Sea box cooler comprising an antifouling system

Description

[0001] The invention relates to a sea box cooler on ships and offshore platforms wherein barnacles, mussels and other fouling organisms are killed by means of an integrated antifouling system due to overheating which can be regularly repeated.

Prior art

[0002] Fouling on ships, parts of ships and in systems of pipes as well as in the components thereof has rapidly risen not least because of the increased water pollution. Internationally, it is attempted to reduce and avoid this fouling, respectively, by means of various methods.

[0003] A method and a device are described in DE-PS 19921433 C1 which is based on the object to develop an effective and environmentally friendly procedure and a device for antifouling and prevention of fouling on tubing, filters, heat exchangers, fittings, pumps, sea box coolers which are randomly or continuously in contact with sea water in sea boxes, for ships, offshore platforms, etc..

[0004] The procedure is characterized in that the sea water in the sea box is bulk headed from the environment and the sea box cooler is taken out of the cooling circuit, the sea box cooler is used itself for locally restricted short term and regularly repeatable reheating of the confined sea water by mechanical switch-over of the high-temperature circuit to the sea box cooler to be protected.

[0005] The device for performing the procedure consists in that individual sea boxes of a sea water system and the tubing and channels connecting them as well as the components built in the sea water system such as sea box coolers, pumps and fittings comprise separate subsystems such that a short term and locally restricted regular overheating of the confined sea water is carried out, and as a result the entire sea water system is being protected in sections from fouling. Another feature is that the subsystems are subdivided into an active subsystem and a passive subsystem. Then, during operation at sea the shutter in the active sea box is opened and the shut-off fitting is closed, and the passive subsystem is in the cleaning mode having a closed shutter such that the components in the passive sea box will be overheated locally restricted, short term and in a regularly repeatable manner.

[0006] The disadvantages of this invention consist in that modifications to the structure of ship are required such as because of the necessary installation of a flap for closing the outlet gaps of the sea box. Any service efforts on the seals are frequently possible only in the dock and might result in interruptions in the ship operation not being scheduled.

[0007] In DE-PS 102005029988 B3 there is shown a device the object of which is to protect the heat transfer medium from fouling durably and effectively without interrupting the operation of the heat exchanger.

[0008] This problem is to solve in heat exchangers which consist of a plurality of single heat exchangers in that the fluid of at least one single heat exchanger is separated from the actual cooling circuit by movable hoppers being positioned above the inlet and return openings of the single heat exchangers. This fluid is carried into the separated circuit by means of a pump, flows through the heat source and is brought there to a higher temperature level. Then, the heated fluid recirculates the single heat exchanger separated from the cooling circuit. After the completion of the heating-up cycle the hoppers are sealingly positioned above another single heat exchanger such that the course is being repeated for all single heat exchangers.

[0009] The disadvantage of the device consists in that the inlet and outlet hoppers in various chambers of the cooler cap have to be mechanically connected with each other so as to allow the inlet hoppers to be positioned above the inlet, and so as to allow the outlet hoppers to be positioned above the outlet of the same single heat exchanger in order to release them from the cooling circuit and thus to protect them from fouling in a separate heating-up cycle. The engineering effort for mechanical coupling the two hoppers with each other seems to be very costly and susceptible to faults. Further, the device described in DE-PS 102005029988 B3 employs a separate electric heating unit for heating-up which results in an additional energy demand of up to 60 kW being estimated and thus should be absolutely prevented from reasons of the sustainability and environmental protection.

Disclosure of the invention

[0010] It is an object of the invention to design a sea box cooler against fouling caused by micro organisms such as barnacles, mussels, algae, etc., already in its construction method such that if possible a simple device is able to protect the sea box cooler in a full automatic manner by continuous overheating a defined number of tube registers both during the actual cooling mode and in the standstill. This is to carry out without any system separation.

The required heating-up energy is to decouple in an energetically efficient manner from the hot high-temperature circuit of the main engine or auxiliary diesel engine, for example.

[0011] In accordance with the invention the object has been solved according to the features of the claims.

[0012] In the sea box coolers comprising an integrated thermal antifouling system called TAS in the following, because of the new design of the tube bundle, there is developed a nearly circular or square arrangement of the heat exchanger tubes 20 including special sections which enable single circle segments of the tube bundle of the sea box cooler to be charged by means of hot water through a mechanical TAS device during or out of the cooling mode. By way of example, this TAS device comprises a nozzle 1 rotating in angular steps which follows the near-circular arrangement of the heat exchanger tubes 20 in the tube plate 14 such that the fouling organisms in the respective section are killed due to the periodical exposure of heated up water of single heat exchanger tubes 20 or sections of the sea box cooler on the external tube wall and/or in the immediate vicinity of the tube bundle.

[0013] Then, possibly the cooling surface of the sea box cooler is to enlarge correspondingly allowing to dissipate the heat introduced into the system additionally, preferably from the hot engine cooling water circulation (ME-HAT). However, this may be become more than being compensated by means of the reduction of the fouling margin due to the much clean coolers in the most cases.

[0014] The advantages of the invention consist in that the fouling protection of the sea box cooler comprising the integrated TAS is possible during the running operation at sea and without having to switch off the box cooler. By longer lay days the fouling protection can be carried out during the harbour operation through a separate preheater in the TAS circuit such as the auxiliary condenser or overproduction condenser as well. A further positive side effect is that during the harbour operation the low-temperature circuit ME-LT can be preheated through the device thus keeping the main engine in operating condition any time. As a result, the conventional preheating unit can be relinquished which saves current energy cost and acquisition cost.

Brief description of the figures

[0015] The invention will be explained in greater detail on the basis of an embodiment in which:

[0016] Fig. 1a shows a sea box cooler comprising the TAS device 13 for fouling protection;

Fig. 1b is a top view of the tube plate 14 having circular segments 15;

Fig. 1c is a top view of the tube plate 14;

Fig. 2 shows a path of the heated up water with the nozzle 1 lowered;

Fig. 3 is a side sectional view of the TAS device 13 with the nozzle 1 lowered;

Fig. 4 shows the TAS device 13 with the nozzle 1 elevated;

Fig. 5 shows a figure of the travel of the TAS nozzle 1 in the TAS operation;

Fig. 6 shows a flow chart of a sea box cooler comprising an integrated TAS.

Implementation of the invention

[0017] Fig. 1a shows the sea box cooler 16 with the main components thereof such as the tube bundle 9, cover 12 and the integrated TAS device 13. The engine cooling water enters through the inlet piece 2 into the chamber of the sea box cooler 16 which is being formed by the cover 12 and tube plate 14.

[0018] Fig. 1b and Fig. 1c show the design of the tube plate 14 with the circular arrangement of the U-shaped tubes and the central tube plate area of the nozzle chamber 21 (from Fig. 1a) onto which the TAS nozzle 1 (from Fig. 1a) above the TAS device 13 (from Fig. 1a) works in a specific manner in order to protect the heat exchanger tubes 20 (from Fig. 1a) against fouling.

[0019] As shown in Fig. 2, the heated up water flows through the TAS water inlet 8 having the stop valve 10 thereof, through the rotary union 6 to the TAS nozzle 1 towards a small number of heat exchanger tubes 20 of the tube bundle 9 to heat them up. The rotary union 6 seals the TAS device 13 to the sea box cover 12 to the outside and simultaneously transfers the TAS water further to the TAS nozzle 1 enabling rotational and axial movements of the TAS nozzle 1.

[0020] Fig. 3 and Fig. 4 are sectional views through the cover 12 which show the TAS nozzle 1 in a lowered position and a raised position. These (figures) describe the integrated TAS device 13 according to the invention with the lifting unit 4 (shown in Fig. 2) which forces against the shaft of the rotary union 6 and provides lifting the TAS nozzle 1, which keeps the TAS nozzle 1 in an elevated position during turning on into the next position, then lowers the TAS nozzle 1 after reaching the next position and ensures forcing the TAS nozzle 1 against the tube plate 14 in order to heat up the next circular segment of heat exchanger tubes 20. According to the implementation, the rotary actuator 5 transfers the torque to the shaft of the rotary union 6 by means of a belt 7.

[0021] Fig. 5 shows the circular arrangement of the heat exchanger tubes 20. The TAS nozzle 1 rotates in angular steps following to the near-circular arrangement of the heat exchanger tubes 20 in the tube plate 14 and thus provides special sections separating them because of that from the actual cooling water. The TAS nozzle 1 pressurizes the bulk headed circular segment of the tube bundle 9 of individual heat exchanger tubes 20 with hot water. With sextuple or multiple flow sea box coolers 16 a separate TAS device 13 is installed in each nozzle chamber 21, however, at least in every second nozzle chamber 21. The TAS nozzle 21 can also be implemented both radially as shown in Fig. 5 and over the entire diameter or in a circular segment shape manner.

[0022] Fig. 6 shows the fundamental arrangement of the components in the low temperature circuit of the engine cooling water (ME-LT) so as to heat up a partial stream of this engine cooling water and to enter into the sea box cooler 16 through the TAS water inlet 8 having its stop valve 10.The water is heated by means of the temperature control valve 19 up to a temperature level of at least 75°C. The valves 22 and 23 are opened in a temperature-dependent manner by means of a control system. The TAS nozzle 1 is lowered before, and the TAS water being heated up flows into the section bulk headed by the TAS nozzle 1 thus heating up this section. The course of an entire TAS cycle is carried out in angular steps namely as long as the nozzle has executed a whole circular motion of at least 360°.

List of reference numerals

1	TAS nozzle
2	Cooling water inlet piece
3	Cooling water outlet piece
4	Lifting unit
5	Nozzle rotary actuator
6	Rotary union
7	Belt
8	Heated water
9	Tube bundle
10	Stop valve
11	Temperature sensor
12	Cooler cover
13	TAS device
14	Tube plate
15	Circular segment
16	Sea box cooler
17	TAS circulating pump
18	TAS heat exchanger
19	TAS temperature control valve
20	Heat exchanger tubes
21	Nozzle chamber
22	TAS water valve outlet

Claims

1. A sea box cooler comprising an integrated antifouling system for killing barnacles, mussels and other fouling organisms by means of regularly repeatable overheating, **characterized in that**

the heat exchanger tubes (20) of the tube bundle (9) in said sea box cooler (16) are arranged such that at least one near-circular or square partial surface of the tube plate (14) is created,

and by mounting on a TAS nozzle (1) in a mechanical TAS device (13) in the nozzle chamber (21), a single circular segment (15) consisting of a plurality of said heat exchanger tubes (20) of said tube bundle (9) will be covered such that then said environmentally sealed and bulk headed heat exchanger tubes (20) are protected against sea water caused fouling by means of heated up water being separately supplied during or out of the normal cooling mode.

2. A sea box cooler comprising an integrated antifouling system as claimed in claim 1, **characterized in that**

said heat exchanger tubes (20) comprise a structured surface because of which both improved heat transfer and increased resistance to built-up of deposits against fouling are achieved.

3. A sea box cooler comprising an integrated antifouling system as claimed in claim 1 and claim 2, **characterized in that**

said TAS device (13) is a rotating device in order to cover and heat up a new circular segment (15) from said single heat exchanger tubes (20) by further rotating

4. A sea box cooler comprising an integrated antifouling system as claimed in claim 1 to claim 3, **characterized in that**

a rotary union (6) as a part of said TAS device (13) seals the water chamber within the cooler cover (12) to the outside.

5. A sea box cooler comprising an integrated antifouling system as claimed in claim 4, **characterized in that**

said TAS nozzle (1) is mounted to said rotary union (6) in said water chamber and the outer shape thereof being a copy of said one or several circular segments (15).

6. A sea box cooler comprising an integrated antifouling system as claimed in claim 1 to 5, **characterized in that**

a lifting unit (4) is additionally mounted which lifts said TAS nozzle (1) before each further rotating said TAS device (13) and lowers it again after further rotating, and selectively forces said TAS device (13) against said tube plate (14).

7. A sea box cooler comprising an integrated antifouling system as claimed in claim 1 to 6, **characterized in that**

lifting, lowering and forcing said TAS device (13) against said tube plate (14) is carried out hydraulically by means of a piston integrated into said TAS nozzle (1) according to the telescopic principle.

8. A sea box cooler comprising an integrated antifouling system as claimed in claim 1 to 7, **characterized in that**

the rotational speed of said TAS nozzle (1) of said TAS device (13) is being specifically adapted by means of a geared motor.

9. A sea box cooler comprising an integrated antifouling system as claimed in claim 1 to 8, **characterized in that**

the rotation of said TAS device (13) is being implemented by means of a water turbine not shown in greater detail which is fitted in the water flow.

10. A sea box cooler comprising an integrated antifouling system as claimed in claim 1 to 9, **characterized in that**

several said TAS devices (13) are fitted and operated individually in time or at the same time each by a separate or common drive (10).

11. A sea box cooler comprising an integrated antifouling system as claimed in claim 1 to 10, **characterized in that**

said TAS device (13) is fabricated from specific friction-reducing material.

12. A sea box cooler comprising an integrated antifouling system as claimed in claim 1 to 11, **characterized in that**

local short-term overheating is carried out in a self-acting and regular manner and as well as being supervised automatically by means of integrated measuring and open-loop control systems.

13. A sea box cooler comprising an integrated antifouling system as claimed in claim 1 to 12, **characterized in that**

in said sextuple and multiple flow sea box coolers 16 one said separate TAS device 13 is placed in each said nozzle chamber 21, however, at least in each second said nozzle chamber 21.

14. A sea box cooler comprising an integrated antifouling system as claimed in claim 1 to 13, **characterized in that**

said TAS nozzle 1 is configured as a single radial circular segment (15), a circular segment (15) across the whole diameter or in another circular segment shape.