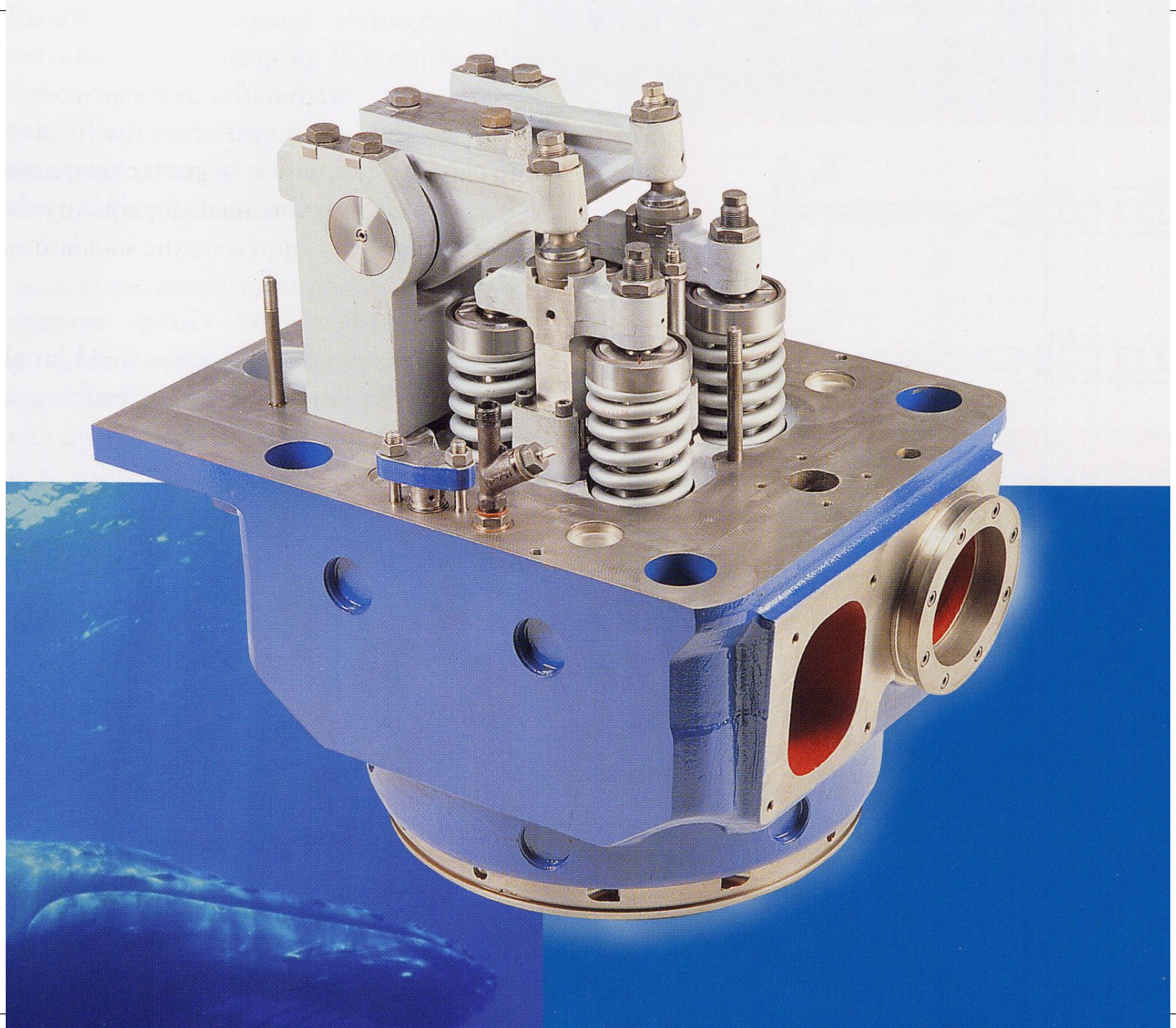
CYLINDER HEADS AND VALVES



1. DEFINITION

- Cylinder head is a casting that covers the top of a cylinder

2.FUNCTION

- to close tightly / seal off the top of cylinders.
- to form the combustion chamber, together with the piston crown or in some cases with the liner itself.
- to carry the injector and the valves

3. VALVES

All internal combustion engines (2- or 4-stroke) have:

- an ***air starting valve*** which admits compressed air into the cylinder for starting purposes;
- a ***safety*** or ***relief valve*** is a spring loaded valve set to a safe limit which releases excessive pressure;
- an ***indicator cock*** which is used as a point of the indicator mechanism attachment.

4-stroke engines have inlet/intake and exhaust valves.

4. STRESSES

- High pressure and temperature due to combustion.

5. REQUIREMENTS

- Strong, sturdy construction/ manufacture.
- Carefully cooled

6. COOLING

- Is executed by F.W. circulation, as excessive temperature may give rise to damage by cracking.

7. MATERIAL

- Cast or forged steel
- Special cast iron

8. DESIGN - not simple. It has valve bores and passages.

- **RND-M** One piece steel block with cooling bores.
- **B & W** (K-GF Type) Two parts, outer cover and inner insert. The head is a solid steel plate with radial cooling water bores. The insert contains a bore for the exhaust valve cage and mountings for fuel valves, a safety valve and an indicator valve.
- **B & W** (K-GF Type) One piece of forged steel with cooling water drillings.
- **Sulzer** Z40 The double bottom water cooled cylinder head made of special cast iron. It has two inlet and two exhaust valves as well as a centrally arranged fuel valve.

9. HEAD SECURING

- By **studs** made of alloyed steel with close-pitch thread.
- The heads are held in place/ held against the cylinder liner top collar by :
  - studs screwed into the cylinder block
  - studs attached to the cylinder frame
  - studs tightened by hydraulic tools.

Reading 1

- Each cylinder is closed by a separate cylinder head which carries the injector and the valves. It is secured by studs which hold it down to the cylinder block or water jackets. These studs carry the firing loads and at the same time provide the forces which hold together the seal between the head and the liner.
- There is a metallic joint, a copper or soft iron ring, interposed to make a seal. Fig.6.1. shows the cylinder cover of the Sulzer RND Diesel Engine. The cylinder cover is made of two parts: The outer cylinder cover (1) and the cylinder cover-insert (2) which is provided with the necessary boreholes to accommodate the starting (7), fuel injection (6), and indicator (5) valves.
- All these valves can be removed as a complete unit. The cylinder cover-insert is tightened up by means of the tensioning studs (4) on the cylinder cover. The outer cover is clamped down onto the liner by means of the cylinder cover studs (3).
- The joints between the cylinder outer cover and the cover-insert (13) and between the cylinder liner and the cover (11) are sealed off with the aid of the sealing rings.

Reading 1 - verbs

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- There _____ a metallic joint, a copper or soft iron ring, _____ to make a seal. Fig.6.1. shows the cylinder cover of the Sulzer RND Diesel Engine. The cylinder cover is _____ of two parts: The outer cylinder cover (1) and the cylinder cover-insert (2) which is _____ with the necessary boreholes to _____ the starting (7), fuel injection (6), and indicator (5) valves.
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Reading 1- complete the gaps

- Each cylinder is closed by a separate cylinder head which carries …… and …..
- It is secured by studs which hold it down to the ……
- These studs carry the firing loads and at the same time provide the forces which hold together the _____ between the head and the liner.
- There is a metallic joint, a copper or soft iron ring, interposed to ……
- The cylinder cover is made of two parts: the …… (1) and the …… (2) which is provided with the necessary boreholes to accommodate the starting (7), ……(6), and indicator (5) valves.
- The cylinder cover-insert is tightened up by means of the …… (4) on the cylinder cover.
- The outer cover is clamped down onto the liner by means of the …… (3).
- The joints between the cylinder outer cover and the cover-insert (13) and between the cylinder liner and the cover (11) are sealed off with the aid of the …… .

Reading 2

- A control bore is provided in the cylinder cover to enable possible gas leakage to be detected between the two parts of the cover. The cover studs differ in number according to the design of the engine. To make a satisfactory joint and to ensure that the studs are not subjected to the excessive fatigue loads it is essential to tighten them evenly and to the correct tension. If they are tightened manually, then each stud should be tightened a small amount in turn, following the sequence to bring the head down on all sides evenly. The tension at the final tightening should be ensured by careful use a torque wrench or better still by observing the stretch of each stud. In four-stroke and two-stroke loop scavenge engines the injector is placed centrally in the cylinder head . In two-stroke engines, with exhaust valves in the head, there are usually two or more injectors positioned symmetrically, the nozzles being arranged to spray the fuel tangentially.

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evenly, in addition to, normally, at the highest point , in a uniform manner, together with

- The cylinder head of four-stroke cycle engines …… the injector, air starter and relief valves has to accommodate the air inlet and exhaust valves …… appropriate passages for the air and the exhaust gas, all of which are surrounded by the water spaces.
- The cylinder covers are …… cooled with the fresh water.
- Openings distributed …… over the top and around the covers' circumference permit cleaning and inspection of the cooling water spaces.
- To enable the hot wall to be cooled ……, the cooling water is admitted to the cooling space via a conducting pipe (9). See Fig.6.1.
- The cooling water leaves the insert …… via an outlet pipe (10) which is equipped with the thermometer.

Reading 2

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Questions and discussion

1. What does the cylinder head carry ?
2. What does the cylinder head of the Sulzer RND engines consists of ?
3. What are the function of the studs ?
4. What does the metallic joint provide ?
5. How is the combustion chamber of the Sulzer RND Engines sealed off ?
6. Why should the studs be tightened evenly ?
7. How are the studs tightened ?
8. What are the openings (doors) on the cylinder head fitted for ?
9. What is the purpose of the control bore ?
10. How can the injector be arranged ?
11. What else does the cylinder head accommodate ?

I. Complete the following sentences with the appropriate terms from lesson 6.

II. Fig.6.3

- Look at Fig.6.3. below and notice that the numbers 1-5 illustrate some engine components, while the letters a-e refer to spaces and passages.

- Label the diagram and give a description of its parts

- State how cooling is carried out (note the tiny arrows showing the path followed by the coolant)

III. Fill the blanks in the following sentences with the right verb in its active or passive voice choosing from the list below

accommodate

admit

clamp

come

enter

make

remove

seal

subject

tighten

Supply the missing info

1. The cylinder covers _____ of special cast-iron and each _____ to the top of the cylinder liners by heavy studs.
2. The nut of the stud must _____ up simultaneously by hydraulic jacks.
3. In order to _____ off the combustion chamber a metal ring is provided.
4. Joints of copper or soft iron _____ a good seal.
5. Rubber rings are fitted in the lower end of the cylinder liner to prevent oil to _____ in contact with water.
6. In the four-stroke medium-speed engines each cover _____ two air inlet valves, two exhaust valves, one fuel valve, one starting air valve and one safety valve.
7. The valves are installed in housing with the result that they _____ without lifting the cylinder head.
8. As the cylinder head _____ to high temperature stresses, much attention has been given to efficient cooling.
9. Nearly always the cooling water _____ to the lower end of the cylinder jacket, where the cylinder wall temperature is moderate, then it _____ the cylinder head through special guide tubes.

IV . Give the opposites to the words in the left column and use them in sentences.

▶ to loosen the studs	• _____
▶ to fit the valves to the cylinder head	• _____
▶ injector placed centrally	• _____
▶ gas exhaust inlet pipe	• _____
▶ the cooling water leaves the head at the highest point	• _____
▶ wall heated by hightemperature gases	• _____
▶ cross scavenging	• _____
	• _____
	• _____
	• _____

V. Study the meaning of the verb TO CARRY in the following sentences

- In the engine it is essential to ensure that the bearings carrying the crankshaft are in good alignment. (L2)
- Several designs of high output engines have cylinder liners with deep flanges in which a large number of small passages are drilled to carry the coolant close to the cylinder bore. (L6)
- Each cylinder is closed by a separate cylinder head which carries the injector and the valves. (L6)
- The studs carry the firing loads and at the same time provide the forces which hold together the seal between the head and the liner. (L6)
- That ship was designed to carry liquid petroleum gas at very low temperatures. (Book I, L4)

- As it appears from the previous examples the verb TO CARRY has several distinct meanings:
  1. **support** (nositi,podupirati),
  2. **conduct** (voditi,odvoditi),
  3. **have (imati,nalaziti se), sustain,**
  4. **bear** (podnijeti, preuzimati),
  5. **transport** (prevoziti)

Give the exact meaning of the verb TO CARRY putting the suitable synonym in the blank space at the end of each sentence

- Copper carries electricity better than iron does. (_____)
- The cylinder covers of the M.A.N. engines consists of two parts: the lower part, made of cast steel, carries the openings for fuel valve arranged vertically in the centre. (_____)
- The engine frame consists of short column of cast iron, which carries the cylinder block. (_____)
- All the major tensile loads are carried by the tie bolts. (_____)
- The rod has a bore throughout its length which carries oil from the large end to the small end for lubrication and cooling. (_____)
- A turbocharger is basically two wheels connected by a shaft. Both wheels carry vanes which make them act like fans. (_____)
- In the ring belt region, a thick wall is needed to carry the heat. (_____)
- The old " STAR DRAGON " has been converted to carry containers. (_____)
- The top ring carries the greatest load because it is operated at highest pressure and temperature. (_____)

VI Like other verbs TO CARRY may be followed by prepositions and adverbs. Often such a combination has an idiomatic meaning as:

- **CARRY OUT** (perform a duty, accomplish a work)
- **CARRY ON** (continue)

Fill in the blanks in the following passage with the correct form of the verb TO CARRY combined with a suitable preposition or adverb from those listed below:

to, through, up, out, away, down

ach of them is used only once)

r walls of the piston are thick not only to withstand the gas pressure
o _____ the heat transfered to the piston crown by the
ases. In some designs cooling of the piston is _____ by
lubricating oil on the underside of the crown. The oil is supplied
crankcase and _____ a passage bored in the connecting
ns are fitted with rings at the bottom of the skirt to scrape the excess
liner so that it is _____ again into the crankcase. These oil-
ngs prevent surplus oil from being _____ into combustion
where it would burn incompletely and form carbon. At the same
allow sufficient oil to be _____ the upper part of the
ng the upstroke to lubricate the piston surface.

VII Ask questions to which the boldface parts of the following statements are replies. Begin each sentence with the appropriate question-word supplied below:

HOW? WHAT? WHEN? WHERE? WHY?

Ex.

- The inlet valve closes at the end of the suction stroke.
- When does the inlet valve close ?

1. The link between the piston and the connecting rod is the gudgeon pin.
2. In the cylinder the gases expand during the firing or the power stroke.
3. The cooling of the piston is carried out by circulating lubricating oil.
4. The simplest means of carrying out the cooling of the piston is by splash or spray.
5. Compression occurs after the cylinder has been filled with air.
6. A compression plate or shim is interposed between the foot and the box of the rod large end.
7. Pistons can also be made in aluminium alloy so that they can keep the weight down.
8. In the "marine" type design the rod large end consists of a separate bearing box.
9. On the bedplate is mounted the casting termed as column.
10. In order to seal off the combustion chamber a metallic joint is placed between the cylinder head and the liner.
11. When worn out the liner must be replaced.

VIII. Translate into English:

Na glavi motora se nalaze ubrizgač i ventili.

Sile koje se stvaraju izgaranjem u komori cilindra prenose se sa stapa putem ojnice na koljenastu osovinu i glavne ležajeve.

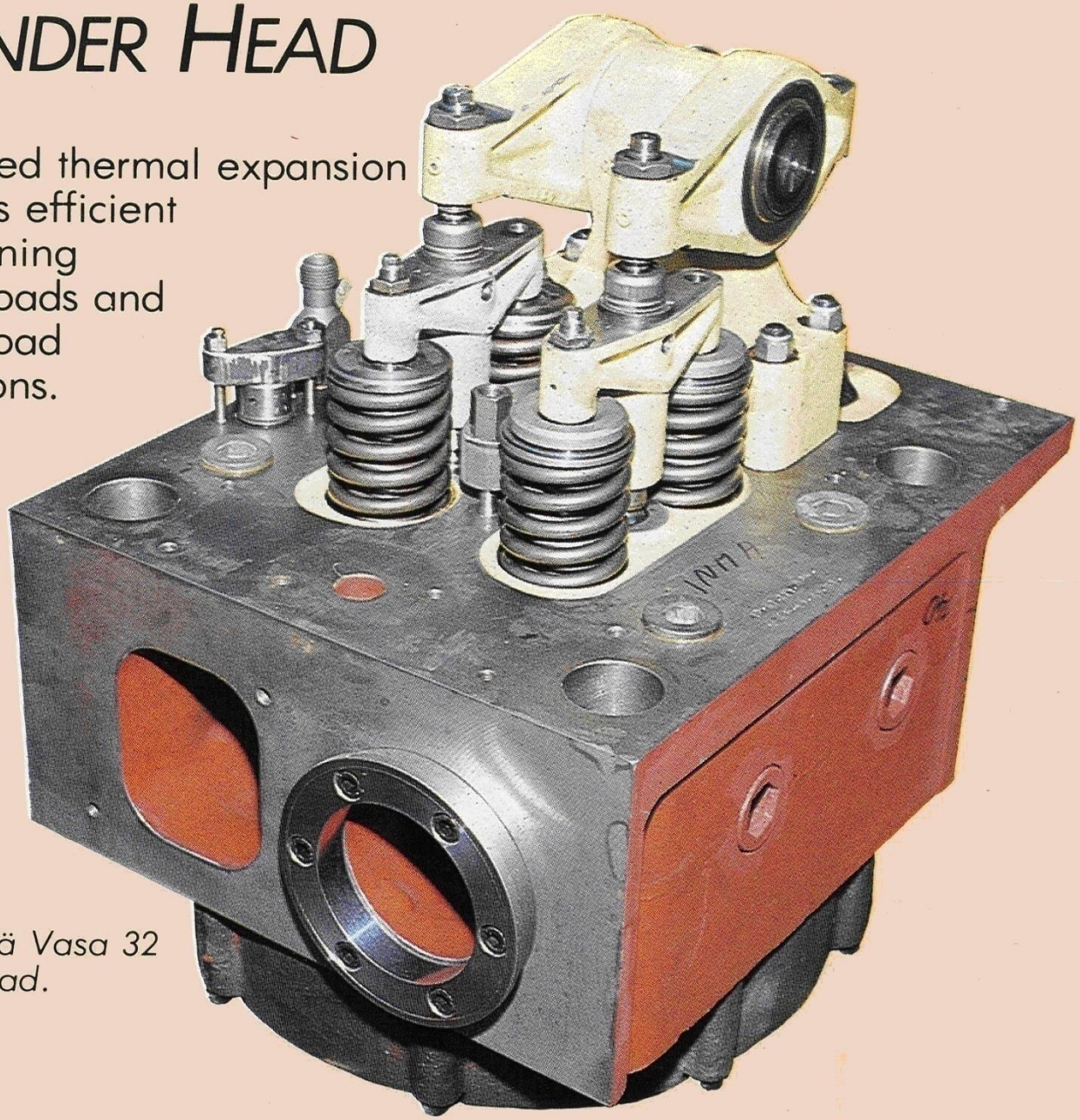
Vijci ne smiju trpjeti preveliko opterećenje.

Da bi se izvršilo konačno pritezanje vijaka, valja koristiti moment-ključ.

Kod dvotaktnih motora s ispiranjem zrakom ubrizgač je smješten sa strane tako da se gorivo ubrizgava tangencijalno.

CYLINDER HEAD

- Balanced thermal expansion ensures efficient functioning at all loads and rapid load variations.



The Wärtsilä Vasa 32 cylinder head.