

June 15, 1943.

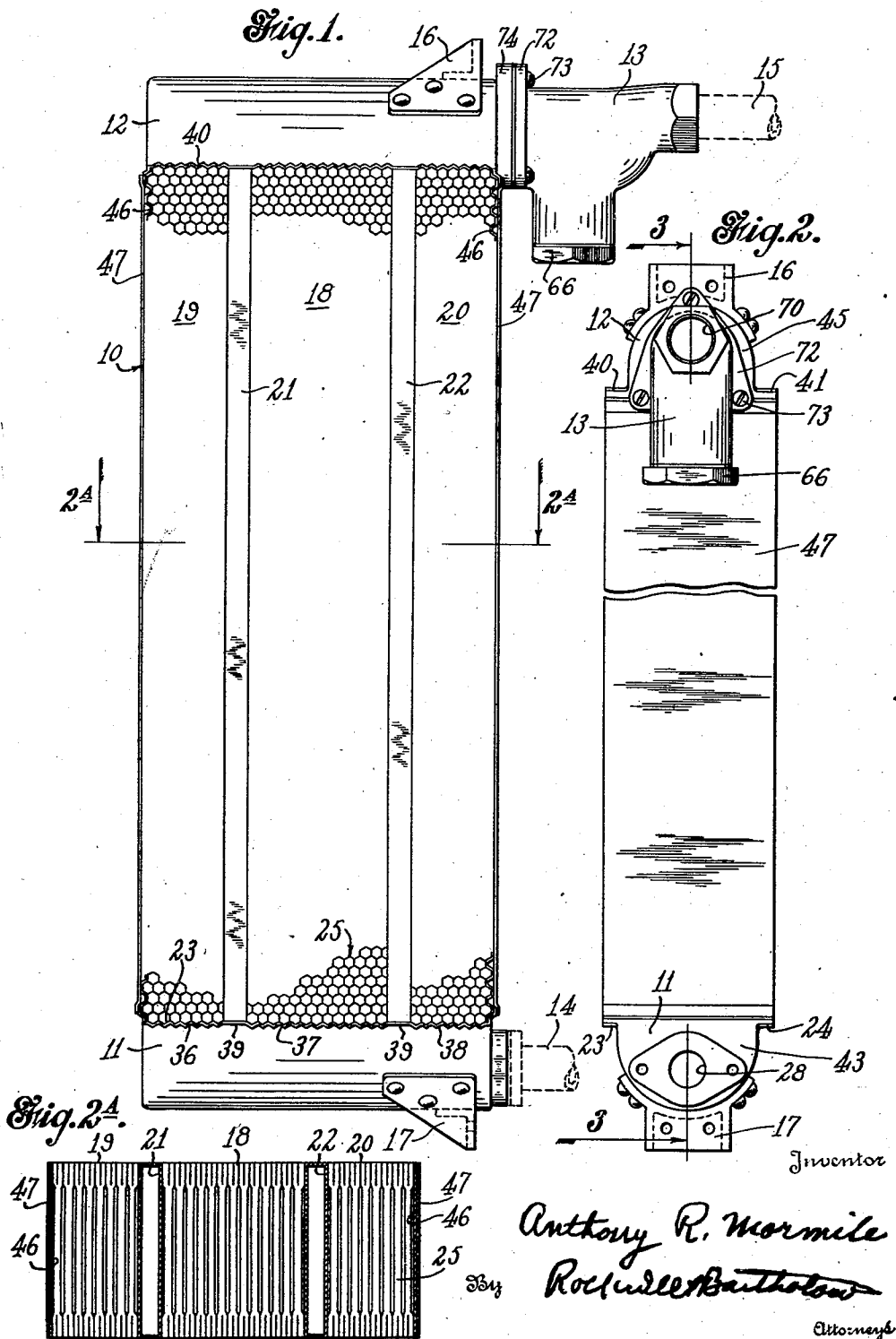
A. R. MORMILE

2,322,047

OIL COOLER

Filed March 16, 1942

3 Sheets-Sheet 1



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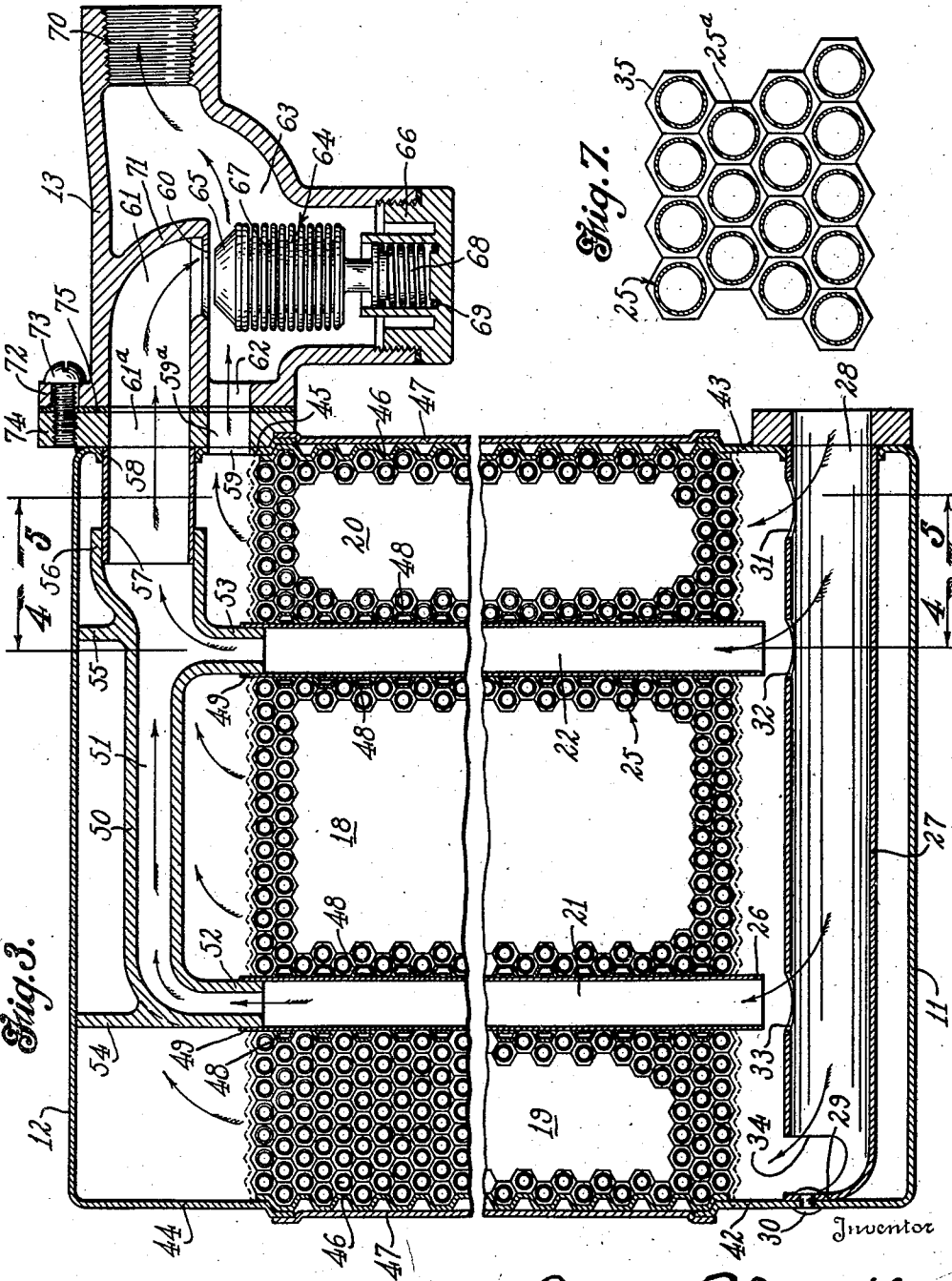
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

Fig. 4.

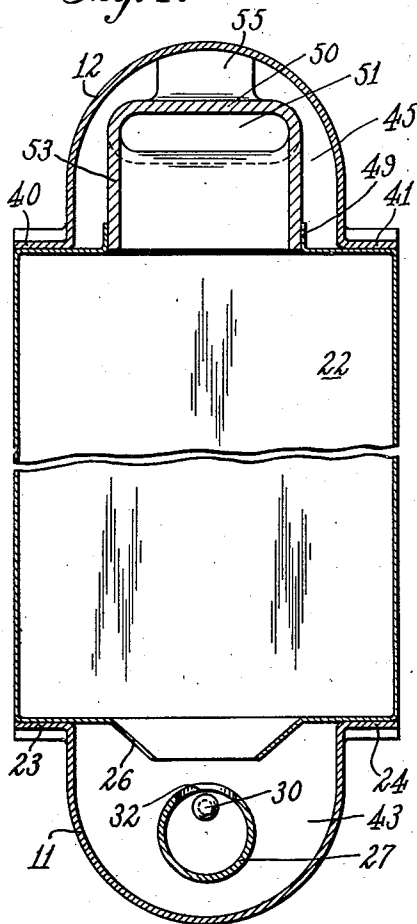


Fig. 5.

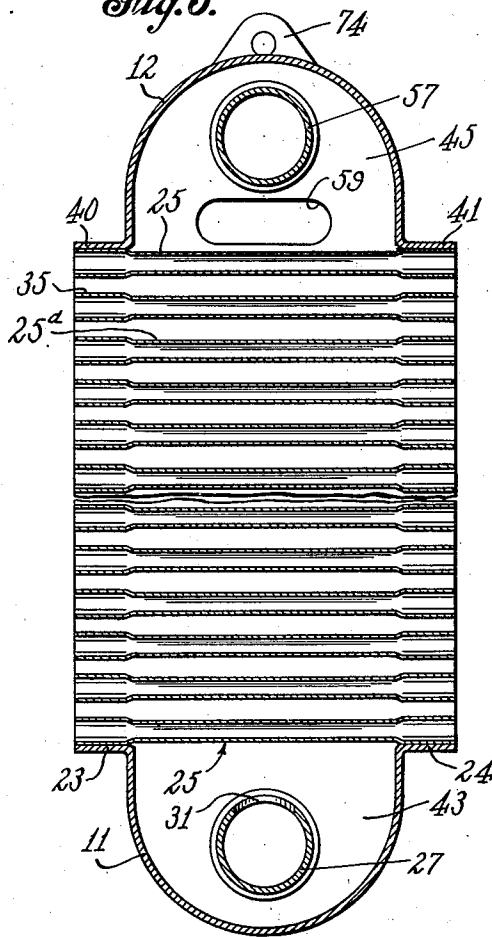


Fig. 6.

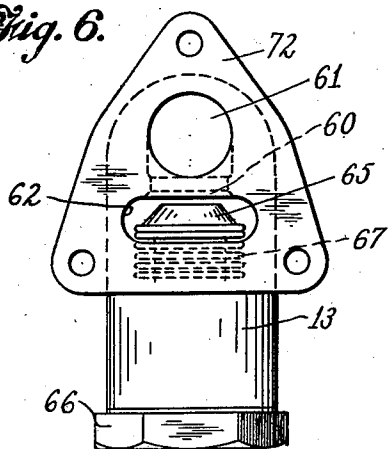
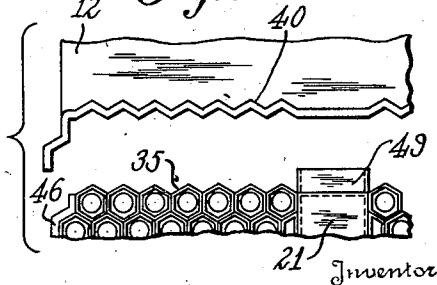


Fig. 5A.



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UNITED STATES PATENT OFFICE

2,322,047

OIL COOLER

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Application March 16, 1942, Serial No. 434,878

Claim. (Cl. 257—2)

This invention relates to oil coolers such as used for cooling the lubricating oil of internal combustion engines and other devices.

Coolers of this nature have been used in which a valve-controlled by-pass structure is employed for the purpose of hastening the warming up and circulation of the oil when the latter has been congealed by exposure to low temperatures, but previous devices have been open to certain objections and drawbacks which, by the present invention, it is aimed to overcome.

One of the objects of the present invention is to simplify the structure of the cooler and render it easier to construct, more serviceable, and adapted to withstand heavy strains and stresses and rough usage, and temperature variations throughout a very wide range.

Another object is to provide an improved arrangement of cooling sections and by-pass conduits or passages, lending itself to a simple, compact and strong cooler structure.

To these and other ends the invention consists in the novel features and combinations of parts to be hereinafter described and claimed.

In the accompanying drawings:

Fig. 1 is a front elevation of an oil cooler embodying my improvements, the connecting piping being omitted, as well as certain portions of the means for supporting the cooler in the upright position;

Fig. 2 is an end elevation of the device;

Fig. 2^A is a somewhat diagrammatic section on line 2^A—2^A of Fig. 1;

Fig. 3 is a section on an enlarged scale taken on line 3—3 of Fig. 2, the valve controlling the oil by-pass being shown in the open position;

Fig. 4 is a section on line 4—4 of Fig. 3;

Fig. 5 is a section on line 5—5 of Fig. 3;

Fig. 5^A is a detail showing portions of the upper header and the main cooling section as they appear before being juxtaposed in assembly;

Fig. 6 is a detail end view of the valve housing showing it detached from the cooler body; and

Fig. 7 is a detail sectional view of several of the cooling tubes.

In the preferred form shown in the drawings, my improved oil cooler is characterized by a relatively shallow rectangular body somewhat elongated so that its vertical dimension is considerably greater than its lateral dimension. The depth, that is to say, the distance from the front face to the rear face, is, on the other hand, considerably less than the lateral dimension. The main part of the body is constituted by a cooler

section having horizontal tubes, and also having associated therewith certain intermediate vertical by-pass conduits, as hereinafter described. Above and below the main section are headers attached to and forming parts of the cooler body. Within the lower header are provisions for conducting and distributing incoming oil received at one end of said header. Within the upper header are provisions for receiving and conducting to a valve housing oil passing upwardly around the cooling tubes, and oil passing upwardly through the by-pass conduits. In this particular case the controlling valve is located in a housing extending laterally beyond the upper header at one end of the latter and having communication with the oil spaces around the cooling tubes, and with a manifold which is in communication with by-pass conduits arranged between certain cooler tube sections.

In the drawings, the cooler body is indicated generally at 10, the lower or receiving header at 11, the upper header at 12, and the valve housing at 13. The lubricating oil coming from the motor or the like is conducted to the right-hand end (Fig. 1) of lower header 11 by a connection 14, and oil passing from the valve housing 13 is carried back to the motor or the like by a suitable connection 15 attached to housing 13. By suitable means the cooler is rigidly supported, when in use, in the vertical position shown in Figs. 1 and 2, and in this particular instance I have shown brackets 16 and 17 attached to the upper and lower headers, respectively, constituting one means by which the cooler can be fastened to a suitable support.

The main cooling section extends from the lower header to the upper header, and in this particular case comprises three portions or banks of cooling tubes, namely, a middle portion 18 and two end portions which are indicated at 19 and 20, respectively. Interposed between portions 18 and 19 is a vertical by-pass conduit or passage 21, and between portions 18 and 20 is a second by-pass conduit 22, and it may be observed that in this particular case the cooling tube capacity available at opposite lateral faces of each by-pass conduit is substantially the same, this being accomplished by properly dimensioning the middle tube portion 18 with respect to portions 19 and 20.

The by-pass conduits 21 and 22 are co-extensive in depth with the associated cooling core portions, having exposed front and rear faces flush or substantially flush, with the mouths of the horizontal air passages. In this particular

case the by-pass conduits are of elongated rectangular cross-section, the elongation being depth-wise of the core.

In the form shown, the headers are constructed of sheet metal, and have the rounded cross-sectional form shown, for example, in Fig. 4, the body portions of rounded cross-sectional form being provided at the front and rear with lateral securing flanges. In Fig. 4 the lateral flange which is at the front of the lower header 11 is indicated at 23, and it will be seen that it extends from the body of the header to the front face of the cooling section. A similar flange 24 is provided on the header 11 at the rear, the flanges 23 and 24 underlying the horizontal cooling tubes 25, and also underlying lower corner portions of the conduits 21, 22, as shown in Fig. 4.

From the lower ends of the conduits 21, 22, portions 26 are bent down so as to extend to a degree into the interior of the lower header these portions 26 providing mouths or entrances at the lower ends of the conduits into which oil is supplied from a distributing tube 27 extending lengthwise of the lower header. This header has at the right-hand end (Fig. 3) an opening 28, and one end of the tube 27 is fastened to the header so as to be in communication with this opening 28. At the opposite end, the distributing tube 27 is rigidly supported within the header by suitable means, as, for example, by bending up a portion 29 at the end of the tube, and attaching it by means such as rivet 30 to the end wall of the header. This tube 27 is provided with suitable upper distributing openings for facilitating passage of oil in the proper amount and proportions to the lower ends of the conduits 21 and 22, and the lower ends of the cooling portions 18, 19, 20. In this particular instance an opening 31 is provided in the distributing tube below cooling portion 20, an opening 32 is provided below and in line with the lower mouth of conduit 22, another opening 33 is similarly provided in association with conduit 21, and an opening 34 is provided beneath cooling portion 19. Such an arrangement provides very effective distribution of the oil coming in at the inlet, but is shown only by way of example.

The cooling tubes 25 are provided with enlarged hexagonal end portions 35 so that when the tubes are placed in a bank with the ends or heads abutted against each other in the relation shown in Fig. 7, the body portions 25^a of the tubes are spaced apart to provide passages through which the oil may pass upwardly while air is passing through the tubes substantially horizontally. In order to conform to the lowermost tubes which are supported thereon, the header flange 23 is provided with bent zig-zag portions 36, 37 and 38, as shown particularly in Fig. 1, and in the places where the flange underlies and supports portions of the by-pass conduits, it is provided with flat portions 39. It is to be understood, of course, that the corresponding flange 24 at the rear is similarly formed, and also that the upper header 12 has correspondingly formed front and rear securing flanges 40 and 41.

It will be observed from Fig. 3 that the end walls 42 and 43 of the lower header are extended upwardly somewhat beyond the level of the flanges 23, 24. Similarly, the end wall 44 and 45 of the upper header are continued downwardly somewhat beyond the flanges 40 and 41. It will be observed from Fig. 3 also that adjacent the left-hand boundary of the tubes of portion 19 a

corrugated plate 46 is provided which is shaped to receive and hold the head portions of adjacent cooling tubes, this plate being extended so as to somewhat overlap the adjacent header end walls.

At the outer face of the plate 46 a plain plate 47 is arranged covering the tube bank at the side, this plate 47 being somewhat overlapped on the header end walls and suitably fastened thereto. Adjacent the left-hand wall of the conduit 21 (Fig. 3), suitable filler strips 48 are provided, as required for locating and holding the associated tube heads. Additional filler strips 48 are also used in association with the right-hand wall of the conduit 21 (Fig. 3), and similar filler strips are also used at both sides of the conduit 22. At the right-hand side of the core the construction is the same as at the left-hand side, there being another corrugated tube-head-seating plate 46, and another plate 47 at the exterior.

At their upper ends each of the conduits 21 and 22 is provided with an open flanged portion 49 extending upwardly somewhat into the upper header, which in plan is of a generally elliptical shape. Each portion 49 serves to receive a leg of a manifold 50 located in the upper header. This manifold is preferably formed as a casting, and it has a hollow tubular body 51 in communication at the left-hand end (Fig. 3) with a hollow leg 52, the lower end of which is inserted into flanged portion 49 of conduit 21. Adjacent the right-hand end (Fig. 3) the manifold has a similar hollow leg 53 extended into the conduit 22. At its upper part the manifold is provided with integral lugs 54 and 55 which extend upwardly from the manifold body and are provided with curved upper surfaces so as to fit within and against the inner surface of the header body in the proper relation when the two parts are assembled. The legs 52 and 53 are of substantially elliptical cross-section, and so is the body portion 50 of the manifold. The lug 54 is associated with the left-hand end of the manifold (Fig. 3), and the lug 55 near the right-hand end. At the right-hand end of the manifold (Fig. 3) the same is enlarged, and of round open formation, as indicated at 56. This provides removable telescoping connection with a short tube or sleeve 57 leading to and fastened in an open portion or port 58 in the adjacent end wall of the header. The header end wall also has an additional opening or port 59, preferably of elliptical shape, as shown in Fig. 5, located below opening 58, and providing an additional passage in communication with the interior of the valve housing 13 previously mentioned. The opening 58 is approximately in line with the bore in the body of the manifold, and the opening 59 is only slightly above the adjacent bank of cooling tubes. The manifold 50 can be installed with considerable ease, as the manifold legs can be connected to the by-pass conduits merely by thrusting them therein.

The valve housing 13 has a chambered interior and is equipped with a valve seat 60 horizontally arranged adjacent the right-hand end (Fig. 3) of a duct or passage 61 in communication with the opening 58 previously mentioned. The valve housing is also provided at the left-hand end (Fig. 3) with an inlet port 62 that is in communication with the opening or port 59 previously mentioned. This port 62 leads into a chamber 63 in the lower part of the valve housing, and in this chamber 63 is a valve device 64 having a valve 65 located beneath the seat 60 and movable upwardly to engage the seat and downwardly to

disengage it. Preferably the valve device 64 is supported by and reacts against an adjustable screw-threaded plug 66 in the lower part of the valve housing, and the valve may be controlled in its operation by suitable thermostatic means such as a gas-filled metal bellows or corrugated shell 67 such as commonly used for thermostatic control. Also the valve may be under the control of a spring such as the helical spring 68 placed beneath the valve stem in a suitable socket 69 provided adjacent the inner face of the plug 66.

The chamber 63 is in communication with an outlet 70 provided on the valve housing, and in communication with the pipe 15 or other connection back to the motor or other apparatus. It will be seen from Fig. 3 that oil in passage 61 will be deflected by a curved wall 71 if the valve seat is open, and will pass downwardly through the valve seat into chamber 63, and thence upwardly to outlet 70. On the other hand, oil passing into the valve housing through the port 62 will move approximately horizontally around the valve, and thence in a slightly upward course to outlet 70.

Preferably the housing 13 is provided at the inlet end with a flange 72 by means of which it is detachably connected as by screws 73 to a corresponding flange 74 that is suitably fastened to the adjacent end wall of the upper header. The port 62 is formed directly in this flanged end wall of the housing, and the passage 61 extends through this end wall. The securing flange 74 on the right-hand end of the upper header (Fig. 3) has an opening 61' registering with the passage 61 and with the interior of sleeve 57, and is provided with a port 59a registering with port 59 and port 62, and between this flange and the flange of the valve housing suitable packing material is interposed, as shown at 75.

In the operation of my improved cooler, oil is supplied to the lower header at the right-hand end (Fig. 3), and under conditions of moderate temperature the oil feeding upwardly from the openings of the distributing tube of the lower header will pass upwardly through the cooling portions 19, 18 and 20. Under these circumstances, the valve device 64 will be in the closed position, the expansion of the bellows being sufficient in degree to hold the valve proper against the seat 60. This will prevent circulation of oil upwardly through the conduits 21 and 22 and through the manifold 50 connected to said conduits. The oil moving vertically through the portions 19, 18 and 20 will move upwardly around the tubes 25 while being cooled by air moving horizontally through the tubes. When the oil moves upwardly beyond the upper level of the tube banks, it enters the upper header at the lower part of the latter, and then, by a generally horizontal movement, in which it circulates at least partially around the manifold 50, it passes into the valve housing 13 by way of the port 62, around the valve, to the outlet 70, and thence back to the mechanism which is being lubricated. In this manner the oil, while being circulated, is cooled in a very effective manner by the air passing through the tubes 25. There is an additional cooling effect under these circumstances owing to the extraction of heat from those faces of the conduits 21 and 22 which are exposed to the air, into which faces heat is carried from the cooling tubes adjacent the conduits.

In starting the motor or the like, or at other times, there may be a condition in which the oil in the tubular sections is congealed, so that oil cannot take the course of flow mentioned above,

or can do so only to a limited degree. Under these conditions, however, the thermostatically controlled valve device 64 (having been set to open at a predetermined temperature) is open and therefore permits upward circulation of the oil through the conduits 21 and 22. Therefore oil, coming into the distributing tube 27, can pass upwardly through openings 32 and 33 into the lower ends of the conduits, and can move upwardly in the conduits in a straight course so as to enter the manifold 50 and then pass by a substantially straight path to the valve seat 60, and thence to the outlet 70. Hot oil, moving upwardly through the conduits 21 and 22 in this way, will quickly warm up the oil in the cooling sections, and this oil will start circulating, taking the course previously described. Oil moving up through conduit 21 passes into leg 52 of the manifold and through the body of the manifold, and at a certain point is joined by the body of oil passing upwardly through conduit 22, and these bodies of oil, mixed together, pass through the sleeve 57 and passage 61. When a certain temperature is attained in the region of the valve device (this being a properly selected temperature), the valve closes so as to eliminate any further circulating of the oil through the by-pass system which in this particular case is provided by the vertical passages in the core, the manifold, with its associated manifold sleeve 57, and by a part of the valve housing 13.

The valve spring 68 is used in addition to the bellows 67 as a matter of precaution. Should the valve stick in the closed position under improper operation of the bellows, at a time when the by-passing of the oil should occur, the downward pressure of the oil above the valve seat 60, when a certain pressure has built up, will cause the valve to open by a thrust overcoming the supporting action of the spring. It is understood, however, that while I have shown herein the valve as being under the control of a thermostatic element and also a resilient element, the particular valve control means is not important in the broader aspects of the invention.

It is of distinct advantage that the cooler of my invention is of a simple, compact and rugged character and not likely to get out of order. The by-pass conduits used in connection with the tubular cooling body are straight, which facilitates circulation, and on the other hand ample by-pass capacity for the intended purposes is provided. It is of advantage also that the by-pass conduits used in multiple are in communication with a common receiver or manifold which carries the oil in a very direct manner to the valve seat. It is also of advantage that there is direct and facile communication between the upper ends of the tubular cooling portions and the hot oil outlet of the device. Other advantages of my new structure will also be obvious to those skilled in the art.

It will be understood that in manufacturing the oil cooler, the cooling section comprising the individual tubes and the interposed by-pass conduits can be readily built up. The headers with their interior parts in position can then be placed against the ends of the cooling section, with their flanges lying in contact with the ends of the conduits and with the enlarged ends of the adjacent cooling tubes. Then by dipping the respective face portions of the assembly in solder, the individual cooling tubes are secured together in a body and secured to the conduits, and the headers secured to the cooling section. In manufacturing the cooler, all of the various fastenings or

seurements necessary between the structural parts can be made very easily.

In the case shown in the drawings there are two by-pass conduits, each centrally arranged in a section of the cooler disposed at one side of a vertical center line. In some cases, however, the number of the conduits may be varied, also their arrangement. In the case shown in the drawings, the cooling sections are made up from individual cooling tubes, as this is regarded as preferable, but in some instances the tube structure comprising the horizontal air passages and the substantially upright liquid passages may be constructed from bent and folded metal sheets. The heat exchange structure can also be used for other purposes than the regulation of the temperature of lubricating oil.

While I have shown herein only one form of my improved device, it is to be understood that the invention can take various forms, and that various changes in the organization of parts and in the details may be made without departing from the principles of my invention or the scope of the claim.

What I claim is:

An oil cooler comprising a tubular cooling sec-

tion having horizontal air passages and generally vertical oil passages, upright by-pass conduits in spaced parallel relation arranged within the body of said cooler section, a lower header having an inlet for oil to be cooled, means in said header for distributing oil to the oil passages of the cooling section and to the lower ends of the by-pass conduits, an upper header having its interior in communication with the oil passages of the cooling section and having a discharge for oil issuing from the oil passages of the cooling section, said upper header also having a second discharge, a manifold within the upper header having a hollow body and hollow legs, the legs being in communication with the upper ends of said by-pass conduits and said manifold being adapted to carry oil from said conduits to said second discharge, a valve housing having portions respectively in communication with the respective discharges of the upper header and divided from each other by a valve seat, and a valve adapted to engage and disengage said valve seat and adapted to control by-passing of the oil through the by-pass conduits and the manifold.

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