No. 676,309. Patented June 11, 1901.

E. E. GOLD.

MEANS FOR CONTROLLING ELECTRIC HEATERS.

(Application filed Nov. 9, 1899.)

(No Model.) 2 Sheets—Sheet 1.

FIG. 1.

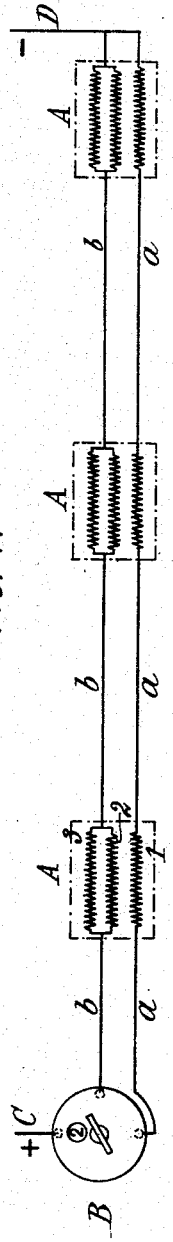

FIG. 3.

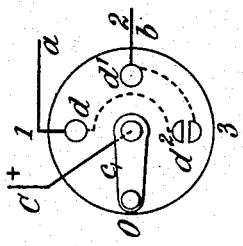

FIG. 2.

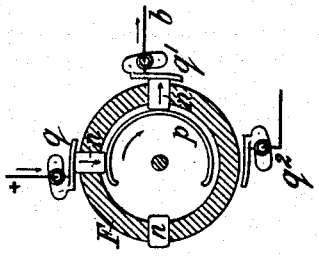

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FIG. 4.

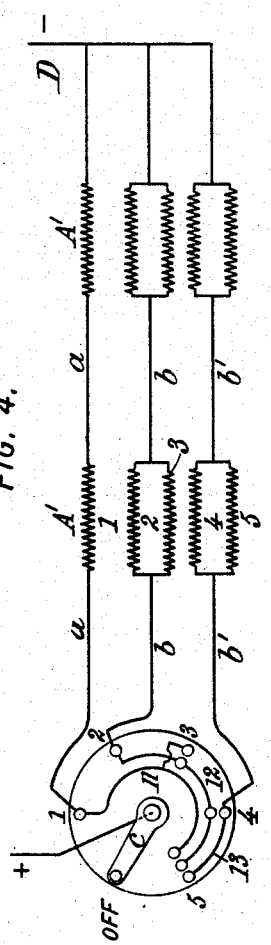
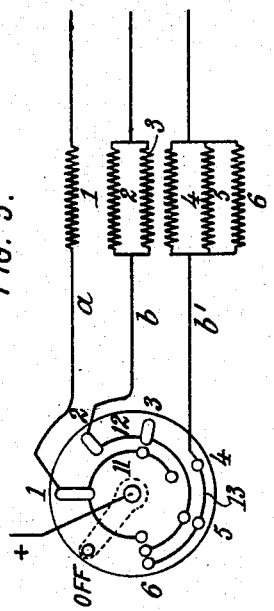


FIG. 5.



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UNITED STATES PATENT OFFICE.

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MEANS FOR CONTROLLING ELECTRIC HEATERS.

SPECIFICATION forming part of Letters Patent No. 676,309, dated June 11, 1901.

Original application filed March 10, 1897, Serial No. 626,750. Divided and this application filed November 9, 1899. Serial No. 736,320. (No model.)

To all whom it may concern:

Be it known that I, EDWARD E. GOLD, a citizen of the United States, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Means for Controlling Electric Heaters, of which the following is a specification.

The present application is a division of my application filed March 10, 1897, Serial No. 626,750, patented December 12, 1899, No. 639,170.

The present invention has been patented in Great Britain, No. 7,318, dated April 4, 1896; in Austria, No. 46/2,643, dated July 2, 1896, and in France, No. 268,222, dated June 26, 1897.

This invention relates to means for controlling electric heaters having a multipicity of coils or resistant conductors connected in parallel. In heaters of this type the degree of heat is controlled by varying the number of coils or resistances in circuit. With a uniform difference of potentials at the main conductors or leads and with coils of equal resistance the amount of heat generated would be in exact proportion to the number of coils in circuit—a theoretical ratio which is approximated in practice.

My invention will be best understood with reference to the accompanying drawings, wherein—

Figure 1 is a diagrammatic view showing a switch or controller and three heaters with their circuit connections, the controller being adapted for heaters having each two unequal heating elements. Fig. 2 is a sectional elevation of the electrical parts or elements of the switch B shown in Fig. 1. Fig. 3 is a similar elevation of a modified construction of switch. Figs. 4 and 5 show my system as adapted for heaters having three heating elements.

In Fig. 1, let A A designate the electric heaters of, for example, a street-railway car, each heater consisting of three coils, (or other resistant conductors,) which are marked, respectively, 1, 2, and 3. The dotted rectangle inclosing the coils may be taken to indicate the casing of the heater.

The particular construction of the heater is quite immaterial to my present invention; but a suitable construction is that set forth in my application, Serial No. 586,396, filed April 6, 1896, or my later application, Serial No. 597,874, filed July 2, 1896.

The only characteristic of the electric heater itself which is essential to my present invention is the mode of connecting or grouping the coils (or other resistant conductors) of the heaters. In a three-coil heater one coil—for instance, No. 1 in Fig. 2—is connected alone or by itself with the conducting-wire *a*, which leads to and from it. The other two coils, Nos. 2 and 3, are connected together at their terminals, (so that together they constitute a coil or heater element of greater heat-generating capacity than the single coil 1,) and the intermediate connection is joined to a conducting-wire *b*. Thus for a three-coil heater there are only two conducting-wires *a* and *b*. These wires lead at one end to the switch or controller B, which is connected to one of the leads C, and at the other end the wires connect with the opposite lead or main conductor D, Fig. 1. Between the controller B and the opposite lead D there is introduced a series or plurality of electric heaters with their coils No. 1 all connected in series on the wire *a* and their coils 2 and 3 connected in parallel series on the wire *b*—that is to say, the successive groups each composed of the coils 2 and 3, joined in parallel with each other, are connected serially on the wire, as clearly shown in Fig. 1. Hence for a succession of three-coil heaters only two wires are employed between the controller and all the heaters of the series.

The conditions essential to the switch or controller B may be best understood from the modification, Fig. 3, which shows an ordinary hand-switch, the conducting-arm *c* of which is connected with one of the main leads C, and the contacts *d d'* of which are connected with the wires *a b*. In position O the arm rests on a blind contact, so that the circuit is broken, the heaters being thus shut off. In position 1 the arm rests on the first contact *d*, and thereby connects with wire *a*, so that the current traverses coil No. 1. In position No. 2 the arm rests on the second contact *d'*, which communicates through the wire *b* with the coils 2 and 3. In position No. 3 the arm rests on a double contact d^2, which is con-

nected by conductors (shown in dotted lines) to the other contacts, so that in this position the arm is in connection with both wires *a* and *b*, and consequently the current traverses all three coils. Hence the degree of heat given out by the heater or heaters can be determined by the position of the switch, since in position No. 1 the current traverses only one coil of the heater and the lowest degree of heat is generated. In position No. 2 the current traverses two coils of the heater and a greater degree of heat is generated. In position No. 3 the current traverses all three of the heater-coils and the maximum degree of heat is generated. It is an advantage peculiar to this mode of connecting the coils of electric heaters in connection with a proper switch for controlling them in the manner just described that the heating service is in a measure equally apportioned between the three coils of the heater, since in the mildest weather in which the heater is in use coil No. 1 is alone used, while in weather a little colder this coil is thrown out of use and coils Nos. 2 and 3 are alone used. The system upon which my invention is directly an improvement is the one in which with the minimum degree of heat coil No. 1 is in use, with the medium degree of heat coils Nos. 1 and 2 are in use, and with the maximum degree of heat coils Nos. 1, 2, and 3 are employed, so that under all conditions whenever any heat is turned on at all coil No. 1 is in service and maintained at a high temperature. Assuming the variations in weather conditions to be such that the minimum, medium, and maximum degrees of heat are required each during about one-third of the time, as is approximately the case in practice, it follows that coil No. 1 has three times the extent of service of coil No. 3 and coil No. 2 twice the extent of service of coil No. 3, and as in practice there is some inevitable oxidation or other deterioration of the coils it follows that coil No. 1 will last only one-third as long as coil No. 3 and only one-half as long as coil No. 2. This inequality in the lifetime of the three coils is prevented by my invention, which insures that coil No. 1 shall be in service only during the minimum and maximum degrees of heat generation and shall be out of service and kept cool during the medium degree, so that assuming an equal time interval for the use of each of the three degrees and assuming that the coils are exactly alike there results an equality of endurance or equal lifetime for the three coils. The prior system referred to also demands the use of three wires, one for each coil, which by my system is reduced to two wires, thereby simplifying the connections and cheapening the installation of the heaters.

The simple switch shown in Fig. 3 requires setting or adjusting by hand and makes no provision against the formation of arcs between the contacts, which would burn out the switch. To this end it is desirable to employ some one of the well-known constructions of snap-switch in which the switch-arm or circuit-controlling part is moved so quickly as to prevent the formation of an arc. Numerous constructions of these switches are well known and in common use. In my application, Serial No. 626,750, filed March 10, 1897, Patent No. 639,170, dated December 12, 1899, (of which application my present application is a division,) I have shown and claimed a construction of snap-switch adapted to carry out the principle and mode of controlling electric heaters which is made the subject of the claims in my present application.

To enable the application of my present invention to a snap-switch to be understood, I show in Fig. 2 a simple form of such switch, omitting the mechanical snap-action device. In Fig. 2 F shows a disk which is caused to execute a rapid quarter-revolution each time the knob of the switch is turned. This disk carries three conducting-blocks *n n*, of metal. As the conducting-blocks are carried around by the movements of the disk their inner ends rub against a conducting-strip *p*. Outside of the disk are placed equidistant spring-contacts $q\ q'\ q^2$. The main lead or conductor C is connected to the contact *q*, the wire *a* is connected to the opposite contact q^2, and the wire *b* to the intermediate contact q'. The result of this arrangement is that of the four stopping positions of the disk F in the first there is no block *n* in contact with the initial contact-strip *q*, and consequently no current can pass to the heater. In the next position two blocks touch, respectively, the contacts $q\ q^2$, so that the current passes by wire *a* to coil No. 1 of the heater. In the next forward movement the switch is brought to the position shown in Fig. 2, wherein two blocks *n* touch the contacts *q* and q', so that the current passes to the coils Nos. 2 and 3 of the heater. In the fourth position all three blocks *n* are in contact with all three contact-pieces, so that the current divides, passing through all three coils of the heater. For a more full description of the mode of construction and operation of a switch of this character (which is not in itself claimed in my present application) I refer to my said Patent No. 639,170.

Ordinarily in electric heating it is not necessary or desirable to provide more than three different gradations of heat. Hence a three-coil heater is sufficient for every ordinary requirement of practice; but if heaters of a greater number of gradations are required my invention may be extended in its scope to serve for the control of such heaters. One example of such development of my invention is shown in Fig. 4, where each of the heaters (here lettered A′) is provided with five coils instead of three. In this case coil No. 1 is connected in conducting-wire *a*, coils Nos. 2 and 3 are joined at their ends and connected with wire *b*, and coils 4 and 5 are joined together at their ends and connect

in a third wire b'. The switch here shown is for clearness of the same order as that shown in Fig. 3, differing therefrom only in that a greater number of contacts are provided in order to establish the greater number of combinations required for controlling a five-coil switch. In position No. 1 the current traverses only wire a and coil No. 1. In position No. 2 it traverses only wire b and coils Nos. 2 and 3. In position No. 3 the arm rests on two contacts, one of which is electrically connected by wire 11 with the first contact and wire a and the other of which is connected by a wire 12 with the second contact and wire b, so that the current traverses both these wires and the three coils 1, 2, and 3. In position No. 4 the arm rests on two contacts, one of which is connected by wire 12 with the second contact and the wire b and the other of which is in connection with the wire b', so that the current traverses four coils Nos. 2, 3, 4, and 5, and, finally, in position 5 the arm rests upon three contacts, two of which are connected by wires 11 and 12 with wires a and b and the third of which is connected by wire 13 with wire b', so that in this position the current divides and traverses all five coils.

In Fig. 5 the same principle is shown as applied to a six-coil heater. Coil No. 1 is connected with wire a, as before. Coils Nos. 2 and 3 are connected in wire b, as before. Coils 4, 5, and 6 are joined together at their ends and connected in the third wire b'. The switch differs only in the arrangement of the contacts and intervening electric connections. In position No. 1 the switch-arm connects only with wire a and coil No. 1. In position 2 it connects only with wire b and coils 2 and 3. In position 3 the arm rests on two contacts, which connect, through wires 11 and 12, with the first and second contacts and wires a and b, so that the current traverses all three coils 1, 2, and 3. In position 4 the arm rests on two contacts, one of which connects by wire 11 with wire a and coil No. 1 and the other of which connects with wire b' and coils 4, 5, and 6, so that in this position four coils are in circuit. In position 5 the arm rests on two contacts, one of which connects by wire 12 with wire b and coils 2 and 3 and the other of which connects by wire 13 with wire b' and coils 4, 5, and 6, so that in this position five coils are in circuit, and, finally, in position No. 6 the arm rests upon three contacts, which connect, respectively, with the three wires leading to the three groups or divisions of coils, so that all six coils are in circuit.

Whatever be the number of coils in the heater they are grouped or subdivided into groups or divisions which are unequal in number, the first group, for example, containing one coil and the second group containing two coils, and if additional coils exist they are put in an additional group, which in a five-coil heater contains the two remaining coils and in a six-coil heater contains three coils or in a seven-coil heater would contain four coils. Of course the principle could be carried to heaters having a still greater number of coils and requiring the arrangement of a fourth group, or even more; but this would transcend all requirements of ordinary practice.

It is not necessarily essential to my invention that the heat generating or resistant elements of the heaters should be coils of wire, as other resistances might be substituted; nor is it necessarily essential that two or more such coils or resistances should be grouped in parallel to constitute the heating element of double heat-generating capacity, as any other known arrangement or proportion by which the branch circuit a may contain a minor heat-generating element (of which the coil 1 is an example) and the branch b a major heat-generating element (of which the coils 2 and 3 are an example) is within the principle of my invention.

I claim as my invention the following-defined novel features, substantially as hereinbefore specified, namely:

1. The combination of a succession of electric heaters, each including heating elements of unequal heat-generating capacity, two branch circuits traversing the successive heaters, the one including the minor heating elements thereof, and the other including the major heating elements thereof, and a switch at the junction of said branches with the main circuit, movable to as many different positions as the number of degrees of heat desired, in one position connecting the main circuit with only one branch circuit, in another position with only the other branch, and in a third position with both branches.

2. The combination of a succession of electric heaters A A, each including heating elements of unequal heat-generating capacity, two branch circuits a b traversing the successive heaters, the one including the minor heating elements thereof, and the other including the major heating elements thereof, said branches connected at one end permanently to one circuit-wire D, and at the other end connected through a switch B with the other circuit-wire C, and said switch movable to as many different positions as the number of degrees of heat desired, in one position connecting the main circuit with only one branch circuit, in another position with only the other branch, and in a third position with both branches, to the effect set forth.

3. The combination of a succession of electric heaters, each including heating elements of unequal heat-generating capacity, consisting of resistant-coils of naked wire exposed to circulation of air, the minor elements comprising a single coil and the major elements comprising a plurality of coils grouped in parallel, two branch circuit-wires traversing the successive heaters, one wire connecting serially the coils constituting the minor heat-

ing elements thereof, and the other wire connecting serially the groups of coils constituting the major heating elements thereof, and a switch at the junction of said branches with the main circuit, movable to as many different positions as the number of degrees of heat desired, in one position connecting the main circuit with only one branch circuit, in another position with only the other branch, and in a third position with both branches, to the effect set forth.

4. The combination of a succession of electric heaters, each including heating elements of unequal heat-generating capacity, two branch circuits traversing the successive heaters, the one including the minor heating elements thereof, and the other including the major heating elements thereof, and a switch at the junction of said branches with the main circuit, movable to as many different positions as the number of degrees of heat desired, in one position connecting the main circuit with only one branch circuit, in another position with only the other branch, and in a third position with both branches, the switch connections being so arranged that a different degree of heat is obtained for each of the different positions of the switch.

5. The combination of a succession of electric heaters, each including heating elements of unequal heat-generating capacity, two branch circuits traversing the successive heaters, the one including the minor heating elements thereof, and the other including the major heating elements thereof, a switch at the junction of said branches with the main circuit, a contact-making member in said switch movable to as many different positions as the number of degrees of heat desired, the switch connections being so arranged that a continuous operation of said contact-making member produces the different degrees of heat always in the same order of succession.

6. The combination of a series of electric heaters suitably disposed for heating a car or apartment, each heater including heating elements of unequal heat-generating capacity, the major element having approximately twice the capacity of the minor element, two branch circuits extending through the car or apartment and traversing the successive heaters, the one branch including in series the minor heating elements thereof, and the other including the major heating elements thereof, with circuit-closing means adapted at will to open or close either of said branch circuits, whereby the current may be passed solely through the branch containing the minor heating elements for giving the minimum or first degree of heat, or solely through the branch containing the major heating elements for giving an intermediate or second degree of heat, or simultaneously through both branches for giving the maximum or third degree of heat.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

EDWARD E. GOLD.

Witnesses:
ARTHUR C. FRASER,
FRED WHITE.