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(54) Heat exchanger

(57) The invention concerns a heat exchanger for exchanging heat between a first fluid flow generated by pumping fluid through a ship's engine and/or other heat generating equipment and through a cooling channel (11,12,13) and a second fluid flow generated by a ship's propeller (3) and the ship's speed comprising a nozzle surrounding the ship's propeller (3) having an outer wall (16) that forms an outside surface (6) of the nozzle and an inner wall (17) that forms an inside surface (4) of the nozzle and the outer wall (16) and the inner wall (17) form a cooling surface between the first fluid flow and the second fluid flow over approximately the whole perimeter of the nozzle.
In accordance with the invention, the cooling surface area is approximately constant along the length of the cooling channel (11,12,13) in the nozzle.

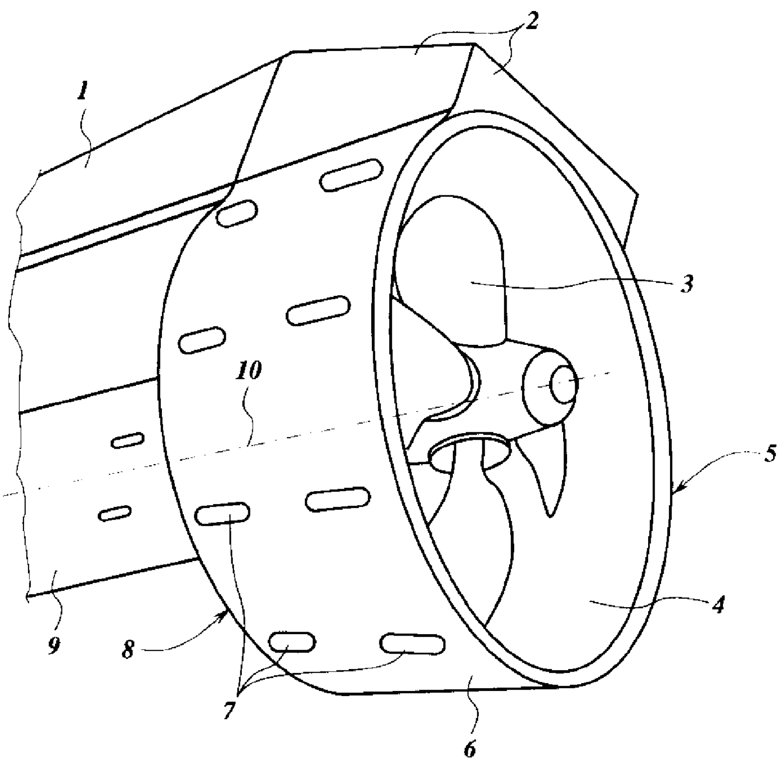

Fig. 1

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Description

[0001] The invention concerns a heat exchanger in accordance with the preamble of claim 1. The document JP 58183816 discloses such a heat exchanger. The disadvantage of the known heat exchanger is that the first fluid flow in the nozzle flows along a small part of the top surface of the rear of the nozzle and then flows back along the top of the front of the nozzle and then back towards the heat generating equipment. This means that in the lower half of the nozzle there is locally almost no first fluid flow, this limits the heat exchange capacity of the nozzle. In order to overcome this disadvantage the device is according to claim 1. In this way, the cooling surface along the length of the cooling channel is approximately constant which leads to an approximately constant cooling capacity for cooling the first fluid and the complete nozzle surfaces contributes to the heat exchange between the first fluid and the second fluid. This avoids local areas with no or limited first fluid flow that cause areas with reduced heat exchange and strongly reduced cooling capacity of the nozzle.

[0002] In accordance with an embodiment, the heat exchanger is according to claim 2. In this way, the flow speed in the cooling channel is approximately constant, which improves the heat exchange.

[0003] In accordance with an embodiment, the heat exchanger is according to claim 3. In this way, the ring-shaped chamber has a reduced longitudinal cross section so that the flow speed of the first flow is higher which increases the heat exchange with the second flow.

[0004] In accordance with an embodiment, the heat exchanger is according to claim 4. In this way, the first flow flows full circles around the nozzle and circulates first through a first ring-shaped chamber and then through a second ring-shaped chamber and if applicable to the next ring-shaped chamber and the temperature of the first flow diminishes in the longitudinal direction of the nozzle. The temperature might be highest at the rear side of the nozzle, which improves the heat transfer between the first fluid flow and the second fluid flow.

[0005] In accordance with an embodiment, the heat exchanger is according to claim 5. In this way, also the forward surface and/or the rearward surface of the nozzle are effective for exchanging heat.

[0006] In accordance with an embodiment, the heat exchanger is according to claim 6. In this way, the inner walls and the outer walls are reinforced so that oscillations or deformations are prevented. The location of the openings ensures a higher flow speed near the walls, which improves the heat exchange between the first fluid and the walls.

[0007] In accordance with an embodiment, the heat exchanger is according to claim 7. In this way, the second fluid circulates within the inner wall with a speed that is as high as possible and the exchange of heat between the first fluid and the second fluid increases.

[0008] In accordance with an embodiment, the heat exchanger is according to claim 8. In this way, the support maintains the circular shape of the nozzle and prevents deformations and/or oscillations, so that the gap between the propeller and the nozzle can be very small and the speed of the second fluid flow along the inner wall equals the tip speed of the propeller, which increases the heat exchange capacity.

[0009] In accordance with an embodiment, the heat exchanger is according to claim 9. In this way, the longitudinal stiffness of the attachment of the nozzle to the ship is as high as possible and resistance against deformations is maximal.

[0010] Hereafter the invention is explained by describing an embodiment of the invention with the aid of a drawing. In the drawing

Figure 1 shows a perspective view of a ship's propeller surrounded by a nozzle that is attached to the ship,
Figure 2 shows a typical longitudinal cross section of the nozzle of figure 1,
Figure 3 shows a front view of the nozzle of figure 1,
Figure 4 shows section IV-IV of the nozzle of figure 3,
Figure 5 shows a top view of the nozzle of figure 3, and
Figure 6 shows a schematic view of the cooling fluid circulation through the nozzle of figure 1.

[0011] Figure 1 shows a propeller 3 at the stern of a ship 1. A shaft (not shown) with a centreline 10 rotates the propeller 3 and a shaft support 9 supports the shaft. An engine (not shown) rotates the shaft and a cooling fluid conveys the heat generated by the engine to the water that flows alongside the ship. In order to improve the efficiency of the propeller a ring-shaped nozzle surrounds the propeller 3. A support 2 connects the nozzle to the ship 1. The nozzle has a nozzle front 8 and a nozzle rear 5, an inside surface 4 and an outside surface 6. On the outside surface 6 and the shaft support 9 are anodes 7 to prevent or reduce corrosion. For the heat transfer from the cooling fluid to the surrounding water the cooling fluid flows through the internal construction of the nozzle.

[0012] Figure 2 shows a typical cross section of the nozzle with the inside surface 4 formed by an inner wall 17 that ends at the nozzle front 8 against a front profile 8'. The inner wall 17 ends at the nozzle rear 5 against a rear profile 5'. An outer wall 16 between the front profile 8' and the rear profile 5' forms the outside surface 6. A first ring-shaped wall 14 and a second ring-shaped wall 15 form with the inner wall 17 and the outer wall 16 a ring-shaped front chamber 13, a ring-shaped middle chamber 12 and a ring-shaped rear chamber 11. The cooling fluid flows through the ring-shaped chambers 11, 12, and 13. In embodiments where the nozzle has one or more reinforcement walls 20' in longitudinal direction (see figure 3) there are one or more outside flow openings 18 between the outer wall 16 and the reinforcement wall 20' and one or more inside flow openings 19 between the inner wall 17 and/or the reinforcement wall 20'. In the shown embodiment, there are three ring-shaped chambers. In other embodiments, this number can be reduced to two ring-shaped chambers or there can be more ring-shaped chambers.

[0013] In the ring-shaped chambers 11,12,13 the inner wall 17 and the outer wall 16 form the heat exchanging surfaces between the cooling fluid in the nozzle and the water around the nozzle. The heat-exchanging surface has an approximately constant surface area for each cross-section in the direction of the fluid flow so that the heat exchanging capacity remains more or less constant along the length of the fluid flow. Approximately constant surface area means that the heat-exchanging surface area may fluctuate around an average value with plus or minus 50% or plus or minus 30%. It will be clear that the total less fluctuation in the heat-exchanging surface area will mean that the average is higher and that this increases the heat exchanging capacity of the nozzle.

[0014] Also the cross section area perpendicular to the fluid flow is more or less constant in the three ring-shaped chambers. This means that the cross section area may fluctuate around an average value with plus or minus 50% or plus or minus 30%. The more or less constant cross section area leads to a more or less constant flow speed of the fluid flow, which means there is less fluctuation in the fluid flow speeds so that the average flow speed is higher, which increases the heat exchanging capacity of the nozzle.

[0015] Figures 3, 4, and 5 show the nozzle in different views. In the top of the nozzle, a partition wall 20 limits the circular flow through ring-shaped chambers 11, 12, and 13 and guides the cooling fluid near the partition wall 20 through a first opening 25 that connects the ring-shaped front chamber 13 and the ring-shaped middle chamber 12. A second opening 25 connects the ring-shaped middle chamber 12 and the ring-shaped rear chamber 11. A cooling fluid inflow line 21 connects to the ring-shaped rear chamber 11 and a cooling fluid outflow line 22 connects to the ring-shaped front chamber 13. In this way, the channel for the cooling fluid flow inside the nozzle has an approximately constant cross section area so that the cooling fluid flows with an approximately constant flow speed through the channel. This means that the flow speed along the length of the channel is over the whole length near its maximum value, which improves the heat exchange.

[0016] Figure 6 shows a cooling fluid flow 24 around the propeller 3 in a circular shaped cooling channel through the internal structure of the nozzle. The propeller 3 generates a water flow 23 along the inside surface 4 of the nozzle, this flow is in the longitudinal direction of the nozzle and has a rotational component due to the rotation of the propeller. Along the outside surface 6 of the nozzle, there is a water flow in longitudinal direction. In the shown embodiment, the cooling fluid where it is leaving the nozzle has exchanged heat with the water flow 23 entering the nozzle, which means that the cooling of the cooling fluid is most effective as the average temperature difference between the cooling fluid flow 24 and the water flow 23 is as high as possible.

[0017] In a further embodiment, the cooling fluid can follow different patterns of flow in the nozzle. There can be many ring-shaped flow chambers through which the cooling fluid can flow in series or through which the cooling fluid can flow parallel. The many ring-shaped chambers result in a high flow speed of the cooling fluid and for instance two ring shaped chambers around the propeller are parallel.

[0018] In another embodiment of the invention (not shown), there are partitions in the inside of the nozzle between the inner wall 17 and the outer wall 16 around the circumference of the nozzle. The distance between the partitions is less than three times and possibly less than twice the distance between the inside wall 17 and the outside wall 16. These partitions create a zigzag flow of the cooling fluid between the nozzle front 8 and the nozzle rear 5 whereby the flow speed is sufficient high to make the heat exchange effective.

[0019] In another embodiment of the invention, a support is mounted on the inner wall 17 of the nozzle to support the propeller 3 and the support includes a bearing for a drive axis of the propeller 3.

Claims

1. Heat exchanger for exchanging heat between a first fluid flow (24) generated by pumping fluid through a ship's engine and/or other heat generating equipment and through a cooling channel and a second fluid flow (23) generated by a ship's propeller (3) and the ship's speed comprising a nozzle surrounding the ship's propeller having an inside surface (4) and an outside surface (6) wherein the nozzle has an outer wall (16) with an approximately constant wall thickness that forms the outside surface (6) of the nozzle and an inner wall (17) with an approximately constant wall thickness that forms the inside surface of the nozzle and the outer wall and the inner wall form a cooling surface between the first fluid flow (24) and the second fluid flow (23) over approximately the whole perimeter of the nozzle **characterized in that** the cooling surface area is approximately constant along the length of the cooling channel (11,12,13) in the nozzle.

2. Heat exchanger in accordance with claim 1 wherein the cooling channel (11,12,13) in the nozzle has a section area that is approximately constant over its length.

3. Heat exchanger in accordance with claim 1 or 2 wherein the inner wall (17) and the outer wall (16) form at least two ring-shaped chambers (11,12,13) around the propeller separated by a ring-shaped wall

(14,15).

4. Heat exchanger in accordance with claim 3 wherein each ring-shaped chamber (11,12,13) has one partition wall (20) in longitudinal direction and each ring-shaped wall (14,15) has one opening (25) connecting two ring-shaped chambers and the first fluid flow (24) first enters a first ring-shaped chamber (11) and successively flows through one or more next ring-shaped chamber(s) (12,13), wherein the first ring-shaped chamber can be at the rear of the nozzle.

5. Heat exchanger in accordance with one of the preceding claims wherein the distance between the most forward surface of the nozzle (8) and/or the most rearward surface of the nozzle (5) and the nearest ring-shaped chamber (11,13) is less than the distance between the inner wall (17) and the outer wall (16).

6. Heat exchanger in accordance with one of the preceding claims wherein in a longitudinal direction of the nozzle the ring-shaped chambers (11,12,13) have reinforcement walls (20') which are evenly distributed around a circumference of the nozzle and wherein the reinforcement walls have openings (18,19) that are adjacent to the inner wall (17) and/or the outer wall (16).

7. Heat exchanger in accordance with one of the preceding claims wherein the inner wall (17) has a surface (4) that can be cylindrical and that narrowly encloses the propeller (3).

8. Heat exchanger in accordance with one of the preceding claims wherein a support (2) connects the nozzle's outer wall (16) to the ship and wherein the support has a width of at least 0,5 times and preferably at least 0,65 times the diameter of the nozzle.

9. Heat exchanger in accordance with claim 8 wherein the support (2) extends over the full length of the nozzle.

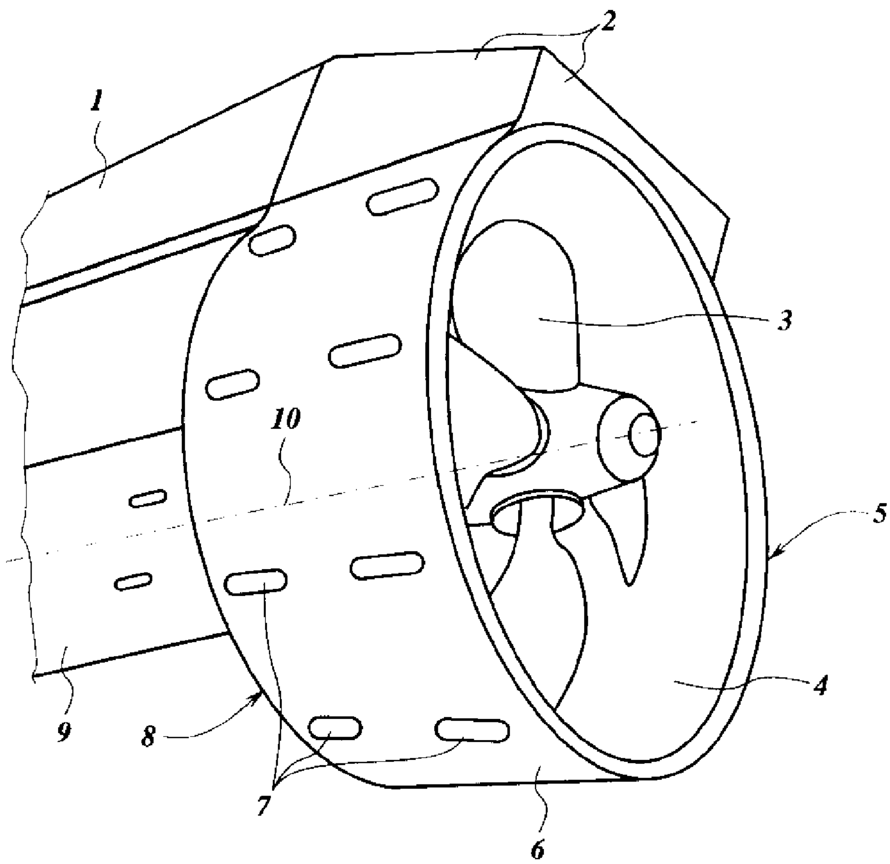

Fig. 1

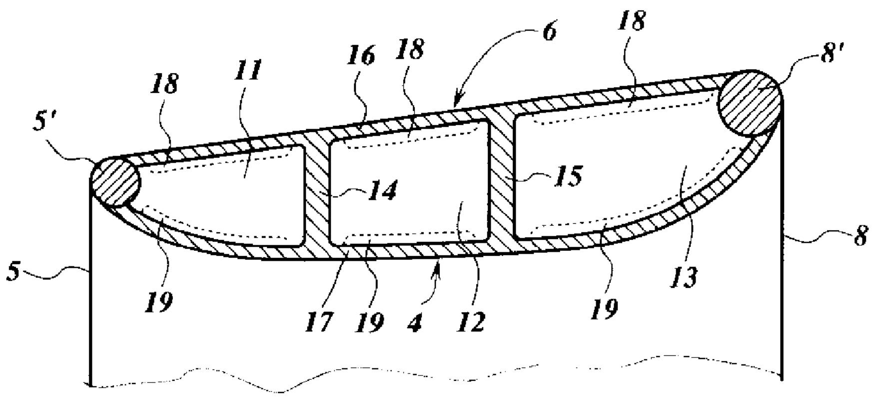

Fig. 2

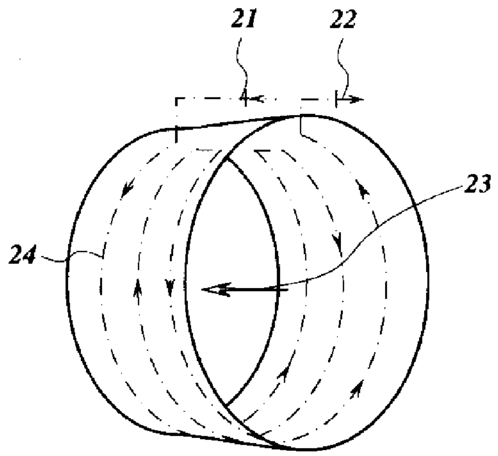

Fig. 6

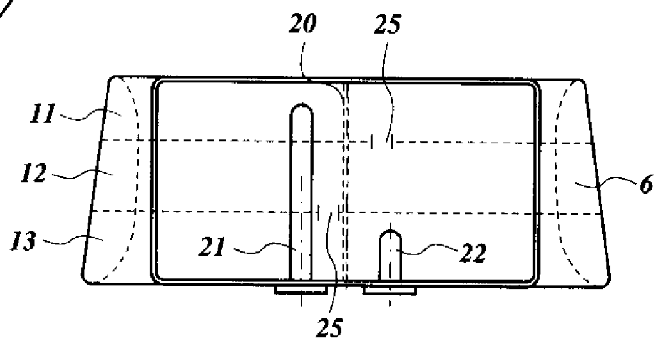

Fig. 5

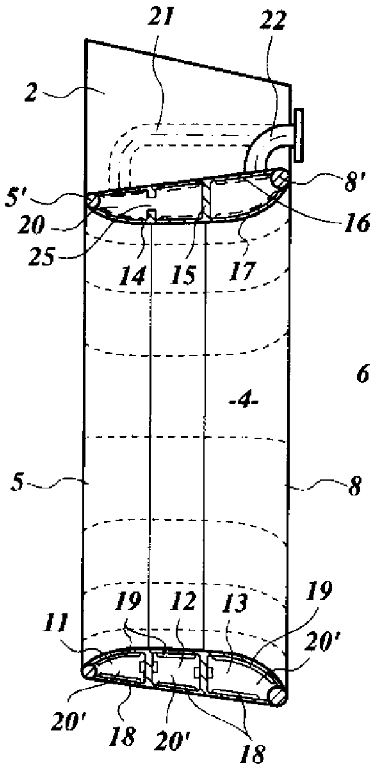

Fig. 4

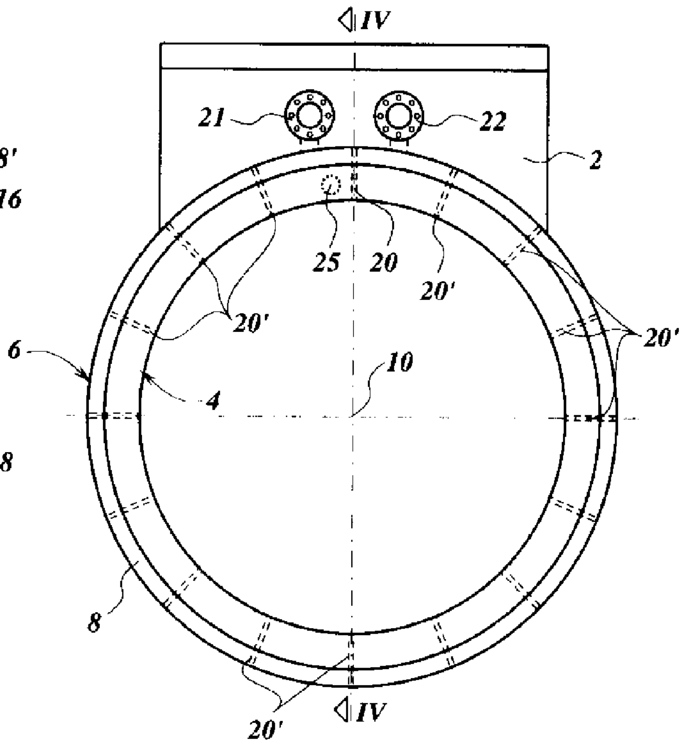

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 10 15 5255

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	DE 23 55 974 A1 (BECKER KG GEBR) 22 May 1975 (1975-05-22) * page 4 - page 5; figures *	1-9	TECHNICAL FIELDS SEARCHED (IPC) F01P B63H F28D F28F

The present search report has been drawn up for all claims

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Place of search	Date of completion of the search	Examiner
The Hague	24 August 2010	Van Dooren, Marc

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 10 15 5255

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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