

June 29, 1937.

C. REIGART ET AL

2,085,041

HEAT EXCHANGE APPARATUS

Filed May 24, 1935

Fig. 1.

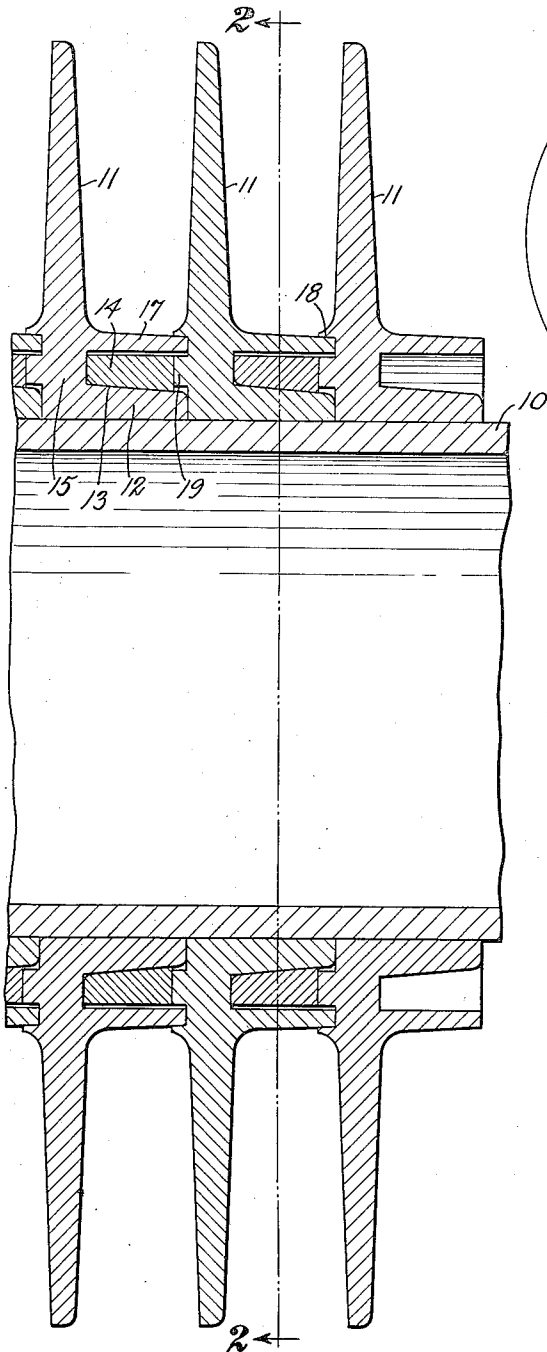


Fig. 2.

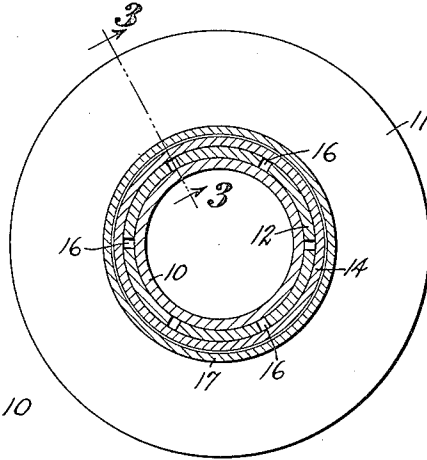
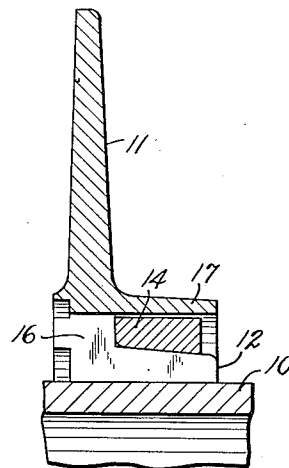


Fig. 3.



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UNITED STATES PATENT OFFICE

2,085,041

HEAT EXCHANGE APPARATUS

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Application May 24, 1935, Serial No. 23,236

17 Claims. (Cl. 257—262)

This invention pertains to heat exchange apparatus and more particularly relates to extended heating surfaces for the tubes of such apparatus and to means for securing the extended surface members to the tubes.

In order that an extended surface member after being positioned on a tube may form an efficient means of transferring heat between the extended surface and the tube, it is important that the common or contacting surfaces of the tube and the extended surface be of essentially the same contour, of ample extent, and that they be held tightly together at all temperatures which the tube and extended surface must withstand. A common means of providing a tube with an extended surface has been to shrink or force a ring or disc, which forms the extended surface, on to the tube.

When a ring or disc is shrunk onto a tube and the assembly is heated, the ring or disc expands and contracts simultaneously with the tube. If the coefficient of expansion of the ring is less than that of the tube, the ring will grip the tube more tightly when the temperature of the tube and ring is raised. For this reason, when cast iron extended surface rings are shrunk on steel tubes, the combination forms effective means for transferring heat to the fluid in the tubes from a fluid of higher temperature which contacts with the rings for the reason that the coefficient of expansion of the cast iron rings is less than that of the steel tubes. Where, however, metals other than cast iron are utilized for the extended surface members to the end that the weight of the extended surface members may be reduced, it has been found that such lighter metals or alloys, particularly aluminum and its alloys, do not remain in good thermal contact with the tubes when subjected to heat because such lighter metals have higher coefficients of expansion than the steel tubes. In consequence, the ring or disc grips the tube less tightly upon heating, which makes it necessary to provide an unduly great difference between the temperature of the extended surface members and of the tubes in order to transfer heat between the rings and the tubes in commercial amounts.

The present invention provides readily applied and efficient means for attaching to tubes extended surface members having higher coefficients of expansion than the tubes to which they are secured, so that the thermal conductivity between the extended surface members and the tubes will not be reduced or materially lessened

when the members and tubes are subjected to high temperatures.

The invention further provides effective means for shielding the means for securing the extended surface members to the tubes to protect the securing means against any corrosive action of the heating medium.

The invention will be understood from the following description when considered in connection with the accompanying drawing forming a part thereof and in which:

Fig. 1 is a longitudinal sectional view of part of a tube included in heat transfer apparatus and provided with extended surface members secured to the tube in accordance with the present invention;

Fig. 2 is a sectional view on a reduced scale, taken on line 2—2 of Fig. 1; and

Fig. 3 is a partial sectional view, taken on line 3—3 of Fig. 2.

Like characters of reference refer to the same or similar parts in the several views.

The invention will be described in connection with heat transfer apparatus consisting essentially of steel tubes to which are secured extended surface discs or rings of aluminum or aluminum alloy which are secured to the steel tubes by steel retaining rings or bands having a coefficient of expansion no greater and preferably less than the coefficient of expansion of the steel tubes. It will be understood, however, that the invention is not limited to these particular metals for the several parts but that the invention is applicable to the securing of extended surface members to tubes in all cases where the coefficient of expansion of the extended surface members is greater than that of the tubes.

In the drawing, reference character 10 designates a steel tube forming part of a tubular heat exchange apparatus. The extended surface members secured to the outer cylindrical surface of the tubes, in the embodiment shown, consist of a plurality of separate discs 11 of aluminum or aluminum alloy. Each of the discs 11 is provided with an annular flange or hub 12 which extends radially outwardly from one side of the inner peripheral portion of the disc. The inner cylindrical surface of the flange 12 is preferably of a diameter slightly less than the outer cylindrical surface of the tube 10 so that the discs may be forced or shrunk onto the tubes. The radially outer cylindrical surface 13 of each of the flanges 12 is preferably inclined, as shown, outwardly from the side of the disc from which the flange extends and toward the axis of the

tube. The retaining rings 14 are made of steel having a coefficient of expansion equal to or somewhat less than that of the steel tube 10 and are provided with a tapering or inclined inner cylindrical surface which cooperates with the inclined surface 13 of flange 12. The diameter of the inner cylindrical surface of the retaining rings is preferably somewhat less than that of the surface 13 of flange 12 so that the rings may be driven on to the flanges 12 to provide a good driving fit.

If desired, the inner cylindrical portion 15 of the discs 11 and the flanges 12 may be cut or formed to provide a plurality of slots 16 preferably disposed more or less uniformly about the hub of the discs. In the embodiment shown, these slots extend from the inner cylindrical surface of the discs toward the outer peripheries thereof but only to a point just outwardly of the outer cylindrical surface of the retaining rings 14. It will be understood however that these slots may extend outwardly toward the outer peripheries of the discs 11 as far as desired and in some instances the slots may extend entirely outwardly to the periphery, thereby completely severing the discs in one or more places. These slots provide the discs or the hub portions thereof with a degree of resiliency they would not otherwise possess and facilitate the securing of the discs to the tubes and the maintenance of good thermal contact between the discs and tubes when the temperature of both is increased. In some instances, it may be found that a single slot for each disc will suffice.

For some purposes it may be found undesirable to expose the retaining rings 14 to the fluid on the outside of the heating elements. To prevent such exposure, means are provided for shielding the retaining ring from contact with such fluid. In the form of the invention shown, such means consists of an annular flange 17 which extends outwardly from the same side of the discs 11 from which the flange 12 extends. Flange 17 is spaced radially outwardly from the flanges 12, a distance which is sufficient so as not to interfere with the application of the retaining rings 14. As shown, the flange or shroud 17 is formed integrally with the disc 11, but if desired, it may be made independent of the disc and thereafter secured thereto, or it may be retained in position by contact with adjacent discs between which it is disposed. The flange 17 is proportioned so that it fits snugly into an annular recess 18 of the adjacent disc 11 with which it comes in contact, or in lieu of this arrangement, the flange may be proportioned so that its end will come into firm contact with the adjacent disc and thereby prevent the access of fluid on the outside of the tubes 10 to the retaining rings.

An annular abutment 19 may be provided which extends from the side of the disc opposite that from which the flanges 12 and 17 extend, and which is disposed and proportioned with respect to the disc so that it contacts the retaining ring 14 when the latter is in position and thereby maintains it in such position.

The extended surface members 11 are driven onto the tubes 10 in an axial direction or are shrunk thereon individually. After a disc has been driven onto or shrunk in position on a tube, the retaining ring is driven onto and over the flange 12. The cooperating conical surfaces of the flange 12 and ring 14 forces the inner cylindrical surface of the member 11 into

firm contact with the tube 10 to thereby lessen the resistance to the flow of heat between the contacting surfaces of the tube and the extended surface member to a minimum. When the tubes and the extended surface members thereon are subjected to higher temperatures, since the members 11 have a higher coefficient of expansion than the tubes, they tend to separate their contacting surfaces, but any such tendency is wholly prevented by the retaining rings 14 which expand no more than, or somewhat less than the tubes 10. With this arrangement it will be perceived that regardless of variations in temperature to which the tubes and their extended surface members are subjected, the initially good thermal contact between the tubes and the extended surface members will be maintained at all times and will tend to become better with increases in temperatures.

The form of the invention selected for disclosure is to be considered as a preferred form only. Variations in the form, location and arrangement of the several parts, as well as the materials thereof, may be effected without transcending the principles of the invention. For instance, the cooperating surfaces between the flanges 12 and the retaining rings 14 may be cylindrical or concentric with respect to the axes of the tubes, rather than tapering or conical, as shown in the drawing. Additionally, other means may be employed for protecting the retaining rings against any injurious effects of fluids which may be used with the apparatus in lieu of the form of the shroud disclosed. For example, the exposed area of the retaining rings may be plated or covered with some metal or substance which is not affected by the fluids used.

It will be understood that no intention is entertained to limit the invention except by the scope of the claims appended hereto.

What is claimed is:

1. Heat exchange apparatus including a tube, a disc constituting an extended surface member for the tube having a higher coefficient of expansion than the tube and having one or more slots extending radially outwardly from the inner periphery of the member and terminating short of the outer periphery thereof, and means having a coefficient of expansion no greater than the tube for securing and retaining the member to the tube.

2. Heat exchange apparatus including a tube, a disc constituting an extended surface member for the tube having a higher coefficient of expansion than the tube and having a portion engaging the tube, said tube engaging portion having one or more slots therein terminating short of the periphery of the member, and means having a coefficient of expansion no greater than the tube for engaging said tube engaging portion for securing the member to the tube.

3. Heat exchange apparatus including a tube, a disc constituting an extended surface member for the tube having a higher coefficient of expansion than the tube, means having a coefficient of expansion no greater than the tube for securing the member to the tube, and means for shielding the securing means from injurious effects of fluid passing through the apparatus.

4. Heat exchange apparatus including a tube, a disc constituting an extended surface member for the tube having a higher coefficient of expansion than the tube and having a tube engaging flange, an annulus having a coefficient of expansion no

greater than the tube for engaging said flange for securing the member to the tube, and means for shielding the annulus from injurious effects of fluid passing through the apparatus.

5 5. Heat exchange apparatus including a tube, an extended surface member for the tube having a higher coefficient of expansion than the tube and having a tube engaging flange, an annulus having a coefficient of expansion no greater than
10 the tube for engaging said flange for securing the member to the tube, and a shroud integral with said member for shielding the annulus from injurious effects of fluid passing through the apparatus.

15 6. Heat exchange apparatus including a tube, an extended surface member for the tube having a higher coefficient of expansion than the tube and having a tube engaging flange, an annulus having a coefficient of expansion no greater than
20 the tube for engaging said flange for securing the member to the tube, and a shroud integral with said member for shielding the annulus from injurious effects of fluid passing through the apparatus, said member having a recess for receiving the outer end of the shroud of an adjacent member.

7. Heat exchange apparatus including a tube, an extended surface member for the tube having a higher coefficient of expansion than the
30 tube and having a tube engaging flange, an annulus having a coefficient of expansion no greater than the tube for engaging said flange for securing the member to the tube, and a shroud integral with said member for shielding the annulus from injurious effects of fluid passing
35 through the apparatus, the shroud being proportioned so as to engage the adjacent member when positioned on the tube.

8. Heat exchange apparatus including a tube,
40 a disc constituting an extended surface member for the tube, means for securing the member to the tube, and means for shielding the securing means from injurious effects of fluid passing through the apparatus.

45 9. Heat exchange apparatus including a tube, a disc constituting an extended surface member for the tube, means for securing the member to the tube, and means integral with said member for shielding the securing means from injurious effects of fluid passing through the apparatus.

50 10. Heat exchange apparatus including a tube, a disc constituting an extended surface member for the tube having a tube engaging flange, an annulus for engaging the flange for securing the member to the tube, and a shroud for shielding the annulus from injurious effects of fluid passing through the apparatus.

55 11. Heat exchange apparatus including a tube, an extended surface member for the tube having
60 a tube engaging flange, an annulus for engaging

the flange for securing the member to the tube, and a shroud for shielding the annulus from injurious effects of fluid passing through the apparatus, said member having a portion for engagement with the shroud of an adjacent member.

12. Heat exchange apparatus including a tube, an extended surface member for the tube having a tube engaging portion, means engaging said portion to secure the member to the tube, and a shroud for the first mentioned securing means, said member having a portion for engagement with the securing means and the shroud of an adjacent member.

13. An extended surface member for the tubes of heat exchange apparatus comprising a disc having a tube engaging portion arranged to receive a securing member and a shroud disposed so as to shield the securing member from injurious effects of fluid passing through the apparatus.

14. An extended surface member for the tubes of heat exchange apparatus comprising a disc having a tube engaging portion arranged to receive a securing member, said portion having one or more slots which terminate short of the outer periphery of the member.

15. An extended surface member for the tubes of heat exchange apparatus comprising a disc having a tube engaging portion arranged to receive a securing member, said portion having one or more slots which terminate short of the outer periphery of the member, and a shroud disposed so as to shield the securing member from injurious effects of fluid passing through the apparatus.

16. An extended surface member for the tubes of heat exchange apparatus comprising a disc having a tube engaging portion arranged to receive a securing device, said portion having one or more slots which terminate short of the outer periphery of the member, and a shroud disposed so as to shield the securing device from injurious effects of fluid passing through the apparatus, the member being adapted to engage the shroud of an adjacent member.

17. An extended surface member for the tubes of heat exchange apparatus comprising a disc having a tube engaging portion arranged to receive a securing device, said portion having one or more slots which terminate short of the outer periphery of the member, and a shroud disposed so as to shield the securing device from injurious effects of fluid passing through the apparatus, the member being adapted to engage the shroud and the securing device of an adjacent member.

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