United States Patent

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[54] **ROTARY COIL FOR HEAT EXCHANGERS AND SIMILAR DEVICES EQUIPPED WITH SUCH COIL**
9 Claims, 7 Drawing Figs.

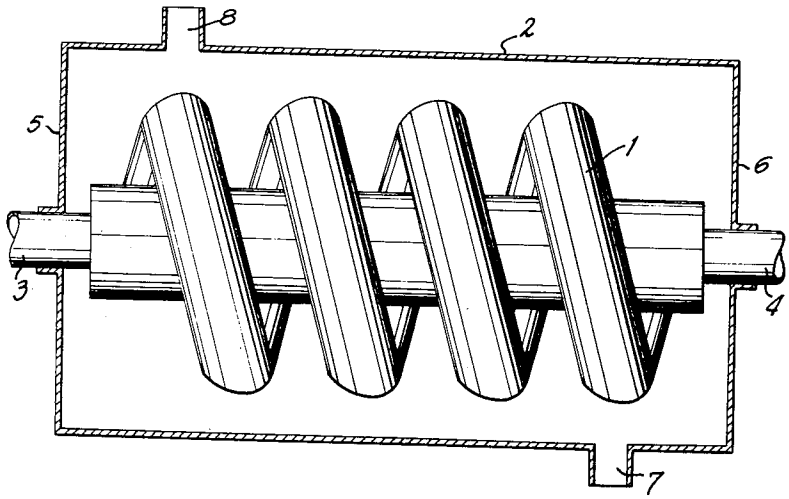
[52] **U.S. Cl.** **165/87,** 165/135, 159/28
[51] **Int. Cl.** **F28f 13/14**
[50] **Field of Search** ..... 165/87–92, 133–135; 259/156–157; 159/25, 28 B, 28 C, 28 D

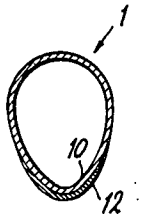
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ABSTRACT: A rotary coil for heat exchangers and similar devices, having a substantially airfoil-shaped cross section.





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SHEET 1 OF 2

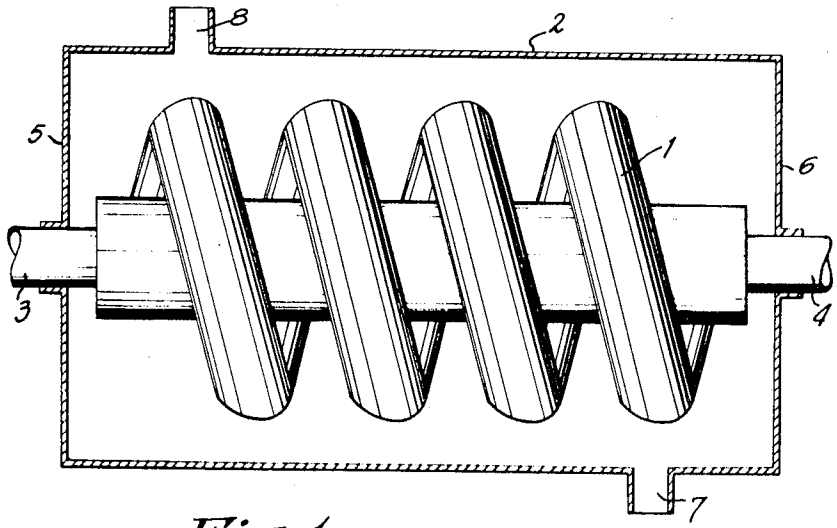


Fig. 1

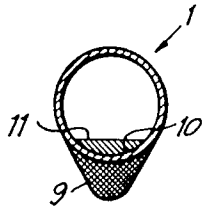


Fig. 2

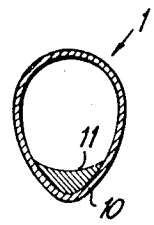


Fig. 3

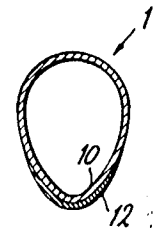


Fig. 4

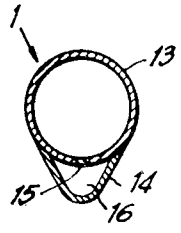


Fig. 5

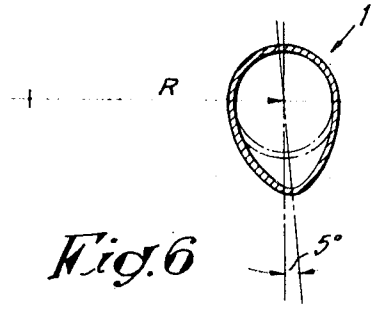


Fig. 6

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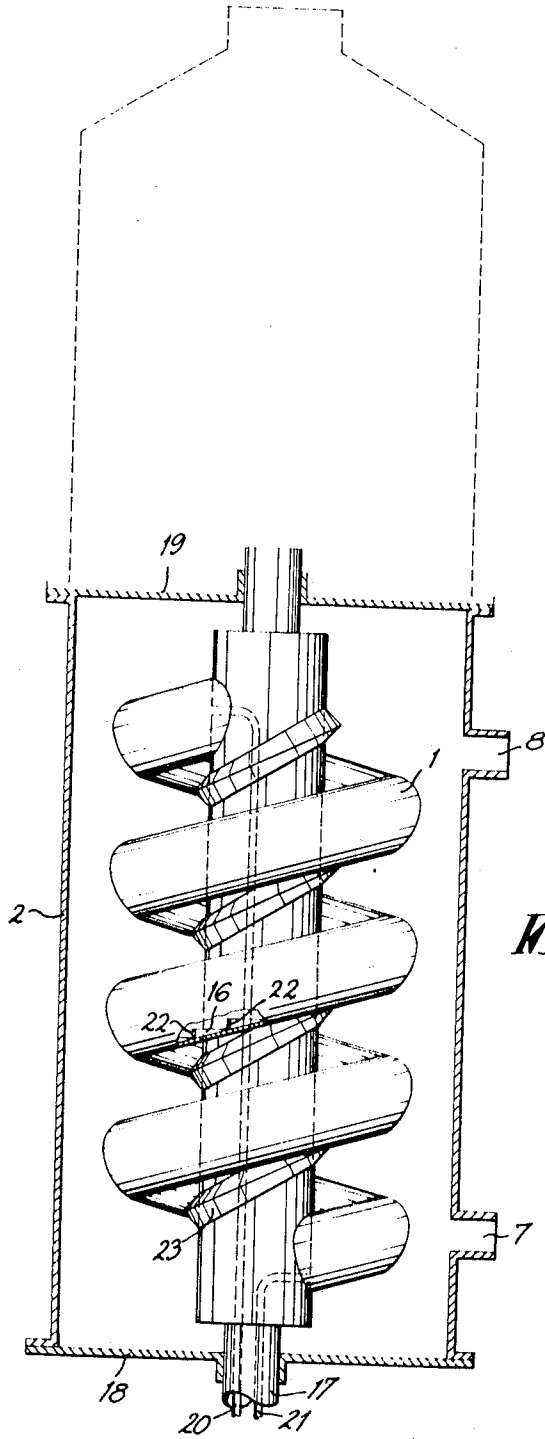


Fig. 7

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ROTARY COIL FOR HEAT EXCHANGERS AND SIMILAR DEVICES EQUIPPED WITH SUCH COIL

The present invention relates to an improved rotary coil for heat exchangers and similar devices.

Rotary steam coil devices have already been used a evaporators—either atmospheric or vacuum—in the food industry for making high-density food products, such as tomato paste, strawberry preserves etc.

Generally, such rotary stream coils are rotatably mounted, with their central axis horizontal, inside the dimple jacketed pan section of evaporators. They are driven at a determined speed and kept covered at all times with the product to be evaporated. Steam is passed through the coil which is constituted by a helically wound tube of circular cross section.

It has been found that in normal operation, as such known coils rotate, a cavity develops in the product on the trailing side of the coil, due to the velocity and the lead of the latter and to the viscosity of the product.

This cavity causes a fine film of the product to be deposited on the hot trailing edge of the coil, so that undesired burn on is experienced. This of course is detrimental mainly to the flavor of the finished product.

It is one object of the present invention to eliminate this disadvantage. To this end, an improved rotary coil construction is proposed, wherein the trailing region of the coil transfers less heat than the rest of the coil.

Preferably, this novel coil will have an airfoil-type cross section. Another object of this invention is to provide a novel coil construction whereby, besides eliminating the risk of burn on, the problem of evacuating the considerable amounts of steam condensate formed during high rates of heat transfer can easily be solved and in such a way that the ratio of heat transfer by the trailing edge of the coil is further reduced.

These and other objects and advantages of the invention will be apparent from the following description wherein reference is made to the accompanying drawings, in which:

FIG. 1 is a schematical longitudinal section of a heat transfer device embodying a coil according to this invention;

FIG. 2 is a cross section of a conventionally shaped coil, improved according to this invention;

FIGS. 3–5 respectively show cross sections of preferred coil constructions;

FIG. 6 schematically shows a preferred coil configuration; and

FIG. 7 schematically shows a preferred set up of the coil according to this invention in an after heater, respectively an evaporator.

As shown in FIG. 1, the improved coil according to the invention may be used, e.g., as a heater. Therefor, coil 1 is horizontally disposed and rotatably carried within a shell 2, coil supporting hollow shafts 3 and 4 being journaled in the end plates 5 and 6 respectively of shell 2. The hollow shaft 3 is connected to one end of the coil, the other end of which being connected to shaft 4. Steam is injected into coil 1 through shaft 3, whereas condensate is evacuated through shaft 4, the steam and condensate path being schematically indicated by the dot and dash line on FIG. 1.

The product is led in shell 2 through inlet pipe 7 and pumped out through outlet pipe 8.

As the coil rotates within the product the lead in the coil and the velocity of the latter provide a rapid movement through the product, and, as a result, and because of the consistency of the product, a cavity may develop on the trailing side of the coil. If the latter is given a traditional circular cross section, this cavity may assume the shape indicated at 9 is FIG. 2. Such a situation may cause a film of the product to be deposited on the hot trailing side 10 of the coil where it would burn. To prevent this burn on, and according to this invention, the trailing side 10 is made less heat conductive than the rest of the coil. This may be achieved by partially filling the coil with a slow heat transfer material such as lead, solder or Teflon, in such manner that this filling wire form a backing to the trailing side of the coil, as indicated at 11 in FIG. 2. The

outer surface of said trailing side may further be provided with a layer of nonsticking material such as Teflon.

In order to reduce the volume of cavity 9 and thereby the surface of the film liable to deposit on and stick to the trailing side 10 of the coil, the latter may preferably be given an airfoil cross section, as shown in FIG. 3. The trailing edge 10 thereof may also be backed by a filling 11.

Alternately, it may be sufficient to only provide the outer surface of said trailing edge 10 with a Teflon coating 12, as shown in FIG. 4.

As shown in FIG. 5, a fabricated coil according to the invention may consist of two sections, namely one round tube 13 and a formed cap 14 welded to said tube 13 to obtain an airfoil section. This construction provides heat only in the tube section with conduction heating through the metal of cap 14, forming the trailing edge, rapidly diminishing as said cap extends from the tube 13 up to edge 10. With this construction, it would not be necessary to provide any internal or external insulation.

Preferably, passages 15 are provided through the wall of tube 13, whereby the inner volume of tube 13 communicates with that of cap 14, thereby allowing condensate to collect in the cap 14, as indicated at 16. This condensate further cools the trailing edge region of the coil.

Preferably, with any of the embodiments according to FIGS. 3 to 5, the trailing edge 10 of the airfoil section is slightly angled outwardly, i.e., about 5° from the axis of rotation of the coil. This provides for a better laminar flow of the product with respect to the outer surface of the coil as the latter rotates, and more specifically around the trailing edge thereof.

A particularly advantageous arrangement of the coil as described hereabove is shown in FIG. 7, schematically representing a heater or a vacuum evaporator (dotted lines).

In this example, coil 1 is rotatably mounted in a shell 2, so that its axis of rotation is vertical. Said coil 1 is supported by a hollow shaft 17 journaled in the bottom and top plates, respectively 18 and 19, of shell 2. In the case of a vacuum evaporator, a supporting bracket (not shown) is substituted for the plate 19.

Steam is led through the hollow shaft 17, and through steam conduit 20, to the upper part of coil 1, while condensate is removed from the lower part of said coil, through the outlet conduit 21. Due to the rotation of the coil and the slope of the lead thereof, the condensate will run down freely without interfering with the passage of steam, said condensate accumulating in the trailing edge of the coil, thereby cooling the latter. To further improve said cooling, barrier plates may be provided within the coil at the back of the trailing edge, as indicated at 22 in the broken off part of FIG. 7.

To improve product circulation in shell 2 and thereby obtain a more efficient heat transfer, a helical rib 23 may be provided on shaft 17.

As various modifications to the embodiments described hereabove will readily occur to those skilled in the art, all suitable modifications and equivalents are considered to fall within the scope of the invention, as claimed hereafter.

What we claim is:

1. In a heat exchanger, a shell with an inlet and an outlet for the substance to be heated, a rotary shaft in said shell, a hollow heating coil fixed upon said shaft, said coil having an air foil cross section, and heat conductivity reducing means carried upon that surface of the coil which is trailing in relation to a direction of rotation of the coil and the shaft.

2. Improved rotary coil according to claim 1, wherein said means consist of a backing, partially filling the coil in the trailing region thereof, said backing consisting of a slow heat transfer material.

3. Improved rotary coil according to claim 1, wherein said means consist of an external Teflon coating on said trailing surface.

4. Improved rotary coil according to claim 1, wherein said coil consists of a round tube to which a formed cap is affixed, said tube and cap defining an airfoil cross section.

5. Improved rotary coil according to claim 3, wherein passages are provided in said tube wall, whereby the inner space of said tube communicates with that of said cap.

6. A device according to claim 1, wherein the coil is of air-foil cross section which is angled outwardly from the axis of rotation of the coil.

7. A device according to claim 1, wherein the coil is mounted in a vertical position.

8. A device according to claim 7, wherein steam is in the upper region of the coil and condensate led out at the lower end of the coil.

9. A device according to claim 8, wherein internal barrier plates are provided in the trailing edge region of the coil.

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