March 5, 1946. L. E. SKELLY ET AL 2,395,943

FLUID TEMPERATURE CONTROLLING DEVICE

Filed Sept. 18, 1942 4 Sheets-Sheet 1

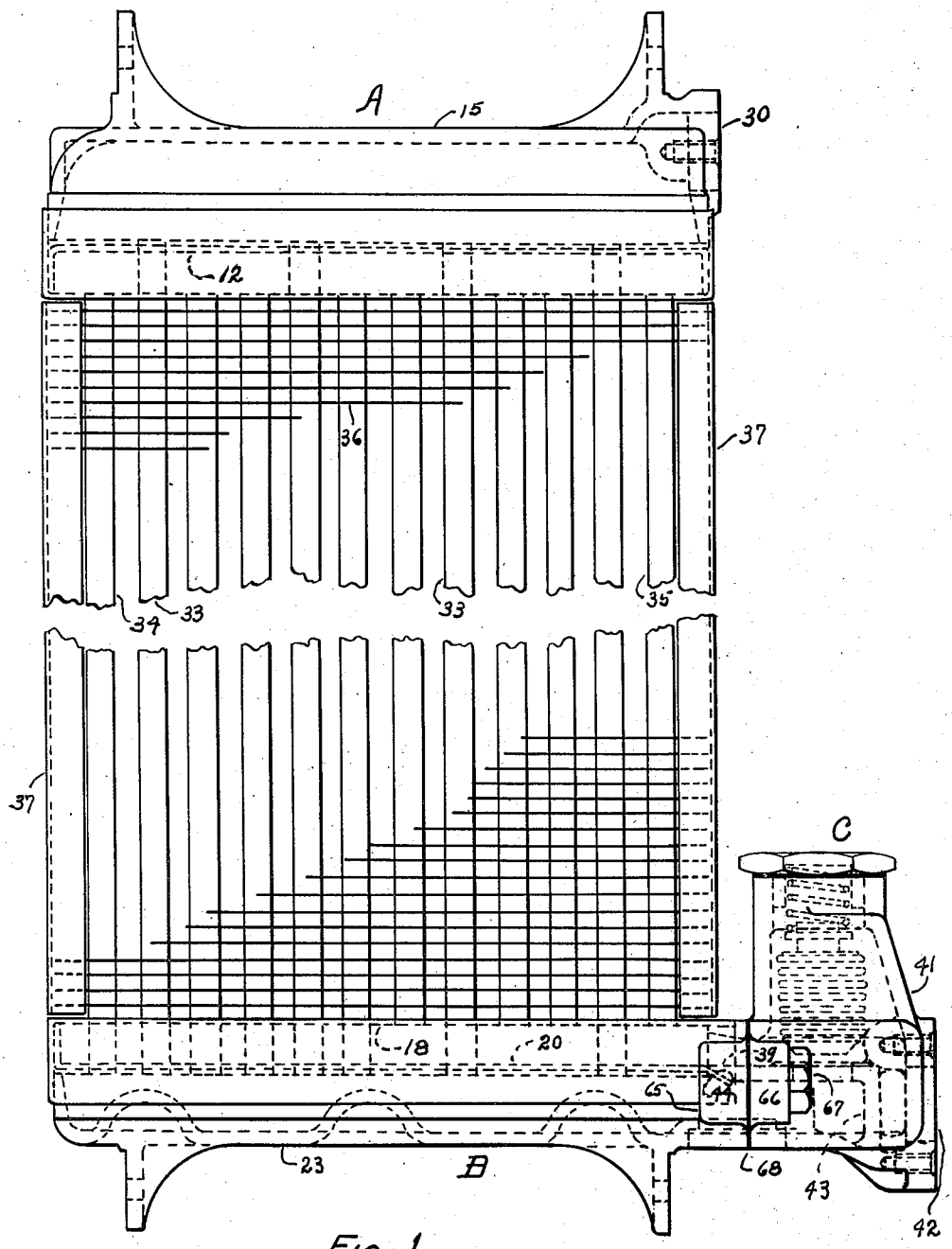


FIG. 1

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FLUID TEMPERATURE CONTROLLING DEVICE

Filed Sept. 18, 1942 4 Sheets-Sheet 2

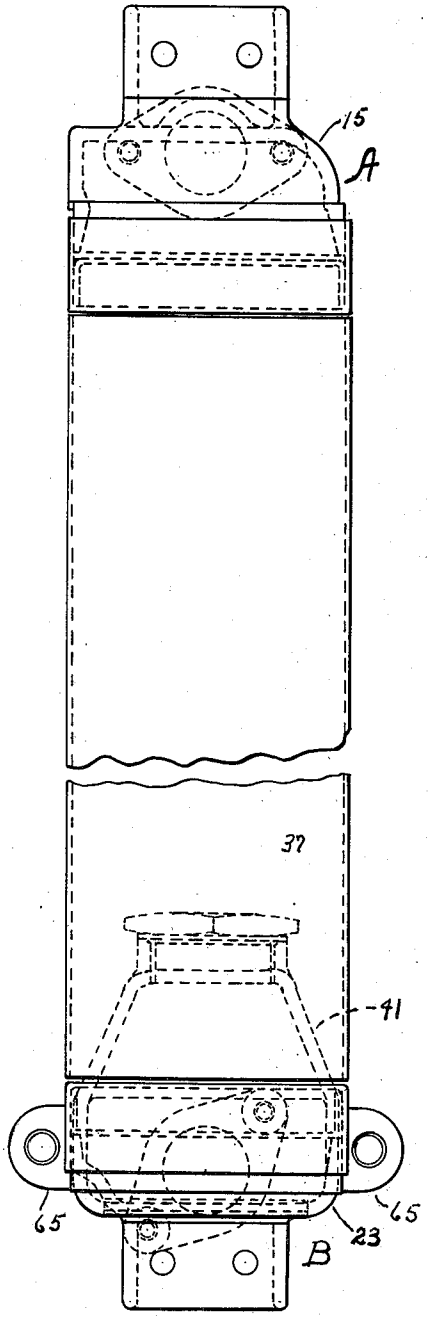


FIG. 2

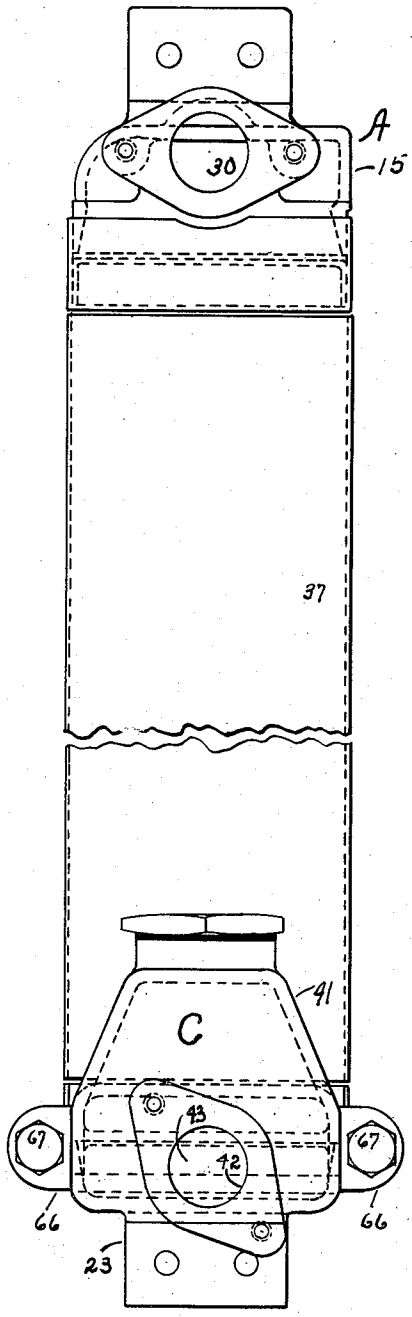


FIG. 3

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FLUID TEMPERATURE CONTROLLING DEVICE

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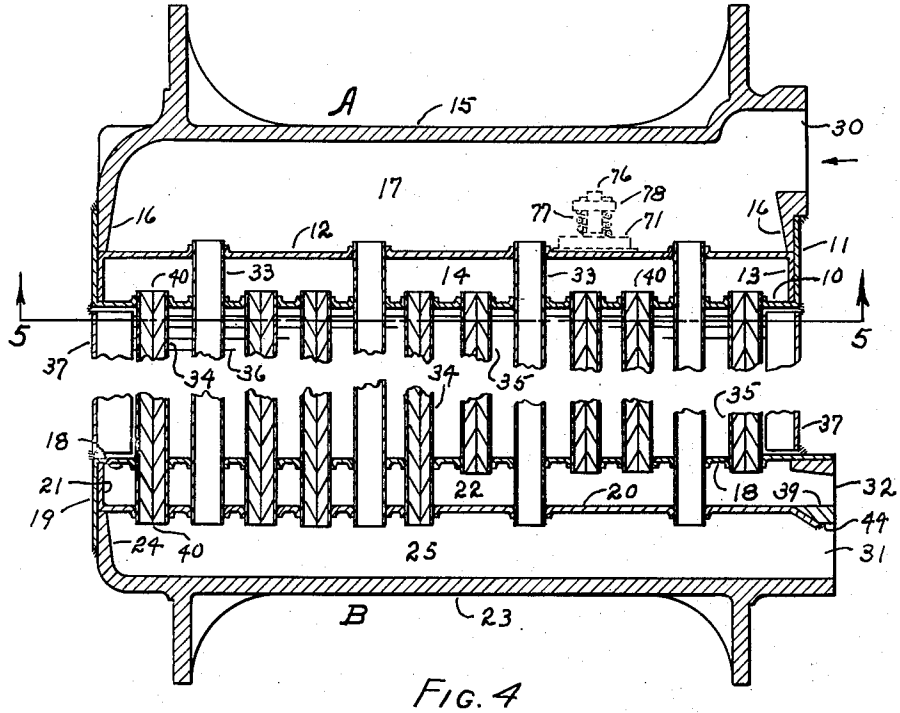


FIG. 4

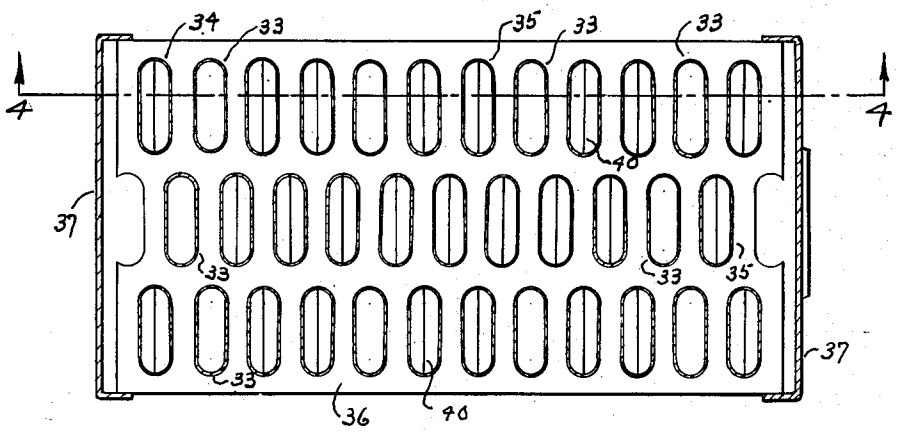


FIG. 5

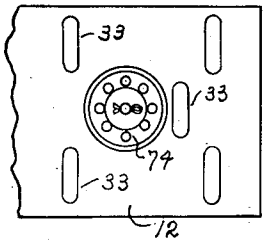


FIG. 8

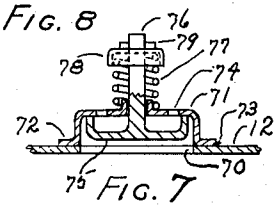


FIG. 7

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FLUID TEMPERATURE CONTROLLING DEVICE

Filed Sept. 18, 1942 4 Sheets-Sheet 4

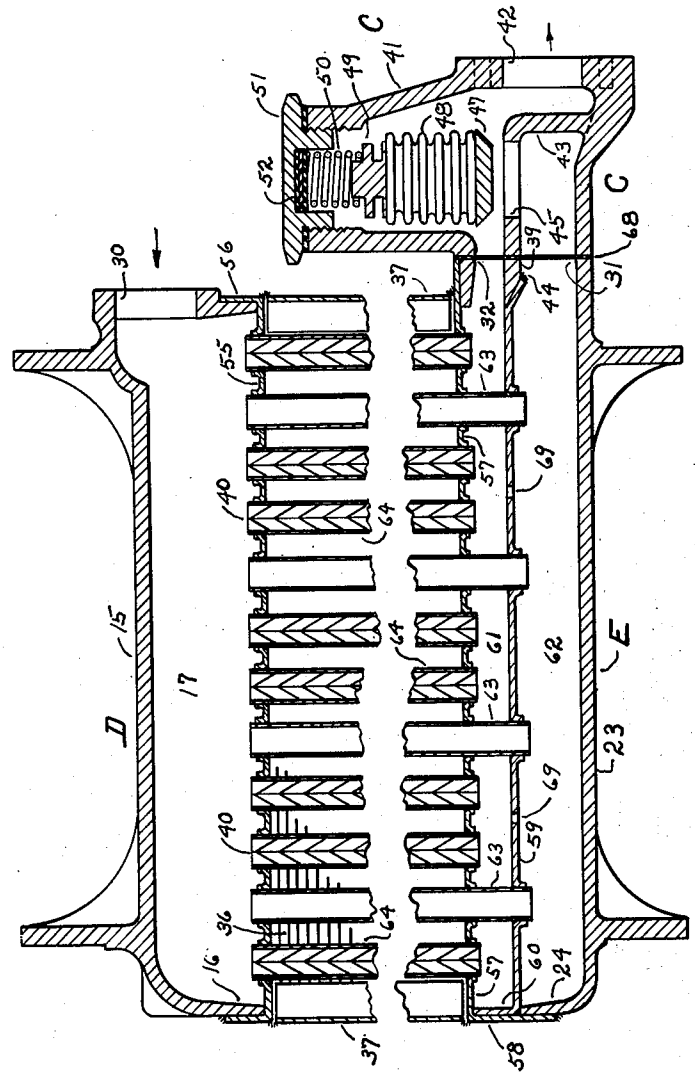


FIG. 6

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Patented Mar. 5, 1946 2,395,943

UNITED STATES PATENT OFFICE

2,395,943

FLUID TEMPERATURE CONTROLLING DEVICE

Lawrence E. Skelly and Howard F. Brinen, Racine, Wis., assignors to Young Radiator Company, Racine, Wis., a company of Wisconsin

Application September 18, 1942, Serial No. 458,904

3 Claims. (Cl. 257—2)

The present invention relates to means associated with an internal combustion engine wherein when the engine is first started, if the lubricating oil is chilled, it will be permitted to warm quickly and after the oil has been warmed to an operating temperature, to prevent it from rising above a predetermined temperature.

A further object of our invention is to provide means for controlling the temperature of clutch and transmission fluids.

Generally stated, an object of the present invention is to provide a simple easily manufactured heat exchanger which is convenient to install and may be cooled either by water or a blast of air and wherein the cooling valve may be either thermally controlled, spring loaded, or both.

Another object of our invention is to provide a simple, easily installed, safe and economical device suitable for combat vehicles, marine, aircraft and stationary use wherein high rate of heat transfer and thaw-out and anti-congealing characteristics are important objects.

A further object of our invention is to provide a few low resistance tubes through which the fluid is caused to pass when chilled and a large number of higher resistance and higher heat exchange capacity tubes through which the fluid is caused to pass after it has been sufficiently warmed.

A still further object of our invention is to provide means whereby a certain volume of fluid may, at all times, be caused to pass through certain low resistance tubes.

A further object of our invention is to provide a few relatively small apertures in the tube plate separating adjacent second header chambers so when the valve is closed, some fluid may pass between adjacent headers to thereby assist in warming the higher resistance tubes and to permit the low resistance tubes to be permanently active as heat exchangers regardless of the position of the valve.

Another object of our invention is to provide a conventional heat exchanger core which may be operated on the two pass system; thus to increase the length of travel of the oil when passing through the higher resistance tubes.

A further object of our invention is to provide a heat exchange core which may be easily packed or crated and to which the valve may be removably attached.

To these and other useful ends, our invention consists of parts, combinations of parts, or their equivalents, and mode of operation, as hereinafter set forth and claimed and shown in the accompanying drawings in which:

Fig. 1 is a fractional front elevational view of one form of our invention.

Fig. 2 is a left side view of the device shown in Figure 1.

Fig. 3 is a right side view of the device shown in Figure 1.

Fig. 4 is a fractional sectional view of the device taken on line 4—4 of Figure 5.

Fig. 5 is a transverse sectional view taken on line 5—5 of Figure 4.

Fig. 6 is a fractional section of a modification, the section being taken on a line similar to that shown in Figure 4 but showing the valve in position and in section through its center.

Fig. 7 is a sectional view of our inlet header by-pass valve shown in superimposed position in Figure 4.

Fig. 8 illustrates a top view of the valve shown in Figure 7 in position on the top header tube plate.

As thus illustrated, our device comprises two pairs of headers, one pair being designated by reference character A and the other pair by reference character B. The controlling valve is designated in its entirety by reference character C.

Headers A comprise a tube plate 10 having upturned flanges 11 and a tube plate 12 having downturned flanges 13 which fit into flanges 11 and are bonded thereto so as to make a header chamber 14. We provide a header cap 15 with flanges 16 adapted to lie on member 12 and fit snugly into flanges 11 and be bonded thereto; thus providing an outer header chamber 17.

Header B comprises an inner tube plate 18 having downwardly extending flanges 19 and a tube plate 20 having upturned flanges 21 adapted to fit snugly within flanges 19 and being bonded thereto forming a header chamber 22. We provide a lower header cap 23 having flanges 24 adapted to fit snugly within flanges 19 and be bonded thereto forming a lower header chamber 25.

At the right of member A a flanged inlet connection 30 is provided and at the right of member B a flanged outlet connection 31 is provided for chamber 25 and a flanged outlet connection 32 is provided for chamber 22. These two outlet connections are provided for a purpose which will hereinafter appear.

Header chambers 17 and 25 are operatively connected together by a limited number of tubes 33, the ends of the tubes being bonded to plates

12 and 20; thus a direct fluid passageway from inlet 30 through tubes 33 to outlet 31 is provided.

We provide a large number of what we term higher resistance tubes. One half of these tubes is designated by reference numeral 34, the ends extending through tube plates 10 and 20. The other half of these higher resistance tubes is designated by reference numeral 35, their ends extending through tube plates 10 and 18; thus forming passageways between chamber 14 and chambers 22 and 25 so fluid may pass from chamber 17 to chamber 25 then into chamber 14 and from chamber 14 to outlet 32.

It will be understood that while we have shown our heat exchanger in an elongated vertical position, it may be positioned horizontally; therefore the terms "top, bottom, right and left" are used merely as a matter of convenience.

By scrutinizing Figure 4, it will be seen that if outlet 31 is closed, oil that passes down through tubes 33 can only reach outlet 32 by passing up through tubes 34 and down through tubes 35; thus forming a two pass heat exchanger for the higher resistance core. When our device is cooled by a liquid, for example sea water, when used on marine engines, fins may not be necessary although they are shown in the figures and designated by reference numeral 36.

In order to provide channels through which either air or cooling liquid may be forced and in direct contact with the fins and tubes, we provide side plates 37—37. These plates cooperate with tube plates 10 and 18 to form a channel or duct through which the tubes extend. Members 37 may be secured to the pairs of headers in any convenient manner and the air or liquid connection to the front and rear of the duct formed may be made in any convenient manner.

In order to greatly increase the heat exchange contact with the oil passing through tubes 34 and 35, we provide agitator strips 40. These strips are preferably similar to that shown in a copending application Serial No. 451,583, filed July 20, 1942, now Patent No. 2,359,288, dated October 3, 1944, Turbulence strip; inventor, Howard F. Brinen. By the use of these strips, heat exchange between the passing liquid in tubes 34 and 35 will be increased to a point where it will be about equivalent to the heat exchange contact with the outside of the tubes and fins 36. Inlet 30 is adapted to be operatively connected to the oil line of the engine or discharge line of the device being cooled. The connection to the other end of the heat exchanger is as follows:

We provide valve C as illustrated in Figures 1 and 6 which is preferably dually controlled, the plan being to hold the valve closed when the temperature of the discharged fluid has reached a predetermined point so it will all be forced through tubes 34 and 35 after passing through tubes 33 in the following manner:

We provide a valve housing 41 having a flanged outlet 42 with an L-shaped partition 43, the inner end of which registers with a partition 39, this partition being secured to tube plate 20 as at 44. Partition 43 is provided with a valve seat 45. A valve 47 is adapted to rest on seat 45 and being suitably connected to a metallic bellows 48 which contains a sufficient quantity of thermally sensitive liquid. Metallic bellows 48 is provided with suitable means 49 forming a rest for a spring 50, the spring extending into an opening in cap 51 and being preferably adjustably secured to the cap in any well known manner.

In Figure 6, we have illustrated a number of thin plates 52 which may answer as adjusting means; for example by adding or removing plates, the valve may be held on its seat when the fluid in contact with metallic bellows 48 has reached a predetermined temperature. Clearly when the valve is on its seat, the fluid will generally be caused to flow through all of the tubes in the device, pass around metallic bellows 48 and leave the device at outlet 42.

After the machine has been operated for sometime and the chilled fluid in tubes 34 and 35 has been somewhat warmed because of heat exchange contact with tubes 33 through fins 36 and the fluid passing between the tubes and fins, the fluid will begin to flow through tubes 34, through chamber 14 and into chamber 22 through tubes 35 and escape through outlet 32, metallic bellows 48 acting to hold the valve on its seat when the temperature of the passing fluid has reached a predetermined point.

Clearly we have provided a dual control, namely a valve which will be held in an open position when the metallic bellows is in contact with chilled fluid and in a closed position when the fluid has been sufficiently warmed, the fluid being permitted to warm quickly when the valve is open because of the limited number of tubes 33.

Generally the position of the valve is determined by the temperature of the fluid around metallic bellows 48 and in this respect, spring 40 might be dispensed with and member 49 extended to members 52; however there are times in the operation of a device of this character which might cause an excessive or dangerous pressure. In this event, the pressure is controlled by spring 50.

In some installations, we may elect to dispense with metallic bellows 48 and hold the valve on its seat by means of a spring only. In either event, the operation of the device will be satisfactory, however the addition of the metallic bellows between the spring and valve provides closer regulation of the temperature of the oil.

It will be seen that we have provided a rectangular heat exchanger which can be readily installed and a valve which can be readily attached and detached, that the device is suitable for cooling by a blast of air when used on an airplane or combat vehicle or by sea water when used to cool the lubricating oil of a marine engine.

In Figure 6, we illustrate a modification wherein a single header is provided at the inlet of the device and a pair of headers is provided at the other end of the device as in the other figures. The single header is provided with the header cap 15, an inlet 30 and a tube plate 55 having flanges 56 to which flanges 16 of cap 15 are secured.

The inlet header in Figure 6 is designated in its entirety by reference character D and the outlet header is designated in its entirety by reference character E. Header E comprises a tube plate 57 having flanges 58. We provide a tube plate 59 having flanges 60 adapted to be engaged by flanges 58 and being bonded thereto.

The header cap in member E is similar to that shown in Figure 4 and is designated by a similar numeral 23, the flange 24 fitting into flanges 58 and being bonded thereto as in header B; thus an inner header chamber 61 and an outer header chamber 62 is provided, these chambers having outlets similar to that shown in Figure 4 and bearing the same numerals, the outlets having

a flange suitable for the reception of valve chamber 41.

In this design, we provide a limited number of low resistance tubes 63, the ends extending through plates 55 and 59 and being bonded thereto. We provide a large number of tubes 64, each of which is supplied with an agitator strip 40, the ends of the tubes extending through plates 55 and 57 and being bonded thereto. It will be seen that when the fluid is too viscous to pass through tubes 64, it will pass through tubes 63 to header chamber 62 wherein there will be sufficient pressure created to lift the valve 47 as in the other design.

The operation of the valve shown in Figure 6 is similar to that shown in the other figures except that a single pass cooling core is provided instead of a double pass whether controlled by the spring only, the metallic bellows only or by a spring and metallic bellows in combination.

It will be noted that members B and E are supplied with lugs 65—65 and valve C is supplied with registering lugs 66—66. Members 65 are provided with threaded openings and members 66 are provided with registering apertures whereby cap screws 67 and a suitable gasket 68 may be used for binding and sealing the valve to the outlet of headers B and E.

A number of apertures 69, two only being shown, are suitably positioned in tube plate 59 so when the valve is closed, a limited volume of oil may pass through these apertures directly from chamber 62 into chamber 61 and join any oil that may be discharged from tubes 64 escaping through outlet 42. This by-pass of a limited volume of oil assists in warming the outlet ends of tubes 64 and tube plate 57; thus to provide an earlier passage of oil through tubes 64 and permit metallic bellows 48 to act more efficiently. Apertures 69 also permit tubes 63 to act as heat exchangers even though valve 47 is closed.

Referring again to Figure 4. It will be noted that the only path for the oil from chamber 17 is through tubes 33. In order to facilitate the passage of oil from chamber 17 to chamber 22, when it is chilled, we preferably provide a valve, as illustrated in Figures 7 and 8 and shown in a superimposed position by dotted lines in Figure 4.

A circular opening 70 is cut in tube plate 12 and a valve chamber 71 having a flange 72 is positioned over the opening and welded or bonded to plate 12 as at 73. Member 71, as illustrated, is provided with a number of apertures 74. A cup shaped valve 75 having a stem 76 is provided which extends through an opening in member 71. A spring 77 is mounted on member 71 and under a cup shaped washer 78 which is held against the end of the spring 77 preferably by means of a cotter pin 79. Spring 77 is adapted to hold valve 75 on its seat under a predetermined pressure, preferably to about 15 lbs. per square inch.

When the oil in tubes 34 and 35 is chilled, the pressure in chamber 17 may rise considerably above 15 lbs. In this event, valve 75 may be open and permit some oil or fluid to pass through the higher resistance tubes 35; thus to partially by-pass tubes 33 temporarily and assist in warming the fluid in tubes 35 as a single pass system.

In the various figures, it will be noted that tubes 33 and 63 extend through tube plates 10, 18 and 57 and that at these points of contact, the tubes are bonded to the plates.

Clearly many minor detail changes may be made in the device without departing from the spirit and scope of the present invention, as recited in the appended claims.

Having thus shown and described our invention, we claim:

1. A device of the character described, comprising two pairs of spaced integrally formed headers, an inlet in the outer header of one of said pairs of headers and an outlet in the inner header of the other pair of headers, a small number of low resistance tubes forming operating connections between said outer headers, a large number of high resistance tubes forming operating connections between the inner headers of said pairs of headers and another large number of high resistance tubes forming operating connections between the inner header of said first pair of headers and the outer header of said second pair of headers, an outlet valve in the outer header of said second pair of headers having means whereby when the fluid is too viscous to pass readily through said high resistance tubes, the valve will be opened to permit the fluid to pass through the low resistance tubes only and whereby when the fluid is warm enough to pass readily through said high resistance tubes, the valve will be closed to thereby force the fluid to pass in multiple series through said high resistance tubes into said first outlet.

2. A device as recited in claim 1 including; a multiplicity of closely spaced fins through which all of said tubes extend whereby heat exchange takes place between said low resistance and high resistance tubes.

3. A device as recited in claim 1 including; a pressure operated valve positioned between said first pair of headers having means whereby a predetermined pressure difference between the outside header and its inside header will lift the valve and permit fluid to pass directly into the inside header.

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