L. D. LOVEKIN.

FLUID HEATER AND COOLER.

APPLICATION FILED FEB. 11, 1911.

1,005,442.

Patented Oct. 10, 1911.

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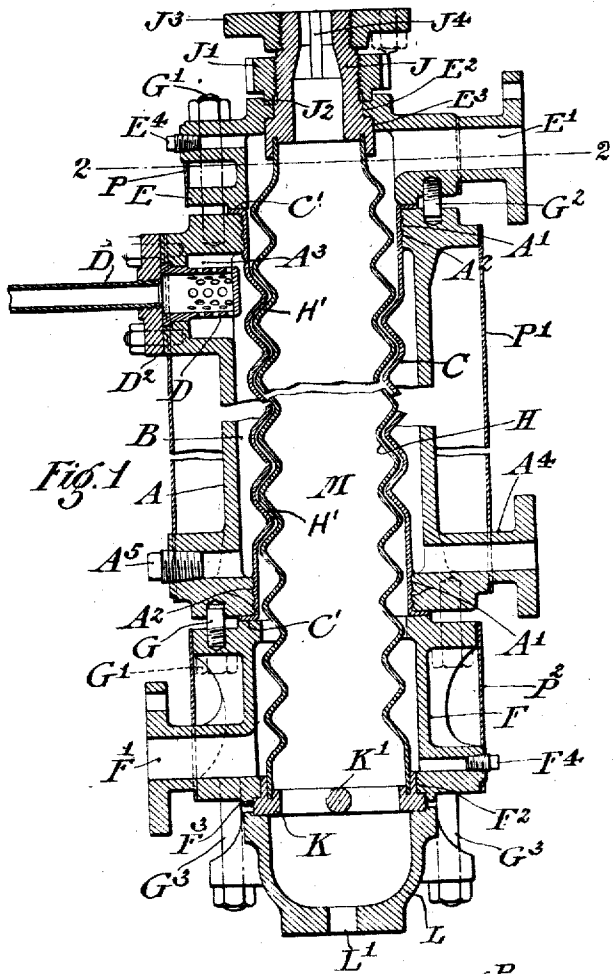

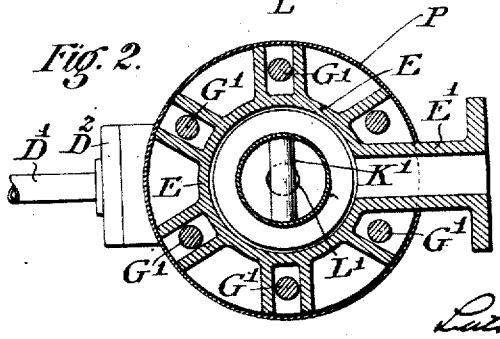

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2 SHEETS—SHEET 2.

Fig. 3.

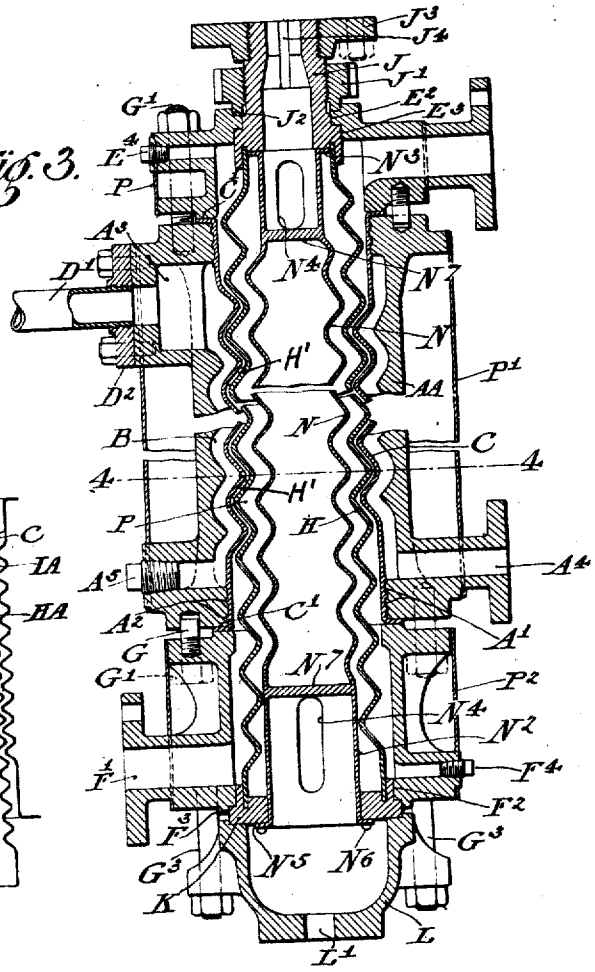


Fig. 5.

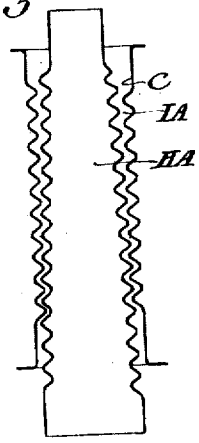
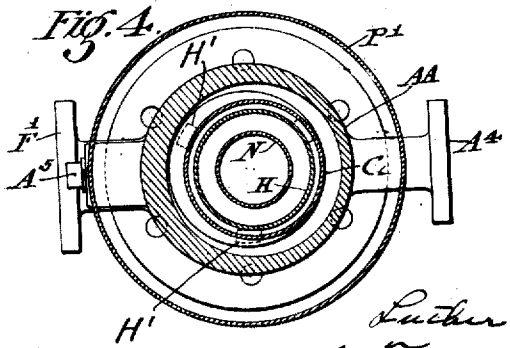


Fig. 4.



Witnesses:

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UNITED STATES PATENT OFFICE.

LUTHER D. LOVEKIN, OF PHILADELPHIA, PENNSYLVANIA.

FLUID HEATER AND COOLER.

1,005,442. Specification of Letters Patent. Patented Oct. 10, 1911.

Application filed February 11, 1911. Serial No. 607,940.

To all whom it may concern:

Be it known that I, LUTHER D. LOVEKIN, a citizen of the United States of America, residing in the city of Philadelphia, county of Philadelphia, and State of Pennsylvania, have invented a certain new and useful Improvement in Fluid Heaters and Coolers, 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 relates to apparatus for effecting a rapid and efficient transfer of heat between the fluids of different temperatures, and more particularly to apparatus of the kind disclosed and claimed in my prior Patent No. 904,627, granted November 24, 1908, and in my pending application, Serial Number 463,962, filed November 23, 1908, in which a film like space for one of the fluids is provided between tubular elements arranged one within the other and having adjacent surfaces spirally corrugated, the other fluid contacting the other surface of one or both walls of said film space.

The general object of my invention is to provide improved apparatus of the kind specified, characterized by the high efficiency obtainable with it, and the simplicity and reliability of the construction and the comparative ease with which it may be assembled and disassembled when necessary for cleaning and repairs.

A more specific but highly important object of the invention is to provide a construction in which the joints through which leakage may occur are so disposed that leakage from any one of the fluid spaces of the apparatus may escape freely to the exterior of the apparatus and will not pass into the space or spaces in the apparatus traversed by a different fluid.

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 and the advantages possessed by it, reference should be had to the accompanying drawings and descriptive matter, in which I have illustrated and described, preferred forms of apparatus embodying the invention.

Of the drawings, Figure 1 is a sectional elevation of a fluid cooling and heating device. Fig. 2 is a sectional plan taken on the line 2—2 of Fig. 1. Fig. 3 is a view taken similarly to Fig. 1, showing a slightly modified construction. Fig. 4 is a sectional plan taken on the line 4—4 of Fig. 3, and Fig. 5 is a sectional elevation of a modified arrangement of the spirally corrugated tubular elements.

In the drawings, and referring first to the construction shown in Figs. 1 and 2, A represents the open ended tubular casing body of a device for heating oil or water by the use of steam though adapted to be used with little or no change for practically any purpose in which it is desired to effect a transfer of heat between two fluids. Within the body A and separated therefrom by the space B is the spirally corrugated tubular element C formed of some metal such as copper having good heat conductivity. The element C, in the construction illustrated is expanded at its ends to fill grooves A^2 formed in the end openings A′ of the end member A. As shown the diameters of the openings A′ are less than the interior diameter of the body A proper. The ends of the member C terminate in outturned flanges C′ which abut against the ends of the body A.

A^3 and A^4 represent passages formed in the member A and communicating with the opposite ends of the space B. As shown, A^3 is the steam inlet chamber and receives an apertured or cage member D which prevents the steam supplied by the pipe D′ from impinging directly against the element C. The member D is detachably secured in place by a cap member D^2 into which the pipe D is threaded. The passage A^4 serves as the outlet from space B for the water of condensation.

Annular casing end members E and F are secured to the ends of the body A as by bolts G and G′.

G^2 represents positioning dowels. The members E and F bear against the corresponding flanges C′ and are thereby spaced away from the member A. The members E and F are formed with hollow radial extensions, to which pipe connections may be made. E′ and F′ respectively indicate the passages in these extensions. Within the

tubular element C is disposed a similar spirally corrugated member H. The diameters of the elements C and H are so proportioned that a film-like and corrugated space I is provided between the elements C and H, and it is to the ends of this space that the passages in the extensions E′ and F′ lead. The member H has permanently secured to its ends, as by brazing, end connections J and K. The end connection J has a body portion passing through the aperture E^2 in the end member E and a rib at its inner end entering a recess E^3 formed in the member E surrounding the inner end of the aperture E^2. A nut J′ threaded on the member J on the outer side of the member E and provided with a reduced end portion entering a recess in the member E surrounding the outer end of the aperture E^2 serves to detachably secure the members E and J together.

J^3 represents a member which may be threaded onto the outer end of the member J for securing the device to a reservoir wall or pipe connection.

The member K comprises a body portion which fits in the aperture F^2 in the outer end of the member F and an external rib which enters a recess F^3 surrounding the outer end of the aperture F^2. The member K is clamped in place by a cup-shaped member L which abuts against the outer end of the member K and is detachably secured to member A by bolts G^2. The member L is formed with a port L′ which serves to connect the space M within the member H to a suitable pipe connection or drain.

It will be observed that the opening through the end member F is greater in diameter than the maximum diameter of the corrugated portion of the member H and of the end member J. Furthermore, the thickness of the film space between the corrugated portions of the members C and H is substantially less than the depths of the corrugation grooves in the adjacent surfaces of these members. In consequence, while it is impossible to remove the element H from the element C, by a simple longitudinal movement, the member H may be readily removed, after the parts J′, J^3 and L are detached, by threading it out of the member C. This makes it easy to assemble the apparatus and to disassemble it for inspection, cleaning or repairs. No claim is made herein to the features of construction and arrangement whereby this ready assemblage and disassemblage of the parts may be secured, as this is disclosed and claimed in my prior application No. 463,962.

To facilitate the threading of the elements H into and out of place, and to anchor and release the end connections, provisions may be made whereby the parts J and K may be grasped and held. For instance, as shown in Figs. 1 and 2. The member K is provided with a diametrically extending crossbar K′ serving as a handle and the member J is formed with recesses J^4 adapted to receive a screwdriver or like implement. Passages in the members A and E and F, normally closed by the plugs A^5, E^4 and F^4 are provided for cleaning out the fluid spaces B and I.

At intervals along the length of the film space I arrange sets of lugs H′ which serve to space the tubular elements apart and prevent lateral displacement or sagging of one with respect to the other, and serve also as cleaning devices which wipe and clean the inner corrugated surfaces of the element C when the element H is threaded out of the element C. Advantageously each set of lugs may consist of three lugs equally spaced apart around the axis of the element H and secured, two on one side, and one on the other side of a single corrugation convolution of the member H so that the lugs are substantially in the same transverse plane.

The body A and end members E and F may be jacketed as usual to prevent loss of heat. In the drawings the outer casing portions of such a heat insulating jacket are indicated at P, P′ and P^2.

As before stated the apparatus shown in Figs. 1 and 2 is primarily devised for use in heating oil by the use of steam. In this use of the apparatus, steam is admitted to the space B through the pipe D, and water of condensation escapes from the space B through the passage A^4. Steam is also admitted to the space M through the thoroughfare formed in the member J and the water of condensation from this space escaped through the member L and the port L′ formed in the bottom of the latter. The oil to be heated enters the film space I through the passage F′ and passes out of this space through the passage way E′. It will be observed that the direction of the flow of the fluid (oil) heated, and of the fluid (steam) cooled is that which experience has shown to be the most advantageous for obtaining an efficient and effective transfer of heat between the two fluids.

With the construction described, the important advantage is obtained, that any leakage from any of the fluid receiving spaces of the apparatus along the unbrazed joints at the ends of the tubular elements, escapes freely to the exterior of the apparatus and hence, leakage through one joint from one fluid space does not tend to flow, in whole, or in part along another joint into a space receiving the other fluid. This is of especial importance in apparatus for heating oil fuel by the use of steam on ship-

board, or elsewhere, under conditions which it is desirable that the water of condensation, formed from the steam, shall be pure. Under such circumstances, the very minute leakage of oil into the steam spaces of the apparatus which has occasionally been experienced in the use of apparatus of this general type heretofore constructed, has been found to be highly objectionable. With the present construction this is entirely done away with. It will be apparent from inspection that leakage from the spaces B or I, for instance, through the joints formed at the opposite sides of the flanges C′ will escape freely to the exterior of the apparatus at the peripheries of these flanges, owing to the spacing apart of the members E and A and F and A. This applies also to the joints between the member K and the members F and L. Similarly, no leakage from the space C to the space M can take place through the joint between the members E and J although the construction at this joint is different in character from that at the other joints referred to.

The apparatus shown in Figs. 1 and 2 can be used without any change at all, or with slight changes, for many different purposes. For cooling oil by the use of water, the external connections should preferably be so changed that the oil enters the film space I through the passage E′ and passes out through the passage F′, while the cooling water enters the spaces M and B through the passages A^4 and L′ respectively, and passes out through the pipe D′ and passageway E′ respectively. In this use of the apparatus, the cage D would be purposeless, and may well be dispensed with.

In using the apparatus shown in Figs. 1 and 2 as a condenser, the steam or other vapor to be condensed should preferably be admitted to the film space I through the passage way E′ and the condensate removed through the passageway F′, the cooling water, or other fluid, flowing through the apparatus, as in the oil cooling operation described above. Where, as in cooling oil or condensing vapor, water, or other cooling or heating liquid is caused to flow through the spaces B and M, I find it advantageous to corrugate the inner surfaces of the casing body A A, as shown in Figs. 3 and 4, and to provide a displacing body N in the space M for the purpose of providing a water channel through the element H which like the space B shall be shallow. This increases the rapidity of flow of the cooling water through the apparatus and breaks up the streams of water with an increase in the efficiency of the apparatus. The breaking up of the streams of water avoids the loss of effectiveness experienced with smooth unbroken streams from the fact that the surface portion or portions of such unbroken streams serve in effect as insulating layers preventing the free transfer of heat to what may be called the core portions of the streams of water.

In the construction shown in Figs. 3 and 4 the displacing body N employed comprises a body portion spirally corrugated to the same pitch as the members C and I and uncorrugated end portions N′ and N^2 receiving plugs N^7 which may be brazed in place and are located at the inner ends of parts N^4 formed in the uncorrugated end portions of the member N. The end portion N′ terminates in a flange N^3 which abuts against a shoulder formed on the member J and fits snugly within the corresponding uncorrugated end portion of the element H. At its lower end the member N is formed with a similar flange N^5 which abuts against the outer end of the member J. The displacing member N may be held in place by any convenient means, as by screws N^6 passing through the flange N^5 into the member K.

When the apparatus is used for condensing apparatus, I find it advantageous to taper one or both of the elements C and H in order to make the film space of decreasing thickness from its upper end at which the vapor is admitted to its lower end at which the condensate is discharged. Such a construction is illustrated in Fig. 5, wherein the outer spirally corrugated element C may be similar to the element C of Figs. 1 to 4 inclusive, while the element HA differs from the element H of Figs. 1 to 4 inclusive, in that it is conical so that the film space IA decreases in thickness from top to bottom. This arrangement in condensing apparatus gives high efficiency combined with compactness and an effective use of material.

While in accordance with the provisions of the statute 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 can be made in the form of the apparatus disclosed without departing from the spirit of my invention, and that certain features of the invention may sometimes 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 kind specified, a casing portion provided with a chamber apertured at its ends, a tubular element received in but not filling said chamber whereby a fluid space surrounding said element is provided between the element and the wall of said chamber, said element having end portions passing through said apertures, one

of which is provided with an external flange abutting against the end of the casing at the margin of the corresponding aperture, an annular member abutting against said flanged end portion and forming an extension of the space within said element and means for securing said member to said casing, said member being spaced away from the end of the casing by said end portion whereby the external ends of the joints between said flanged end portion and said casing and the said member are spaced apart.

2. In a device of the kind specified, a casing portion provided with a chamber apertured at its ends, a tubular element received in but not filling said chamber whereby a fluid space surrounding said element is provided between the element and the wall of said chamber, said element having end portions passing through said apertures, one of which is provided with an external flange abutting against the end of the casing at the margin of the corresponding aperture, an annular member abutting against said flanged end portion and forming an extension of the space within said element, and means for securing said member to said casing, said member being separated from the end of the casing to provide an open space into which open the spaced apart ends of the joints between said flanged end portion and said casing and said member.

3. A device of the character described comprising a tubular body, a tubular element arranged within and separated from said body by a surrounding space and terminating in flanges abutting against the end surfaces of the first mentioned tubular element, annular end members secured to the body and abutting against the outer surfaces of said flanges and separated from said body portion at the peripheries of the flanges by open spaces, a second tubular element arranged within the first mentioned element and separated therefrom by a space and connected to said end members at the outer ends of the latter.

4. In a condenser, the combination of a spirally corrugated vertical tubular element adapted to have a cooling fluid passed through it and a body surrounding said element and separated therefrom by a space in which the vapor to be condensed is introduced and condensed, said body having its inner surface spirally corrugated with the corrugation convolutions nesting with those of said element said body and said element being so relatively formed that the space between them decreases in thickness from its upper end to its lower end.

5. A device of the character described comprising a tubular body portion having its inner surface spirally corrugated, a spirally corrugated tubular element arranged within said body and separated therefrom by a surrounding space, annular end members secured to the ends of said body a second spirally corrugated tubular element received within the first mentioned element and connected at its ends to the outer ends of said end members and separated from the first mentioned element to provide a fluid space, the corrugations of said first mentioned element nesting with the corrugations of said body and said second element.

6. In a device of the character specified, the combination of a pair of spirally corrugated tubular elements threaded together, but of such diameters that a fluid space is provided between them, and a spirally corrugated displacing body arranged within the inner element with its corrugations nesting with the corrugations of the latter, and of such diameter that a fluid space is provided between said body and said inner element.

7. In apparatus of the kind described, a spirally corrugated tubular element, a surrounding tubular member spirally corrugated internally, said element and member being so formed and proportioned that a film-like space is provided between them, the thickness of which is less than the depths of the corrugation grooves, said element having one or more joints along its length, a plurality of spaced apart lugs secured externally on the outer surface of a single corrugation convolution.

8. In apparatus of the kind described, a spirally corrugated tubular element, a surrounding tubular member spirally corrugated internally, said element and member being so formed and proportioned that a film-like space is provided between them, the thickness of which is less than the depths of the corrugation grooves, said element having one or more joints along its length, a plurality of spaced apart lugs secured externally on the outer surface of a single corrugation convolution, said lugs comprising; two located on one slope and a third located on the other slope of said convolution.

9. In a device of the kind specified, the combination of means providing fluid space annular in cross section, said means comprising a spirally corrugated tubular element forming the inner wall of said space, and a displacing member comprising a spirally corrugated body portion arranged within but not filling said element and spider-like end portions through which said member is supported.

10. In a device of the kind specified, the combination of means providing fluid space annular in cross-section, said means comprising a spirally corrugated tubular ele-

ment forming the inner wall of said space, and a tubular displacing body arranged within but not filling said element, and comprising a corrugated body portion and uncorrugated end portions terminating in flanges closing the ends of the fluid space between said body and said element and formed with ports connecting the last mentioned space with the interiors of said end portions and diaphragms closing the inner ends of said uncorrugated end portions.

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Witnesses:
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