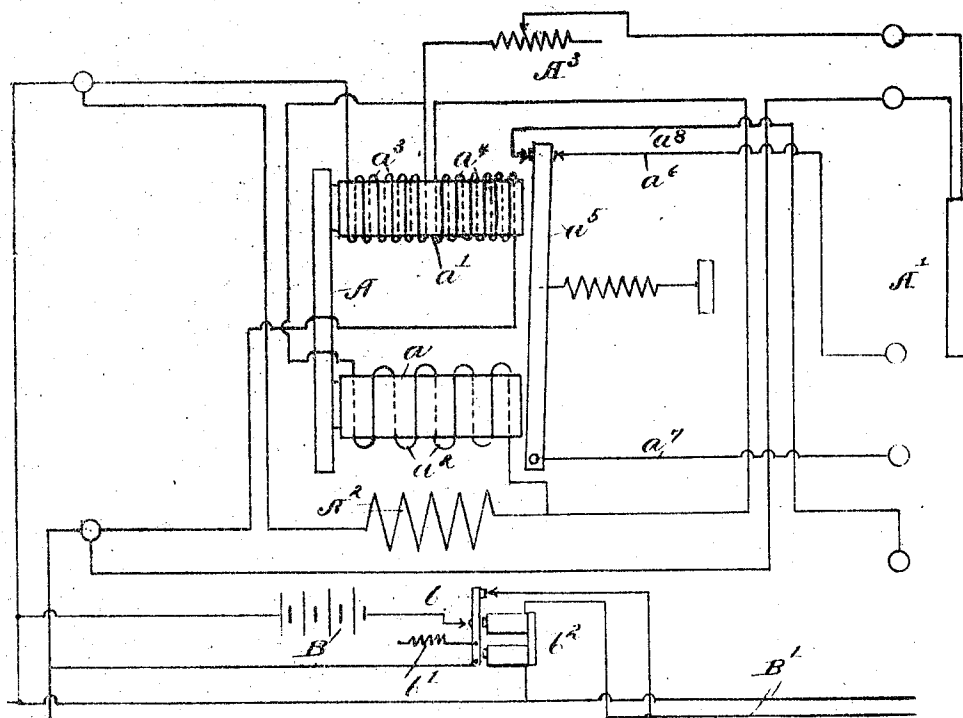


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TEMPERATURE CONTROLLED REGULATING DEVICE.
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UNITED STATES PATENT OFFICE.

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TEMPERATURE-CONTROLLED REGULATING DEVICE.

1,059,971.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, HENRY EARL BEIGHLEE, citizen of the United States, resident of East Cleveland, county of Cuyahoga, and State of Ohio, have invented a new and useful Improvement in Temperature-Controlled Regulating Devices, of which the following is a specification, the principle of the invention being herein explained and the best mode in which I have contemplated applying that principle, so as to distinguish it from other inventions.

This invention, pertaining as stated to temperature controlled regulating devices, relates more especially to apparatus of this sort wherein the desired regulation is effected through the medium of an actuating electric circuit.

The control of the latter, then, is the object in view, and it will be obviously immaterial whether such actuating circuit be employed simply to give an alarm or to directly affect heating means, a damper, or other mechanism.

Further objects of the invention are to much simplify apparatus of this sort, also to render the apparatus effective over wide ranges of temperature, and at the same time leave the apparatus sensitive to very small changes of temperature at any portion of such range.

To the accomplishment of these and related ends said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims.

The annexed drawing and the following description set forth in detail certain mechanism embodying the invention, such disclosed means constituting, however, but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawing the figure is a diagrammatic view of temperature controlled regulating apparatus involving my several improvements.

It has already been indicated that my invention chiefly concerns the arrangement of the control circuit in apparatus of the class in hand, a relay being utilized in connection with such control circuit, by the operation of which the main, or actuating, circuit may be either closed or opened as desired to variously affect any desired operating mechanism, be this a damper, an alarm, or in the case of an electric furnace an electric switch or any other mechanism. The control cir-

cuit is characterized by the employment therein of a thermo-sensitive coil, such coil, as will now be explained, being so connected, in a net work of conductors that the changes of resistance incident to the changes in temperature to which it is exposed will serve to variously affect the relay aforesaid.

Referring, then, first of all to the form of apparatus illustrated in the figure, the relay will be seen to comprise an ordinary electromagnet A, one leg a of which includes a single coil a^2 wound in the ordinary fashion, the other a' of which includes two concentrically wound coils a^3 a^4 differentially connected so that as long as the same current flows through said coils there will be no resulting magnetic field induced and no actuation of the armature a^5 had. The differential relay thus constituted by said two differentially connected coils of such electromagnet, together with the thermo-sensitive resistance A' and another resistance A^2 are arranged (as will be obvious from an inspection of the figure) in the form of a Wheatstone bridge, wherein said two differentially connected coils a^3 a^4 constitute the arms adjacent to the thermo-sensitive resistance. The coil a^2 wound about the other leg of the electro-magnet is connected across such bridge in the same fashion as the galvanometer is ordinarily included. In the same arm with the thermo-resistance A' there is furthermore included an adjustable resistance A^3 as shown. As a source of current a battery B adapted to be connected in the usual fashion to the respective coils and resistances that enter into the bridge, is provided or current may be taken from a light or power line B' as hereinafter more particularly explained.

The main or actuating circuit is shown with three leads a^6 , a^7 , and a^8 , and the movement of the armature a^5 is adapted to complete the circuit through the lead a^7 , and either the lead a^6 or a^8 depending on the position of the armature as controlled by the coils.

Having thus described the general arrangement of apparatus entering into my invention, the manner of its operation may be briefly set forth.

Assuming that actuation of the relay armature is desired upon variation from any desired temperature at the point where the thermo-sensitive resistance A' is located, the variable resistance A^3 included in the same

arm with the thermo-sensitive resistance is adjusted until, when said latter resistance is subjected to the temperature aforesaid, the bridge will be accurately balanced. In this state of affairs, the current flowing through the two differentially connected coils $a^3 a^4$ have a counteracting effect, while no current whatever will flow through the coil a^2 that is wound on the other leg of magnet A and connected across the bridge. If now, however, the temperature at the point where the thermo-resistance is located varies in either direction, the resistance of such coil will likewise vary and the balance of the bridge be immediately destroyed. Not only will there then be a current flowing through the bridge coil of the relay but the currents flowing through the coils of the differentially wound magnet leg will no longer be the same, and such coils will likewise be effective. The coils on both legs will accordingly tend to actuate the armature of the relay. By reason of these coils having obviously cumulative effect, an exceedingly small change in the resistance of the thermo-sensitive coil will suffice to cause the relay to attract the armature.

As illustrated in the figure, the actuating circuit is shown with three leads $a^8 a^9 a^7$, whereby reversible operation of the motor or other device connected therewith may be had. This, however, is immaterial, the arrangement of this part of the apparatus forming no part of the present invention.

It is contemplated that in numerous instances where apparatus of the type in hand may be employed, it will be more convenient to utilize current off a line than to employ a battery. In using a line, however, there is this difficulty to be apprehended, namely, that should the current through any failure of the dynamo or power station be interrupted, the regulating apparatus is instantly incapacitated for use, by reason of which serious damage may result, depending upon the character of the regulation effected thereby. To guard against evils arising from this situation I have accordingly devised an automatic switch (see figure), by means of which the current from the line B' , as on 110 volt service, will normally be used, but should this fail a constant current battery B will be automatically put in circuit. This device comprises simply a switch b adapted to close either the battery or line circuit, and simultaneously break the other. A spring b^1 connected with such switch tends normally to close the battery circuit. A high resistance relay b^2 , however, in shunt with the line service is effective to retain such switch open as long as current is flowing through said line. If, now, such current should accidentally, or otherwise, cease, the battery will be instantly thrown in circuit. Conversely, upon resumption of the

flow of current in the line, the battery will be cut out without any further attention, the operation throughout being entirely automatic.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any one of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:—

1. In apparatus of the character described, the combination with a main circuit and a branched control circuit, of a differentially wound electro-magnet having its coils connected in the branches of said control circuit respectively, a thermo-sensitive coil connected in one of said branches, a second electro-magnet connected across said branches, and an armature for said electro-magnets so connected in the main circuit as to alternately make or break said circuit.

2. In apparatus of the character described, the combination with a main circuit and a branched control circuit, of a differentially wound electro-magnet having its coils connected in the branches of said control circuit respectively, a thermo-sensitive coil and an adjustable resistance connected in one of said branches, a second electro-magnet connected across said branches, and an armature for said electro-magnets so connected in the main circuit as to alternatively make or break said circuit.

3. In apparatus of the class described, the combination with a main circuit, of a control circuit comprising a thermo-sensitive resistance and three other resistances arranged to form a Wheatstone bridge, the two resistances adjacent to said thermo-sensitive resistance comprising the coils of a differentially wound electro-magnet, an electro-magnet connected across said bridge and cooperative with the first electro-magnet, and an armature for said electro-magnets so connected in the main circuit as to alternatively make or break said circuit.

4. In apparatus of the class described, the combination with a main circuit, of a control circuit comprising a thermo-sensitive resistance and three other resistances arranged to form a Wheatstone bridge, the two resistances adjacent to said thermo-sensitive resistance comprising the coils of a differentially wound electro-magnet, an adjustable resistance included in the same arm with said thermo-sensitive resistance, an electro-magnet connected across said bridge and cooperative with said first electro-magnet, and an armature for said electro-magnets so connected in the main circuit as to alternatively make or break said circuit.

5. In apparatus of the class described, the

combination with a main circuit, of a control circuit comprising a thermo-sensitive resistance and three other resistances arranged to form a Wheatstone bridge, the two resistances adjacent to said thermo-sensitive resistance comprising the coils of a differentially wound electro-magnet, an electro-magnet connected across said bridge and coöperative with said first electro-magnet,
10 an armature for said electro-magnets so

connected in the main circuit as to alternatively make or break said circuit, and means for holding said armature away from said electro-magnets when an equilibrium exists in said bridge.

Signed by me this 9th day of June, 1908.
H. EARL BEIGHLEE.

Attested by—

E. R. RODD,
JNO. F. OBERLIN.