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OIL COOLERS FOR ENGINES

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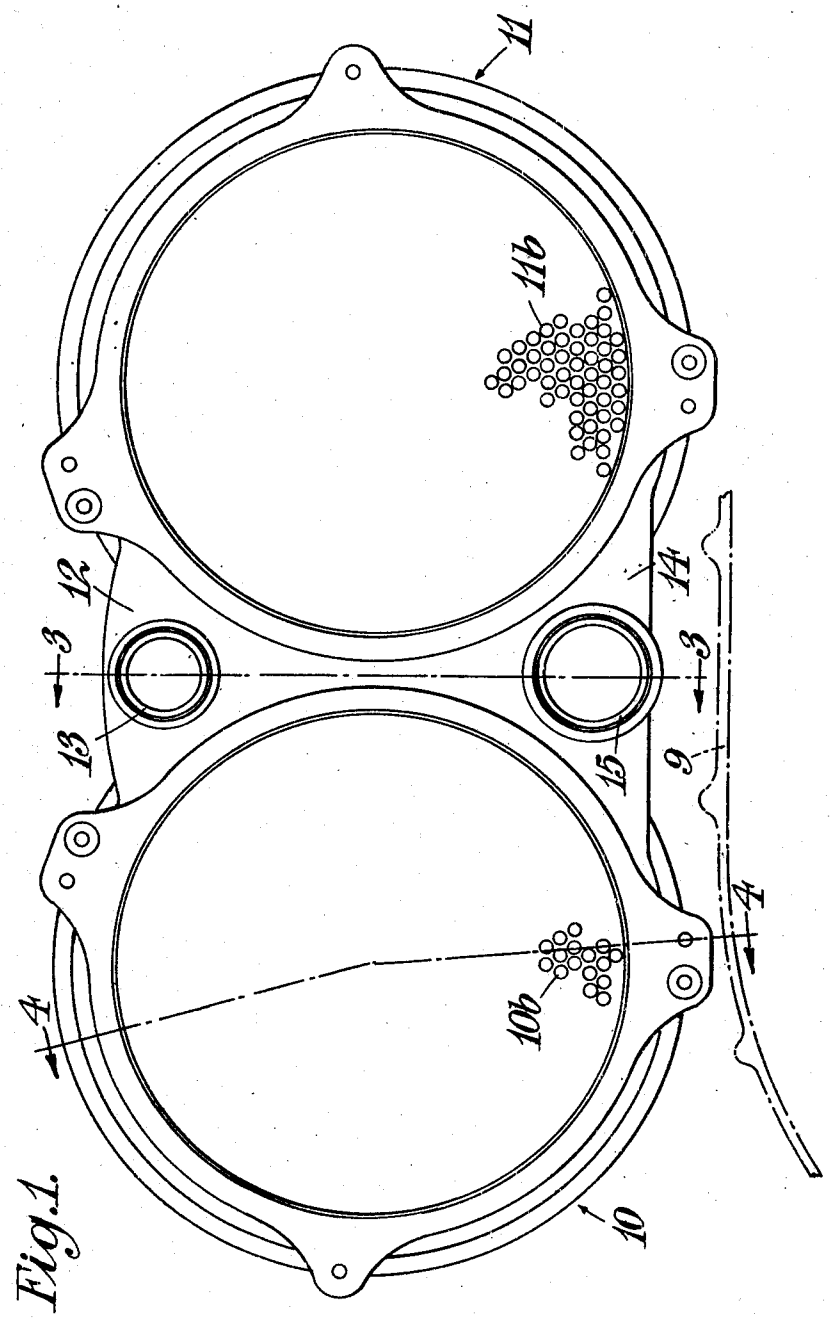


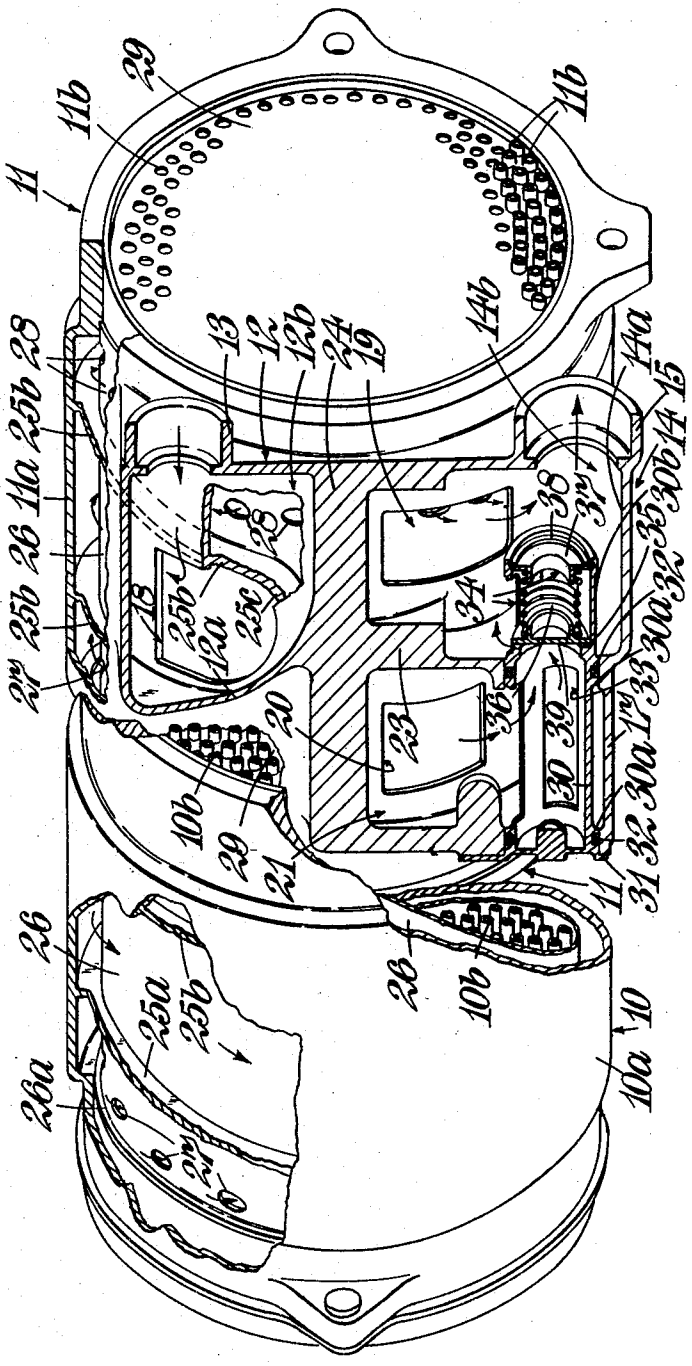
Fig. 1.

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Fig. 2.



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Fig.3.

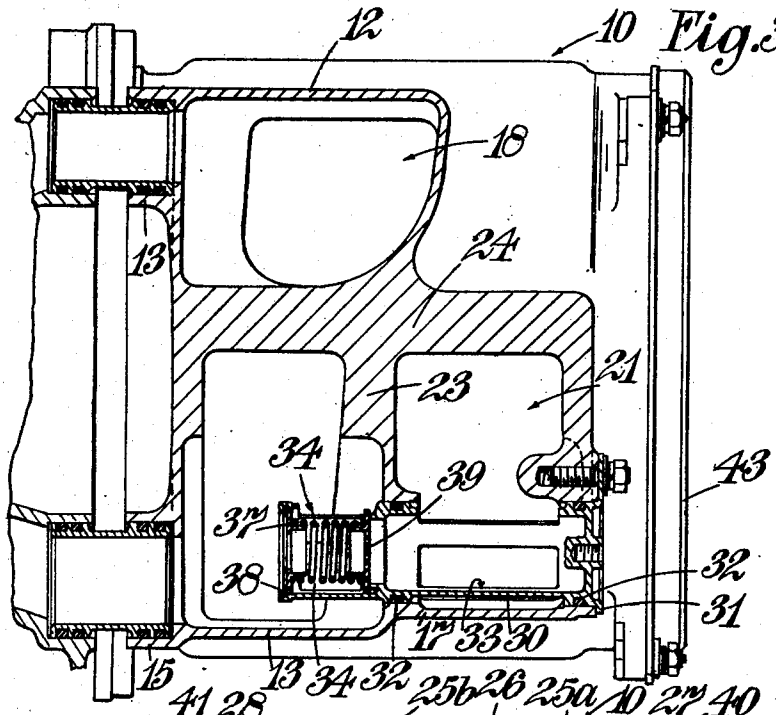
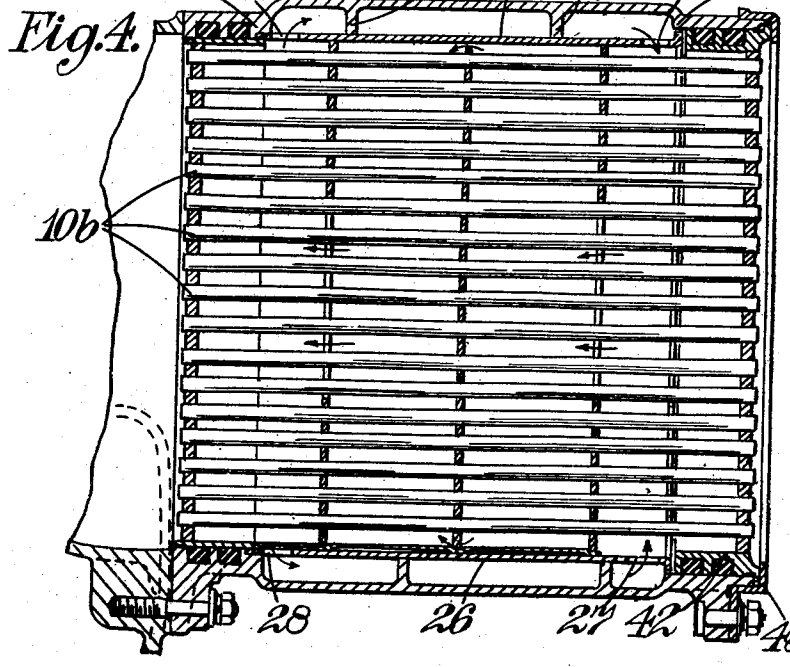


Fig.4.

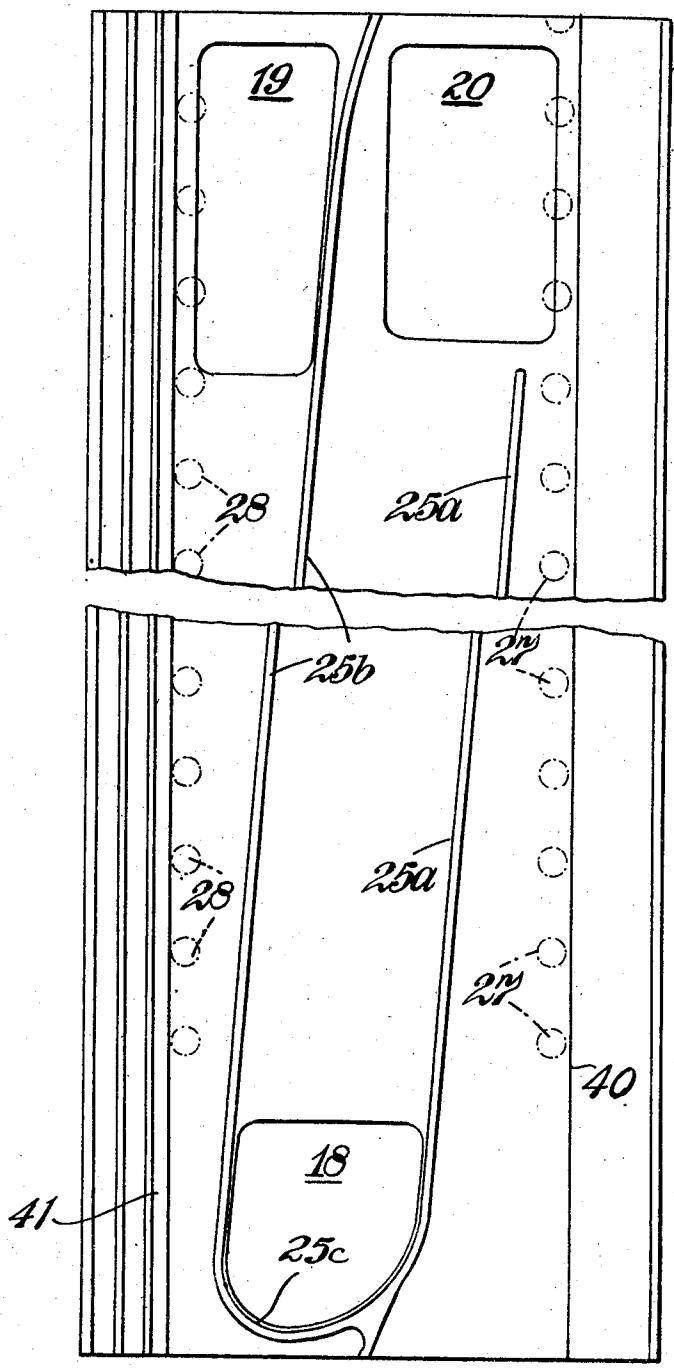


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Fig.5.



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OIL COOLERS FOR ENGINES

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Application April 2, 1956, Serial No. 575,516

Claims priority, application Great Britain April 7, 1955

1 Claim. (Cl. 257—128)

This invention is concerned with oil coolers for engines such as gas turbine engines and has for an object to provide an improved oil cooler giving advantage in installation.

According to the invention, an oil cooler comprises a pair of oil cooling matrices of generally cylindrical form arranged in corresponding casings disposed closely side by side to form between them cusp-shaped spaces, there being disposed in said spaces or in one of said spaces a common oil inlet chamber with ports into said casings, a common oil outlet chamber with ports leading from said casings and a by-pass valve through which the inlet chamber is connected to the outlet chamber.

By providing the two matrices side by side and by so arranging the inlet and outlet chambers and by-pass valve, the cooler can be disposed besides an engine, such as a gas turbine engine, so as to occupy substantially less space radially of the engine than would a cooler having a single matrix equivalent to the two matrices.

According to a preferred feature of the invention, the inlet chamber is disposed in one cusp-shaped space, and the outlet chamber and a by-pass chamber are end to end in the other cusp-shaped space, the outlet chamber being connected through the by-pass valve to the by-pass chamber and there being a passage connection between the inlet and by-pass chambers. In one arrangement according to this preferred feature, the inlet chamber is connected to the by-pass chamber through passages extending around the two matrices so that in use the matrices are heated even when oil is flowing between the inlet and outlet chambers only through the by-pass valve.

A preferred form of oil cooler according to this invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is an end view of oil cooler,

Figure 2 is an isometric view with parts broken away showing details of construction of the oil cooler.

Figure 3 is a section on the line 3—3 of Figure 1,

Figure 4 is a section on the line 4—4 of Figure 1, and

Figure 5 is a developed view illustrating a detail of the oil cooler.

Referring first to Figure 1, the oil cooler comprises a pair of similar tube oil cooler units **10**, **11** of cylindrical form arranged closely side by side so as to form between them cusp-shaped spaces the upper of which is in part occupied by a hot oil inlet manifold **12** with an inlet connection **13** and the lower of which is occupied by an oil outlet manifold **14** with an outlet connection **15**, and by a by-pass valve casing lying behind the manifold **14** as viewed in this figure of the drawings. The cooling air tubes of the matrices **10***b*, **11***b* are also indicated. The units **10**, **11** are of right-and-left form respectively as will become apparent.

It will be seen that an oil cooler of this form when mounted beside an engine, say a gas turbine engine of

which a portion of the casing is indicated at **9**, will not increase the frontal dimensions of the engine to such an extent as would a conventional single circular matrix oil cooler of the same capacity.

Referring now to Figures 2 to 5, the oil cooler comprises an outer casing which is a unitary cast structure including outer cylindrical casing sections **10***a*, **11***a* (for accommodating the tube matrices **10***b*, **11***b*), an inlet manifold casing section **12***a*, an outlet manifold casing section **14***a*, and a by-pass valve casing section **17**. Each of the casing sections **10***a*, **11***a* has a corresponding inlet port **18** formed in it, the inlet ports opening into the inlet manifold chamber **12***b*, one on each side of the central plane of the oil cooler (which plane is the plane of section **3—3**), a corresponding outlet port **19**, which ports **19** open into the outlet manifold chamber **14***b* one on each side of the central plane, and a by-pass port **20**, which ports **20** open into a by-pass chamber **21** in the by-pass valve casing section **17**, one on each side of the central plane.

The by-pass chamber **21** is separated from the outlet manifold chamber **14***b* by an internal casing wall **23**, and the inlet and outlet chambers **12***b*, **14***b* are separated by internal integral wall **24**.

Each of the casing sections **10***a*, **11***a* also has a pair of narrow axially-spaced circumferentially-extending helical internal webs **25***a*, **25***b* (Figures 2 and 5) which at one end lie to one side and the other of the inlet port **18** and are joined at this end by a curved web portion **25***c* around one side of the corresponding inlet port **18** so that it opens to the space between the webs, of which the web **25***a* at its opposite end terminates near the lowermost point of the casing adjacent the corresponding by-pass port **20** so that the space between the webs is in communication with the space between the web **25***a* and an inturned end portion **40**, and of which the web **25***b* extends between the corresponding outlet port **19** and by-pass port **20** and is joined at its other end to the curved portion **25***c* so that the outlet port **19** is separated from the spaces in communication with the ports **18**, **20** and opens to an annular space defined between the web **25***b* and an internal flange **41**. Figure 5 shows this arrangement in a developed view looking on the inside of the casing section.

Each cooler unit has a pair of header plates **29**, one seated in each end of the casing section **10***a* or **11***a*, and the cooling air tubes **10***b*, **11***b* extend axially through the heat-exchange space and header plates to protect slightly from the outer surfaces of the header plates. In use cooling air enters the tubes at the one end and leaves at the other end.

Each of the cooler units also has a liner **26** which forms the outer wall of the tube matrix and which affords within itself the heat exchange space, and the liner **26** spigots into the respective casing section **10***a*, **11***a* at one end and is formed with a flange **26***a* which fits within the casing at its other end. The liner **26** is retained axially by abutment at its flanged end with an axial circumferential flange **42** on the adjacent header plate, which is in sealing engagement with the end portion of the casing section **10***a*, **11***a*. A flanged retaining ring **43** is secured to the casing section to retain the matrix in position.

The liner has at its end adjacent the web **25***a*, a first ring of holes **27** forming inlets leading from the space between the web **25***a* and the inturned portion **40** into the heat exchange space, and at its other end a second ring of holes **28** which form oil outlets from the heat exchange space to the space between the web **25***b* and the flange **41**.

The by-pass valve is provided in a flow connection between the chambers **21** and **14***b* and comprises a

generally cylindrical body 30 extending from an aperture in the by-pass casing section 17 across the chamber 21 through an aperture in the wall 23 into the chamber 14*b*. The body 30 is provided with a flange 31 at one end which is secured to the wall of the by-pass casing section, and also with two lands 30*a*, each with a groove for receiving a sealing ring 32, the lands engaging respectively in the aperture in the wall of the by-pass casing section 17 and in the aperture in wall 23. The portion 30*b* of the body 30, which projects into chamber 14*b* accommodates the by-pass valve. A series of inlet ports 33 are provided in the body 30 to place its interior in open communication with the chamber 21 and outlet ports 34 are provided in the body portion 30*b* to place the interior of this portion in open communication with the chamber 14*b*. The by-pass valve comprises a disc valve element 39 which is urged on to a seating 35 under the influence of a spring 36 having an abutment 37 retained in the body portion 30*b* by a circular spring clip 38.

In use, hot oil flows into the oil cooler through inlet 13 into the common inlet chamber 12*b*, and through ports 18 into the spaces between the webs 25*a*, 25*b* of the two cooler units. The oil flows around each of the matrices in these spaces, so heating the units, to beyond the ends of webs 25*a*, and then either flows through the rings of inlet holes 27 into the heat-exchange spaces, through these spaces where it is cooled by air flowing through the tubes 16, out through holes 28 into the spaces between the webs 25*b* and flanges 41 to the ports 19 and thus into the common outlet chamber 14*b*, or flows through the by-pass ports 20 into the by-pass chamber 21, past valve 39, valve seating 35 and into the outlet chamber 14*b*. The oil leaves the cooler through outlet 15.

I claim:

An oil cooler comprising a pair of oil cooling tube matrices of generally cylindrical form; a unitary casing structure having a pair of substantially cylindrical casing sections each accommodating an associated one of the tube matrices, said casing sections being side by side so as to define between them a pair of cusp-shaped spaces, a third casing section in one of the cusp-shaped spaces and interconnecting said substantially cylindrical casing sections, said third casing section defining an oil inlet chamber having an inlet connection facing axially of said pair of casing sections and first ports opening laterally

therefrom into said pair of substantially cylindrical casing sections, a fourth casing section in the other of the cusp-shaped spaces and also interconnecting said pair of substantially cylindrical casing sections, said fourth casing section defining an oil outlet chamber and an oil by-pass chamber and including a common wall separating said chambers, the oil outlet chamber having an oil outlet connection facing axially of the pair of substantially cylindrical casing sections and having second ports opening laterally therefrom into each of said pair of casing sections, and the oil by-pass chamber having third ports opening laterally therefrom into each of said substantially cylindrical casing sections, a porting in said common wall connecting said oil outlet and oil by-pass chambers, a valve member co-operating with said porting to permit oil flow from said oil by-pass chamber into said oil outlet chamber, spring means loading said valve member, each of said substantially cylindrical casing sections having internally thereof a plurality of axially-spaced circumferential webs and a liner fitted within each of the substantially cylindrical casing sections, surrounding the associated tube matrix and co-operating with the internal webs to define a first oil passage extending circumferentially around the cylindrical casing section from said first port to said third port, a second oil passage extending circumferentially around the cylindrical casing section and communicating with the first oil passage and through holes at one end of the liner with the associated tube matrix, and a third oil passage extending circumferentially around the cylindrical casing section from said second port and communicating through holes in the opposite end of said liner with the associated tube matrix.

References Cited in the file of this patent

UNITED STATES PATENTS

2,180,840	Tuley et al.	Nov. 21, 1939
2,288,127	Dykeman et al.	June 30, 1942
2,387,057	Burns	Oct. 16, 1945
2,447,970	Wareing	Aug. 24, 1948
2,453,737	Worth	Nov. 16, 1948
2,469,316	Shaw	May 3, 1949
2,474,689	Ramsaur	June 28, 1949

FOREIGN PATENTS

523,245	Great Britain	July 9, 1940
533,767	Great Britain	Feb. 19, 1941