Dec. 3, 1940. J. D. LEAR 2,223,662

OIL RADIATOR

Filed Nov. 10, 1939 2 Sheets-Sheet 1

Fig. 4

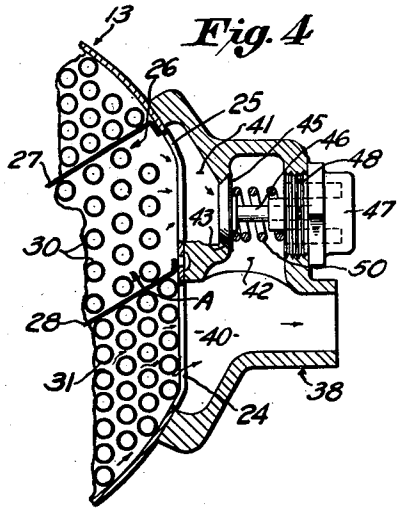


Fig. 6

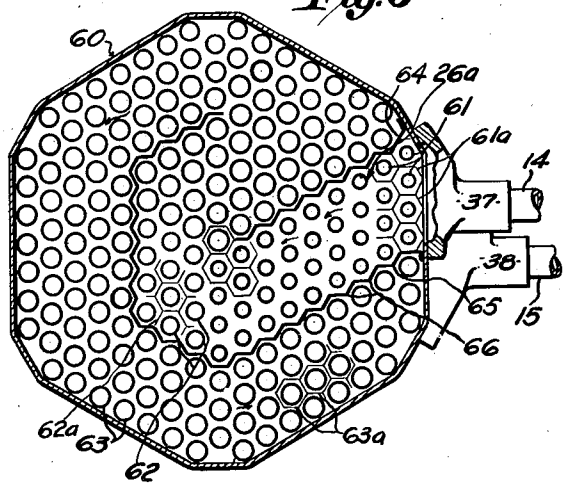


Fig. 1

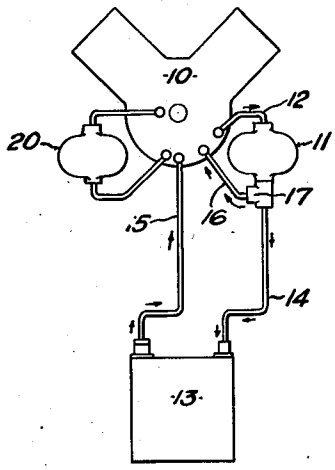
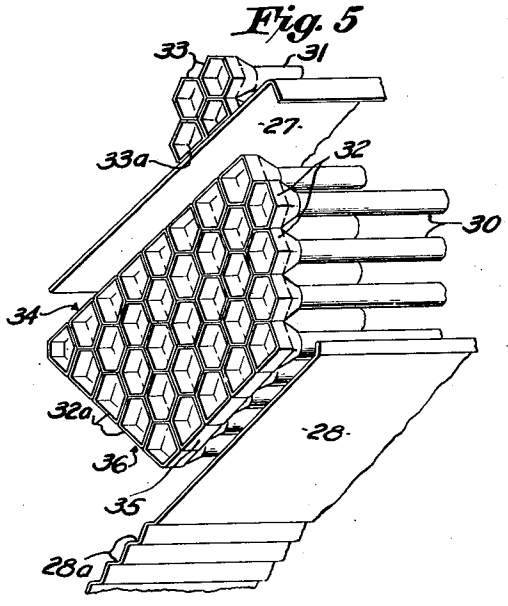


Fig. 5



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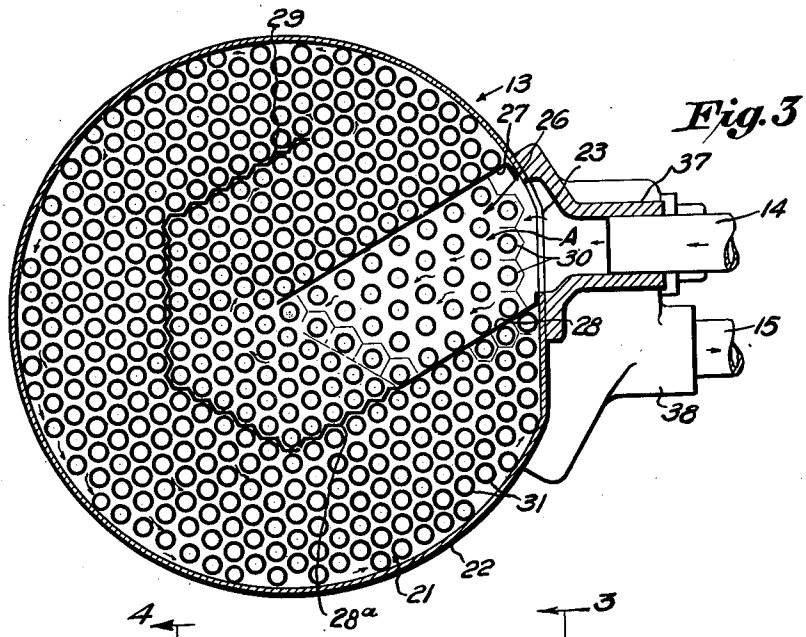


Fig. 3

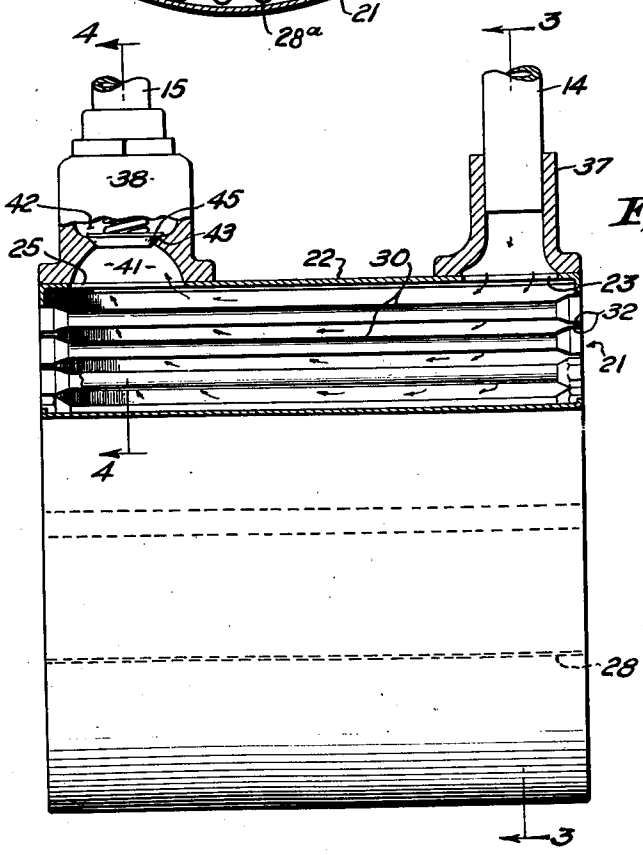


Fig. 2

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UNITED STATES PATENT OFFICE

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OIL RADIATOR

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Application November 10, 1939, Serial No. 303,813

4 Claims. (Cl. 257—2)

This invention relates to oil cooling radiators which are adapted for use with internal combustion engines.

The invention is particularly directed to oil radiators of the self-heating type, wherein hot entrant oil is utilized to preheat the core whenever the oil in the core becomes too viscous and cold to be forced freely therethrough. In the present invention it is proposed both to simplify and to reduce the weight of the cooler by a novel core structure including a single tortuous channel arrangement through which the oil may selectively flow either transversely or longitudinally, depending upon temperature conditions in the cooler and a responding circuit control instrumentality which is included in the unit. In attaining this result, the cellular structure of the core is progressively modified along said passage so that the core elements themselves form heating zones for succeeding groups of cells.

Thus the present invention provides a self-heating core which does not require a heating jacket or like preheating structure, as is typical of prior art coolers. As a result, it has been found that the invention permits an appreciable saving in space, material and assembly cost, and increased aerodynamic and thermal efficiency in active use.

Other advantages and features of the invention are more fully set forth in the specification and accompanying drawings, wherein:

Fig. 1 is a diagrammatic view of an oil cooling system for an internal combustion engine;

Fig. 2 is a side view of the oil cooler of the invention with the fittings and adjoining portions of the core shown in section;

Fig. 3 is a section on the line 3—3 of Fig. 2;

Fig. 4 is a fragmentary section on the line 4—4 of Fig. 2;

Fig. 5 is a fragmentary perspective view of the tube group located in the inlet portion of the tortuous channel of the core of Fig. 2;

Fig. 6 is a cross section through the cooler of a further embodiment of the invention.

A typical oil supply and cooling system is shown in Fig. 1, wherein the engine 10 operates an oil cooler supply pump 11, which receives oil from the engine sump through a conduit 12 and delivers it to the oil cooler 13 through a conduit 14. After being cooled, the oil is directed from the cooler back to the engine through a conduit 15. A by-pass conduit 16, including a by-pass valve 17, is arranged between the outlet of the pump 11 and the engine sump, and it provides a safety device which protects both the pump and the cooler 13 from excessive head pressures which may result from blocking of the circuit by highly viscous cold oil. If desired, the pump 11 may be used solely for supplying the cooler, and a second pump 20 provided for supplying the bearings of the engine 10.

The oil cooler 13 includes a core 21 and an enclosing casing 22 therefor, which casing is most advantageously of cylindrical form. The casing is provided at one end with an inlet port 23 and at the opposite end with an oil outlet port 24 and approximate relief outlet port 25. It is proposed to form a single tortuous passage or channel 26 within the cooler, through which the oil may be directed from the inlet port 23 to the outlet port 24, and such passage is formed by a baffle plate 27 extending radially from the casing 22 toward the center of the core and a spaced parallel plate 28 whose extremity is formed with a reentrant bent portion 29. The inlet port 23 is located between the plates 27 and 28, and thus oil may be directed therefrom toward the center of the cooler, and about the bent portion 29, whence it is guided counter-clockwise within the casing 22 until it emerges from the outlet port 24, which port (Fig. 4) is disposed immediately beneath the plate 28.

It is not intended to limit the invention to the shape and proportions herein shown, and it will be hereinafter obvious that both the cooler and the channel 26 therein may take other geometrical forms which are too numerous to describe. In this connection, it will be noted that the baffle plate 27 may be eliminated entirely in smaller forms of coolers.

The core 21 is preferably fabricated of individual elements, which in Figs. 2 to 5 consist of elongated tubes 30 and 31 of the same diameter but formed with large and small hexagonal heads 32 and 33 respectively. The tubes 30 are all located in a group A at the inlet end of the channel 26, while the remainder of the available space within the casing is packed with the tubes 31. To reduce the soldering operations and facilitate assembly, the marginal tubes of the group A may be formed with pentagonal heads 32*a*, so that when this group is assembled in nested relation (Fig. 5), planar surfaces 34, 35 and 36 are presented to the baffle plates 27 and 28, and to the adjacent tubes 31. Similarly, the marginal tubes 31 may be formed with similar special heads 33*a*.

After the tubes are arranged within the casing 22 in nested relation, the adjoining surfaces of the heads are soldered together, and the periph-

eral tube heads are also soldered to the casing 22. This seals the spaces between the tubes into one locular mass within the confines of the casing 22. The interior tube passages provide a plurality of parallel conduits through which air may be directed through the core. It will be noted that the bent portion 29 of the baffle plate 28 is corrugated, as indicated by the numeral 28a, and further that it is of a general hexagonal formation. This permits the heads 33 of the tubes 31 to be nested therewith in perfect registry.

Inlet and outlet fittings 37 and 38 respectively are soldered to the casing 22, and they communicate with the previously mentioned conduits 14 and 15. The outlet fittings 38 contain two passages 40 and 41, which overlie the outlet port 24 and relief port 25 respectively. A transverse valve chamber 42 opens into the passage 40 and it is formed with a valve seat 43 leading into the passage 41. A valve 45 is positioned on the seat 43, and it is provided with a stem 46 which is slidably carried in a nut member 47. The nut member is removably positioned in a tapped hole 48 in the fitting 38, and it carries a spring 50 which engages the valve 45.

In the operation of the oil cooling system, it will be apparent that a uniform pressure will be maintained therein through the operation of the valve-controlled by-pass circuit 16 about the pump 11. As a result, the oil cooler will be protected from rupturing pressures when the oil therein is in a highly viscous state. Under such conditions, when the oil enters the cooler through the conduit 14 and inlet port 23, its passage through the tortuous channel 26 will be blocked by thick, cold oil lying between the tubes 31. Thus, the oil, in following the path of the least resistance, will flow axially along the entrance tubes 30 to the relief port 25. The valve accordingly will be forced open, and the oil will flow through the seat 43 and valve chamber 42 to the outlet conduit 15. It will be noted that the relatively wide spacing between the tubes 30 provides a plurality of axial passages of generous proportions which offer only a small resistance to the relief flow of oil. The oil, in passing axially through the cooler, will give up some of its heat to the baffle structure and to the adjoining portions of the cold and stagnant main oil body. It will also be observed that the heat exchange action is accompanied by a physical action, in which the warm moving oil directly contacts the cold oil in a wiping or loosening effect. Thus, the cold oil in the remote spaces of the tubes 31 will be cleared away and the warm oil flow will progressively advance to the center of the core, where its heat exchange action with the tubes 30 will be most effective.

As the engine warms up, the transient oil will become warmer and less viscous, and as a result its velocity through the cooler will become greater and its heat exchange ability more effective. Thus the cold oil in the cooler will be rapidly heated, whereupon normal flow through the tortuous channel 26 will be instituted and the axial flow will be progressively diverted until the entire flow will pass out of the cooler through the outlet port 24.

In Fig. 6 similar results are obtained with a modified core structure. In this embodiment the casing 60 contains tubes 61, 62 and 63 of progressively greater diameter, whose heads 61a, 62a, 63a are of identical proportions. Baffle plates 64 and 65 form a tortuous channel 26a disposed similarly to that of the first embodiment, and it will be observed that such plates are corrugated as indicated by the numeral 66, so that the tubes and plates may be nested without special assembly provisions. The tubes are arranged in groups with the smallest tubes 61 disposed adjacent the entrance of the channel 26a, and the next largest tubes 62 arranged adjacent to the tubes 61. Thus it will be seen that the relatively large spaces between the tubes 61 provide an axial passage for the oil in its initial relief flow from the fitting 37 to the fitting 38, while the intermediate spaces between the tubes 62 provide for easy communication with the remaining tubes 63 after the warming progresses to the center of the core.

It will be apparent to those skilled in the art that it is intended herein to disclose a principle of construction wherein the core itself is devised with a preheating section. Thus the invention is not intended to be limited to specific forms of valves, casings and tube elements, except as set forth in the accompanying claims.

I claim:

1. An oil cooler comprising a cellular core formed with parallel air passages and a thermally related locular mass of internal oil passages, a casing sealing open portions of the oil passages, baffle means secured to the casing and extending into the oil passages to form a tortuous channel therein, spaced inlet and relief ports formed in the casing and both communicating with one extremity of said tortuous channel, an outlet port formed in the casing and communicating with the remaining extremity of said channel, the oil passages in the first named extremity of the tortuous channel being formed and proportioned to offer less resistance to the passage of viscous oil than the remaining passages, whereby oil may flow axially from the inlet to the relief ports when flow through the channel is blocked by cold oil, and valve controlled means responsive to pressure conditions within the core for connecting said relief and outlet ports.

2. An oil cooler comprising a plurality of elongated tubes having enlarged polygonal heads at each extremity, means securing the heads together in interengaging relation to form a core having a locular mass of internal oil passages, a casing enclosing the tubes and sealing therein the exposed portions of the tube passages, baffle means secured to the casing and extending into the oil passages to form a tortuous channel therein, spaced inlet and relief ports formed in the casing and both communicating with a common extremity of said tortuous channel, an outlet port formed in the casing and communicating with the remaining extremity of the channel, the heads of the tubes at the inlet extremity of the channel being larger than the heads of the remaining tubes to provide increased tube spacing at such portion of the core, whereby oil may flow axially along the tubes when flow through the channel is blocked by cold oil, and valve controlled means responsive to pressure conditions within the core for connecting said relief and outlet ports.

3. An oil cooler comprising a plurality of elongated tubes having enlarged and similarly proportioned polygonal heads at each extremity, means securing the heads together in interengaging relation to form a core having a locular mass of internal oil passages, a casing enclosing the tubes and sealing therein the exposed portions of the tube passages, baffle means secured to the casing and extending into the oil passages

to form a tortuous channel therein, spaced inlet and relief ports formed in the casing and both communicating with a common extremity of said tortuous channel, an outlet port formed in the casing and communicating with the remaining extremity of said channel, the tubes at the inlet extremity of the channel being of lesser diameter than the remaining tubes, whereby oil may flow axially along the tubes from the inlet to the relief ports when flow through the channel is blocked by cold oil, and valve controlled means responsive to pressure conditions within the core for connecting said relief and outlet ports.

4. An oil cooler comprising a plurality of elongated tubes having enlarged and similarly proportioned heads at each extremity, means securing the heads together in interengaging relation to form a core having a locular mass of internal oil passages, a corrugated baffle plate disposed between the tubes and having its extremities engaged betwen the heads of the tubes, said plate forming a tortuous oil channel within the core, a casing enclosing the tubes and sealing therein the exposed portions of the oil passages, spaced inlet and relief ports formed in the casing and both communicating with a common extremity of said tortuous channel, an outlet port formed in the casing and communicating with the remaining extremity of said channel, the tubes at the inlet extremity of the channel being of lesser diameter than the remaining tubes, whereby oil may flow axially along the tubes from the inlet to the relief ports when flow through the channel is blocked by cold oil, and valve controlled means responsive to pressure conditions within the core for connecting said relief and outlet ports.

JOSEPH D. LEAR.