LUBRICATION SYSTEM

The high pressure lubrication requirements of Deltic engines are met completely by one main pressure pump. A metering pump is used to feed oil to the blower bearings, and a trailing pump provides independent lubrication for those gearbox components rotated by a trailing propeller when the engine has stopped or is running in neutral.

A reduced pressure system, supplied from the main pressure system, feeds oil to those components not supplied by the main pressure system.

Scavenge oil drains to the sump in 'CA' crankcase from which it is drawn by the scavenge oil pump and returned to the tank through an oil cooler.

Main Pressure System.

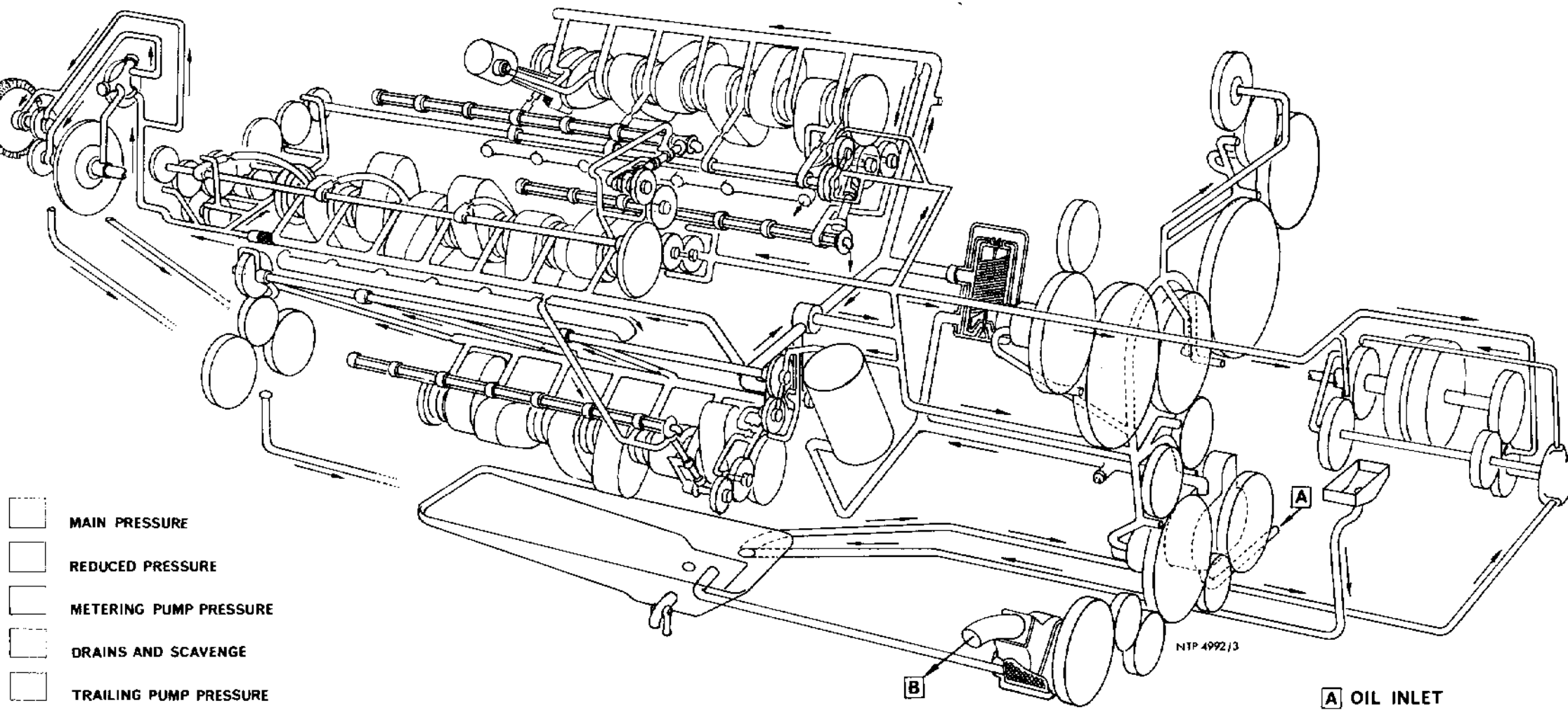
In the main pressure system, oil is drawn from a tank by the pressure pump which is mounted on 'A' side of the phasing gear case, low down on the free end face. The pressure pump passes the oil to the pressure filters mounted on the phasing gear case, through two non-return valves to galleries within the phasing gear casings. From the phasing case galleries the oil is passed through passageways to the main oil galleries in the three crankcases.

Distribution of main pressure oil in the three crankcases is similar: the oil flows from the main galleries through drillings in the crankcase webs to the crankshaft main bearings, and to the big-end bearings through drillings in the crank webs and crankpins. From the big-end bearings the oil is passed through drillings in the connecting rods to lubricate the small end bearings.

A hole drilled in the small-end of each connecting rod conducts oil to the space between the gudgeon pin housing and the piston body. Inertia forces due to reciprocation causes the oil to be shaken within this space, the oil collecting heat near the piston crown and transferring it to the piston walls. Excess oil is spilled through drillings to the inside of the gudgeon pin housing and splashed on to the cylinder walls where it is collected by the scraper rings and returned to the crankcases.

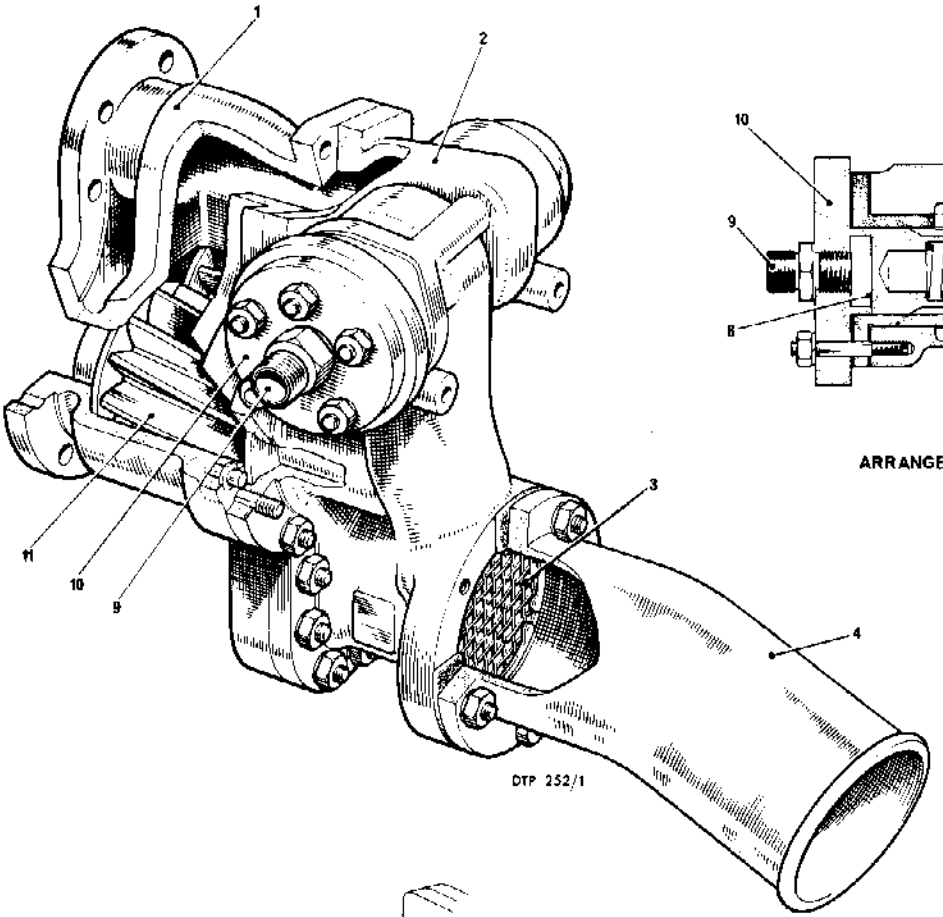
Pressure Oil Pump

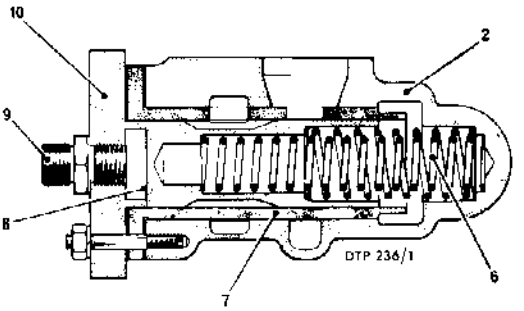
The gear type main oil pressure pump is mounted on the free end face of the phasing gear case low down on 'A' side of the engine and is driven by idler gears from 'CA' crankshaft gear. It is a gear type pump incorporating a relief valve of a non-adjustable type, the relieving pressure being pre-determined by the arrangement of the springs and form of the valve. Movement of the valve is controlled from the reduced pressure system. Control oil is fed to a pressure face on the valve by a pipe from the reduced oil pressure side of the pressure reducing valve. The relief valve operates to stabilize output and control the pressure by diverting excess oil from the delivery side to the inlet side of the pump.



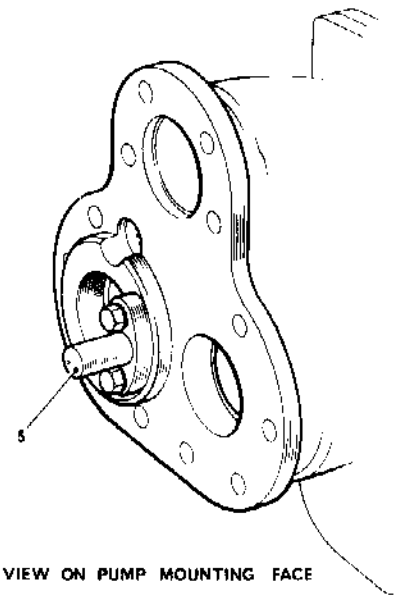
LUBRICATION SYSTEM – DIAGRAMMATIC

T 18-37K ENGINE





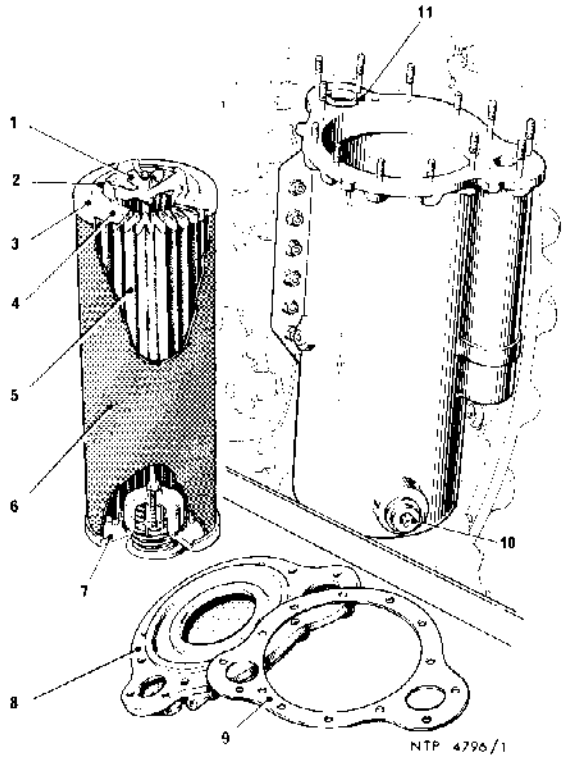
ARRANGEMENT OF RELIEF VALVE



VIEW ON PUMP MOUNTING FACE

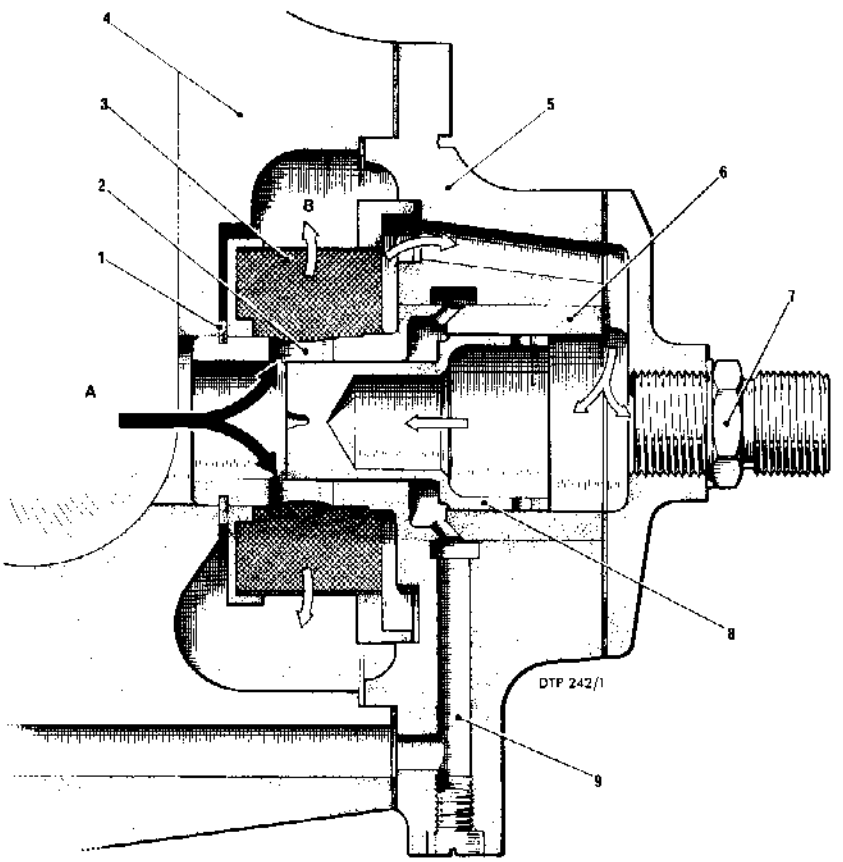
1. Pump body
2. Pump cover
3. Strainer
4. Inlet connection
5. Sparge jet
6. Relief valve springs
7. Sleeve
8. Relief valve, pressure face
9. Control oil supply union
10. Cover plate
11. Pump driven gear

PRESSURE OIL PUMP



1. Wing nut
2. Joint ring
3. Top cap
4. Top end-pad
5. Filter element
6. Filter cage
7. Bottom end-pad
8. Filter cover
9. Joint washer
10. Drain plug
11. Seal ring

PRESSURE OIL FILTER



A. Main pressure oil
B. Reduced pressure oil

1. Circlip
2. Port
3. Strainer
4. Phasing case free-end casing
5. Reducing valve housing
6. Liner
7. Union, reduced pressure to pressure pump relief valve
8. Floating plunger
9. Drain duct

PRESSURE REDUCING VALVE

Pressure Oil Filters.

The filters are of the fine element full-flow type and are housed in castings secured to the sides of the phasing gear case. Oil flows to the top of the filter and passes from the inside to the outside of the element.

The filter element is seated on a spring and should the element become choked, the oil pressure overcomes the spring pressure and forces the element of the top sealing ring to permit a full flow of oil.

The felt element is of the corrugated type and is surrounded on its outside surface by wire gauze, the convulutions of the element offer a large filtration area consistent with a small overall diameter. The element is sandwiched between end plates by a tie bolt passing through the centre, and a perforated metal cage seated in the end plates, surrounds the element. Rubber end pads are interposed between the element and the end plates at either end. Should the element be removed for inspection the rubber end pads must always be changed regardless of the state of the element. Filter elements should be renewed if in a dirty condition and no attempt made to clean the elements. It should be noted that the felt of the element will become impregnated with dirt particles which it is impossible to satisfactorily dislodge.

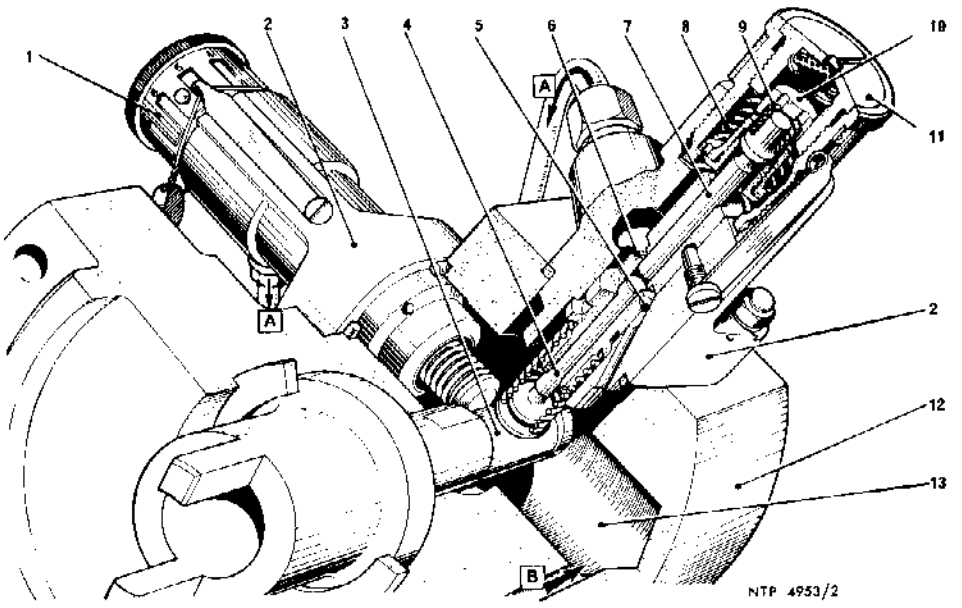
Clutch Pump

On Deltic engines incorporating a bi-directional gear box, the clutch is served with pressure oil from a pump located in the hydraulic control unit. This clutch pump draws oil through an external pipe from the main pressure gallery in 'BC' crankcase and supplies it, at a pressure above that of the main pressure sysyem, to operate the clutch. The pump is of the gear type, and a relief valve is incorporated in the system to divert excess pressure to the inlet of the pump.

Priming and Instrument Connections.

A priming connection, incorporating a non-return valve is located on 'C' side of the phasing gear case free end casing. This may be connected to either a hand pump or motorised pump dependent upon the installation requirement, the pump drawing its supply from a convenient point between the service oil tank and the pressure pump. The priming point is upstream of the pressure filters.

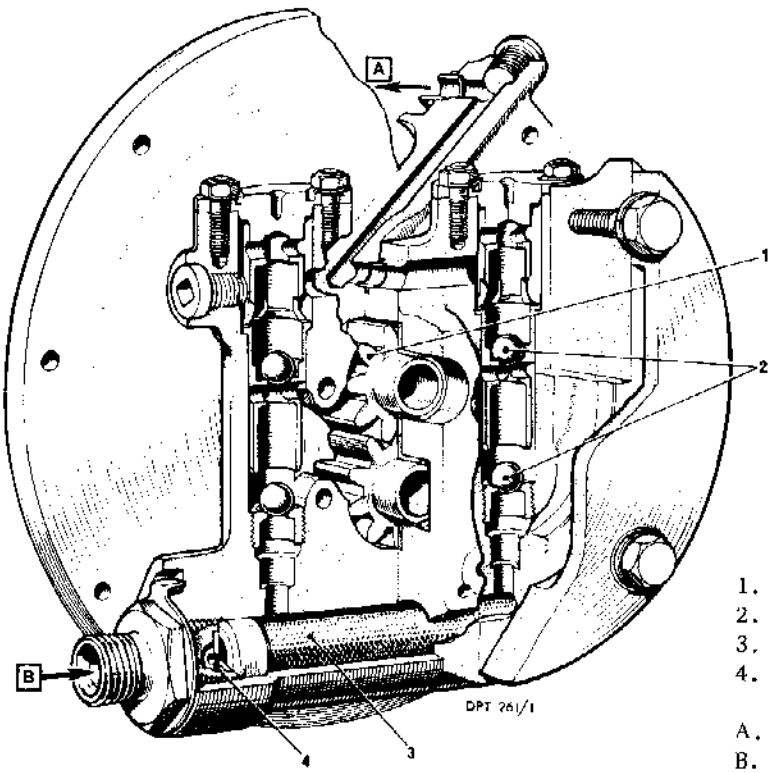
As there is a variation of engine types and installations the positioning of the various instrumentation connection points will be discussed in later chapters dealing with the particular installation. Provision is made for connecting pressure and temperature gauges and pressure and temperature warning and/or shut-down switch pipes.



A. Oil delivery to impeller bearings
B. Oil supply from 'BC' crankcase

1. Calibration setting slots
2. Micro pump
3. Cam
4. Displacement plunger
5. Inlet port
6. Outlet port
7. Metering piston
8. Main spring
9. Resistance spring
10. Inner cap
11. Adjusting head cap
12. Pump casting
13. Reservoir chamber

METERING PUMP



1. Driving gear
2. Double acting ball valves
3. Strainer
4. Restrictor

A. Outlet to trailing sparge jets
B. Pump inlet

TRAILING PUMP

Reduced Pressure System.

The reduced pressure lubrication system is supplied with oil from the main pressure system, the high pressure oil being passed either through a pressure reducing valve located on the free end of the phasing gear case (positioned in the main transverse oil gallery) or through restrictors situated at various points in the main pressure system. The reduced pressure system supplies the sparge jets which lubricate the phasing gear trains, the bi-directional gearbox or end cover which may be fitted and the drives not supplied from the main pressure system.

Pressure Reducing Valve.

The valve is a differential pressure type on which main pressure oil is applied to one end of a floating plunger. The pressure exerted by the main pressure oil moves the plunger to open ports in a liner through which the oil is directed, through a strainer, to the reduced pressure system and also the other end of the plunger. The plunger takes up a balanced position when the main and reduced pressures are in inverse ratio to the areas on which they act. A tapping is taken from the reduced pressure side of the valve to operate the main oil pressure pump relief valve.

Restrictors.

Restrictors are placed at convenient points in the lubrication system to regulate the flow of oil to components, or groups of drives and bushes.

Reduced pressure oil flowing through restrictors in the main galleries of each crankcase is fed to the camshaft drives and bushes and camshaft bushes. Restrictors in the crankcase webs pass oil from the main bearing positions in alternate webs to the flexible drive shaft bushes. The blower gear trains are lubricated through spray jets, the supply of oil being passed from a restrictor sited near the free end of 'BC' crankcase main oil gallery, this restrictor also supplies the metering pump and the turbine bearings.

Phasing Gear Case.

Spray jets in the phasing gear case are supplied through passages fed from the reducing valve to lubricate the gear trains and the output shaft assembly.

Crankcases.

The annuli surrounding the drive end main bearings of the crankshafts are tapped to supply oil through restrictors to the bearings of the gears driving the camshafts and the bearings of the camshaft drive bevel shafts.

Passages in the phasing gear casing conduct oil from the pressure reducing valve to the crankcase oil ways, which feed oil to the sparges lubricating the gears driving the flexible drive shafts and to the drive end bearings of these gears. The bearings at the free end of these gears, and the bearing of the flexible drive shafts (except the bearing at the free end of the auxiliary gear box flexible drive shaft, 'CA' crankcase) are lubricated through restrictors from the annuli surrounding alternate crankshaft main bearings. Oil is supplied through a restrictor on the end of 'CA' crankshaft main gallery to the bearing on the free end of the auxiliary gearbox flexible drive shaft and from there a supply passes to the bearings and gears in the auxiliary gearbox.

Camshaft Casings.

The bearings of 'A' and 'C' camshafts are lubricated by oil fed through external pipes from restrictors in the main galleries of the top two crankcases. Oil enters the camshaft casing at the driving end, is directed to the bevel gears at the camshaft end of the driving quill-shaft and through the hollow camshaft to the camshaft bearings. The camshaft bearings are grooved to permit a quantity of the oil to escape on to the adjacent fuel pump tappet. The lubrication of 'B' camshaft casing is similar except that the oil is fed through a restrictor from the annulus, surrounding the drive end main bearing on 'BC' crankcase into the driving end of the top oil gallery which is plugged internally after a short distance of its length. A union sited in this portion of the gallery leads the oil through an external pipe to the camshaft casing.

Turbo-Blower

The turbo-blower is lubricated by oil fed from a restrictor at the free end of the main oil gallery in 'BC' crankcase. Oil enters the restrictor through a strainer and flows through an external flexible pipe to the compressor casing. Passages in the casing deliver oil to the spray jets to lubricate the gears and bearings of the speed increasing gear train and to the metering pump. The metering pump supplies the bearings of the compressor impeller shaft. A tapping on the compressor casing delivers oil through an external flexible pipe to the turbine casing, the oil being directed by passages in the casing to lubricate the turbine shaft bearings. The turbine casing and compressor casing are drained by external pipes to the auxiliary gearbox.

The metering pump is mounted on the turbo-blower casing and is driven from the blower gear train. It contains two micro pump units of the reciprocating type and these supply oil to the impeller shaft bearings at a rate proportional to the blower speed.

The layout of the pump is seen in the accompanying illustration. Oil from the engine low pressure system enters the inlet port of a pump unit and fills the space between the displacement plunger and the piston. The relative positions of the inlet and outlet ports can be seen and, during the first third of the inward movement of the displacement plunger no pumping action takes place but complete sealing of the inlet port is assured. During this initial movement, the piston is displaced outwards compressing the smaller of the two springs.

The movement outwards of the displacement plunger, trapped oil and piston, compresses the small spring, continued movement will compress the large spring until the piston uncovers the outlet port and the oil is discharged. The displacement plunger makes contact with the piston at the end of the outward stroke and the two members then move down together, thus ensuring a zero clearance volume and a high suction on the pump inlet.

Bi-directional Gearbox.

An external pipe conducts oil from the reduced pressure gallery of the phasing gear case to a union at the top of the bi-directional gearbox. Oil is fed through passages in the gearbox casings to spray jets to lubricate the gear trains. Oil drains to the bottom of the gearbox casings where it passes through a flexible pipe to the engine sump.

Trailing Pump

The trailing pump is fitted on the bi-directional gearbox to ensure that the gears are adequately lubricated when rotated by a trailing propeller. The pump, which is a gear type, draws oil from the bottom of 'CA' crankcase and delivers it to two auxiliary spray jets, sited so that they lubricate the two trains of drive. This system is also operative when the engine is running and provides additional lubrication.

The trailing pump is mounted on the drive end casing of the gearbox and is driven through a quill-shaft from the layshaft. Each side of the pump is connected to both inlet and outlet passages through double ball valves, thus ensuring that oil flows in the same direction regardless of the direction of drive. A gauze strainer is incorporated in the pump body, and all oil being drawn from 'CA' crankcase must pass through this strainer before entering the gears of the pump.

The pump body has a machined face to which a shaft tachometer generator may be mounted if so required. The tachometer takes its drive from the trailing pump by a quill-shaft. If no speed registering machine is fitted, the mounting face is blanked by a cover plate.

Drain and Scavenge System.

'CA' crankcase forms a sump into which all drain oil returns after performing its various services within the engine and auxiliary components. Oil supplied to the bearings and shafts in 'CA' crankcase and the auxiliary gearbox drains directly to the sump; 'AB' and 'BC' crankcases are drained by manifolds and hence via external pipes to 'CA' crankcase.

The camshaft casings are drained by external pipes into the adjacent crankcases. The turbo-blower drains into the auxiliary gearbox, the bi-directional gearbox drains through external pipes into 'CA' crankcase. All drain oil in 'CA' crankcase is drawn away by the scavenge oil pump, mounted on 'C' side of the phasing gear case and returned to a service tank through coolers or heat exchangers, a thermostatically controlled valve and a de-aerator.

Scavenge Oil Pump

The gear type scavenge oil pump is mounted on the free end face of the phasing gear case, low down on 'C' side of the engine and is driven through idler gears and a quill-shaft from 'CA' phasing gear. A wire mesh strainer is incorporated in the body of the pump on the suction side, oil being drawn from the sump, though the strainer, by the pump.

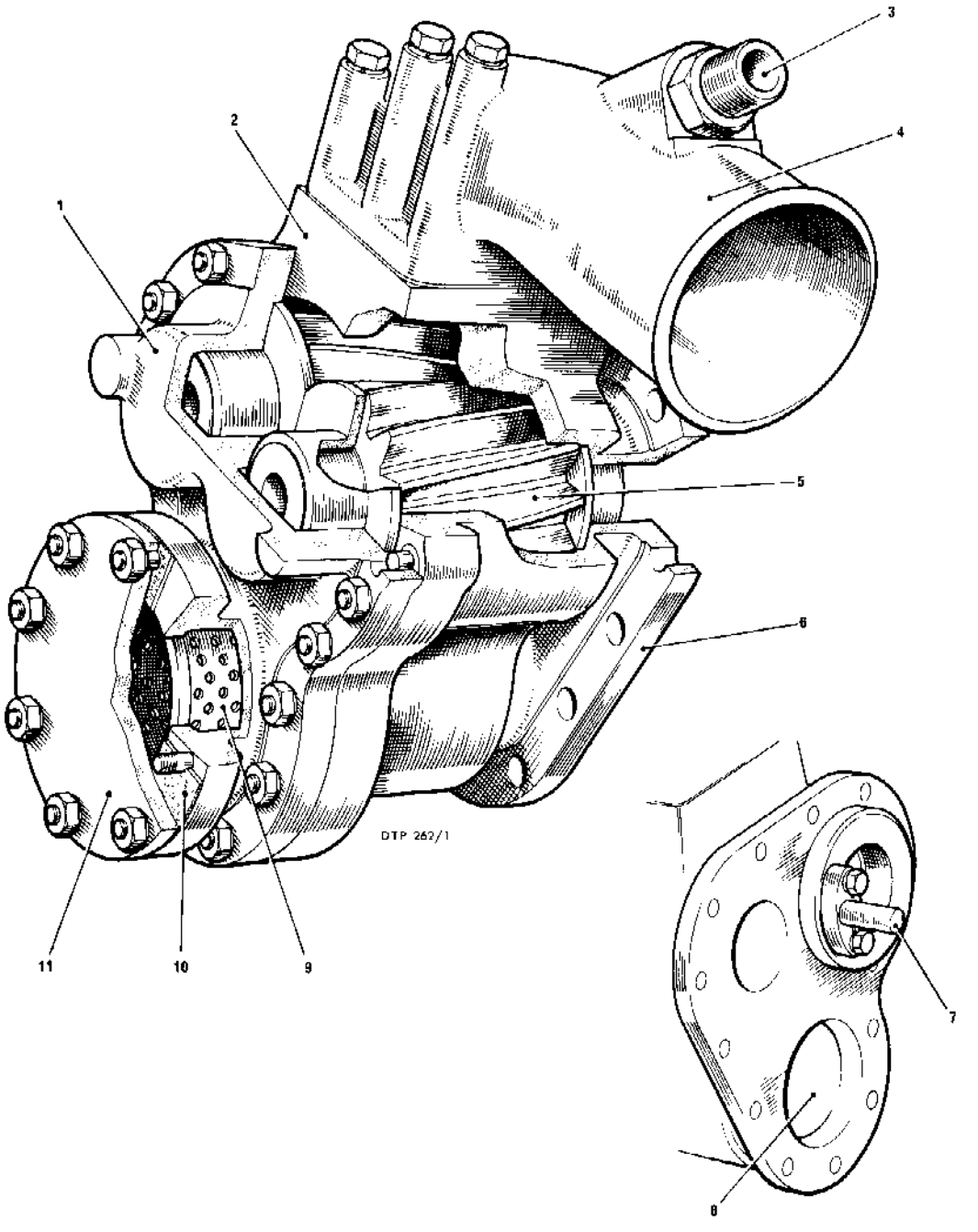
Draining the Sump

To facilitate complete draining of the sump, a suction drain connection may be fitted instead of a drain cock. The drain plug is situated at the lowest point of 'CA' crankcase cover and is provided to drain residual oil.

Engine Breather System

For breathing purposes the bottom crankcase is vented through the phasing gear case to the top two crankcases. 'AB' and 'BC' crankcases are interconnected by large bore flexible pipes and the turbine drive end casing is also vented into the interconnecting pipes by a tee-piece and large bore pipe. The compressor drive end casing is vented into one of the top two crankcases.

A centrifugal breather, which comprises a fan and oil seal assembly is bolted to the free end of the damper assembly of one of the top two crankshafts with the oil seal assembly housed in the damper cover. The assembly of the centrifugal breather can be positioned either in 'AB' or 'BC' crankcase dependent upon installation requirements. The fan is designed to centrifuge the oil laden air within the crankcase, in order that the air passing through the fan and out of the engine breather connection at the free end of the crankcase is free from droplets of oil.



VIEW ON PUMP MOUNTING FACE

1. Pump cover
2. Pump body
3. Oil outlet temperature thermometer socket
4. Outlet connection
5. Pump driven-gear
6. Mounting flange
7. Sparge jet
8. Suction inlet from phasing gear case
9. Scavenge-oil strainer
10. Joint washer
11. Strainer cover plate

SCAVENGE OIL PUMP