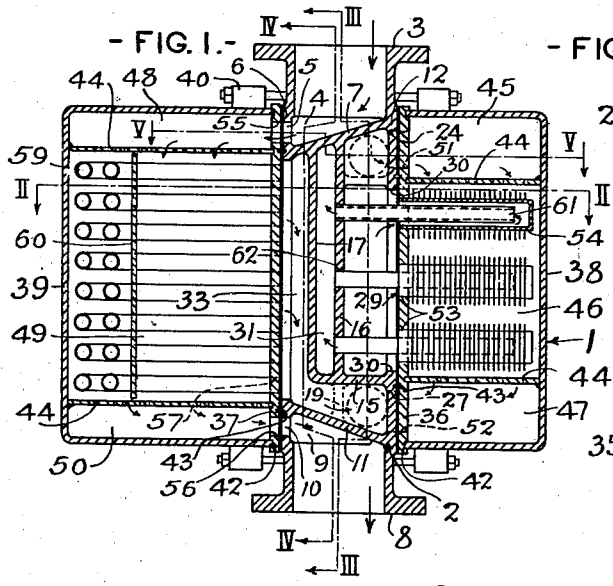
Dec. 4, 1945. A. Y. GUNTER 2,390,436

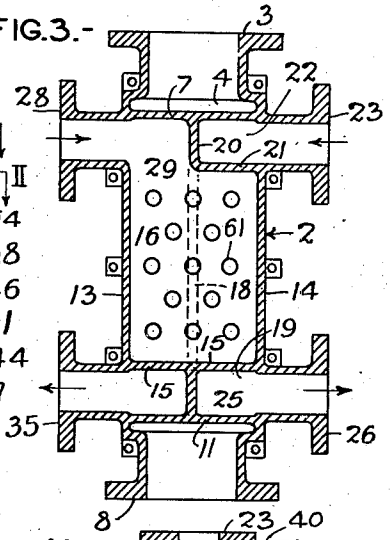
HEAT EXCHANGER

Filed Dec. 29, 1943

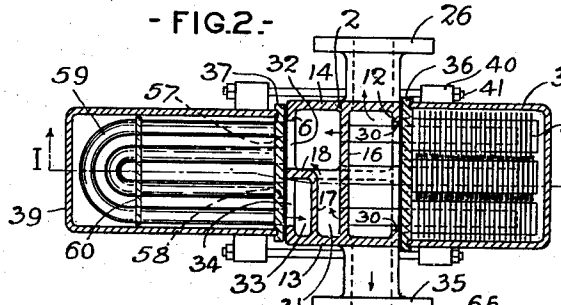
- FIG. 1.-

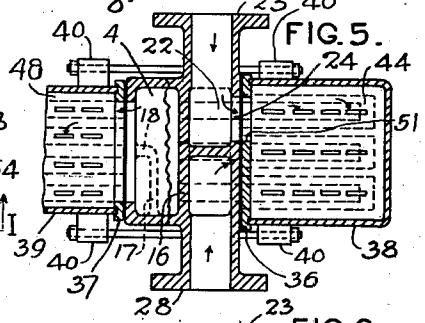


- FIG. 3.-



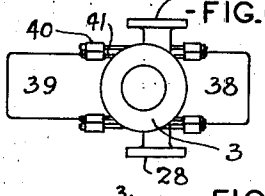
- FIG. 2.-



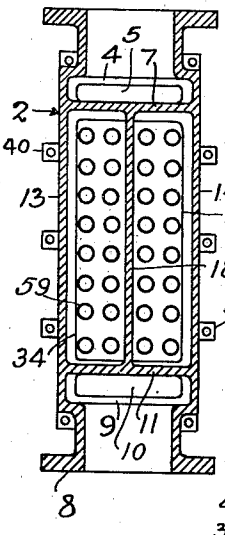


- FIG. 5.

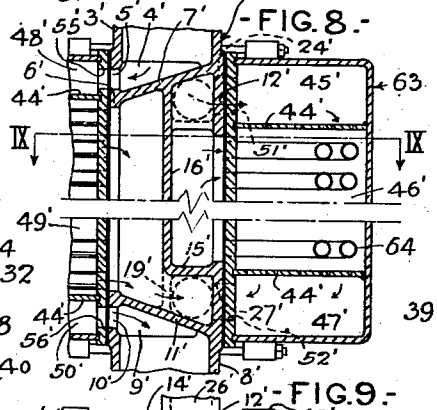
- FIG. 6.-



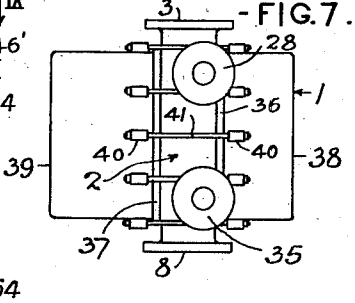
- FIG. 4.-



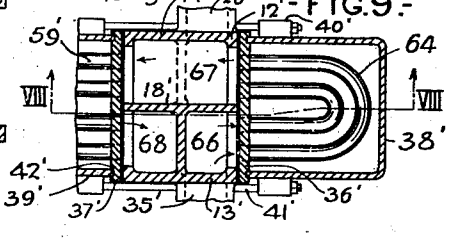
- FIG. 8.-



- FIG. 7.-



- FIG. 9.-



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HEAT EXCHANGER

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Application December 29, 1943, Serial No. 516,003

3 Claims. (Cl. 257—241)

This invention relates to heat exchangers and more particularly to a combination lubricating oil and jacket water cooler.

An object of the present invention is to provide a heat exchanger adapted for the flow therethrough in heat exchange relation of three fluids.

A further object is to provide a combination lubricating oil and jacket water cooler of compact design.

Other and further objects of and advantages achieved by the present invention will be apparent from the following description of approved embodiments thereof.

Referring to the drawing forming a part of this application, Figure 1 is a vertical section of the heat exchanger of the present invention, taken on the line I—I of Fig. 2, parts being shown in full; Fig. 2 is a section on the line II—II of Fig. 1; Fig. 3 is a section on the line III—III of Fig. 1; Fig. 4 is a section on the line IV—IV of Fig. 1; Fig. 5 is a section on the line V—V of Fig. 1, part of the exchanger being broken away; Fig. 6 is a reduced plan view of the exchanger; Fig. 7 is a reduced front elevation of the exchanger; Fig. 8 is a foreshortened section, similar to Fig. 1, of a portion of a modified heat exchanger embodying the present invention, taken on the line VIII—VIII of Fig. 9; and Fig. 9 is a section on the line IX—IX of Fig. 8.

The heat exchangers shown in the drawing are designed to operate as combination lubricating oil and jacket water coolers. However, the invention has application to heat exchangers for other purposes.

The combination lubricating oil and jacket water cooler is indicated in the drawing (Figs. 1–7) generally by the reference numeral 1. It includes a header member 2 which is provided with a plurality of nozzles, chambers and a tube sheet in the following manner:

Referring to Figs. 1 and 2, it will be seen that the member 2 is an intermediate part of the cooler. A jacket water inlet nozzle 3, at the top of member 2, opens into a jacket water inlet chamber 4 provided with a port 5 in the left side wall 6 of the cooler. Nozzle 3 may be connected to piping leading from the cylinder jacket water circulating pump of an internal combustion engine (not shown) for conducting hot water to the cooler. Chamber 4 extends across the full width of the member 2 and is closed at the bottom by an inclined wall 7. A jacket water outlet nozzle 8, at the bottom of member 2, opens from a jacket water outlet chamber 9 provided with a port 10 in the left side wall 6 of the member 2. Nozzle 8 may be connected to piping leading to the engine cylinder jacket (not shown) for returning cooled water to the engine. Chamber 9 extends across the full width of the member 2 and is closed at the top by an inclined wall 11.

Member 2 further has a right side wall 12, a forward wall 13 and a rear wall 14. A horizontal wall 15, somewhat above wall 11, extends from wall 13 to wall 14. Wall 15 also extends from wall 12 to a point half way between walls 6 and 12. At this point it is connected by a vertical tube sheet wall 16 with wall 7, wall 16 extending from wall 13 to wall 14. Wall 15 extends beyond wall 16 from the half thereof adjacent wall 13 to a point about half way between wall 16 and wall 6. A vertical wall 17 connects the end of wall 15 with wall 7. As the extended portion of wall 15 only extends from the wall 13 half way to the wall 14, wall 17 extends a like distance from the wall 13. The inner edge of wall 17 is connected with the wall 6 by a vertical wall 18, at right angles to wall 17, which extends from the wall 7 downwardly to the wall 15 and further extends below the wall 15 to the walls 11 and 12. A vertical wall 19 below and in line with wall 16, is connected at its four edges with walls 15, 18, 11 and 14. A vertical wall 20 (Fig. 3) in line with wall 18 is connected at its top and side edges with the walls 7, 16 and 12 and at its bottom edge with the inner edge of a horizontal wall 21, which is connected at its other three edges with the walls 16, 12 and 14.

Walls 20 and 21 with the adjacent portions of walls 7, 12, 14 and 16, define an oil inlet chamber 22 into which a nozzle 23 opens. Nozzle 23 may be connected to piping leading from the crankcase oil circulating pump of the internal combustion engine (not shown) for conducting hot oil to the cooler. A port 24 is formed in wall 12, into which chamber 22 opens.

Wall 19 with the adjacent portions of walls 15, 11, 18 and 14 define an oil outlet chamber 25 which opens into a nozzle 26. Nozzle 26 may be connected to piping leading to the engine crankcase (not shown) for returning cooled oil to the engine. A port 27 is formed in the wall 12, into which chamber 25 opens.

A cooling water inlet nozzle 28, in line with nozzle 23, opens into a primary cooling water chamber 29 in line with chamber 22 and defined by the adjacent portions of walls 7, 12, 15, 13, 14 and 16. Wall 12 at the chamber 29 is provided with a large opening 30 for a purpose later to be mentioned. Nozzle 28 may be connected to

piping leading from a source of cold water (not shown).

A secondary cooling water chamber 31 is defined by the walls 16, 19 and 17, and the adjacent portions of the walls 7, 15, 11, 13, 14, 18 and 6. Wall 6 to the rear of wall 18 is provided with a large opening 32 for a purpose later to be mentioned.

A third or final cooling water chamber 33 is defined by the walls 17 and 18 and the adjacent portions of walls 6, 7, 11, 13, 15 and 12. Wall 6 to the front of wall 18 is provided with a large opening 34 for a purpose later to be mentioned. A cooling water outlet nozzle 35, in line with nozzle 26, opens into chamber 33 adjacent the juncture of walls 12 and 13. Nozzle 35 may be connected to piping for conveying away the water heated in the cooler.

A tube sheet 36 covers wall 12 and a tube sheet 37 covers wall 6. A shell 38 is mounted against tube sheet 36 and a shell 39 is mounted against tube sheet 37. Orificed lugs 40 are secured to the shells and bolts 41 extend through these lugs and are provided at both ends with nuts. Bolts 41 secure the shells, tube sheets and member 2 together. The tube sheets are entirely within the confines of the bolts and are held in proper position by grooves 42 formed therein in which the inner edges of the shells are disposed. Suitable gaskets (not shown) are provided between the shells and tube sheets and between the tube sheets and member 2 to prevent leakage. Weep grooves 43 are also provided at suitable places to prevent contamination of one fluid by another.

Each shell is provided with an upper and lower slotted sprinkling plate 44 which also are disposed with their inner edges in grooves formed in the tube sheets. Their other edges are welded to the shell. The plates 44 of shell 38 form an upper oil inlet chamber 45, an intermediate oil heat exchanger chamber 46 and a lower oil outlet chamber 47. The plates 44 of shell 39 form an upper jacket water inlet chamber 48, an intermediate jacket water heat exchanger chamber 49, and a lower jacket water outlet chamber 50.

Tube sheet 36 is provided, adjacent chamber 45, with a port 51 in line with port 24, and adjacent chamber 47 with a port 52 in line with port 27, and with tube orifices 53 in line with the opening 30. Straight fin-tubes 54, closed at their outer ends, are disposed in chamber 46 with their open ends in the orifices 53.

Tube sheet 37 is provided, adjacent chamber 48, with a port 55 in line with port 5, and adjacent chamber 50, with a port 56 in line with port 10, tube orifices 57 in line with opening 32 and other tube orifices 58 in line with opening 34. U-tubes 59 are disposed in chamber 49 each with an end disposed in an orifice 57 and its other end disposed in an orifice 58. The U-tubes are supported adjacent their bends by an orificed plate 60, the legs of the U-tubes being disposed in the orifices of the plate.

Straight bayonet tubes 61 are secured in tube orifices 62 formed in tube sheet wall 16 in line with fin-tubes 54 into which they extend, tubes 61 opening into tubes 54 adjacent the closed ends thereof and being of a smaller outside diameter than the inside diameter of the tubes 54.

All the tubes of the cooler are secured in their tube orifices by a well-known means, such as by being expanded therein. Each shell forms a section, and the tubes therein another section, of a heat exchanger unit. Thus cooler 1 has two such units.

The operation of the cooler is as follows:

Cooling water enters the cooler through the nozzle 28, flows into primary cooling water chamber 29 and therefrom through the opening 30 and into the fin-tubes 54 where it is brought into heat exchange relation with hot lubricating oil, the hot oil entering the cooler through the nozzle 23, flowing through oil inlet chamber 22 and through ports 24 and 51 into the upper oil inlet chamber 45. The oil in chamber 45 drips through the slots in the adjacent upper sprinkling plate 44 into the intermediate heat exchange chamber 46 and onto the tubes 54. Thus the oil is cooled by the cold water contained in tubes 54. The oil, after flowing over the tubes 54, leaves chamber 46 in a cooled state through the slots in the lower sprinkling plate 44 adjacent thereto, and flows through the lower oil outlet chamber 47, ports 52 and 27, oil outlet chamber 25 and nozzle 26. Thus chambers 22 and 25 are for supply of oil to the shell 38.

The cooling water flows from the fin-tubes 54 into bayonet tubes 61, therefrom into the secondary cooling water chamber 31, and therefrom through the opening 32 into the U-tubes 59. Hot jacket water, entering the cooler through the nozzle 3, flows through jacket water inlet chamber 4, and ports 5 and 55 into the upper jacket water inlet chamber 48, therefrom through the slots in the adjacent upper sprinkling plate 44 into the intermediate heat exchange chamber 49, dripping on the tubes 59 and thereby being cooled by the cooling water in the tubes 59. The jacket water leaves the chamber 49 in a cooled state through the slots in the adjacent bottom sprinkling plate 44, passes through the lower jacket water outlet chamber 50, ports 56 and 10 into jacket water outlet chamber 9 from which it leaves the cooler through the nozzle 8. Thus chambers 4 and 9 are for supply of jacket water to the shell 39. The cooling water, which is now at about the same temperature as the jacket water flowing through the nozzle 8, leaves the U-tubes through the opening 34, passes through the third cooling water chamber 33 and out of the cooler through the nozzle 35. Thus chambers 29, 31 and 33 are for supply of cooling water to the tubes of the cooler, chamber 31 being common to both tube sections of the cooler.

From the above it will be seen that cold water entering the cooler, is first brought into indirect heat exchange with hot lubricating oil, thereby cooling same, and thereafter, at a somewhat higher temperature, is brought into indirect heat exchange with hotter jacket water, thereby also cooling the jacket water.

A modification of the invention is shown in Figs. 8 and 9, the cooler therein shown being indicated by the reference numeral 63. It differs from the cooler 1 in that U-tubes 64 are employed instead of the fin-tubes 54 and bayonet tubes 61. Accordingly, the member 65, which corresponds to the member 2, is somewhat different from the member 2. Parts of cooler 63 which are similar to cooler 1 will be indicated by like reference numerals with an accent added. The difference in structure of the member 65 from the member 2 may be clearly seen to be that there is a primary cooling water chamber 66 which supplies cooling water to the U-tubes 64 for cooling the oil. The cooling water flows from the U-tubes 64 into a secondary cooling water chamber 67 and therefrom into the U-tubes 59' for cooling the jacket water. The cooling water cooling the jacket water returns to a third or final cooling water chamber

68 which opens into an outlet nozzle 35'. No further description of this modification of the present invention is deemed necessary, as in other respects it is similar to the cooler 1.

While the present invention has been described as a combination lubricating oil and jacket water cooler, it may, of course, be employed with other fluids, if desired.

While there have been hereinbefore described approved embodiments of this invention, it will be understood that many and various changes and modifications in form, arrangement of parts and details of construction thereof, may be made without departing from the spirit of the invention, and that all such changes and modifications as come within the scope of the appended claims are contemplated as a part of this invention.

The invention claimed and desired to be secured by Letters Patent is:

1. A combination heat exchanger for indirect heat exchange relation of a common fluid with two other separate fluids comprising two opposed tube-shell heat exchangers, the shells thereof being separated one from the other, each of said shells being for one of said separate fluids and said tubes being for said common fluid; and a single unitary header for both of said exchangers and disposed therebetween, said header including seven separated chambers, a pair of said seven chambers provided each with a port and opening each to one of said shells serving one as an inlet and the other as an outlet therefor, another pair of said seven chambers provided each with a port and opening each to the other of said shells serving one as an inlet and the other as an outlet therefor the remaining three of said seven chambers including a chamber common to the tubes of both exchangers and communicating with the tubes of one of said exchangers for receiving said common fluid therefrom and communicating with the tubes of the other of said exchangers for supplying said common fluid thereto, and a pair of chambers, one having an outlet port and communicating with and serving as an outlet for the tubes receiving said common fluid from said common chamber and the other having an inlet port and communicating with and serving as an inlet for the tubes from which said common chamber receives said common fluid, whereby a single tube fluid will be in indirect heat exchange relation with each of said separate shell fluids.

2. A combination heat exchanger for indirect heat exchange relation of a common fluid with two other separate fluids comprising two opposed tube-shell heat exchangers, the shells thereof being separated one from the other and each of the tubes thereof having two legs in communication at their outer ends, and having their inner ends serving one as an inlet and the other as an outlet therefor, each of said shells being for one of said separate fluids and said tubes being for said common fluid; and a single unitary header for both of said exchangers and disposed therebetween, said header including seven separated chambers, a pair of said seven chambers provided each with a port and opening each to one of said shells serving one as an inlet and the other as an outlet therefor, another pair of said seven chambers provided each with a port and opening each to the other of said shells serving one as an inlet and the other as an outlet therefor, the remaining three of said seven chambers including a chamber common to the tubes of both exchangers and communicating with said outlets of the tubes of one of said exchangers for receiving said common fluid therefrom and communicating with said inlets of the tubes of the other of said exchangers for supplying said common fluid thereto, and a pair of chambers, one having an outlet port and communicating with said outlets of the tubes receiving said common fluid from said common chamber and the other having an inlet port and communicating with said inlets of the tubes from which said common chamber receives said common fluid, whereby said common tube fluid will be in indirect heat exchange relation with each of said separate shell fluids.

3. A combination heat exchanger for indirect heat exchange relation of a common fluid with two separate liquids comprising two opposed tube-shell heat exchangers, the shells thereof being separated one from the other, each of said shells being for one of said separate liquids and the tubes thereof being horizontal and for said common fluid, each of said shells having a horizontal sprinkling plate above its said tubes; and a single unitary header for both of said exchangers disposed therebetween, said header including seven separated chambers, a pair of said seven chambers provided each with a port and opening each to one of said shells serving one as an inlet above the correlated sprinkling plate and the other as an outlet below the correlated tubes thereof, another pair of said seven chambers provided each with a port and opening each to the other of said shells serving one as an inlet above the correlated sprinkling plate and the other as an outlet below the correlated tubes thereof, the remaining three of said seven chambers including a chamber common to the tubes of both exchangers and communicating with the tubes of one of said exchangers for receiving said common fluid therefrom and communicating with the tubes of the other of said exchangers for supplying said common fluid thereto, and a pair of chambers, one having an outlet port and communicating with and serving as an outlet for the tubes receiving said common fluid from said common chamber and the other having an inlet port and communicating with and serving as an inlet for the tubes from which said common chamber receives said common fluid, whereby a single tube fluid will be in indirect heat exchange relation with each of said separate shell liquids.

ADDISON Y. GUNTER.