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OIL COOLING

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Fig. 1.

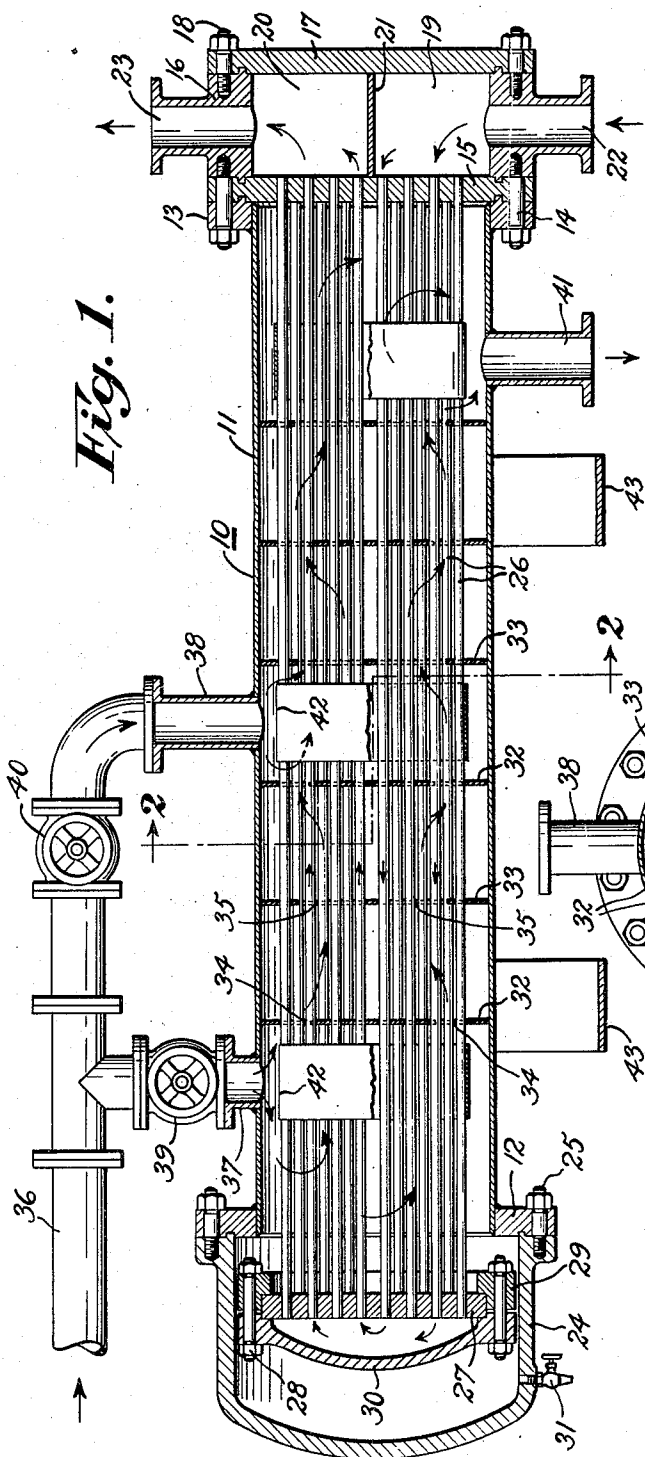


Fig. 3.

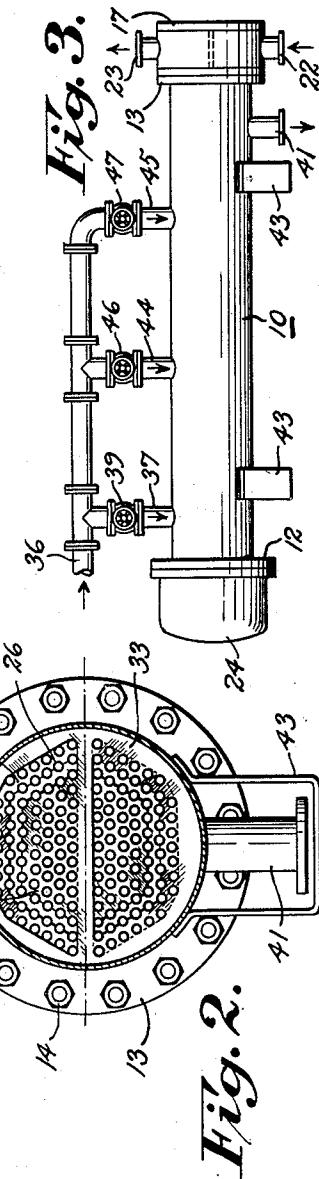


Fig. 2.

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OIL COOLING

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My invention relates to heat exchangers and particularly to heat exchangers for cooling a stream of oil.

One of the objects of my invention is to provide a heat exchanger wherein it is possible to regulate and control the outlet temperature of the oil so as to maintain it substantially constant although the temperature of the cooling water varies. Heretofore an attempt has been made to accomplish this result by either reducing the quantity of cooling water or by by-passing a portion of the oil to be cooled around the heat exchanger in the event that the temperature of the cooling water becomes lower. In the first case, the temperature of the small amount of cooling water used becomes so high that the tubes are liable to scale or the heat exchanger may become steam bound. In the second case, the portion of the oil which is passed through the heat exchanger may be cooled to such an extent as to solidify within the heat exchanger and thus prevent further flow of oil therethrough.

I propose to maintain a constant outlet temperature of oil by providing one or more auxiliary oil inlets to the heat exchanger so arranged that the oil admitted through these auxiliary inlets passes in contact with but a portion of the heat exchange surface. Hence, if the temperature of the cooling water is low, one or more of the auxiliary inlets may be opened, in which case a portion of the oil, which is admitted through the main inlet, will pass in contact with all of the heat exchange surface while the remainder of the oil will pass in contact with but a portion of the surface. By regulating the proportionate quantities of oil admitted through the main inlet and through the auxiliary inlet a substantially constant outlet temperature may be obtained with varying cooling water temperatures.

Further objects and advantages of my invention will be apparent from the following description considered in connection with the accompanying drawing, which forms a part of this specification and on which:

Fig. 1 is a longitudinal cross-sectional view of a preferred embodiment of my invention;

Fig. 2 is a transverse cross-sectional view taken on the line 2—2 of Fig. 1; and

Fig. 3 is an elevational view of an apparatus embodying my invention and provided with a plurality of auxiliary oil inlets.

Referring more particularly to Fig. 1, reference character 10 designates generally a heat exchanger. Heat exchanger 10 comprises a cylindrical shell 11 to the ends of which are suitably secured, as by welding, annular rings 12 and 13. Bolted to ring 13 by means of bolts 14 is a tube head 15 to the outer side of which is secured by means of the bolts 14 a cylindrical header member 16. An end plate 17 is bolted to header member 16 by means of bolts 18. The interior of header member 16 is divided into a cooling water inlet compartment 19 and a cooling water outlet compartment 20 by means of a partition 21. Cooling water may be admitted to inlet compartment 19 through a flanged connection 22 while cooling water may be discharged from outlet compartment 20 through a flanged connection 23.

A cap 24 is secured to ring 12 by means of bolts 25 and serve to close the left hand end of shell 11. Suitably secured to and extending through head 15 is a series of water tubes 26. The other ends of tubes 26 are suitably secured in a floating tube head 27 within cap 24. Clamped to head 27 by means of bolts 28 are an annular ring 29 and a return header member 30. Cap 24 may be provided with a drain-cock 31 for the purpose of draining oil therefrom when the heat exchanger is not in use.

Within shell 11 is a series of transverse baffles spaced longitudinally of the shell through which tubes 26 extend. These baffles are of two types, the first of which is designated by reference character 32 and the second by reference character 33. Adjacent baffles are of different types while alternate baffles are of the same type. Baffles 32 consist of a disc having an opening 34 of generally annular form near the circumference thereof through which a number of tubes 26 extend while the central part of the baffle is provided with a plurality of circular openings just large enough to accomodate a

single tube. Baffles 33 are similar to baffles 32 except that an opening 35 of generally annular form is provided nearer the center of the baffle than is opening 34 in baffle 32. A series of circular openings just large enough to accommodate a single tube is provided near the circumference of baffles 33.

A conduit 36 supplies hot oil to the heat exchanger through a main inlet 37 and an auxiliary inlet 38. A valve 39 is provided in main inlet 37 while a valve 40 controls flow through auxiliary inlet 38. Flanged connection 41 constitutes an outlet for the cooled oil and is located near the opposite end of shell 11 from main inlet 37. Cylindrical baffles 42 are placed around tubes 26 adjacent to inlet 37 and auxiliary inlet 38 in order that the hot oil admitted at these points will not impinge directly on the tubes.

The arrangement of floating tube head 27 is such that expansion of tubes 26 due to heating may take place freely by the movement of header 27 within cap 24. The heat exchanger may be supported in any suitable manner, as by members 43.

The operation of the above described device is as follows:

Cooling water is admitted through connection 22 into inlet compartment 19 from whence it passes through the lower group of tubes 26 into return header 30. From here the cooling water passes back through the upper group of tubes 26 to outlet compartment 20, wherefrom it is discharged through connection 23.

Hot oil is supplied through conduit 36. This oil may be admitted to within shell 11 through main inlet 37 and through auxiliary inlet 38. The oil so admitted strikes baffles 42 and is thus prevented from impinging upon the tubes. The oil flows from left to right, as viewed in Fig. 1, through shell 11. The oil passes through openings 34 in baffles 32 and through openings 35 in baffles 33. These baffles, with their openings arranged out of alignment as previously described, cause the oil to flow first in contact with the tubes 26 which are near the circumference of shell 11, and then in contact with the tubes which are near the center of the shell and so on to the right hand end of the heat exchanger. From here the cooled oil is discharged through connection 41.

If the temperature of the cooling water admitted through connection 22 at any given time is such that the temperature of the oil discharged through connection 41 is satisfactory if all the oil supplied by conduit 36 passes in contact with all of the heat exchange surface provided by tubes 26, then in this case valve 39 in main inlet 37 is wide open while valve 40 in auxiliary inlet 38 is closed. If the temperature of the cooling water supplied decreases, the temperature of the oil discharged through conduit 41 would also

decrease, assuming the same rate of oil flow. In order to prevent this and to maintain the temperature of the oil discharged at a substantially constant value, valve 40 is opened to a greater or less extent, thus allowing a portion of the oil to be admitted near the central part of the heat exchanger. Under these conditions the portion of the oil admitted through main inlet 37 will flow in contact with all the heat exchange surface while that portion admitted through auxiliary inlet 38 will flow in contact with only approximately one-half of the heat exchange surface. The result will be that the portion admitted through auxiliary inlet 38 will not be cooled as much as though it had passed in contact with all of the surface and therefore the temperature of the oil discharged through conduit 41 will be higher than it otherwise would. The proportion of oil admitted through main inlet 37 and auxiliary inlet 38 may be so regulated as to maintain the temperature of the oil discharged at substantially constant value or any desired value in spite of wide fluctuations in the cooling water temperature.

In the arrangement shown in Fig. 1 the capacity of the heat exchanger may be varied from full to one-half. Regulation between full and approximately three quarters capacity may be obtained by adjusting only valve 40, leaving valve 39 wide open, for, if both valves are open, the flow of oil will be divided between the two inlets. Hence, if this amount of regulation is all that is required, valve 39 may be omitted. In order to operate the heat exchanger at one-half capacity valve 39 is entirely closed and valve 40 is wide open so that all of the oil is admitted through auxiliary inlet 38 and hence passes in contact with approximately one-half of the heat exchange surface. If it is desired to obtain regulation within wider limits a plurality of auxiliary inlets may be provided. In the apparatus shown in Fig. 3 there are provided two auxiliary inlets 44 and 45 controlled by valves 46 and 47, respectively. If valve 39 in main inlet 37 and valve 46 in auxiliary inlet 44 are both closed and all of the oil is caused to pass through auxiliary inlet 45 this oil will pass in contact with but a small portion of the heat exchanger surface and hence is not cooled below the desired temperature even though the temperature of the cooling water has become extremely low.

Inasmuch as the temperature of any part of the oil passing through the heat exchanger is not reduced below the desired degree, regardless of the temperature of the cooling water, it is impossible for the oil to solidify within the exchanger. Likewise, inasmuch as it is not necessary to vary the quantity of cooling water used, there is no danger that the heat exchanger will become steam bound

due to excessive heating of a comparatively small quantity of water.

It is possible with this arrangement to use less water when the cooling water temperature is low and to thus conserve water. In order to do this the supply of cooling water may be reduced until its outlet temperature becomes fairly warm but not hot enough for the formation of steam. If, under these conditions, the temperature of the oil discharged is still too low, it may be regulated by adjusting the valve or valves in the auxiliary inlets as above explained.

While I have shown and described preferred embodiments of my invention, it is to be understood that modifications thereof such as are apparent to one skilled in the art fall within its scope which is to be limited only by the appended claims viewed in the light of the prior art.

What I claim is:

1. Heat exchange apparatus comprising an extended shell, a plurality of tubes within said shell, means for passing cooling water through said tubes, means for introducing a fluid to be cooled into said shell near one end thereof, means for removing fluid from near the other end of said shell and means for introducing fluid to be cooled into said shell at an intermediate point.

2. Heat exchange apparatus comprising an extended shell, a plurality of tubes within said shell, means for passing cooling water through said tubes, means for introducing a fluid to be cooled into said shell near one end thereof, means for removing fluid from near the other end of said shell and means for introducing fluid to be cooled into said shell at a plurality of intermediate points.

3. Heat exchange apparatus comprising an extended shell, a plurality of tubes within said shell, means for passing cooling water through said tubes, means for introducing a fluid to be cooled into said shell near one end thereof, means for removing fluid from near the other end of said shell, means for introducing fluid to be cooled into said shell at an intermediate point and means for regulating the amount of fluid admitted at said intermediate point.

4. Heat exchange apparatus comprising an extended shell, a plurality of tubes within said shell, means for passing cooling water through said tubes, means for introducing a fluid to be cooled into said shell near one end thereof, means for removing fluid from near the other end of said shell, means for introducing fluid to be cooled into said shell at an intermediate point and for regulating the proportionate amounts of fluid admitted at said intermediate point and near said first mentioned end, respectively.

5. Heat exchange apparatus comprising an extended shell, a plurality of tubes within said shell, means for passing cooling water

through said tubes, means for introducing a fluid to be cooled into said shell near one end thereof, means for removing fluid from near the other end of said shell, means for introducing fluid to be cooled into said shell at a plurality of intermediate points and means for regulating the amount of fluid admitted at each of said intermediate points.

6. Heat exchange apparatus comprising an extended shell, a plurality of tubes within said shell, means for passing cooling water through said tubes, means for introducing a fluid to be cooled into said shell near one end thereof, means for removing fluid from near the other end of said shell, means for introducing fluid to be cooled into said shell at a plurality of intermediate points and means for regulating the proportionate amounts of fluid admitted at each of said intermediate points and near said first mentioned end, respectively.

7. Heat exchange apparatus comprising means forming a first path for the flow of cooling medium, means forming a second path for the flow of fluid to be cooled in heat exchange relation with said first path, means for supplying fluid to be cooled to one end of said second path and means for supplying fluid to be cooled to an intermediate point of said second path.

8. Heat exchange apparatus comprising means forming a first path for the flow of cooling medium, means forming a second path for the flow of fluid to be cooled in heat exchange relation with said first path, means for supplying fluid to be cooled to one end of said second path, means for supplying fluid to be cooled to an intermediate point of said second path and means for regulating the amount of fluid supplied to said intermediate point.

9. Heat exchange apparatus comprising means forming a first path for the flow of cooling medium, means forming a second path for the flow of fluid to be cooled in heat exchange relation with said first path, means for supplying fluid to be cooled to one end of said second path, means for supplying fluid to be cooled to a plurality of intermediate points of said second path and means for regulating the amount of fluid supplied to each of said intermediate points.

10. Heat exchange apparatus comprising means forming a first path for the flow of cooling medium, means forming a second path for the flow of fluid to be cooled in heat exchange relation with said first path, means for supplying fluid to be cooled to one end of said second path, and means for supplying fluid to be cooled to a plurality of intermediate points of said second path.

11. Heat exchange apparatus comprising means forming a first path for the flow of cooling medium, means forming a second path for the flow of fluid to be cooled in

heat exchange relation with said first path, means for supplying fluid to be cooled to one end of said second path, means for supplying fluid to be cooled to an intermediate point of said second path and means for regulating the proportionate amounts of fluid supplied at said end of said second path and at the intermediate point, respectively.

12. Heat exchange apparatus comprising means forming a first path for the flow of cooling medium, means forming a second path for the flow of fluid to be cooled in heat exchange relation with said first path, means for supplying fluid to be cooled to one end of said second path, means for supplying fluid to be cooled to a plurality of intermediate points of said second path and means for regulating the proportionate amounts of fluid supplied to said end of said second path and each of said intermediate points, respectively.

13. The method of exchanging heat between a cooling fluid and a fluid to be cooled which comprises passing the cooling fluid in contact with a heat exchange surface, passing a portion of the fluid to be cooled in contact with all of said surface and passing the remainder of the fluid to be cooled in contact with a portion of said surface.

14. The method of exchanging heat between a cooling fluid having a varying temperature and a fluid to be cooled which comprises passing the cooling fluid in contact with a heat exchange surface, passing a portion of the fluid to be cooled in contact with all of said surface, passing the remainder of the fluid to be cooled in contact with a portion of said surface and varying the proportion of the remainder to the total quantity of fluid to be cooled so as to maintain substantially constant the temperature of the cooled fluid.

In testimony whereof I hereunto affix my signature.

EVERETT NORMAN SIEDER.