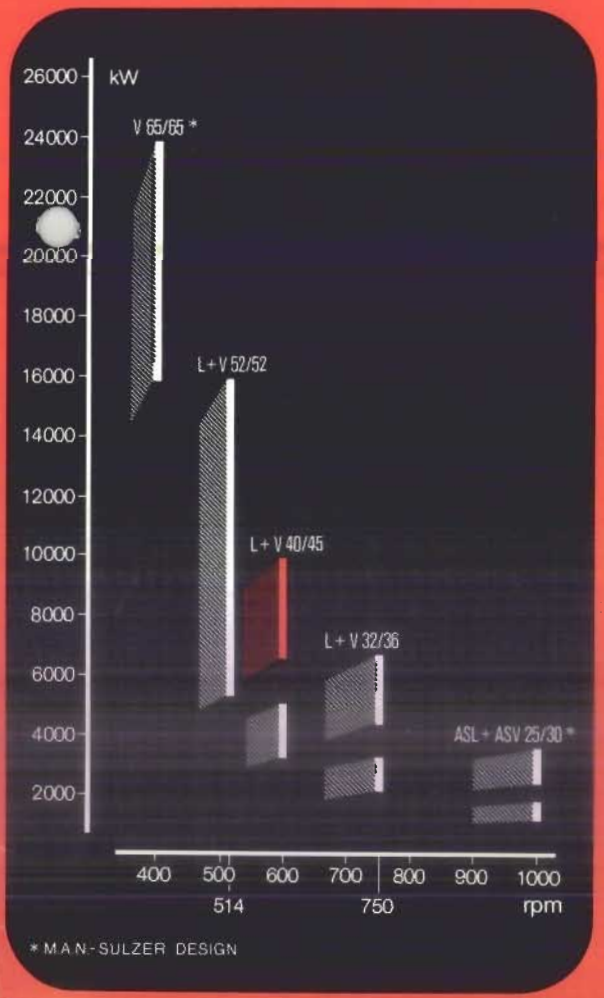
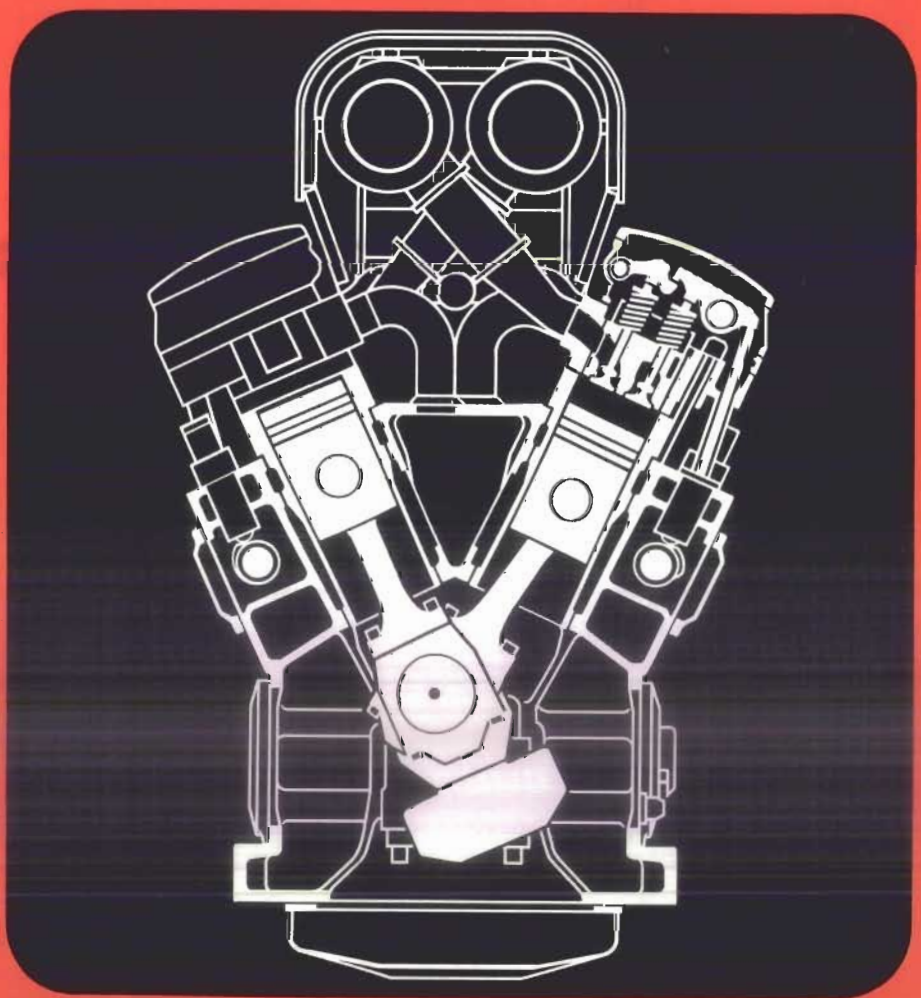
Brief Specification
Status: November 1977

M·A·N

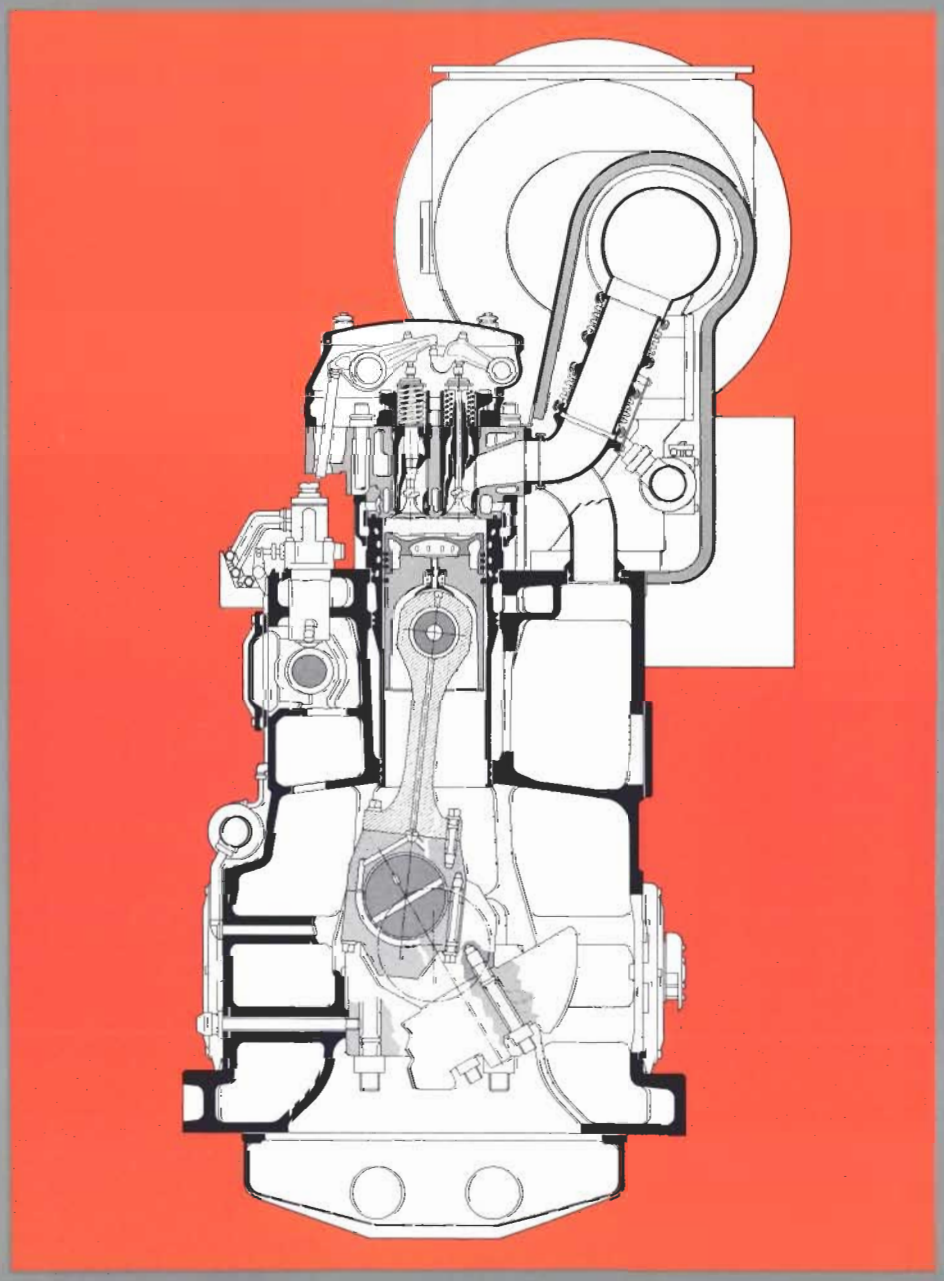
Four-stroke Diesel engine L-V 40/45
550 kW/cyl., 600 rpm

V40/45





L-V 40/45 Four-stroke Diesel engine 550 kW/cyl. 600 rpm



Ratings

General definition of diesel engine ratings (to ISO 3046/I)

Cont. rating 10% overload capacity for 1 hour's service within 12

Reference conditions:

Air temperature	300 K (27°C)
Air pressure	1 bar
Cooling water temperature before charge-air cooler	300 K (27°C)

Power ranges for marine propulsion engines

MCR = Maximum Continuous Rating (fuel stop power)

I = operating range for continuous service

II = operating range temporarily admissible, e.g. during acceleration, manoeuvring (torque limit)

FP = design range for fixed-pitch propeller (Fig. 1)

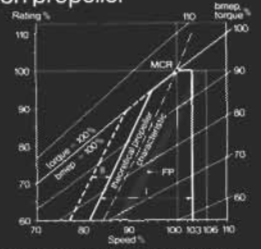
VP = design range for controllable-pitch propeller with combinator (Fig. 2)

Reference conditions:

Air temperature	318 K (45°C)
Air pressure	1 bar
Cooling water temperature before charge-air cooler	305 K (32°C)

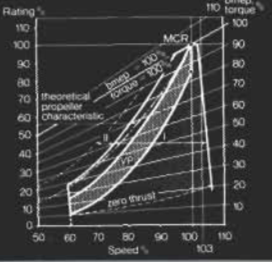
Marine propulsion engine with fixed-pitch propeller

Fig. 1



Marine propulsion engine with controllable-pitch propeller

Fig. 2



Technical Data

L-V 40/45 Four-stroke Diesel engine 550 kW/cyl. 600 rpm

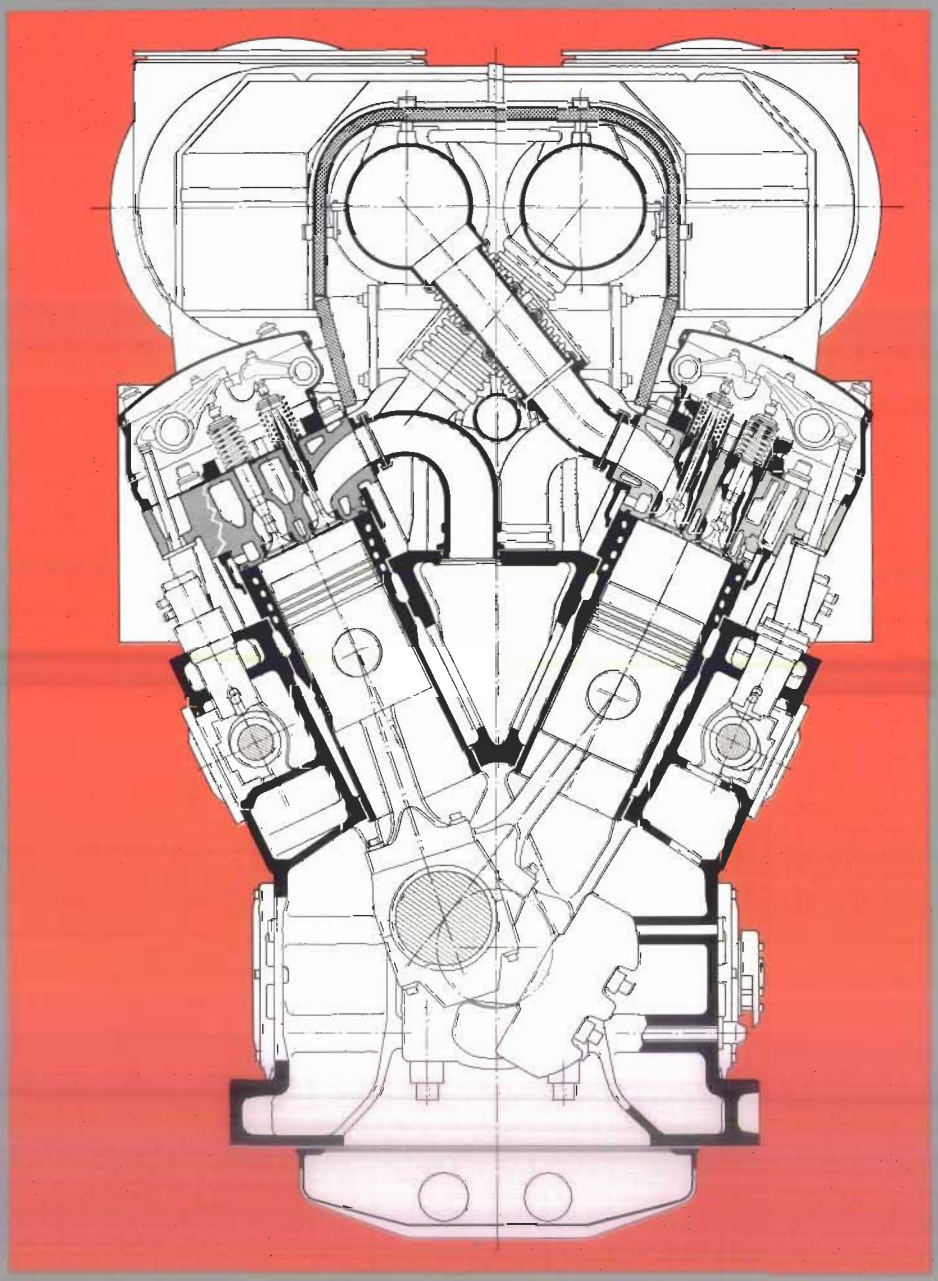
Working cycle:	4-stroke
Combustion process:	direct injection
Number of cylinders:	6,8,9,12,14,16,18
Cylinder bore:	400 mm
Piston stroke:	450 mm
Swept volume per cylinder:	56.5 dm^3
Cylinder output:	550 kW 750 hp
Power/weight ratio:	
L-Engine	14.5-15.2 kg/kW 10.7-11.1 kg/hp
V-Engine	11.6-12.0 kg/kW 8.5- 8.8 kg/hp
Coolant:	Water
Starting:	by compr. air
Specific fuel consumption at full load:	
L-Engine:	206 g/kWh 152 g/hp-h
V-Engine:	205 g/kWh 151 g/hp-h

(Tolerance 3%)

Performance Data:

Speed	rpm		600
Mean piston speed	m/s		9.0
Mean effective pressure	bar		19.5

		kW	hp
6L 40/45	6 cyl.	3300	4500
8L 40/45	8 cyl.	4400	6000
9L 40/45	9 cyl.	4950	6750
12V 40/45	12 cyl.	6600	9000
14V 40/45	14 cyl.	7700	10500
16V 40/45	16 cyl.	8800	12000
18V 40/45	18 cyl.	9900	13500

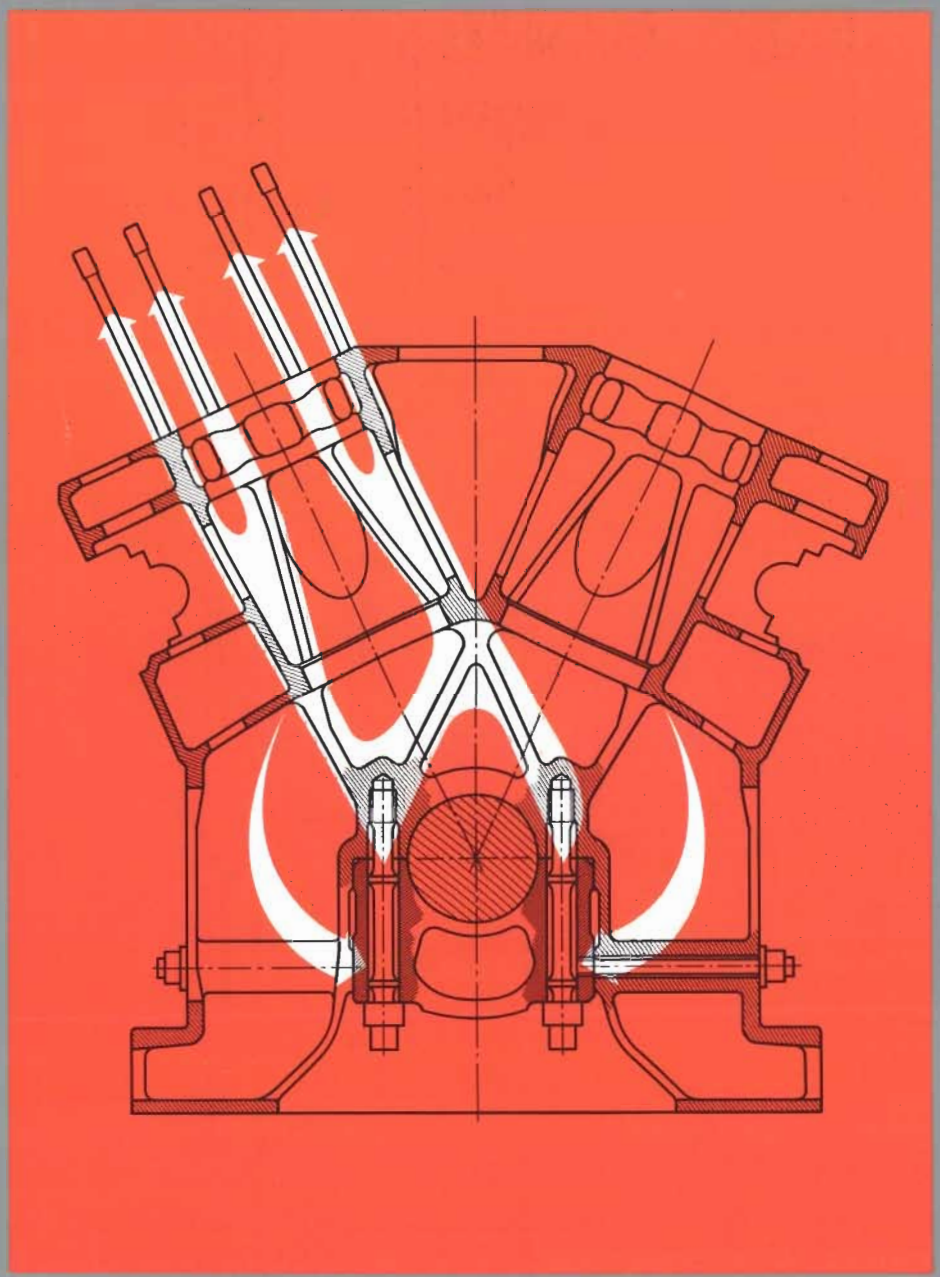


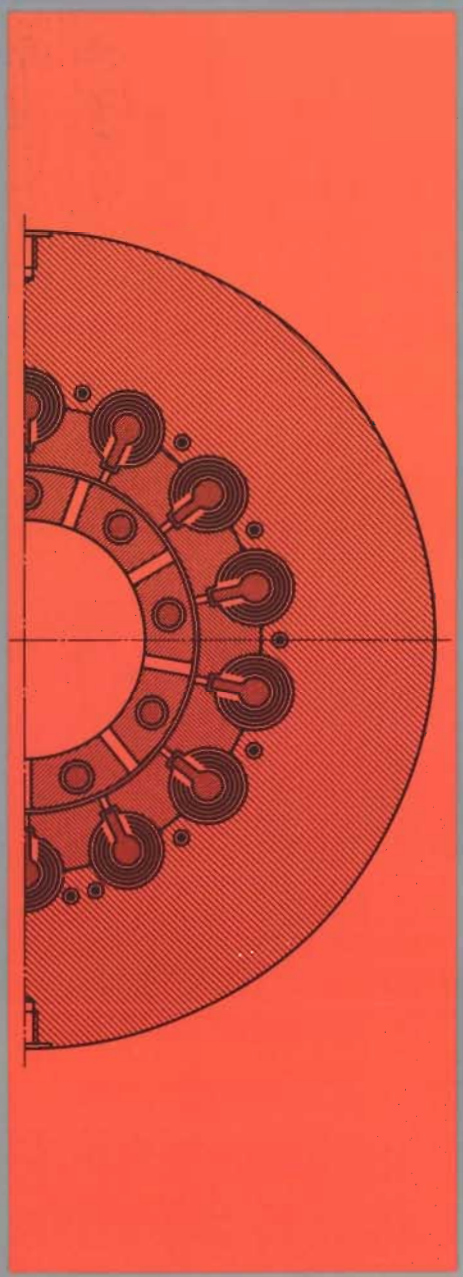
Engine frame

The size of the 40/45 engine is such that the entire frame can still be made as a monobloc casting. This means that the cylinder blocks, the timing gear, the bearings of the camshafts, the spaces to house the injection pumps and inlet and exhaust tappets, the charge-air pipe (in the case of the Vee engine, arranged in the V) and the cover of the vibration damper at the free end are all incorporated in a single structure. It also means that the engine has no tierods and, what is important, the crankshaft is underslung. This one-piece engine frame enables the flow of force from cylinder head bolts down to crankshaft bearings to be so evenly distributed over the intervening surfaces that both material stresses and structural deformations are minimized. Small deformations mean first and foremost that the cylinder liners remain perfectly round during operation and that the engine frame is extremely rigid in relation to the foundation thanks to the generous dimensions of the cross-sections running the entire length of the engine. The bearing caps of the underslung crankshaft are vertically and horizontally bolted to the engine frame, producing a ring-shaped enclosure around the crankshaft bearings. This gives rise to a tunnel-shaped flow of force. Thanks to horizontal-bolting of the bearing caps to the engine frame, positive connections such as serrations can be dispensed with. This horizontal bolting selected for the V 40/45 prevents movement of the bearing covers in relation to the engine frame. The fillet between the horizontal seating surface and vertical fitting surfaces, generally considered critical, is subjected to initial compressive stressing so that the dynamic stress amplitudes, which are small anyway, can be controlled even more easily.

Vibration damper

An M.A.N. sleeve-spring vibration damper is fitted at the free end. This design was chosen because it combines long service life with constant detuning. Maintenance requirements are minimal.



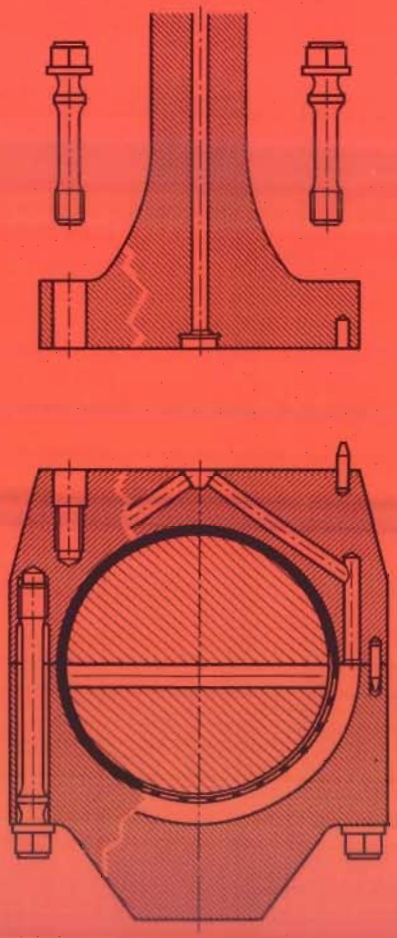


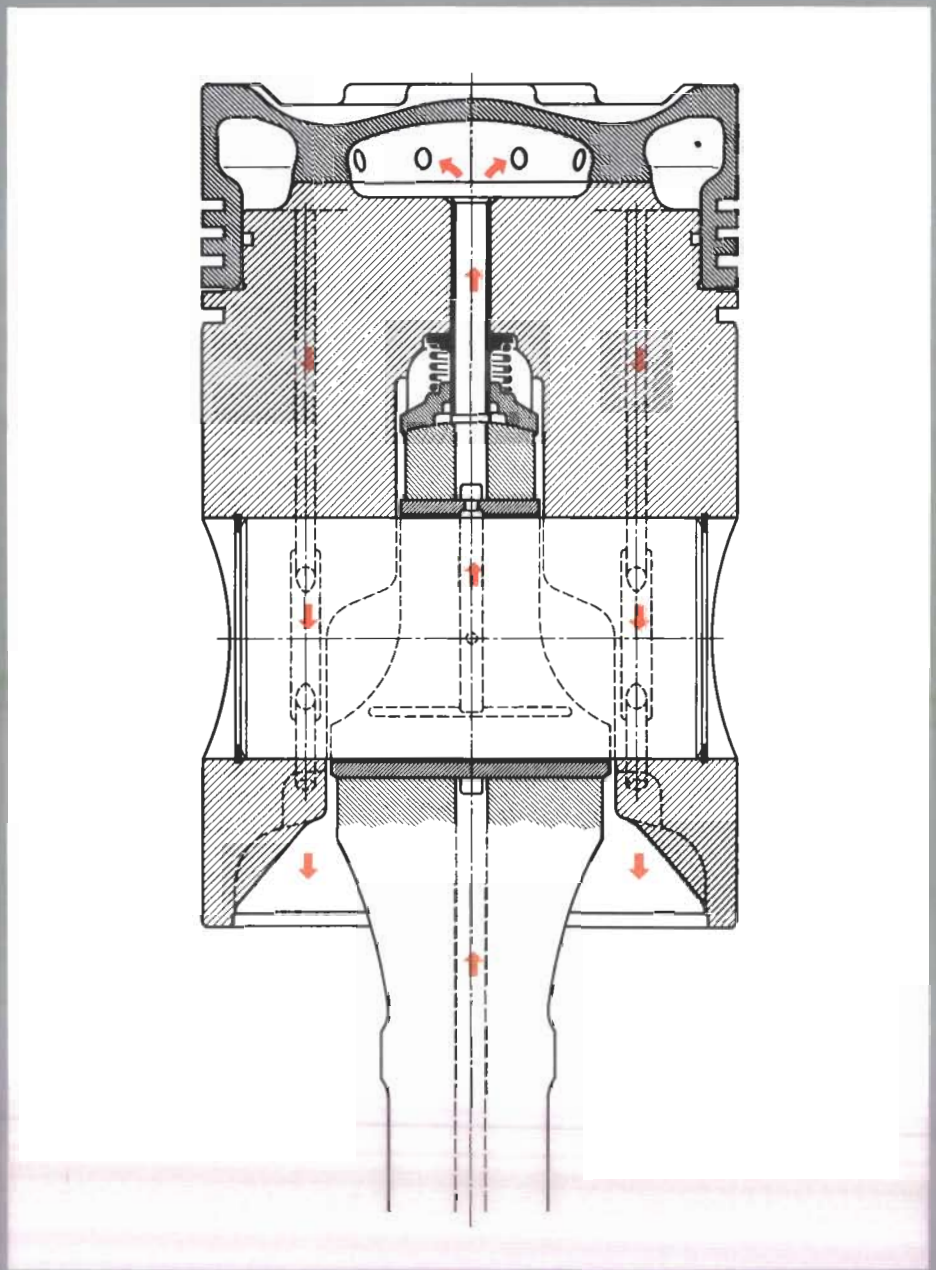
Connecting rods

The connecting rods of the V 40/45 engine have been developed not so much with an extremely short engine or particularly small masses in mind, but sturdiness of construction combined with ease of maintenance. The big end is therefore horizontally divided twice. For normal maintenance purposes, only the upper connection is loosened, leaving the bearing undisturbed on the crankshaft. Running-in procedures usually required after the bearing has been opened up can thus be dispensed with. Less space is needed overhead for piston withdrawal, therefore resulting in a lower engine room height.

Pistons

The composite piston used for medium-speed engines of this size burning heavy fuel oil is a standard M.A.N. component. It consists of a forged aluminium skirt bolted to a forged steel crown, a design backed by a wealth of experience. As of November 1977, 779 engines totalling 9543 cylinders with pistons of this design were in service or on order.
A major feature of the engine is that it can burn heavy fuel oil, provided the fuel quality complies with M.A.N. specifications. This is obtained by means of hardened piston ring grooves in the wear-resistant forged steel crown. The first compression ring has a particularly wear-resistant running layer applied using a plasma spray technique. The piston skirt has a double oval shape and hence fits the cylinder liner surface well during the reciprocating movement.





Cylinder heads

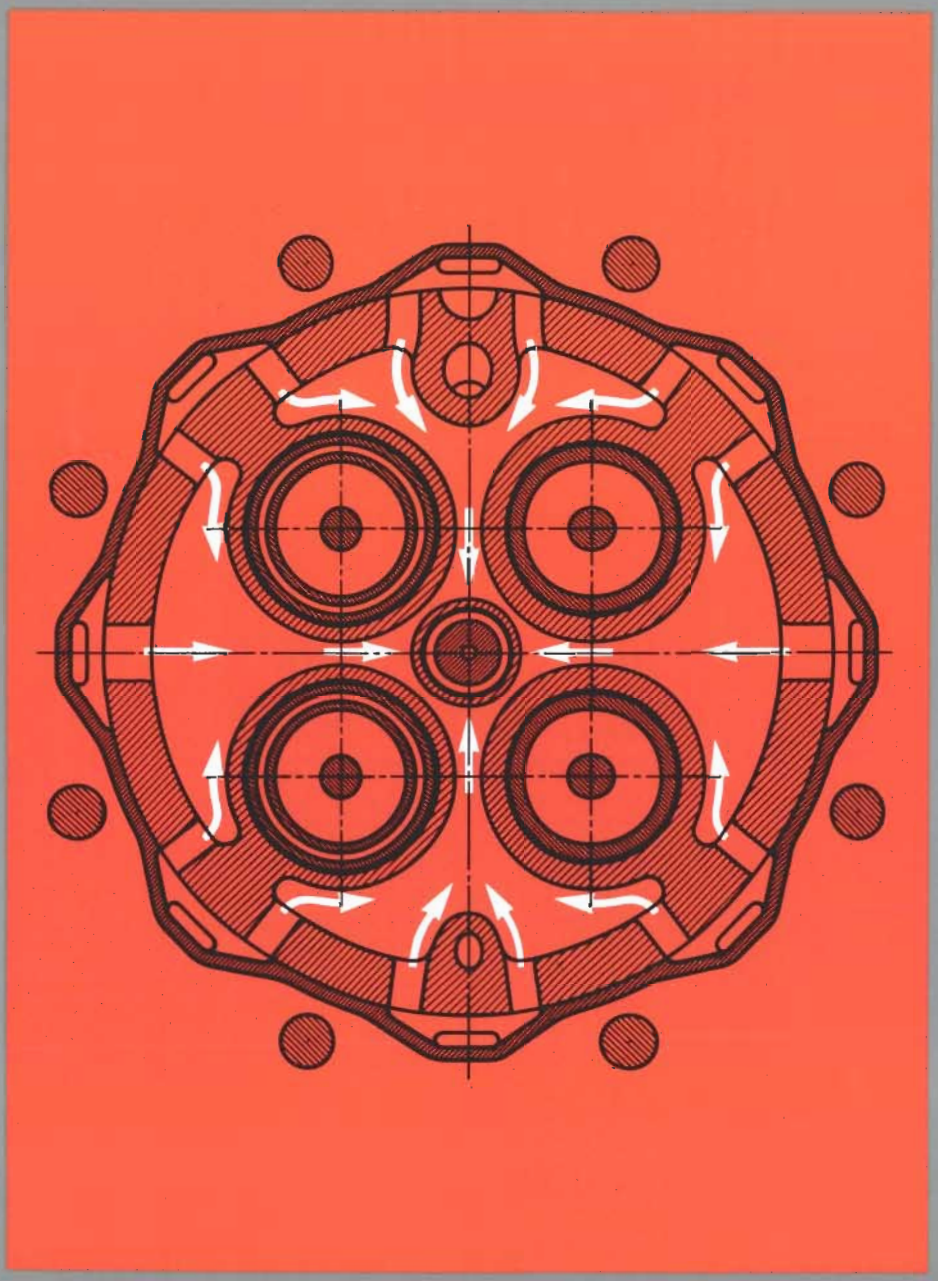
The cylinder heads of all modern-day four-stroke engines are subject to great thermal and mechanical stresses. The thin, uniformly cooled flame plate absorbs the thermal load, while a sturdy deck plate supports the head against the firing forces. The radial flow of cooling water between the two decks from the circumference to the centre exposed to intensive thermal loads and the progressive decrease in wall thickness towards the middle yield uniform temperature gradients and low temperatures altogether. The firing forces are evenly transmitted from the deck plate to the eight cylinder head bolts with nuts, which hold cylinder head, liner and engine frame together with little deformation.

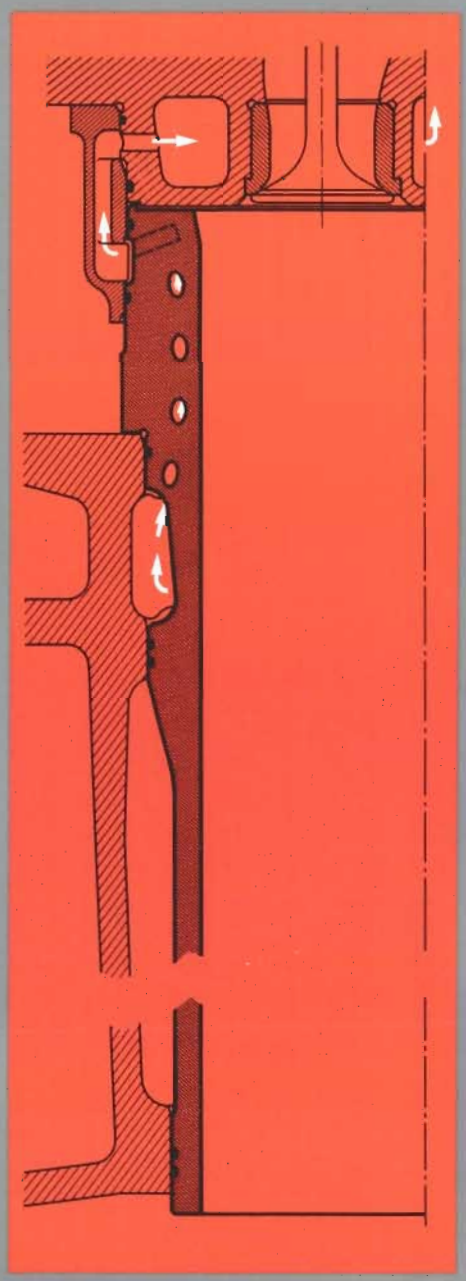
Exhaust valve cages are considered most suitable for engines of this size. The cages are seated on the intensively cooled flame plate of the cylinder head and can move with it, as they are not attached at any other point. Valve seat and valve guide are thus properly coordinated at all load conditions. Thanks to an air-blown conical gap, the exhaust valve cages can be readily removed even after long periods of service. The cages are intensively cooled at the valve seats, yet the ducts remain hot enough to suppress corrosion. The water inlets and outlets are automatically sealed during dismantling of the cages.

Cylinder liner

Extra-thick walls make the liners rigid. Intensive cooling, of the collar only, makes for very uniform distribution of temperature over the entire length of the liner. These two features ensure that the liner remains pefectly round during operation.

The liner is radially supported at three levels to curb unwanted deformation of its longitudinal axis.





Valves

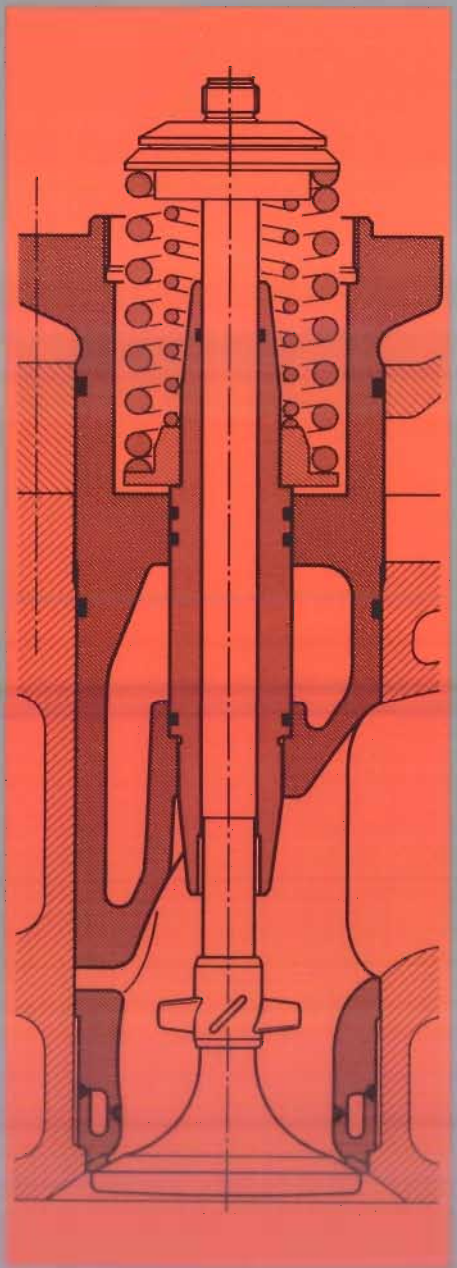
The seats of the exhaust valve cages are hardened and cooled in the manner common to M.A.N. engines. The seat of the valve has a wear-resistant contact surface. The valve head is rotated by vanes fitted to the stem and driven by the exhaust gases expelled from the cylinder. This rotator is simple and effective. The valve still has sufficient momentum to rotate as the head comes to touch the seat, thus scraping off the thin deposits formed. The material of the cages is particularly insensitive to corrosion, and the temperature of the duct surface is high enough to prevent the exhaust gas from condensing. The continuous, single-piece valve guides are sealed at the top end, from which the oil is evenly fed. This does much to prevent stem corrosion.

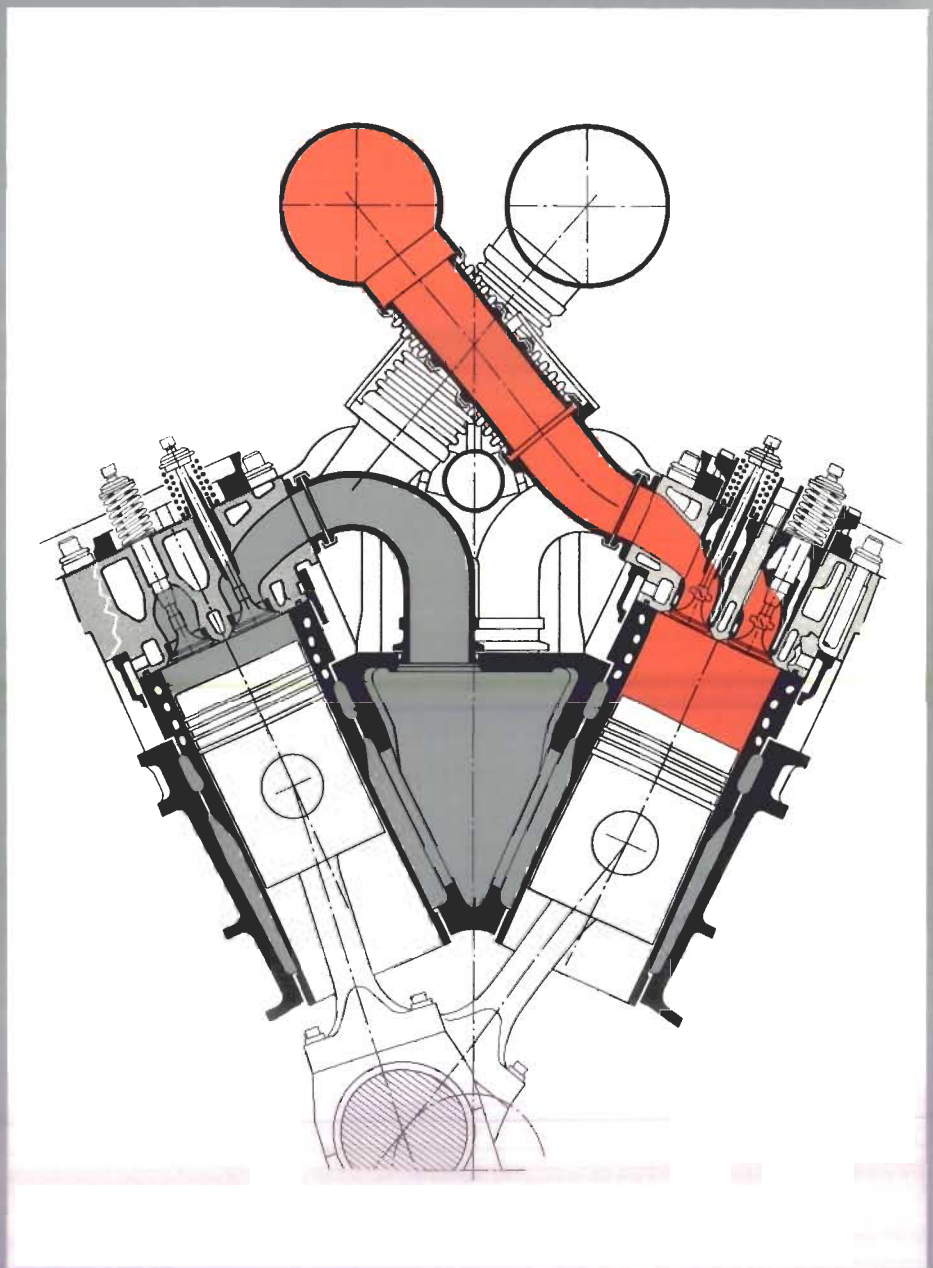
Turbocharging system

The engine is constant-pressure turbocharged. Thanks to the charge air pipe being integrated in the engine casing of both the Vee and in-line engines, the pipe arrangement is simple and silencing is efficient. Air is admitted to the cylinder heads through pipes secured to the cylinder heads by quick-acting couplings. Above the charge air pipe one exhaust manifold per cylinder bank is arranged. Each manifold leads to a turbocharger at the end of engine. To the benefit of the exhaust turbine, some of the outlet velocity of the exhaust gas is converted into static pressure in the conical adaptors. As in the case of the other constant-pressure turbocharged medium-speed M.A.N. engines, the exhaust manifolds are inter-connected by a transverse pipe at the end opposite to the turbochargers so that, in the event of one turbocharger failing, the engine can still develop an output higher than that of a naturally aspirated engine. The individual components of the exhaust gas system can easily be dismantled, and furthermore the simple exhaust gas piping can easily be jacketed for heat and sound insulation.

Camshafts

The single-piece shafts have hydraulically press-fitted cams. Two-part cams can be fitted for urgent repairs, but, if more time is available, press-fitting will present no major engineering problems. The camshaft can be laterally removed with ease.



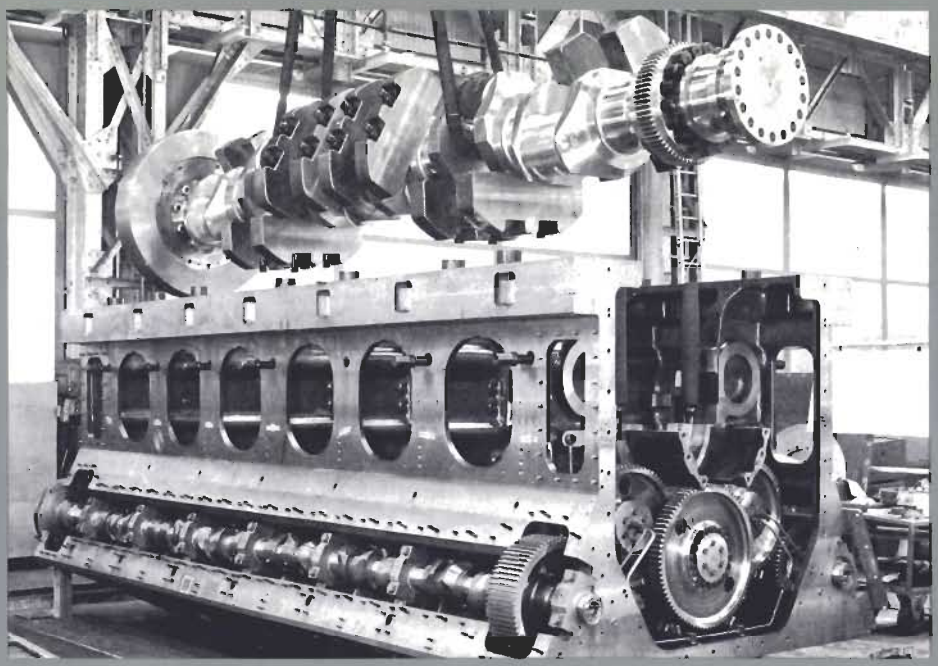


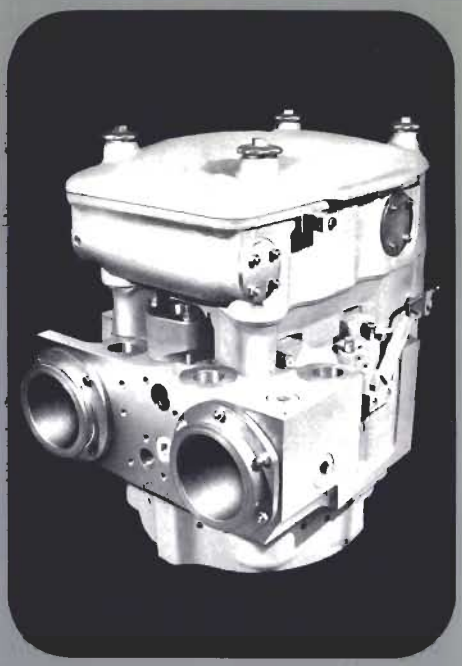
L-V 40/45 Four-stroke Diesel engine 550 kW/cyl. 600 rpm

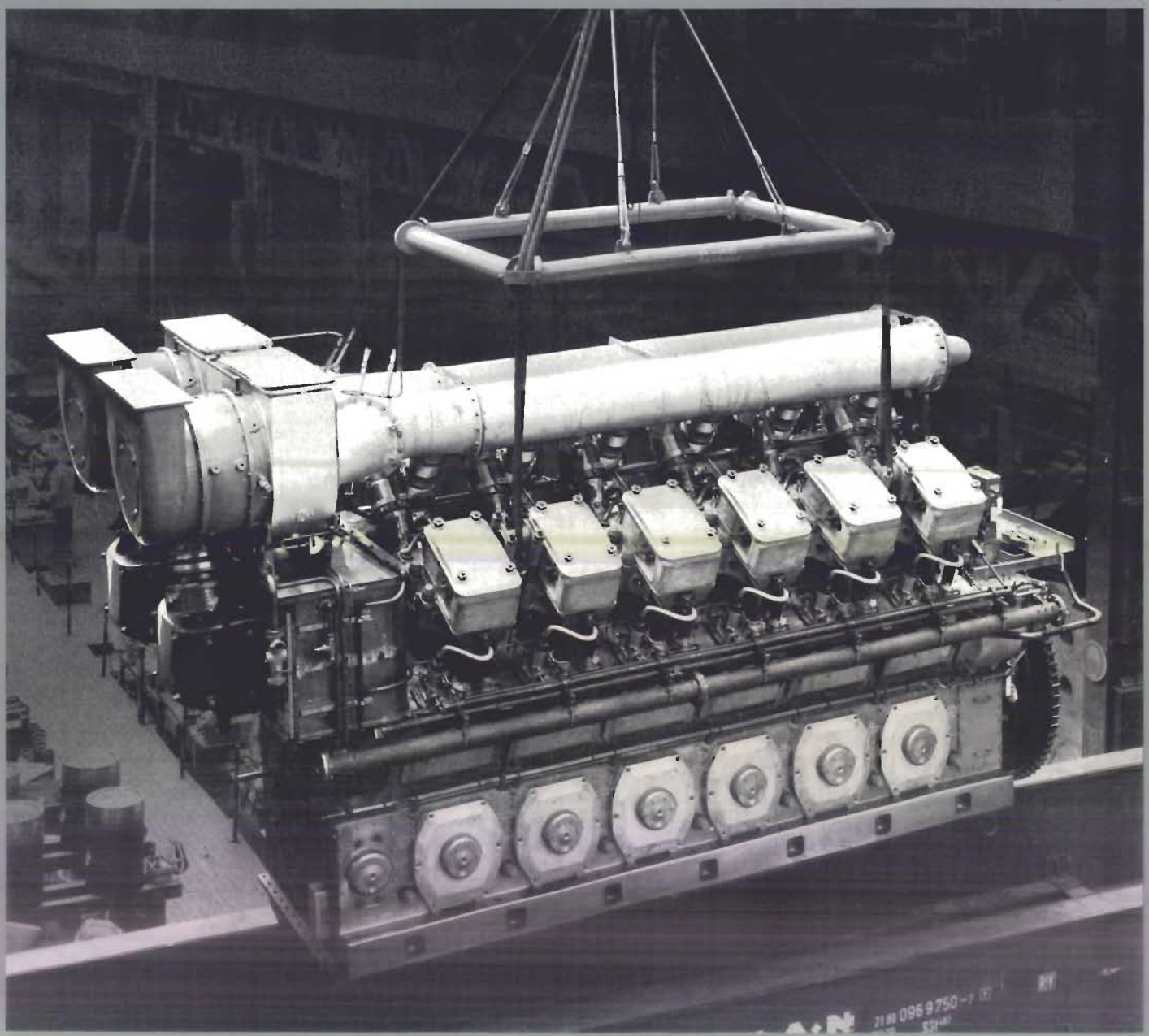
Injection system

The engine is fitted with individual pumps designed for high pressures. Each plunger features not one, but two, offset control edges, so that fuel is released in stages after the end of delivery and the peak pressures in the delivery pipe are reduced, thus preventing flow cavitation and erosion of the plunger barrel and pump casing. The pump barrel has three annular grooves. The top groove reduces the pressure between plunger and barrel to that of the suction space. The bottom groove conducts lubricating oil. The middle groove permits the mixture of fuel and lubricating oil formed to be discharged without pressure, thus preventing contamination of the lubricating oil by the fuel. Ample plunger lubrication makes for smooth pump action. The fuel delivery pipe is very short and resistant to deformation. The needle valve can easily be withdrawn from the rocker arm casing once the lateral connection in the cylinder head has been removed.

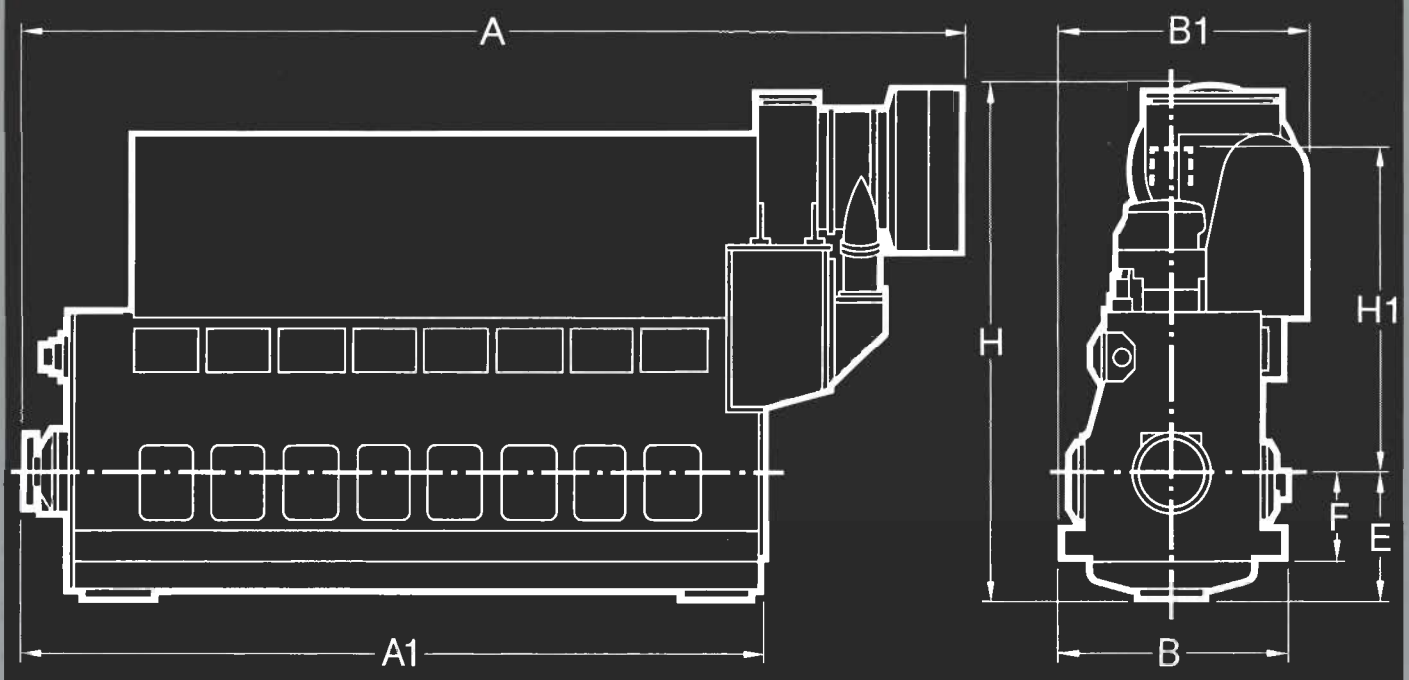
L and V engines have been deliberately designed so as to make their components identical as far as possible and reasonable. This applies to all cylinder parts, such as cylinder head, piston, liner, connecting rod, injection parts, exhaust gas pipe compensators and camshaft drive gearwheels. The crankcases have been designed to the same principle. The crankcase of the L engines is shorter, since there is only one connecting rod per crankpin.
The advantages of this design are reduced spare parts stock-keeping and later changeability of service experience between the two types.







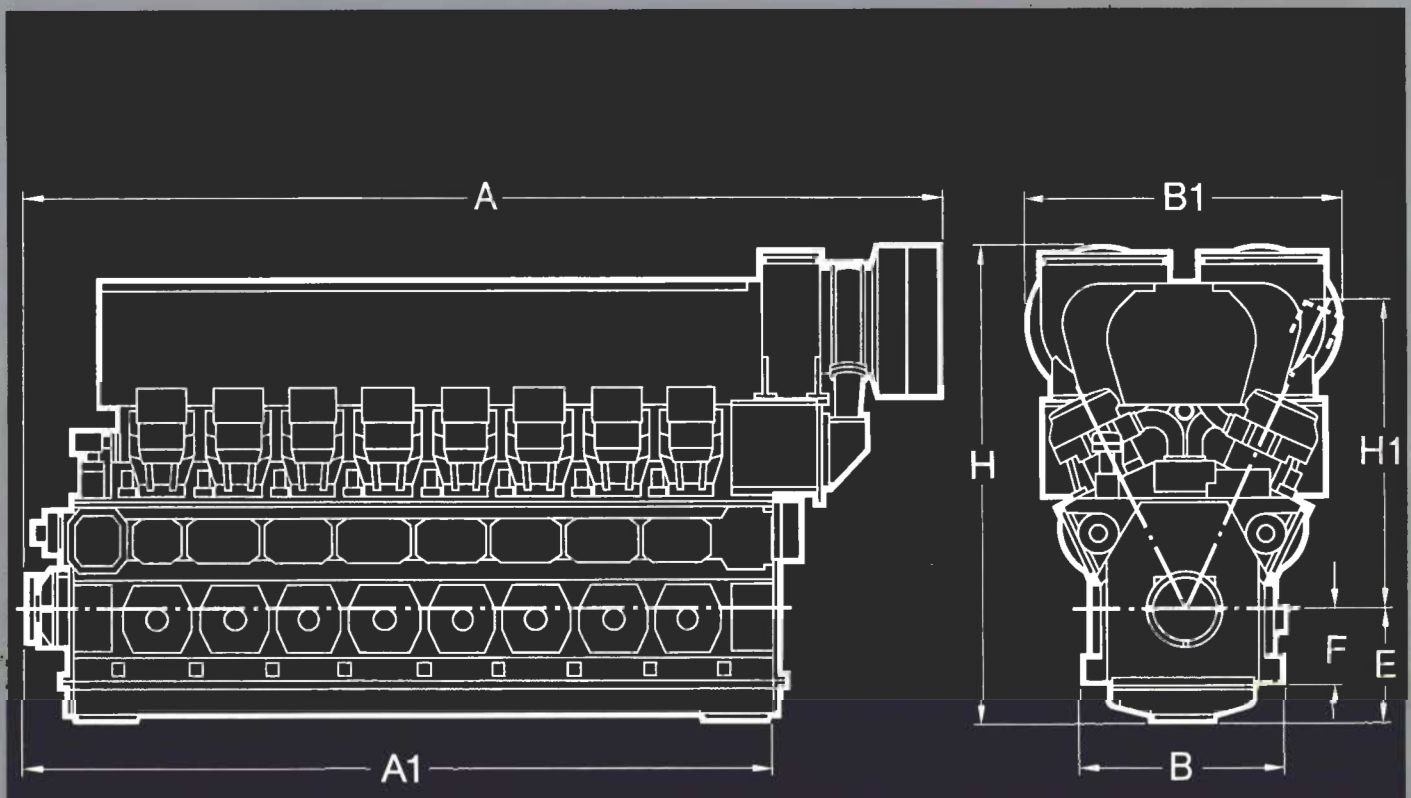
L-V 40/45
Four-stroke Diesel engine
550 kW/cyl.
600 rpm



Engine	No. of cyls.	A mm	A_1 mm	B mm	B_1 mm	H mm	E mm	F mm	H_1 mm	Wt t
6L 40/45	6	7100	5440	2000	2400	4550	1145	750	3380	50
8L 40/45	8	8600	6800	2000	2400	4700	1145	750	3380	64
9L 40/45	9	9300	7480	2000	2400	4700	1145	750	3380	72

H_1 = Height required for removing cylinder liner and piston

L-V 40/45
Four-stroke
Diesel engine
550 kW/cyl.
600 rpm



Engine	No. of cyls.	A mm	A_1 mm	B mm	B_1 mm	H mm	E mm	F mm	H_1 mm	Wt t
12V 40/45	12	7650	6040	2000	3050	4600	1168	750	3170	79
14V 40/45	14	8600	6820	2000	3100	4750	1168	750	3170	92
16V 40/45	16	9350	7600	2000	3100	4750	1168	750	3170	102
18V 40/45	18	10150	8380	2000	3100	4750	1168	750	3170	115

H_1 = Height required for removing cylinder liner and piston

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L40/45