J. PRICE.

HEAT INTERCHANGER.

APPLICATION FILED FEB. 8, 1919.

1,382,670.

Patented June 28, 1921.

2 SHEETS—SHEET 1.

Fig. 1,

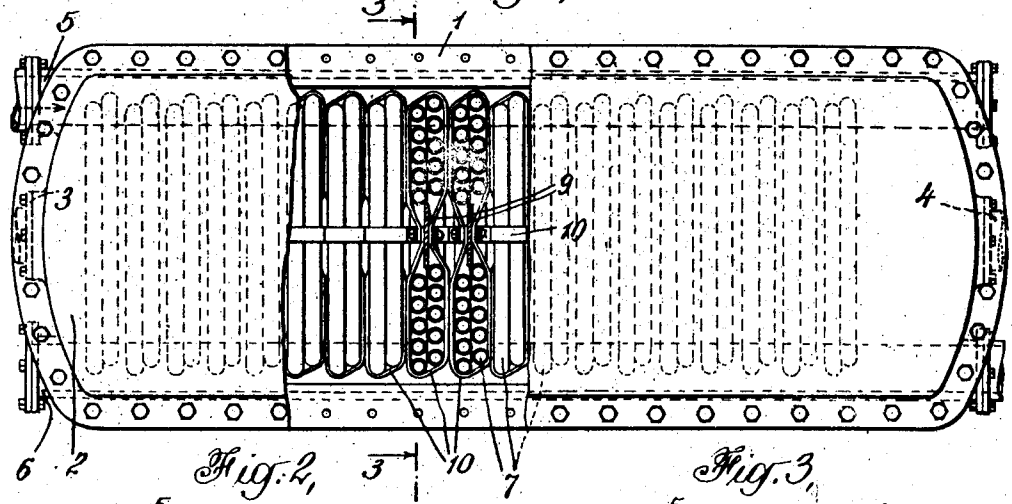


Fig. 2,

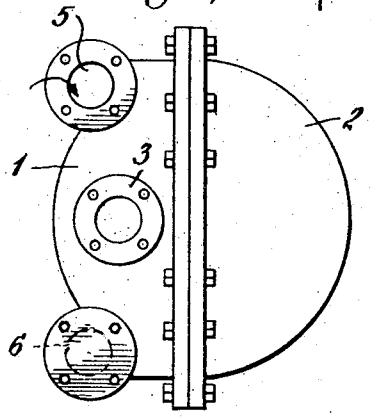


Fig. 3,

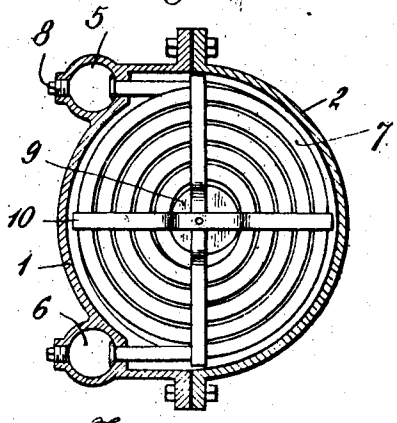


Fig. 4,

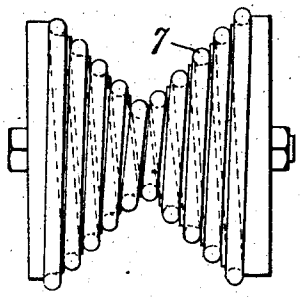
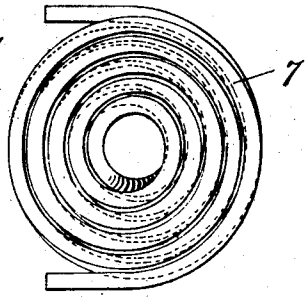


Fig. 5,



Fig. 6.



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2 SHEETS—SHEET 2.

Fig. 7,

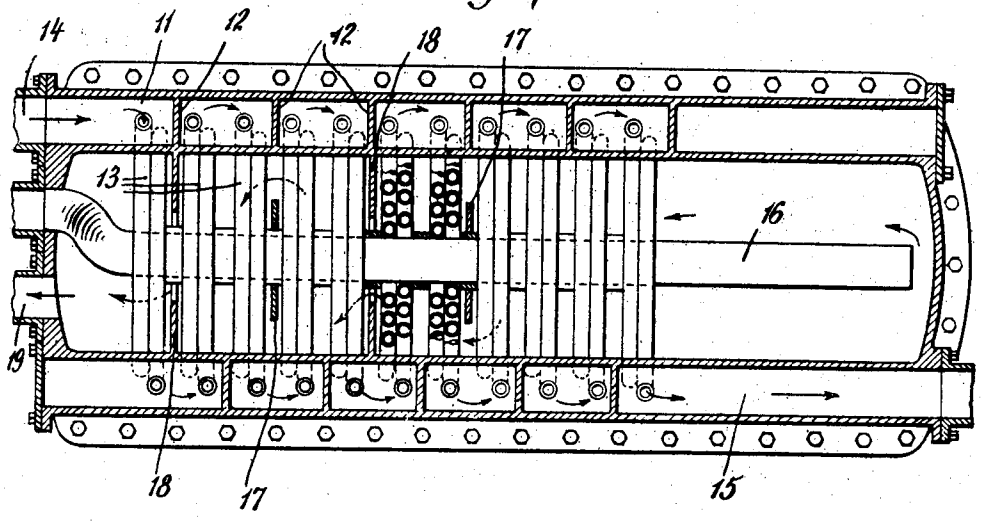


Fig. 8,

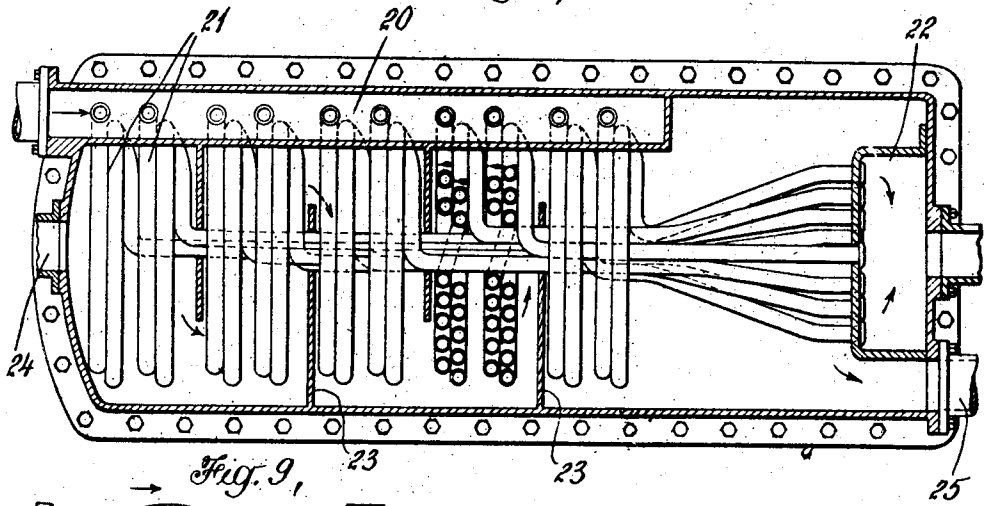


Fig. 9,

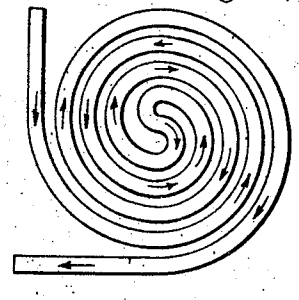


Fig. 10.



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UNITED STATES PATENT OFFICE.

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HEAT-INTERCHANGER.

1,382,670. Specification of Letters Patent. Patented June 28, 1921.

Application filed February 8, 1919. Serial No. 275,746.

To all whom it may concern:

Be it known that I, JOSEPH PRICE, a citizen of the United States, residing at New York city, in the county of New York, State of New York, have invented certain new and useful Improvements in Heat-Interchangers; 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 purpose of this invention is to provide an improved construction of heat interchanger, wherein economy of first cost and of maintenance is combined with efficient heat interchange and a substantial degree of flexibility with respect to the capacity that may be attained by installing a greater or less number of like units in a heat interchanger shell of standard construction.

To this end a simple and rugged split shell of any desired length is combined with any desired number of independent and separately removable coil units of special design, and preferably of a novel double coil type in which the two coils are compactly arranged in staggered relation and are of such shape as to have a large mean radius without abrupt or short turns, so as to produce a relatively clean coil system with relatively low pressure drop from the inlet to the outlet.

The apparatus hereinafter described in detail has been particularly designed as an oil cooler, but the invention is applicable to a cooler, heater, condenser, or any other type of heat interchanger; and the cooler fluid, either liquid or gaseous, may be passed through the shell while the hotter fluid is passed through the coil system, or vice versa.

The particular nature of the invention will be more completely understood from the following description of some preferred embodiments thereof, and from the accompanying claims which define the novel features of the invention.

In the accompanying drawings, Figure 1 is an elevation of the preferred embodiment, with a portion of the shell broken away and two of the coils shown in section, for the purpose of illustration; Fig. 2 is an end view of this apparatus, and Fig. 3 is a section on the line 3—3 of Fig. 1. Figs. 4, 5 and 6 illustrate the preferred form of novel double coil unit, Fig. 4 showing the coil in the process of construction on the forming mandrel; Fig. 5 being a cross section of the completed flattened coil unit, and Fig. 6 being a plan of the completed coil unit. Fig. 7 is a longitudinal section of a modified form of unit of heat interchanger, in which the coil units are arranged for series flow, and one of the shell manifolds passes through and blocks off the circular openings at the centers of the coil units; Fig. 8 is a longitudinal section of a further modified form in which one of the coil manifolds is at the end of the shell, one terminal of each coil being extending centrally of the apparatus to this manifold; and Figs. 9 and 10 illustrate a modified form of coil unit, Fig. 9 being a plan and Fig. 10 a cross section.

The apparatus illustrated in Figs. 1, 2 and 3 comprises a split shell generally circular in cross section and made up of two semi-cylindrical elements 1 and 2 provided with suitable flanges so that the elements may be bolted together, as shown, to form the completed shell. At the two ends of the element 1, which may be considered the fixed element of the apparatus, are provided the inlet and outlet connections 3 and 4 by means of which one of the heat interchange fluids may be passed through the shell and over the coils arranged within it. As shown in Fig. 3, a suitable gasket is placed between the flanges of the two shell elements to prevent leakage at the joint. The element 1 is provided with two longitudinally extending manifolds 5 and 6, one end of each of which is closed, and the other ends are connected to suitable conduits for the other heat interchange fluid which is to be passed through the coil units.

Each of the coil units 7, in the preferred form here illustrated, consists of a flat double spiral with the turns of the two spiral layers in staggered relation. The manner of forming these units and their characteristic features will be understood from Figs. 4, 5 and 6, from which it will be seen that the unit is formed by coiling a length of piping, preferably a thin copper piping, on the mandrel of Fig. 4, which consists of a double cone on the surface of which two screw threads or surfaces have been cut, as illustrated, the two conical portions of the mandrel being held together by any suitable connections, while the mandrel is being used

to wind the coil. After the coil is wound, the two conical portions of the mandrel are disconnected and removed from the coil, which is then compressed into the flat shape shown in Fig. 5; and it will be seen that when so compressed the turns of the two spirals are in staggered relation so that the turns of one spiral match more or less closely with the spaces between the turns of the other. This construction of the coil unit is especially advantageous where liquids are to be cooled, and particularly such liquids as oil, because the construction affords means for filming the liquid by forcing it through the narrow interstices between the surfaces of the turns. In practice, I have so wound the coils that the spaces between the surfaces of the turns are about one-sixteenth of an inch wide, thus causing the oil or liquid passing through the shell of the apparatus to be spread into films about one-sixteenth of an inch thick. As is well understood, this is an important feature in effective cooling of all liquids, and particularly of oil. Furthermore, it will be observed that by reason of the double spiral construction the coil unit has two outside and easily accessible terminals, which may be extended in to the two manifolds 5, 6, as shown in Fig. 3, and there secured preferably by expanding the ends, in the well known way. For the purpose of effecting this spreading of the ends of the coils, it is convenient to provide plug openings, as at 8, in the manifolds opposite the openings into which the coil ends are extended, as shown in Fig. 3. Longitudinally split manifolds and screwed coil unions may be employed if desired.

It is further to be observed that this construction of coil, which leaves a fairly large opening at the center, gives a relatively large mean radius to the coil turns, and avoids abrupt or short turns which might give rise to stoppages and large pressure drops from the inlet to the outlet. Where liquids are to be passed through the shell, it is advisable to make the coil fit rather closely the interior diameter of the shell sections and to block off the central openings through the coils for the purpose of causing all of the fluid to pass through the narrow interstices between the turns of the coil units. For this purpose I have shown, in the arrangement of Figs. 1, 2 and 3, baffle disks 9 supported at the centers of the coils and held in place by crossed chafing straps 10. These straps not only serve to support the disks, but also serve to hold the coils apart and to prevent the chafing which otherwise might occur by reason of the vibration to which the coils may be subjected by the pumping of the fluids through the apparatus.

In Fig. 7, which shows a heat interchanger having its coil units arranged for series flow, the manifolds 11 are provided with partitions 12, thus forming chambers to which the end of the separate coils 13 are connected, the partitions of one manifold being staggered with relation to those of the other, so that liquid entering the first coil through the inlet port 14 flows through all of the coils in succession and leaves the interchanger at the opposite end 15 of the other manifold. In this form of interchanger one of the shell manifolds 16 may be passed through the central openings of the coils to block off these openings and cause the liquid to travel through the interstices between the turns of the coils. The manifold 16 may be provided with baffles 17 and other baffles 18 extending inwardly from the shell may be provided, so that the liquid passes over a sinuous path as it flows toward the outlet 19.

The interchanger shown in Fig. 8 is provided with a manifold 20 to which one terminal of each of the separate coils 21 is connected, and the other terminals pass through the central openings of the coils and are connected to a common manifold 22 at the other end of the shell. In this modification the shell may be provided with baffle plates 23 to block off the openings of the coils not occupied by the central terminals, and these baffles preferably extend inwardly from opposite sides of the shell in alternate relation to produce the most effective flow of liquid from one port 24 of the shell to the other port 25.

In Figs. 9 and 10 there is shown a heat interchanging unit consisting of a flat reversely wound spiral coil formed of tubing of rectangular cross section. This coil does not possess all of the effectiveness of the type of coils shown in the preceding figures, but it does possess the advantage that both terminals of the coil are on the outside and closely adjacent to each other, which arrangement is of value when applying the coil to certain types of heat interchanger. By extending one of the terminals at right angles to the other, as shown in Fig. 9, the coil may be connected to heat interchangers of the type shown in Figs. 1, 2, 3 and 7, in which the manifolds are spaced apart on the same side of the shell.

I claim:

1. A heat interchanger comprising a longitudinally split shell provided with inlet and outlet connections for the flow of one of the heat interchange fluids and a plurality of flat coils arranged within the shell in staggered relation to the flow of fluid therethrough and provided with inlet and outlet connections for the flow of the other heat interchange fluid.

2. A heat interchanger comprising a shell provided with inlet and outlet connections for the flow of one of the heat interchange fluids, and a plurality of flat coils in two coil

units arranged within the shell each coil being in staggered relation to the other coil of the same unit and the adjacent coil of the next unit in the direction of the flow of fluid therethrough said coils being provided with inlet and outlet connections for the flow of the other heat interchange fluid.

3. A heat interchanger comprising a shell provided with inlet and outlet connections for the flow of one of the heat interchange fluids, inlet and outlet manifolds for the other heat interchange fluid extending lengthwise of the shell, and a plurality of flat double spiral coil units with the convolutions of each spiral lying in the same plane and in staggered relation to the convolutions of the other spiral.

4. A heat interchanger comprising a shell provided with inlet and outlet connections for the flow of one of the heat interchange fluids, a plurality of flat coils arranged within the shell in staggered relation to the flow of fluid therethrough and provided with inlet and outlet connections for the flow of the other heat interchange fluid, and means for maintaining the individual turns of said coils in definitely spaced relation.

5. A heat exchanger comprising a shell provided with inlet and outlet connections for the flow of one of the heat interchange fluids, a plurality of flat coils arranged within the shell in staggered relation to the flow of fluid therethrough and provided with inlet and outlet connections for the flow of the other heat interchange fluid, and cross straps attached to the individual turns of said coils for maintaining said turns in definitely spaced relation.

6. A heat interchanger comprising a shell provided with inlet and outlet connections for the flow of one of the heat interchange fluids, a plurality of flat coils of diameter substantially equal to the inner diameter of the shell and positioned within said shell in staggered relation to the flow of fluid therethrough, cross straps attached to the individual turns of said coils for maintaining said turns in definitely spaced relation, and disk members provided on said cross straps concentric with said coils for preventing the flow of fluid through the open central portions of said coils.

7. A heat interchanger comprising a longitudinally split shell one part of which is provided with inlet and outlet connections for the flow of one of the heat interchange fluids, a plurality of identical flat double coil units within said shell, the turns of each unit being in staggered relation to the flow of fluid through the shell and successive units being in identical relation with the axis of said shell, inlet and outlet connections for the other heat interchange fluid, and detachable connections between said inlet and outlet means and said coil units for permitting independent removal of said units.

In testimony whereof I affix my signature.

JOSEPH PRICE.