

Oct. 26, 1943.

A. A. ABBATIELLO
HEAT EXCHANGER SYSTEM

2,332,882

Filed Feb. 5, 1942

2 Sheets-Sheet 1

Fig. 1.

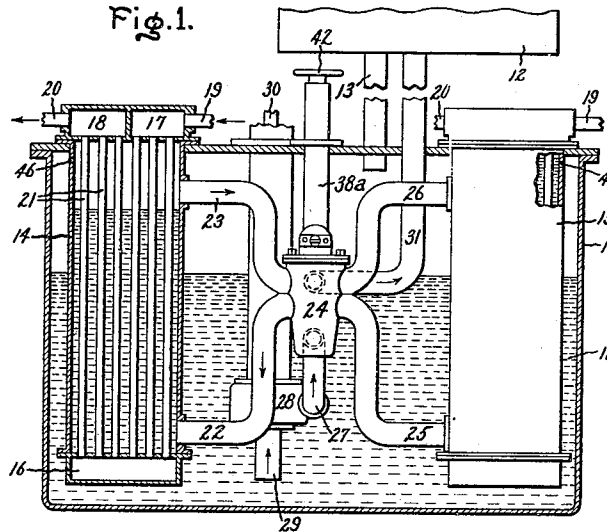
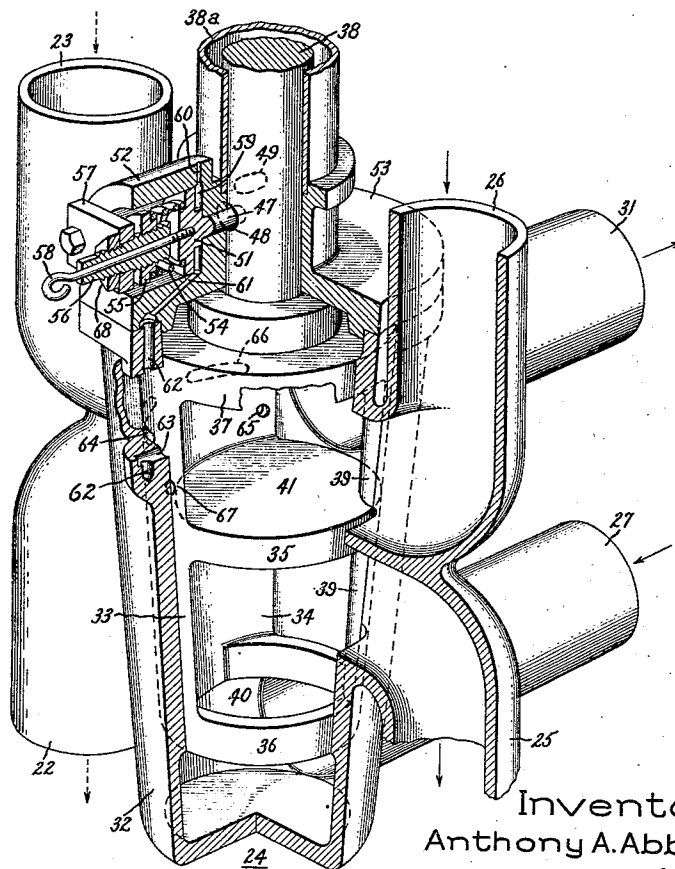


Fig. 2.



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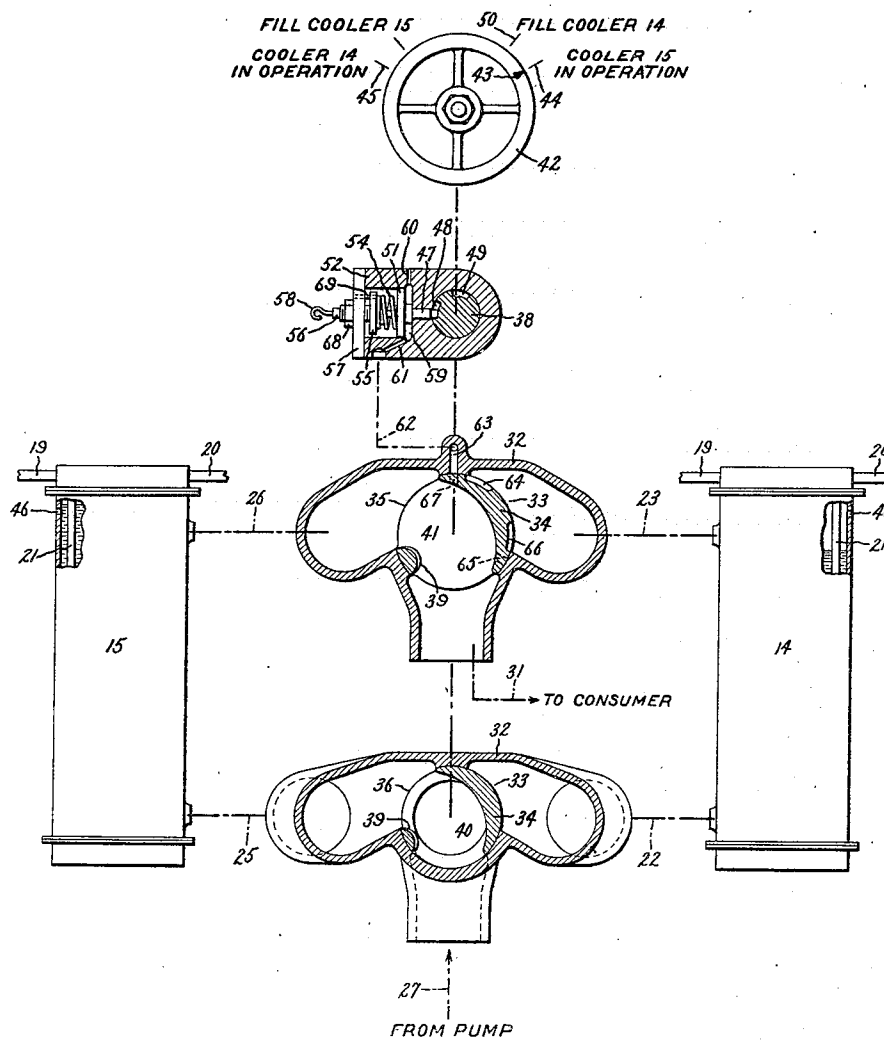
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Fig. 3.



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UNITED STATES PATENT OFFICE

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HEAT EXCHANGER SYSTEM

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7 Claims. (Cl. 257—215)

The present invention relates to heat exchanger systems for transferring heat from oil or like medium to another medium. More particularly, the invention relates to oil cooling systems of the kind including several oil coolers for alternate use. The invention is of particular significance in connection with elastic fluid power plants in which oil or like liquid is continuously circulated from a source through an oil cooler to bearings, hydraulic motors and other elements requiring oil under pressure during operation. The oil discharge from these elements is returned to the source. Several coolers are usually provided to avoid interruption of operation in case one of the coolers has to be shut down for the purpose of cleaning or repair. The change of operation from one cooler to another cooler usually is effected by a valve mechanism. Difficulties have heretofore been experienced with this kind of arrangement upon sudden transfer of operation from one cooler to another cooler without giving such other cooler sufficient time to become filled with oil.

The object of my invention is to provide an improved construction and arrangement of heat exchanger systems, in particular oil cooler systems, for use in turbine power plants and the like whereby the above difficulties are substantially eliminated. This is accomplished in accordance with my invention by the provision of means including a locking device cooperatively associated with the valve mechanism and making it impossible to transfer the operation of the system from one cooler to another as long as such other cooler is not completely filled with oil or like liquid.

For a better understanding of what I believe to be novel and my invention, attention is directed to the following description and the claims appended thereto in connection with the accompanying drawings.

In the drawings Fig. 1 illustrates an oil cooler system embodying my invention; Fig. 2 is a perspective view partly broken away of a part of Fig. 1; and Fig. 3 is an explanatory view of the arrangement of Fig. 1 when viewed from the rear.

The arrangement comprises a tank 10 for containing oil or like liquid 11 to be supplied to a consumer such as bearings 12 of an elastic fluid turbine or the like. The oil is discharged from the bearings 12 through a conduit 13 and returned to the tank 10. Two oil coolers 14 and 15 are substantially entirely disposed within the tank 10. Each cooler has a lower header 16 and upper headers 17, 18 with inlets and outlets 19 and 20 respectively. The lower header is connected to

the upper headers by a bank or banks of cooling tubes 21. During operation cooling medium such as water is conducted through the inlet conduit 19 to the upper header 17, whence it flows through some of the tubes 21 in to the lower header 16. From the lower header 16 the cooling medium is forced through other tubes 21 into the outlet header 18 to be discharged through the outlet conduit 20. The first cooler 14 has an inlet conduit 22 and an outlet conduit 23 for oil to be cooled connected to a valve mechanism 24. Similarly the second cooler 15 has an inlet conduit 25 and an outlet conduit 26 corresponding to the conduits 22 and 23 respectively of the first cooler and also connected to the valve mechanism 24. The mechanism 24 broadly constitutes a double valve, that is a unit of two valves for connecting either of the coolers in series between the mechanism 24 and the consumer 12.

The valve mechanism has an inlet conduit 27 connected to the discharge of a pump 28 which latter has an inlet conduit 29. The valve mechanism 24 and the pump 28 are substantially immersed in the oil in the tank 10 and the pump is driven by a shaft 30 projecting through the cover of the tank 10 and ordinarily driven through a gearing by a prime mover or like power agency, not shown. The valve mechanism also has a discharge conduit 31 for conducting oil to the consumer 12.

The valve mechanism as shown in Figs. 2 and 3 comprises a conically-shaped casing 32 and a rotatable valve member in the form of a plug valve 33. The casing 32 has six openings to which are attached the aforementioned conduits 22, 23, 25, 26, 27 and 31. The three conduits 22, 25 and 27 are connected to lower portions of the casing 32 and the other conduits 23, 26 and 31 are connected to upper portions of the casing 32. The rotatable valve member 33 has a tapered wall 34 which in one position, as indicated in Fig. 2, covers the openings to which the conduits 22, 23 are connected. Upon rotation of the plug valve member 33 the wall 34 covers the openings to which the conduits 25, 26 are connected. The valve member 33 in addition has a disk 35 integrally formed with an intermediate portion of the wall 34 and a ring 36 integrally formed with the lower end of the wall 34. The upper end of the wall 34 is integrally secured to a top 37 to which a valve stem 38 is connected. The stem 38 is enclosed in a bushing 38a flanged to the cover of the tank 10. The upper wall or top 37, the disk 35 and the ring 36 are connected by a re-

inforcing rib 39 arranged diametrically opposite the wall 34.

The plug valve member 33 together with the casing 32 form two chambers 40 and 41. The lower chamber 40, as shown in Figs. 2 and 3, communicates with the conduits 25 and 27 and the upper chamber 41 communicates with the conduits 26 and 31. Thus, in the position shown, oil is discharged from the pump 28, conducted through the conduit 27 to the chamber 40 and discharged therefrom to the conduit 25 into the second cooler 15. Oil is discharged from the latter through the conduit 26 into the chamber 41, whence the oil is conducted through the conduit 31 to the consumer 12. Upon turning of the plug valve 33 the cooler 14 is put into operation. In this case, as described above, oil is discharged from the pump 28 through the pipe 27 into the chamber 40, whence it is conducted through the conduit 22 to the cooler 14 and discharged from the latter through the conduit 23 into the chamber 41. From the latter the oil is forced through the conduit 31 into the consumer 12. The rotatable valve member is moved from one position to another position by means of a handwheel 42 secured to the upper end of the stem 38. The handwheel has a mark 43 in cooperative relation with other marks 44 and 45. In Fig. 3 the mark 43 registers with the mark 44, indicating that the cooler 15 is in operation. Upon counterclockwise turning of the wheel 42 until the mark 43 registers with the mark 45 the cooler 14 is placed in operation.

As stated above, my invention comprises the provision of means for locking the valve mechanism and making it impossible to change from operation of one cooler to the other cooler until such other cooler is substantially filled with oil. As shown in Fig. 1, the cooler 15 is in operation and substantially entirely filled with oil while the cooler 14 is only partly filled. Each cooler 14, 15 has a vent 46 slightly below the upper headers 18, 17. During the operation of a cooler its oil level is above the vent and after such cooler is put out of operation the oil level is below the vent. The vents 46 may be omitted in case the connections of the conduits 23 and 26 to the coolers are close to the headers of the coolers 14 and 15, respectively.

In a preferred embodiment the locking mechanism according to my invention includes an element, such as a locking pin, cooperatively associated with the valve mechanism normally preventing complete rotation of the latter but permitting limited movement. This locking element is connected to a pressure responsive device, such as a hydraulic motor arranged for connection to the cooler to be filled. This hydraulic motor has a vent. As long as the cooler to be operated is partly empty, air is discharged therefrom to the pressure responsive device and passes through its vent, thus preventing the building up of a substantial pressure in the device. As soon as the cooler is filled with oil, oil is passed therefrom into the pressure responsive device. Oil having a high viscosity as compared with air passes only slowly through said vent and thus causes the building up of pressure in the device whereby the latter is moved to unlock said locking member. In the arrangement shown in the drawings I have indicated a locking pin 47 in cooperation with one of two openings or slots 48 and 49 in the stem 38. In Figs. 2 and 3 the locking pin 47 projects into the opening 48. Each opening 48, 49 extends over a circumferential

portion of the stem 38 of a width sufficient to permit slight rotation of the latter. Thus, in the position shown in Fig. 3, the stem 38 may be rotated to move the mark 43 to register with a mark 50 in which position the other cooler, in the present instance the cooler 14, is being filled with oil for operation.

The locking pin 47 forms a projection of a piston 51 slidably disposed within a cylinder 52 suitably attached to a coverplate 53 of the valve casing 32. The piston 51 is biased into locking position of the pin 48 by a spring 54 engaging at one end the piston 51 and at the other end a spring plate 55. The latter is threaded onto a stud 56 suitably secured to a mounting plate 57 bolted onto the end of the cylinder 52. An eye-bolt 58 projects slidably through a bore of the stud 56 and is fastened to the piston 51 for the purpose of moving the piston 51 against the biasing force of the spring 54 during emergency conditions. The bottom of the cylinder 52 and the piston 51 form a pressure chamber 59 between them which is vented to atmosphere by a small vent or bore 60 in the cylinder 52. The chamber 59 may be connected to communicate with either of the coolers 14 and 15 upon rotation of the valve stem 38. Thus in the arrangement shown the chamber 59 may be connected to communicate with the cooler 14 upon slight turning of the handwheel 42 until the mark 43 registers with the mark 50. To this end the cylinder 52 is provided with a channel 61 connected to a vertical bore or channel 62 in the casing 32. The lower end of the channel 62 communicates with a radial bore or channel 63 in the casing 32, which latter upon turning of the plug valve 33 communicates with a circumferential short recess 64 (Figs. 2 and 3) in the outer surface of the wall 34. Assuming now that the plug valve 33 is slightly turned to establish communication between the recess 64 and the channel 63. Air may then be discharged from the cooler 14 (Fig. 3) through the conduit 23 into the recess 64, whence the air flows through the channels 63, 62, 61 into the pressure chamber 59 and is vented therefrom through the vent 60. The vent 60, as pointed out above, permits rapid discharge of air or like gas and thus prevents the building up of pressure in the chamber 59 during the discharge of air from the cooler 14. While thus air is discharged from the cooler 14 through the vent 60 of the pressure responsive device, oil is supplied at the same time to the cooler 14. This supply is accomplished by the provision of a hole 65 in the wall 34. The hole 65 and the vents 46 and 60 have to be properly proportioned for best result. Upon slight rotation of the wall 34 the hole 65 establishes communication between the chamber 41 and the conduit 23 (Fig. 3). Thus, while the cooler 15 continues to operate upon slight turning of the plug valve, simultaneously air is discharged from the cooler 14 and oil is supplied to the latter. The discharge of air from the cooler 14 through the vent 60 of the pressure responsive device as well as through the vent 46 of the cooler 14 continues until the oil level in the cooler 14 rises above the connection of the conduit 23 with the cooler 14. As the oil level in the cooler 14 rises above the connection of the conduit 23 the discharge of air through the conduit 23 and the vent 60 of the pressure responsive device is prevented. Instead of air, oil from the cooler 14 flows through the conduit 23 and is discharged through the recess 64 and the passages 63, 62, 61 into the pres-

sure chamber 59. Due to its high viscosity only a small amount of oil is discharged through the vent 60 of the pressure responsive device and the vent 46. The oil level continues to rise until it reaches the vent 46. Thus, when oil instead of air is emitted through the vent 46 oil pressure is built up in the pressure chamber 59 and forces the piston 51 outward against the biasing force of the spring 54 into a position in which the locking pin is entirely removed from the opening 48 in the valve stem 38. In the unlocked position of the pin 47 the valve stem may be turned counterclockwise into the operating position of the cooler 14 in which the mark 43 registers with the mark 50. Thus, the operator must wait until the valve stem 38 is unlocked before he can turn the handwheel 42 into the position marked "cooler 14 in operation."

The arrangement so far described includes means to prevent operation of the cooler 14 until such cooler 14 is filled with oil. This arrangement includes the provision of the recess 64 in the outer surface of the wall 34 and the bore 65 through the wall.

In order to prevent rapid transfer of operation from the cooler 14 to the cooler 15 until the latter is filled with oil, I provide another recess 66 in the outer surface of the wall 34, corresponding to the recess 64, and another bore 67 through the wall 34 and corresponding to the bore 65. During transfer from operation of the cooler 14 to the cooler 15 the operation of the arrangement is similar to that described above. The recess 66 serves to establish communication between the conduit 26 and the channel 63, permitting the discharge of air from the cooler 15 through the pressure responsive device. Simultaneously oil is supplied from the chamber 41 through the bore 67 to the conduit 26 and the cooler 15.

During emergency condition a sudden transfer from one cooler to the other cooler may be effected by manually unlocking the pin 47 and this is done by pulling the eyebolt 58 outward against the biasing force of the spring 54. The tension of the spring 54 may be varied. To this end a locking nut 68 locking the stud 56 to the mounting plate 57 is loosened. Thereupon the stud 56 may be turned in either direction to move the spring plate 55 towards or away from the mounting plate 57. Upon adjustment the locking nut 68 is tightened again on the mounting plate 57. The spring plate 55 is normally held in fixed position and prevented from rotation by a locking pin 69 (Fig. 3) secured to the mounting plate 57 and projecting into an opening of the spring plate 55.

Thus with my invention I have accomplished an improved construction and arrangement of heat exchanger systems. Such system includes a source of liquid, two heat exchangers and means including a valve mechanism for connecting in one position one of the heat exchangers in series between the source of liquid and a consumer for liquid under pressure, and in another position for connecting the other heat exchanger or cooler in series between such source and consumer. The valve mechanism is moved from one position to the other by means of an actuating member such as a rod and a handwheel in the above instance. A locking means is associated with the actuating member normally to prevent sudden transfer of operation from one cooler to the other and to permit limited movement only of the valve mechanism. A device, in the above instance a pressure

responsive device, forming a pressure chamber is associated with the locking means to render the latter inoperative as the cooler to be put in operation is substantially filled with liquid. Said pressure responsive device in a certain position of the valve mechanism communicates with the cooler to be placed in operation and causes the building up of pressure to render the locking means inoperative when the liquid in the cooler to be operated has reached a certain level.

The valve mechanism in a preferred embodiment, as described above, briefly includes a casing with a plug or valve member therein. The casing together with the plug form two chambers, a first chamber for connection to a source of liquid under pressure such as a pump and a second chamber for connection to a consumer of liquid. The casing of the valve mechanism has two pairs of additional openings, one pair for communication with the first chamber and another pair for communication with the second chamber. In one position of the plug member one opening of each pair is connected to the inlet and outlet respectively of a first cooler and in any other position of the plug member the other opening of each pair is connected to the inlet and outlet respectively of a second cooler. The movable valve member or plug has two bores and two recesses. Assuming that the plug member is in a position in which the first pair of the aforementioned openings is in communication with said chambers, during such communication the plug member may be turned slightly so that liquid may be conducted from the second chamber through a bore into one of the other openings and simultaneously air may be conducted from such other opening through a recess into a channel formed by the casing for connection to a pressure responsive device.

Having described the method of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, I desire to have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. Heat exchanger system comprising two surface type heat exchangers for alternate use, means including a valve mechanism for connecting either of the heat exchangers in series between a source of liquid and a consumer, means for actuating the valve mechanism to transfer operation from one heat exchanger to the other, and locking means associated with said transfer means normally to prevent transfer of operation from one heat exchanger to the other until such other heat exchanger is substantially filled with operating liquid.

2. Heat exchanger system comprising a source of liquid, a consumer, a first and a second surface type heat exchanger, means including a valve mechanism for connecting either of the heat exchangers in series between the source and the consumer, a locking member associated with the valve mechanism to prevent transfer of operation from one heat exchanger to the other, and means connected to the locking member and responsive to a condition indicative of a predetermined degree of filling of one of the heat exchangers for rendering the locking member inoperative.

3. Heat exchanger system comprising a first and a second heat exchanger, a source of liquid, a consumer of liquid, means including a valve

mechanism for connecting in one position the first and in another position the second heat exchanger in series between the source and the consumer, means for actuating the valve mechanism, a locking pin cooperatively associated with the actuating means and normally permitting limited movement only of the latter, and means including a device connected to the locking pin for moving the locking pin and automatically rendering it inoperative upon a predetermined liquid level in one of the heat exchangers.

4. Heat exchanger system comprising a tank for liquid, two liquid coolers, a consumer for liquid, means including a pump and a valve mechanism for forcing in one position of the mechanism liquid from the source to one of the coolers to the consumer and for forcing in another position of the valve mechanism liquid from the source through the other cooler to the consumer, an actuating member for the valve mechanism to change operation from one cooler to the other, and means cooperatively associated with the member and the coolers for preventing sudden transfer of the operation from one cooler to the other and permitting such other cooler to be placed in operation only when substantially filled with liquid.

5. Heat exchanger system comprising a tank for liquid, a first and a second liquid cooler, a consumer of liquid, means including a pump and a valve mechanism for forcing in one position of the mechanism liquid from the source through the first cooler to the consumer and for forcing in another position of the valve mechanism liquid from the source through the second cooler to the consumer, an actuating member for the valve mechanism to change operation from one cooler to the other, means associated with the valve mechanism and the coolers for preventing sudden transfer of operation from one cooler to the other and to permit operation of such other cooler only when the latter is substantially filled with liquid, and other means for rendering the last named means inoperative during emergency.

6. Heat exchanger system comprising a tank for liquid, two coolers for alternate use sub-

stantially enclosed within the tank, means including a pump and a valve mechanism for forcing in one position of the mechanism liquid through one of the coolers and in another position of the valve mechanism through the other cooler to a consumer, means normally locking the valve mechanism and permitting limited movement thereof only to prevent sudden transfer of operation from one cooler to the other, and means including a pressure responsive device and channels, bores formed in the mechanism which upon limited movement of the valve mechanism establish communication between the cooler not operating and the device for rendering the locking means inoperative upon said non-operating cooler becoming substantially filled with liquid.

7. Valve mechanism comprising a casing having an inlet and an outlet, a plug valve member movable between two end positions and having two spaced slots each corresponding to one of said end positions disposed within the casing and forming a first and a second chamber therewith communicating with the inlet and the outlet respectively, two openings in the casing communicating with the first and second chamber respectively in a certain end position of the plug valve member and another two openings in the casing for communication with the first and second chambers respectively in another end position of the plug valve member, means including a locking pin adapted to project into either of said slots for limiting movement of the plug valve member between the corresponding one of said end positions and a position away from said end position insufficient to change the communication of said chambers, and means for removing the locking pin including a cylinder forming a pressure chamber and channels formed in the cylinder and the valve casing for connecting the pressure chamber with one of said openings and for establishing communication between said opening and one of said valve chambers upon the plug valve member being moved away from either of said end positions.

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