L. D. LOVEKIN.

FLUID HEATING AND COOLING APPARATUS.

APPLICATION FILED JULY 15, 1912.

1,139,549.

Patented May 18, 1915.

2 SHEETS—SHEET 1.

FIG. 1.

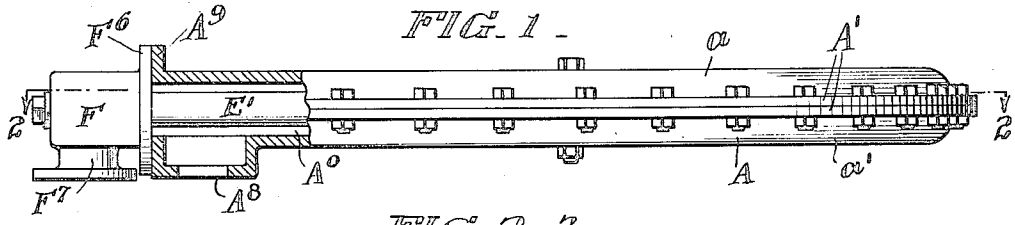


FIG. 2.

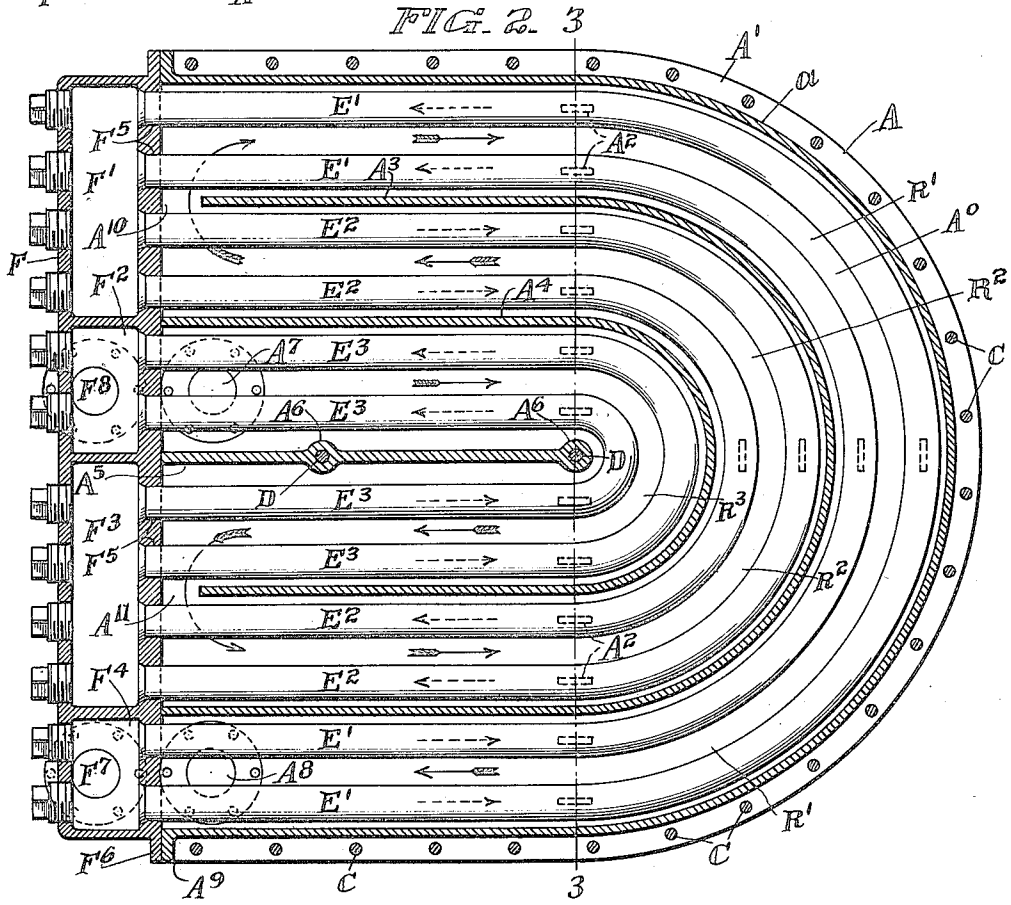
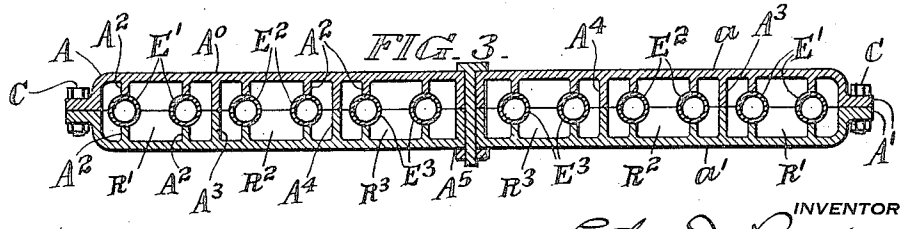


FIG. 3.



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2 SHEETS—SHEET 2.

FIG. 4.

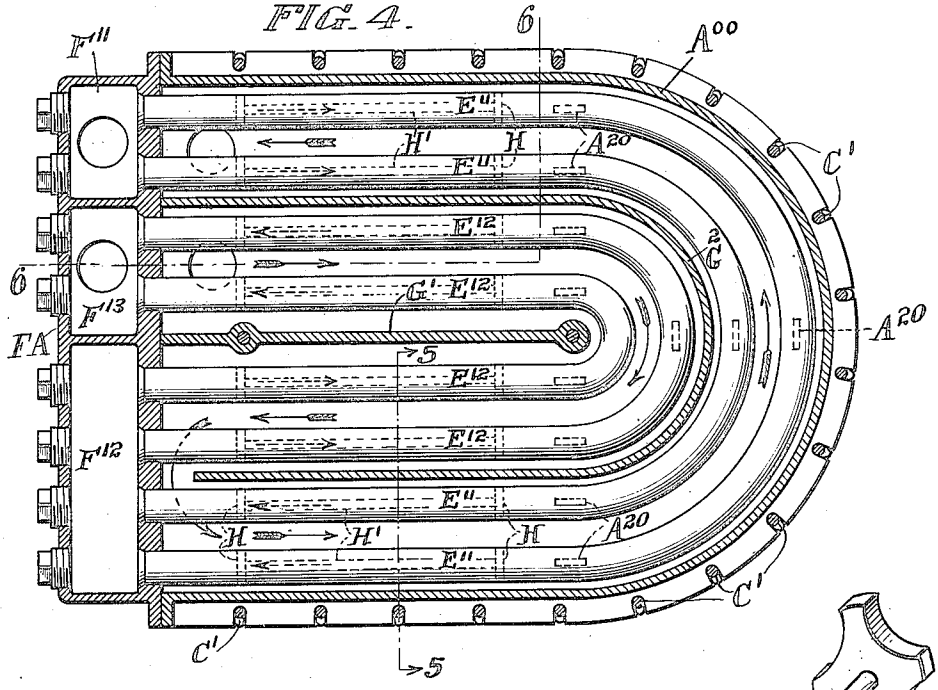


FIG. 5.

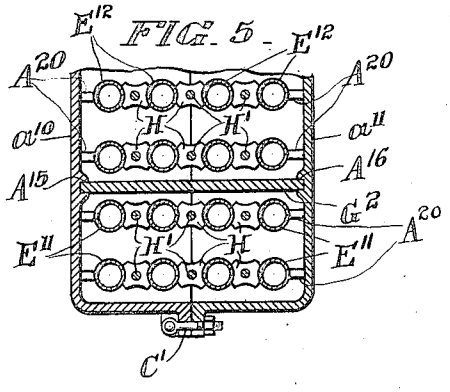


FIG. 7.

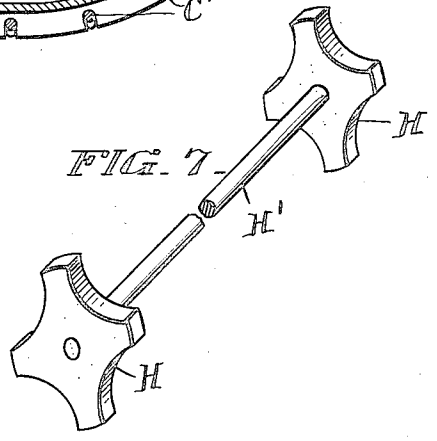
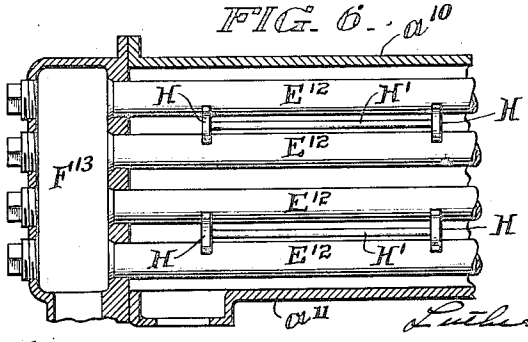


FIG. 6.



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FLUID HEATING AND COOLING APPARATUS.

1,139,549. Specification of Letters Patent. Patented May 18, 1915.

Application filed July 15, 1912. Serial No. 709,356.

To all whom it may concern:

Be it known that I, LUTHER D. LOVEKIN, a citizen of the United States of America, residing in Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a certain new and useful Improvement in Fluid Heating and Cooling Apparatus, of which the following is a true and exact description, reference being had to the accompanying drawings, which form a part thereof.

My present invention consists in an improved device for effecting a transfer of heat between two fluids at different temperatures, useful alike where the ultimate object is either to heat the cooler or to cool the hotter of the two fluids.

The primary object of the invention is to provide an effective device for the general purpose specified, which shall be highly compact, relatively inexpensive to manufacture, and easy to assemble and to disassemble when necessary for cleaning, repairs or other purpose.

More specifically, the object of my invention is to provide an improved device of the character disclosed and embodying inventive features claimed in my prior application, No. 547,597, filed March 5, 1910.

My improved device is like that disclosed and claimed in my prior application in that it comprises a chamber receiving one of the two thermally interacting fluids and into which project bowed tubes nested together in one or more groups, and having their ends connected to provide a path for the second of the two thermally interacting fluids, comprising successive looped sections formed by the various bowed tubes.

My present invention comprises simple and effective provisions for obtaining a "counter current" flow through said chamber of the fluid directly admitted thereto, along a path parallel to the path for the fluid passing through the bowed tubes.

The invention also comprises certain improvements in construction and arrangement hereinafter specified.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, and of the advantages possessed by it, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described forms of apparatus embodying my invention.

Of the drawings, Figure 1 is a side elevation, partly in section, of one form of the apparatus constructed in accordance with my present invention, Fig. 2 is a sectional plan taken on the line 2—2 of Fig. 1, Fig. 3 is a sectional elevation taken on the line 3—3 of Fig. 1, Fig. 4 is a sectional plan, taken similarly to Fig. 2, of a modified construction, Fig. 5 is a partial sectional elevation taken on the line 5—5 of Fig. 4, Fig. 6 is a partial sectional elevation taken on the line 6—6 of Fig. 4, and Fig. 7 is a perspective view of a tube spacing element employed in the construction shown in Fig. 4.

In drawings, and referring first to the construction shown in Figs. 1, 2 and 3, A represents the casing body inclosing, except at one edge, a chamber A^0 into which one of two thermally interacting fluids is directly admitted. As shown, the casing body A is formed of similar upper and lower halves a and a' formed with flanges A' adapted to be detachably secured together as by means of the bolts C. The casing parts a and a' are formed with opposed tube spacing lugs A^2, and opposed baffle ribs A^3 A^4 and A^5. As shown, each pair of ribs A^3, A^4 and A^5 meet edge to edge at the center of the chamber A^0. The opposed baffle plates A^5 are formed with hollow bosses A^6 receiving stay bolts D for securing the central portion of the casing parts a and a' together. The casing element a' is also formed with inlet and outlet openings A^7 and A^8, respectively, for the fluid admitted to the chamber A^0. As shown, the inlet and outlet openings are both formed in the lower casing element a'. The arrangement of the tube spacing lugs A^2, the baffle ribs A^3, A^4 and A^5, and the inlet and outlet ports A^7 and A^8 with respect to each other and to the bowed tubes which enter the chamber A^0, is hereinafter described.

In the form shown in Figs. 1, 2 and 3, six bowed tubes, all lying in the same plane and nested together, and of progressively varying lengths, are employed to carry the second of the two thermally interacting fluids through the chamber A^0. For convenience, I designate the outer two tubes E', the middle pair of tubes E^2, and the inner pair of tubes E^3. The ends of these tubes

are expanded into or otherwise secured in any usual or suitable manner in apertures F^5 formed in a chambered member F which closes the otherwise open edge of the chamber A^0. As shown, the member F is formed with a flange F^6 adapted to be bolted to the flanges A^9 formed on the casing parts *a* and *a'* at the margin of the open edge of the chamber A^0. The chambered member F is formed with chambers F', F^2, F^3 and F^4 so arranged that the ends, of the tubes E' and E^2 which are nearer the top of Fig. 2 open into the chamber F'; the corresponding ends of the tubes E^3 open into the chamber F^2; the ends of the tubes E^2 and E^3 which are nearer the bottom of Fig. 2 open into the chamber F^3, and the corresponding ends of the tubes E' open into the chamber F^4. The inlet port F^7 for the fluid circulating through the bowed tubes is formed in one wall of the chamber F^4, and the outlet port F^8 for this fluid is formed in one wall of the chamber F^2. With the arrangement described, it will be apparent that the fluid entering the chamber F^4 through the inlet port F^7 will pass through the tubes E' to the chamber F', and from thence will pass through the tubes E^2, chamber F^3 and tubes E^3 to the chamber F^2, and the outlet port F^8 opening therefrom. Each of the bowed tubes is engaged and held against undesirable movement by corresponding opposed pairs of lugs A^2.

The baffles formed by the opposed contacting pairs of baffle ribs A^3, A^4 and A^5 are arranged to form a serpentine path through the chamber A^0 for the fluid directly admitted to the latter through the inlet port A^7 which is parallel to the path for the fluid flowing through the tubes, the direction of the flow of the two fluids in adjacent portions of their paths being opposite, however. This result is accomplished by disposing of the baffle ribs A^3 so that they form a U shaped baffle lying between the tubes E' and E^2 and extending at its end nearer the bottom of Fig. 2 to the casing element F, but separated therefrom at its other end by a space forming a port A^{10}. This port connects the U shaped channel portion R' of the chamber A^0 lying on the outer side of the baffle ribs A^3 with the U shaped channel R^2 formed between these baffle ribs and the generally similar baffle formed by the ribs A^4. The latter extend at their ends nearer the top of Fig. 2 to the casing element F but are separated from the latter at their other ends by a space forming a port A^{11}, connecting the channel R^2 to the U shaped channel R^3 into which the portion of the chamber A^0, lying within the baffle formed by the ribs A^4, is divided by the uncurved central baffle formed by the rib A^5. The last mentioned baffle lies between the legs of the inner bowed tube E^3 and extends from the casing element F nearly, but not quite, to the yoke portion of the inner tube E^3. The inlet port A^7 opens to the end of the U shaped channel R^3 nearer the top of Fig. 2 and the outlet port A^8 from the chamber A^0 opens from the end of the U shaped channel R' nearer the bottom of Fig. 2.

The ease with which the construction described can be assembled and taken apart for cleaning and repairs, and the inherent relatively low cost of manufacture of the construction will be obvious to those skilled in the art. The tube and baffle arrangement by which the countercurrent flow of the thermally interacting fluids is obtained, tends to high efficiency and the paths of travel for the two fluids may be made long enough to effect the desired transfer of heat from one fluid to the other in apparatus of minimum bulk. The tubes are uniformly spaced and relatively close together to permit rapid and effective circulation of the two fluids. The shape of the tubes insures freedom from troubles due to expansion and contraction.

The apparatus is obviously suitable for evaporating one fluid by heat derived from the other, or for pre-heating boiler feed water, or for cooling oil, and in general for any purpose where it is desired to raise or lower the temperature of one fluid by transferring heat from or to another fluid. When the fluids treated are both liquids or both gases, it is practically immaterial whether the legs of the bowed tubes lie in a horizontal, vertical or inclined plane. When one of the fluids is a vapor, it is of course desirable to arrange the apparatus so that condensed vapor will drain out of the apparatus, and in particular where steam is passed to the inlet port F^7, and is condensed in whole or in part within the bowed tubes and the chambers communicating therewith, I consider it desirable to arrange the tubes in a plane inclined slightly to the horizontal to give the desired drainage downward to the ends of the tubes.

In the form of the invention shown in Figs. 1, 2 and 3, the apparatus is so arranged that the path for the liquid flowing through the bowed tubes comprises three successive loops, each of which is formed by the tubes E', E^2 or E^3. It will be apparent that the two tubes which together form each loop are duplicates, and that the removal of one of the two tubes forming each loop, or the addition of tubes so connected into the chambers of the member F as to form additional subdivisions of the loops, would not affect the apparatus in principle, but merely the cross sectional area of the fluid path formed by the tubes. It will be apparent, moreover, that the number of the loops in the fluid path formed by the tubes need not necessarily be three, but may be

two or any greater number which conditions may make desirable.

An example of a construction differing from that shown in Figs. 1, 2 and 3, both in the number of the loops into which the fluid path formed by the tubes is divided, and in the number of the bowed tubes employed in each of said loops, is illustrated by Figs. 4, 5 and 6, wherein the chambered member FA is formed with an inlet compartment F^{11}, a loop connecting compartment F^{12}, and an intermediate outlet compartment F^{13}. In this construction, there are four parallel layers or groups of nested U tubes E^{11} and E^{12}, each of the tubes havins its end nearer the bottom of Fig. 4, open to the chamber F^{12}, while the other ends of the tubes E^{11} are connected to the inlet chamber F^{11}, and the other ends of the tubes E^{12} are connected to the outlet chamber F^{13}. In the form of the invention shown in Fig. 4, the central baffle G′ and the curved baffle G^2, employed to divide the chamber A^{00} into a two-looped path for the fluid directly admitted to that chamber, are made separable from the casing parts a^{10} and a^{11}, which are formed with grooves A^{15} and A^{16} receiving the edges of the baffles, and holding them against displacement. The casing parts a^{10} and a^{11} are provided with spacing lugs A^{20} for the two outer layers of tubes and the superimposed tubes are spaced apart by spacers which, as shown in Figs. 5 and 6, each comprise a pair of notched plates H connected together by a rod H′. These plates are placed on edge between adjacent superimposed tubes and each plate H and the rod H′ serves to prevent the accidental displacement of the other plate. The casing parts may be connected by hinged bolts C′ as shown in Figs. 4, 5 and 6.

While in accordance with the provisions of the statutes I have illustrated and described the best forms of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit of my invention, and that under some conditions certain features of my invention may be used with advantage without a corresponding use of other features.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is—

1. In a device of the character described having a chamber into which one of two thermally interacting fluids is directly admitted, the combination of one or more tube groups extending into said chamber, each comprising a plurality of bowed tubes nested together, and connected at their ends to provide a path comprising two or more successive loop sections for the second of said two fluids, and baffle means dividing said chamber into a path for the fluid directly admitted thereto, comprising successive loop sections parallel to, and alongside of the first mentioned loop sections whereby a counter current flow of the two fluids may be obtained.

2. In a device of the kind described, the combination with a chamber of one or more tube groups extending into said chamber, each including a plurality of bowed tubes nested together, and having their ends connected to provide a fluid path comprising two or more successive loop sections, and baffle means disposed in said chamber to provide a serpentine path for fluid directly admitted to the chamber comprising loop sections parallel to and inclosing the corresponding loop sections of the path formed by the tubes, whereby there may be obtained a counter current flow of the two fluids passing through the said chamber one within and the other without said tubes.

3. In a device of the character described, the combination of a casing comprising a pair of casing parts detachably connected together and inclosing, except at one edge, a chamber into which one of two thermally interacting fluids is directly admitted, a chambered member detachably connected to said casing parts and closing the open edge of said chamber, one or more tube groups extending into said chamber and each comprising a plurality of bowed tubes nested together and having their ends secured to said chambered member and connected by the chambers therein so that said tubes form a path comprising successive loop sections for the second of said fluids, and baffle means dividing said chamber into a path for the fluid directly admitted thereto, comprising successive loop sections parallel to and inclosing the loop sections formed by the tubes whereby a counter current flow of the two fluids may be obtained.

LUTHER D. LOVEKIN.

Witnesses:
ARNOLD KATZ,
D. STEWART.