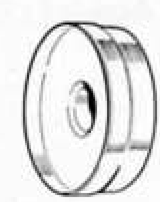
CP.6160 Camshaft Bearing Remover and Replacer

Consists of a main tool and adaptors to allow easy removal and replacement of the camshaft bearings.



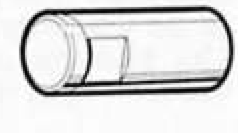
CP.6165 Crankshaft Rear Oil Seal Remover and Replacer

This tool, together with a 550 handle, is used to remove and replace the oil seal in the carrier.



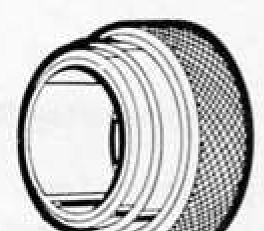
CP.6172A Rocker Stud Replacer

This tool gives the correct protrusion 55.1 mm. (2.17 in.) when replacing the longer rocker stud.



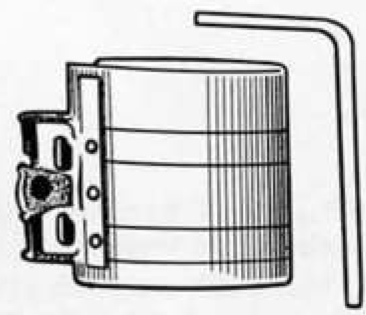
P.6173 Crankshaft Rear Oil Seal Aligner

This tool is a modified version of CP.6147 and can be utilised when replacing the rear oil seal carrier to in-line engines also.



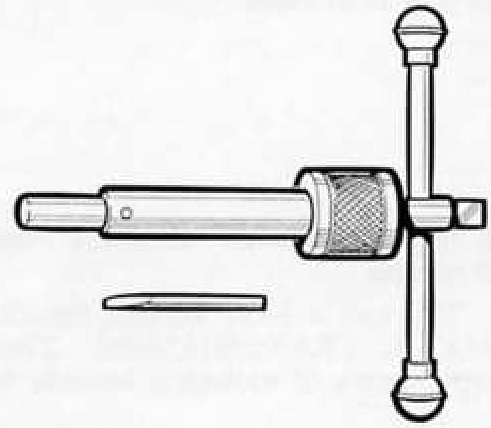
CP.6176 Crankshaft Front Oil Seal Remover and Replacer

The larger diameter side of this tool abuts the outer face of the seal, enabling it to be removed without risk of distorting the housing. For replacement, the smaller diameter side of the tool locates in the seal, the collar abutting the front face, thus avoiding damaging the seal.



38U3 Piston Ring Compressor

This is a ring of spring steel into which the piston, complete with a set of rings, is placed. The ring is contracted with a key-operated ratchet to compress the piston rings. A lever on the side of the tool releases the ratchet to open it.



316X Valve Seat Cutter Handle

This tool is used, together with 316-10, 317-27, 317-T-24, FMC.317-P-26, to cut the valve seats in the cylinder heads.

316-10 Valve Seat Cutter Pilot

Used with 316X, FMC-317-24, 317T-24, FMC-317-24, FMC-317P-26, 317-27, FMC-317-27. (Existing Tool.)

317-T-24 15° Valve Seat Narrowing Cutter—Exhaust

FMC-317-24 Valve Seat Cutter—Exhaust

FMC-317-P-26 Valve Seat Narrowing Cutter—Inlet

FMC-317-27 Valve Seat Narrowing Cutter—Exhaust

317-27 Valve Seat Cutter—Inlet

These cutters are a full set for engines fitted to the Transit range.

EXTRA FOR DIESEL ENGINE

335 Connecting Rod Alignment Jig

336 Arbor Tool

This tool is used for checking small end bush alignment.

CT.6120 Piston Protrusion Gauge

This tool is used with P.4008 Gauge Tool to check the piston protrusion.

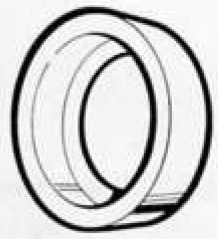
PD.150-5 Cylinder Liner Press Adaptor

This tool is used with a suitable press to remove the cylinder liners.

MANUAL GEARBOX AND CLUTCH

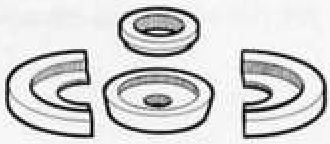
CP.4000-32 Main Drive Gear Bearing Remover

This tool is used with CP.4000 Hand Press to enable the main drive gear bearing to be removed without damage.



CP.4090-7A Synchro Hub Remover and Replacer and Main Drive Gear Bearing Replacer

This tool is used with 370 Taper Base and a hydraulic press. The tool is placed on the hub or bearing, and is pressed out of or into its location.

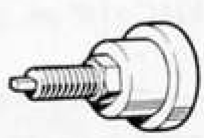


P.7040 Extension Housing Bearing Remover and Replacer

This tool is NOT suitable for vehicles fitted with AUTOMATIC TRANSMISSION. The tool may be used for replacement of extension housing bearings.

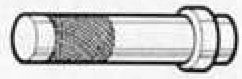
CP.7043 Reverse Idler Shaft Remover

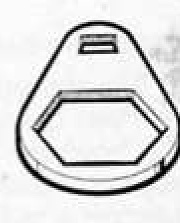
This tool locates over the end of the reverse idler shaft, and is used to remove the mainshaft ball bearing and idler shaft.



CP.7064A Transmission Mainshaft Oil Seal Replacer

The oil seal fits over the boss on the tool and is fully supported and protected during replacement.



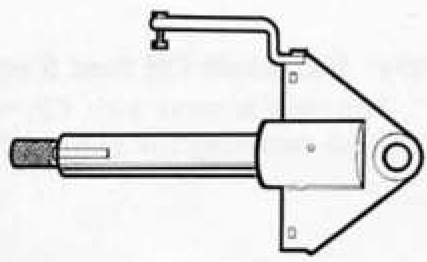


CP.7098 Mainshaft Nut Wrench

This is a specially shaped wrench with a $\frac{1}{2}$ in. square drive. Used in conjunction with a suitable tension wrench, ensures correct torque loading of the mainshaft nut.

C.7109 Dummy Countershaft

The countershaft gear and rollers are assembled on the dummy countershaft. The assembly is then located in the gearbox.

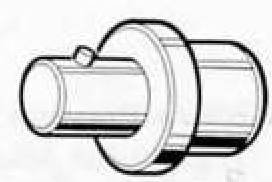


CP.7111 Gearbox Bracket

This tool is used with 200A Engine Stand, and enables the gearbox to be held rigid when stripping or re-assembling. This is suitable for left- or right-hand drive vehicles.

CP.7112A Clutch Plate Locator

This tool considerably simplifies correct alignment of the clutch disc when assembling the clutch to the flywheel. The tool fits through the centre of the plate and locates in the spigot bearing.

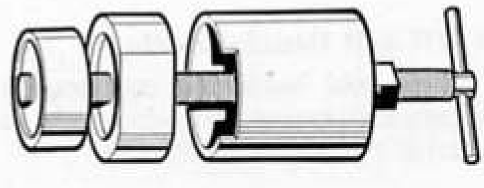


CP.7119 Main Drive Gear Retainer Oil Seal Replacer

This tool is used with 575 Handle, allowing easy and correct fitting of the seal without damage.

CP.7123 Spigot Bearing Replacer

This tool is used with the 550 Handle, and enables the bearing to be replaced squarely and without distortion.

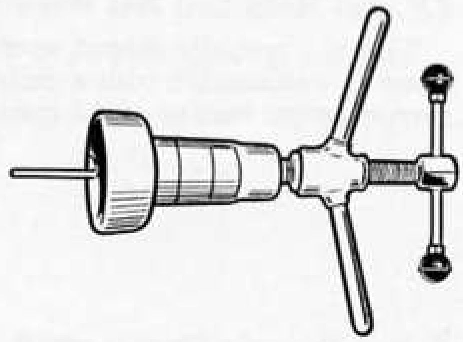


C.7124 Gearbox Insulator Mounting Remover and Replacer

This tool locates onto the gearbox and insulator and, by turning the handle, either presses the insulator in or out.

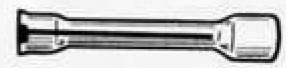
7600 Flywheel Bearing Remover Main Tool

The appropriate collet is contracted and pushed through the flywheel bearing and allowed to expand with the lugs behind the bearing. The main tool screws into the collet to hold it expanded and with the outer casing abutting the flywheel the bearing is pulled out with the centre screw.



CPT.7600-6 Spigot Bearing Remover

The collet is contracted and pushed through the spigot bearing and then expanded. The bearing is then pulled out.

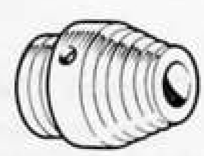


7657 Mainshaft Oil Seal Remover

This tool is used with CP.7657-3A to remove the oil seal without removing the gearbox from the vehicle.

P.7657-3A Mainshaft Oil Seal Remover Adaptor

This tool is used with 7657. The coarse taper thread is turned to bite into the oil seal, which can then be removed easily.



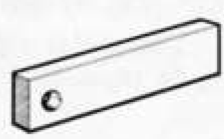
AUTOMATIC TRANSMISSION

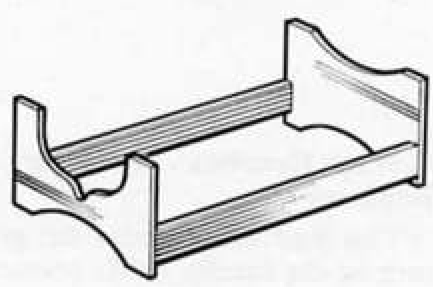
CBW.1A Pressure Test Gauge

A gauge and hose used with CBW.38-1 connected to the pressure take-off point on the transmission.

CBW.34 Front Band Spacer Gauge

A small steel gauge used to obtain the correct setting when adjusting the front band.



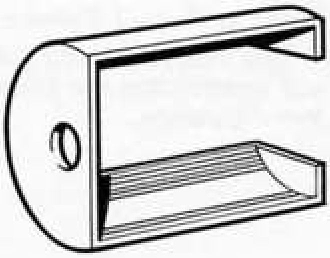


CBW.35B Bench Cradle

This tool holds the complete transmission assembly and allows adjustment, strip-down and re-assembly operations to be carried out without difficulty.

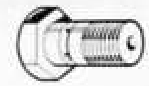
CBW.37A Clutch Spring Compressor

This tool is used with a hydraulic press, and enables the spring to be compressed, facilitating removal of the snap ring.



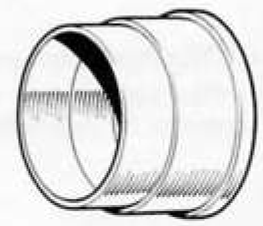
CBW.38A Hydraulic Test Equipment Adaptor

This tool is used with CBW.1A and consists of two adaptors which fit to the transmission assembly and allow all the necessary pressure tests to be carried out.



CBW.41 Rear Clutch Piston Replacer

On the rear clutch the replacer is fitted prior to fitting the piston assembly. This tool will prevent damage and resultant leakage.



CBW.42 Front Clutch Piston Replacer

This tool protects the oil rings during assembly of the piston.

CBW.547A-50 Rear Spring Tension Wrench

CBW.547A-50-2A Rear Servo Adjuster Socket Adaptor

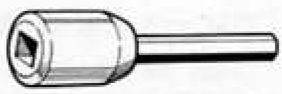
This tool is used with CBW.547A-50. It is a $\frac{5}{16}$ in. bi-square x $\frac{3}{8}$ in. square drive socket used to set the rear band adjustment.

CBW.547A-50-3 Inhibitor Switch Locknut Adaptor

This tool is used with CBW.547A-50. It is a special "U" shaped adaptor used to replace the inhibitor switch when the transmission assembly is in the vehicle.

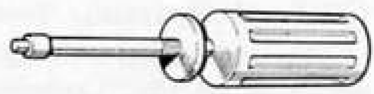
CBW.547A-50-4 Pressure Take-Off Plug Adaptor

This tool is used with CBW.547A-50 and a suitable extension and ensures that the pressure point plug is replaced without over-tightening.



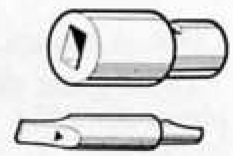
CBW.548 Spintorq Screwdriver

A small pre-set torque screwdriver with a ¼ in. square drive, adjustable from between 0 and 51.8 kg. cm. (0 and 45 lbs. in.).



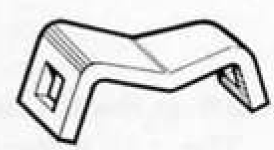
CBW.548-1 Spintorq Screwdriver Adaptor

This tool is used with CBW.548 and allows slotted head screws to be tightened to their correct torque setting.



CBW.548-2A Front Servo Adjuster Adaptor

This tool is used with CBW.548 and CBW.34, and is used when the transmission assembly is fitted to the vehicle.



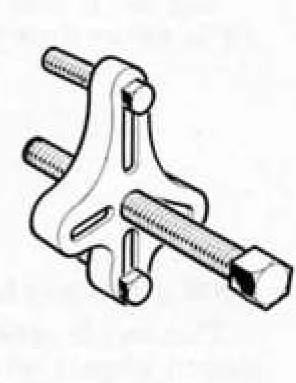
7066J Circlip Pliers 'J' Type Points

This tool is used with 7066 Circlip Pliers for use on 'J' type points fitted on the transmission assembly.

COOLING SYSTEM

C.6156 Water Pump Impeller Remover

This tool is used to remove the water pump pulley of the diesel engines.

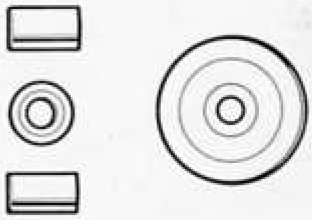


CPT. 8000 Water Pump Overhaul Tool (Main Tool)

This is a hand press used in conjunction with CP. 8010 kit.

CP.8010 Water Pump Overhaul Kit

This tool is a complete kit for the overhaul of the water pump. Full instructions for use are included with the kit.



GENERAL TOOLS

55 Puller

This is a puller body used with C.4068 to remove the differential and gearbox coupling flange.

200B Engine Stand

Using the appropriate mounting bracket, the various engines, gearboxes and differential assemblies in the Ford range can be mounted on this stand to facilitate dismantling and assembly.

370 Base

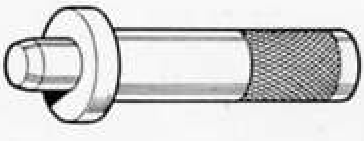
This tool fits on the bed of most workshop presses to take the various split adaptors etc., from the hand presses.

512 Piston Pull Scale

This is a light spring balance with provision for a feeler blade to be attached.

550 Oil Seal Driver Handle

This tool has a spigot at one end, onto which the various oil seal replacers etc., will fit.



575 Light Universal Handle

This tool is a lighter version of 550.

7066 Circlip Pliers

This tool is used for removing and replacing circlips. An adaptor is used for the automatic transmission.

Section 14

SPECIFICATIONS

CONTENTS

SUBJECT

SPECIFICATIONS

GENERAL DATA

WHEELS AND HUBS

Pressed steel wheels. Twin rear wheels on 130 – 175. Front hubs mounted on taper roller bearings. Rear hubs mounted on single bearing on 75 – 115, twin bearings on 125 – 175.

BRAKING SYSTEM

Hydraulically operated internally expanding braking system. Two leading shoes front. One leading, one trailing on 75 – 115. On 130 – 175 a duo-servo is fitted. Both dual line and single line systems are available in boosted and unboosted form, and from December 1970 pendant pedals and a direct servo (where applicable) are fitted.

FRONT AXLE AND STEERING GEAR

Cranked, 'I' section front axle forging. Worm and nut steering box with recirculating ball action. A safety steering column is also available for some territories.

REAR AXLE

Three-quarter floating hypoid on 75 – 115. Fully floating hypoid on 125 – 175. The 125 has basically the LCY axle modified to take single wheels.

FRONT AND REAR SUSPENSION

Longitudinal semi-elliptical leaf springs, telescopic double acting shock absorbers. From December 1970 all front springs are single leaf and all rear springs are minimum leaf.

ENGINE

Petrol. Two versions, 1664 c.c. (101.5 c.i.d.) and 1996 c.c. (121.8 c.i.d.). Both available with high or low compression ratio. Cylinder block and crankcase cast integrally. Detachable cast iron cylinder heads, incorporating push rod operated, stud mounted valve gear. Forged steel, three bearing crankshaft. Aluminium alloy solid skirt pistons.

Diesel. Two versions, 4/99 (prior to May 1966) and 4/108 (from May 1966). Cylinder block and crankcase cast integrally. Wet cylinder liners (4/99), dry cylinder liners (4/108). Detachable cast-iron cylinder head, incorporating push rod operated valve gear. Forged three bearing crankshaft. Aluminium alloy pistons.

GEARBOX AND CLUTCH

Manual or automatic transmission available. Manual gearbox is four-speed with synchromesh on all forward gears. Single dry plate, diaphragm spring type clutch. Mechanically operated clutch release mechanism. Automatic transmission has a torque converter and a hydraulically controlled automatic epicyclic gearbox.

A combined cable and rod clutch release mechanism was fitted across the range from December 1970.

COOLING SYSTEM

Pressurised system, forced circulation type. Centrifugal, belt-driven pump.

FUEL SYSTEM

Petrol. Single-venturi, downdraught carburettor. Mechanical fuel pump.

Diesel. Delay-type pintle nozzle injectors. Distributor type fuel injection pump. Mechanical fuel pump.

ELECTRICAL SYSTEM

Alternator charging system. 12 volt, negative earth battery. Printed circuit dashboard wiring. Wiring circuits fully fused. From December 1970 a new loom was introduced, hazard warning lights became a standard item and the option of a foot-operated wipe/wash switch was included.

WHEELS AND HUBS

WHEELS

Axle Capacity	Type	Model	Details
(Front)			
1,020 kg. (2,250 lb.) ..	23 ..	75 – 115 ..	35.6 cm. (14 in.) wheels. One-piece drop centre rims. Five-stud fixing.
1,020 kg. (2,250 lb.) ..	23 ..	125 – 175 ..	35.6 cm. (14 in.) wheels. One-piece drop centre rims. Six-stud fixing.
(Rear)			
1,250 kg. (2,750 lb.) ..	27 (34 Opt.)	75	35.6 cm. (14 in.) wheels. One-piece drop centre rims. Five-stud fixing. ¾ floating axle shafts.
1,550 kg. (3,400 lb.) ..	34 ..	90 – 115 ..	
2,360 kg. (5,200 lb.) ..	52 ..	125 – 175 ..	35.6 cm. (14 in.) wheels. One-piece drop centre rims. Six-stud fixing. Fully floating axle shafts.

WHEEL NUTS

Tightening torque .. .. 7.6 to 9.8 kg.m. (55 to 70 lb. ft.)

TYRES

Model	Tyre	Pressures			
		Front		Rear	
		kg./sq. cm.	lb./sq. in.	kg./sq. cm.	lb./sq. in.
60	6·50 × 14 6PR	2·1	30	2·5	36
60	6·50 × 14 6PRC	2·5	36	3·2	45
60	7·00 × 14 4PR	2·1	30	2·1	30
60	7·00 × 14 6PR	2·1	30	2·5	36
60	165 × R14 Reinforced	2·1	30	3·0	42
60	185 × R14 Reinforced	2·1	30	3·0	42
75	6·50 × 14 6PR	2·1	30	2·5	36
75	6·50 × 14 6PRC	2·5	36	3·2	45
75	7·00 × 14 4PR	2·1	30	2·1	30
75	7·00 × 14 6PR	2·1	30	2·5	36
75	7·00 × 14 6PRC	2·1	30	3·2	45
75	7·50 × 14 4PR	2·1	30	2·1	30
75	165 × R14 6C	2·5	36	3·2	45
75	165 × R14 Reinforced	2·1	30	3·0	42
75	185 × R14 Reinforced	2·1	30	3·0	42
90	7·00 × 14 6PRC	2·1	30	3·2	45
90	7·50 × 14 6PRC	2·1	30	3·2	45
90	7·75 × 14 6PR	1·7	24	2·5	36
90	7·75 × 14 6PRC	1·7	24	3·2	45
90 (Bus) ..	7·75 × 14 6PRC	1·7	24	2·5	36
90	185 × R14 6C	2·1	30	3·2	45
90	195 × R14 6C	1·7	24	3·2	45
90 (Bus) ..	195 × R14 6C	1·7	24	2·5	36
90 (Crewbus)..	195 × R14 6C	1·7	24	2·1	40
100	7·00 × 14 6PRC	2·1	30	3·2	45
100	7·50 × 14 6PRC	2·1	30	3·2	45
100	7·50 × 14 8PR	2·1	30	3·2	45
100	7·50 × 14 8PRC }	2·1	30	{ 3·2	*45
100	7·50 × 14 8PRC }			{ 3·8	55
100	7·75 × 14 6PR	1·7	24	2·5	36
100	7·75 × 14 6PRC }	1·7	24	{ 2·5	*36
100	7·75 × 14 6PRC }			{ 3·2	45
100	185 × R14 6C	2·1	30	3·2	45
100	195 × R14 6C	1·7	24	3·2	45

*Depending on model load application.

Tyres—*continued*

Model	Tyre	Pressures			
		Front		Rear	
		kg./sq. cm.	lb./sq. in.	kg./sq. cm.	lb./sq. in.
115	7·50 × 14 6PRC	2·1	30	3·2	45
115	7·50 × 14 8PR	2·1	30	3·2	45
115	7·50 × 14 8PRC	2·1	30	3·2	*45
115	7·50 × 14 8PRC			3·8	55
115	7·75 × 14 6PRC	1·7	24	3·2	45
115	195 × R14 6C	1·7	24	3·2	45
125	205 × R14 6C	1·7	24	3·2	45
130	6·50 × 14 4PR	2·1	30	2·1	30
130	6·50 × 14 6PR	2·5	36	2·5	36
130	6·50 × 14 6PRC	2·5	36	2·5	36
130	7·00 × 14 4PR	2·1	30	2·1	30
130	7·00 × 14 6PR	2·1	30	2·1	30
130	165 × R14 6C	2·5	36	2·5	36
130	165 × R14 Reinforced	2·5	36	2·5	36
150	6·50 × 14 6PRC	2·5	36	2·5	36
150	7·00 × 14 4PR	2·1	30	2·1	30
150	7·00 × 14 6PR	2·1	30	2·1	30
150	7·00 × 14 6PRC	2·1	30	2·1	30
150	7·50 × 14 4PR	2·1	30	2·1	30
150	165 × R14 6C	2·5	36	3·0	42
150	165 × R14 Reinforced	2·5	36	3·0	42
150	185 × R14 Reinforced	2·1	30	2·5	36
175	6·50 × 14 6PRC	2·5	36	3·2	45
175	7·00 × 14 6PRC	2·1	30	3·2	45
175	7·50 × 14 6PR	2·1	30	2·5	36
175	7·50 × 14 6PRC	2·1	30	2·5	36
175	185 × R14 6C	2·1	30	3·2	45
175	185 × R14 Reinforced	2·1	30	3·0	42

*Depending on model load application.

BRAKING SYSTEM

TYPE .. .. Hydraulic

FRONT BRAKES	75 – 90	115 – 125
Drum diameter (cm. & in.)	22.86 (9)	25.4 (10)
Lining length (cm. & in.)	21.84 (8.6)	24.38 (9.6)
Lining width (cm. & in.)	6.98 (2.75)	6.98 (2.75)
Lining thickness (mm. & in.)	4.83 (0.19)	4.83 (0.19)
Lining area (sq. cm. & sq. in.)	306 (47.4)	342.0 (52.8)
Wheel cylinder dia. (cm. & in.)	2 at 2.03 (0.8)	2 at 2.03 (0.8)

FRONT BRAKES	130	150 – 175
Drum diameter (cm. & in.)	25.4 (10)	25.4 (10)
Lining length (cm. & in.)	24.38 (9.6)	24.38 (9.6)
Lining width (cm. & in.)	5.71 (2.25)	6.98 (2.75)
Lining thickness (mm. & in.)	4.83 (0.19)	4.83 (0.19)
Lining area (sq. cm. & sq. in.)	278.5 (43.2)	342.0 (52.8)
Wheel cylinder dia. (cm. & in.)	2 at 2.22 (0.875)	2 at 2.22 (0.875)

REAR BRAKES

	75 – 90	115	125
Drum diameter (cm. & in.)	22.86 (9)	22.86 (9)	25.4 (10)
Lining length (cm. & in.)	21.84 (8.6)	21.84 (8.6)	21.84 (8.6)
Lining width (cm. & in.)	4.44 (1.75)	4.44 (1.75)	4.44 (1.75)
Lining thickness (mm. & in.)	4.83 (0.19)	4.83 (0.19)	4.83 (0.19)
Lining area (sq. cm. & sq. in.)	197.5 (30.0)	197.5 (30.0)	197.5 (30.0)
Wheel cylinder dia. (cm. & in.)	1 at 1.90 (0.75)	1 at 2.03 (0.8)	1 at 1.59 (0.625)

REAR BRAKES

	130	150 – 175
Drum diameter (cm. & in.)	25.4 (10)	25.4 (10)
Lining length—primary (cm. & in.)	24.38 (9.6)	24.38 (9.6)
—secondary (cm. & in.)	27.68 (10.9)	27.68 (10.9)
Lining width (cm. & in.)	5.71 (2.25)	6.98 (2.75)
Lining thickness—primary (mm. & in.)	4.83 (0.19)	4.83 (0.19)
—secondary (mm. & in.)	6.35 (0.25)	6.35 (0.25)
Lining area (sq. cm. & sq. in.)	297.5 (46.1)	364.0 (56.4)
Wheel cylinder dia. (cm. & in.)	1 at 1.59 (0.625)	1 at 1.90 (0.75)

MASTER CYLINDER (Up to December 1970)	75 – 175
Bore diameter (cm. & in.)	1.905 (0.75)
Stroke (cm. & in.)	3.327 (1.31)
Displacement (cu. cm. & cu. in.)	1.475 (0.58)

TANDEM MASTER CYLINDER (Up to December 1970)

Main bore diameter (cm. & in.)	1.905 (0.75)
Pressure differential bore diameter (cm. & in.)	0.950 (0.37)
Stroke (cm. & in.)	3.600 (1.42)

BRAKE FLUID	ME-3833-E or SM6C-1002-A

SERVO UNIT (Up to December 1970)

Outside diameter (cm. & in.)	17.8 (7.0)
Effective diameter (cm. & in.)	15.25 (6.0)
Slave cylinder diameter (cm. & in.)	2.22 (0.875)
Stroke (cm. & in.)	5.23 (2.06)
Displacement (cu. cm. & cu. in.)	20.31 (1.24)
Reaction plunger diameter (cm. & in.)	0.787 (0.31)
Booster weight (kg. & lb.)	2.97 (6.6)

MASTER CYLINDER (December 1970 onwards)

	Single line boosted	*Single line non-boosted*
Bore (cm. & in.)	2.064 (0.8125)	1.905 (0.75)
Stroke (cm. & in.)	3.30 (1.30)	3.556 (1.40)
Displacement (cu. cm. & cu. in.)	9.98 (0.674)	9.92 (0.608)
	Dual line boosted	*Dual line non-boosted*
Bore (cm. & in.)	2.064 (0.8125)	1.905 (0.75)
Stroke—primary piston (cm. & in.)	1.539 (0.606)	1.70 (0.669)
—secondary piston (cm. & in.)	1.727 (0.680)	1.90 (0.748)
Displacement—primary piston (cu. cm. & cu. in.)	4.62 (0.282)	4.85 (0.312)
—secondary piston (cu. cm. & cu. in.)	5.27 (0.322)	5.41 (0.342)

BOOSTER (December 1970 onwards)

Outside diameter (cm. & in.)	20.44 (8.04)
Effective diameter (cm. & in.)	18.75 (7.39)

TIGHTENING TORQUES

Bridge Pipe Unions	0.76 to 0.97 kg.m. (5.5 to 7 lb. ft.)
Wheel Cylinder Bolts—6.35 mm. ($\frac{1}{4}$ in.) bolt	0.97 to 1.27 kg.m. (7 to 9 lb. ft.)
—7.94 mm. ($\frac{5}{16}$ in.) bolt	1.45 to 1.73 kg.m. (10.5 to 12.5 lb. ft.)

FRONT AXLE AND STEERING

AXLE BEAM

Type	"I" section, cranked
Material	Forged steel
Height at centre	4.97 cm. (1.96 in.)
Width	3.81 cm. (1.50 in.)
Web thickness	0.533 cm. (0.21 in.)
Section modulus at centre	11.7 cm.^{3} (0.713 in.^{3})
Spindle bolt centres at the tops of the bores	148 cm. (58.25 in.)
Spring centres	90 cm. (35.44 in.)
Spindle above spring pad	5.25 cm. (2.07 in.) at wheel centre
Spindle bolt—Diameter	2.06 cm. (0.812 in.)
—Length	15.5 cm. (6.10 in.)
—Bushing length	3.05 cm. (1.20 in.)

STEERING LINKAGE

Castor Angle

Multi-leaf front springs:

	75 - 115 (*Before February 1967*) *Maximum*	*Minimum*	130 - 175 (*Before 3rd July 1967*) *Maximum*	*Minimum*
Van, Bus, Combi	5¾°	3¼°	6°	4°
Chassis cab, Chassis windshield, Chassis cowl	5½°	2¾°	6°	3½°

	75 - 115 (*February 1967 – December 1970*) *Maximum*	*Minimum*	130 - 175 (*July 1967 – December 1970*) *Maximum*	*Minimum*
Van, Bus, Combi	5¼°	2¾°	5½°	3½°
Chassis cab, Chassis windshield, Chassis cowl	5°	2¼°	5½°	3°

Single leaf front springs:

	75 - 125 *Maximum*	*Minimum*	130 - 175 *Maximum*	*Minimum*
Van, Bus, Combi	5¾°	3¼°	6°	4°
Chassis cab, Chassis windshield, Chassis cowl	5½°	2¾°	6°	3½°

Camber angle	0° — 1°
Toe-in	2.38 to 3.97 mm. (0.094 to 0.156 in.) for textile tyres 0.00 to 1.60 mm. (0.00 to 0.063 in.) for radial tyres
King pin inclination	5° ± 10′
Wheel turning angles: Back lock (maximum)	42° 40′
Front lock (maximum)	33°

Turning circles:

	Wheel Circle	*Swept Circle*
75 - 125: 2.79 m. (106 in.) wheelbase	10.36 m. (34.0 ft.)	11.03 m. (36.2 ft.)
130 - 175: 3.0 m. (118 in.) wheelbase	11.36 m. (37.25 ft.)	12.05 m. (39.5 ft.)

STEERING GEAR (Except 9/12 Seat Diesel Bus)

Type	Worm and Nut (Recirculating Ball)
Lubricant	Ford Steering Gear Grease ESW-M-IC-87A
Capacity	0.32 kg. (0.7 lb.)
Ratio	19.88 : 1

Adjustments

Worm shaft pre-load	4.0 to 7.0 kg. cm. (3.5 to 6.0 lb. in.)
Total pre-load (worm shaft pre-load plus mesh load)	45 kg. cm. (39 lb. in.)

STEERING GEAR (9/12 Seat Diesel Bus)

Type	Worm and nut (Recirculating Ball)
Lubricant	Steering gear oil ME-568-C
Capacity	0.42 litre (0.74 pint)
Ratio	20.55 : 1 (at straight ahead position)

Tightening Torques

Side cover bolts	2.07 to 2.49 kg.m. (15 to 18 lb. ft.)
Upper bearing retainer bolts	2.07 to 2.49 kg.m. (15 to 18 lb. ft.)

REAR AXLE

DRIVELINE

75 - 125	Single Piece—106 in. wheelbase
130 - 175	Two Piece—118 in. wheelbase
Centre Bearing	Lubricated for life

REAR AXLE

Type .. .. Hypoid, Three-quarter Floating (75 – 115). Fully Floating (125 – 175)

Ratios .. 75 (2750 lb. Axle) Type 27

Petrol		*Diesel*	
4.11 : 1	4.44 : 1	4.11 : 1	4.44 : 1
4.62 : 1	5.14 : 1	4.62 : 1	5.14 : 1

Ratios .. 90 (3400 lb. Axle) Type 34

Petrol		*Diesel*	
4.11 : 1	4.44 : 1	4.11 : 1	4.44 : 1
4.62 : 1	5.14 : 1	4.62 : 1	5.14 : 1

Ratios .. 115 (3400 lb. Axle) Type 34

Petrol		*Diesel*	
4.44 : 1	4.62 : 1	4.44 : 1	4.62 : 1
5.14 : 1		5.14 : 1	

Ratios .. 125 (5200 lb. Axle) Type 52

Petrol	*Diesel*
4.625 : 1	4.625 : 1
5.143 : 1	5.143 : 1

Ratios .. 130 (5200 lb. Axle) Type 52

Petrol		*Diesel*	
4.62 : 1	5.14 : 1	5.14 : 1	5.83 : 1
5.83 : 1	6.17 : 1	6.17 : 1	

Ratios .. 150 (5200 lb. Axle) Type 52

Petrol		*Diesel*	
4.62 : 1	5.14 : 1	5.83 : 1	6.17 : 1
5.83 : 1	6.17 : 1		

Ratios .. 175 (5200 lb. Axle) Type 52

Petrol		*Diesel*	
4.62 : 1	5.14 : 1	5.83 : 1	6.17 : 1
5.83 : 1	6.17 : 1		

Ratio	Teeth on Pinion	Teeth on Crown Wheel
4.11 : 1	9	37
4.44 : 1	9	40
4.625 : 1	8	37
5.143 : 1	7	36
5.833 : 1	6	35
6.17 : 1	6	37

LUBRICANT

Grade (2750 & 3400 lb. Axles)	S.A.E. 90 hypoid
(5200 lb. Axle) Initial Fill	EM-2C-29 Stuart hypoid
Top up	S.A.E. 90 hypoid
Capacity (2750 & 3400 lb. Axles)	2.13 litres (4.5 U.S. pints, 3.75 Imp. pints)
(5200 lb. Axle)	1.7 litres (3.0 U.S. pints, 2.50 Imp. pints)

ADJUSTMENTS

75 — 115

Crown wheel and pinion backlash	0.127 to 0.178 mm. (0.005 to 0.007 in.)
Pinion bearing pre-load	0.265 to 0.323 kg.m. (23 to 28 lb. in.)
Differential bearing pre-load (cap spread)	0.127 to 0.178 mm. (0.005 to 0.007 in.)

125 — 175

Crown wheel to pinion backlash	0.12 to 0.22 mm. (0.005 to 0.009 in.)
Differential bearing cap spread	0.16 to 0.22 kg.m. (0.006 to 0.009 in.)
Pinion bearing pre-load	0.14 to 0.17 kg.m. (12 to 15 lb. in.)

TIGHTENING TORQUES

75 — 115

Crown wheel to differential case bolts	6.9 to 7.6 kg.m. (50 to 55 lb. ft.)
Differential carrier to axle housing nuts	3.5 to 4.2 kg.m. (25 to 30 lb. ft.)
Differential bearing locking plate bolts	1.7 to 2.1 kg.m. (12 to 15 lb. ft.)
Differential bearing cap bolts	9.7 to 11.1 kg.m. (70 to 80 lb. ft.)
Driveshafts bolt	3.1 to 3.7 kg.m. (22 to 27 lb. ft.)
Spring clip bolts	7.6 to 9.0 kg.m. (55 to 65 lb. ft.)
Axle hub nut (*minimum*)	18 kg.m. (130 lb. ft.)

125 — 175

Differential backplate bolts	1.8 to 2.3 kg.m. (13 to 17 lb. ft.)
Differential case bolts	3.1 to 3.5 kg.m. (22 to 25 lb. ft.)
Crown wheel to differential case bolts	10 to 14 kg.m. (72 to 101 lb. ft.)
Pinion flange nut	10 to 12 kg.m. (72 to 87 lb. ft.)
Hub to axle shaft nuts	7.0 to 7.6 kg.m. (50 to 55 lb. ft.)
Differential bearing cap bolts	10 to 12 kg.m. (72 to 87 lb. ft.)

Depth of Mesh Shims

Part No.	*Size*	
11—620—564	1.720—1.740 mm.	(0.0677—0.0685 in.)
11—620—565	1.750—1.766 mm.	(0.0689—0.0695 in.)
11—620—566	1.780—1.796 mm.	(0.0701—0.0707 in.)
11—620—567	1.810—1.826 mm.	(0.0713—0.0719 in.)
11—620—568	1.838—1.854 mm.	(0.0724—0.0730 in.)
11—620—569	1.868—1.884 mm.	(0.0736—0.0742 in.)
11—620—570	1.898—1.914 mm.	(0.0748—0.0754 in.)
11—620—571	1.928—1.944 mm.	(0.0760—0.0766 in.)
11—620—572	1.958—1.974 mm.	(0.0772—0.0778 in.)
11—620—573	1.986—2.002 mm.	(0.0783—0.0789 in.)
11—620—574	2.016—2.032 mm.	(0.0795—0.0801 in.)
11—620—575	2.046—2.062 mm.	(0.0807—0.0813 in.)
11—620—576	2.076—2.092 mm.	(0.0819—0.0825 in.)
11—620—577	2.106—2.122 mm.	(0.0831—0.0837 in.)
11—620—578	2.136—2.152 mm.	(0.0843—0.0849 in.)
11—620—579	2.164—2.180 mm.	(0.0854—0.0860 in.)
11—620—580	2.194—2.210 mm.	(0.0866—0.0872 in.)
11—620—581	2.230—2.240 mm.	(0.0878—0.0882 in.)

Pinion Pre-load Spacers

Part No.	*Size*	
11—440—306	10.300—10.310 mm.	(0.4055—0.4059 in.)
11—440—307	10.315—10.325 mm.	(0.4061—0.4065 in.)
11—440—308	10.330—10.340 mm.	(0.4067—0.4071 in.)
11—440—309	10.345—10.355 mm.	(0.4073—0.4077 in.)
11—440—310	10.360—10.370 mm.	(0.4079—0.4083 in.)
11—440—311	10.375—10.385 mm.	(0.4085—0.4089 in.)
11—440—312	10.390—10.400 mm.	(0.4091—0.4095 in.)
11—440—313	10.405—10.415 mm.	(0.4096—0.4100 in.)
11—440—314	10.415—10.425 mm.	(0.4102—0.4106 in.)
11—440—315	10.430—10.440 mm.	(0.4108—0.4112 in.)
11—440—316	10.445—10.455 mm.	(0.4114—0.4118 in.)
11—440—317	10.460—10.470 mm.	(0.4120—0.4124 in.)
11—440—318	10.475—10.485 mm.	(0.4126—0.4130 in.)
11—440—319	10.490—10.500 mm.	(0.4132—0.4136 in.)
11—440—320	10.505—10.515 mm.	(0.4138—0.4142 in.)
11—440—321	10.520—10.530 mm.	(0.4144—0.4148 in.)
11—440—322	10.535—10.545 mm.	(0.4150—0.4154 in.)
11—440—323	10.550—10.560 mm.	(0.4156—0.4160 in.)
11—440—324	10.565—10.575 mm.	(0.4161—0.4165 in.)
11—440—325	10.580—10.590 mm.	(0.4167—0.4171 in.)
11—440—326	10.595—10.605 mm.	(0.4173—0.4177 in.)
11—440—327	10.610—10.620 mm.	(0.4179—0.4183 in.)
11—440—328	10.625—10.635 mm.	(0.4185—0.4189 in.)
11—440—329	10.640—10.650 mm.	(0.4191—0.4195 in.)
11—440—330	10.655—10.665 mm.	(0.4197—0.4201 in.)
11—440—331	10.670—10.680 mm.	(0.4203—0.4207 in.)
11—440—332	10.685—10.695 mm.	(0.4209—0.4213 in.)
11—440—333	10.700—10.710 mm.	(0.4215—0.4219 in.)
11—440—334	10.715—10.725 mm.	(0.4221—0.4225 in.)
11—440—335	10.730—10.740 mm.	(0.4226—0.4230 in.)
11—440—336	10.745—10.755 mm.	(0.4232—0.4236 in.)
11—440—337	10.760—10.770 mm.	(0.4238—0.4242 in.)
11—440—338	10.775—10.785 mm.	(0.4244—0.4248 in.)
11—440—339	10.790—10.800 mm.	(0.4250—0.4254 in.)
11—440—340	10.805—10.815 mm.	(0.4256—0.4260 in.)
11—440—341	10.825—10.835 mm.	(0.4262—0.4266 in.)
11—440—342	10.840—10.850 mm.	(0.4268—0.4272 in.)
11—440—343	10.855—10.865 mm.	(0.4274—0.4278 in.)
11—440—344	10.870—10.880 mm.	(0.4280—0.4284 in.)
11—440—345	10.885—10.895 mm.	(0.4285—0.4289 in.)
11—440—346	10.900—10.910 mm.	(0.4291—0.4295 in.)
11—440—347	10.915—10.925 mm.	(0.4297—0.4301 in.)
11—440—348	10.930—10.940 mm.	(0.4303—0.4307 in.)
11—440—349	10.945—10.955 mm.	(0.4309—0.4313 in.)
11—440—350	10.960—10.970 mm.	(0.4314—0.4319 in.)
11—440—351	10.975—10.985 mm.	(0.4321—0.4325 in.)
11—440—352	10.990—11.000 mm.	(0.4327—0.4331 in.)
11—440—353	11.000—11.010 mm.	(0.4333—0.4337 in.)
11—440—354	11.015—11.025 mm.	(0.4339—0.4343 in.)
11—440—355	11.030—11.040 mm.	(0.4345—0.4349 in.)
11—440—356	11.045—11.055 mm.	(0.4351—0.4355 in.)
11—440—357	11.060—11.070 mm.	(0.4357—0.4361 in.)
11—440—358	11.075—11.085 mm.	(0.4363—0.4367 in.)
11—440—359	11.090—11.100 mm.	(0.4368—0.4372 in.)
11—440—360	11.105—11.115 mm.	(0.4374—0.4378 in.)
11—440—361	11.120—11.130 mm.	(0.4380—0.4384 in.)
11—440—362	11.135—11.145 mm.	(0.4386—0.4390 in.)
11—440—363	11.150—11.160 mm.	(0.4392—0.4396 in.)
11—440—364	11.165—11.175 mm.	(0.4398—0.4402 in.)
11—440—365	11.180—11.190 mm.	(0.4404—0.4408 in.)

FRONT AND REAR SUSPENSION

Until December 1970 — Except Parcel Van

FRONT SPRINGS (Multi-leaf) .. **75 to 175** .. Semi-elliptic, mounted on rubber-bushed shackles and pins.

	Petrol Engines	Diesel Engines
No. of Leaves	3	3 and one spacer
Deflection rate (unclamped)	36.0 kg. cm. (200 lb. in.)	36.0 kg. cm. (200 lb. in.)
Width	5.99 cm. (2.36 in.)	5.99 cm. (2.36 in.)
Length	120.015 cm. (47.25 in.)	120.015 cm. (47.25 in.)
Thickness	3 at 0.828 cm. (0.326 in.)	3 at 0.828 cm. (0.326 in.) spacer at 0.813 cm. (0.32 in.)

FRONT SPRINGS (Single-leaf) .. **75 to 175** .. Semi-elliptic, mounted on rubber-bushed shackles and pins.

No. of leaves	1 (plus spacer with diesel engines)
Deflection rate (unclamped)	36.0 kg. cm. (200 lb. in.)
Width	5.99 cm. (2.36 in.)
Length	120.015 cm. (47.25 in.)
Thickness	Tapered

REAR SPRINGS .. **75 to 115** .. Semi-elliptic, mounted on rubber-bushed shackles and pins.

	75	90	115
No. of leaves	5 (Single Rate)	5 (Progressive Rate)	6 (Progressive Rate)
Deflection rate (unclamped)	30.0 kg. cm. (168 lb. in.)	50.0 kg. cm. (280 lb. in.)	71.0 kg. cm. (395 lb. in.)
Width	5.99 cm. (2.36 in.)	5.99 cm. (2.36 in.)	5.99 cm. (2.36 in.)
Length	116.84 cm. (46 in.)	116.84 cm. (46 in.)	116.84 cm. (46 in.)
Thickness	5 at 0.64 cm. (0.252 in.)	4 at 0.571 cm. (0.225 in.) 1 at 1.196 cm. (0.471 in.)	4 at 0.559 cm. (0.220 in.) 2 at 1.170 cm. (0.461 in.)

REAR SPRINGS .. **130 to 175** .. Semi-elliptic, mounted on a rubber-bushed front pin and a rear slipper bracket. Progressive rate of deflection.

	130	150	175
No. of leaves	7 (Progressive Rate)	7 (Progressive Rate)	7 (Progressive Rate)
Deflection rate (unclamped)	90.55 kg. cm. (507 lb. in.)	106.3 kg. cm. (595 lb. in.)	123.6 kg. cm. (692 lb. in.)
Width	5.99 cm. (2.36 in.)	5.99 cm. (2.36 in.)	5.99 cm. (2.36 in.)
Length	141.0 cm. (55.5 in.)	141.0 cm. (55.5 in.)	141.0 cm. (55.5 in.)
Thickness	5 at 0.635 cm. (0.250 in.) 2 at 1.331 cm. (0.524 in.)	5 at 0.648 cm. (0.255 in.) 2 at 1.496 cm. (0.598 in.)	5 at 0.658 cm. (0.259 in.) 2 at 1.582 cm. (0.623 in.)

Parcel Van

FRONT SPRINGS (Multi-leaf) .. **130 and 175** .. Semi-elliptic, mounted on rubber-bushed shackles and pins.

	Petrol Engines	Diesel Engines
No. of leaves	3	3 and one spacer
Deflection rate (unclamped)	59.0 kg. cm. (330 lb. in.)	59.0 kg. cm. (330 lb. in.)
Width	5.99 cm. (2.36 in.)	5.99 cm. (2.36 in.)
Length	120.015 cm. (47.25 in.)	120.015 cm. (47.25 in.)
Thickness	3 at 0.965 cm. (0.38 in.)	3 at 0.965 cm. (0.38 in.) spacer at 0.800 cm. (0.315 in.)

REAR SPRINGS .. **130** .. .. Semi-elliptic, mounted on rubber-bushed shackles and pins.

	Petrol and Diesel Engines
No. of leaves	6 (Progressive Rate)
Deflection Rate (unclamped)	103.24 kg. cm. (580 lb. in.)

Width	5.99 cm. (2.36 in.)
Length	116.84 cm. (46.00 in.)
Thickness	4 at 0.559 cm. (0.22 in.) 2 at 1.496 cm. (0.589 in.)

REAR SPRINGS .. **175** .. Semi-elliptic, mounted on a rubber-bushed front pin and a rear slipper bracket.

Petrol and Diesel Engines

No. of leaves	8 (Progressive Rate)
Deflection rate (unclamped) ..	173.55 kg. cm. (975 lb. in.)
Width	5.99 cm. (2.36 in.)
Length	127.0 cm. (50.0 in.)
Thickness	5 at 0.708 cm. (0.314 in.) 3 at 1.582 cm. (0.623 in.)

From December 1970

FRONT SPRINGS .. **75 to 175** Single leaf, semi-elliptic, mounted on rubber-bushed shackles and pins.

No. of leaves	1
Width	6.8 cm. (2.67 in.)
Length	120.02 cm. (47.25 in.)
Basic Part No. ..	70VB–5310

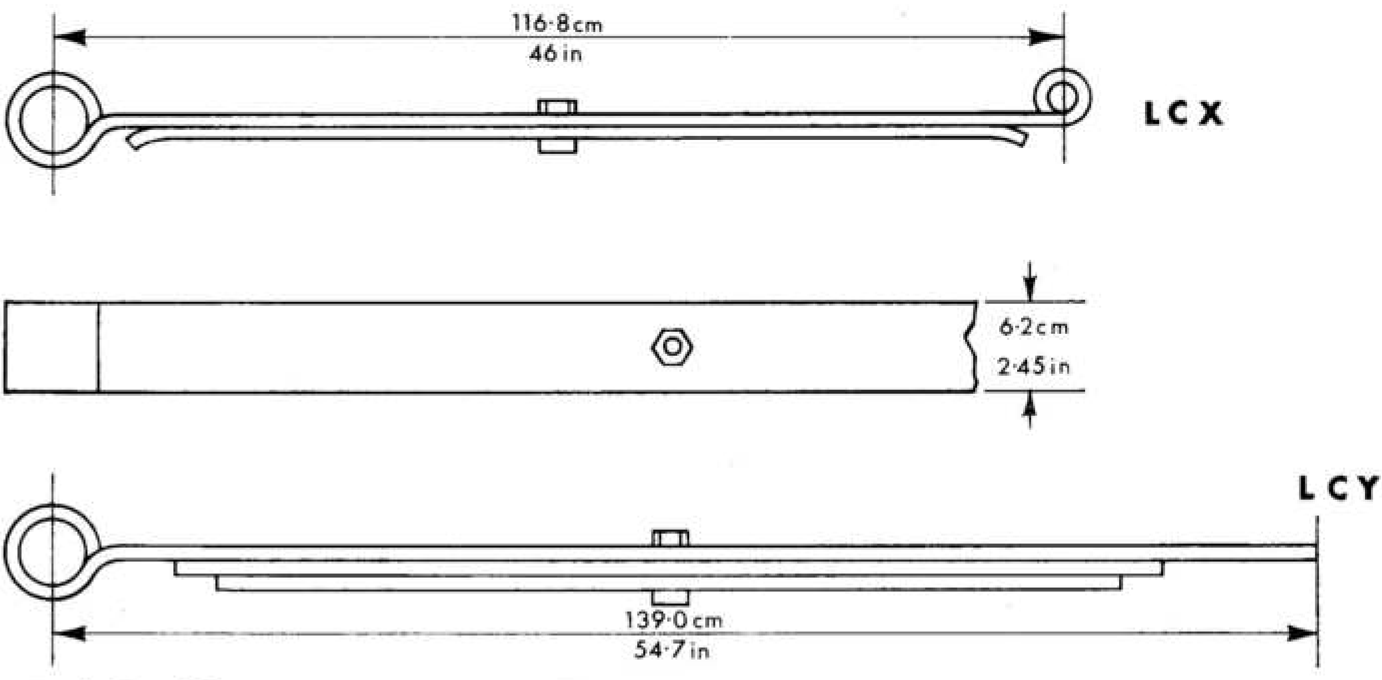
For full list of Part Numbers and their application, see Parts Catalogue.

REAR SPRINGS .. **75 to 125 (LCX)** .. Minimum leaf, semi-elliptic, mounted on rubber-bushed shackles and pins.

No. of leaves	2 or 3
Width	6.2 cm. (2.45 in.)
Length	116.8 cm. (46 in.)

REAR SPRINGS .. **130 to 175 (LCY)** .. Minimum leaf, semi-elliptic, mounted on rubber-bushed front pin and a rear slipper bracket.

No. of leaves	3
Width	6.2 cm. (2.45 in.)
Length	139.0 cm. (54.7 in.)



Basic Part No. .. 70VB–5560

For full list of Part Numbers and their application, see Parts Catalogue.

ENGINE

PETROL

	1.7 *Litre*		2.0 *Litre*	
Type	4 cylinder 60° Vee O.H.V.			
Bore	93.67 mm. (3.6878 in.)		93.67 mm. (3.6878 in.)	
Stroke	60.35 mm. (2.376 in.)		72.42 mm. (2.851 in.)	
Cubic Capacity	1663 c.c. (101.5 C.I.D.)		1996 c.c. (121.8 C.I.D.)	
Compression ratio	8 : 1	9.1 : 1	8 : 1	8.9 : 1
Brake horse power	73 at 4750 rev./min.	81.5 at 4750 rev./min.	85.5 at 4750 rev./min.	93 at 4750 rev./min.
Torque	91 lb. ft. at 3000 rev./min.	99.5 lb. ft. at 3000 rev./min.	114 lb. ft. at 2750 rev./min.	123.5 lb. ft. at 2750 rev./min.
Firing order	1, 3, 4, 2			
Cylinder numbering	1 & 2 Right-hand Bank, 3 & 4 Left-hand Bank			
Location of No. 1 cylinder	Right-hand bank next to radiator			
Engine weight (less clutch)	144 kg. (318 lbs.)		145 kg. (320 lbs.)	

CAMSHAFT

Camshaft drive .. .. .. Gear

	Prior to Feb. 1968	*Feb.* 1968 *onwards*
Cam lift—Intake	6.47 mm. (0.25465 in.)	6.48 mm. (0.25498 in.)
—Exhaust	6.62 mm. (0.26065 in.)	6.63 mm. (0.26098 in.)

No. of bearings	3
Bearing diameter—Front	47.64 to 47.66 mm. (1.8757 to 1.8763 in.)
—Intermediate	46.10 to 46.13 mm. (1.8153 to 1.8163 in.)
—Rear	44.58 to 44.6 mm. (1.7553 to 1.7563 in.)
Bearing length—Front	21.3 mm. (0.84 in.)
—Intermediate	26.9 mm. (1.06 in.)
—Rear	21.3 mm. (0.84 in.)
Bearing clearance	0.066 to 0.02 mm. (0.0026 to 0.0008 in.)
Type of bearing	Steel backed babbit
Shaft diameter	24.4 mm. (0.96 in.)
Journal diameter—Front	47.59 to 47.61 mm. (1.8735 to 1.8745 in.)
—Intermediate	46.07 to 46.09 mm. (1.8137 to 1.8145 in.)
—Rear	44.54 to 44.56 mm. (1.7537 to 1.7545 in.)
End float	0.076 to 0.178 mm. (0.003 to 0.007 in.)
Backlash—Crankshaft to camshaft gear	0.05 to 0.10 mm. (0.002 to 0.004 in.)

CRANKSHAFT

No. of main bearings	3
Main journal diameter—blue	63.515 to 63.536 mm. (2.5006 to 2.5014 in.)
Main journal diameter—red	63.526 to 63.535 mm. (2.5010 to 2.5014 in.)
Journal length—Front	24.13 to 25.4 mm. (0.95 to 1.00 in.)
—Intermediate	26.89 to 26.95 mm. (1.059 to 1.061 in.)
—Rear	26.92 to 27.68 mm. (1.06 to 1.09 in.)
Main journal fillet radius—centre and oil slinger double radius of	1.78 and 2.03 mm. (0.07 and 0.08 in.)
—Front and rear	2.032 to 2.388 mm. (0.080 to 0.094 in.)
Crankpin diameter	60.36 to 60.34 mm. (2.3764 to 2.3756 in.)
Crankpin length	21.29 to 21.39 mm. (0.838 to 0.842 in.)
Crankpin journal fillet radius	2.032 to 2.388 mm. (0.080 to 0.094 in.)
Oversize thrust washers available	0.064 mm. (0.0025 in.), 0.127 mm. (0.005 in.) 0.191 mm. (0.0075 in.), 0.254 mm. (0.010 in.)
End float	0.076 to 0.279 mm. (0.003 to 0.011 in.)

CONNECTING ROD

Length	143.281 to 143.332 mm. (5.641 to 5.643 in.)
Piston pin fit in rod	0.0203 to 0.0381 mm. (0.0008 to 0.0015 in.) interference
End float on shaft	0.102 to 0.254 mm. (0.004 to 0.010 in.)
Big end bearings	Steel back aluminium/tin or copper/lead liners
Big end bore	64.033 to 64.046 mm. (2.5210 to 2.5215 in.)
Bearing liner wall thickness	1.826 to 1.835 mm. (0.0719 to 0.07225 in.)
Undersize bearings available	0.25 mm. (0.010 in.), 0.51 mm. (0.020 in.) 0.76 mm. (0.030 in.), 1.02 mm. (0.040 in.) on I.D.
Small end diameter	23.769 to 23.779 mm. (0.9358 to 0.9362 in.)

PISTONS

Type	Cut-away skirt with combustion chamber in crown
Material	Aluminium alloy tin plated
Weight—1.7 litre	608.0 to 612.0 grams
—2 litre	563.0 to 567.0 grams
Number of rings	Two compression, one oil control
Width of ring grooves—Compression rings	2.032 to 2.057 mm. (0.080 to 0.081 in.)
—Oil control ring	4.787 to 4.762 mm. (0.1885 to 0.1875 in.)
Piston pin bore diameter	Graded
Grade—Red	23.810 to 23.813 mm. (0.9374 to 0.9375 in.)
—Yellow	23.813 to 23.815 mm. (0.9375 to 0.9376 in.)
Blue	23.815 to 23.818 mm. (0.9376 to 0.9377 in.)
Piston pin bore offset	1.59 mm. (0.06 in.) towards thrust face
Piston clearance in cylinder bore	0.0356 to 0.0508 mm. (0.0014 to 0.0020 in.)
Piston pull	4.08 to 5.89 kg. (9 to 13 lb.) pull on 0.0508 mm. (0.002 in.) feeler blade, 12.7 mm. (0.5 in.) wide
Piston diameter	93.642 to 93.659 mm. (3.6867 to 3.6870 in.) Measured at right angles to, and level with, piston bore pin
Oversize pistons available	0.0635 mm. (0.0025 in.) 0.381 mm. (0.015 in.), 0.762 mm. (0.030 in.) 1.14 mm. (0.045 in.), 1.52 mm. (0.060 in.)

PISTON PINS

Type	Semi-floating, pressed into connecting rod
Material	Machined seamless steel tubing
Length	74.42 to 74.93 mm. (2.93 to 2.95 in.)
Outside diameter	23.793 to 23.806 mm. (0.9370 to 0.9373 in.)
Clearance in piston	0.0076 to 0.0127 mm. (0.0003 to 0.0005 in.) selective

PISTON RINGS

Upper Compression Ring

Material	Cast iron and chrome plated
Type	Barrel face
Radial thickness	4.24 to 3.98 mm. (0.167 to 0.157 in.)
Width	1.956 to 1.981 mm. (0.077 to 0.078 in.)
Ring to groove clearance	0.0508 to 0.1016 mm. (0.002 to 0.004 in.)
Ring gap	0.254 to 0.508 mm. (0.010 to 0.020 in.)

Lower Compression Ring

Material	Cast iron
Type	Externally stepped on the lower face
Radial thickness	4.14 to 4.67 mm. (0.163 to 0.184 in.)
Width	1.956 to 1.981 mm. (0.077 to 0.078 in.)
Ring to groove clearance	0.0508 to 0.1016 mm. (0.002 to 0.004 in.)
Ring gap	0.254 to 0.508 mm. (0.010 to 0.020 in.)

Oil Control Ring

Material	Cast iron
Type	"Micro-land" scraper with slotted channel
Radial thickness	3.81 to 4.06 mm. (0.150 to 0.160 in.)
Width	4.711 to 4.73 mm. (0.1855 to 0.1865 in.)
Ring to groove clearance	0.0254 to 0.0762 mm. (0.001 to 0.003 in.)
Ring gap	0.254 to 0.381 mm. (0.010 to 0.015 in.)
Oversize rings available	0.0635 mm. (0.0025 in.), 0.381 mm. (0.015 in.), 0.762 mm. (0.030 in.), 1.14 mm. (0.045 in.), 1.52 mm. (0.060 in.)

CYLINDER BLOCK

Type	Cylinder cast integral with top half of crankcase
Material	Ford cast iron alloy
Water jackets	Full length
Angle of Vee	60°
Nominal cylinder bore diameter	93.67 mm. (3.6878 in.)
Cylinder liners available	Std. and 0.51 mm. (0.020 in.) o/s on O.D.
Bore for cylinder liners	97.320 to 97.345 mm. (3.8315 to 3.8325 in.) Std. 97.828 to 97.854 mm. (3.8515 to 3.8525 in.) oversize
Bore for main bearing liners—Red	67.701 to 67.711 mm. (2.6654 to 2.6658 in.)
—Blue	67.711 to 67.721 mm. (2.6658 to 2.6662 in.)

CYLINDER HEAD

Type	Cast iron with vertical valves. Separate inlet and exhaust ports
Bolt size	½ in.—13 UNC×3$\frac{11}{16}$ in. long
Valve guides	Machined directly in the head but guide bushes are available
Bore for guide bushes	11.133 to 11.153 mm. (0.4383 to 0.4391 in.)
Valve guide inside diameter	7.912 to 7.938 mm. (0.3115 to 0.3125 in.)
Valve seat angle	44° 30′ to 45° inlet and exhaust
Valve seat width—Inlet	1.397 mm. (0.055 in.)
—Exhaust	1.930 mm. (0.076 in.)

Valve Seat Inserts

Insert	*Valve*	*I.D. of Recess in Head*	*Depth of Recess in Head*
Standard	Inlet Exhaust	41.656/41.668 mm. (1.6400/1.6405 in.) 37.846/37.859 mm. (1.4900/1.4095 in.)	8.23/8.28 mm. (0.324/0.326 in.)
0.254 mm. (0.010 in.) o/s dia std. depth	Inlet Exhaust	41.910/41.923 mm. (1.6500/1.6505 in.) 38.100/38.113 mm. (1.5000/1.5005 in.)	8.23/8.28 mm. (0.324/0.326 in.)
0.254 mm. (0.010 in.) o/s dia. and depth	Inlet Exhaust	41.910/41.923 mm. (1.6500/1.6505 in.) 38.100/38.113 mm. (1.5000/1.5005 in.)	8.48/8.53 mm. (0.334/0.336 in.)
0.508 mm. (0.020 in.) o/s dia. std. depth	Inlet Exhaust	42.164/42.177 mm. (1.6600/1.6605 in.) 38.354/38.367 mm. (1.5100/1.5105 in.)	8.23/8.28 mm. (0.324/0.326 in.)
0.508 mm. (0.020 in.) o/s dia. and depth	Inlet Exhaust	42.164/42.177 mm. (1.6600/1.6605 in.) 38.354/38.367 mm. (1.5100/1.5105 in.)	8.74/8.79 mm. (0.344/0.346 in.)

Bore for rocker stud (std.) .. .. 9.360 to 9.385 mm. (0.3685 to 0.3695 in.)

VALVES

Valve stem diameter—Inlet	7.861 to 7.887 mm. (0.3095 to 0.3105 in.)
—Exhaust	7.838 to 7.864 mm. (0.3086 to 0.3096 in.)
Valve stem to guide clearance—Inlet	0.025 to 0.076 mm. (0.001 to 0.003 in.)
—Exhaust	0.048 to 0.099 mm. (0.0019 to 0.0039 in.)
Oversize stems available	0.076 mm. (0.003 in.), 0.381 mm. (0.015 in.), 0.76 mm. (0.030 in.)
Valve head diameter—Inlet	40.44 to 40.69 mm. (1.592 to 1.602 in.)
—Exhaust	36.27 to 36.52 mm. (1.428 to 1.438 in.)
Valve face angle	45° to 45° 15′
Valve face run-out	0.025 mm. (0.001 in.) T.I.R.

VALVE SPRINGS

Free length	51.51 mm. (2.028 in.)
Diameter	33.63 to 34.24 mm. (1.324 to 1.348 in.)
Total number of coils	6.75
Wire diameter	4.24 to 4.29 mm. (0.167 to 0.169 in.)
Load at 40.64 mm. (1.60 in.) length (valve closed)	27.10 to 31.64 kg. (59.75 to 69.75 lb.)
Load at 31.06 mm. (1.223 in.) length (valve open)	58.97 to 65.32 kg. (130 to 144 lb.)

VALVE TIMING AND CLEARANCES

Nominal valve timing: Valve clearances 0.457 mm. (0.018 in.) inlet and 0.66 mm. (0.026 in.) exhaust

	Prior to Feb. 1968	*Feb.* 1968 *onward*
Inlet opens	20° B.T.D.C.	20° B.T.D.C.
Inlet closes	56° A.B.D.C.	64° A.B.D.C.
Exhausts opens	62° B.B.D.C.	70° B.B.D.C.
Exhaust closes	14° A.T.D.C.	14° A.T.D.C.
Valve lift—Inlet	9.296 mm. (0.366 in.)	8.56 mm. (0.335 in.)
—Exhaust	9.296 mm. (0.366 in.)	8.56 mm. (0.335 in.)
Valve clearance (set dynamically [engine running] at normal operating temperature)—Inlet	0.25 mm. (0.010 in.)	0.25 mm. (0.010 in.)
—Exhaust	0.46 mm. (0.018 in.)	0.46 mm. (0.018 in.)

ENGINE DIMENSIONS

Length	518.16 mm. (20.4 in.)
Overall width (alternator in maximum adjustment position)	690.88 mm. (27.2 in.)
Height (less air cleaner)	660.40 mm. (26.0 in.)

FLYWHEEL

Run-out clutch face (T.I.R. max.)	0.18 mm. (0.007 in.) at 107.9 mm. (4.25 in.) radius
No. of teeth on ring gear	121
Flywheel retention	Dowel and bolts
Ring gear retention	Shrunk into position

BALANCE SHAFT

End-float	0.254 to 0.381 mm. (0.010 to 0.015 in.)
Bearing clearance	0.046 to 0.084 mm. (0.0018 to 0.0033 in.)
Backlash—crankshaft to balance shaft gear	0.05 to 0.10 mm. (0.002 to 0.004 in.)

LUBRICATION

System	Pressure feed
Pressure feed bearings	Mains, big ends, camshaft and balance shaft
Metered feed	Rocker gear
Timing gear lubrication	Controlled spray
Oil pump	Eccentric bi-rotor or sliding vane types

Eccentric Bi-Rotor Type Pump

Inner and outer rotor clearance	0.152 mm. (0.006 in.) maximum
Outer rotor and housing clearance	0.254 mm. (0.010 in.) maximum
	After Oct. 1968 0.381 mm. (0.015 in.) maximum
Inner and outer rotor end-float	0.127 mm. (0.005 in.) maximum
Capacity	4.425 litres (12 U.S. galls., 10 Imp. galls.)/min. at 2,500 rev./min.

Sliding Vane Type Pump

Rotor to pump body clearance	0.127 mm. (0.005 in.) maximum
Vane clearance in rotor	0.127 mm. (0.005 in.) maximum
Rotor and vane end-float	0.127 mm. (0.005 in.) maximum
Vane to body clearance	0.279 mm. (0.011 in.) maximum
Capacity	4.425 litres (12 U.S. galls., 10 Imp. galls.)/min. at 2,500 rev./min.
Oil pressure	3.15 to 3.61 kp./sq. cm. (45 to 50 lb./sq. in.)
Oil filter type	External full flow pressure relief type
Sump capacity	4.54 litres (9.6 U.S. pints, 8 Imp. pints)
Oil filter capacity	0.85 litres (1.8 U.S. pints, 1.5 Imp. pints)

SAE Viscosity No.	*Temperature Range* Use Below	Use Above	Max. High	Min. Low
5W-20 and 5W-30	—23.3°C (—10°F)	—	0°C (+32°F)	—
10W-30	—	General Use	+32.2°C (+90°F)	—23.3°C (—10°F)
10W-40	—	General Use	—	—23.3°C (—10°F)
10W-50	—	General Use	—	—23.3°C (—10°F)
20W-40 and 20W-50	—	+32.2°C (+90°F)	— —	0°C (+32°F)
10W	—12.2°C (+10°F)	—23.3°C (—10°F)	—	—
10W-20	0°C (+32°F)	—12.2°C (+10°F)	—	—
30	+32.2°C (+90°F)	0°C (+32°F)	—	—
40	—	+32.2°C (+90°F)	—	—

4/99 DIESEL ENGINE

Bore	76.2 mm. (3 in.)
Stroke	88.9 mm. (3.5 in.)
Number of cylinders	4
Capacity	1,621 c.c. (99 cu. in.)
Compression ratio	20 : 1
Firing order	1, 3, 4, 2
Maximum b.h.p.	42 at 3,600 rev./min.
Maximum torque	10.09 kg.m. (73 lb. ft.) at 2,250 rev./min.
Valve clearance (hot)	0.25 mm. (0.010 in.)
Valve seat and face angle	45
Cam lift	6.6 mm. (0.26 in.)
Sump capacity	4.9 litres (10.3 U.S. pints, 8.6 pints)
Filter capacity	1.1 litres (2.4 U.S. pints, 2.0 pints)
Oil pressure	2.8123 kg. sq. cm. (40 lb. sq. in.)
Injection pressure	130 atmospheres

TIGHTENING TORQUES

Cylinder head nuts	5.25 to 5.81 kg.m. (38 to 42 lb. ft.)
Connecting rod bolts	5.0 to 5.2 kg.m. (36 to 38 lb. ft.)
Main bearing bolts	10.9 to 11.75 kg.m. (79 to 85 lb. ft.)
Flywheel bolts	7.6 to 8.3 kg.m. (55 to 60 lb. ft.)
Idler gear set-screws	4.56 to 4.98 kg.m. (33 to 36 lb. ft.)
Crankshaft pulley retaining bolt	19.35 to 20.73 kg.m. (140 to 150 lb. ft.)
Injector securing nuts	1.38 to 1.66 kg.m. (10 to 12 lb. ft.)
Rocker shaft pedestal nuts	1.66 to 2.08 kg.m. (12 to 15 lb. ft.)

CYLINDER BLOCK

Total height of cylinder block between top and bottom faces	252.37 to 252.45 mm. (9.936 to 9.939 in.)
Cylinder bore diameter	76.20 to 76.23 mm. (3.000 to 3.001 in.)
Main bearing parent bore diameter	60.833 to 60.846 mm. (2.3950 to 2.3955 in.)
Camshaft bore diameter No. 1	45.568 to 45.696 mm. (1.794 to 1.7955 in.)
Camshaft bore diameter No. 2	44.314 to 45.390 mm. (1.784 to 1.787 in.)
Camshaft bore diameter No. 3	45.110 to 45.161 mm. (1.776 to 1.778 in.)
Tappet bore diameter	14.275 to 14.307 mm. (0.562 to 0.56325 in.)
Cylinder liner protrusion	—0.025 to +0.076 mm. (—0.001 to +0.003 in.)

PISTONS, PINS AND RINGS

Height of piston crown above cylinder block at T.D.C.	0.216 to 0.305 mm. (0.085 to 0.012 in.)
Piston pin diameter	23.811 to 23.816 mm. (0.9375 to 0.9377 in.)
Top compression ring groove width	2.03 to 2.06 mm. (0.0801 to 0.0811 in.)
Top compression ring width	1.96 to 1.974 mm. (0.0871 to 0.0781 in.)
2nd and 3rd compression ring groove width	1.638 to 1.664 mm. (0.0645 to 0.0655 in.)
2nd and 3rd compression ring width	1.562 to 1.587 mm. (0.0615 to 0.0625 in.)
Oil control ring groove width	4.826 to 4.851 mm. (0.190 to 0.191 in.)
Oil control ring width	4.737 to 4.762 mm. (0.1865 to 0.1875 in.)
Top compression ring gap	0.305 to 0.432 mm. (0.012 to 0.017 in.)
2nd and 3rd compression ring gap	0.229 to 0.381 mm. (0.009 to 0.015 in.)
Oil control ring gap	0.229 to 0.381 mm. (0.009 to 0.015 in.)

CONNECTING ROD

Big end bore	54.508 to 54.521 mm. (2.146 to 2.1465 in.)
Big end bearing liner bore (std.)	50.838 to 50.863 mm. (2.0015 to 2.0025 in.)
Small end bush bore (ream bushes to suit individual piston pins)	23.828 to 23.844 mm. (0.9382 to 0.93875 in.)

CRANKSHAFT

Main journal diameter (std.)	57.099 to 57.112 mm. (2.248 to 2.2485 in.)
Main journal diameter 0.254 mm. (0.010 in.) U/S	56.845 to 56.858 mm. (2.238 to 2.2385 in.)
Main journal diameter 0.508 mm. (0.020 in.) U/S	56.591 to 65.604 mm. (2.228 to 2.2285 in.)
Main journal diameter 0.762 mm. (0.030 in.) U/S	56.337 to 56.350 mm. (2.218 to 2.2185 in.)
Front main journal width	49.592 to 50.393 mm. (1.39125 to 1.43125 in.)
Centre main journal width	37.968 to 38.202 mm. (1.496 to 1.504 in.)
Rear main journal width	38.075 to 38.125 mm. (1.499 to 1.501 in.)
	After re-grinding 38.506 mm. (1.516 in.) max.
Main journal fillet radius	3.175 to 3.572 mm. ($\frac{1}{8}$ to $\frac{9}{64}$ in.)
Crankpin diameter (std.)	50.787 to 50.80 mm. (1.9995 to 2.000 in.)
Crankpin diameter 0.254 mm. (0.010 in.) U/S	50.533 to 50.546 mm. (1.9895 to 1.990 in.)
Crankpin diameter 0.508 mm. (0.020 in.) U/S	50.279 to 50.292 mm. (1.9795 to 1.980 in.)
Crankpin diameter 0.762 mm. (0.030 in.) U/S	50.025 to 50.038 mm. (1.9695 to 1.970 in.)
Crankpin width	30.162 to 30.213 mm. (1.1875 to 1.1895 in.)
	After re-grinding 30.594 mm. (1.2045 in.) max.
Crankpin fillet radius	3.97 to 4.37 mm. ($\frac{5}{32}$ to $\frac{11}{64}$ in.)
Crankshaft end-float	0.051 to 0.36 mm. (0.002 to 0.014 in.)
Standard thrust washer thickness	2.311 to 2.362 mm. (0.091 to 0.093 in.)
Oversize thrust washer thickness	2.502 to 2.553 mm. (0.0985 to 0.1005 in.)

CAMSHAFT AND TIMING GEARS

Front journal diameter	45.49 to 45.52 mm. (1.791 to 1.792 in.)
Centre journal diameter	45.24 to 45.26 mm. (1.781 to 1.782 in.)
Rear journal diameter	44.03 to 45.06 mm. (1.773 to 1.774 in.)
Cam lift	6.60 to 6.76 mm. (0.260 to 0.266 in.)
Timing gear backlash between crankshaft, idler and camshaft gears	0.038 to 0.076 mm. (0.0015 to 0.003 in.)

VALVES AND GUIDES

Inlet valve stem diameter	7.924 to 7.950 mm. (0.312 to 0.313 in.)
Exhaust valve stem diameter	7.912 to 7.937 mm. (0.3115 to 0.3125 in.)
Inlet valve head clearance below cylinder head face	0.711 to 1.22 mm. (0.028 to 0.048 in.)
Exhaust valve head clearance below cylinder head face	0.523 to 1.22 mm. (0.021 to 0.048 in.)
Valve guide bore diameter	7.976 to 8.012 mm. (0.314 to 0.3155 in.)

ROCKER SHAFT

Rocker bush bore diameter	15.862 to 15.894 mm. (0.6245 to 0.62575 in.)
Rocker shaft diameter	15.805 to 15.843 mm. (0.62225 to 0.62375 in.)

TAPPETS

Tappet shank diameter	14.224 to 14.249 mm. (0.560 to 0.561 in.)

FLYWHEEL

Run-out at 101.6 mm. (4 in.) radius on clutch face	0.102 mm. (0.004 in.) T.I.R. max.
Run-out periphery	0.305 mm. (0.012 in.) T.I.R. max.

OIL PUMP

Housing (diameter of pocket)	40.72 to 40.74 mm. (1.603 to 1.604 in.)
Housing (depth of pocket)	34.92 to 34.95 mm. (1.375 to 1.376 in.)
Housing (bore diameter for shaft)	12.70 to 12.73 mm. (0.500 to 0.501 in.)
Shaft diameter	12.656 to 12.664 mm. (0.4983 to 0.4986 in.)
Driving gear to housing	0.787 to 1.194 mm. (0.031 to 0.047 in.)

4/108 DIESEL ENGINE

Bore	79.375 mm. (3.125 in.)
Stroke	88.9 mm. (3.5 in.)
Number of cylinders	4
Capacity	1760 c.c. (107.4 cu. in.)
Compression ratio	22 : 1
Firing order	1, 3, 4, 2
Maximum b.h.p.	52 at 4,000 rev./min.
Maximum torque	10.92 kg.m. (79 lb. ft.)
Valve clearance (hot)	0.25 mm. (0.010 in.)
Valve seat and face angle	45°
Cam lift	6.6 mm. (0.26 in.)
Sump capacity	5.0 litres (10.5 U.S. pints, 8.75 Imp. pints)
Filter capacity	1.02 litres (2.16 U.S. pints, 1.8 Imp. pints)
Oil pressure (nominal)	2.8123 kg./sq. cm. (40 lb./sq. in.)
Injection pressure	Setting 150 atmospheres Working 135 atmospheres

TIGHTENING TORQUES

Cylinder head nuts	7.6 to 8.3 kg.m. (55 to 60 lb. ft.)
Connecting rod bolts	5.0 to 5.2 kg.m. (36 to 38 lb. ft.)
Main bearing bolts	10.9 to 11.75 kg.m. (79 to 85 lb. ft.)
Flywheel bolts	7.6 to 8.3 kg.m. (55 to 60 lb. ft.)
Idler gear set-screws	4.56 to 4.98 kg.m. (33 to 36 lb. ft.)
Crankshaft pulley retaining bolt	19.35 to 20.73 kg.m. (104 to 105 lb. ft.)
Injector securing nuts	1.38 to 1.66 kg.m. (10 to 12 lb. ft.)
Rocker shaft pedestal nuts	1.66 to 2.08 kg.m. (12 to 15 lb. ft.)

CYLINDER BLOCK

Total height of cylinder block between top and bottom faces	252.374 to 252.451 mm. (9.936 to 9.939 in.)
Parent bore diameter for cylinder liner (cast iron)	82.525 to 82.550 mm. (3.249 to 3.250 in.)
Main bearing parent bore diameter	60.833 to 60.846 mm. (2.3950 to 2.3955 in.)
Camshaft bore diameter No. 1	45.568 to 45.606 mm. (1.794 to 1.7955 in.)
Camshaft bore diameter No. 2	44.314 to 45.390 mm. (1.784 to 1.787 in.)
Camshaft bore diameter No. 3	45.110 to 45.161 mm. (1.776 to 1.778 in.)
Tappet bore diameter	14.275 to 14.307 mm. (0.562 to 0.56325 in.)
Fuel pump drive hub bearing bore diameter	46.037 to 46.078 mm. (1.8125 to 1.8141 in.)

CYLINDER LINER (Cast Iron)

Type	Dry—interference fit
Interference fit of liner	0.076 to 0.127 mm. (0.003 to 0.005 in.)
Inside diameter of liner after finish boring and honing	79.375 to 79.400 mm. (3.125 to 3.126 in.)
Height of liner in relation to cylinder block top face	0.584 to 0.686 mm. (0.023 to 0.027 in.) ABOVE
Overall length of liner	164.973 to 165.227 mm. (6.495 to 6.505 in.)

PISTONS

Type	Flat topped
Overall height (skirt to crown)	79.934 to 80.010 mm. (3.147 to 3.150 in.)
Centre line of gudgeon pin to piston skirt	29.388 mm. (1.157 in.)
Piston to bore clearance (cold)	0.127 to 0.152 mm. (0.005 to 0.006 in.)
Piston height in relation to cylinder block top face	0.051 to 0.152 mm. (0.002 to 0.006 in.) ABOVE
Bore diameter for gudgeon pin	26.989 to 26.994 mm. (1.06255 to 1.06275 in.)
Compression ring groove width—top	2.807 to 2.832 mm. (0.1105 to 0.1115 in.)
Compression ring groove width—second	1.638 to 1.664 mm. (0.0645 to 0.0655 in.)
Compression ring groove width—third	1.638 to 1.664 mm. (0.0645 to 0.0655 in.)
Oil control ring groove width—Fourth	3.200 to 3.225 mm. (0.126 to 0.127 in.)
Oil control ring groove width—Fifth	4.826 to 4.851 mm. (0.190 to 0.191 in.)

Note: There is a 0.762 mm. (0.030 in.) × 3.759 to 3.861 mm. (0.140 to 0.152 in.) Steel insert fitted into the top groove and located immediately above the top compression ring.

PISTON RINGS

Top—compression	Parallel faced
Second and third—compression	Internally stepped
Fourth—oil control	Laminated segment
Fifth—oil control	Slotted groove
Top compression ring width	1.958 to 1.984 mm. (0.0771 to 0.0781 in.)
Ring clearance in groove	0.061 to 0.112 mm. (0.0024 to 0.0044 in.)
Second and third compression ring width	1.562 to 1.587 mm. (0.0615 to 0.0625 in.)
Ring clearance in groove	0.051 to 0.102 mm. (0.002 to 0.004 in.)
Fifth scraper ring width	4.737 to 4.762 mm. (0.1865 to 0.1875 in.)
Ring clearance in groove	0.063 to 0.114 mm. (0.0025 to 0.0045 in.)
Ring gap—top compression	0.229 to 0.381 mm. (0.009 to 0.015 in.)
Ring gap—second and third compression	0.229 to 0.356 mm. (0.009 to 0.014 in.)
Ring gap—fourth scraper	0.305 to 0.432 mm. (0.012 to 0.017 in.)
Ring gap—fifth scraper	0.229 to 0.356 mm. (0.009 to 0.014 in.)

GUDGEON PIN

Type	Fully floating
Outside diameter of gudgeon pin	26.987 to 26.993 mm. (1.0625 to 1.0627 in.)
Length of gudgeon pin	67.894 to 68.250 mm. (2.673 to 2.687 in.)
Fit in piston boss	Transition

SMALL END BUSH

Type	Steel backed, lead-bronze lined
Length of small end bush	23.749 to 24.257 mm. (0.940 to 0.950 in.)
Outside diameter of small end bush	31.013 to 31.039 mm. (1.221 to 1.2225 in.)
Inside diameter before reaming	26.657 to 26.784 mm. (1.0495 to 1.0545 in.)
Inside diameter after reaming	27.005 to 27.019 mm. (1.0632 to 1.06375 in.)
Clearance between small end bush and gudgeon pin	0.0127 to 0.0318 mm. (0.0005 to 0.00125 in.)

CONNECTING ROD

Type	'H' section
Cap location to connecting rod	Serrations, offset 45° to the horizontal
Big end parent bore diameter	54.508 to 54.521 mm. (2.146 to 2.1465 in.)
Small end parent bore diameter	30.956 to 30.982 mm. (1.21875 to 1.21975 in.)
Length from centre line of big end to centre line of small end	157.912 to 157.963 mm. (6.217 to 6.219 in.)
Big end set-screw	0.375 in. (⅜ in.) U.N.F.

CRANKSHAFT

Overall length	536.575 mm. (21.125 in.)
Main journal diameter Nos. 1 and 2	57.099 to 57.112 mm. (2.248 to 2.2485 in.)
Main journal diameter No. 3	57.086 to 57.099 mm. (2.2475 to 2.248 in.)
Main journal length No. 1	35.719 mm. (1.40625 in.)
Main journal length No. 2	37.998 to 38.202 mm. (1.496 to 1.504 in.)
Main journal length No. 3	38.075 to 38.151 mm. (1.499 to 1.502 in.)
Main journal fillet radii	3.175 to 3.581 mm. (0.125 to 0.141 in.)
Crankpin diameters	50.787 to 50.800 mm. (1.9995 to 2.000 in.)

Crankpin lengths	30.162 to 30.213 mm. (1.1875 to 1.1895 in.)
Crankpin fillet radii	3.969 to 4.366 mm. (0.15625 to 0.17187 in.)
Surface finish—all journals	0.2 to 0.4 micron (8 to 16 micro-in.)
Main journal and crankpin regrind undersizes	0.25, 0.51, 0.76 mm. (0.010, 0.020, 0.030 in.)
Oil seal helix diameter	56.153 to 56.178 mm. (2.21075 to 2.21175 in.)
Oil seal helix width	1.270 to 2.032 mm. (0.050 to 0.080 in.)
Oil seal helix depth	0.102 to 0.203 mm. (0.004 to 0.008 in.)
Flange diameter	101.562 to 101.587 mm. (3.9985 to 3.9995 in.)
Flange width	12.700 mm. (0.500 in.)
Spigot bearing recess depth	22.225 mm. (0.875 in.)
Spigot bearing recess bore	31.750 mm. (1.250 in.)
Crankshaft end-float	0.0508 to 0.381 mm. (0.002 to 0.016 in.)

CRANKSHAFT THRUST WASHERS

Type	Steel backed—Lead-bronze faced
Position in engine	Rear main bearing
Thrust washer thickness (std.)	2.261 to 2.311 mm. (0.089 to 0.091 in.)
Thrust washer thickness (o/s)	2.451 to 2.553 mm. (0.0965 to 0.1005 in.)
Thrust washer outside diameter	82.423 to 82.677 mm. (3.245 to 3.255 in.)
Thrust washer inside diameter	65.786 to 66.040 mm. (2.590 to 2.600 in.)

MAIN BEARINGS

Type	Pre-finished, steel backed, aluminium-tin lined
Shell width	31.623 to 31.877 mm. (1.245 to 1.255 in.)
Outside diameter of main bearing	60.846 mm. (2.3955 in.)
Inside diameter of main bearing	57.163 to 57.188 mm. (2.2505 to 2.2515 in.)
Running clearance—Nos. 1 and 2	0.051 to 0.089 mm. (0.002 to 0.0035 in.)
Running clearance—No. 3	0.038 to 0.102 mm. (0.0015 to 0.004 in.)

CONNECTING ROD BEARINGS

Type	Pre-finished, steel backed, aluminium-tin lined
Shell width	22.098 to 22.352 mm. (0.870 to 0.880 in.)
Outside diameter of connecting rod bearing	54.521 mm. (2.1465 in.)
Inside diameter of connecting rod bearing	50.838 to 50.863 mm. (2.0015 to 2.0025 in.)
Running clearance	0.038 to 0.076 mm. (0.0015 to 0.003 in.)

CAMSHAFT

No. 1 journal length	34.214 to 34.315 mm. (1.347 to 1.351 in.)
No. 1 journal diameter	45.491 to 45.517 mm. (1.791 to 1.792 in.)
No. 2 cylinder block camshaft bore diameter	45.568 to 45.606 mm. (1.794 to 1.7955 in.)
No. 1 journal running clearance	0.051 to 0.114 mm. (0.002 to 0.0045 in.)
No. 2 journal length	31.750 mm. (1.250 in.)
No. 2 journal diameter	45.237 to 45.263 mm. (1.781 to 1.782 in.)
No. 2 cylinder block camshaft bore diameter	45.314 to 45.390 mm. (1.784 to 1.787 in.)
No. 2 journal running clearance	0.051 to 0.152 mm. (0.002 to 0.006 in.)
No. 3 journal length	25.400 mm. (1.000 in.)
No. 3 journal diameter	45.034 to 45.060 mm. (1.773 to 1.774 in.)
No. 3 cylinder block camshaft bore diameter	45.110 to 45.161 mm. (1.776 to 1.778 in.)
No. 3 journal running clearance	0.051 to 0.127 mm. (0.002 to 0.005 in.)
Cam lift	6.766 mm. (0.266 in.)
Oilways for rocker shaft lubrication	No. 2 journal

CAMSHAFT THRUST PLATES

Type	180° oil impregnated sintered iron
Thrust plate outside diameter	64.897 to 64.948 mm. (2.555 to 2.557 in.)
Cylinder block recess diameter for thrust plate	64.986 to 65.240 mm. (2.5585 to 2.5685 in.)
Clearance fit of thrust plate in recess	0.038 to 0.348 mm. (0.0015 to 0.0135 in.)
Thrust plate inside diameter	38.100 mm. (1.500 in.)
Thrust plate thickness	4.060 to 4.115 mm. (0.160 to 0.162 in.)
Cylinder block recess depth for thrust plate	4.009 to 4.166 mm. (0.158 to 0.164 in.)
Thrust plate height in relation to cylinder block face	0.102 mm. (0.004 in.) above or below
Camshaft end-float	0.076 to 0.228 mm. (0.003 to 0.009 in.)

CYLINDER HEAD

Overall length of cylinder head	508.000 mm. (20.000 in.)
Overall depth of cylinder head	66.472 to 66.878 mm. (2.617 to 2.633 in.)
Pressure for water leakage test	1.4 kg./cm.^{2} (20 lb./in.^{2})
Valve seat angle	45°
Bore in cylinder head for guide	12.687 to 12.713 mm. (0.4995 to 0.5005 in.)
Bore in cylinder head for combustion chamber inserts	31.750 to 31.801 mm. (1.250 to 1.252 in.)
Depth of bore in cylinder head for combustion chamber inserts	9.474 to 9.550 mm. (0.373 to 0.376 in.)

COMBUSTION CHAMBER INSERTS

Outside diameter of insert	31.699 to 31.724 mm. (1.248 to 1.249 in.)
Length of insert	9.499 to 9.525 mm. (0.374 to 0.375 in.)
Height of insert in relation to cylinder head face	0.051 mm. (0.002 in.) above or below
Clearance fit of insert in cylinder head bore	0.025 to 0.102 mm. (0.001 to 0.004 in.)
Method of location in cylinder head	By cylinder block face and expansion washer

VALVE GUIDES (Inlet)

Inside diameter	7.988 to 8.014 mm. (0.3145 to 0.3155 in.)
Outside diameter	12.744 to 12.757 mm. (0.50125 to 0.50175 in.)
Interference fit of guide in cylinder head bore	0.019 to 0.057 mm. (0.00075 to 0.00225 in.)
Overall length of guide	54.102 mm. (2.130 in.)
Guide protrusion above top face of cylinder head	20.320 to 20.701 mm. (0.800 to 0.815 in.)

VALVE GUIDES (Exhaust)

Inside diameter	7.988 to 8.014 mm. (0.3145 to 0.3155 in.)
Outside diameter	12.744 to 12.757 mm. (0.50125 to 0.50175 in.)
Interference fit of guide in cylinder head bore	0.019 to 0.057 mm. (0.00075 to 0.00225 in.)
Depth of counterbore	9.650 mm. (0.380 in.)
Overall length of guide	61.980 mm. (2.440 in.)
Guide protrusion above top face of cylinder head	20.320 to 20.701 mm. (0.800 to 0.815 in.)

VALVES (Inlet)

Valve stem diameter	7.925 to 7.950 mm. (0.312 to 0.313 in.)
Clearance fit of valve stem in guide	0.038 to 0.089 mm. (0.0015 to 0.0035 in.)
Valve head diameter	35.814 to 35.916 mm. (1.410 to 1.414 in.)
Valve face angle	45°
Valve head depth below cylinder head face	0.711 mm. (0.028 in.) minimum 0.991 mm. (0.039 in.) maximum
Overall length of valve	116.637 to 117.043 mm. (4.592 to 4.608 in.)
Sealing arrangement	Rubber oil seal

VALVES (Exhaust)

Valve stem diameter	7.912 to 7.937 mm. (0.3115 to 0.3125 in.)
Clearance fit of valve stem in guide	0.051 to 0.102 mm. (0.002 to 0.004 in.)
Valve head diameter	30.251 to 30.353 mm. (1.191 to 1.195 in.)
Valve face angle	45°
Valve head depth below cylinder head face	0.53 mm. (0.021 in.) minimum 0.813 mm. (0.032 in.) maximum
Overall length of valve	116.840 to 117.246 mm. (4.600 to 4.616 in.)
Sealing arrangement	None fitted to exhaust valve

INNER VALVE SPRINGS

Fitted length	38.862 mm. (1.530 in.)
Load at fitted length	13.0 kg. ± 0.91 kg. (28.6 lb. ± 2 lb.)
Fitted position	Damper coil to cylinder head

OUTER VALVE SPRINGS

Fitted length	45.212 mm. (1.780 in.)
Load at fitted length	25.4 kg. ± 1.27 kg. (56.0 lb. ± 2.8 lb.)
Fitted position	Damper coil to cylinder head

ROCKER LEVERS

Length between centre line of adjusting screw and centre line of rocker shaft	26.467 to 26.873 mm. (1.042 to 1.058 in.)
Length between centre line of rocker lever pad and centre line of rocker shaft	39.802 to 40.208 mm. (1.567 to 1.583 in.)
Inside diameter of rocker lever bore	18.237 to 18.275 mm. (0.7180 to 0.7195 in.)
Outside diameter of rocker lever bush	18.275 to 18.243 mm. (0.7195 to 0.71825 in.)
Transition fit of bush in rocker lever	0.038 to 0.032 mm. (0.0015 to 0.00125 in.)
Finished inside diameter of rocker lever bush	15.862 to 15.894 mm. (0.6245 to 0.62575 in.)
Clearance of rocker lever bush on rocker shaft	0.019 to 0.089 mm. (0.00075 to 0.0035 in.)

VALVE CLEARANCES

Clearance between valve stem tip and rocker lever	0.25 mm. (0.010 in.) hot 0.30 mm. (0.012 in.) cold

ROCKER SHAFT

Overall length of shaft	369.887 mm. (14.5625 in.)
Outside diameter of shaft	15.805 to 15.843 mm. (0.62225 to 0.62375 in.)
Lubrication	Oil feed from cylinder head through central passage to individual rocker levers

PUSH RODS

Overall length	216.12 to 217.01 mm. (8.5085 to 8.5435 in.)
Outside diameter	6.350 mm. (0.250 in.)

TAPPETS

Overall length	57.150 mm. (2.250 in.)
Outside diameter of tappet shank	14.224 to 14.249 mm. (0.560 to 0.561 in.)
Cylinder block tappet bore diameter	14.275 to 14.307 mm. (0.562 to 0.56325 in.)
Tappet running clearance in cylinder block bore	0.025 to 0.082 mm. (0.001 to 0.00325 in.)
Outside diameter of tappet foot	38.075 to 38.125 mm. (1.245 to 1.255 in.)

TIMING GEARS

CAMSHAFT GEAR

Number of teeth	48
Inside diameter of gear boss	44.450 to 44.476 mm. (1.750 to 1.751 in.)
Outside diameter of camshaft hub	44.430 to 44.458 mm. (1.7496 to 1.7503 in.)
Transition fit of gear on hub	0.008 to 0.036 mm. (0.0003 to 0.0014 in.)

FUEL PUMP GEAR

Number of teeth	48
Inside diameter of cylinder block bore for fuel pump drive hub bearing	46.037 to 46.078 mm. (1.8125 to 1.8141 in.)
Outside diameter of fuel pump drive hub bearing	46.088 to 46.106 mm. (1.8145 to 1.8152 in.)
Interference fit of drive hub bearing in cylinder block bore	0.010 to 0.069 mm. (0.0004 to 0.0027 in.)
Inside diameter of fuel pump drive hub bearing	33.35 to 33.41 mm. (1.313 to 1.314 in.)
Outside diameter of fuel pump gear drive hub	33.274 to 33.299 mm. (1.310 to 1.311 in.)
Running clearance of drive hub in bearing	0.051 to 0.102 mm. (0.002 to 0.004 in.)
Drive hub end-float	0.127 to 0.203 mm. (0.005 to 0.008 in.)

IDLER GEAR AND HUB

Number of teeth	57
Inside diameter of gear boss	43.655 to 43.680 mm. (1.7187 to 1.7197 in.)
Inside diameter of gear boss with bush fitted	39.682 to 39.708 mm. (1.5627 to 1.5633 in.)
Outside diameter of gear hub	39.654 to 39.668 mm. (1.5612 to 1.5619 in.)
Running clearance of gear on hub	0.0203 to 0.0533 mm. (0.0008 to 0.0021 in.)
Idler gear width	33.287 to 33.363 mm. (1.3105 to 1.3135 in.)
Hub width	33.439 to 33.490 mm. (1.3165 to 1.3185 in.)
Idler gear end-float	0.076 to 0.203 mm. (0.003 to 0.008 in.)

CRANKSHAFT GEAR

Number of teeth	24
Inside diameter of gear	31.750 to 31.780 mm. (1.250 to 1.2512 in.)
Crankshaft diameter for gear	31.750 to 31.765 mm. (1.250 to 1.2506 in.)
Transition fit of gear on crankshaft	0.015 to 0.030 mm. (0.0006 to 0.0012 in.)

TIMING GEAR BACKLASH

Clearance between crankshaft/idler and camshaft/idler gears	0.038 to 0.064 mm. (0.0015 to 0.0025 in.)

LUBRICATION SYSTEM

Lubricating oil pressure	2.1 to 4.2 kg./cm.² (30 to 60 lb./in.²) at normal working speed and temperature

SUMP

Dipstick position	Camshaft side of engine opposite No. 2 cylinder
Strainer location	End of suction pipe to lubricating oil pump
Capacity	5.0 litres (10.5 U.S. pints, 8.75 Imp. pints)

LUBRICATING OIL PUMP

Type	Rotor type
Number of lobes—inner rotor	4
No. of lobes—outer rotor	5
Method of drive	By spiral gears from the camshaft

PUMP CLEARANCES

Inner rotor to outer rotor	0.152 mm. (0.006 in.) maximum
Outer rotor to pump body	0.140 to 0.254 mm. (0.0055 to 0.010 in.)
Top of rotor to surface of pump body	0.025 to 0.127 mm. (0.001 to 0.005 in.)
Inside diameter of bore for pump shaft	12.700 to 12.725 mm. (0.500 to 0.501 in.)
Outside diameter of pump shaft	12.655 to 12.664 mm. (0.4983 to 0.4986 in.)
Running clearance of shaft in bore	0.036 to 0.069 mm. (0.0014 to 0.0027 in.)
Lubricating oil pump drive gear backlash	0.394 to 0.483 mm. (0.0155 to 0.019 in.)

LUBRICATING OIL PUMP

Minimum delivery rate at 800 pump rev./min. 2.81 kgf./cm.² (40 lbf./in.²)	9.1 litre/min. (2.4 U.S. gall./min. or 2.0 Imp. gall./min.)

LUBRICATING OIL PUMP DRIVE GEAR

Number of teeth	12
Inside diameter of gear bore	12.611 to 12.624 mm. (0.4965 to 0.4970 in.)
Outside diameter of oil pump drive shaft	12.655 to 12.664 mm. (0.4983 to 0.4986 in.)
Interference fit of gear on shaft	0.033 to 0.053 mm. (0.0013 to 0.0021 in.)

RELIEF VALVE

Type	Spring loaded plunger
Pressure setting	3.5 to 4.6 kg./cm.² (50 to 65 lb./in.²)
Length of plunger	13.99 to 14.15 mm. (0.551 to 0.557 in.)
Outside diameter of plunger	14.19 to 14.21 mm. (0.5585 to 0.5595 in.)
Inside diameter of valve housing bore	14.24 to 14.29 mm. (0.5605 to 0.5625 in.)
Clearance of plunger in bore	0.025 to 0.102 mm. (0.001 to 0.004 in.)
Outside diameter of spring	9.881 to 10.287 mm. (0.389 to 0.405 in.)
Spring—free length	39.688 mm. (1.5625 in.)
Spring—solid length	20.63 mm. (0.812 in.)

LUBRICATING OIL FILTER

Type	Full flow
Element type	Paper
By-pass valve setting	Opens between 0.91 to 1.2 kg./cm.² (13 to 17 lb./in.²) pressure differential
Type of valve	Spring loaded ball

GEARBOX

MANUAL GEARBOX

RATIOS

First	4.412 : 1
Second	2.353 : 1
Third	1.505 : 1
Fourth	1 : 1
Reverse	4.667 : 1

MAIN DRIVE GEAR

Number of teeth	17
I.D. gear end	30.712 to 30.729 mm. (1.2091 to 1.2098 in.)
Main shaft pilot end diameter (Prior to April 1966)	21.154 to 21.166 mm. (0.8329 to 0.8334 in.)
Main shaft pilot end diameter (After April 1966)	14.978 to 14.989 mm. (0.5897 to 0.5901 in.)

COUNTERSHAFT GEAR

Number of teeth	35 26 21 15 Reverse 14
End-float	0.203 to 0.508 mm. (0.008 to 0.020 in.)
Bore diameter (for rollers)	25.7114 to 25.7366 mm. (1.01225 to 1.01325 in.)
Rear thrust washer, thickness	1.549 to 1.600 mm. (0.061 to 0.063 in.)
Front thrust washer, thickness	2.362 to 2.431 mm. (0.093 to 0.095 in.)
Number of rollers	44
Countershaft diameter	19.325 to 19.338 mm. (0.7610 to 0.7615 in.)

FIRST GEAR

End-float	0.254 to 0.432 mm. (0.010 to 0.017 in.)
Internal diameter (Prior to April 1966)	39.429 to 39.446 mm. (1.5523 to 1.5530 in.)
Internal diameter (After April 1966)	37.643 to 37.668 mm. (1.482 to 1.483 in.)
Number of teeth	30

FIRST GEAR BUSH (Prior to April 1966 only)

Internal diameter	32.009 to 32.034 mm. (1.2602 to 1.2612 in.)
External diameter	39.370 to 39.383 mm. (1.5500 to 1.5505 in.)

SECOND GEAR

End-float	0.127 to 0.229 mm. (0.005 to 0.009 in.)
Internal diameter (Prior to April 1966)	39.421 to 39.446 mm. (1.552 to 1.553 in.)
Internal diameter (After April 1966)	45.008 to 45.034 mm. (1.772 to 1.773 in.)
Number of teeth	24

THIRD GEAR

End-float	0.127 to 0.406 mm. (0.005 to 0.016 in.)
Internal diameter	39.421 to 39.446 mm. (1.552 to 1.553 in.)
Number of teeth	19

REVERSE MAINSHAFT GEAR
(First and Second Gear Synchroniser Sleeve)

Number of teeth	34

REVERSE IDLER GEAR

Internal diameter	19.050 to 19.070 mm. (0.7500 to 0.7508 in.)
Shaft diameter	18.961 to 18.973 mm. (0.7465 to 0.7470 in.)
Number of teeth	17

LUBRICANT

Grade	S.A.E. 80 E.P.
Capacity	2.6 litres (5.4 U.S. pints, 4.5 Imp. pints)
Additive	4 oz. (Part No. ESET-M996C-1004-A)

TORQUE FIGURES

Extension housing to transmission case	5.5 to 6.2 kg.m. (40 to 45 lb. ft.)
Transmission drive flange retaining nut (where fitted)	5.5 to 6.9 kg.m. (40 to 50 lb. ft.)
Drive flange insert	4.8 to 5.5 kg.m. (35 to 45 lb. ft.)
Selector housing to transmission case bolts	1.7 to 2.1 kg.m. (12 to 15 lb. ft.)
Main drive gear bearing retainer to transmission case bolts	1.7 to 2.1 kg.m. (12 to 15 lb. ft.)
Clutch housing to transmission case bolts	5.5 to 6.2 kg.m. (40 to 45 lb. ft.)

CLUTCH

Type	Single dry plate, diaphragm spring
Actuation	Mechanical
Clutch disc lining outside diameter	21.59 cm. (8.50 in.)
Pressure plate diameter	21.59 cm. (8.50 in.)

TIGHTENING TORQUES

Pressure plate to flywheel bolts	1.6 to 2.0 kg.m. (12 to 15 lb. ft.)

AUTOMATIC GEARBOX

GEAR RATIOS

First	2.393 : 1
Second	1.450 : 1
Third	1.000 : 1
Reverse	2.094 : 1
Lubricant	M-2C-33F
Capacity (including Converter)	6.39 litres (13.5 U.S. pints, 11¼ pints)
Gear train end-float	0.254 to 0.762 mm. (0.010 to 0.030 in.)

TORQUE FIGURES

Transmission case to converter housing	1.1 to 1.4 kg.m. (8 to 10 lb. ft.)
Extension housing to transmission case	1.1 to 1.4 kg.m. (8 to 10 lb. ft.)
Gearbox sump	1.1 to 1.4 kg.m. (8 to 10 lb. ft.)
Front servo to transmission case	1.1 to 1.4 kg.m. (8 to 10 lb. ft.)
Rear servo to transmission case	1.4 to 1.8 kg.m. (10 to 13 lb. ft.)
Pump adaptor to front pump housing (set-screw)	0.3 to 0.4 kg.m. (24 to 36 lb. in.)
(5/16 in. bolt)	2.4 to 3.1 kg.m. (17 to 22 lb. ft.)
Pump adaptor to transmission case	1.1 to 1.2 kg.m. (8 to 8.5 lb. ft.)
Rear adaptor to transmission case (¼ in. bolt)	0.55 to 0.7 kg.m. (4 to 5 lb. ft.)
(set-screw)	0.24 to 0.35 kg.m. (20 to 30 lb. in.)
Centre support to transmission case	1.4 to 1.8 kg.m. (10 to 13 lb. ft.)
Outer lever to manual valve shaft	0.83 to 0.97 kg.m. (6 to 7 lb. ft.)
Pressure point (use sealer)	0.55 to 0.7 kg.m. (4 to 5 lb. ft.)
Gearbox drain plug	1.4 to 1.9 kg.m. (10 to 14 lb. ft.)
Oil tube collector to lower body	0.24 to 0.35 kg.m. (20 to 30 lb. in.)
Governor line plate to lower body	0.24 to 0.35 kg.m. (20 to 30 lb. in.)
Lower body end plate to lower body	0.24 to 0.35 kg.m. (20 to 30 lb. in.)
Upper body front or rear end plate to upper body	0.24 to 0.35 kg.m. (20 to 30 lb. in.)
Upper body to lower body	0.24 to 0.35 kg.m. (20 to 30 lb. in.)
Valve bodies assembly to transmission case	0.55 to 0.7 kg.m. (4 to 5 lb. ft.)
Front pump strainer to lower body	0.24 to 0.35 kg.m. (20 to 30 lb. in.)
Downshift valve cam bracket to valve body	0.24 to 0.35 kg.m. (20 to 30 lb. in.)
Governor body to sleeve	0.55 to 0.7 kg.m. (4 to 5 lb. ft.)
Governor cover plate to governor body	0.24 to 0.35 kg.m. (20 to 30 lb. in.)
Front servo lever adjusting screw locknut	2.1 to 2.8 kg.m. (15 to 20 lb. ft.)
Rear servo adjusting screw locknut	3.5 to 4.14 kg.m. (25 to 30 lb. ft.)
Starter inhibitor switch locknut	0.55 to 0.83 kg.m. (4 to 6 lb. ft.)
Downshift valve control cable adaptor to case	1.1 to 1.24 kg.m. (8 to 9 lb. ft.)
Filler tube connector adaptor to case	1.4 to 4.1 kg.m. (10 to 30 lb. ft.)
Filler tube to connector sleeve nut	2.34 to 2.5 kg.m. (17 to 18 lb. ft.)
Stone guards to converter housing	0.19 to 0.22 kg.m. (1.4 to 1.6 lb. ft.)
Drive plate to torque converter	3.5 to 4.14 kg.m. (25 to 30 lb. ft.)
Transmission drive flange retaining nut	6.3 to 7.7 kg.m. (45 to 55 lb. ft.)

COOLING SYSTEM

COOLANT CAPACITY

Petrol	7.1 litres (15 U.S. pints, 12.5 pints)
Petrol (with heater)	8.1 litres (17.1 U.S. pints, 14.25 pints)
Diesel	6.5 litres (13.8 U.S. pints, 11.5 pints)
Diesel (with heater)	7.7 litres (16.2 U.S. pints, 13.5 pints)

THERMOSTAT

Petrol

Type	Wax capsule
Opening temperature	85 to 88° C. (185 to 190° F.)
Fully open at	100° C. (212° F.)

Diesel

Type	Wax capsule
Opening temperature	79.5 to 83.5° C. (175 to 182° F.)
Fully open at	93.5 to 96° C. (200 to 205° F.)

PRESSURE CAP

Operates at	0.49 kg./cm.^{2} (7 lb./in.^{2}) Diesel 0.91 kg./cm.^{2} (13 lb./in.^{2}) Petrol

WATER PUMP

Type	Centrifugal—belt driven from crankshaft pulley
Petrol	
Outside diameter of shaft for pulley	12.725 to 12.738 mm. (0.5010 to 0.5015 in.)
Inside diameter of pulley bore	12.675 to 12.7 mm. (0.499 to 0.500 in.)
Interference fit of pulley on shaft	0.025 to 0.0630 mm. (0.0010 to 0.0025 in.)
Outside diameter of shaft for impeller	12.725 to 12.738 mm. (0.5010 to 0.5015 in.)
Inside diameter of impeller bore	12.687 to 12.713 mm. (0.4995 to 0.5005 in.)
Interference fit of impeller on shaft	0.0127 to 0.0508 mm. (0.0005 to 0.002 in.)
Outside diameter of impeller	60.452 mm. (2.38 in.)
Impeller to body clearance	0.508 to 1.016 mm. (0.020 to 0.040 in.)
Seal type	Alumina ceramic faced rubber
Outside diameter of seal	33.528 to 33.452 mm. (1.320 to 1.3170 in.)
Inside diameter of pump housing for seal	33.274 to 33.350 mm. (1.310 to 1.313 in.)
Interference fit of seal in pump housing	25.502 to 25.654 mm. (1.004 to 1.010 in.)
Outside diameter of slinger	13.03 to 13.31 mm. (0.513 to 0.524 in.)
Inside diameter of slinger	12.624 to 12.7 mm. (0.497 to 0.500 in.)
Interference fit of slinger on shaft	0.114 to 0.025 mm. (0.0045 to 0.001 in.)
Inside diameter of seat	12.065 to 12.319 mm. (0.475 to 0.485 in.)
Interference fit of seat on slinger	0.711 to 1.245 mm. (0.028 to 0.049 in.)
Diesel	
Outside diameter of shaft for pulley	14.099 to 15.006 mm. (0.5905 to 0.5908 in.)
Inside diameter of pulley bore	14.935 to 14.961 mm. (0.588 to 0.598 in.)
Interference fit of pulley on shaft	0.038 to 0.071 mm. (0.0015 to 0.0028 in.)
Outside diameter of shaft for impeller	12.649 to 12.675 mm. (0.498 to 0.499 in.)
Inside diameter of impeller bore	12.624 to 12.636 mm. (0.497 to 0.4975 in.)
Interference fit of impeller on shaft	0.013 to 0.051 mm. (0.0005 to 0.002 in.)
Outside diameter of impeller	78.588 to 79.375 mm. (3.094 to 3.125 in.)
Impeller to body clearance	0.127 to 0.635 mm. (0.005 to 0.025 in.)
Water pump seal	Synthetic rubber—Carbon faced
Water pump insert	Ceramic faced
Outside diameter of insert	41.250 to 41.263 mm. (1.624 to 1.6245 in.)
Inside diameter of insert bore in water pump housing	41.275 to 41.300 mm. (1.625 to 1.626 in.)

ANTI-FREEZE TABLE

PETROL CAPACITY 7.1 LITRES (15 U.S. PINTS, 12.5 PINTS)

Volume of ESE-M97B18C Anti-freeze in Water	*Coolant remains fluid down to the following temperatures*	*Anti-freeze Quantity Required*	
		With Heater	*Without Heater*
10%	— 4°C (+25°F)	0.9 litres (1.5 pints)	0.7 litres (1.25 pints)
15%	— 7°C (+20°F)	1.1 litres (2.0 pints)	1.0 litres (1.75 pints)
20%	— 9°C (+15°F)	1.7 litres (3.0 pints)	1.4 litres (2.50 pints)
25%	—13°C (+ 9°F)	2.0 litres (3.5 pints)	1.7 litres (3.00 pints)
30%	—16°C (+ 3°F)	2.3 litres (4.0 pints)	2.1 litres (3.75 pints)
40%	—25°C (—13°F)	3.1 litres (5.5 pints)	2.8 litres (5.00 pints)
50%	—37°C (—34°F)	4.0 litres (7.0 pints)	3.6 litres (6.25 pints)

DIESEL CAPACITY 6.5 LITRES (13.8 U.S. PINTS, 11.5 PINTS)

Volume of ESE-M97B18C Anti-freeze in Water	*Coolant remains fluid down to the following temperatures*	*Anti-freeze Quantity Required*	
		With Heater	*Without Heater*
10%	— 4°C (+25°F)	0.9 litres (1.5 pints)	0.7 litres (1.25 pints)
15%	— 7°C (+20°F)	1.1 litres (2.0 pints)	1.0 litres (1.75 pints)
20%	— 9°C (+15°F)	1.6 litres (2.75 pints)	1.3 litres (2.25 pints)
25%	—13°C (+ 9°F)	1.8 litres (3.25 pints)	1.6 litres (2.75 pints)
30%	—16°C (+ 3°F)	2.3 litres (4.0 pints)	2.0 litres (3.50 pints)
40%	—25°C (—13°F)	3.1 litres (5.5 pints)	2.6 litres (4.50 pints)
50%	—37°C (—34°F)	3.8 litres (6.75 pints)	3.3 litres (5.75 pints)

FUEL SYSTEM

PETROL

CARBURETTOR (Prior to May 1967)

Type .. .. Zenith 36 IV Downdraught

	1700 c.c.	2000 c.c.
Venturi diameter	28 mm. (1.11 in.)	29 mm. (1.14 in.)
Main jet	92	102
Slow running jet	55	55
Compensating jet	112	120
Fuel enrichment jet	110	80
Accelerator pump jet	55	55
Part throttle air bleed	2.6	2.6

Alternative jets for use at various altitudes:

MAIN JETS	1700 c.c.	2000 c.c.
0 to 610 m. (zero to 2,000 ft.)	107	102
610 to 1830 m. (2,000 to 6,000 ft.)	105	100
1930 to 3050 m. (6,000 to 10,000 ft.)	100	97

COMPENSATING JETS	1700 c.c.	2000 c.c.
0 to 610 m. (zero to 2,000 ft.)	92	120
610 to 1830 m. (2,000 to 6,000 ft.)	90	117
1830 to 3050 m. (6,000 to 10,000 ft.)	92	117

CARBURETTOR (May 1967 to September 1968)

Type .. .. Ford Single Venturi downdraught with manual or automatic choke, and accelerator pump

	1700 c.c.	2000 c.c.
Manual choke	C7EH-9510-A	C7EH-9510-B
Automatic choke	C6CH-9510-A	C7EH-9510-E
Throttle barrel diameter	36 mm. (1.42 in.)	36 mm. (1.42 in.)
Venturi diameter	28 mm. (1.10 in.)	30 mm. (1.18 in.)
Main jet	140	150
Idling speed	580 to 620 r.p.m.	
Fast idle speed—manual choke	750 to 850 r.p.m.	
—automatic choke	2000 to 2200 r.p.m.	1800 to 2000 r.p.m.
Fast idle setting—manual choke	No. 64 drill 0.9 mm. (0.035 in.)	
—automatic choke	3.8 to 4.3 mm. (0.15 to 0.17 in.)	
Choke plate pull-down—manual choke	2.8 mm. (0.110 in.)	4.0 mm. (0.150 in.)
—automatic choke	4.2 mm. (0.165 in.)	3.4 mm. (0.135 in.)
Accelerator pump stroke	4.5 mm. (0.175 in.)	3.4 mm. (0.135 in.)
Float setting—inverted from casting	28.5 to 29.0 mm. (1.12 to 1.14 in.)	
—upright from casting	35.0 to 35.5 mm. (1.38 to 1.40 in.)	

Alternative main jets for use at various altitudes:

	1700 c.c.	2000 c.c.
0 to 915 m. (zero to 3,000 ft.)	140	—
915 to 2,135 m. (3,000 ft to 7,000 ft.)	137	—
2,135 to 3,050 m. (7,000 ft. to 10,000 ft.)	132	—
0 to 2,135 m. (zero to 7,000 ft.)	—	150
2,135 to 3,050 m. (7,000 ft. to 10,000 ft.)	—	145

CARBURETTOR (September 1968 onwards)

Type .. Ford Single Venturi downdraught with manual or automatic choke, and accelerator pump

	1700 c.c.	2000 c.c.
Manual choke	C8EH-9510-A	C8EH-9510-B
Automatic choke	C8CH-9510-B	C8EH-9510-C
Throttle barrel diameter	36 mm. (1.42 in.)	36 mm. (1.42 in.)
Venturi diameter	28 mm. (1.10 in.)	30 mm. (1.18 in.)
Main jet	140	150
Idling speed	580 to 620 r.p.m.	
Fast idle speed—manual choke	750 to 850 r.p.m.	
—automatic choke	2000 to 2200 r.p.m.	1800 to 2000 r.p.m.
Fast idle setting—manual choke	No. 64 drill 0.9 mm. (0.035 in.)	
Choke plate pull-down—manual choke	0.100 to 0.120 in.	0.140 to 0.160 in.
—automatic choke	0.155 to 0.175 in.	0.125 to 0.145 in.
Accelerator pump stroke	0.170 to 0.180 in.	0.130 to 0.140 in.
Float setting—inverted from casting	30.75 to 31.24 mm. (1.21 to 1.23 in.)	
—upright from casting	35.81 to 36.32 mm. (1.41 to 1.43 in.)	

CARBURETTOR (Exhaust Emission)	1700 c.c.	2000 c.c.
Manual choke	712W-9510-KA	712W-9510-DA
Throttle barrel diameter	36 mm.	36 mm.
Venturi	28 mm.	28 mm.
Main jet	1.57 mm.	1.65 mm.
Idle speed	700 r.p.m.	700 r.p.m.
Fast idle speed	1600 to 1800 r.p.m.	1550 to 1750 r.p.m.
Fast idle setting	1.20 mm.	1.20 mm.
Pull down	0.140 to 0.160 in.	0.140 to 0.160 in.
Accelerator pump	0.140 to 0.150 in.	0.140 to 0.150 in.
Float setting—inverted	1.21 to 1.23 in.	1.21 to 1.23 in.
—upright	1.41 to 1.43 in.	1.41 to 1.43 in.

FUEL TANK

Capacity— 75—125	42.1 litres (11.1 U.S. gall., 9.25 gall.)
—130—175	68.1 litres (18.0 U.S. gall., 15.0 gall.)

FUEL PUMP

Type	Mechanical
Delivery pressure	0.07 to 0.175 kg./sq. cm. (1 to 2.5 lb./sq. in.)
Inlet depression	21.6 cm. mercury (8.5 in.)
Static pressure (i.e. no flow condition)	0.25 to 0.35 kg./sq. cm. (3.5 to 5.0 lb./sq. in.)

DIESEL

FUEL INJECTION PUMP

Type	Distributor	
Rotation	Clockwise from drive end	
Pumping element plunger diameter	5 mm. (4/99) 6 mm. (4/108)	
Governor type	Hydraulic	
Maximum speed full load	3,800 r.p.m. (4/99) 4175 r.p.m. (4/108)	
Maximum speed no load	4,100 r.p.m. (4/99) 4480 r.p.m. (4/108)	
Idling speed	625 r.p.m.	
Governor spring rate	0.357 kg./mm.	4/99 ONLY
Governor spring free length	18.8 mm. ± 0.5 mm.	4/99 ONLY
Total number of coils	7	4/99 ONLY
Idling spring rate	1.04 kg./mm.	4/99 ONLY
Idling spring free length	8.5 mm.	4/99 ONLY
Regulating valve spring rate	0.453 kg./mm.	4/99 ONLY
Regulating valve spring free length	12.5 mm. ± 0.5 mm.	4/99 ONLY
Advance mechanism	Combined light load and speed advance	4/99 ONLY
Light load advance	4° to $4\frac{1}{2}^\circ$	4/99 ONLY
Total advance	$5\frac{1}{2}^\circ$ to $6\frac{1}{4}^\circ$	4/99 ONLY
Inner advance spring rate	0.05 kg./mm.	4/99 ONLY
Inner advance spring free length	24 mm.	4/99 ONLY
Outer advance spring rate	0.88 kg/mm.	4/99 ONLY
Outer advance spring free length	27 mm.	4/99 ONLY

Tightening Torques:

Advance ball stud	345.6 kg. cm. (300 lb. in.)
Drive plate bolts	184.3 kg. cm. (160 lb. in.)
Drive plate bolts (using Tool No. CA.57)	144.0 kg. cm. (125 lb. in.)
Advance mechanism banjo bolt	403.2 kg. cm. (350 lb. in.)
Advance mechanism securing nut	126.7 kg. cm. (110 lb. in.)
Hydraulic head locking screws	195.8 kg. cm. (170 lb. in.)
Transfer pump rotor	74.9 kg. cm. (65 lb. in.)
End plate bolts	51.8 kg. cm. (45 lb. in.)
Fuel inlet connection	414.7 kg. cm. (360 lb. in.)

SUBSTITUTE FUEL OIL

Amoco (U.K.) Limited	
Castrol Limited	H.111/60
Alexander Duckham and Company Limited	
Esso Petroleum Company Limited	T.S.D. 81.5
Mobil Oil Company Limited	
Petrofina (Great Britain) Limited	
Regent Oil Company Limited	
Shell Mex& B.P. Limited	Shell "Fusus" Oil "A" Shell D.T. 11.

FUEL INJECTOR

Type	Pintle
Opening pressure	130 atmospheres (4/99) 150 atmospheres (4/108)
Spray cone angle	12° (symmetrical about injector centre line)
Needle seat leakage	No seepage or leaking should occur with pressure maintained at 110 atmospheres
Back leak test	Time, for pressure to drop from 100 to 75 atmospheres (4/99), 120 to 100 atmospheres (4/108), not less than 6 sec.
Securing nut torque	1.93 kg.m. (14 lb. ft.)

FUEL LIFT PUMP

Type	Diaphragm, with hand primer. Operated by push rod from engine camshaft
Delivery pressure	0.422 to 0.703 kg./sq. cm. (6 to 10 lb./sq. in.)
Inlet depression	21.59 cm. of Hg. (8½ in. of Mercury)
Diaphragm spring test length and pressure	5.433 kg. ± 56.7 grm. at 11.98 mm. (12 lb. ± 2 oz. at 0.468 in.)
Free length	28 mm. approx. (1⅛ in.)

FUEL FILTERS

Primary	Sediment bowl and gauze screen
Secondary	Replaceable paper element

FUEL TANK

Capacity— 75—125	42.1 litres (11.1 U.S. gall., 9.25 Imp. gall.)
130—175	68.1 litres (18.0 U.S. gall., 15.0 Imp. gall.)

THERMOSTART

Current consumption (maximum)	12.9 amps at 11.5 volts
Reservoir capacity	25 c.c.
Flow rate	4.3 to 4.9 c.c. per min. at 21°C (70°F)

AIR CLEANER

Type	Oil bath
Oil capacity	132 c.c. (0.3 U.S. pint, ¼ Imp. pint)
Oil grade	As for engine

ELECTRICAL SYSTEM

BATTERY

Type	Lead acid
Voltage	12
Terminal earthed	Negative
Capacity—Standard	38 A/H
—Optional	57 A/H
Plates per cell—Standard	9
—Optional	13
Specific gravity—charged	1.275 to 1.290
Low limit while discharging at 20 hr. rate	1.105
Electrolyte capacity—Standard	2.5 litres (5.4 U.S. pints, 4.5 Imp. pints)
—Optional	3.6 litres (7.7 U.S. pints, 6.4 Imp. pints)

ALTERNATOR (Prior to September 1968)

Type	Lucas 11 A.C.
Nominal voltage	12
Nominal D.C. output	43 amps
Resistance of field coil at 20°C (68°F)	3.8 ohms
Stator phases	3
Stator connection	star
No. of rotor poles	8
No. of field coils	1

Slip-ring brushes:

Length new	15.9 mm. (0.625 in.)
Replace at	4.0 mm. (0.156 in.)

Brush spring tests:

Load at 19.9 mm. (25/32 in.)	113 to 142 gm. (4 to 5 oz.)
Load at 10.3 mm. (13/32 in.)	212 to 241 gm. (7.5 to 8.5 oz.)

Tightening torques:

Brushbox screws	0.115 kg.m. (10 lb. in.)
Diode heat sink fixings	0.288 kg.m. (25 lb. in.)
Alternator through bolts	0.518 to 0.576 kg.m. (45 to 50 lb. in.)

ALTERNATOR (September 1968 onwards)

	Petrol	*Diesel*
Type	Lucas 15 ACR.	Lucas 17 ACR.
Nominal voltage	12	12
Nominal D.C. output	28 amps.	36 amps.
Resistance of field coil at 20°C (68°F)	4.33 ohms.	4.165 ohms.
Stator phases	3	3
Stator connection	Star	Star
No. of rotor poles	12	12
No. of field coils	1	1
Slip-ring brushes:		
Length new	12.6 mm. (0.50 in.)	12.6 mm. (0.50 in.)
Replace at	5.0 mm. (0.20 in.)	5.0 mm. (0.20 in.)
Brush spring test:		
Load with brush pushed back flush with the housing	198 to 283 g. (7 to 10 oz.)	198 to 283 g. (7 to 10 oz.)

Tightening Torques:

Diode heat sink fixing	0.404 to 0.450 kg.m. (35 to 40 lb. in.)
Alternator through bolts	0.518 to 0.576 kg.m. (45 to 50 lb. in.)

STARTER MOTOR (Inertia)

Type		12 volt, 4-pole
Number of brushes		4 (2 earthed)
Ampere draw	zero r.p.m.	340 amps at 7.4 volts
	1,000 r.p.m.	245 amps at 8.7 volts
Lock torque		0.84 kg.m. (6.4 lb. ft.)
Number of teeth on ring gear		121
Number of teeth on pinion		9
Gear ratio		13.44 : 1

Commutator end bearing bush:

Length	1.257 to 1.283 cm. (0.495 to 0.505 in.)
Inside diameter (assembled in end plate)	1.269 to 1.271 cm. (0.4995 to 0.5005 in.)
Outside diameter	1.584 to 1.586 cm. (0.6235 to 0.6245 in.)

Drive end bearing bush:

Length	1.7492 to 1.8262 cm. (0.68875 to 0.71875 in.)
Inside diameter (assembled in end plate)	1.9042 to 1.9063 cm. (0.7495 to 0.7505 in.)
Outside diameter	2.062 to 2.064 cm. (0.812 to 0.813 in.)

STARTER MOTOR (Pre-engaged with Parallel Solenoid)

Ampere draw (pinion locked)	430
Ampere draw (normal cranking)	260
Teeth on pinion	9
Teeth on ring gear	121
Gear ratio	13.4 : 1
Lock torque	2.21 kg.m. (16.5 lb. ft.)
Minimum brush length	7.5 mm. (0.3 in.)
Brush spring pressure	0.91 kg. (32 oz.)

STARTER MOTOR (Pre-engaged with Moving Pole Shoe Solenoid)

Ampere draw (pinion locked)	460
Ampere draw (normal cranking)	250
Teeth on pinion	9
Teeth on ring gear	121
Gear ratio	13.4 : 1
Lock torque	1.24 kg.m. (9 lb. ft.)
Minimum brush length	6.4 mm. (0.25 in.)
Brush spring pressure	1.15 kg. (40 oz.)

COIL

Type	12 v., oil filled, high performance
Current consumption	Standstill, 3.9 amp. 2,000 r.p.m., 1.4 amp.

PLUGS

Type	Autolite AG22
Gap	0.59 to 0.70 mm. (0.023 to 0.028 in.)

DISTRIBUTOR (Lucas)

Type	Single pair contact breaker point
Drive	Skew gear from camshaft
Ignition advance	Centrifugal and vacuum controlled
Static advance (initial)	6° before T.D.C. (on upper timing mark)

Automatic advance (no vacuum):

Starts	950 r.p.m. (crankshaft) low compression
Ends	4,100 r.p.m. (crankshaft) low compression
Breaker arm spring tension	510.3 to 680.36 gms. (18 to 24 oz.)
Condenser capacity	0.18 to 0.22 microfarad
Contact breaker points gap	0.356 to 0.406 mm. (0.014 to 0.016 in.)
Dwell angle	60° + 3°

Distributor shaft:

Diameter	12.432 to 12.450 mm. (0.4895 to 0.490 in.)
End-float (at max. wear limit)	0.127 mm. (0.005 in.)
End-float (on initial assembly or when fitting new washer)	0.000 to 0.038 mm. (0.000 to 0.0015 in.)

Advance characteristics (Low Compression):

Mechanical		*Vacuum*	
Distributor Speed rev./min.	*Degrees Advance (Distributor)*	*Vacuum cm. of Hg. (in. of Hg.)*	*Degrees Advance (Distributor)*
2,500	15°—17°	50.8 (20)	5°—7°
2,050	15°—17°	35.6 (14)	4½°—6½°
1,500	11°—13°	25.4 (10)	3°—5°
1,000	7°—9°	20.3 (8)	2°—4°
800	4°—6°	15.2 (6)	1¼°—2½°
600	1°—3°	10.2 (4)	No advance
400	No advance		

TRANSIT

DISTRIBUTOR (Autolite)

Type	Single pair contact breaker point
Automatic advance	Mechanically and vacuum controlled
Drive	Skew gear from camshaft
Rotation	Clockwise from rotor end
Shaft end-float	0.012 to 0.190 mm. (0.0005 to 0.0075 in.)

Identification:

Low compression (C6CH-12100-B)	Green paint mark on vacuum plug
High compression (C6CH-12100-A)	Red paint mark on vacuum plug
Static advance (initial)	6° L.C. before T.D.C. 4° H.C. with 94 octane petrol 8° H.C. with 97 octane petrol
Breaker arm spring tension	481.9 to 567.0 gms. (17 to 21 oz.)
Condenser capacity	0.21 to 0.25 microfarad
Contact breaker points gap	0.64 mm. (0.025 in.)
Dwell angle	38° to 42°
Firing order	1, 3, 4, 2

Advance characteristics (Low Compression):

Mechanical		*Vacuum*	
Distributor Speed rev./min.	*Degrees Advance (Distributor)*	*Vacuum cm. of Hg. (in. of Hg.)*	*Degrees Advance (Distributor)*
700	2° to 4°	17.8 (7)	1½° to 5°
900	5° to 7½°	22.9 (9)	4½° to 7½°
1,200	9° to 11°	27.9 (11)	7° to 10°
2,000	14½° to 16½°	33.0 (13) and up	8° to 11°

Advance characteristics (High Compression):

Mechanical		*Vacuum*	
Distributor Speed rev./min.	*Degrees Advance (Distributor)*	*Vacuum cm. of Hg. (in. of Hg.)*	*Degrees Advance (Distributor)*
600	½° to 2½°	20.3 (8)	1° to 2°
900	7° to 9°	27.9 (11)	3° to 6°
1,200	10° to 12°	40.6 (16) and up	5° to 8°
2,100	14° to 16°	—	—

LIGHT BULBS

Description	*Quantity*	*Wattage*
Sealed beam units	2	60/45
Side lights	2	5
Front direction indicator	2	21
Rear direction indicator	2	21
Rear and stop light	2	5/21
Rear number plate light	1	6
Interior light	1	6
Instrument panel lights and warning lights	6	2.2

Section 15

SERVICE SCHEDULE

Diesel Engines: Under all operating conditions whether the vehicle is used for short or long journeys, the oil and filter MUST be changed every 2,000 miles. If these instructions are not adhered to, high oil contamination, condensation and sludge formation will result, with consequential damage to the engine.

First 1,000 km. (600 miles) Service.

Check engine oil level.

Check coolant level.

Check windscreen washer reservoir.

Check brake fluid level.

Check battery electrolyte level.

Check tyre pressures and condition.

Tighten cylinder head bolts to correct torque.

Tighten inlet and exhaust manifold bolts to correct torque.

Adjust valve clearances.

Check carburettor idling and mixture setting.

Check torque of exhaust manifold to downpipe bolts.

Check torque of sump bolts.

Check clutch adjustment.

Inspect brake hoses.

Check for oil or water leaks.

Check operation of lights.

Adjust steering box.

Adjust front wheel bearings.

Torque "U" bolts.

Adjust toe-in.

Road test or roller test with brake function test.

Diesel as above plus:—

Change engine oil and filter.

Check injector pump idling and max. no-load speed.

First 5,000 km. (3,000 miles) and every subsequent 10,000 km. (6,000 miles). (Standard Service).

Check and, if necessary, top up coolant level.

Check and, if necessary, top up brake fluid reservoirs.

Check and, if necessary, top up windshield washer reservoir.

Change engine oil and renew filter element.

Clean sparking plugs and set gaps – replace if required.

Examine distributor points, check and adjust dwell angle, clean distributor cap, coil and H.T. leads, lubricate distributor and check ignition timing.

Check carburettor idling/mixture setting – adjust as required.

Clean crankcase emission valve and oil filler cap.

Check and adjust valve clearances.

Check drive belts for tension and wear.

Check battery charge, clean and grease connections and top up.

Inspect radiator and heater hoses for leaks or deterioration.

Check and lubricate accelerator linkage or cable – adjust if required.

Change manual transmission oil. (First 5,000 km. (3,000 miles) only.)

Check engine for oil or water leaks.

Check transmission oil level and top up if required.

Check rear axle oil level and top up if required.

Check torque of spring "U" bolts.

Adjust front wheel bearings.

Check brake linings for wear.

Adjust brakes.

Inspect brake system for leaks and hoses chafing.

Check exhaust system for damage or leaks and external condition.

Check suspension and steering linkages for wear.

Adjust steering box (at first 5,000 km. (3,000 miles) and 25,000 km. (15,000 miles) and thereafter every 30,000 km. (18,000 miles).

* Grease spindle pins.

Grease prop. shaft sliding joint (130, 150 and 175 models only).

Check toe-in.

Clean air cleaner element.

Cheque torque of inlet manifold bolts.

Check condition of steering and ball joint covers.

Check clutch adjustment.

Check operation of all controls, instruments and lights.

Lubricate door locks, lock cylinders, bonnet safety catch pivot, door striker wedges, door check straps, hinges, sliding door and all oil can points.

Lubricate handbrake linkage – adjust if required.

Check seat belts for security and wear.

Check tyre pressures, and condition.

Lubricate multi leaf springs (except when anti-squeak strip is fitted).

Lubricate sliding step.

Road test or roller test with brake function and check operation of automatic transmission.

First 25,000 km. (15,000 miles) and every subsequent 30,000 km. (18,000 miles). (Major Service).

As 10,000 km. (6,000 miles) plus:—

Clean, repack and adjust front and rear wheel bearings (rear wheel bearings on 130, 150 and 175 models only).

Change air cleaner element (petrol only).

Adjust steering box.

* A Molybdenum Disulphide Lithium base grease should be used.

NOTE:

These are recommended intervals only. Vehicles operating under arduous conditions may need more frequent attention to certain components.

Arduous conditions would include:
Constant Stop-Start work.
Off-road or poor road surfaces.
Hilly country.

Components which could need additional attention include:

Front and rear brake bands on automatic transmission.

Brakes.

Air cleaner.

Steering components.