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HEAT EXCHANGER

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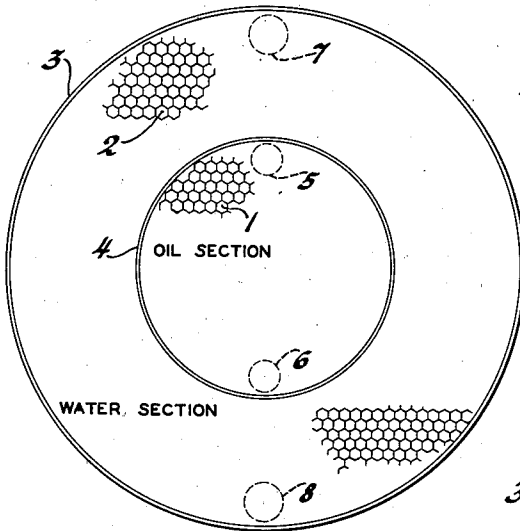


Fig. 1

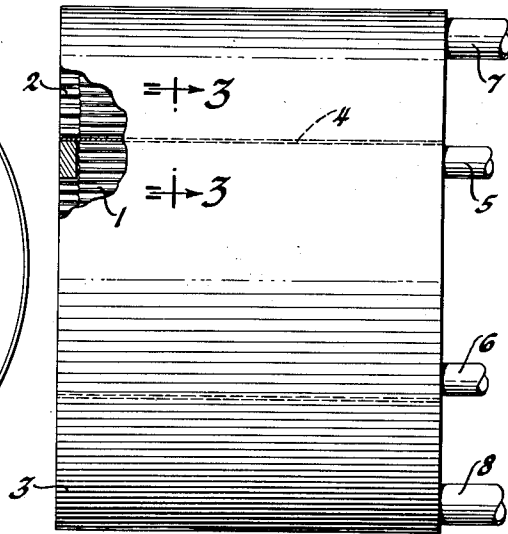


Fig. 2

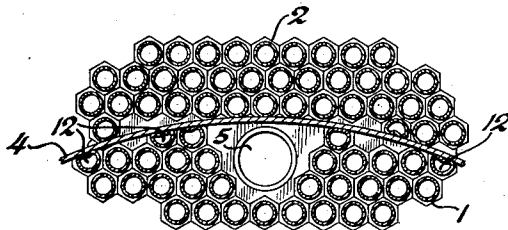


Fig. 3

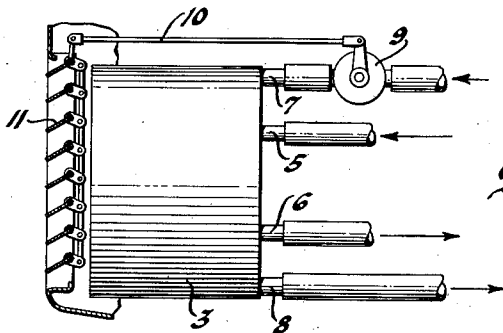


Fig. 4

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HEAT EXCHANGER

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3 Claims. (Cl. 257—128)

This invention relates to engine cooling systems and more particularly to an improved radiator especially designed for the regulation of operating temperatures of airplane engines. Quick engine warm up at the start and the maintenance of proper operating temperature during flight are important factors in the use and maneuver of aircraft and with these things in mind it is proposed according to the present invention to interchange heat between the engine lubricating system and the engine cooling system in addition to the dissipation of excess heat from both systems. Although the lubricating oil may be sluggish and stiff at first the interchange of heat in the radiator will insure free flow promptly.

It is an object of the invention to provide an air cooled radiator structure for the interchange of heat between and the dissipation of excess heat from the engine cooling system and the lubricating system. More specifically the invention aims to provide a reliable low cost structure combining in a single assembly two air cooled units, one for connection with the engine cooling system circuit and the other for connection in the lubricating system circuit and one embracing the other for the direct conduction and exchange of heat.

A further object of the invention is to enable definite savings in weight and space requirements so essential to aircraft design by providing a radiator assembly comprising an annular or ring-like group of tubes constituting one air cooled unit surrounding a central core or bundle of tubes constituting the second air cooled unit with a circular separator band interposed between the peripheral margin of the central core unit and the inner margin of the outer ring unit and constituting a division wall common to both units.

Additional objects and advantages will become apparent during the course of the following specification having reference to the accompanying drawing wherein Figures 1 and 2 are front and side elevations of the improved radiator structure; Figure 3 is a detailed section taken on line 3—3 of Figure 2 and Figure 4 is a view illustrating a typical installation.

In the preferred embodiment illustrated, use is made of a bundle of spaced tubes having enlarged polygonal end portions nested together in the front and rear faces of the assembly so as to space the tubes apart and to close off the intervening spaces and the transfer of heat is through the tube walls from liquid flowing in thin streams

within the enclosed space to the several air streams flowing interiorly of the tubes. The tubes are arranged in concentrically disposed groups, those indicated at 1 affording a central core unit and those indicated at 2 being in the form of a ring-like unit peripherally surrounding the core tubes 1. Peripherally embracing the tubes 2 is a band or closure wall 3 and closing or separating the spaces between the outer annulus of tubes 2 from the spaces between the central core tubes 1 is an endless separator wall 4.

Both walls 3 and 4 are of a width conforming to the depth of the assembly and are sealed to the enlarged tube ends which are sealed to one another as by means of the conventional solder dipping operation. The sealing and joining of the complete assembly may be performed in the one step although it will be understood that the central core and outer ring unit may be separately formed as sub-assemblies and subsequently interfitted, and furthermore, that the interfitted surfaces of the complementary units may be other than the regular circular outline illustrated. In any event the division wall 4 separates the two core units from one another and being common to both will transmit heat from the liquid within one unit to that within the other unit. This interchange of heat is important at the start of engine operation in cold weather when the engine oil is stiff because the cooling liquid on taking up heat quickly in the engine cooling jacket and coming in contact with one side of the wall 4 will warm the wall and send heat to the lubricating oil on the opposite side of the wall. The warmth imparted causes the oil to lose its stiffness and conditions it for freer flow.

While the radiator assembly may be constructed so that either the center core unit or the outer ring unit may be incorporated in the engine cooling system the preferred arrangement illustrated has the central core provided near its periphery and at diametrically opposite points with inlet and outlet fittings 5 and 6, respectively, for connection with the lubricating system and the outer ring has similar inlet and outlet fittings 7 and 8 for connection with the cooling system. Figure 4 shows the connection with the inlet to the cooling system section as including a thermostatic unit 9 for automatically operating through the link 10, the pivoted shutters 11 covering the front face of the radiator and controlling cooling air flow in accordance with temperature change of the cooling system.

Below predetermined cooling system tempera-

ture the shutters are closed and no air cooling takes place, the only exchange of heat in the radiator occurring through the division wall 4 and between the liquid flow through the cooling system section and the cold oil immediately adjacent the wall. Sluggish flow of oil through the central core unit is corrected in the region closest to the division wall 4 and the accelerated rate of flow is initially through arcuate paths between the peripherally located inlet 5 and outlet 6 until the oil supply gradually becomes of higher temperature throughout. As a safety precaution the lubricating circuit may include the usual by-pass around the temperature regulating unit. As the temperature of both the cooling system liquid and lubricating oil increases with continued engine operation the need for heat rejection arises and is satisfied by the thermostatic actuation of the shutters 11 for the flow of cooling air through the radiator. The amount of heat to be dissipated in any given installation will determine the number of cooling tubes employed in the respective radiator sections.

For convenience of manufacture the individual tubes 1 and 2 are circular in cross section but it will be noted that certain of the tubes in the marginal portions of each unit are flattened on one side as indicated at 12 in Figure 3 to fit better the circular outline of the division wall 4. It will be noted also that while the spaces between the tubes allow the liquids to contact the division wall for the interchange of heat as before mentioned a number of the tubes come in contact with the wall surface so that in effect the wall at spaced circumferential intervals is directly associated with air spaces in the direction of the tube length. This arrangement of having a balanced portion of the wall surface for contact with

the two liquids and the cooling air will assist in controlling the amount of heat transferred from the engine cooling liquid to the lubricating oil after each has reached its maximum operating temperature.

I claim:

1. A multiple-unit heat-exchanger comprising concentric fluid containing units, a heat-transmitting partition between adjacent units constituting a common wall in contact on opposite sides with the contained fluids of said adjacent units, parallel heat-dissipating passages through the fluid containing space of said units, and a separate inlet and outlet for each of said units, whereby each unit may be connected with a separate heat-exchange system.

2. A multiple-unit heat-exchanger, comprising concentric fluid containing units, a heat-transmitting partition between adjacent units constituting a common wall in contact on opposite sides with the contained fluids of said adjacent units, honeycomb-type heat-dissipating passages through the fluid containing space of said units, and a separate inlet and outlet for each of said units, whereby each unit may be connected with a separate heat-exchange system.

3. In a heat interchange device, a pair of concentric heat exchange units, each of said units comprising a group of laterally arranged air tubes having their adjacent ends joined and sealed to form a closed liquid space surrounding the tubes, a heat transmitting division wall common to both units and sealing each from the other to afford interchange of heat from the fluid of one unit to the fluid of the other unit, and a separate inlet and outlet for each unit.

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