Feb. 3, 1925.

1,525,094

R. C. JONES

MULTIVANE COOLER

Filed March 5, 1921

2 Sheets-Sheet 1

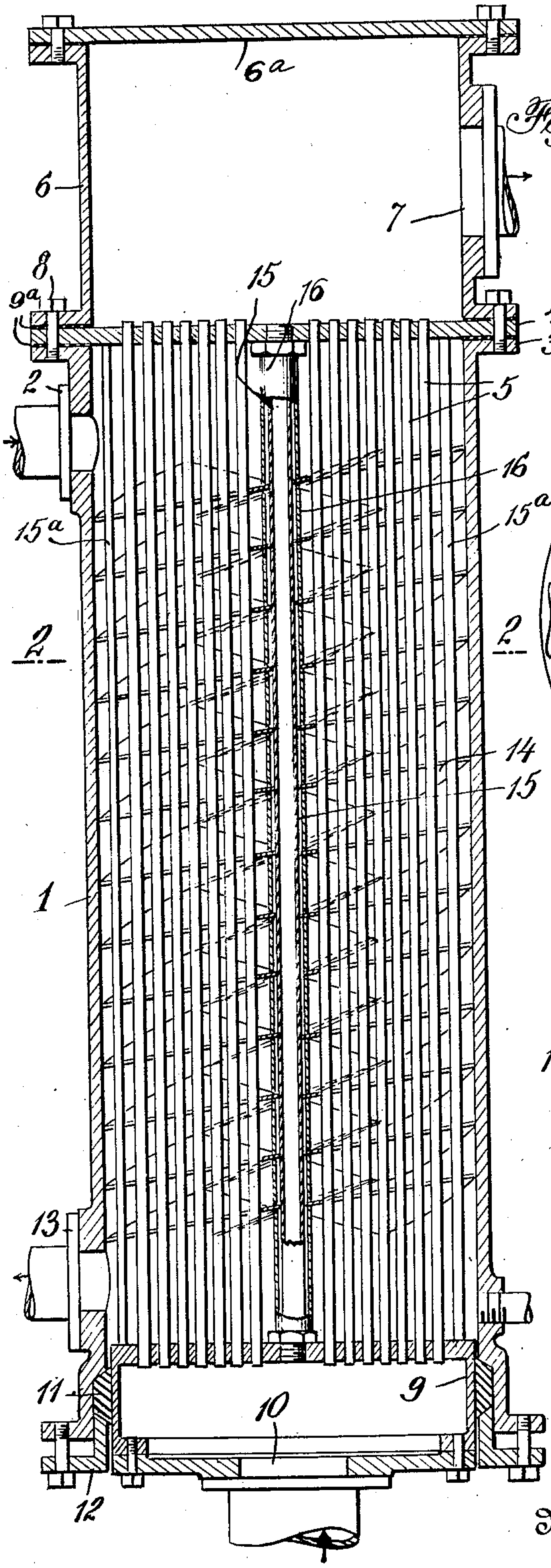


Fig. 1,

Fig. 2,

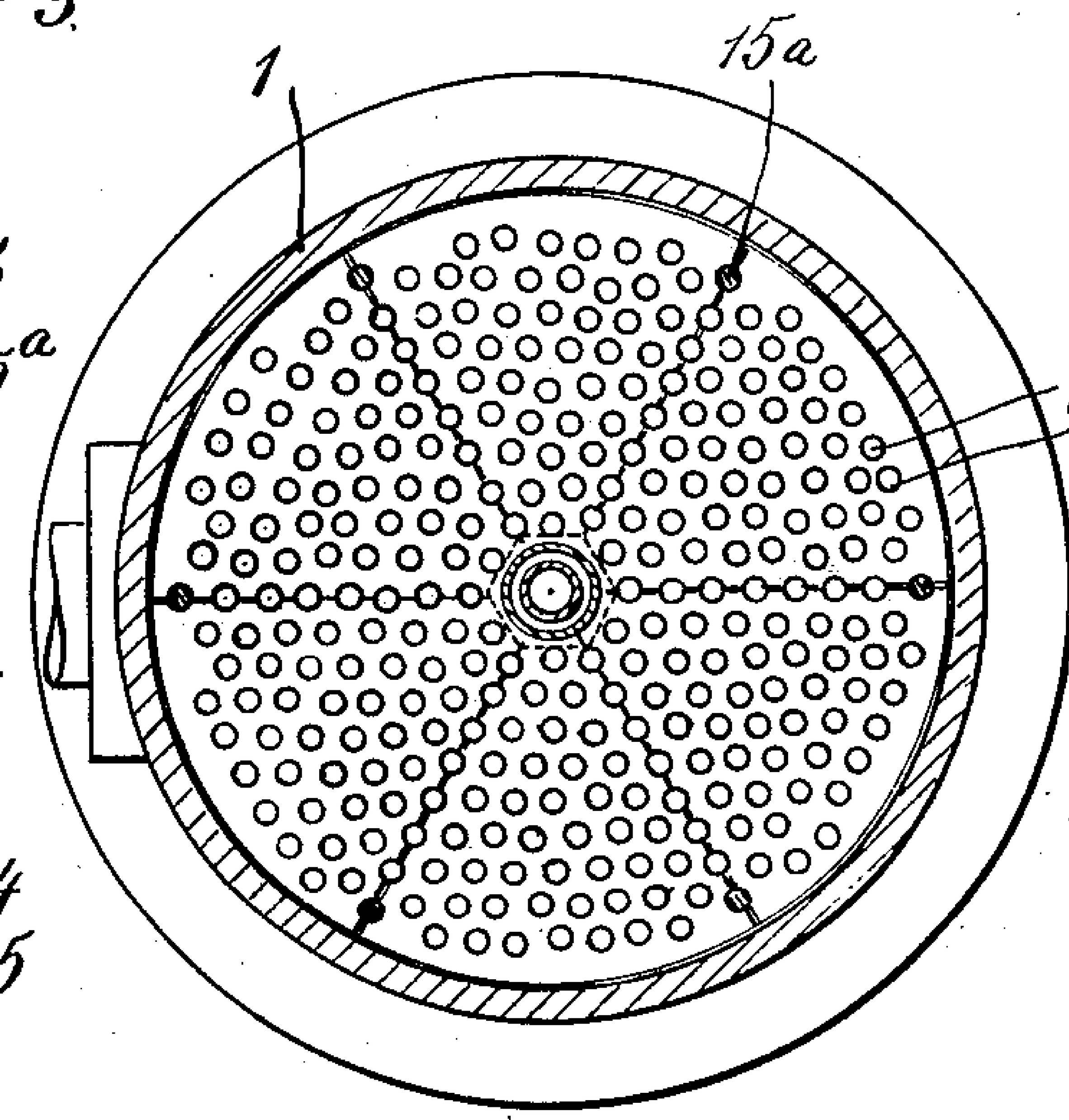


Fig. 3,

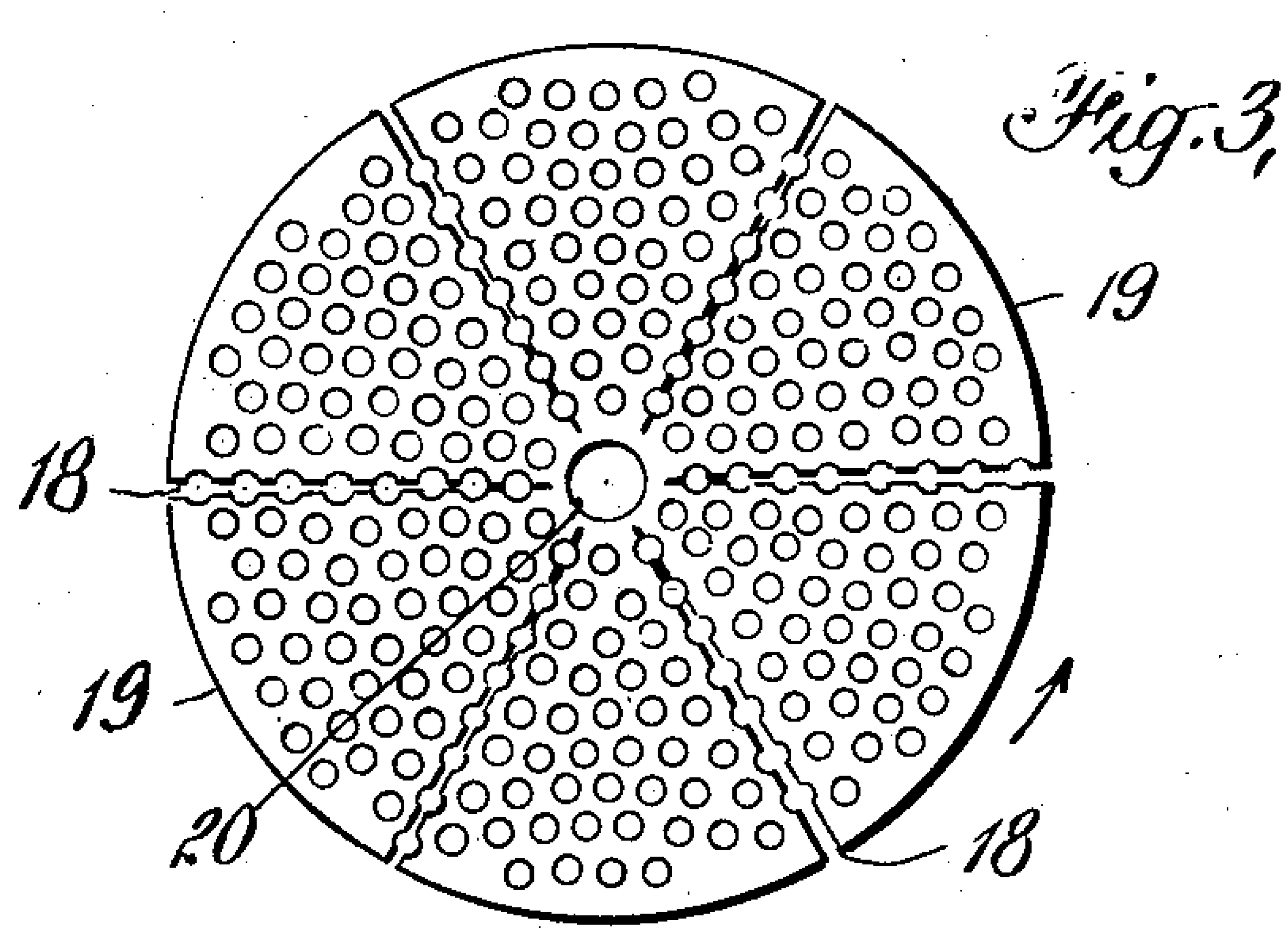
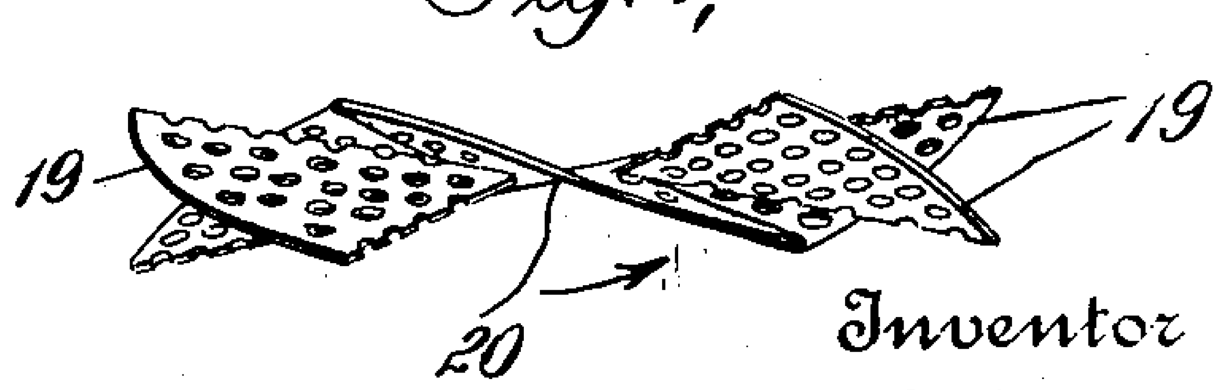


Fig. 4,



Inventor
Russell C. Jones

By his Attorneys
Pennie, Davis, Marvin, & Edmonds

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2 Sheets-Sheet 2

Fig. 6,

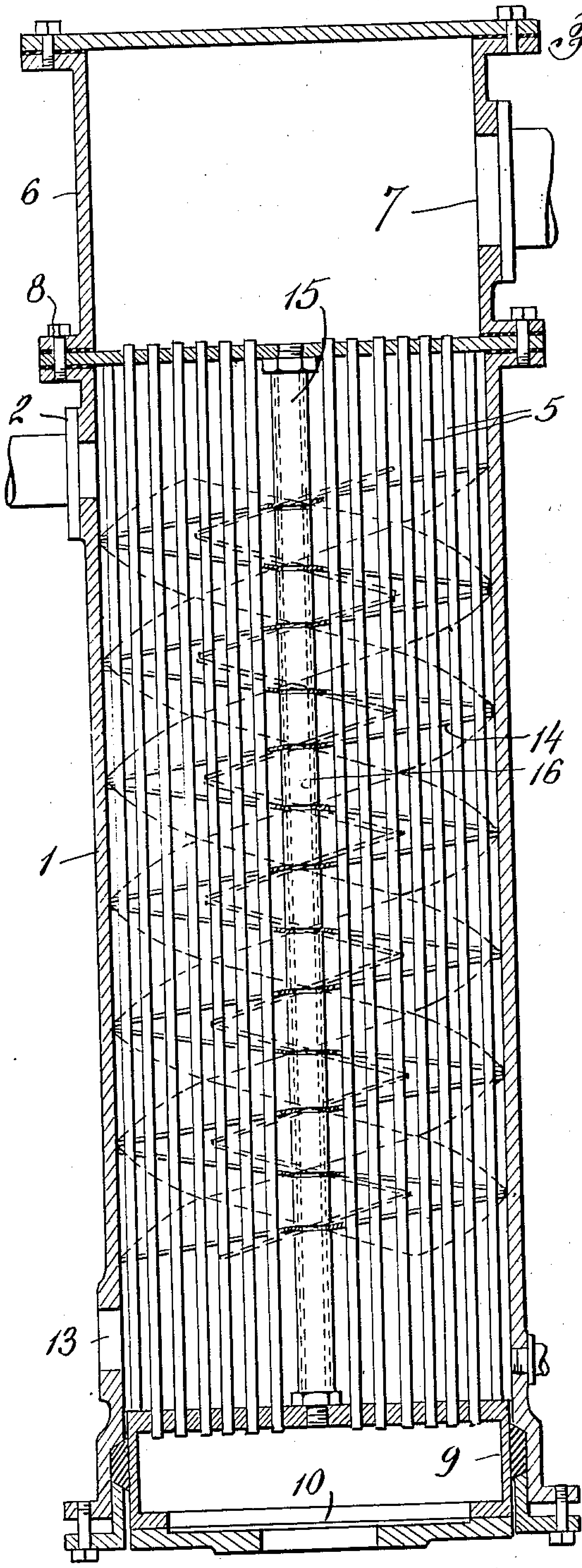


Fig. 5,

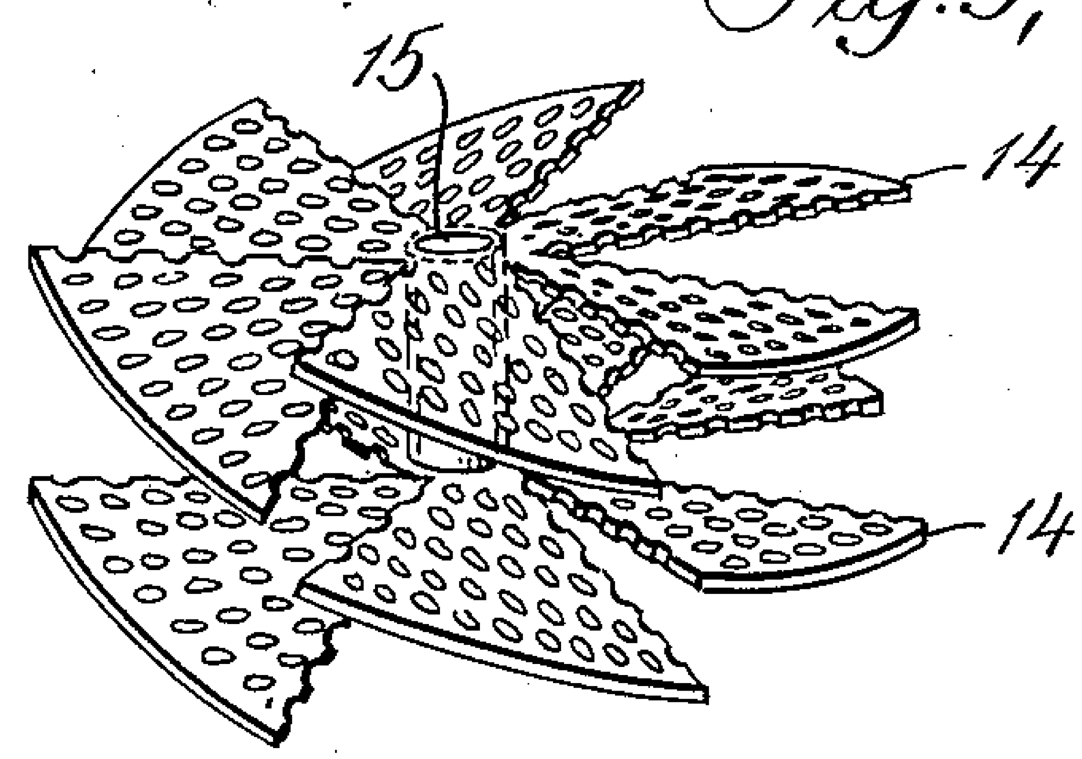


Fig. 7,

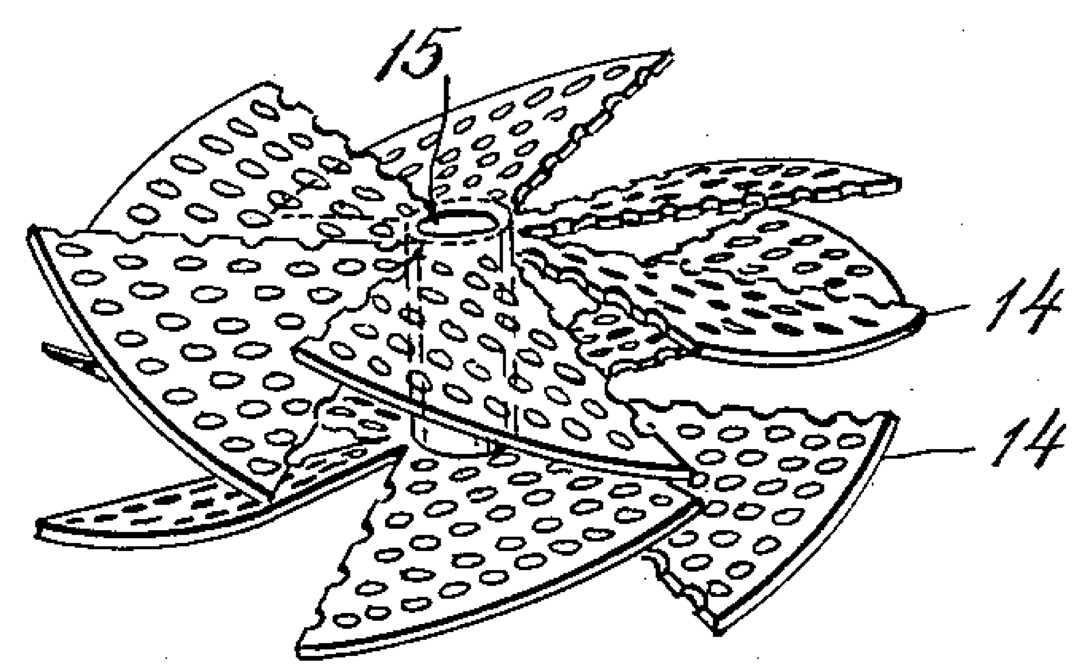


Fig. 8.

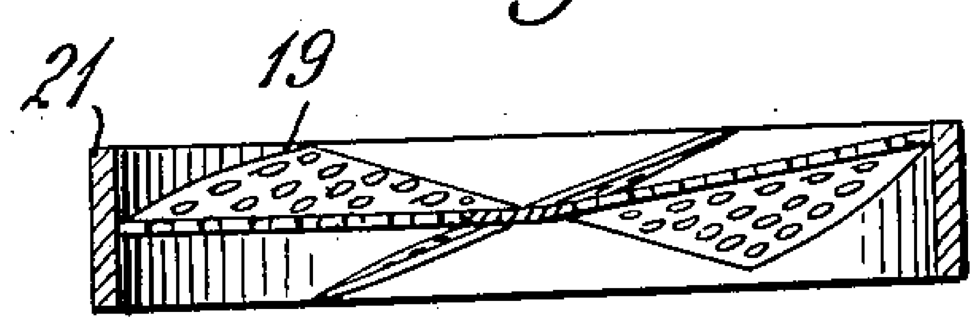
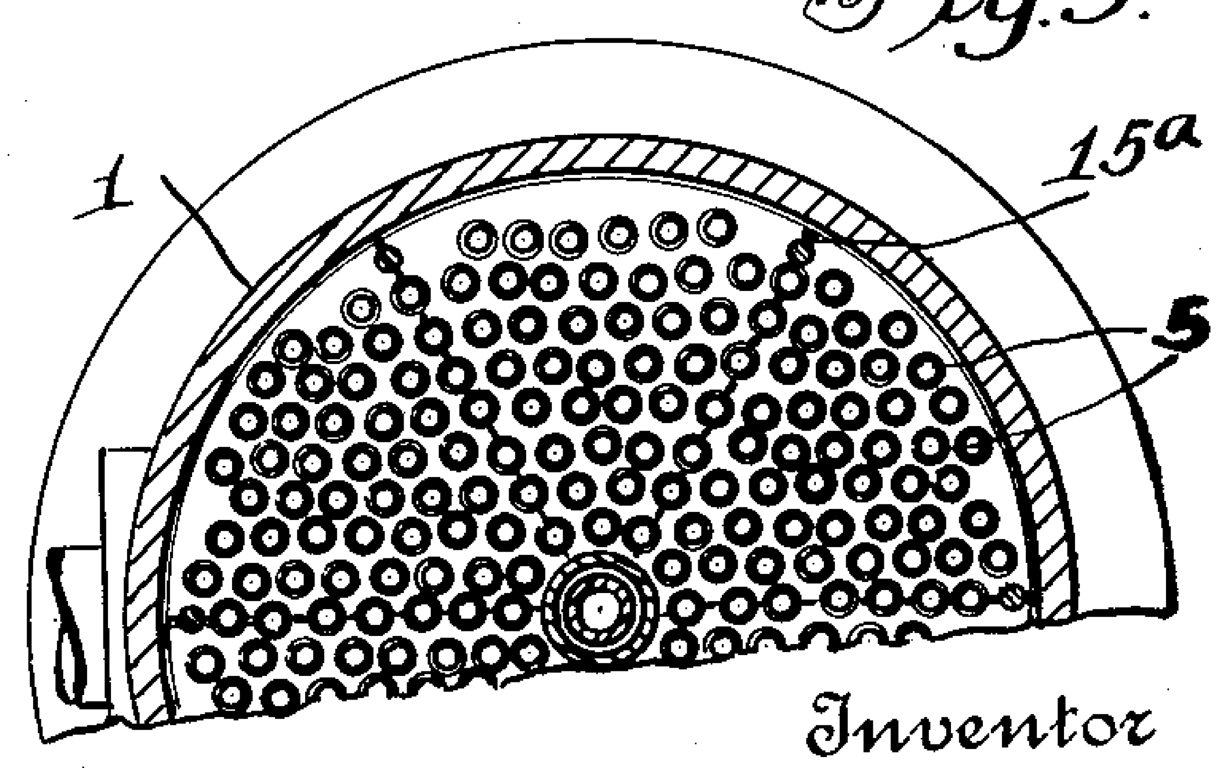


Fig. 9.



Inventor
Russell C. Jones

By his Attorneys
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Patented Feb. 3, 1925.

1,525,094

UNITED STATES PATENT OFFICE.

RUSSELL C. JONES, OF BRONXVILLE, NEW YORK, ASSIGNOR TO THE GRISCOM RUSSELL COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

MULTIVANE COOLER.

Application filed March 5, 1921. Serial No. 449,678.

To all whom it may concern:

Be it known that I, RUSSELL C. JONES, a citizen of the United States, residing at Bronxville, in the county of Westchester, State of New York, have invented certain new and useful Improvements in Multivane Coolers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains, to make and use the same.

The present invention relates to heat exchangers of the type in which heat is transferred from one fluid to another, and has to do particularly with improvements in that type of heat exchanger disclosed in the patent to Russell C. Jones, No. 1,335,506 dated March 30th, 1920.

The efficiency of a heat exchanger of this type and the rate of transfer of heat depend directly on the temperature difference between the heat transferring surface and the fluid immediately adjacent to it. Accordingly, it is necessary that the fluid be maintained in constant agitation to secure a uniform heat distribution throughout its volume and thereby obtain a maximum temperature difference at the heat transferring surface.

This is epecially true in the case of a viscous liquid. In an oil heater, for instance, that portion of the oil immediately in contact with the heating element becomes heated almost to the temperature of the heating surface, forming a relatively thin film of limpid oil about the heating surface from which the remaining volume of the oil is heated chiefly by conduction unless some means be provided whereby thorough agitation of the entire volume may be secured. In such a case the temperature difference at the heat transferring surface is small, and the heat transfer takes place at an accordingly low rate. The apparent temperature difference is much greater than that actually existing. The same is true in the cooling of a viscous liquid, in which case the film of liquid immediately adjacent to the cooling surface becomes congealed producing a low actual temperature difference, even though the average temperature of the entire volume of the liquid to be cooled is much higher than that of the portion immediately adjacent to the cooling surface.

It is, therefore, necessary that some means be provided in a heat transferring apparatus of this type whereby thorough agitation of the liquid to be acted upon may be secured and the entire volume of this liquid brought repeatedly into immediate contact with the heating or cooling element. This agitation must, however, be secured by means compatible in cost, power consumption, and the like, with the rest of the apparatus. Furthermore, any such means which necessitates a considerable pressure drop throughout the apparatus is generally undesirable. In the case of oil coolers and other apparatus in which the fluid to be acted upon is drawn directly from a retort, evaporator, or like device, the discharge from the heat transferring apparatus is normally to atmospheric pressure, and any pressure difference required to maintain the flow of the liquid through the apparatus results in a back pressure being transmitted to the retort or evaporator. Such back pressure is undesirable in that it raises the boiling point of the liquid to be evaporated and consequently reduces the output of the evaporating apparatus.

The present invention has for its principal object to provide a heat transferring apparatus in which these objectionable features are avoided and in which a positive flow and thorough agitation of the fluid to be acted upon is maintained through the apparatus with a very low pressure difference.

It is a further object of the invention to provide an apparatus of the above type which in units of small dimensions have fluid paths of considerable length, whereby the entire volume of fluid is repeatedly brought into contact with the heat transferring surface and a long period of contact is attained.

It is also an object of the invention to provide an apparatus of this type which is relatively simple in construction and of low manufacturing cost, with very little machining or special construction of any sort.

It is also an object of the present invention to provide a heat transferring apparatus which is adapted for use with liquids of various viscosities, and in which there is no danger of clogging due to the viscosity of the liquid, or accumulation of sludge or foreign matter of any sort.

I have illustrated a preferred embodiment of my invention in the accompanying drawings in which

Fig. 1 is a longitudinal sectional view of a heat transferring apparatus in accordance with my invention;

Fig. 2 is a transverse section taken on the line 2—2 of Fig. 1;

Fig. 3 is a plan view, and Fig. 4 a side view of one of the individual elements constituting the fluid passage;

Fig. 5 is an enlarged perspective view of two of the baffle elements properly positioned in the shell;

Fig. 6 is a longitudinal section showing a modified form of my invention;

Fig. 7 is an enlarged perspective view showing the relation of successive baffle elements as positioned in the modified form of apparatus shown in Fig. 6;

Fig. 8 is a detail view showing a modified form of the vane or element used in constructing the fluid passage;

Fig. 9 is a partial sectional view similar to Fig. 2, showing a somewhat modified type of baffle element.

Referring to the drawings, particularly to Fig. 1, 1 indicates the shell of the apparatus which is shown here as a metal casting approximately cylindrical in shape and provided near one end with the flanged inlet 2 for the liquid to be acted upon. The end of the shell adjacent to this inlet 2 is flanged at 3 to provide a seat upon which the tube plate 4 is clamped. Supported in the plate 4 is a plurality of longitudinal tubes 5 arranged with alternate rows of tubes staggered as shown in Fig. 2. The tubes are welded or expanded into the plate 4 to provide fluid tight joints, and a central supporting column 15 is normally provided parallel to the tubes and extending the length of the shell.

A chamber or water head 6, having an outlet 7 for the working fluid, is provided at the upper end of the shell 1 and is flanged at its lower edge to provide means for attachment to the shell. The top of the chamber 6 is fitted with a removable cover 6ª which gives direct access to the tubes and allows them to be cleared while the apparatus is in operation. This upper head 6 and the tube plate 4 are rigidly bolted to the shell 1 by means of bolts 8, packing being provided at 9ª to insure fluid tight joints.

The opposite ends of the tubes 5 are expanded into a floating head 9 permitting of vertical movement to compensate for longitudinal expansion and contraction of the tubes due to temperature changes. The head 9 is provided with an inlet 10 for the working fluid, and the joint between it and the walls of the shell 1 is made fluid tight by means of packing 11 held in place by packing ring 12.

The shell 1 is also provided near this end with a flanged outlet 13 for the fluid which is acted upon. The apparatus thus comprises two longitudinal fluid passages, one extending from the head 9, through the tubes 5, and out at the chamber 6, and the other occupying the space surrounding tubes 5, having its inlet at 2 and its outlet at 13. It is to be noted that there are no packed joints between these two fluid passages, and that any leak occurring through the various joints will take place to the exterior of the apparatus and not from one passage into the other.

A long tortuous path for the liquid to be acted upon is provided by means of the baffle 14 which is preferably constructed in a series of elements similar to that shown in Figs. 3 and 4. Each of these elements consists essentially of a metal plate slit radially, as at 18, at equally spaced intervals, the slits extending from the outer edge to a point near the center of the plate. In this manner a number of separate sectors 19 is formed, and by bending each of these a given amount out of its original plane a series of blades is obtained generally similar to the blades of an ordinary fan of the so-called propeller type. These separate baffle elements may be stamped out of a sheet of metal at a single stroke and the sectors distorted to the desired form by a simple bending operation.

Vertical separator rods 15ª are preferably provided at the cut edges of the sheet and serve to hold the blades of the element in properly spaced relation. These separator rods are welded to the blades, the rods and baffle elements forming a unitary rigid structure. The baffle elements may be positioned one above the other in the shell without further means of support, in which case the central core tube may be dispensed with if desired. Each element is further provided with holes for the tubes and, in case a central core tube is used, with a central opening adapted to fit around the core tube. If desired, a spacing sleeve 16 may be provided at the center of each plate adapted to fit around the central tube 15 and hold the plates at fixed distances apart. The sleeve 16 and the rods 15ª may both be used or either may be used without the other. The successive elements are preferably placed in the shell with their blades sloping in the same direction as shown in Fig. 5.

Ordinarily the blades of successive elements will have uniform slopes, but in case of viscous liquids it is often desirable to build these elements with blades of various slopes, the steeper blades being placed near the end of the cooler where the liquid is hottest and consequently most limpid for the purpose of producing a more violent agitation at that point.

The baffles are placed in the shell in such a manner that the liquid to be acted upon when admitted through the inlet 2 flows in a direction relative to the baffle as indicated by the arrow in Figs. 3 and 4, the flow being in the direction of the slope of the blades. A portion of the liquid passes through the space between the first two blades while the remainder passes on to successive blades, additional amounts of the liquid escaping through the spaces between successive blades. Thus the fluid passing through the spaces between blades is given by gravity a downward velocity and also a component velocity tangential to the baffle at that particular point, due to the slope of the blades. As the liquid drops from one element of the baffle to the next it is given a continuous whirling motion, and a steady flow and thorough agitation through the apparatus is maintained largely by the action within the apparatus, thus requiring a very small pressure difference to be impressed between the ends of the passage through the shell.

In Fig. 9 I have shown the baffle elements provided with holes slightly larger than the outer diameter of the tubes 5 so that when the baffles are in place in the shell there will be a small annular space between each tube and the adjacent portion of the baffle. These annular spaces permit a certain portion of the fluid to pass from one turn of the baffle to the next by flowing through the annular spaces and contacting directly with the material of the tubes. This arrangement provides a cleaning or scouring action and prevents accumulation of congealed oil and sediment at the junctions between the baffles and the tubes. My improved baffle may be constructed to provide annular spaces about the tubes as shown in Fig. 9, or to fit closely about the tubes in the manner illustrated in Fig. 2, as desired. The provision of the annular spaces is similar to the constructions shown and described in the application of Russell C. Jones, Serial No. 359,607, which application is assigned to the company which is the assignee in the present case. In this application the provision of the annular spaces adjacent the heat transferring tubes is accomplished in an apparatus employing a continuous spiral baffle. Accordingly, I do not in the present application claim broadly the provision of such spaces, but merely claim them in combination with the particular type of baffle disclosed in this application.

In Figs. 6 and 7 I have illustrated an embodiment of my invention in which the blades of successive elements comprising the baffle slope in opposite directions. Liquid passing through the apparatus will have its direction of flow changed at the passage of each baffle element due to the reverse slope of the blades. This feature tends to promote a more violent agitation of the fluid but is likely to retard the flow through the shell to some extent and necessitate a slightly greater pressure difference to secure a steady flow.

In Fig. 8 I have illustrated a modification of a separate vane which may be employed as an individual element of the baffle, and which is particularly adapted to be cast rather than stamped from sheet metal. Elements of this type may be successfully employed without machining. In the type shown the baffle is provided with an annular band 21 along its outer edge, the height of the flange being equal to the desired distance between the elements and uniform throughout. The elements are placed one upon the other in the shell, the successive blades forming a continuous passage for imparting a whirling motion to the fluid being passed through the apparatus.

It is to be understood that the specific structure of the invention may be varied in detail without departing from the spirit of the invention. The exact form and construction of shell illustrated in the drawings need not be adhered to, the method of providing for expansion of the tubes may be varied, and other modifications in the structure may be resorted to within the scope of the appended claims.

I claim:

1. In heat exchanging apparatus for handling liquid of changing viscosity, the combination of an enclosing shell, a passage through the shell for working fluids, and a second passage through the shell for the said liquid, said second passage containing a baffle member having a plurality of blades, serving to agitate and film out said liquid during its passage through the apparatus.

2. In heat exchanging apparatus for handling oil or similar liquids, the combination of an enclosing shell, a plurality of longitudinal tubes constituting a passage through the shell for the working fluid, a second passage through the shell for the oil, a baffle in said shell consisting of a number of elements, each element having a plurality of radial blades sloping in the direction of flow of the oil and serving to produce a positive flow across said tubes, thereby bringing the entire volume of the oil into repeated and intimate contact with the heat transferring surfaces.

3. In an oil handling apparatus of the class described, the combination of an en-

closing shell, a plurality of heat transferring tubes constituting a passage through the shell for the working fluid, a second passage through the shell for the oil and a baffle in said shell consisting of a number of elements, each element having a plurality of radial blades for agitating and filming out the oil passing therethrough and passing it into positive contact with said heat transferring tubes, said baffle elements being provided with holes adapted to fit loosely around said tubes, thereby constituting an annular passage immediately adjacent the heat transferring surface.

4. In heat exchanging apparatus for handling oil or similar liquids, the combination of an enclosing shell, a plurality of longitudinal tubes constituting a passage through the shell for the working fluid, and a baffle member in said shell having a plurality of slanted blades for imparting a whirling motion to the main body of the said liquid and permitting it to fall under the influence of gravity upon lower blades, thereby effecting agitation of the liquid and imparting a whirling motion thereto, said blades being provided with holes adapted to fit loosely around said tubes for creating a secondary flow substantially parallel to the length of the shell.

5. In an oil handling apparatus of the class described, the combination of an enclosing shell through which one of the fluids is circulated, a plurality of longitudinal tubes constituting a passage through the shell for the working fluid, and a baffle member comprising a number of elements placed one above the other in the shell, each of said elements having a plurality of radial blades perforated to fit about said tubes and cause the oil to fall from one blade to the next for effecting agitation thereof and the blades of successive baffle elements sloping in opposite directions to oppositely deflect the impinging oil in successive baffle stages.

6. In a heat exchanging apparatus for handling oil the combination of an enclosing shell, a plurality of longitudinal tubes constituting a passage through the shell for the working fluid, a second passage through the shell for the oil, a baffle in said shell consisting of a number of elements, each element having a plurality of radial blades sloping in the direction of flow of the oil and serving to produce a positive flow across said tubes thereby bringing the entire volume of the oil into repeated and intimate contact with the heat transferring surfaces, and spacing sleeves extending between successive baffle elements and maintaining said baffle elements in properly spaced relation.

In testimony whereof I affix my signature.

RUSSELL C. JONES.