July 13, 1943. J. J. HILT 2,323,994

OIL COOLER

Filed Nov. 4, 1940 2 Sheets-Sheet 1

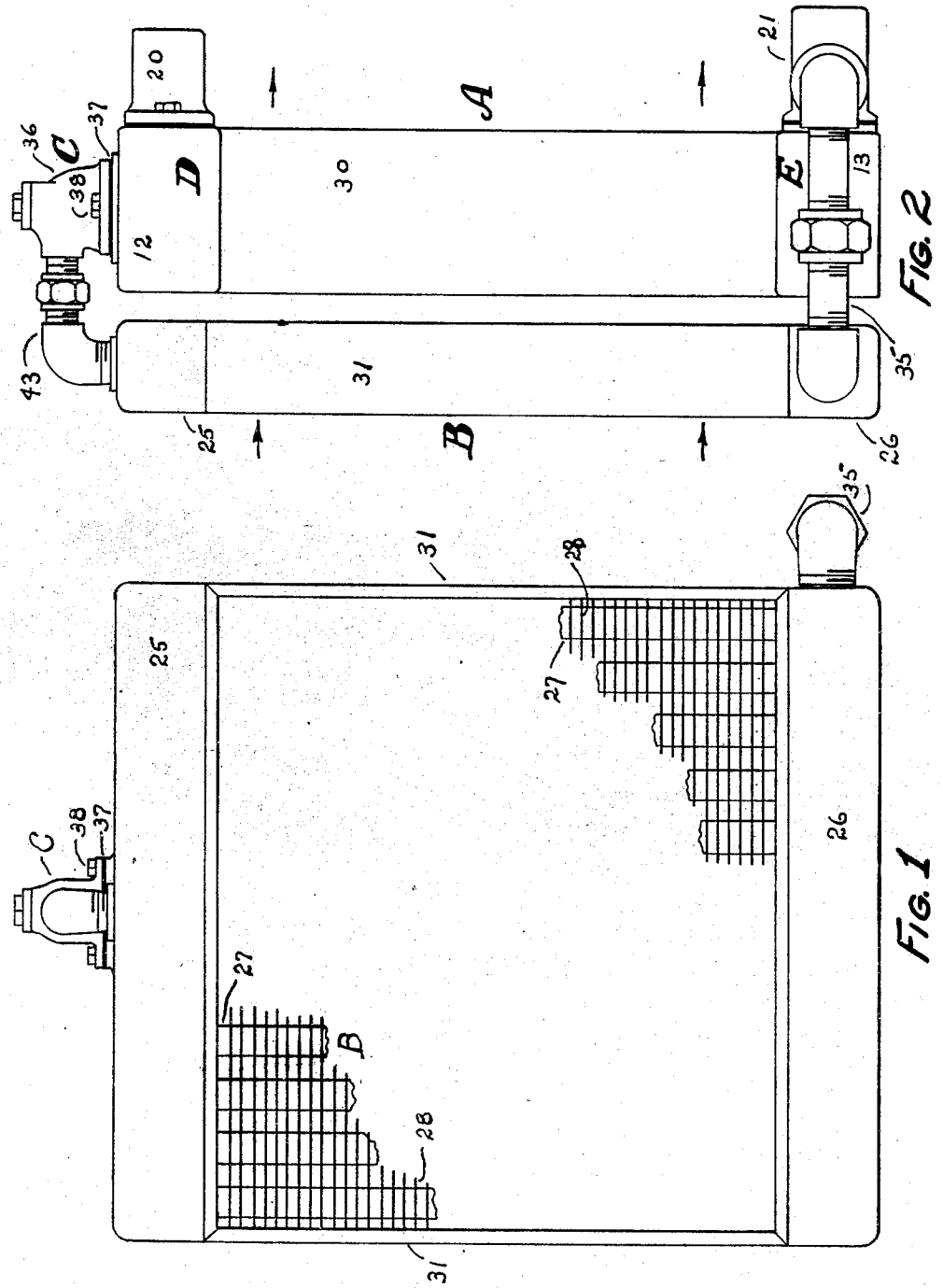


FIG. 2

FIG. 1

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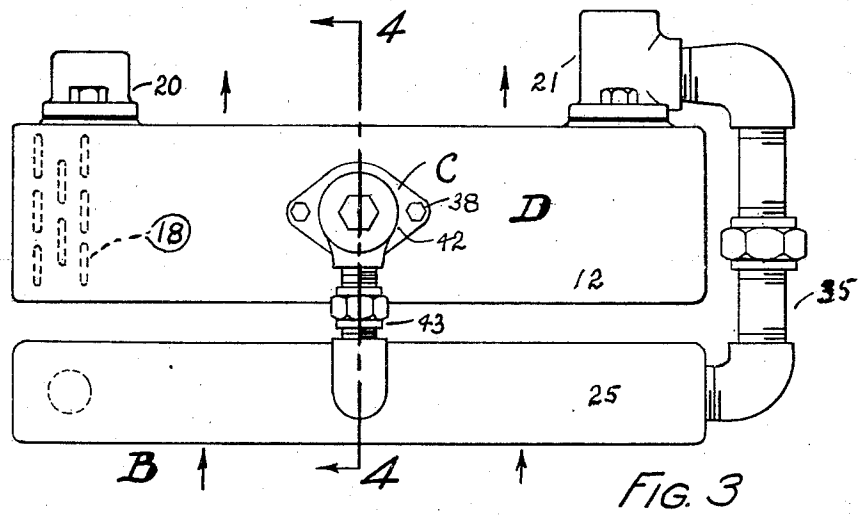


FIG. 3

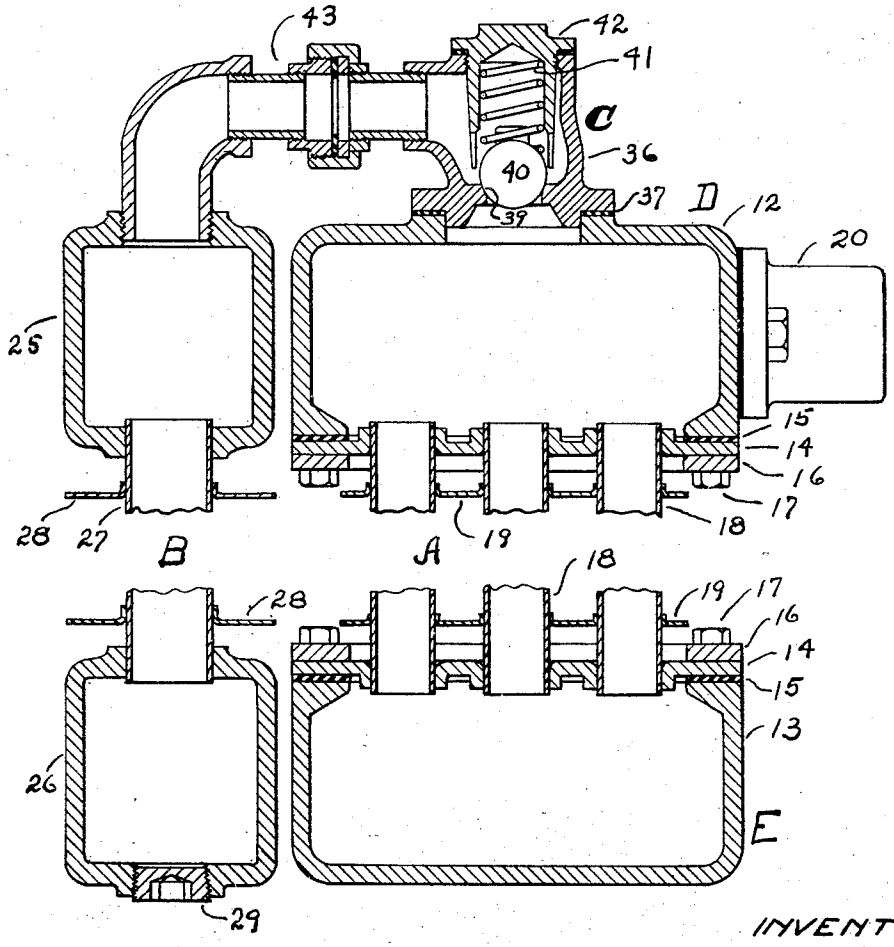


FIG. 4

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OIL COOLER

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2 Claims. (Cl. 257—2)

The present invention relates to means for controlling the temperature of the lubricating oil of an airplane engine.

An object of my invention is to provide two cores through each of which the oil may flow independently or simultaneously and having a by-pass valve adapted to control this flow of the oil.

In the present invention, it is desirable that directly after starting the engine, the oil will be permitted to heat quickly by passing it through a cooling core of small heat transfer capacity and after it has become heated to a predetermined point to then pass the oil through a heat transfer cooling core of large capacity. I position the small capacity core in front of the other core whereby the large capacity core will be prewarmed by the air after passing through the small capacity core.

To accomplish the desired objects, I provide two heat exchange cores, one offering low resistance to the passage of oil and having considerable less heat transfer capacity than the other core and the other core having a large heat transfer capacity but offering considerable resistance to the passage of the oil when its temperature is below a predetermined point.

In order to accomplish the objects of the present invention, I place a by-pass valve in the circuit which may be either thermally or pressure controlled wherein when the oil is too thick to pass through the large high resistance core, the valve will be opened and the oil permitted to pass through the small low resistance core; thus providing means whereby the oil will be permitted to heat quickly when the engine is first started and the high resistance core warmed by the air after passing through the low resistance core.

Generally stated, the objects of the present invention are to provide an oil cooling and temperature controlling device for aviation engines which is simple, efficient, light, economical and safe, and whereby the cooling air is forced through the cores by frontal pressure.

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 front view of my improved device.

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

Fig. 3 is a top view of the device shown in Figures 1 and 2.

Fig. 4 is an enlarged transverse sectional view of the device taken on line 4—4 of Figure 3, a fraction of the tubes and fins being removed.

As illustrated in the various figures, the high resistance large heat transfer capacity core is designated in its entirety by reference character A, this core however does not offer high resistance to the passage of oil when it and the oil are hot. The permanently low resistance small heat transfer capacity core is designated in its entirety by reference character B. The controlling valve of the device is designated in its entirety by reference character C.

Member A comprises a top header D and a bottom header E. The headers are formed as illustrated in Figure 4 comprising an upper cap 12 and a lower cap 13, each having tube plates 14—14 which are bound and sealed to the cap by means of a gasket 15, bars 16 and bolts 17.

The cores of unit A are formed by means of flattened in cross section tubes 18, the ends of which extend through tube plates 14. A multiplicity of closely spaced fins 19 are provided through which the tubes extend forming a conventional core. Tubes 18 are flattened so the inside widths are around $\frac{1}{16}$'' whereby the skin friction of the oil at low temperature is great enough to practically prevent the flow of oil under normal operating pressure. Cap 12 is provided with an inlet connection 20 and cap 13 is provided with an outlet connection 21.

Unit B comprises an upper header 25 and a lower header 26. A number of round in cross section and comparatively large tubes 27 form operating connections between headers 25 and 26 (see Figures 1 and 4) and having a multiplicity of closely spaced fins 28 through which the tubes extend.

Headers 25 and 26 are preferably cast integral as illustrated and the tube ends expanded into round apertures in the tube plate as illustrated. For this operation, screw threaded apertures are provided in the outer surface of the headers for the reception of the tube expanding tool, after which screw threaded plugs 29 are used for sealing these openings.

The tube plates of units A and B are preferably on about the same horizontal and transverse plane to thus form a straight through air passageway between these units. Each unit is provided with side plates 30 and 31. Thus a single straight through air passageway through two separate cores is formed. The practice is preferably to place the device on an airplane so the air blast is forced through this duct in the direction shown by arrows in Figures 2 and 3 by

frontal pressure. Clearly when the valve is open the air passing through unit B will be heated, the object of which will hereinafter appear.

Header 26 of unit B is provided with a suitable outlet connection 35 which is operatively connected to member 21 (see Figures 2 and 3). An operating connection is formed between headers D and 25 as follows:

A valve housing 36 is suitably bound and sealed to cap 12 by means of a gasket 37 and bolts 38. An opening is provided which extends to a valve seat 39 having a valve 40 which is yieldingly held on the seat by means of a spring 41, cap 42 answering as a guide for the valve and spring as illustrated.

Member 36 is provided with a suitable outlet connection 43 to member 25. Thus it will be seen that sufficient pressure in header D will lift valve 40 so the oil may pass into unit B and return to outlet 21 through connections 35. The operation of the device is as follows:

It will be noted that tubes 18 are flat and quite narrow as indicated by dotted lines in Figure 3 and that these tubes and fins 19 provide a large heat exchange surface but that when the oil is quite thick, as for example when the temperature is below zero, it will not flow through these tubes unless the pressure is great enough to possibly destroy the device. When the oil will not flow through the tubes, the pressure will build up to a point where valve 40 will be lifted and as a result, the oil that enters fitting 20 will by-pass through unit B and return to the outlet connection 21 through connection 35.

The radiating surface of member B is as stated small and therefore it will not prevent the oil from heating quickly and as the oil is heated, unit B will warm the air passing therethrough and this air in turn will warm the core in unit A so that in time the oil will be permitted to pass through this core and when the oil is sufficiently heated, valve 40 will close and all of the oil will pass through unit A and be cooled thereby.

Clearly my device will act to permit the oil to heat quickly so an engine will operate safely and economically practically from the start and then, after the oil has reached a desirable temperature, it will be caused to pass entirely through the large cooling core A.

It will be understood that if, for example, the airplane moved from a high temperature into a temperature of say 20, 30 or 40 degrees below zero and unit A is cooled to a point where the oil will not freely pass through the tubes of unit A, it will again by-pass through unit B and a working temperature maintained. Thus it will be seen that the two units and valve C cooperate to control the pressure and temperature of the oil under all conditions.

The advantages of my device are its simplicity, high capacity, low cost and light weight. Cores of the class are easily manufactured and easily given an adequate factor of safety.

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

Having thus shown and described my invention, I claim:

1. A device of the class described, comprising two separate heat exchangers each comprising spaced headers and finned tubes forming operating connections therebetween, two faces of said heat exchangers being in juxtaposition whereby a single direct air passageway between the fins and tubes of each exchanger are provided, one of said heat exchangers adapted to offer low resistance to the passage of viscous oil through the tubes thereof and the other heat exchanger adapted to offer high resistance to the passage of viscous oil through the tubes thereof, said low resistance exchanger being positioned in front of the high resistance exchanger whereby cooling air may first pass between the tubes and fins thereof and then between the tubes and fins of the other exchanger, inlet and outlet connections in the headers of said high resistance exchanger, operating connections between adjacent headers, a by-pass valve in one of said operating connections having means whereby when the oil is too viscous to pass through the tubes of said high resistance exchanger, it will be permitted to pass through the tubes of said low resistance exchanger and whereby when the oil will pass freely through the tubes of said high resistance exchanger, said valve will be closed.

2. A device as recited in claim 1 including; one of said operating connections being long enough to permit free unequal expansion and contraction between said exchangers.

JOHN J. HILT.