

Aug. 25, 1942.

F. M. YOUNG

2,293,960

AVIATION OIL COOLER

Filed Oct. 11, 1940

4 Sheets-Sheet 1

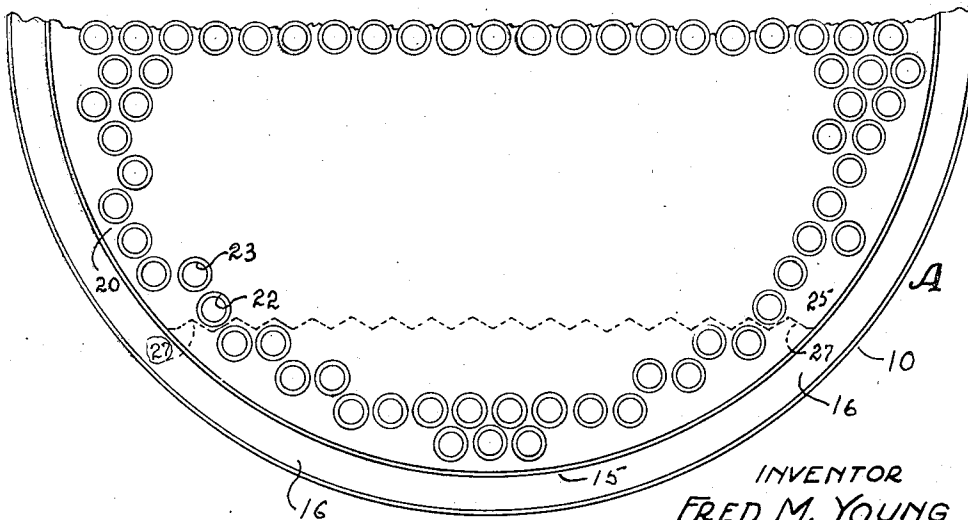
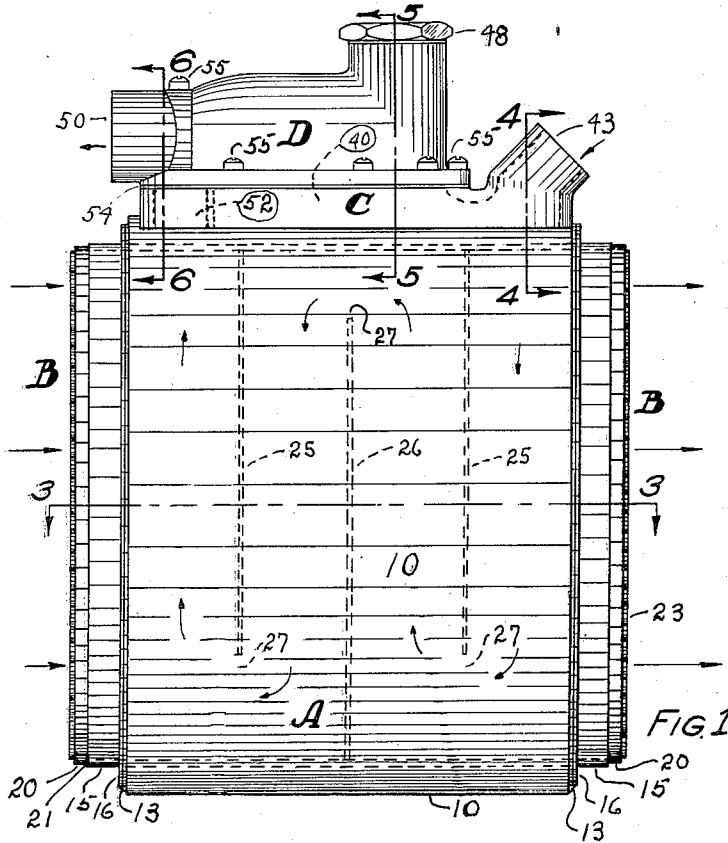


FIG. 2

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4 Sheets-Sheet 2

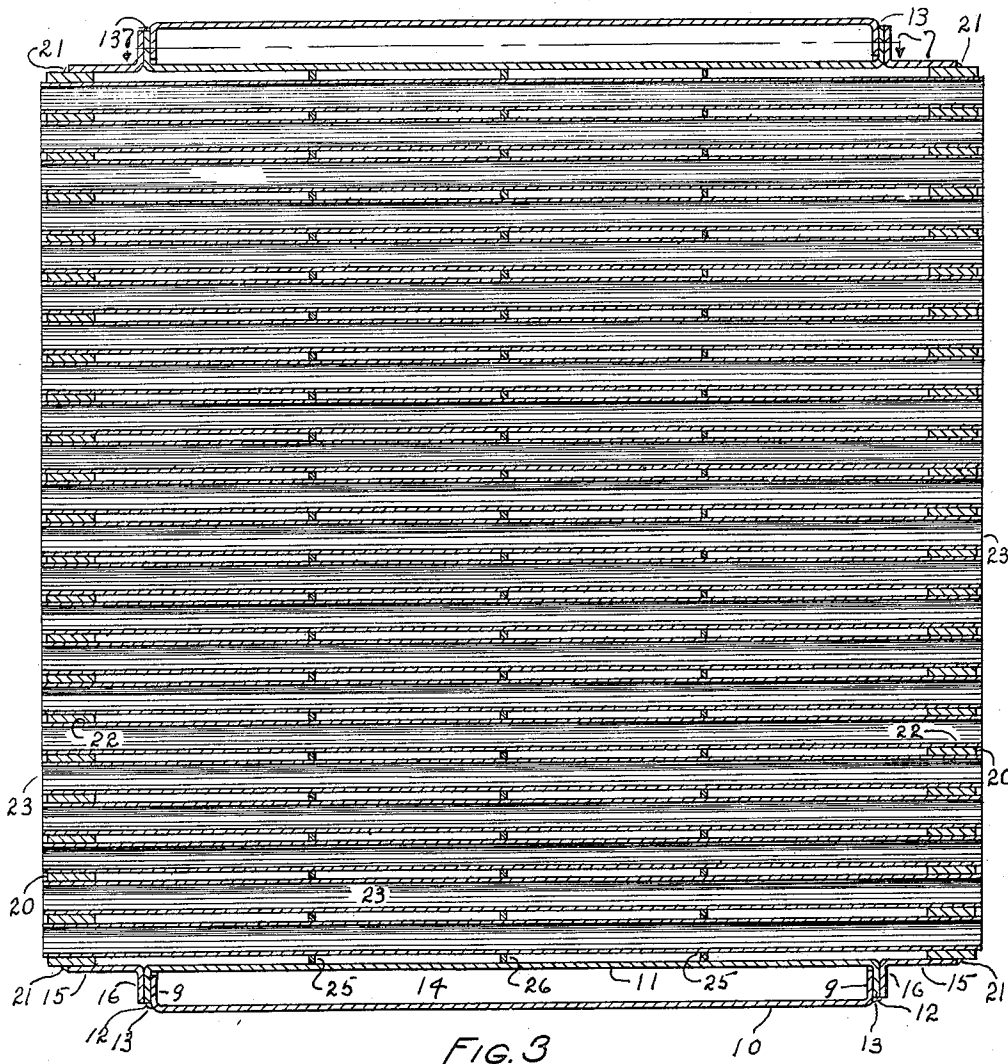


FIG. 3

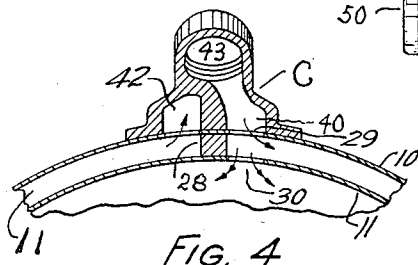


FIG. 4

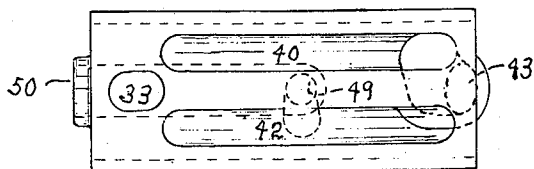


FIG. 11

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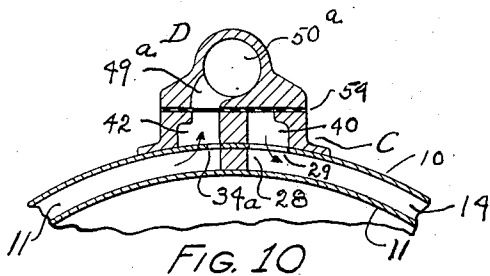
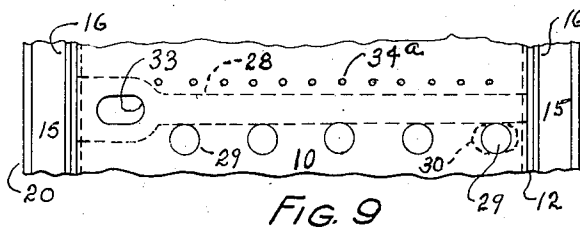
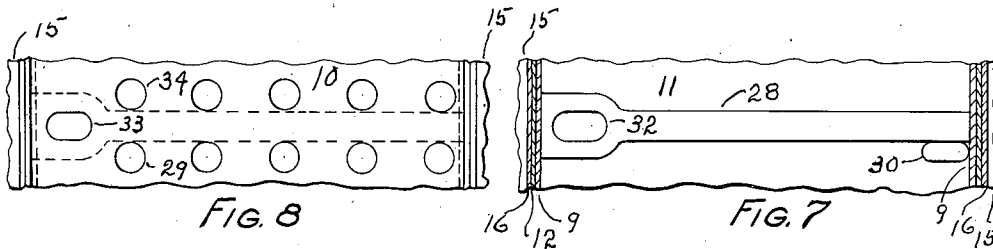
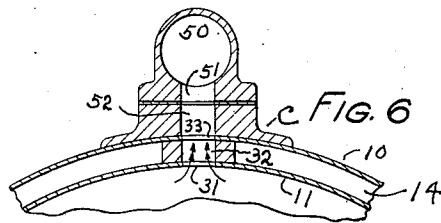
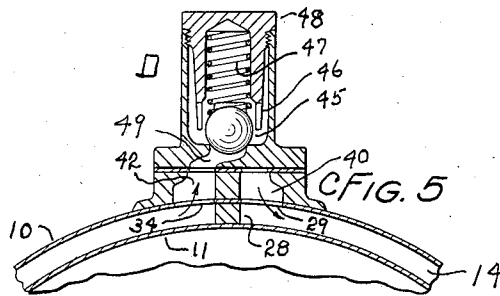
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AVIATION OIL COOLER

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4 Sheets-Sheet 3



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AVIATION OIL COOLER

Filed Oct. 11, 1940

4 Sheets-Sheet 4

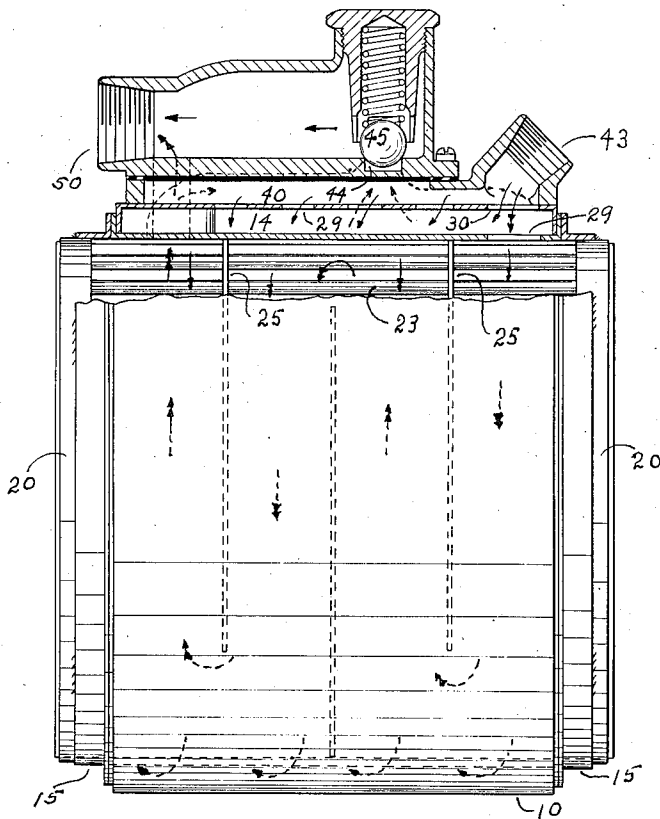


Fig. 12

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UNITED STATES PATENT OFFICE

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AVIATION OIL COOLER

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Application October 11, 1940, Serial No. 360,725

2 Claims. (Cl. 257—236)

The present invention relates to aviation oil coolers wherein the cooling medium is air which is forced through the tubes by frontal pressure, the oil being forced between the tubes by pump pressure, the device having means whereby the oil will be shunted around a preheating chamber when it is too thick to pass between the tubes.

In devices of the class, it has been customary to use round tubes having their ends enlarged and hexed, these ends being bonded together and to the housing so as to form end closures for the tube chamber. This manner of forming the core is quite expensive and not altogether satisfactory for a number of obvious reasons.

An object of the present invention is to provide means whereby round tubes may be used which are expanded into the tube plates in very close formation.

A further object of the present invention is to provide a housing having an annular pre-warming chamber and end extensions which, in addition to providing holders for the tube plates, also provide means whereby the plates may be made from thick aluminum and welded to the outer ends of these extensions before the tube apertures are drilled in the plates; and whereby the extensions may be welded to the ends of the annular chamber before the tubes are inserted in their apertures.

If the apertures are drilled in the plates before the plates are welded to the extensions, the plates and apertures would be distorted and rendered useless. Therefore I drill the apertures in the plates after the plates have been welded to the extensions.

In the present invention, the extension flanges are welded to the ends of the chamber a distance from the plates. Therefore they may be welded to the chamber without danger of injuring the drilled plates.

An object of the present invention is to provide means whereby tubes which are round in cross section may be used whereby they may be easily and effectively expanded in round apertures in the tube plates and extended through spaced baffle plates whereby the oil will be caused to pass between the tubes transversely and through the chamber sinuously.

I provide means whereby when the oil is too thick to pass between the tubes, a by-pass valve will be caused to open and the oil permitted to pass through an outside annular chamber in a manner which will quickly preheat the oil in the chamber.

Generally stated, the objects of the present in-

vention are to provide a simple, safe, and economical device which can be built at low cost and attached to the airplane by means of standard equipment.

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 complete device.

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

Fig. 3 is a horizontal section taken on line 3—3 of Figure 1.

Fig. 4 is a transverse section taken on line 4—4 of Figure 1.

Fig. 5 is a transverse section taken on line 5—5 of Figure 1.

Fig. 6 is a transverse section taken on line 6—6 of Figure 1.

Fig. 7 is a top view of a fraction of the inner cylinder showing the annular chamber partition in position.

Fig. 8 is a fractional top view of the cylinder with the valve base removed.

Fig. 9 illustrates a modification.

Fig. 10 illustrates a transverse section similar to Figure 5 but illustrating the device designed to be used without a relief valve.

Fig. 11 is a bottom view of member D.

Fig. 12 is a partially sectional elevational view of the device as shown in Figure 1 illustrating by single and double pointed arrows the flow of oil through the annular chamber and cooling core.

As thus illustrated, the housing part of the device, forming the annular chamber, is designated in its entirety by reference character A. The extensions, including the tube plates, are designated in their entirety by reference character B; the valve base is designated in its entirety by reference character C and the valve is designated in its entirety by reference character D.

Member A comprises an outer circular shell 10 preferably having inturned flanges 9—9 and an inner shell 11 having preferably out-turned end flanges 12—12 (see Figure 3) which are brazed or welded to member 10, as at 13; thus forming an annular chamber 14. The end extensions comprise circular members 15—15 which are the same diameter as member 11 and having preferably outwardly extending flanges 16 adapted to lie against members 12 and be bonded thereto and to member 10, as at 13.

It will be seen that members 15 are enough smaller in diameter than member 10 to provide spaces for the reception of bands with which to attach the device to the frame of the airplane, as is now common practice.

I provide relatively thick imperforated tube plates 20—20 preferably of aluminum and weld them to members 15 as at 21. Closely spaced apertures 22 are then drilled in plate 20 and tubes 23 are inserted in these apertures, as illustrated in Figure 3, the ends preferably being expanded into the apertures so as to make pressure tight joints between the tube ends and the tube plates.

I will now explain my method of manufacturing and assembling the device as already described and pointed out in the figures.

Plates 20 are first welded to extensions 15 as at 21, after which the plates are drilled as at 22, then the extensions are welded to the chamber as at 13. The tubes may then be inserted in their apertures, the ends protruding slightly through the plates and then their ends being expanded into their apertures.

In devices of the class it is necessary to closely space the tubes and to have the outer tubes spaced from the shell generally not more than the spacing between the tubes. Members 15 and aluminum plates 20 could not easily be welded together after the apertures are drilled in the plates. The heat would tend to warp the adjacent apertures and perhaps destroy the plate. I first preferably weld the plates to members 15 as shown and then drill apertures 22 after which the end assembly consisting of members 15 and 20 is welded to the annular chamber, the weld at 13 being far enough removed from the plates so as not to injure the plates after they have been drilled. Clearly an inclosure is formed for the bundle of tubes and an annular chamber is formed around the inclosure in heat exchange contact therewith.

I provide a number of spaced partitions 25 and 26 each being cut-away as at 27 (see Figure 1) the tubes extending through these partitions (see Figure 3). A partition 28 (see Figures 4 through 10) is bonded so as to form a pressure tight joint between members 9, 10 and 11. On one side of partition 28, I cut spaced apertures 29 in member 10 (see Figures 5 and 9).

A port 30 is cut in member 11 adjacent port 29 (see Figures 4 and 9) and a port 31 is cut in the other end of member 11 (see Figure 6). Partition 28 at one end, is made wide enough to encircle a port 32 which registers with port 31 and a corresponding opening 33 is cut into member 10 (see Figures 6, 8 and 9).

A number of spaced ports 34 are cut in member 10 on the opposite side of member 28 from ports 29. Base plate C is bonded to member 10 and is provided with a channel 40 which extends for the greater part of the length of member C and intersects ports 29. A channel 42 is provided in member C which intersects ports 34.

It will be seen that oil may enter channel 40 from inlet connection 43 and pass into annular chamber 14 through openings 29, from whence it may travel around the annular chamber to openings 34, and then into channel 42. Or the oil may enter the tube chamber through port 30 and travel between the tubes sinuously to port 31 and then through ports 32 and 33 (see dotted lines and arrows in Figure 1).

A valve 45 is adapted to rest on a valve seat in member D (see Figure 5) and having a valve guide 46 and a spring 47 which extends upwardly

into member 48 which is, as illustrated, screw threaded into the top of chamber D. A port 49 forms a connection between channel 42 and the valve (see Figure 5). When the valve is lifted, oil may pass from port 49 into the valve chamber, the chamber having an outlet 50 to the left hand end of chamber D, this outlet having a port 51 which registers with port 32 by means of a port 52 in member C (see Figure 6).

It will be seen that oil may pass from inlet 43 through the annular chamber to outlet 50 by lifting the valve against the pressure of spring 47 (see Figure 5). However, after the oil has been prewarmed, and the pressure is not great enough to lift valve 45, it may pass into one end of the tube chamber through port 30 and through the tube chamber sinuously around partitions 25 and 26, as illustrated by arrows in Figure 1, and then escape to outlet 50, through ports 31, 32, 33, 51, and 52.

It will be seen that when the engine is first started and the oil is too thick to flow freely between the tubes in the tube chamber, it may flow through the annular preheating chamber 14 and that when the oil in the tube chamber has been sufficiently heated, it may all pass between the tubes, as already described and as illustrated in Figure 12, the single pointed arrows indicating the flow of the oil through the annular chamber and valve and the double pointed arrows indicating the flow of the oil through the cooling core.

An advantage of the present design is that the only part which must be bonded to the annular chamber is member 28; that member C is bonded to shell 10 and that when member D is secured to member C by means of gasket 54 and bolts 55, and the oil is controlled by means of a valve, a minimum number of ports and bonded joints are necessary.

A further advantage of the present invention is that the oil is forced to pass between the tubes in a transverse direction, and since the tubes are staggered, obviously the oil will be caused to closely wipe the tubes.

In the present invention, after starting the engine, the oil is exposed to a minimum area of radiating surface so it will be permitted to heat quickly, and when the desired temperature of the oil in the tube chamber is reached, or in other words, when the oil reaches a suitable consistency, it will be caused to pass between the tubes and cooled by the air passing through the tubes.

A feature of the present invention is that the heat exchange between the air and oil is on the reverse flow principle. That is, the oil enters and contacts the tube ends which are in contact with the heated air (see arrows in Figure 1) and the fresh air enters the tube ends which contact the oil at its lowest temperature, thus providing greater control over the device with respect to atmospheric conditions.

An advantage of the present invention is the arrangement of ports and openings whereby oil is caused to pass into the annular chamber on one side of a partition for almost the length of the annular chamber and passes out of the chamber on the other side of the partition for almost the length of the chamber. Thus the entire annular chamber will be brought in active contact with the oil.

In Figures 9 and 10, I illustrate a modification wherein a large number of small apertures 34 are used as a substitute for apertures 34 and

valve 45, as illustrated in Figure 5, is dispensed with and port 49^a leads directly into outlet passageway 50^a which is equivalent to member 50 in the other figures. The object is to offer considerable resistance to the flow of oil through ports 34^a so the bulk of the oil may travel through these ports when too thick to pass between the tubes but the bulk of the oil will be caused to pass between the tubes when the oil in the tube chamber is sufficiently warmed. In other words, ports 34^a will act similar to valve 45.

Having thus shown and described my invention, I claim:

1. A device of the class described, comprising an inner and an outer cylinder having flanges

and being secured together by welding, forming a narrow elongated annular chamber, relatively short cylinders having a diameter substantially the same as said inner cylinder, said relatively short cylinders contacting said first flanges and being welded thereto, relatively thick tube plates having closely spaced apertures and being welded into the other ends of said short cylinders, and tubes forming an operating connection between registering apertures in said tube plates.

2. A device as recited in claim 1 including; said tube plates protruding whereby the weld to said short cylinders is spaced a distance from the front of the protruding end.

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