GENERAL DESCRIPTION OF THE ENGINE

The basic structure of the engine is formed by three cylinder blocks and three crankcases held together by high-tensile steel tie-rods passing through the cylinder blocks and crankcases and torque loaded to form a basic assembly of great strength and rigidity.

Two important design aspects arise from the triangular lay-out. Firstly, a phase angle different between the inlet and exhaust pistons of one cylinder arises automatically; the exhaust piston leads the inlet piston by 20° and the bottom crankshaft rotates in the opposite direction to the two upper crankshafts. This phasing and engine timing will be discussed in detail in a later chapter. Secondly, in any one crankcase, the crank-pins carry blade and fork type connecting-rods. The pistons attached to the fork rods control the exhaust ports of one bank of cylinders, and the pistons attached to the blade rods control the inlet ports of the other bank of cylinders adjacent to that crankcase. The clearance volume between the two opposing pistons in any one cylinder forms the combustion space. Thus the load on each crank-pin and the power transmitted by each crankshaft is the same, with a large saving of weight owing to the elimination of cylinder heads, valves and valve operating mechanisms.

At the driving end of the main triangle assembly a casing contains phasing gears which link the three crankshafts to a single output gear. Connecting each crankshaft to the phasing gears is a quill-shaft designed in conjunction with a vibration damper to eliminate torsional vibration over the engine range of operating speed. These quill-shafts allow differences of expansion and slight mal-aligment between the crankshafts and phasing gears: by the use of differing numbers of teeth at each end of the quill-shafts the vernier combination so formed is used for phasing the crankshafts.

The phasing gear case also contains auxiliary gear trains to drive some of the engine auxiliaries, and in certain installations auxiliaries may be driven directly from the quill-shafts. The means of transmitting the drive from the output gear of the phasing gear case to the external load will depend on the installation requirements.

When the driven unit is directly mounted on the engine it is secured to the phasing gear case by a flanged adaptor ring and is coupled to the engine by a self-aligning output flange driven from the phasing gear case output gear by a quill-shaft.

For an independently mounted driven unit a pedestal drive end cover is attached to the phasing gear case. An output flange, to which the unit may be coupled, is carried in bearings in the pedestal end cover and is driven by means of a quill-shaft from the output phasing gear.

For marine propulsion application a bi-directional gearbox may be mounted directly on the phasing gear case. A clutch unit driven from the output phasing gear contains two hydraulically operated friction clutches which drive the output shaft through constantly meshing gear trains. The output shaft rotation in either direction may be obtained by engaging either clutch, or the engine can be idled in neutral. High pressure oil for the operation of the clutches is provided by an engine driven gear-type pump.

A 'geared in' type turbo blower unit consisting of a centrifugal compressor and a single stage axial-flow turbine, is mounted on a sandwich piece at the free-end of the triangle. Port timing is so arranged that the blower completely scavenges and pressure-charges the cylinders.

The engine is lubricated on the dry sump principle, with engine driven pressure and scavenge oil pumps. Certain parts of the engine are supplied with oil at a reduced pressure either through a pressure reducing valve or through restrictors taking their oil supply from the main pressure system. The main oil system also supplies oil to the clutch pump when a bi-directional gear box is fitted. The oil is cooled by passing it through a heat exchanger or radiator before returning it to the service tank.

A closed cooling system is used, circulating distilled water inhabited with ethylene glycol. The coolant is circulated through the exhaust manifolds, cylinder blocks, and where applicable, through the turbine casing, by an engine driven pump. A thermostatically controlled heat exchanger or radiator is included in the system, using a raw water or air supply for extracting heat from the engine coolant.

The method of starting the engine may vary with the type of installation; alternative methods used are air-starting, or by motoring the engine through a generator, where the generator is directly coupled to the engine.

For air starting, high pressure from an air reservoir is admitted to one bank of cylinders, by means of a distributor valve, to motor the engine.

Mounted on the free end of the bottom crankcase is an auxiliary drive gear box containing a train of gears driven by a flexible drive shaft from the bottom crankshaft, a similar to the blower flexible drive shafts. This train of gears may drive various engine auxiliaries and in certain applications may have an auxiliary power take-off shaft.

Engine mounting faces are machined on the auxiliary drive gearbox and the pedestal drive cover, or bi-directional gearbox. Where the engine is directly attached to a generator, mounting faces are machined on extensions cast integrally with the bottom crankcase, with further mountings attached to the generator.

An external face machined on each cylinder block carries a camshaft casing; this casing carries individual C.A.V. type fuel injection pumps, each pump supplying a single injector for each cylinder of the block. A fuel circulating pump supplies filtered fuel, under pressure, to the injection pumps. Fuel surplus to the engine requirements is returned to the fuel tank through a spring loaded valve which maintains a pressure in the system, thus eliminating the possibility of air-locks in the fuel system.