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METHOD FOR CLEANING SURFACE CONDENSER AND HEAT EXCHANGER TUBES

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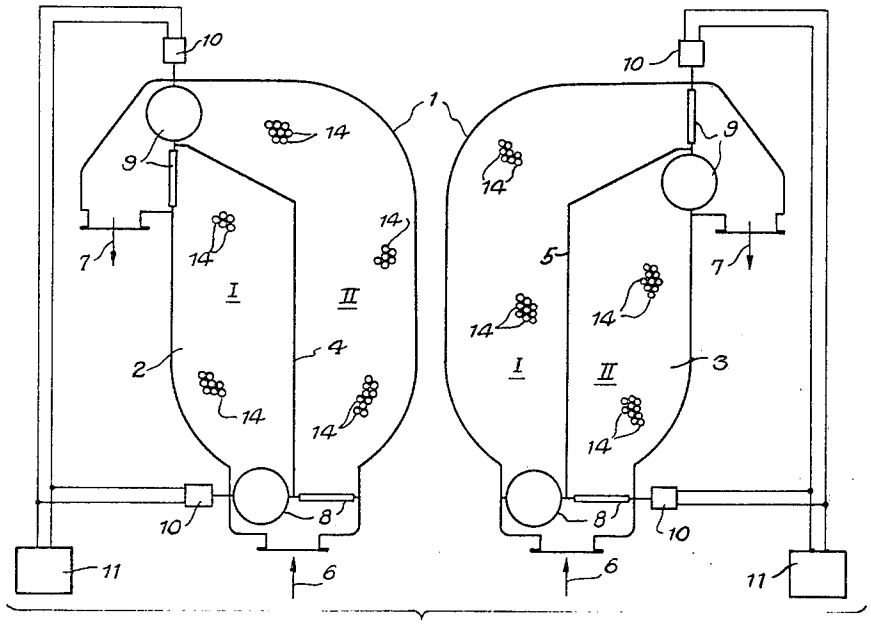


Fig. 1

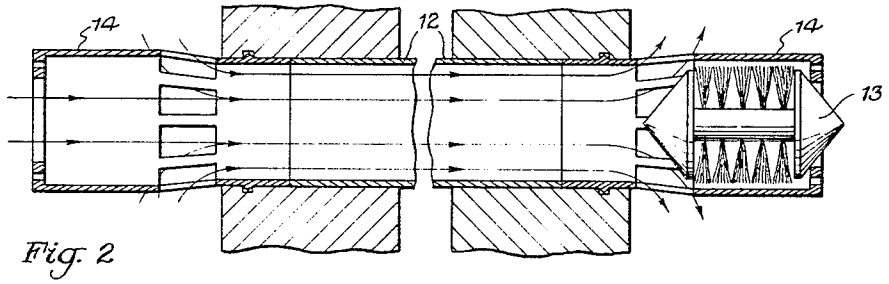


Fig. 2

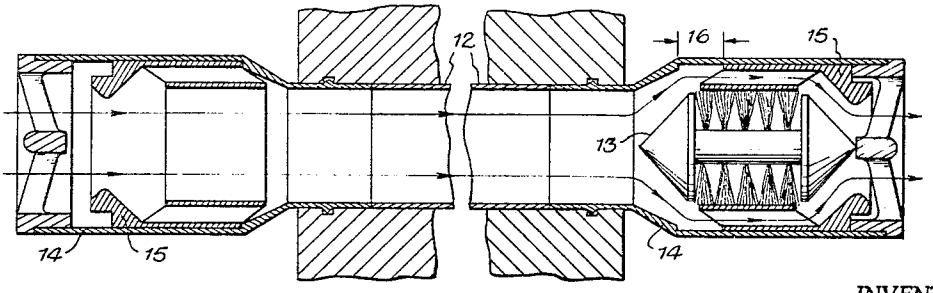


Fig. 3

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METHOD FOR CLEANING SURFACE CONDENSER AND HEAT EXCHANGER TUBES

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Continuation-in-part of application Ser. No. 198,976, May 31, 1962. This application May 8, 1967, Ser. No. 636,714

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Int. Cl. B08b *1/02, 9/04*

U.S. Cl. 134—8 2 Claims

ABSTRACT OF THE DISCLOSURE

Lightweight individual brushes are mounted in each tube, respectively, of a heat exchanger and these brushes are moved back and forth through the tubes by reversing the flow of raw cooling water so that the tubes can be cleaned while the heat exchanger or condenser remains in operation.

This application is a continuation-in-part of our co-pending application Ser. No. 198,976, filed May 31, 1962, now Patent No. 3,319,710 for "Apparatus for Cleaning Surface Condenser and Heat Exchanger Tubes."

This invention relates to a method for cleaning rigid tubes having smooth inner surfaces or longitudinally extending fins in the tubes which form a bundle of the tubes extending into separate water boxes or surface condensers or surface heat exchangers. The raw cooling water is used to move the cleaning members through the tubes to clean the tubes.

The efficiency of a common condensation turbine depends in a large part upon the vacuum produced in the steam condenser. One feature among others substantially influencing the efficiency of the condenser is the amount of scale formed by the cooling water within the cooling tubes. Several methods have been used for cleaning the tubes. The manual cleaning of the tubes with brushes has the disadvantage in that the condenser must be shut down or at least one side emptied. Obviously such a method is not comparable in effectiveness to a method which can be used while the condenser is operating. A so-called self-cleaning method is known which does not require at least a partial shutdown of the condenser and in which spherical cleaning members are continuously pushed through the tubes by cooling water using a special pump. By using a plurality of spherical members, all tubes are periodically cleaned, one by each spherical member. However, difficulty occurs in the movement of the spherical members when the tube sheets in the water boxes are not water-tight, and when dead corners exist in the water boxes. The spherical members get stuck at these points and become inoperative.

According to this invention, these disadvantages are avoided. The method of this invention assures with certainty that all tubes are constantly cleaned.

In this invention, during the operation of the condenser, a cleaning member is moved back and forth in short time intervals through each rigid cooling tube and between perforated catching chambers on the respective ends of the tubes. The movement is caused by the periodic reversal of the raw cooling water, the direction of flow being controlled by a pair of valves positioned at the water inlet and outlet of each water box.

In a further feature of this method, the pairs of valves coupled to one another are actuated for simultaneously reversing the direction of the flow of the cooling water

in the individual tubes of the bundle of tubes. These valves are coupled to each other so that a disruption of possibly parallel operating condensers is avoided.

An apparatus is known for condensing the waste steam of steam turbines in which air is used as the cooling medium and flows through tubes having inserted interior fins in order to achieve the maximum heat conductivity through the tubes. These inserted fins are costly to fabricate in that they are composed of thin sheets of folded white metal. The interior of the tubes are zinc coated and the inserted fins are soldered to the inner wall of the tubes by heating the outside of the tubes. Consequently, fins are formed which extend radially almost to the longitudinal axis of the tubes and form circular segments in the cross-sectional area of the tubes so that the segments between the individual fins diverge toward the wall of the tube. Although such construction may be adequate when using air as the cooling fluid, it would be objectionable when using water cooling as the passages between the fins would quickly accumulate scale which would be difficult to clean, and would result in a poor coefficient of heat transfer.

In another known tube-like type heat exchanger in which heat exchange takes place through a rigid wall, the condensation side of the wall of the heat exchanger is provided with ribs forming grooves in the longitudinal direction of the tube and, in the case of a tube, can be either on the interior or exterior wall of the tube. These projections have such a form that the surface tension of the vapor being condensed forces a decrease in the thickness of the film of vapor in the vicinitly of the apex of the projections.

Also known is a vertical tube cooler for corrosive gases in which lead tubes have an interior fin extending longitudinally of the tube in order to increase the rigidity of the tube.

The advantages of the method of this invention are, first of all, that without shutting down the entire operation of the condenser each individual tube can be safely and positively cleaned of scale and deposits by the back and forth movement of its cleaning member which is moved by a driving medium and, in particular, the raw cooling water. Each cleaning member is flushed out of its rest position in its catching chamber on one side of the condenser and is driven through its tube for cleaning the same by being suspended in the driving medium so that no additional driving means is necessary and no additional structural expense incurred.

The means by which the objects of the invention are obtained are described more fully with reference to the accompanying drawings, in which:

FIGURE 1 is a schematic cross-sectional view through the water boxes of a condenser;

FIGURE 2 is a longitudinal cross-sectional view through a heat exchanger tube having a smooth inner wall and catching chambers at each end of the tube; and

FIGURE 3 is a view similar to FIGURE 2 of a modified form of the invention.

As shown in FIGURE 1, in order to move the cooling water through the two-part condenser **1** for a steam turbine, the water boxes **2** and **3** are subdivided, as is customary, by means of partitions **4** and **5** into two boxes I and II, respectively. The cooling water flows through inlet **6** and is drained from outlet **7**. Valves **8** and **9** are mounted in the inlet **6** and outlet **7**, respectively, in order to reverse the flow of the cooling water through the tube bundles. Each pair of valves is actuated by a servomotor **10**. Each motor is periodically actuated by means of a common switch **11**. The valves may also be manually actuated. The frequency of actuation depends on the rate scale forms in the tubes.

In FIGURE 2, the heat exchanger tube **12** contains a cleaning instrument **13** which is shown in a catching chamber or basket attached to the end of the tube, which chamber has openings for the passage of water. Chambers **14** are preferably made of an inert synthetic material since this is a neutral material. The chambers **14** are either attached directly to the end of the tubes or, as shown, are mounted in openings formed in the tube sheet and secured by any suitable means such as a slot and spring. The cleaning instrument **13** is formed as a brush with conical caps attached to each end of the core. The brush material can be either bristles or foam rubber. Brush **13** is held in the catching chamber as shown by water pressure. When the direction of the water is changed, the brush **13** is pushed by the water pressure into tube **12** and pushed through the pipe until it reaches the opposite catching chamber. This cleans the tube, and the cleaning is repeated when the water flow is again reversed to return the brush to its original position. This operation can be repeated as often as it is necessary to keep the tubes clean, and it does not impair the operation of the condenser. The valves **8** and **9** which are coupled to each other and mounted at the water inlet and outlet serve to control the exact reversal of the direction of flow of the cooling water.

In order to use better the water pressure gradient that exists in tube **12**, according to FIGURE 3, a second smaller housing **15** is axially movably mounted in catching chamber **14**. Housing **15** is longitudinally displaceable by the distance **16** and moves with the brush **13** toward tube **12**. In its closed position, housing **15** seals the tube against the brush so that the full water pressure bears against the brush and thus pushes the brush safely through the tube.

Having now described the means by which the objects of the invention are obtained,

We claim:

1. The method of cleaning the tubes of a raw water cooled heat exchanger such as a surface condenser composed of a bundle of rigid tubes the ends of which extend into common water boxes, respectively, comprising placing a cleaning member in each of said tubes, periodically reversing the direction of flow of the raw cooling water through the tubes to move each member back and forth through its respective tube during the normal operation of the heat exchanger, catching each member in a chamber located at the end of each tube, and discharging the water in the tubes through openings in the chamber communicating with its respective water box.

2. The method of claim **1** further comprising simultaneously reversing the flow of water through the water boxes and the tubes.

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