REPAIR BY UNIT REPLACEMENT

This Chapter details the procedures to be adopted in removing and replacing auxiliary units and components of the engine. Main assemblies such as the bi-directional gearbox, turbo-blower and the phasing gear case, will not normally require to be changed but instructions are provided for use in case of emergency. For details of repair operations beyond the scope of this Chapter, reference should be made to the Overhaul Manual Publication 430.

When returning defective components to the manufacturer or to a repair depot, a brief record of the defect together with the hours run of the unit should accompany the defective item. All open ports, unions, etc., should be suitably blanked off and, in the case of fuel injection pumps and governor, the units should be protected against corrosion during transit by filling with with Shell Calibration Fluid 'B' or equivalent and, the blanking of the units should be such that fluid is not lost during transit. The details of the defect together with the serial numbers of the defective component and replacement unit should be entered in the engine log book, Publication 530.

Mounting faces on the engine and replacement component should be inspected for cleanliness and signs of burrs or scores prior to fitting a a component. Copper joint washers, where used, may be annealed and re-used if undamaged; other metal and composition joint washers should be replaced by new items. For any further information on spare parts available, reference should be made to the Spare Parts Catalogue.

ENGINE - GENERAL

Air Intake Silencers and Filters

Care must be taken not to drop loose parts into the blower when the engine mounted breeches piece is removed. Having removed the securing nuts, and before removing the breeches piece, ensure that all loose parts, tools and equipment are removed from above and on the engine. If the mounting face on the blower is to remain open for any period of time, secure a suitable blanking cover to the mounting face studs.

To clean a wet- or impact-type filter, immerse the filter panel in a paraffin bath and wash thoroughly to remove the dirt particles. Remove the panel from the bath and dry by blowing through the maze element with compressed air. When dry, the filter panel should be treated with a suitable impact-filter compound or, in the event of non-availability of a suitable compound, the element should be immersed in hot engine oil for a few seconds to allow the oil to saturate the maze. Treated elements should be allowed to dry or, in the case of oil immersed elements, to drain completely before being re-fitted to position in the installation.

On certain installations replaceable filter elements are used. When the pressure drop across the filter shows that the element is impregnated with dirt, remove the element panel and remove the elements. Clean the element frame in a suitable medium and dry thoroughly. Insert new elements and replace the assembly.

Exhaust Manifolds

Drain the cooling system and disconnect at the drive end the coolant outlet pipe to the cylinder block. Disconnect the leads to the thermocouple junction boxes; it is recommended that the leads be marked for position with suitable adhesive tape to provide for ease of re-connection. Remove the nuts securing the manifold to the block, removing the spring washers as the nuts are removed. Special cranked spanners are provided in the Maintenance Tool Kit for this operation.

When removing 'B' exhaust manifold, disconnect the fuel and coolant vent pipes from the junction boxes. If the junction boxes are to be removed, care should be taken not to confuse the boxes when refitting.

To replace the exhaust manifold, reverse the removal procedure; renew the manifold gasket and renew any joint washers which have been disturbed. Fill the cooling system, re-connect the thermocouple leads. After the first fifty hours run, check the tightness of the securing nuts.

Thermocouples

Remove the cover from the junction box on the exhaust manifold and disconnect the cable ends from the terminal block. Unscrew the cable gland nut; withdraw the cable. Unscrew the thermocouple retaining nut and withdraw the thermocouple from the exhaust manifold.

To replace a thermocouple, reverse the removal procedure and connect the red and blue cables to the positive and negative terminals respectively.

The reading instruments for exhaust temperature are of the individual instrument type, the eighteen instruments being contained in a panel. The instrument is provided with an adjusting screw to "zero" the instrument. Under normal circumstances there should be no necessity to alter the setting of the adjusting screw. When viewing the instruments of the individual type, it may be seen, with an engine cold, that a slight stagger of the instrument needles is apparent. This does not mean that some instruments are reading incorrectly but could be a true state of temperature variation through the engine. When it is suspected that an instrument is reading incorrectly, no alteration should be made to the adjusting screw until the cables have been disconnected at the rear of the instrument, that is, adjustment must only be made with the instrument in a state of "open circuit". Set the adjusting screw so that the instrument reads 'zero'. Re-make the connections at the rear of the instrument.

LUBRICATION SYSTEM

Pressure-oil Pump

Disconnect the oil inlet connection and unscrew the union on the control oil pipe to the relief valve. Remove the securing nuts and washers and withdraw the pump from the mounting face and from the driving quill-shaft.

To replace a pressure-oil pump, thoroughly clean the mounting face on the phasing gear case, prepare the mating faces of the replacement pump and phasing gear case with jointing compound, renew the rubber 'O' ring seal around the transfer tube in the phasing gear case. Ensure that all blanking material is removed and offer up and secure the pump in position. Connect the control oil supply pipe to the union on the pump cover and connect the oil inlet connection.

Pressure-oil Filter

Provide a clean tray to hold the filter cage and element when these are removed. Drain the oil from the filter casing by removing the drain plug. Remove the filter cover by removing the securing nuts and washers, the filter element is spring loaded against the cover and the nuts should be unscrewed evenly and progressively. Withdraw the filter cage assembly. Flush out the filter casing and wipe it clean, replace the casing drain plug.

Cut the locking wire and remove the wing nut, the top cap and the top end-pad. Remove the filter cage element and bottom end-pad.

> Choked or damaged elements must be renewed. Under no circumstances should these items be cleaned and replaced.
> Top and bottom end-pads must be renewed once they have been disturbed whether or not the filter element is changed.

Clean the filter cage and the top and bottom caps and spring assembly by washing in clean paraffin; dry thoroughly. Re-assemble the filter by reversing the dismantling procedure fitting new end-pads, lock the wing nut with locking wire. Renew the joint ring and renew the rubber 'O' ring seal around the transfer tube.

To replace a pressure filter, ensure that the filter casing is clean and lower the filter into position. Fit a new cover joint washer to the filter casing and place the cover in position. Bear down on the cover to take up the compression of the filter spring and rund down two nuts on diametrically opposite studs to hold the cover in position. Fit the remaining nuts and spring washers. It should be noted that the cover has a spigot which fits inside the filter casing. Ensure that the cover is seating correctly before tightening the securing nuts. Prime the lubrication system.

Scavenge-oil Pump and Strainer

To remove the scavenge-oil pump strainer, provide a container to catch the drained oil, remove the cover plate and withdraw the strainer. Remove and discard the cover joint washer. To replace, reverse the removal procedure fitting a new cover joint washer.

To remove the scavenge-oil pump, slacken and remove the union nut and withdraw the temperature phial. Disconnect the hose from the outlet connection; remove the securing nuts and spring washers and withdraw the pump. Remove and discard the mounting face joint washer.

To replace, position a new facing joint washer in position. Ensure that all blanking material is removed and offer the pump to position and secure with the bolts and spring washers. Connect the pump outlet connection and enter and secure the temperature phial in position.

Pressure Reducing Valve and Strainer

The reducing valve is situated in the main transverse gallery, between the two main oil filters, in the phasing gear case free-end casing and lies on 'C' side of the vertical centre line. To remove the assembly disconnect the pipe from the union on the cover plate. Remove the outer ring of nuts securing the assembly to the phasing gear case and withdraw the unit.

To remove the strainer for servicing, remove the circlip and remove the strainer. Remove and discard the joint washer between the valve housing and the assembly, reverse the removal procedure fitting a new joint washer between the reducing valve housing and the facing on the phasing gear case.

Trailing Pump and Strainer

To remove the trailing pump strainer, disconnect the supply pipe at the union on the pump. Unlock the tabs of the locking washer and unscrew the union from the pump. Withdraw the strainer. To replace the strainer reverse the removal procedure, fitting a new locking washer to the inlet union. After tightening the union, turn over the tabs of the locking washer to lock the union.

To remove a trailing pump, disconnect the supply pipe at the union on the pump and remove the nuts and spring washers securing the pump to the gear-box. Withdraw the pump ensuring that the driving quill-shaft is not misplaced.

To replace a trailing pump, thoroughly clean the mounting faces of the pump and gearbox and prepare the faces with jointing compound. Renew the rubber 'O' ring seal around the transfer tube in the gearbox facing. Ensure that the driving quill-shaft is in position in the gearbox, offer up the pump and secure in position. Connect the supply pipe to the inlet connection on the pump.

Metering Pump and Strainer

The metering pump supply strainer is housed in the free end of the 'BC' crankcase main oil gallery. To remove the strainer, remove the cap nut securing the low oil pressure warning transmitter and remove the transmitter and joint washers. Remove the union and joint washer from the free end of the gallery; the strainer is integral with the union. To replace the strainer, reverse the removal procedure renewing the joint washers as necessary.

The metering pump comprises a body on which are mounted two micro-pump units. To remove a micro-pump unit disconnect the delivery pipe from the union on the micro-pump; remove the two securing nuts and spring washers and withdraw the unit. To replace, reverse the removal procedure renewing the rubber/metal bonded washer, housed in the recess of the metering pump body, as necessary.

To remove the metering pump as a complete assembly, disconnect the delivery pipes from the micro-pump units and remove the nuts and spring washers securing the assembly in position. Withdraw the assembly and remove and discard the facing joint washer. To replace, fit a new joint washer to the blower facing and offer the pump to position, rotating the pump camshaft to engage with the driving dog on the blower gear train. Secure the pump in position and connect the delivery pipes to the micro-pump units.

Oil Thermostatic Valve

For information on the servicing of this unit see Chapter 9, Cooling System, Thermostatic Valves.

COOLING SYSTEM

Coolant Circulating Pump

Drain the system, disconnect the inlet and outlet pipes. Cut the locking wire, unscrew the cap nut and remove the coolant pressure transmitter and joint washers. On engines fitted with a coolant differential pressure switch, disconnect the pipes to the switch at the coolant inlet connection and coolant outlet connection of the pump. Unscrew the nuts securing the mounting bracket and move the assembly clear of the working area. Remove the pump securing bolts and spring washers and withdraw the pump. Remove and discard the facing joint washer.

To replace, reverse the removal procedure. Ensure that the mounting faces of the replacement pump and of the auxiliary gearbox are clean and free from old joint material and fit a new joint washer. Check that the seal drain at the base of the replacement pump casing is clear and not covered by blanking material. Fill the coolant system.

Raw- or Sea-Water Pump

To remove the pump, disconnect the inlet and outlet pipes; remove the securing bolts and spring washers and withdraw the pump. To replace, ensure that the mating faces of the replacement pump and of the auxiliary gearbox are clean and free from old jointing material; check that the seal drain at

the base of the replacement pump casing is clear and not covered by blanking material. Fit a new facing joint washer and secure the pump in position. Connect the inlet and outlet pipes.

Thermostatic Valves

The procedures for the servicing, and removal and replacement of the lubricating oil system and coolant system thermostatic valves is similar. The system should be drained down and the oil cooler or heat exchanger drained. Disconnect the flange joints of the thermostatic valve with the pipes and the cooler and remove the valve. Clean off all the old jointing material from the flanged pipe ends and from the cooler mounting flange.

The valve can be dismantled for cleaning by removing the nuts securing the front cover in position and withdrawing the cover complete with internal assembly. The rear cover should also be removed. Clean the external surface of the rotor valve and as far as possible all working parts. Care should be taken not to damage the copper capsule. Thoroughly clean the internal surfaces of the casing, the end covers, the mounting flanges and the ports.

It is not recommended that the valve be dismantled further than instructed above. In order to maintain a compact assembly the shafts and links are locked together by pinning and rivetting and damage can result from attempting the separate these items. Information on repair and overhaul can be obtained from the manufacturer: Walton, Engineering Company Limited, 50, Pall Mall, London, S.W.1, England. Should a thermostatic valve become defective through causes other than those that can be cured by cleaning the internal working parts, the valve should be returned to the manufacturer for overhaul.

When reassembling the valve, renew the joint washer between the spindle assemble and the front cover and, the joint washers between the end covers and the body.

To replace the valve in position in the installation, prepare three joint washers from suitable material to be interposed between the mating faces of the flanges on the valve and the flanged pipe ends and cooler mounting flange (these joint washers are not supply items). Check that the mating faces of the pipe flanges, cooler and valve are clean and free from old jointing material. Offer the valve to position ensuring that it is correctly sited in relationship to the liquid flows. Secure the valve in position. Re-fill the system. Prime the lubricating oil system. During the next engine run at full power and load, check the temperatures. After the first engine run following the replacement of a thermostatic valve check the contents of coolant header tank or lubricating oil tank as applicable and top up as necessary.

FUEL SYSTEM

Fuel Circulating Pump

To remove the fuel circulating pump, drain the engine fuel system. Disconnect the pump inlet and outlet pipes, remove the securing bolts and spring washers and withdraw the pump.

To replace a pump, ensure that the mating faces of the replacement pump and camshaft casing are clean and free from old jointing material. Ensure that the seal drain in the base of the pump casing is clear and not covered by blanking material. Place a new joint washer in position on the pump; offer up the pump engaging the quill-shaft with the driving coupling and secure the pump to the camshaft casing. Connect the inlet and outlet pipes. Prime and vent the fuel system.

Filters

To inspect the filters, drain the filter casings by removing the drain plugs. Holding the filter casing in one hand, unscrew the securing cap nut and withdraw the casing and element assembly from the body.

To dismantle the element, remove the assembly from the casing and unscrew the knurled nut from the base of the cage, remove the joint washer. Remove the bottom end-cap and remove and discard the bottom end-pad; the element and the inner and outer perforated bylinders can now be removed and the element withdrawn from the cylinders. Remove and discard the top end-pad.

Choked or damaged filter elements must be renewed.
Under no circumstances should these items be cleaned and replaced.
Filter end-pads must be renewed once they have been disturbed whether the filter element is changed or not.

To reassemble the filter element assembly, thoroughly wash all metal parts in clean fuel, white spirit or paraffin and dry with compressed air. Cotton waste or fluffy rags must not be used. Insert the replacement filter element into the perforated cylinders; place a new end-pad on the top end-cap and place the element and cylinders in position ensuring that the outer cylinder is seating correctly. Place a new end-pad on the element and fit the bottom end-cap, joint washer and knurled nut. Secure the assembly by tightening the knurled nut.

Ensure that the inside of the filter casing is clean and insert the filter element over the tie-rod. Place a new joint washer in position over the slotted ports in the top end-cap; fit a new joint ring to the filter body and secure the casing and element assembly in position; fit a new joint washer under the securing cap nut. Prime and vent the fuel system.

FUEL SYSTEM

Fuel Circulating Pump

To remove the fuel circulating pump, drain the engine fuel system. Disconnect the pump inlet and outlet pipes, remove the securing bolts and spring washers and withdraw the pump.

To replace a pump, ensure that the mating faces of the replacement pump and camshaft casing are clean and free from old jointing material. Ensure that the seal drain in the base of the pump casing is clear and not covered by blanking material. Place a new joint washer in position on the pump; offer up the pump engaging the quill-shaft with the driving coupling and secure the pump to the camshaft casing. Connect the inlet and outlet pipes. Prime and vent the fuel system.

Filters

To inspect the filters, drain the filter casings by removing the drain plugs. Holding the filter casing in one hand, unscrew the securing cap nut and withdraw the casing and element assembly from the body.

To dismantle the element, remove the assembly from the casing and unscrew the knurled nut from the base of the cage, remove the joint washer. Remove the bottom end-cap and remove and discard the bottom end-pad; the element and the inner and outer perforated bylinders can now be removed and the element withdrawn from the cylinders. Remove and discard the top end-pad.

Choked or damaged filter elements must be renewed.
Under no circumstances should these items be cleaned and replaced.
Filter end-pads must be renewed once they have been disturbed whether the filter element is changed or not.

To reassemble the filter element assembly, thoroughly wash all metal parts in clean fuel, white spirit or paraffin and dry with compressed air. Cotton waste or fluffy rags must not be used. Insert the replacement filter element into the perforated cylinders; place a new end-pad on the top end-cap and place the element and cylinders in position ensuring that the outer cylinder is seating correctly. Place a new end-pad on the element and fit the bottom end-cap, joint washer and knurled nut. Secure the assembly by tightening the knurled nut.

Ensure that the inside of the filter casing is clean and insert the filter element over the tie-rod. Place a new joint washer in position over the slotted ports in the top end-cap; fit a new joint ring to the filter body and secure the casing and element assembly in position; fit a new joint washer under the securing cap nut. Prime and vent the fuel system.

Fuel Injection Pump

Drain the fuel system. Remove the support clip from the high-pressure fuel pipe and disconnect the pipe from the pump and from the injector. Disconnect the control shaft at the coupling plates on each side of the pump; care should be taken not to misplace the small distance pieces on the connecting bolts of the drive end coupling. Unscrew the securing cap nuts, remove the sealing rings from the studs and withdraw the pump from the camshaft casing; care should be exercised when withdrawing the pump to ensure that the rubber 'O' rings on the transfer tubes do not adhere to the pump face and be displaced into the bore in the camshaft casing.

To replace an injection pump, fit new rubber 'O' ring seals to the transfer tubes in the camshaft casing and a new rubber 'O' ring seal to the recess in the lip of the bore in the camshaft casing. Mount the pump in position, place new seal rings over the mounting studs and secure the pump with cap nuts.

Disconnect the control rod at the drive end of the camshaft casing and move the 'racks' so that the setting pin can be inserted through the setting pin hole and into the indicator arm. On the replacement pump, insert the setting pin into the locking position. Insert the setting pin in the locking position on the pump next to the replacement pump on the free end side. Connect up the control shafts on each side of the replacement pump, ensuring that the distance pieces are correctly positioned and that the plain washers lie under the heads of the bolts; tighten the nuts on the connecting bolts.

NOTE: In order that the calibration of the replacement pump is in phase with the other pumps of the bank, it is essential that the above procedure be followed and, that the tightening of the nuts and bolts on the interconnecting couplings be carried out only when the setting pins are in position as detailed above.

On completion of the above procedure, replace the setting pins in their stowage positions, connect the control rod to the lever at the drive end of the camshaft casing ensuring that the locking washer is turned over to lock the pivot bolt nut. Secure the high-pressure fuel pipe in position and secure the support clip. Prime the fuel system.

Injector

To remove an injector, remove the support clip from the high-pressure fuel pipe and remove the pipe from the injector and from the injection pump. Remove the injector spill pipes. Remove the bolt securing the spill banjo tee-piece to the injector cap and remove the joint washers. Remove the injector securing bolts and withdraw the injector using the extractor tool supplied with the Maintenance Tool Kit. Remove and discard the injector seating joint washer.

To replace an injector, insert the injector, with a new seating joint washer, into the adapter. Enter the securing bolts and secure the injector in position by even and progressive tightening of the two bolts. Replace the high-pressure fuel pipe and support clip; secure the spill banjo in position with joint washers on each side of the banjo tee-piece and reconnect the spill pipes.

Priming Valve

To remove the filter from the priming valve, remove the union nut; remove the filter and joint washer. To replace, reverse the removal procedure.

To dismantle the priming valve, unlock the tabs of the locking washer on the union nut, unscrew the union nut and withdraw the valve. Due to the spring loading, care should be taken when finally removing the union nut. To replace, reverse the removal procedure fitting a new locking washer for the union nut.

Pressurising Valve

To dismantle the pressurising valve, unlock the tabs on the locking washer and unscrew the union nut from the union body. The valve assembly can then be removed. To reassemble the valve, reverse the dismantling procedure fitting a new lock washer for the union nut.

STARTING SYSTEM

Air Start Distributor

To remove the air start distributor, remove the air supply and delivery pipes and the drain pipe; remove the securing bolts and washers and withdraw the distributor.

When replacing the distributor it will be necessary to set the timing relationship between the engine and the distributor. Determine the T.D.C. position of A.1 exhaust piston (see this Chapter, Engine Phasing and Timing). Set the timing dial to read 0° with A.1 exhaust piston at T.D.C. Turn the engine until the timing dial indicates 24° after T.D.C. A.1 exhaust piston.

Alternatively the distributor can be timed from the A camshaft timing scale. If the camshaft is turned until it indicates the engine fuel injection timing (see Maintenance Manual) plus a further 24°, this will be the timing position for the distributor.

Remove the setting pin from the distributor cover and remove the cover from the distributor. Fit a new joint washer to the distributor mounting flange and offer up and secure the distributor in position. Remove the circlip and withdraw the distributor timing valve plate from the shaft splines. Reposition the valve plate on the splines so that, with the setting pin inserted through the enlarged end of the slot in the valve plate, the end of the pin will engage with the port for No. 1 cylinder. The No. 1 port is slightly larger than the other five in order to accept

the pin. If difficulty is experienced in aligning the valve plate and the port with the setting pin, it will be necessary to remove the distributor from the camshaft casing and refit it, turning the distributor shaft by one spline engagement with the driving coupling in the camshaft casing. Reposition the valve plate on the free-end splines and insert the setting pin. When a satisfactory alignment has been made, secure the valve plate with the circlip.

Remove the setting pin and reposition it in the stowage position in the cover. Fit a new joint washer to the distributor body and secure the cover in position. Connect the air supply and delivery pipes and the drain pipe.

Air Start Valve

To remove an air start valve, disconnect the main air supply pipe and the valve operating supply pipe. Remove the two securing bolts and washers and withdraw the valve assembly. Remove and discard the seating joint washer.

To dismantle the valve for cleaning, remove the valve operating supply union. Withdraw the split pin from the slotted nut now exposed and remove the slotted nut and washer. The poppet valve piston and piston stop washer and the spring can now be withdrawn.

Clean the components by washing in paraffin, white spirit or fuel oil and thoroughly dry with compressed air. Ensure that the piston rings are free in their grooves. If necessary, the poppet valve can be lapped to its seating in the body using a fine grinding paste. Ensure that all traces of grinding paste are removed after lapping. Insert the piston stop washer into the body with the stepped side toward the piston. Insert the valve and valve spring and push the piston with its two piston rings into the bore in the body. Secure the piston to the valve stem with the plain washer, slotted nut and split pin. Fit a new joint washer to the supply union and tighten the union in position.

To replace an air start valve, fit a new seating joint washer to the adapter and insert the valve assembly. Secure the valve in position with the two securing bolts and spring washers, tightening the bolts evenly and progressively.

Filters

The filters positioned in the air start system can be removed for inspection and cleaning as required. The filters are positioned as follows:-

1. One in the inlet union to the junction box.
2. One in the inlet union to the priming cock of the cold starting aid system.
3. One in the capsule unit of the cold starting aid.

To remove the filter from the main air inlet junction box, remove the main supply pipe and unscrew the union from the junction box. The filter, of the gauze element type, is integral with the union.

To remove the filter from the cold starting aid system priming cock, remove the air supply pipe from the union on the body of the cock. The filter, which is of the wire-wound edge-type, is housed in the union. When withdrawing the filter it will be seen that the filter carries a rubber 'O' ring seal in a groove at its inner end.

To remove the filter from the capsule unit, remove the emulsifying jet by unscrewing the hexagon headed plug and unscrewing the jet. The filter, which is of the gauze type, can then be removed.

The filters should be cleaned with a soft bristle brush, using trichlorethylene, white spirit or paraffin. Dry thoroughly with compressed air. Fluffy rag or cloth must not be used as a cleaning or drying medium.

To replace the filters, reverse the removal procedure, fitting new joint washers and rubber 'O' rings where applicable. When refitting the priming cock filter, ensure that the end of the filter carrying the rubber 'O' ring is inserted first.

Cold Starting Aid Nozzles

To remove the cold starting aid nozzles for servicing, cut the locking wire on the nut securing the fluid capillary pipe to the nozzle and unscrew the nut and move the pipe clear of the nozzle. Remove the remainder of the locking wire from the lock nut, turn back the locking tab on the lock washer and slacken the lock nut. With a spanner on the hexagon adjacent to the lock nut, slacken and remove the nozzle from the adapter plug.

To dismantle the nozzle, grip the large hexagon of the body and unscrew the union adapter from the body. Care should be exercised, when finally removing the union adapter, that the small sealing ball and spring contained between the union adapter and the body are not misplaced. Clean all parts by washing in paraffin, white spirit or fuel oil, and ensure that the nozzle jet hole(s) are clear. Dry with compressed air.

To reassemble the nozzle, insert the non-return valve spring into the body, position the ball in the adapter union and carefully bring the body and the union together screwing the union home. Tighten the adapter union in position. Position the lock nut on the body thread.

To fit a nozzle to position on the engine, first check that the nozzle is of the correct type:

> Single hole nozzles must be fitted in the air intake manifolds.
>
> Twin hole nozzles must be fitted in the blower volutes.

Position the lock nut on the nozzle body at the extremity of the thread adjacent to the body hexagon. Fit a new lock washer to the adapter plug on the engine, ensuring that the locking tank of the washer seats correctly in the hole provided. Screw in the nozzle. Position the arrow(s) stamped on the body hexagon and tighten the lock nut maintaining the arrow(s) in the correct position; turn up the locking tang of the lock washer to lock the nut. Secure the capillary pipe to the nozzle and, with locking wire, lock the capillary pipe securing nut to the nozzle lock nut.

CONTROL SYSTEM

To remove the governor, disconnect the fuel pipes. Disconnect the link rod between the governor and 'B' injection pumps control shaft bell-crank lever. Disconnect the shut-down control. Disconnect the control cable at the break unit. Disconnect the control cable from the hydraulic control unit. To remove the cover, remove the detent plunger housing assembly; remove the circlips and move the restrictor tubes upwards to clear the cover. Slacken and remove the cover securing nuts and remove the cover. Slacken the pillar nut sufficiently to press the speed selection cam and shaft inwards to disengage the splines of the cable wheel. Slacken the cable clamp and withdraw the cable from the governor and hydraulic control unit. Remove the cable conduit clip; slacken and remove the cable conduit adjuster from the governor. Remove the governor securing nuts and washers and withdraw the governor from the mounting face on the phasing gear case.

To replace the governor, examine the mating joint faces of the governor and phasing gear case and ensure that they are clean and free from burrs or scores. Prepare the faces with jointing compound and offer up and secure the governor in position. Connect up the cable conduit. Connect the control cables and the link rod between the governor and the 'B' control shaft bell-crank lever and adjust to give a 96° rack reading. Check the adjustment of the retractable maximum stop. Connect the fuel pipes and prime and vent the fuel system. During the priming operations, slacken the governor venting blank and, manually discharge the starting accumulator several times in order to assist in venting the governor. When satisfied that all air has been excluded from the system, tighten all venting points. Finally check that a 'rack' reading of at least 130° is obtained when the accumulator is manually tripped. Adjust the slow running speed when the engine is warm and running slow ahead.

Hydraulic Control Unit

To remove a hydraulic control unit, disconnect the clutch oil supply pipes at the unions on the control unit. Disconnect the lubricating oil supply pipe from 'EC' crankcase. Disconnect the electrical connections from the terminal box and, remove the oil pressure transmitter from the connection on the control unit. Remove the circlips and move the restrictor tubes upwards to clear the cable wheel cover. Remove the detent plunger housing assembly. Remove the nuts securing the cable wheel cover and remove the cover. Disconnect the cable from the