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FLUID-COOLED DEVICE

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Fig. 1.

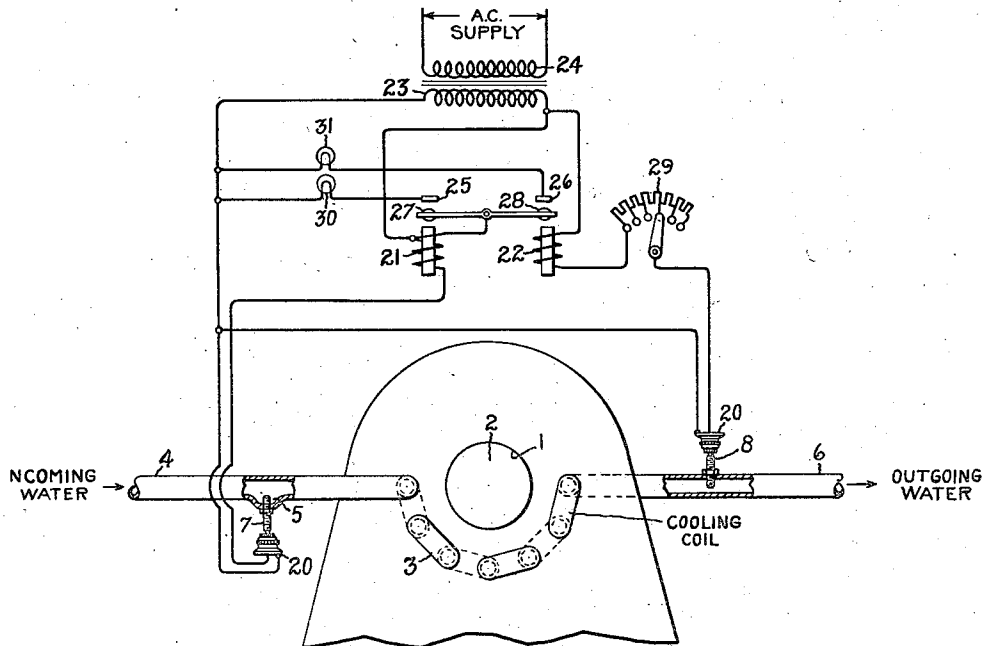
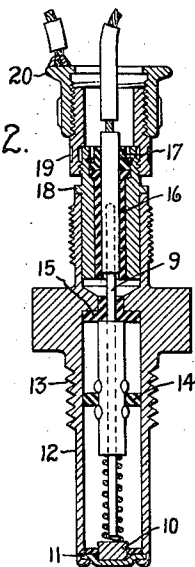


Fig. 2.



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UNITED STATES PATENT OFFICE

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FLUID-COOLED DEVICE

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Application April 28, 1945, Serial No. 590,907

7 Claims. (Cl. 177-311)

My invention relates to fluid-cooled devices such as bearings and particularly to bearings in which the cooling fluid flows through a cooling coil around the bearing and in which a signal is adapted to be operated to indicate any undesirable condition in the cooling system which might result in overheating of the bearing due to an inadequate supply or a failure in the supply of the cooling liquid.

An object of my invention is to provide an improved fluid-cooled device.

Another object of my invention is to provide an improved fluid-cooled bearing with a signal system for indicating the presence of an undesirable rise in temperature of the bearing.

A further object of my invention is to provide an improved alarm signal system for indicating the presence of an undesirable rise in the temperature of a fluid cooled device.

Further objects and advantages of my invention will become apparent and my invention will be better understood from the following description referring to the accompanying drawing, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming part of this specification.

In the drawing, Fig. 1 is a side elevational view of a bearing incorporating an embodiment of my invention with a schematic representation of an alarm system to be used with such a bearing; and Fig. 2 is a side elevational sectional view of a thermally responsive member such as can be used in the alarm circuit provided with my improved bearing.

Referring to the drawing, I have shown my invention in connection with a fluid-cooled bearing device provided with a bearing member 1 adapted to support a shaft 2 and provided with a fluid-cooling circuit including a circulating coil 3 through which water or other suitable cooling liquid is adapted to be passed. A cooling fluid supply, such as a pipe 4, is connected to the coil 3 and is formed with a fluid-collecting well 5 in the underside thereof, such that a certain amount of cooling liquid will remain in this well 5 for a considerable period of time, even though the cooling liquid in the supply has been cut off. A cooling fluid exhaust, including a pipe 6, is connected to the exhaust side of the cooling fluid circuit for removing the water or other cooling fluid after it has passed through the cooling coil. It is desired that the temperature of such a bearing should not exceed a predetermined value, and this can be determined by maintaining a prede-

termined temperature difference between the incoming and outgoing liquid. In my improved bearing construction, I provide an alarm signal system such that an operator of the equipment which is supported by the bearing 1 can readily determine if the predetermined temperature difference is exceeded. This alarm system includes a thermally responsive member formed as a negative temperature coefficient resistance detector 7 arranged in a location, such as the well 5 in the underside of the supply to the bearing cooling circuit, where supply fluid is trapped, and a thermally responsive member including a negative temperature coefficient resistance detector 8 arranged in the upper side of the cooling fluid exhaust 6 to be free from trapped exhaust fluid. These thermally responsive members may be made in any suitable manner, such as that shown in Fig. 2, in which a central terminal 9 is connected to a negative temperature coefficient resistance member 10 which is arranged in good electrical contact with a retaining washer 11 held in the base of a tubular well member 12 adapted to be secured by threads 13 in a threaded opening such as that formed in the supply pipe 4 and the exhaust pipe 6. The outer shell or tubular well 12 forms the other terminal of the thermally responsive member and is insulated by suitable insulating supports 14, 15, 16, and 17 from the inner terminal 9 and its electrical connection to the control circuit. The upper end of the tubular well 12 is electrically and mechanically connected to an electrically conductive bushing member 18, a fitting 19, and a cap 20 which forms the final terminal for the other side of the thermally responsive member. The two thermally responsive members 7 and 8 are connected in series circuit with exciting coils 21 and 22, respectively, of a balanced relay and to the secondary 23 of a transformer which has a primary winding 24 adapted to be connected to a suitable source of alternating current power supply. The balanced relay is provided with two stationary contacts 25 and 26 and two contacts 27 and 28 which are adapted to engage the contacts 25 and 26, respectively, when the relay is actuated by the energization of either of the exciting coils more than the other in response to a predetermined temperature difference between the temperature of the two thermally responsive members 7 and 8. The energizations of these two coils will be substantially equal and tend to maintain open the circuit between the relay contacts. Since the temperature of the outgoing cooling fluid should normally be higher than the temperature of the

incoming fluid, a variable resistor 29 is arranged in circuit with the thermally responsive member 8 in the outgoing or exhaust side of the cooling circuit in order to increase the resistance in this side of the circuit to balance any decrease in the resistance of the thermally responsive member 8 due to the increase in the temperature of the cooling fluid on this side of the circuit. The variable resistor 29 may be adjusted to provide for the desired predetermined temperature difference between the ingoing and outgoing cooling liquid. With this construction, if the bearing should become overheated, an excessive temperature difference will exist between these two thermally responsive members 7 and 8, and the current flowing through the member 8 will be increased because of the reduced resistance in this member as compared to the resistance of the member 7. This will cause the energization of the relay coil 22 to predominate over the energization of the relay coil 21, such that the contacts 25 and 27 will be closed and an alarm signal device, such as a visual signal lamp 30, will be energized by being connected in circuit with the secondary 23 of the transformer across the source of electrical power supply, thereby providing an indication to an attendant that the bearing is becoming overheated. If the supply of cooling fluid should for some reason be cut off while the bearing is in operation, the bearing also might become overheated, and the water which will be collected in the well 5 in the supply pipe 4 will maintain the thermally responsive member 7 at a lower temperature than the thermally responsive member 8 which will become heated by the passage of current therethrough without the benefit of the cooling effect of contact with any cooling fluid, since all of the cooling liquid will be drained from the pipe 6 under these conditions. This will result in an overheating of the thermally responsive member 8 and again produce an unbalance in the energization of the relay exciting coils 21 and 22, such that the coil 22 will draw down the armature of the relay and close the contacts 25 and 27, thereby energizing the relay signal device 30. If the variable resistor 29 is adjusted for a predetermined difference in temperature between the supply and exhaust cooling fluid and too large an amount of cooling fluid is used, such that the desired temperature difference does not exist and the cooling system is, therefore, being inefficiently operated, the current through the thermally responsive member 7 will be greater than the current through the thermally responsive member 8, since the circuit for the member 7 does not include the adjustable resistor 29, and both members 7 and 8 may be near the same temperature. In this instance, the magnetic attraction of the relay coil 21 will overbalance the relay coil 22 and attract the relay armature so as to close the circuit between the contacts 26 and 28, thereby energizing a circuit including an alarm signal device, such as a lamp 31, and warn an operator of the machine of this condition, so that the supply of cooling fluid may be reduced until the desired temperature difference between the ingoing and outgoing cooling liquid again is attained, as indicated by the absence of an alarm signal from either of the lamps 30 or 31.

In some applications, it may be found desirable to have an indication of the presence of normal temperatures in the cooling fluid which flow through the cooling circuit of the device to which the signal system is applied, and in such cases,

the variable resistor 29 may be adjusted to provide a resistance in this circuit which includes the relay coil 22, such that under normal conditions with a normal temperature or temperature difference between the supply and exhaust fluids the relay coil 21 will be energized sufficiently more than the relay coil 22 so as to attract the armature of the relay and close the circuit between the contacts 26 and 28 and energize the signal lamp 31. With this type of signal system, the lamp 31 may be made of a different color from the lamp 30 and may provide a green signal to indicate the safe operating condition of the fluid cooling system for the device, and the green light will remain lit for all normal temperatures of the system. If the temperature difference between the supply and exhaust cooling fluid exceeds a predetermined amount, the resistance of the negative temperature coefficient member 8 will be reduced sufficiently over the resistance of the member 7, such that the circuit of the system including the member 8, the variable resistance 29, and the relay coil 22 will be energized to an extent such that the relay coil 22 will attract the armature of the relay and open the circuit between the contacts 26 and 28 and close the circuit through the contacts 25 and 27 and the signal lamp device 30. This signal lamp 30 preferably is made of a different color from the signal lamp 31 and in this instance may be red, to indicate a dangerously high temperature in the cooling system of the device.

While I have illustrated and described a particular embodiment of my invention, modifications thereof will occur to those skilled in the art. I desire it to be understood, therefore, that my invention is not to be limited to the particular arrangement disclosed, and I intend in the appended claims to cover all modifications which do not depart from the spirit and scope of my invention.

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

1. A fluid-cooled device including a cooling fluid circuit about said device, a cooling fluid supply to said device cooling fluid circuit, a cooling fluid exhaust from said device cooling fluid circuit, a thermally responsive electrical resistance member arranged in a location in said cooling fluid supply for trapping some of the cooling fluid, a second thermally responsive electrical resistance member arranged in said cooling fluid exhaust in a location free from trapped fluid, an electrical signal device, and means including a relay for connecting said electrical signal device to a source of electrical power supply by actuation of said relay in response to a predetermined temperature difference between the temperatures of said thermally responsive members.

2. A fluid-cooled bearing including a bearing member, a cooling fluid circuit about said bearing member, a cooling fluid supply to said bearing member cooling fluid circuit, a cooling fluid exhaust from said bearing member cooling fluid circuit, a thermally responsive negative temperature coefficient electrical resistance member arranged in a well in said cooling fluid supply, a second thermally responsive negative temperature coefficient electrical resistance member arranged in said cooling fluid exhaust in a location free from trapped fluid, an electrical signal device, and means for connecting said electrical signal device to a source of electrical power supply in response to a predetermined temperature

difference between the temperatures of said thermally responsive members.

3. A fluid-cooled device including a cooling fluid circuit about said device, a cooling fluid supply to said device cooling fluid circuit, a cooling fluid exhaust from said device cooling fluid circuit, a thermally responsive negative temperature coefficient electrical resistance member arranged in a well in said cooling fluid supply, a second thermally responsive negative temperature coefficient electrical resistance member arranged in the upper side of said cooling fluid exhaust, an electrical signal device, and means including a balanced relay operable in response to a predetermined temperature difference between the temperatures of said thermally responsive members for connecting said electrical signal device to a source of electrical power supply.

4. A fluid-cooled bearing including a bearing member, a cooling fluid circuit about said bearing member, a cooling fluid supply to said bearing member cooling fluid circuit, a cooling fluid exhaust from said bearing member cooling fluid circuit, a thermally responsive negative temperature coefficient electrical resistance member arranged in a well in said cooling fluid supply, a second thermally responsive negative temperature coefficient electrical resistance member arranged in said cooling fluid exhaust in a location free from trapped fluid, an electrical signal device, means including a balanced relay for connecting said electrical signal device to a source of electrical power supply by actuation of said relay in response to a predetermined temperature difference between the temperatures of said thermally responsive members, and means for adjusting the resistance of the circuit of one of said temperature responsive members.

5. A fluid cooled bearing including a bearing member, a cooling fluid circuit having a circulating coil arranged about said bearing member, a cooling fluid supply to said bearing member cooling fluid circuit, a cooling fluid exhaust from said bearing member cooling fluid circuit, a thermally responsive electrical resistance member arranged in a well in the underside of said cooling fluid supply, a second thermally respon-

sive electrical resistance member arranged in the upper side of said cooling fluid exhaust, an electrical signal device, means including a balanced relay having an exciting coil means connected in circuit with said cooling fluid supply thermally responsive member and a second exciting coil means connected in circuit with said second thermally responsive member for connecting said electrical signal device to a source of electrical power supply by actuation of said relay when either of said exciting coil means is energized more than the other in response to a predetermined temperature difference between the temperature of said thermally responsive members, and means for adjusting the resistance of the circuit of one of said temperature responsive members.

6. An alarm system for a fluid-cooled device having a cooling fluid circuit, a thermally responsive electrical resistance member arranged in a location for trapping some of the cooling fluid in the supply to the cooling fluid circuit, a second thermally responsive electrical resistance member arranged in a location free from trapped fluid on the exhaust of the cooling fluid circuit, an electrical signal device, and means for connecting said electrical signal device to a source of electrical power supply in response to a predetermined temperature difference between the temperatures of said thermally responsive members.

7. An alarm system for a fluid-cooled bearing having a cooling fluid circuit, a thermally responsive negative temperature coefficient electrical resistance member arranged in a well in the supply to the cooling fluid circuit, a second thermally responsive negative temperature coefficient electrical resistance member arranged in the upper side on the exhaust of the cooling fluid circuit, an electrical signal device, and means including a balanced relay for connecting said electrical signal device to a source of electrical power supply by actuation of said relay in response to a predetermined temperature difference between the temperatures of said thermally responsive members.

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