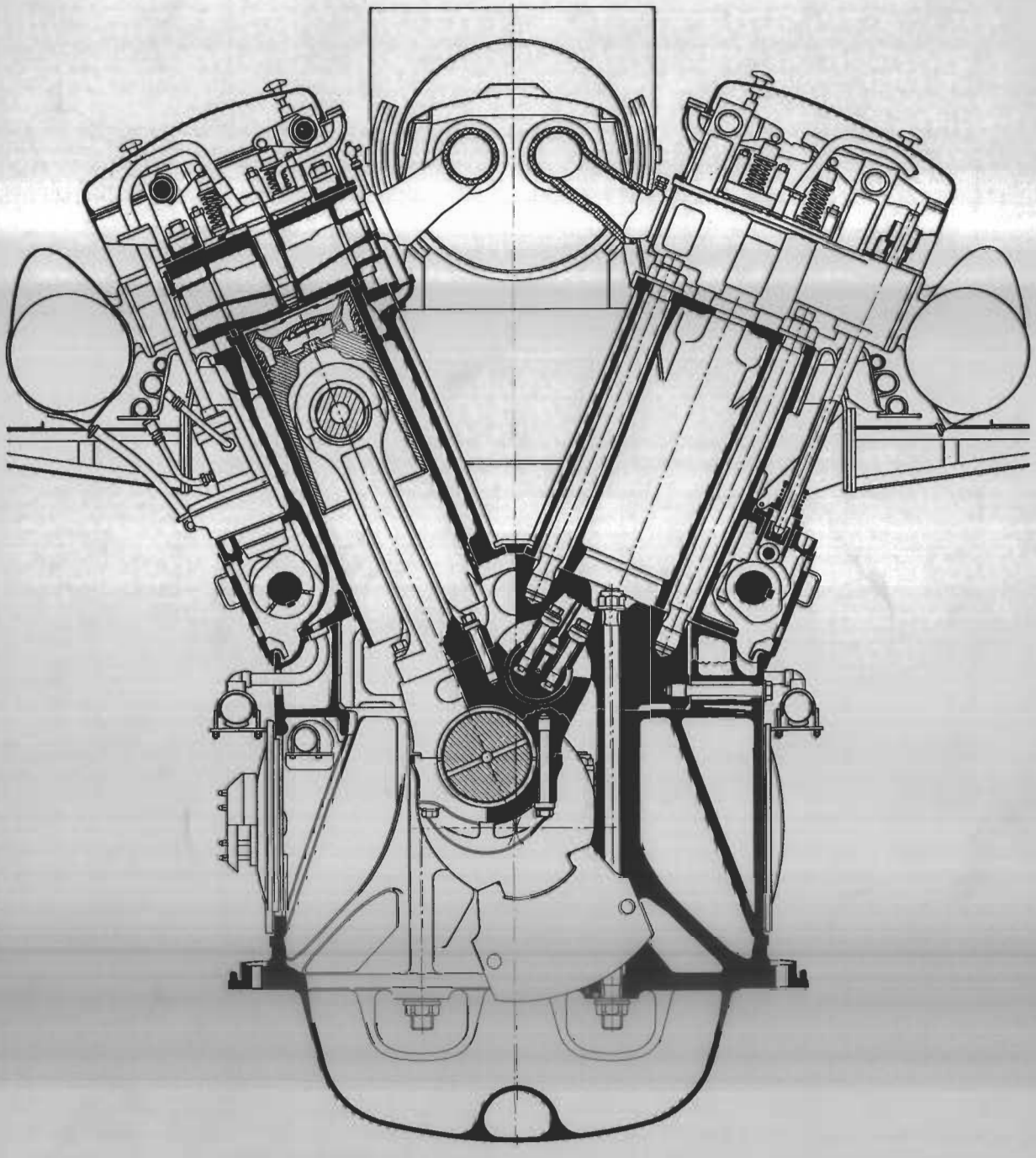
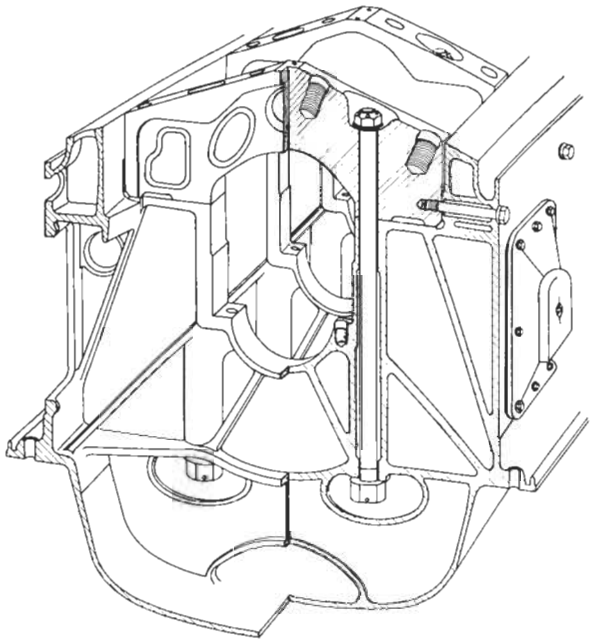
KAWASAKI
HEAVY INDUSTRIES, LTD.

KAWASAKI-M·A·N 4-STROKE DIESEL ENGINE

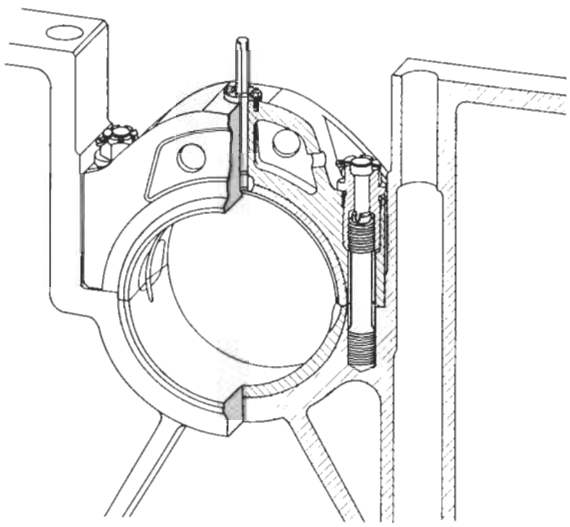
V40/54A



ENGINE FRAME



MAIN BEARING



APPLICATION

Marine propulsion engines
Stationary installations

The engine is of single-acting four-stroke trunk-piston design. The two cylinder banks are arranged at a 45° vee angle. The turbo-charging system employed affords outstanding operating economy, this being characterised by particularly low fuel consumption.

Engine frame

The engine frame, bedplate and oil-tray constitute a monoblock casting. The cut-away portion in the upper half of the frame required for removing the crankshaft is closed off by steel cast members secured to the bearing support by means of waisted bolts. At the side, these members are also bolted to the frame walls thereby stiffening the entire engine structure. The side-walls feature large openings closed off by covers admitting of immediate access to running gear and bearings. Some of the covers are equipped with safety valves, which open and close automatically at a given pressure.

Main bearings

The main bearings are steel shells with lead-bronze lining and electro-plating. One of these bearings is designed as a locating bearing and its thrust face also features the above layers. The bearing cover is secured by 2 laterally disposed bolts. The lubricating oil for crankpin and piston pin bearings as well as for piston cooling is admitted through the main bearings.

Cylinder blocks

Each cylinder bank features a cast cylinder block, common to all cylinders. The cylinder block is secured by tierods to the engine framework, thus relieving it of the tension stresses that occur during combustion.

Cylinder liners

Cylinder liners are of special cast iron and have excellent bearing and wear-resistance characteristics. They are completely surrounded by water and their top flange is ground to the cylinder block The lower end of the liner is free to expand downwards through two water-tight O-rings.

Cylinder heads

These are individual high-quality iron castings bolted to the cylinder block by 8 studs. Each cylinder head carries two inlet valves, two exhaust valves and the fuel injector. The latter is enclosed in a special housing, in the event of fuel leaking, mixing of the oil and fuel is precluded. A starting valve is provided for each cylinder of reversible engines, while only one bank of cylinders has starting valves on uni-directional power units. Marine engines also feature a safety valve in each cylinder head. Layout and arrangement of the water spaces in the cylinder heads ensure efficient heat dissipation. For ease of access large covers have been fitted.

Crankshaft

The crankshaft is an alloyed steel forging. To give good dynamic balancing each web is fitted with a counterweight. Journals and crankpins are ground and polished but not hardened. The lubricating oil is led through drilled passages from the main bearings to the connecting rod bearings. The two-part camshaft drive gear is seated at the coupling end on a collar which stands proud of the journal. If necessary, the "free" end of the crankshaft can be arranged for attachment of an extension shaft and auxiliary drive.

Vibration damper

A vibration damper is mounted on the "free" end of the engine to avoid inadmissibly high vibrations of the crankshaft when passing through critical speed ranges.

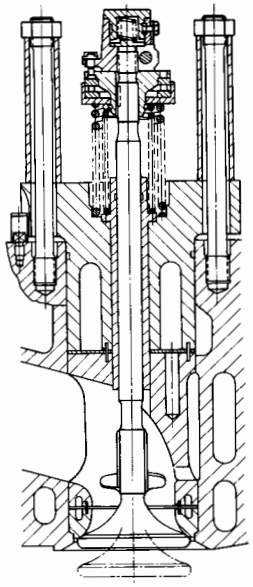
Connecting rods

The connecting rods consists of the master rod and the slave rod articulated by means of a wrist-pin to the common connecting rod big end. Thus, during withdrawal of a piston, main and slave rod can be separated from the connecting rod big end without having to remove the connecting rod bearing. All holding bolts of the connecting rod are of highly resistant material. The two big end bearing halves with their thin steel backing and the crankshaft bearings have a lead bronze lining with a thin electro-plated layer. The same applies to the one-piece wrist-pin bush and the piston pin bush. Drilled passages in the connecting rod shafts lead the oil through non-return valves to the piston pin bearings and the cooling spaces in the piston.

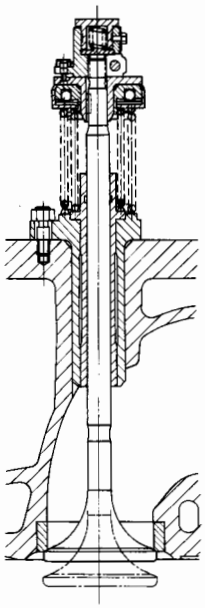
Pistons

The pistons are of two-part design consisting of an aluminium skirt with excellent anti-frictional characteristics and a steel crown of high heat and wear resistance. Both parts are joined together by means of waisted bolts. Each piston is fitted with 4 compression rings and

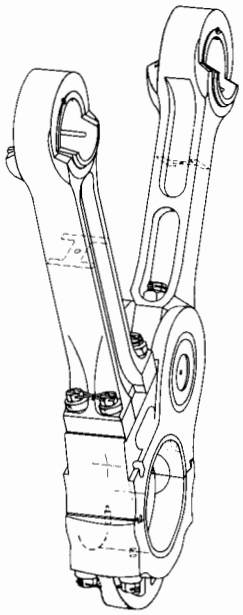
EXHAUST VALVE



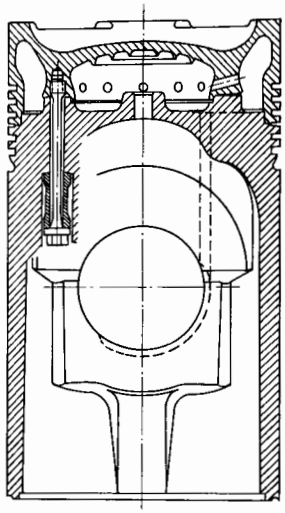
INLET VALVE



CONNECTING ROD



PISTON



1 oil scraper ring. Piston cooling is by lubricating oil. The piston pin is of the semi-floating type. Aluminium discs locate it axially in the piston eyes and ensure proper sealing.

Distribution

The two camshafts are underslung and supported in the cylinder block. They are driven from the crankshaft by a train of gear wheels. The cams operate the fuel injection pumps and, by way of push-rods and rocker arms, the inlet and exhaust valves in the cylinder heads. The cams provided for the fuel injection pump drive are adjustable. In reversible marine engines two of these cams are always adjacent. Reversal is effected by sliding the camshaft hydro-pneumatically from the "ahead" to the "astern" position or vice versa.

Valves

To facilitate maintenance the exhaust valves are located in valve cages, which are cooled right up to the valve seat. Each inlet and each exhaust valve has two springs. A special device turns each valve cone after each stroke and, thus, considerably extends its service life. The exhaust valve stems are sealed with ring packs to prevent blow-by.

Fuel system

A fuel transfer pump, detached from the engine, draws the fuel from the daily service tanks and forces it via a duplex filter to the injection pumps. Each working cylinder features an M.A.N.-type injection pump with a single plunger and helical cutoff surfaces. The beginning of injection can be advanced or postponed by adjusting the fuel cam. The fuel needle valve fitted in the cylinder head is cooled by water.

Lubricating system

The engine is pressure-lubricated throughout. The lubricating oil is supplied by means of an independently driven pump, which is detached from the engine. The lubricating oil is cleaned in an automatic filter with a very fine mesh. An indicator filter is arranged after this unit to increase operational safety by triggering an alarm if irregularities occur with the automatic filter. The oil dripping off these lubricating points collects again in the oil tray.

The valve mechanism on the cylinder head, enclosed by oil-tight, removable covers, has its own lubricating system. The oil pressure in the entire bearing lubricating system can be adjusted by means of a control valve.

Cooling system

Cylinder liners, cylinder heads, and exhaust valve casings are water cooled. The requisite cooling-water pumps must have independent drive and the heat exchangers are to be placed separately.

Starting system

Starting is by compressed air stored at a pressure of 10 – 30 bar. Only one bank of cylinders is started on unidirectional engines, while both banks are started on reversible units. The starting valves in the cylinder head are actuated pneumatically by the starting air pilot valves which, in turn, are operated by a camshaft cam.

Regulation

The amount of fuel delivered to the injector by the fuel injection pump is controlled automatically as a function of load or speed.

Operation

All controls are neatly arranged at the "free" end of the engine. In marine propulsion engines all manoeuvres such as starting, reversing, fuel control and stopping of the engine can be executed there. The engine can be operated from the bridge or from a central control room by using an automatic remote control system. Remote monitoring, warning and safety systems can be connected for fully automated operation with unmanned machinery space.

Exhaust gas turbo-charging

The potential energy of the exhaust gases is utilized in exhaust gas-driven turbo-blowers to raise engine power. The compressed charge air is recooled in inter-coolers fed with water or, in the case of stationary plants, some other coolant, through which air is passed.

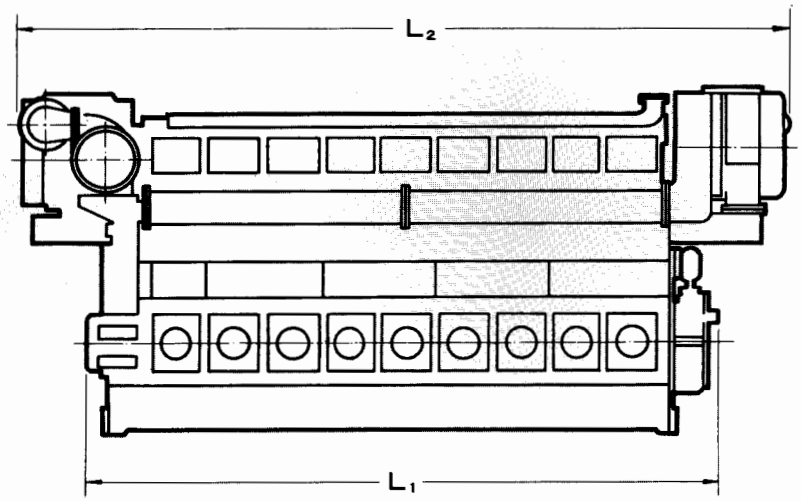
GENERAL

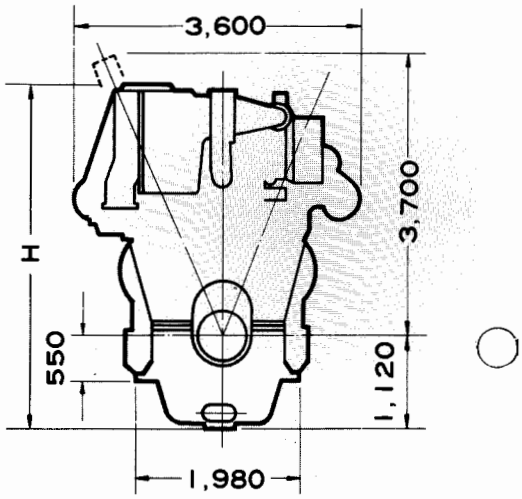
All information and data given in this pamphlet correspond to engine design at the time of going to print and are subject to change without prior notice.

4-STROKE TRUNK PISTON TYPE

Cylinder Bore . . . . . 400 mm
Piston Stroke . . . . . 540 mm
Cylinder Distance . . . . . 710 mm (Vee type)
Cylinder Output . . . . . 625 BHP (460 KW)
Fuel Consumption (10,200 Kcal/kg) . . . . . 153 gr/BHP·hr. +3%

		V 40/54A		Length		Height	Weight	
Engine Speed rpm		430	450					
Mean Piston Speed m/s		7.7	8.1					
Mean Effective Press. kg/cm² (bar)		18.4 (18.05)	18.4 (18.05)	L_1	L_2	H	Engine	Spares & Tools
Engine Type	No. of Cylinders	Maximum Continuous Rating BHP (KW)		mm	mm	mm	ton	ton
10V 40/54A	10	5,950 (4,380)	6,250 (4,600)	4,860	6,540	4,250	81	5.5
12V 40/54A	12	7,140 (5,250)	7,500 (5,520)	5,570	7,250	4,250	92	
14V 40/54A	14	8,330 (6,120)	8,750 (6,440)	6,280	8,160	4,250	107	
16V 40/54A	16	9,520 (7,000)	10,000 (7,360)	6,990	8,870	4,250	118	
18V 40/54A	18	10,710 (7,880)	11,250 (8,280)	7,700	9,580	4,250	131	





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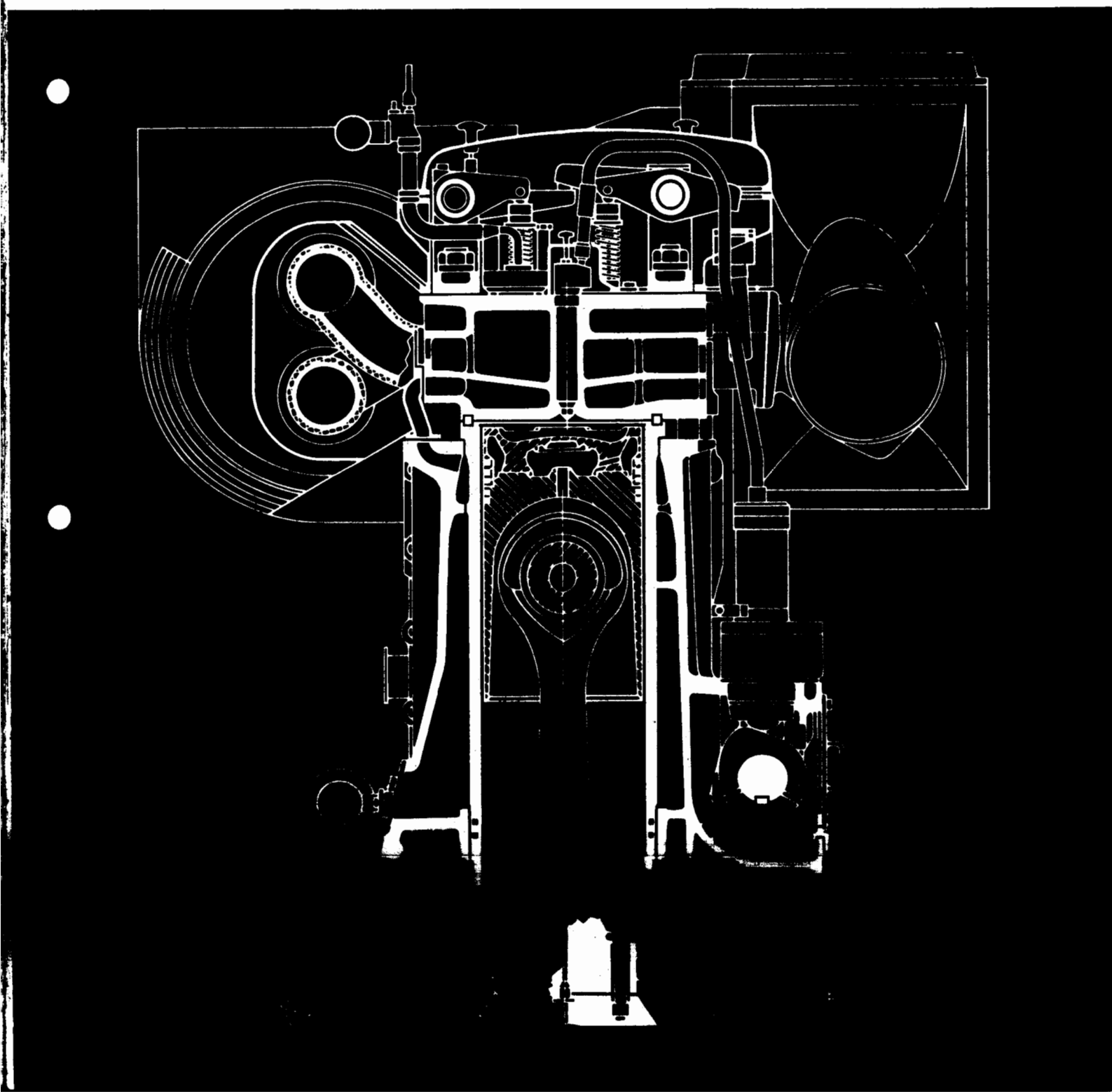
KAWASAKI
HEAVY INDUSTRIES, LTD.

KAWASAKI-M·A·N 4-STROKE DIESEL ENGINE

L40/54A



TECHNICAL DATA

Working cycle:	4-stroke
Combustion process:	direct injection
Number of cylinders:	6—9
Cylinder bore:	400 mm
Piston stroke:	540 mm
Swept volume per cylinder:	67.9 dm³
Cylinder output:	460 kW 625 BHP
Power/weight ratio:	19.8—21.7 kg/kW 14.6—16.0 kg/BHP
Coolant:	Water
Starting:	by compressed air
Specific fuel consumption at full load:	204 g/KWh 150 g/BHP-h

APPLICATION

Marine propulsion engines
Stationary installations

PERFORMANCE DATA

Speed	1/min		450
Mean piston speed	m/s		8.1
Mean effective pressure	bar		18.05
marine propulsion engines maximum continuous rating (blocked) stationary engines continuous rating with 10% overload capacity		kW	BHP
6L 40/54 A	6 cyl.	2760	3750
7L 40/54 A	7 cyl.	3220	4375
8L 40/54 A	8 cyl.	3680	5000
9L 40/54 A	9 cyl.	4140	5625

The engine is of single-acting four-stroke trunk-piston design. The turbo-charging system employed affords outstanding operating economy, this being characterised by particulary low fuel consumption.

Bedplate

The bed-plate is a high-quality monobloc casting. It carries the crankshaft and serves as a lubricating oil sump. As the amount of lubricating oil required for long service periods exceeds the capacity of the bedplate a service tank is provided.

Main bearings

The main bearings are steel shells with lead-bronze lining and an electro-plating. One of these bearings is designed as a locating bearing and at the front ends the shells also feature the above layers. In marine engines, however, which have independent thrust bearings, these axial collars have been machined down on a lathe. The bearing cover is secured by 2 laterally disposed bolts. The lubricating oil for crankpin and piston pin bearings as well as for the piston cooling is admitted through the main bearings.

Engine frame

The engine frame is composed of 2 high-quality castings. The side walls feature large openings closed off by panels, admitting of ready access to running gear and bearings.

Cylinder liners

Cylinder liners are of cast-iron alloy and have excellent bearing characteristics. They are completely surrounded by water and their top flange is ground to the frame. The lower end of the liner is free to expand downwards through two watertight O-rings.

Cylinder heads

These are individual high-quality iron castings and are bolted to the frame by 8 robust studs. Each cylinder head carries two inlet, two exhaust, and one starting valve, as well as a fuel injector in a special housing so that in the event of fuel leakage any mixing of oil and fuel is positively precluded. Marine engines also feature a safety valve. Configuration and arrangement of the water spaces ensures efficient heat dissipation. For ease of access large covers have been fitted.

Crankshaft

The crankshaft is an alloyed steel forging. To give good dynamic balancing each web is fitted with a counterweight. Journals and crankpins are ground and polished but not hardened. The lubricating oil is led through drilled passages from the main to the connecting rod bearings. The two-part camshaft drive gear is seated at the coupling end on a collar which stands proud of the bearing pin. The "free" end of the crankshaft can be arranged for attachment of an extension shaft and auxiliary drive if required.

Vibration damper

A vibration damper has been secured to the "free" end of the engine to avoid inadmissibly high vibrations of the crankshaft when passing through critical speed ranges.

Connecting rods

The connecting rods are drop forgings. The shaft is secured to the big end by special bolts so that the piston can be withdrawn without having to remove the bearing. All holding screws between connecting rod shaft and big end as well as those securing the bearing caps to the big end are made of highly resistant material. The big-end and the crankshaft main bearings are thin-walled precision-type bearings and have a lead-bronze lining with a thin layer. Drilled passages in the connecting rod shaft lead the oil through non-return valves to the piston pin bearings and cooling spaces in the piston.

Pistons

The pistons are of two-part design consisting of an aluminium skirt with excellent antifriction characteristics and a steel crown of high heat and wear resistance. Both halves are joined together by means of bolts which incorporate stretching lengths. Each piston is fitted with 4 compression rings and 1 oil scraper ring. Piston cooling is by lubricating oil. The piston pin is of the fully floating type. Aluminium discs locate it axially in the piston eyes and ensure proper sealing.

Distribution

The camshaft is of the underslung type and supported in the engine frame. It is driven from the crankshaft by a train of gear wheels. The cams operate the fuel injection pumps and, by way of pushrods and rocker arms, the inlet and exhaust valves in the cylinder head. The cams provided for the fuel injection pump drive are adjustable. In reversible marine engines two of these cams are always adjacent. Reversal is effected by sliding the camshaft hydropneumatically from the "ahead" to the "astern" position or vice versa.

Valves

To facilitate maintenance the exhaust valves are located in valve cages, which are cooled right up to the valve seat. Each inlet and each exhaust valve has two springs. A special device turns each valve cone after each stroke and, thus, considerably extends its service life. The exhaust valve stems are sealed with ring packs to prevent blow-by.

Fuel system
A fuel transfer pump, detached from the engine, draws the fuel from the daily service tanks and forces it via a duplex filter to the injection pumps. Each working cylinder features an M.A.N.-type injection pump with single plunger and helical cutoff surfaces. The beginning of injection can be advanced or postponed by adjusting the fuel cam. The fuel needle valve fitted in the cylinder head is cooled by water.

Lubricating system
The engine is pressure-lubricated throughout. The lubricating oil is supplied by means of an independently driven pump, which is detached from the engine. The lubricating oil is cleaned in an automatic filter with a very fine mesh .An indicator filter is arranged after this unit to increase operational safety by triggering an alarm if irregularities occur with the automatic filter. The oil dripping off these lubricating points collects again in the bedplate. Additional lubrication has been provided for the piston bearing faces making it possible to force small quantities of high-grade lubricating oil, which is fresh at all times, to piston and piston rings. The valve mechanism on the cylinder head, enclosed by oil-tight removable covers, has its own lubricating system. The oil pressure in the entire bearing lubricating system can be adjusted by means of a control valve.

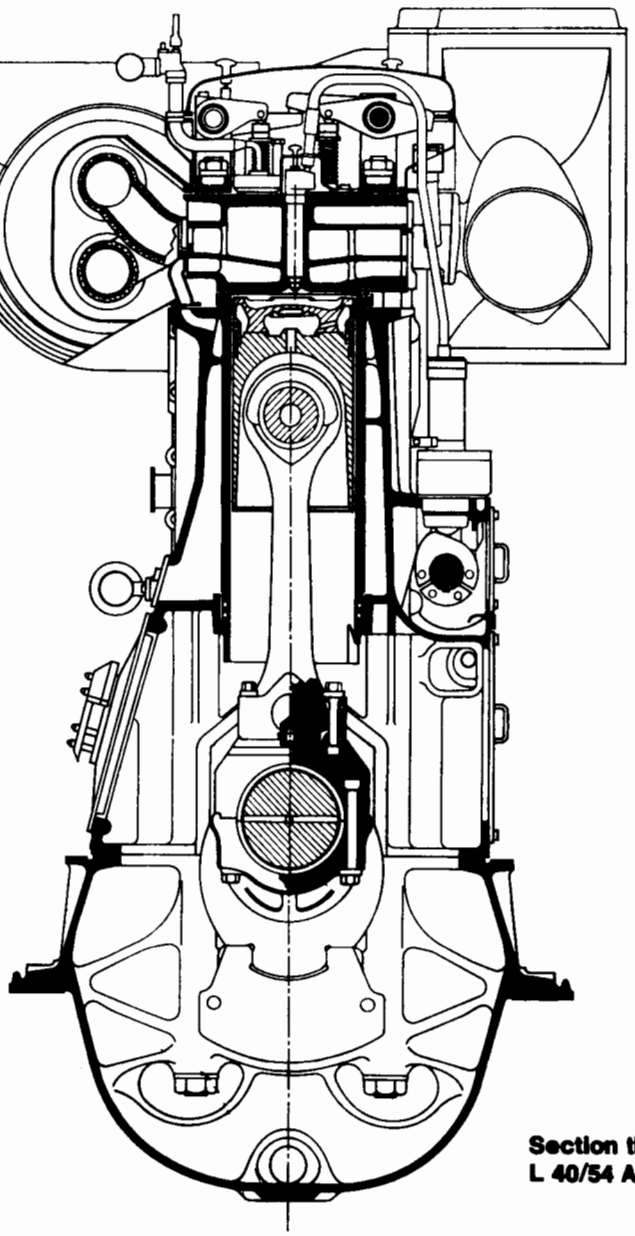
Cooling system
Cylinder liners, cylinder heads, and outlet valve casings are water cooled. The requisite cooling-water pumps must have independent drive and the heat exchangers are to be placed separately.

Starting system
Starting is by compressed air stored at a pressure of 10—30 bar. The starting valves in the cylinder heads are actuated pneumatically by the starting-air pilot valves which, in turn, are operated by timing shaft cams.

Regulation
The amount of fuel delivered to the injector by the fuel injection pump is controlled automatically as a function of load or speed.

Operation
All controls are neatly arranged at the "free" end of the engine. In marine propulsion engines all manoeuvres such as starting, reversing, throttle control and stopping of the engine can be executed from there. The engine can be operated from the bridge or from a central control room by using an automatic remote control system. Remote monitoring, warning and safety systems can be connected for fully automated operation with unmanned machinery space. 40/54 A engines can also be used as stand-by units as all facilities for automatic stopping and starting are provided.

Exhaust gas turbo-charging
The potential energy of the exhaust gases is utilized in exhaust gas-driven turbo-blowers to raise engine power. The compressed charge air is re-cooled in a ribbed cooler fed with water or, in the case of stationary plants, in a separate cooler through which air is passed.



Section through L 40/54 A engine

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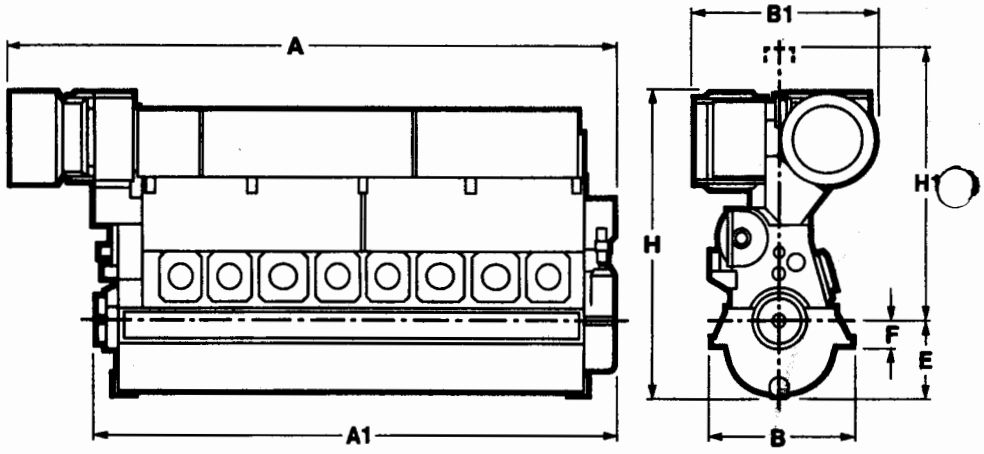
DIMENSIONS, WEIGHTS



Engine	No. of cyls.	A mm	A1 mm	B mm	B1 mm	H mm	E mm	F mm	H1 mm	Weight* t
6L 40/54 A	6	6250	5570	1820	2110	3750	965	300	3590	60
7L 40/54 A	7	7200	6280	1820	2480	4050	965	300	3590	68
8L 40/54 A	8	7950	6990	1820	2480	4050	965	300	3590	75
9L 40/54 A	9	8650	7700	1820	2480	4050	965	300	3590	82

H_1 = height required for removing cylinder liner and piston.
* Weight of main marine engine

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