May 15, 1945. J. C. SHAW 2,376,198

INTERNAL-COMBUSTION ENGINE OIL COOLER

Filed June 22, 1942 3 Sheets-Sheet 1

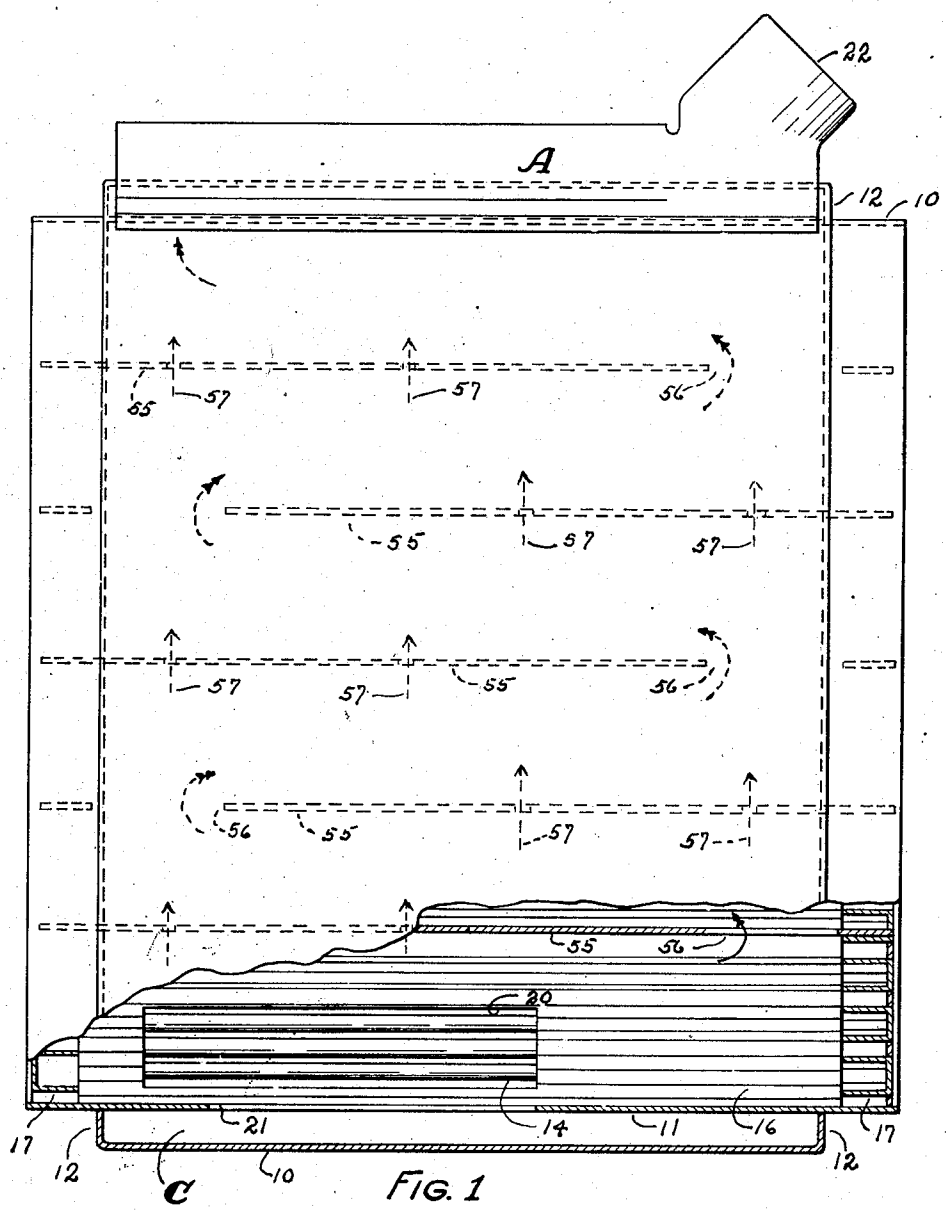


FIG. 1

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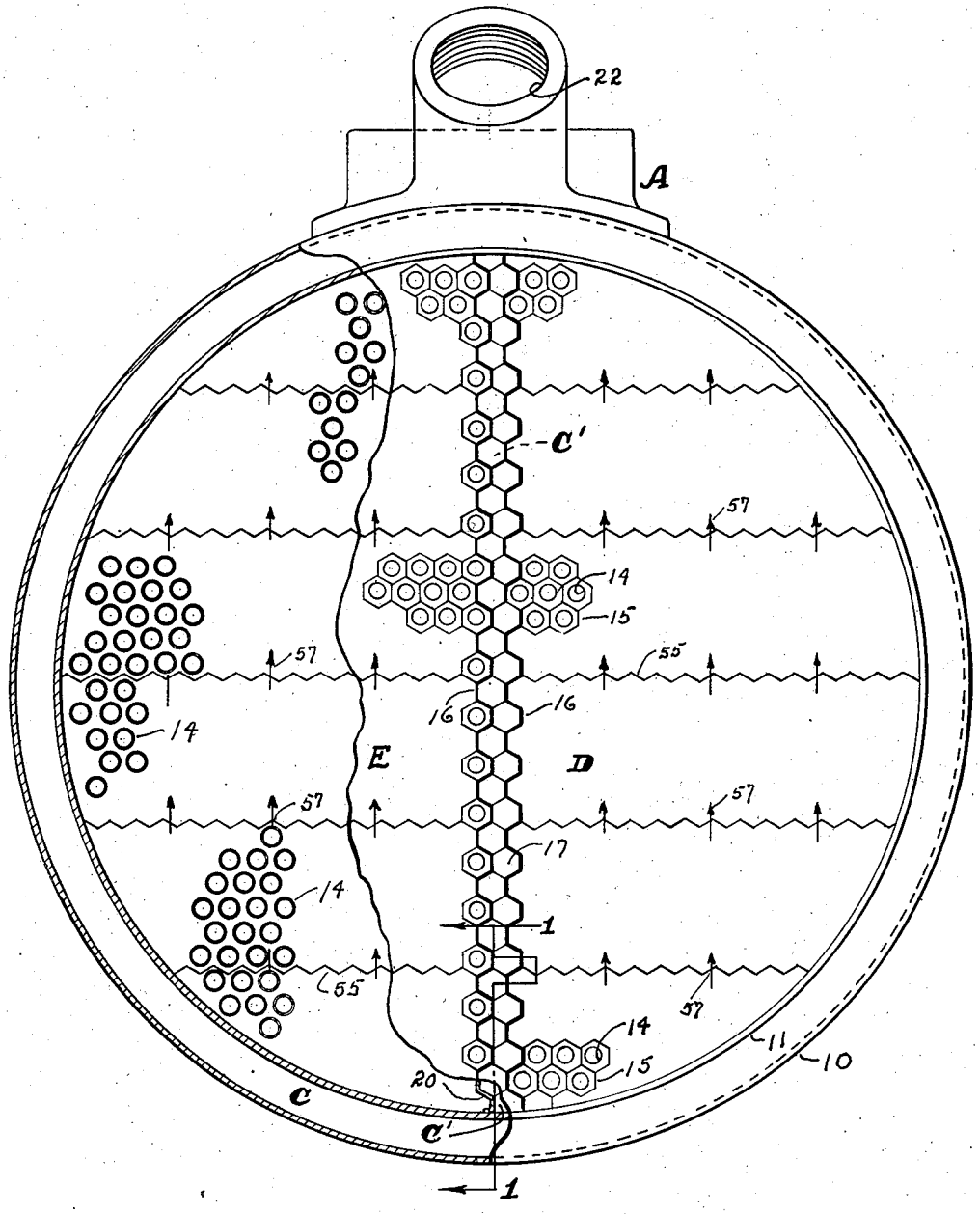


FIG. 2

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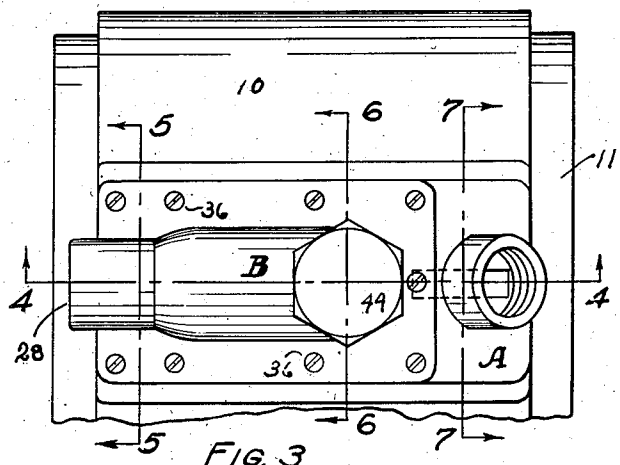


FIG. 3

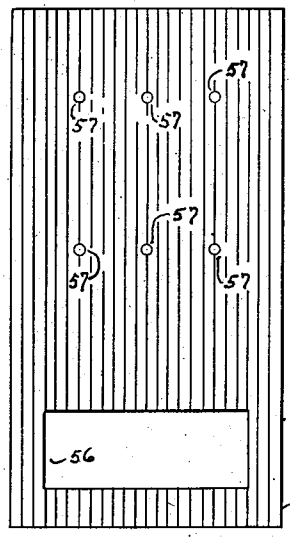


FIG. 8

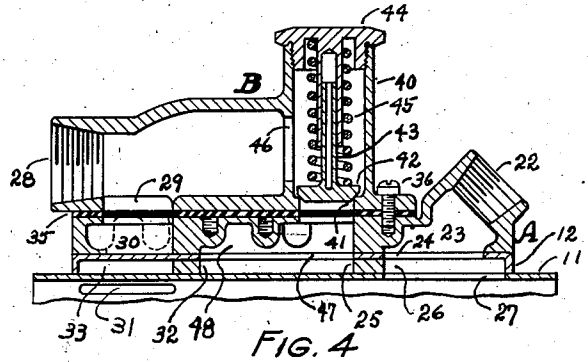


FIG. 4

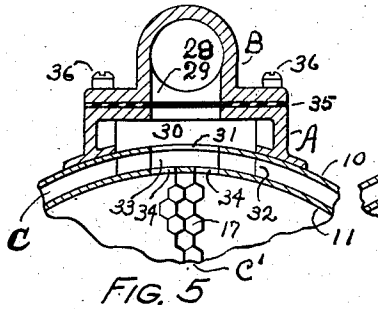


FIG. 5

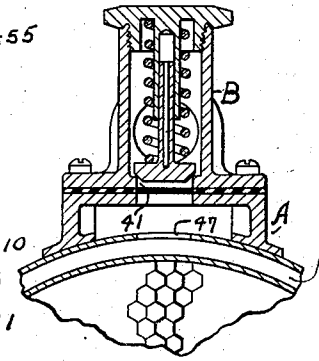


FIG. 6

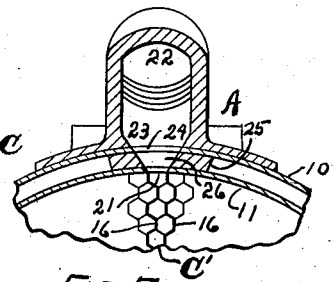


FIG. 7

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UNITED STATES PATENT OFFICE

2,376,198

INTERNAL COMBUSTION ENGINE OIL COOLER

Joe C. Shaw, Racine, Wis., assignor to Young Radiator Company, Racine, Wis., a company of Wisconsin

Application June 22, 1942, Serial No. 448,019

5 Claims. (Cl. 257—2)

The present invention relates to oil coolers commonly used on airplanes wherein air is forced through closely spaced tubes by frontal pressure as a cooling medium and the oil is forced to pass between these tubes for heat exchange contact with the air.

During very cold weather, and before starting the engine, the oil in the tube chamber is congealed and will not flow to an appreciable extent between the tubes.

Generally the tube chamber is circular and from one to two feet in diameter. It is the custom to preheat the oil in the chamber by means of a narrow annular passageway around the chamber or by means of a narrow oil passageway through the center of the chamber or both, through which the engine oil is primarily shunted.

It is desired to heat the oil in the tube chamber as quickly as possible so all of the heat exchange capacity will act to prevent a harmful rise in temperature.

The oil adjacent these oil passageways begins to heat immediately after the engine is started. However, it takes considerable time to sufficiently warm the oil in the tube chamber at points remote from the prewarming passageways. I provide such means which form the subject matter of the present invention. With my invention, all of the oil in the tube chamber is quickly and uniformly heated and the temperature is not permitted to rise more than a few degrees above normal because the oil is soon permitted to flow through the entire heat exchange area.

In devices of the class, in the past, particularly when the tube chamber is dependent upon an annular chamber only or a central passageway for prewarming, the temperature of the oil rises considerable above the desired temperature before the full cooling effect of the device is in action.

I accomplish the desired results by properly positioning a number of suitably sized apertures in the deflector plates so a desired volume of oil may pass directly from one side of the tube chamber to the other without flowing around the deflector plates immediately after the engine is started.

To these and other useful ends, my 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 side elevational view of my device, a fraction being cut-away on line 1—1 of Figure 2.

Fig. 2 is a rear view of the device shown in Figure 1, a portion being cut-away and shown in section.

Fig. 3 is a fractional top view of the device illustrating the base and valve housing in position on the device.

Fig. 4 is a fractional sectional view taken on line 4—4 of Figure 3.

Fig. 5 is a transverse fractional sectional view taken on line 5—5 of Figure 3.

Fig. 6 is a fractional transverse sectional view taken on line 6—6 of Figure 3.

Fig. 7 is a fractional transverse sectional view of the device taken on line 7—7 of Figure 3.

Fig. 8 is a top view of one of the deflectors illustrating the by-pass apertures.

As thus illustrated, the base plate is designated in its entirety by reference character A. The valve and housing in their entireties are designated by reference character B. The prewarming low resistance oil passageways are designated in their entireties by reference characters C and C' and the bundles of tubes on opposite sides of member C' are designated in their entireties by reference characters D and E.

The heat exchange part of the device consists of an outer cylinder 10 and an inner cylinder 11, the outer cylinder having flanges 12—12 and being secured to member 11 whereby a narrow annular closed chamber C is provided.

Members D and E comprise tubes 14, the ends of the tubes being expanded into hexagonal shapes as at 15. These ends are adapted to fill the space and be bonded together and to cylinder 11 so as to form tube plates.

The central oil passageway C' is formed by leaving out one staggered row of tubes. I provide partitions 16—16 defining this oil passageway, the ends being sealed by means of caps 17 as shown in the sectioned part of Figure 1 which are the same shape and size as members 15. Members 17 are shaped so they contact and lie between partitions 16 as indicated in Figure 2 and are bonded to these members and together when the tube ends are bonded together; thus a closed oil passageway is provided from one side of member 11 to the other which divides the space in member 11 into the two chambers.

I provide ports 20 in the bottom of members 16 as clearly shown in Figure 1 forming an outlet from the oil passageway C' into the bottom of the tube chambers. I also provide a port 21 in member 11 which registers with the bottom of the central oil passageway C'.

Member A is shaped as illustrated in Figures 2 to 7 having a surface which fits the outer sur-

face of member 10 and being bonded thereto. Member A is provided preferably with a threaded inlet 22 having a chamber 23 which intersects a port 24 in member 10. As shown in Figure 7, I provide a filler 25 between members 10 and 11, said filler being bonded to the members and having a port 26 which registers with port 21 in member 11; thus an inlet to one end of the central oil passageway C' is provided. Outlets on opposite sides of this oil passageway are provided by openings as previously described.

Member B is provided with preferably a screw threaded outlet 28 having a port 29 which, as shown in Figure 5, registers with a chamber 30 in member A. Chamber 30 registers with a port 31 cut in member 10 and a filler 32 is adapted to fill the space between members 10 and 11, the filler having a passageway 33 which registers with ports 34—34 in casing 11 positioned on opposite sides of the central oil passageway C'; thus outlets are provided from the top of the tube chambers into outlet 28.

Member B is adapted to be bound and sealed to member A by means of a gasket 35 and bolts 36, the gaskets having cut-away portions to accommodate the registering ports in these members.

As shown in Figure 4, I provide a valve chamber 40 having an inlet 41 forming a seat for valve 42 having a stem 43 which extends upwardly into an opening in a cap 44. A spring 45 is adapted to yieldingly hold valve 42 on its seat. The valve chamber has an outlet 46 permitting the oil that passes under the valve to escape through outlet 28.

Member A is provided with a chamber 48 having an opening 47 in member 10 which registers with member 41. Opening 47 is positioned in member 10 so an outlet from the top of chamber C' is provided into the valve; thus it will be seen that oil may pass into inlet 22 and through the central and annular oil passageways C' and C and escape through the valve to outlet 28.

If the pressure required to force the oil between the tubes is not great enough to lift valve 42, then the oil will pass into the bottom of the tube chambers through openings 20 and from these chambers, the oil will pass to outlet 28 as already described.

I provide baffle plates 55 arranged as illustrated in Figures 1 and 2 having alternately positioned openings as at 56 so the oil will pass sinuously between the tubes or around these baffle plates as illustrated by double pointed arrows in Figure 1 and oil passing between the tubes will be in heat exchange contact with the air which is forced through the tubes preferably by means of frontal pressure.

During very cold weather and before the engine is started, the oil between the tubes in the chambers is congealed. The oil pump exerts sufficient pressure on the oil to cause the same to flow through passageways C' and C, lift valve 42 and escape through outlet 28. The oil flowing through passageways C' and C heats the adjacent congealed oil and when it is sufficiently thawed, some oil will pass between tubes D and E around baffle plates 55. However a considerable time will lapse before the oil in the center of the chambers will be warmed enough to flow to an appreciable extent and at times the oil may become over-heated before the full effect of the cooling air can take place.

Clearly when the valve is lifted, there will be very little cooling effect on the oil and therefore it will be permitted to heat quickly, but after the oil in the tube chambers is sufficiently warmed, the valve will seat and the oil will then be in heat exchange contact with the cooling medium passing through the tubes.

It will be noted that when the valve is closed, the oil will be forced to pass from ports 20 sinuously for a considerable distance around the baffle plates 55 in order to reach outlet 28. For some time after the engine is started, only a fraction of the area of the tubes will be effective so that the oil may become overheated for a considerable time.

During the time when only a fraction of the oil within the chambers is preheated, air at very low temperature may be forced through the tubes; therefore this air will act to retard the heating of the oil in the entire tube chambers.

In the present invention, I provide a suitable number of properly positioned apertures 57 in each of the baffle plates; thus when the engine is first started and before any material volume of oil can pass the long route from the inlet to the outlet between the baffle plates, some oil will be forced through these apertures in the baffle plates because of the shortened path provided from ports 20 to outlet 28. This primary movement of oil directly over a short path through the tube chambers, as indicated by single pointed arrows in Figures 1 and 2, will bring about an early warming of the oil in the entire chambers so the desired temperature of the oil is quickly reached and effectively cooled thereafter and without a temporary harmful rise in temperature. It will be understood that apertures 57 also act to prevent recongealing of the oil in the tube chambers under certain operating conditions.

Clearly my invention is especially adaptable to heat exchangers having an annular prewarming chamber only or exchangers having only a center prewarming chamber; therefore it will be understood that the heat exchanger design shown is only for purposes of illustration and forms no part of my invention except to illustrate one application thereof.

Having thus shown and described my invention, I claim:

1. A viscous liquid temperature controlling device of the class described, comprising a chamber having closely spaced tubes which extend therethrough and adapted for the passage therethrough of a cooling medium, spaced inlet and outlet connections in opposite sides of said chamber for the viscous liquid, a number of spaced deflector plates positioned between certain rows of tubes and having means to cause the viscous liquid to pass between the tubes and through the chamber sinuously, a number of spaced relatively small apertures in said deflector plates positioned to thereby permit a portion of the viscous liquid to pass directly through the deflector plates and from opposite sides of the chamber.

2. A device as recited in claim 1 including; a prewarming passageway in heat exchange contact with said chamber and forming a separate passageway between said inlet and outlet connections, a by-pass valve associated with said prewarming passageway adapted to force all of the viscous liquid through said chamber when closed, said valve having means whereby when said viscous liquid will not pass readily through said chamber, it will be lifted and permit the viscous liquid to pass through said prewarming passageway.

3. A lubricating oil temperature regulating de-

vice of the class described, comprising a chamber having closely spaced tubes which extend therethrough, said tubes adapted for the passage therethrough of a cooling medium, spaced inlet and outlet connections in said chamber, spaced deflector plates positioned between certain tubes and having openings in opposite ends thereof to thereby cause the oil to pass through the chamber and between the tubes sinuously, a number of relatively small spaced apertures in each of said deflector plates positioned to thereby permit a relatively small volume of oil to pass directly through said chamber from the inlet to the outlet, whereby a sinuous path of relatively large area and a number of relatively small direct paths are provided between the inlet and outlet of the chamber.

4. A device as recited in claim 3 including; a prewarming passageway in heat exchange contact with said chamber and forming a separate passageway between said inlet and outlet connections, a by-pass valve associated with said prewarming passageway having means to normally force all of the oil through said chamber when closed, said valve having means whereby when said oil will not pass readily through said chamber, it will be lifted and permit the oil to pass through said prewarming passageway.

5. An oil cooler having a matrix comprising a chamber divided into compartments by partitions, tubular members for cooling medium disposed in said chamber and parallel to said partitions, inlet and outlet ports to said chamber to enable oil to be passed through said chamber, an opening of comparatively large area provided in each partition the said opening being disposed at opposite ends of adjacent partitions so that a tortuous path for the oil flow is provided through the said chamber substantially parallel to the cooling medium tubes, and an opening of comparatively small area provided in said partitions at at least one end of said chamber the said comparatively small opening being disposed in a partition at the end remote from the larger opening in said partition and substantially in axial alignment with the larger openings in the partitions next adjacent to said partition thereby providing a shorter path than the said tortuous path substantially transversely of the cooling medium tubes whereby oil will flow in said shorter path when increased viscosity of the oil produces an increased resistance to flow in the said longer tortuous path greater than the increase in resistance to flow in the said shorter path.

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