March 5, 1946. D. B. DEWEY 2,395,995

VIBRATION-RESPONSIVE CONTROL FOR COOLING TOWER FANS

Filed March 19, 1945 2 Sheets-Sheet 1

Fig. 1.

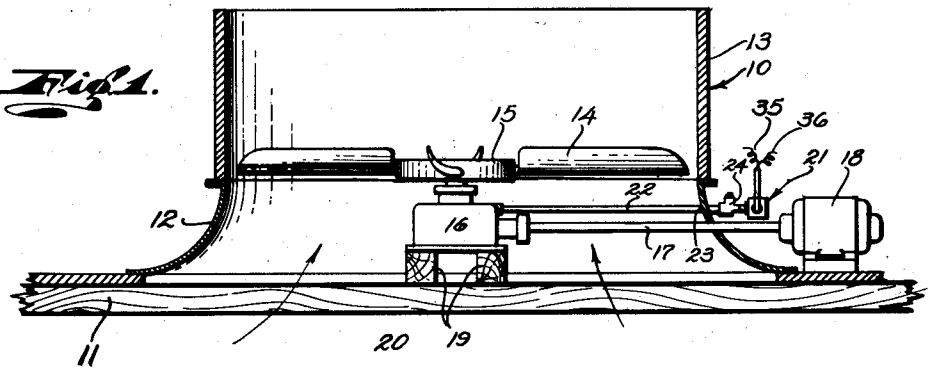


Fig. 2.

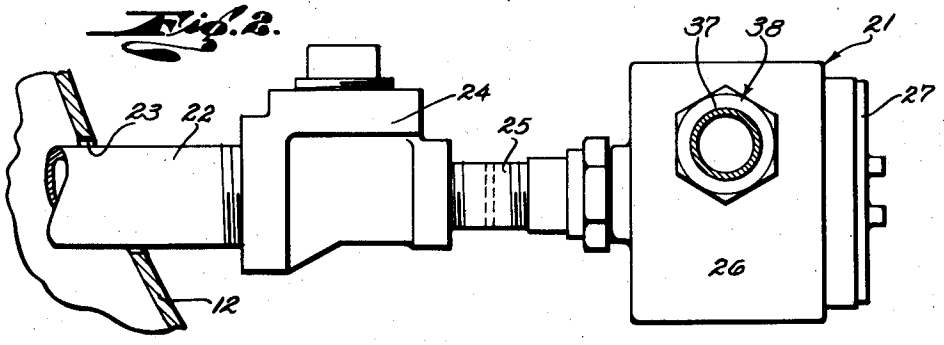
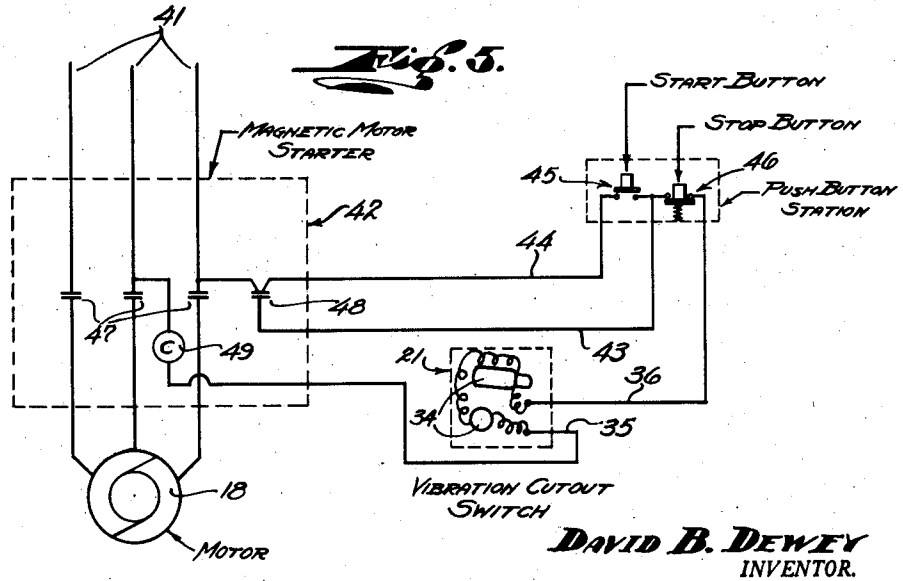


Fig. 5.



DAVID B. DEWEY
INVENTOR.

BY Hadwin White

ATTORNEY

March 5, 1946. D. B. DEWEY 2,395,995

VIBRATION-RESPONSIVE CONTROL FOR COOLING TOWER FANS

Filed March 19, 1945 2 Sheets-Sheet 2

Fig. 3.

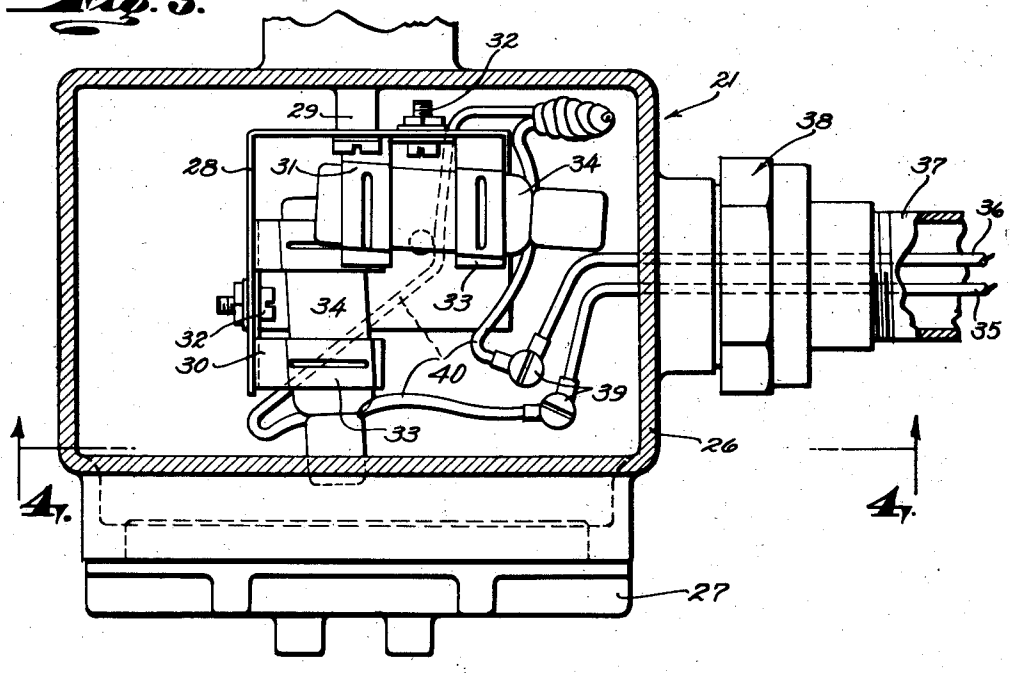
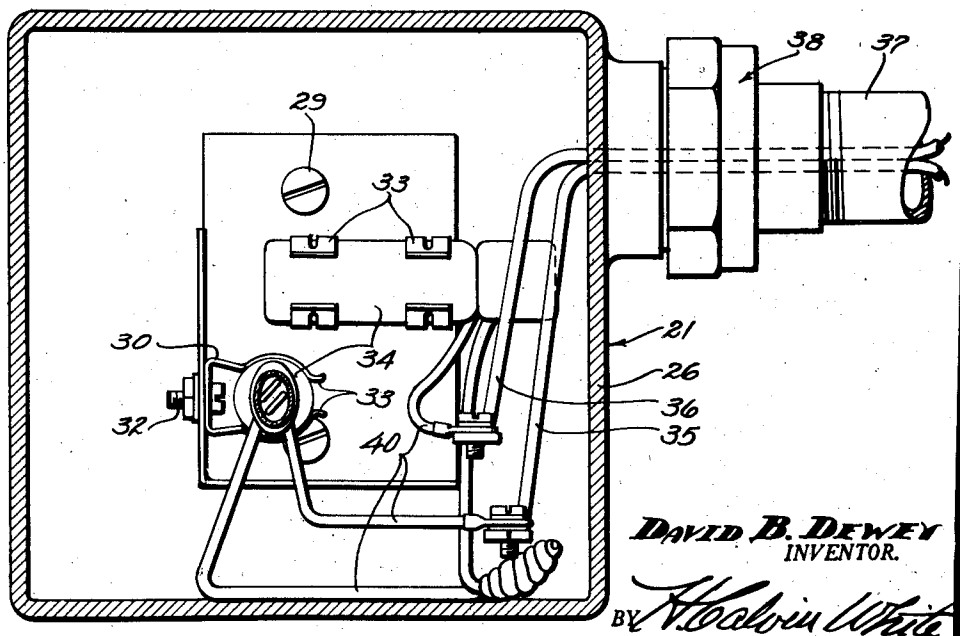


Fig. 4.



DAVID B. DEWEY
INVENTOR.

BY Hoskin White

ATTORNEY

Patented Mar. 5, 1946 2,395,995

UNITED STATES PATENT OFFICE

2,395,995

VIBRATION-RESPONSIVE CONTROL FOR COOLING TOWER FANS

David B. Dewey, Pasadena, Calif., assignor to The Fluor Corporation, Ltd., Los Angeles, Calif., a corporation of California

Application March 19, 1945, Serial No. 583,430

8 Claims. (Cl. 230—17)

This invention has for its general object to provide a novel automatic control for motor-driven water cooling tower or heat exchanger structure fans to prevent damage to the fan and associated parts by reason of excessive fan vibration that may result from various causes responsible for an unbalanced condition of the fan.

More particularly, the invention aims to provide a vibration-responsive control system operable automatically in the event of excessive fan vibration or bodily displacement, to stop the motor before damage can occur.

It is to be understood that the invention is adaptable to such automatic control of fans in mechanical draft cooling towers generally, and in heat exchanger towers or structures, whether of the induced or forced air types, and whether the fluid to be cooled, e. g. water, is directly contacted by the air or indirectly as by way of cooling coils, since the adaptation is simply a matter of mounting the control in such relation to the fan that the fan vibration is transmitted to the control. Merely for purposes of explanation and to illustrate a typical embodiment, the invention is herein described in conjunction with the conventional induced draft fan and ring assembly.

In its preferred form, the control comprises a cut-out switch assembly mounted to receive the fan vibrations, as by connecting the switch with the usual fan gear box. Typically the switch assembly may include one or a plurality of individual mercury switches in the motor control circuit and operable, when bodily vibrated, to break the circuit and thus stop the motor.

A particular feature is the use of plural mercury switches arranged so that the switch assembly is responsive to any of multi-direction vibrations to interrupt the motor operation.

Other features and objects, as well as the details of those referred to in the foregoing, will be understood from the following description of the illustrative form of the invention shown in the accompanying drawings, in which:

Fig. 1 is a vertical sectional view showing a conventional fan, ring and motor-driven assembly for an induced draft tower, together with the automatic cut-out switch;

Fig. 2 is an enlarged view of the cut-out switch and its support;

Fig. 3 is a horizontal sectional view taken through the cut-out switch case;

Fig. 4 is a section on line 4—4 of Fig. 3; and

Fig. 5 is a wiring diagram of the control system for the motor and magnetic starter.

Referring first to Fig. 1, the illustrated fan and ring assembly 10 for an induced draft water cooling tower, condenser or heat exchanger, is supported on the top floor structure or framing 11 of the tower and comprises a convergent throat portion 12 and an upper extended section 13. The ring assembly contains a fan 14, the hub 15 of which is rotatable about a vertical axis and is driven through the usual gear box 16 and shaft 17 by the motor 18. The gear box 16 is suitably supported by the tower structure, as on horizontal beams 19. As will be understood, rotation of the fan operates to induce a high velocity flow of air upwardly through the usual water cooling chamber 20 below.

As previously mentioned, it is possible for excessive vibrations or bodily vibratory displacements of the fan to occur during its operation, for such reasons as the existance of an unbalanced condition resulting, for example, from ice formation on the fan blades, loosening of a blade, or other causes disturbing the normal balance of the fan. The resulting vibration imposes extreme wearing conditions on the transmission 16, and may reach a magnitude such that the fan is impacted against the ring 10, causing resultant severe damage if not virtual destruction of the fan and other parts affected. By mounting the present cut-out switch in such relation to the fan that the fan vibrations are transmitted to the switch, it is made possible to preclude any possibility of damage occurring as a result of the vibration, by automatically discontinuing the motor drive.

In the broad contemplation of the invention, the cut-out switch, generally indicated at 21, may be mounted at any desired location and in any suitable manner permitting transmission to it, of bodily vibration of the fan. Preferably, though typically, the cut-out switch may be mounted on or attached to the gear box 16, inasmuch as the latter provides a convenient support and is subject to the same vibrations that occur in the fan. Accordingly, the cut-out switch is shown to be mounted on the end of the oil filler pipe 22 extending through an opening at 23 in the fan ring section 12. Oil is supplied to the gear box 16 by way of pipe 22 through the normally closed plug fitting 24 and the cut-out switch 21 is connected to the fitting 24 by the blind nipple 25.

Referring to Figs. 3 and 4, the switch assembly 21 comprises a box-like housing 26 closed at its outside by a cover 27 which is removable for access to the inside of the housing. The latter contains a right angle supporting plate 28 attached

at 29 to the housing and carrying a pair of brackets 30 and 31 attached to the inner faces of the supporting plate by bolts 32. Each of the brackets 31 and 30 has integrally formed clips 33 which receive the mercury switches 34 positioned horizontally and at substantially right angles. The switches 34 may be any suitable type of switch adapted to be electrically connected in series and responsive to horizontal displacement or vibration to break the electrical circuit in which they are connected. For example, the standard "Mercoid" tilting switch has been found satisfactory. The sensitivity of the switches in their circuit breaking response to vibrations, may be controlled by tilting them, more or less, from true horizontal position.

The switch is connected in a circuit including wires 35 and 36 running within conduit 37 connected at 38 to the housing. The wires are attached to posts 39 with which the switches 34 are connected in series by conductors 40. As will be understood, horizontal displacement of the assembly 21 as a result of vibrations transmitted from the gear box through pipe 22 in any of various horizontal directions, displaces the mercury in one or the other of switches 34 to break the circuit containing the conductors 35 and 36.

As illustrated in Fig. 5, the usual power conductors 41 and magnetic motor starter 42 may be connected with the cut-out switch circuit 35, 36, and 43. Assuming the cut-out switch 21 to be closed, the motor and fan are started in operation by closing the starting button switch at 45, and thereafter the motor may be manually stopped by opening the switch 46. As will be apparent, using the illustrated control system, once the current supply is interrupted by cut-out switch 21, the magnet coil 49, the main contacts 47 and the auxiliary contact 43 are opened and current supply to the motor is also interrupted. The motor can then only be started again by manually closing the starting switch 45 in the circuit 43, 44.

It will of course be understood that the showing of an electric motor as a prime mover for the fan, is illustrative only and typical of various kinds of fan drivers, such as internal combustion or steam engines, capable of use if desired, and that any of various known types of control systems or circuits, responsive to the present vibration responsive cut-out, may be adapted to the control of a selected kind of prime mover.

I claim:

1. In mechanical draft cooling equipment of the character described including a fan for creating a flow of air, a ring at the outside of said fan and a motor for driving the fan; the combination comprising a control at the outside of said ring and responsive to vibration to interrupt the operation of said motor, and means for transmitting bodily vibration of the fan to said control.

2. In mechanical draft cooling equipment of the character described including a fan for creating a flow of air, a ring at the outside of said fan, and a motor for driving the fan; the combination comprising a control at the outside of said ring and responsive to vibrations in either of two directions to interrupt the operation of said motor, and means for transmitting bodily vibration of the fan to said control.

3. In mechanical draft cooling equipment of the character described including a fan for creating a flow of air, a ring at the outside of said fan, an electric motor for driving the fan, and an electric circuit for controlling the motor; the combination comprising a cut out switch at the outside of said ring in said circuit responsive to vibration to interrupt the operation of said motor, and a member extending through an opening in said ring for transmitting bodily vibration of the fan to said switch.

4. In mechanical draft cooling equipment of the character described including a fan for creating a flow of air, a ring at the outside of the fan, and a motor for driving the fan; the combination comprising a control at the outside of said ring responsive to vibration to interrupt the operation of said motor, and means including a rigid member supporting said control and extending through an opening in said ring for transmitting bodily vibration of the fan to said control.

5. In mechanical draft cooling equipment of the character described including a fan for creating a flow of air, a ring at the outside of said fan, a gear box within said ring and connected to the fan, and a motor for driving the fan through said gear box; the combination comprising a control at the outside of said ring responsive to vibration to interrupt the operation of said motor, and means extending through an opening in said ring and connecting said control to the gear box so that bodily vibration of the fan is transmitted through the gear box to said control.

6. In mechanical draft cooling equipment of the character described including a fan for creating a flow of air, a ring at the outside of said fan, an electric motor for driving the fan, and a magnetic motor starter; the combination comprising a motor starting circuit connected to said starter, a manually operated starter switch in said circuit, a cut out circuit connected to said starter, a manually operated stop switch in said cut out circuit, a cut out switch positioned outside said ring in said cut out circuit and responsive to vibration to interrupt the operation of said motor, and a member extending through an opening in said ring for transmitting bodily vibration of the fan to said cut out switch.

7. In mechanical draft cooling equipment of the character described, a fan for creating a flow of air, a gear box connected to said fan, and a motor for driving the fan through said gear box; the combination comprising an oil filler pipe connected to said gear box, and a control mounted on said pipe and responsive to fan vibration transmitted through the gear box to interrupt the operation of said motor.

8. In mechanical draft cooling equipment of the character described, a fan for creating a flow of air, a gear box connected to said fan, a fan ring surrounding said gear box, and a motor outside said ring and driving the fan through said gear box; the combination comprising an oil filler pipe connected to said gear box and extending through an opening in said ring, and a control mounted on said pipe outside the ring and responsive to fan vibration transmitted through the gear box to interrupt the operation of said motor.

DAVID B. DEWEY.