H. A. STEEN.

ELECTROMAGNETICALLY OPERATED THERMOSTAT.

APPLICATION FILED JULY 22, 1911.

1,110,152. Patented Sept. 8, 1914.

Fig. 1

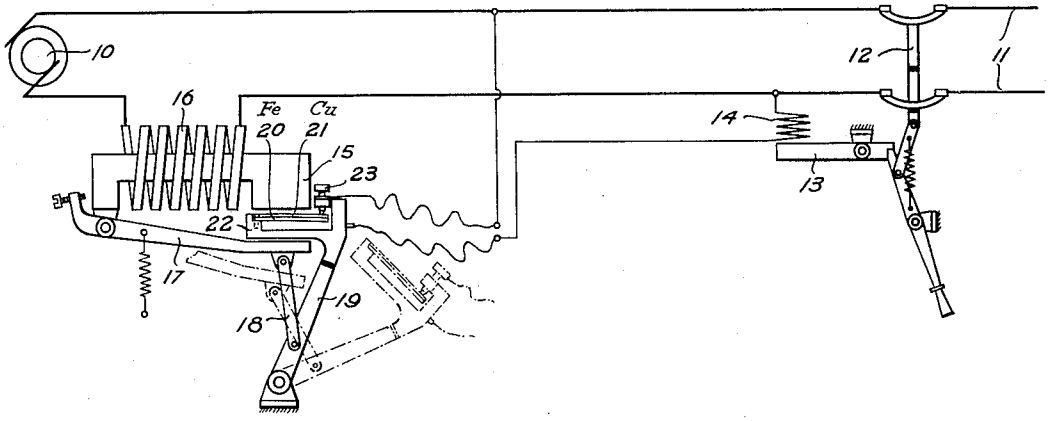
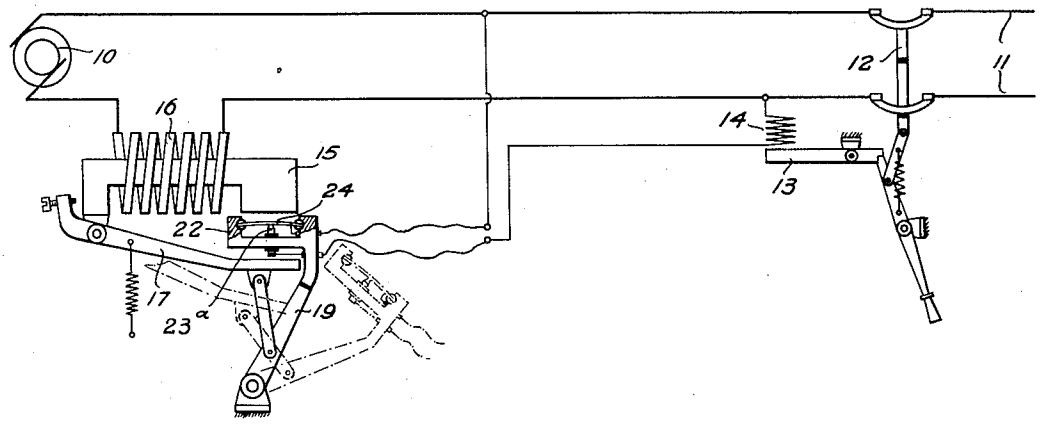


Fig. 2



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UNITED STATES PATENT OFFICE.

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ELECTROMAGNETICALLY-OPERATED THERMOSTAT.

1,110,152. Specification of Letters Patent. Patented Sept. 8, 1914.

Application filed July 22, 1911. Serial No. 639,988.

To all whom it may concern:

Be it known that I, HALFDAN A. STEEN, a subject of the King of Norway, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Electromagnetically-Operated Thermostats, of which the following is a full, clear, and exact specification.

My invention relates to thermostats.

In the operation of electrical apparatus, it is often necessary that an overload or other abnormal condition be allowed to exist for a definite length of time before causing an interruption of the circuit. It is also often desirable that the length of time during which such overload or other abnormal condition may continue vary in inverse sense to the extent of such condition. An excellent device for obtaining these ends is a thermostat.

It is the object of my present invention to provide a thermostat which has certain advantages over, and to control such thermostat in a manner which would give better results than, those heretofore used.

In carrying out my invention there is provided a thermostat which is located in an alternating magnetic field. The alternating flux produces eddy currents in the thermostat, and the thermostat is heated by the eddy currents. The thermostat proper may take various forms; two forms are illustrated, comprising respectively a composite metal strip composed of a plurality of strips or plates having different coefficients of expansion, and a single metal strip or plate slightly bowed and held rigidly so that the heating effect produced by the eddy currents will cause it to bow further.

In the preferred form of my invention the thermostat is normally out of the magnetic field, and is moved bodily into such field upon the rise of the abnormal condition, such as an overload, to be protected against.

The various novel features of my invention will appear from the description and drawings and will be particularly pointed out in the claims.

Figure 1 shows a system embodying one form of my invention; and Fig. 2 shows a similar system embodying a modified form thereof.

The device to be protected is shown as an alternating current generator 10, which is connected to a circuit 11 through a circuit-breaker 12. This circuit-breaker is biased to open position, but in the arrangement shown is normally held in closed position by a latch 13 controlled by a holding coil 14. The coil 14 is shown connected as a no-voltage coil. An overload responsive device, comprising a core 15 and a coil 16, has its coil connected in any suitable manner, as in series, so as to carry a current proportional to that supplied by the generator 10. The movable armature 17 of the overload device is connected by a link 18 to a pivoted arm 19 carrying my eddy current thermostat, through which the circuit of the holding coil 14 is normally completed.

In the form shown in Fig. 1, the eddy current thermostat comprises an iron strip 20 and a copper strip 21, which are rigidly fastened together to form one composite strip which is mounted at one end on an extension 22 of the arm 19. The free ends of the strips 20 and 21 coöperate with and normally engage the adjustable contact 23. The parts are normally in the position shown in dotted lines, the strips 20 and 21 being then entirely out of the magnetic field of the coil 16 and core 15. If the current supplied by the generator 10 exceeds a predetermined value, the coil 16 is energized sufficiently strongly to attract the armature 17. This moves the thermostat to the position shown in full lines, or between the core 15 and the armature 17, so that it will be in the path of the alternating flux produced by the coil 16. This flux induces eddy currents in the strips 20 and 21, and the eddy currents heat such strips. The heating will cause the strips to expand unequally, on account of the different coefficients of expansion of iron and copper, and will thus cause the free end of the composite strip to bend gradually downward. This inequality in expansion will be augmented because of the better conductivity of the copper strip, in consequence of which the eddy currents, and therefore the heating effect, in the copper strip will be greater than in the iron strip. When the thermostat has been sufficiently heated, which will occur after a time which varies in inverse sense to the current supplied by the generator 10, the composite strip will leave the contact

23 and interrupt the circuit of the holding coil 14, thus causing the tripping of the circuit-breaker 12 and the disconnection of the generator 10 from the circuit 11.

In the form shown in Fig. 2, the thermostat proper consists of a single metal strip or plate 24, which is mounted in the rigid frame formed by the free end of the arm 19 and its extension 22. This thermostat is preferably moved into and out of the magnetic field in the same manner and under the same conditions as is the thermostat shown in Fig. 1. When in the magnetic field, as shown in full lines in Fig. 2, the strip 24 will have eddy currents induced in it and will expand because of the heating consequent upon such eddy currents. Since this expansion can not produce any linear extension on account of the rigidity of the frame formed by the arm 19 and its extension 22, which is preferably made of insulating material or of laminated metal to prevent eddy currents from arising in them, it must and does produce merely a further bowing of the strip 24. Upon sufficient bowing of this strip, the latter leaves the adjustable contact 23^a, thus breaking the circuit of the holding coil 14 and causing the tripping of the circuit-breaker 12 in the manner already described.

In either of the arrangements shown, a cessation of the overload by the tripping of the circuit-breaker will cause the thermostat to drop back to the position shown in dotted lines, whereupon the thermostat will cool and be ready for operation upon the next occurrence of an overload.

Many modifications may be made in the precise arrangement shown and described, and I aim to cover all such which do not involve a departure from the spirit and scope of my invention as set forth in the following claims.

What I claim as new is:

1. In combination, a metal thermostat, an alternating current magnet, the thermostat being movable into and out of effective position relative to said magnet for the production of eddy currents in the metal thereof.

2. In combination, a firmly supported thermostatic element which is distorted on being heated, an alternating current magnet and an armature therefor adapted to be drawn toward a pole face of said magnet, said thermostatic element being movable into the magnetic field of said magnet and armature to cause the production of eddy current in the thermostatic element and the heating of the same, and a contact coöperating with said thermostatic element, the engagement of said contact with said thermostatic element depending upon the amount of distortion of said thermostatic element.

3. In a circuit interrupting device, a thermostat, and an electromagnet comprising a current carrying coil, means operatively related to said coil to move said thermostat into position to be heated by energy derived from said coil upon predetermined current flow in said coil.

4. In a circuit interrupting device, a thermostat, and an electromagnet comprising a current-carrying coil, said electromagnet being effective upon flow of current of a predetermined value in said coil to move said thermostat into position to be heated by energy derived from said coil.

5. A thermostatic relay, comprising a magnetizing coil, a movable thermostat, and means operated by said coil upon sufficient energization thereof for moving said thermostat into a position to be heated by the energy taken by said coil.

6. In combination, a thermostat, and means for producing eddy currents in said thermostat to cause a deflection thereof, said thermostat being movable into and out of position in which said means can produce substantial effects.

7. In combination, a thermostat, and a magnet for both moving the thermostat relatively to such magnet and for producing eddy currents in the thermostat to heat it.

8. In an automatic circuit-breaking device, a controlling means comprising an electromagnet in the circuit to be protected, and a movable metal thermostat adapted when in one position to be heated by eddy currents produced by said magnet, said thermostat being movable into effective position relative to said magnet on the occurrence of an abnormal condition in said circuit.

9. In combination, a thermostat, means for heating the same, said thermostat and said heater being relatively movable into and out of a position wherein the thermostat is effectively heated, and means responsive to abnormal changes for producing movement between said thermostat and heater.

Milwaukee, Wis., July 7, 1911.

In testimony whereof I affix my signature, in the presence of two witnesses.

HALFDAN A. STEEN.

Witnesses:

G. B. SCHLEY,

CHAS. L. BYRON.