Oct. 23, 1934. B. E. MEURK 1,978,166

PROTECTIVE DEVICE FOR SURFACE CONDENSERS AND THE LIKE

Filed May 3, 1934

Fig. 1

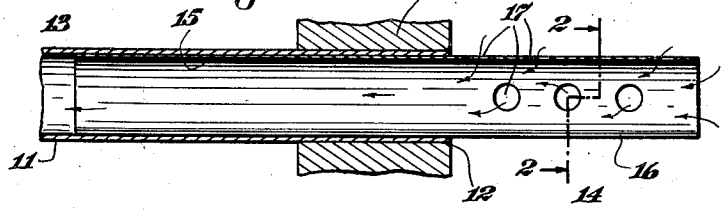


Fig. 2

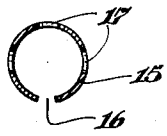


Fig. 3

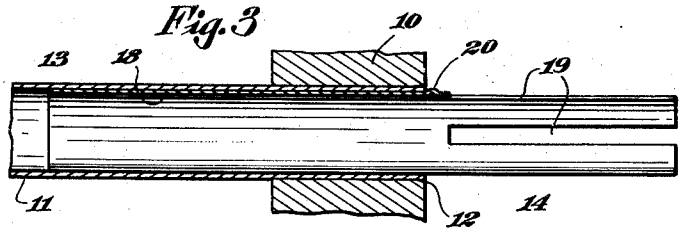


Fig. 4

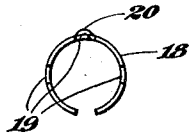


Fig. 5

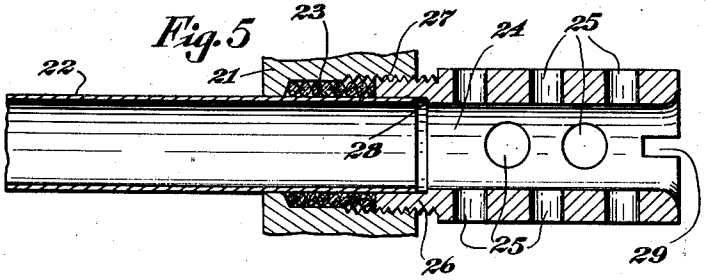


Fig. 6

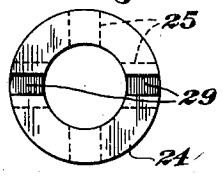


Fig. 7

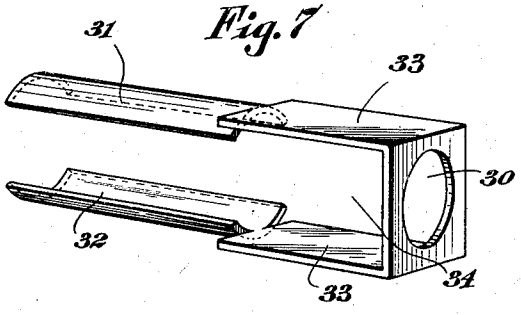


Fig. 8

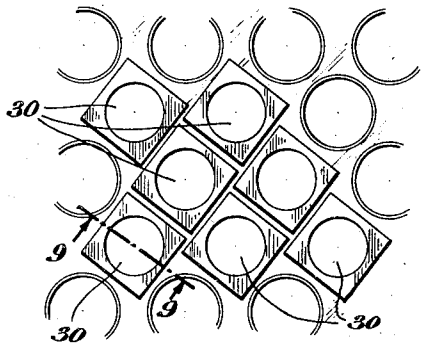
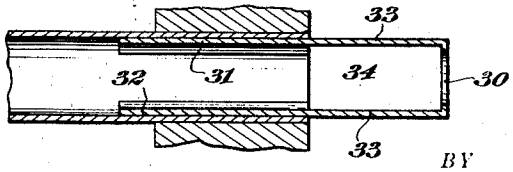


Fig. 9



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UNITED STATES PATENT OFFICE

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PROTECTIVE DEVICE FOR SURFACE CONDENSERS AND THE LIKE

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Application May 3, 1934, Serial No. 723,632

8 Claims. (Cl. 257—1)

My present invention relates generally to heat-exchange apparatus, and has particular reference to an improved device for protecting the tubes of a surface condenser or the like from corrosion.

While I have herein illustrated and shall hereinafter describe and refer to my invention in connection with a surface condenser, nevertheless it will be understood that the invention is not restricted to this specific type of heat-exchange apparatus.

It has long been well known that the tubes of a surface condenser or the like corrode and erode after periods of use, and many attempts have heretofore been made to prevent or minimize such action and thereby increase the useful tube life. The corrosive action is due primarily to chemical and electrolytic causes and can be directly attributed in large measure to the oxygen that is entrained with the water that passes through the tubes. Where salt water is used, as in marine installations, the condition is aggravated.

Attempts have heretofore been made to obviate or minimize corrosion by exposing to the action of the water a material which is electro-positive to the material of the tubes. For example, masses or inserts of zinc have been tried and used heretofore, but because of the haphazard manner of placement and arrangement, and because of the fact that the zinc forms a tenacious crust which must constantly be scaled off, little practical success has been achieved by this method.

My present invention is predicated upon a full realization of the fundamental effect of the entrained air upon the corrosion of the tubes. The water entering a tube from the inlet water box follows the well known rules relating to the flow of liquids through orifices; and in the ordinary installation a vena contracta is formed within the tube end, creating a vacuum around it, and causing the entrained air to be drawn directly into contact with the tube at that region. One of the objects of my present invention is to provide a protective device which avoids the formation of such vena contracta.

Another object of my invention is to provide for the use of an electro-positive material in an improved manner which permits the material to act with maximum efficiency over prolonged periods of time in preventing the corrosion which is sought to be avoided.

Briefly, my invention consists in providing a tube extension of electro-positive material in association with each of the tube ends communicating with the inlet water box. Each tube extension is in the form of a replaceable unit or device which is adapted to be removably applied to a tube end, whereby the extension forms a continuation of the tube and projects for a considerable distance out into the water box. While the provision of such an extension, by itself, obviates any formation of a vena contracta in the tube carrying such an extension, my invention goes even further than this and aims to avoid the formation of a vena contracta in the extension. Quite to the contrary, it is a feature of my invention to form and construct the extension in such a manner as to create a definite and purposeful turbulence in and around the extension as the water enters the same.

One of the features of my invention, accordingly, lies in the provision of an extension having lateral openings therein, whereby any tendency of the entering stream to form a contracted portion is destroyed, and whereby a considerable turbulence ensues as the water enters the extension through its end and simultaneously through the lateral openings. The result is that there is a maximum degree of effective contact between the water and the material of the extension, without any tendency toward an undesirable accumulation or attraction of entrained air.

Another feature of my invention lies in the employment of an electro-positive material of the class which is adapted to form a soluble hydrate under the electrolytic and chemical action of the water. Preferably, I employ soft steel or iron, which forms a ferric hydrate, the latter having no tendency to scale and being of a specific gravity and consistency which permits it to be carried freely through the circulating system as rapidly as it is formed.

I achieve the foregoing objects, and such other objects as may hereinafter or be pointed out, in the manner illustratively exemplified in the accompanying drawing, wherein—

Figure 1 is a side view in cross-section, showing one embodiment of my present invention;

Figure 2 is a cross-sectional view taken substantially along the line 2—2 of Figure 1;

Figure 3 is a view similar to Figure 1, illustrating a modification;

Figure 4 is an end view of Figure 3;

Figure 5 is a view similar to Figure 1, illustrating a further modification;

Figure 6 is an end view of Figure 5;

Figure 7 is a perspective view of a further modification;

Figure 8 is an end view of a tube sheet with

a plurality of devices of Figure 7 shown in position; and

Figure 9 is a cross-sectional view taken substantially along the line 9—9 of Figure 8.

In Figures 1 and 3 I have chosen to illustrate a tube sheet 10 with one of the condenser tubes 11 mounted therein. Each of the tubes thus illustrated is typical of the manner in which the other tubes of the apparatus (usually many hundreds in number) are arranged, and while the invention is illustrated and described in connection with a single tube, it will be understood that the present arrangement contemplates a separate and individual tube extension on each tube communicating with the inlet water box.

In each of Figures 1 and 3 the tube 11 is rolled into association with the tube sheet, as indicated by the reference numeral 12. 13 is the interior of the heat-exchange apparatus, and 14 represents the inlet water box.

In the device of Figures 1 and 2, an extension in the form of a metallic tube 15 is removably applied in snugly fitting manner within the end of the tube 11. The extension 15 thus forms a continuation of the tube 11, projecting well out into the water box 14. Preferably, though not necessarily, the extension 15 of Figure 1 is formed from a flat strip of sheet metal which may be suitably shaped, punched, perforated, etc., and then rolled upon itself into tubular form. When thus rolled, a longitudinal slot 16 extends for the entire length of the device 15, and this slot serves on the exposed portion as a lateral opening, and serves on the inner portion as a longitudinal slit which imparts an inherent resilience to the inner portion, thereby permitting it to be snugly and resiliently fitted into position within the tube 11.

On the exposed portion of the tube extension I provide a plurality of lateral openings which, in the form of Figures 1 and 2, are circular or substantially circular perforations 17.

The device 15 is made of a material which is electro-positive with respect to the material of the tube 11. The latter being usually of brass, a material such as soft steel or iron is admirably suited for the extension. Soft steel and iron are of the class which form a soluble hydrate (ferric hydrate) under the chemical and electrolytic action of the water. Zinc, while electro-positive, is not suited for the present purpose because it forms a scale or crust which deprives it, in short order, of its contemplated utility.

The water entering the tube 11 must necessarily enter through the extension that has been inserted into the end of the tube and, as a result, no vena contracta forms within the tube 11 and no corresponding vacuum is produced to attract or collect entrained air. Furthermore, the water is prevented from forming a vena contracta in the extension itself by virtue of the lateral openings therein. Quite to the contrary, a considerable turbulence is induced by the rush of water along the lines indicated by the arrows of Figure 1, viz., into the extension through the open end thereof and through the lateral openings. The result is that the water is actively and necessarily exposed to a relatively large contact area of the electro-positive material, whereby a cathodic effect, well known per se, results in a corrosion and wearing away of the extension and a consequent protection of the material of the tube 11 itself. It may be mentioned in passing that soft steel and iron are particularly adapted for the present purpose because the ferric hydrate that is formed washes away and is carried through the apparatus by the flowing water; and within the tube 11 this hydrate forms a thin protective scum along the inner surface of the tube.

Within a course of time, the extension will have been worn away to a degree which requires that it be replaced. This is a relatively simple procedure, requiring only that it be forcibly withdrawn from the tube end, since it is positioned therein only by friction.

In Figures 3 and 4 a modified construction is shown in which the extension 18 is provided with longitudinal slots 19 in place of the perforations 17 of Figure 1. In other respects, the construction and operation are the same. Where slots are employed, they may be narrower than the diameter of the openings 17.

To limit the insertion of the device into the tube end it is desirable and preferable to provide an abutment or the like on the extension; and in Figures 3 and 4 I have illustratively shown one manner of accomplishing this object by striking up a portion 20 to provide a protrusion or bump which bears against the end of the tube 11 when the extension has been inserted to the desired extent. It will be understood that a projection of this sort may be provided on the device of Figure 1, as well.

In Figure 5 I have illustrated a tube sheet 21 in conjunction with a tube 22 which is held in position not by rolling but by means of packing 23 and a ferrule. My invention lends itself readily to the provision of a device which serves simultaneously as a tube protecting extension of the present type and a ferrule for holding the tube 22 in position. The extension of Figures 5 and 6 is a tube 24 having the lateral openings 25 therein and having an externally threaded inner end 26 adapted to encircle the end of the tube 22 within the confines of the tube sheet 21 and to engage in threaded relation to the tube sheet, as indicated at 27. A shoulder 28 serves to maintain the tube 22 in its proper position.

The removal and replacement of the device of Figure 5 is accomplished by the unthreading of the extension and by the screwing into position of a replacement element of similar kind. To facilitate this maneuver slots 29 are preferably provided to receive the end of a screw driver or similar tool.

In Figure 7 I have illustrated a modified form of the present device, readily adapted to be made from a blank of sheet material having a medial opening 30 and oppositely extending arms 31 and 32. The blank, when properly shaped and stamped, is bent into the form of Figure 7, whereby the arms 31 and 32 constitute spring fingers or prongs adapted to be readily inserted into the end of the tube, as indicated most clearly in Figure 9. Forwardly of the arms 31 and 32 the device has side walls 33 which are slightly wider than the arms 31 and 32, whereby their rear ends serve as abutments to limit the insertion into the tube. When positioned, the water enters the tube through the end opening 30 and also through the lateral openings 34 between the portions 33.

One advantage of the construction of Figure 7 is that a plurality of devices, each of proper size, when inserted into adjacent tubes, as illustrated in Figure 8, produce a virtual wall or barrier which is highly efficient in developing the turbulence that is desired.

It will be understood that changes in the details, herein described and illustrated for the purpose of explaining the nature of my invention,

may be made by those skilled in the art without departing from the spirit and scope of the invention as expressed in the appended claims. It is, therefore, intended that these details be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, and illustrated its use, what I claim as new and desire to secure by Letters Patent is—

1. A device for protecting the tube of a surface condenser from corrosion, comprising an electropositive tube extension projecting from the end of the tube into the inlet water box, said extension having lateral openings therethrough to prevent the formation of a vena contracta therein and to develop a turbulence in and around said extension as the water enters the same.

2. A device for protecting the tube of a surface condenser from corrosion, comprising an electropositive tube extension projecting from the end of the tube into the inlet water box, said extension having lateral openings therethrough to prevent the formation of a vena contracta therein and to develop a turbulence in and around said extension as the water enters the same; said extension having an inner portion removably engaging the tube within the confines of the tube sheet.

3. A device for protecting the tube of a surface condenser from corrosion, comprising an electropositive tube extension projecting from the end of the tube into the inlet water box, said extension having lateral openings therethrough to prevent the formation of a vena contracta therein and to develop a turbulence in and around said extension as the water enters the same; said extension having a resilient inner portion frictionally and removably insertable into the tube end.

4. A device for protecting the tube of a surface condenser from corrosion, comprising an electropositive tube extension projecting from the end of the tube into the inlet water box, said extension having lateral openings therethrough to prevent the formation of a vena contracta therein and to develop a turbulence in and around said extension as the water enters the same; said extension having a longitudinally split, resilient, inner portion adapted to be removably inserted, in snugly fitting relation, into the tube end.

5. A device for protecting the tube of a surface condenser from corrosion, comprising an electropositive tube extension projecting from the end of the tube into the inlet water box, said extension having lateral openings therethrough to prevent the formation of a vena contracta therein and to develop a turbulence in and around said extension as the water enters the same; said extension having its inner portion formed to serve as a ferrule for engaging the tube sheet and maintaining the tube in position.

6. A device for protecting the tube of a surface condenser from corrosion, comprising an electropositive tube extension projecting from the end of the tube into the inlet water box, said extension having lateral openings therethrough to prevent the formation of a vena contracta therein and to develop a turbulence in and around said extension as the water enters the same; said extension having an externally threaded, inner end encircling the tube end within the confines of the tube sheet and serving as a ferrule for maintaining the tube in position.

7. A device for protecting the tube of a surface condenser from corrosion, comprising an electropositive tube extension projecting from the end of the tube into the inlet water box, said extension having lateral openings therethrough to prevent the formation of a vena contracta therein and to develop a turbulence in and around said extension as the water enters the same; said extension comprising a blank of sheet metal having a medial opening and oppositely extending arms, said arms being bent into parallel relation to form a pair of spring fingers removably insertable into the tube end.

8. A device for protecting the tube of a surface condenser from corrosion, comprising an electropositive tube extension projecting from the end of the tube into the inlet water box, said extension having lateral openings therethrough to prevent the formation of a vena contracta therein and to develop a turbulence in and around said extension as the water enters the same; said extension being composed of a material of the class which forms a soluble hydrate by electro-chemical action with the water and entrained oxygen.

BENGT E. MEURK.