July 19, 1932. C. W. STANCLIFFE 1,868,436

HEAT TRANSFER APPARATUS

Filed Sept. 10, 1930

Fig. 2.

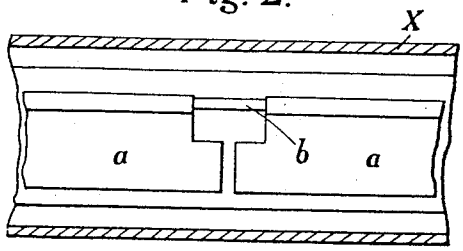


Fig. 1.

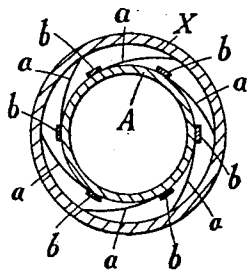


Fig. 4.

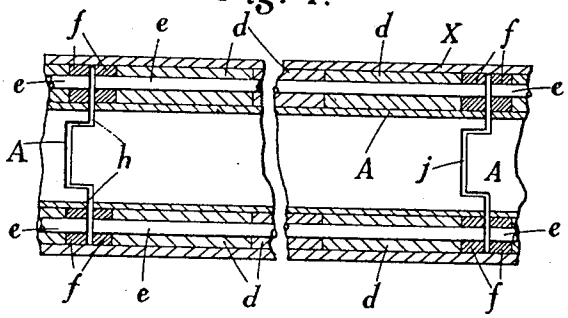


Fig. 3.

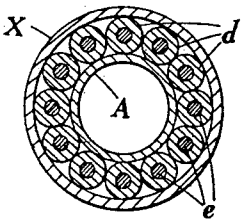
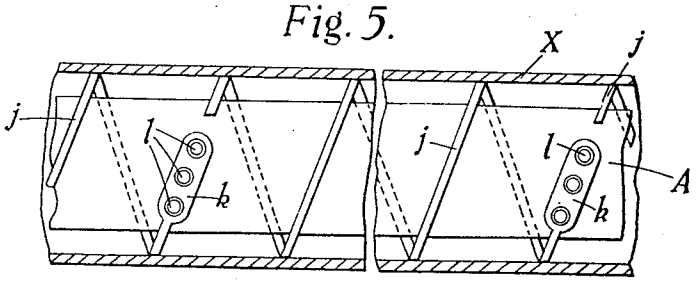


Fig. 5.



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UNITED STATES PATENT OFFICE

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HEAT TRANSFER APPARATUS

Application filed September 10, 1930, Serial No. 481,009, and in Great Britain September 20, 1929.

This invention relates to heat transfer apparatus for the heating and cooling of fluids and has for its object to provide improved apparatus whereby the transfer of heat may be effected in a more efficient manner than hitherto.

To save repetition, the term heating will be used in the remainder of the specification to include the operations of cooling and heating.

The invention relates more particularly to that type of heat transfer apparatus in which the fluid to be heated passes through a tube in which is rotated relatively thereto a member moving in contact with the internal surface of the tube.

In the usual form of apparatus the tube is stationary, and a member which rotates relatively thereto and carries means for wiping the internal surface of the tube will hereinafter be referred to as a rotor, although it is to be understood that the rotor might be stationary and the tube itself rotate.

It has been found that tubes in practice are seldom truly circular and absolutely straight, and experiment has shown that the heat transfer is much more efficient when contact is maintained between the rotor and the tube throughout practically its whole surface. The effect of the lack of absolute circularity and straightness in actual tubes is that in practice the fitting of rotating solid grooved rotors is unsatisfactory as it is practically impossible to make these an absolute fit within the tubes, the result being that as they rotate they contact with certain portions of the tube and not with others.

I have previously proposed a construction in which blades projected outwards from a roller and were held against the inner surface of the tube by spring pressure; this construction enables the blades to maintain contact with the tubes if lacking in true circularity which is maintained through the length of the tube.

In accordance with the present invention, the rotors are so constructed that they maintain close contact with the heat transfer tube even when the latter is lacking in straightness, or has a lack of circularity which is not constant. The improved rotors are both articulated and self-aligning.

In the accompanying drawing which illustrates in a diagrammatic manner three forms of heat-transfer rotors according to the invention, each rotor being shown inside its heat-transfer tube.

Figures 1 and 2 represent in cross-section and plan respectively a form having spring wipers attached in lengths to a core tube.

Figures 3 and 4 represent in cross-section and plan respectively a form having rollers in short lengths supported on rods supported between spiders or end plates on lengths of intermeshing core tubes.

Figure 5 represents a plan of a form having lengths of spiral spring secured to a core tube.

Referring first to Figures 1, 2 the core tube A has secured to it a series of flat spring blades *a*, preferably of phosphor bronze or like suitable metal, which bear against the heat-transfer tube X as the core A is rotated in relation to the tube X. These spring blades are in short lengths and may be spot-welded or otherwise secured direct to the tube A, but in the form shown they pass round strips *b* which are spot-welded at intervals to the core A.

As the core tube A rotates the spring blades will maintain contact with the tube X even if there be slight lack of circularity in either tube or if either tube is slightly out of straight.

In the form shown in Figures 3, 4 a series of short rollers *d* are mounted on rods *e* which are carried between spiders or end-plates *f* which are secured at each end of a length A of core tube. Each core tube length is provided at each end with reversed dog clutch openings *h*, *j* which cause rotation to be transmitted from one length to the next but allows play to give an articulated effect.

Although the rollers *d* are shown in Figure 3 as touching each other it is to be understood that there is sufficient clearance between them to allow independent movement; the parts are so proportioned that the rods *e* are sprung slightly to hold the rollers *d* in close contact with the tube X and there is

preferably a slight clearance between the rollers *d* and the core tube A and the rods *e* can move and deflect to take up very slight lack of circularity of the tube X. Although it is preferred to employ loose rollers mounted on the rods, the rods themselves may be so arranged as to contact with the tube X.

In the form shown in Figure 5, the rotor consists of a core tube A to which is secured a series of spiral springs *j* short in relation to the length of the tube X. These springs are flattened at one end *k* and are secured by suitable means such as rivets or screws *l* to the core tube; the other end of each spring is free. There is clearance between the springs and the core tubes and the springs maintain contact with the tube X even if it be lacking in roundness or straightness.

It is to be understood that the invention is not restricted to the exact details shown and described but embraces such modifications as come within the ambit of the accompanying claims.

I claim:—

1. A rotor core and tube heat transfer apparatus of the type referred to, including a heat transfer tube of considerable length and small diameter, a core member rotatably mounted within the tube to provide an annular passage between it and the tube, a plurality of relatively short wipers carried by the core member and arranged in and dividing said annular passage into a large number of small compartments, and independent spring means for holding each wiper in contact with the inner surface of the tube.

2. A rotor for rotation relative to a heat transfer tube of considerable length and small diameter in a heat transfer apparatus of the type referred to, including a core member capable of relative rotation in said tube and formed in relatively short lengths, articulated connections between said short lengths, wipers carried by said short lengths, and means for maintaining the wipers in close contact with the tube.

3. A rotor for rotation relative to and within a heat transfer tube of considerable length and small diameter in a heat transfer apparatus of the type referred to comprising a core member, a plurality of spiral springs each anchored at one end to said core member, the length of each spring being short in relation to the length of said heat transfer tube and each spring contacting throughout its outer surface with said transfer tube and leaving slight clearance between it and the core.

4. A rotor for rotation relative to and within a heat transfer tube of considerable length and small diameter in a heat transfer apparatus of the type referred to comprising an articulated core member and wipers in short lengths carried by said articulated core member and engaging the inner surface of the heat-transfer tube.

5. A rotor for rotation relative to and within a heat transfer tube of considerable length and small diameter in a heat transfer apparatus of the type referred to comprising an articulated core member and self-aligning wipers carried by said articulated core member.

6. A rotor for rotation relative to a heat transfer tube of considerable length and small diameter in a heat transfer apparatus of the type referred to comprising a core member, and short lengths of metal blades attached to said core member, dividing the space between said core member and said tube into a plurality of passages and bearing against the inner surface of the heat transfer tube.

7. Heat transfer apparatus comprising a heat transfer tube of relatively small diameter with regard to the length, a rotatable core tube within the heat transfer tube, resilient means separating said tubes, said means being secured to said core tube and rotatable therewith.

8. Heat transfer apparatus comprising a heat transfer tube of relatively small diameter with regard to the length, a rotatable core tube within the heat transfer tube, and means aligning said core tube centrally of the heat transfer tube, said means secured to and rotated with said core tube.

In testimony whereof I affix my signature.

CECIL WHEATLEY STANCLIFFE.