No. 639,170. Patented Dec. 12, 1899.

E. E. GOLD.

MEANS FOR CONTROLLING ELECTRIC HEATERS.

(Application filed Mar. 10, 1897.)

(No Model.) 3 Sheets—Sheet 1.

FIG. 1.

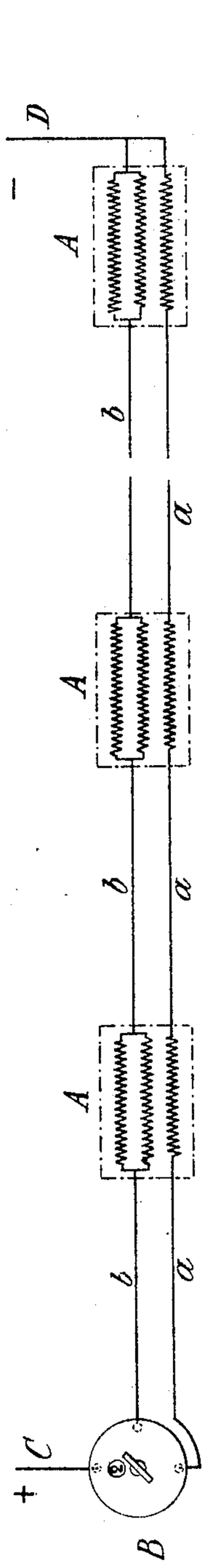


FIG. 7.

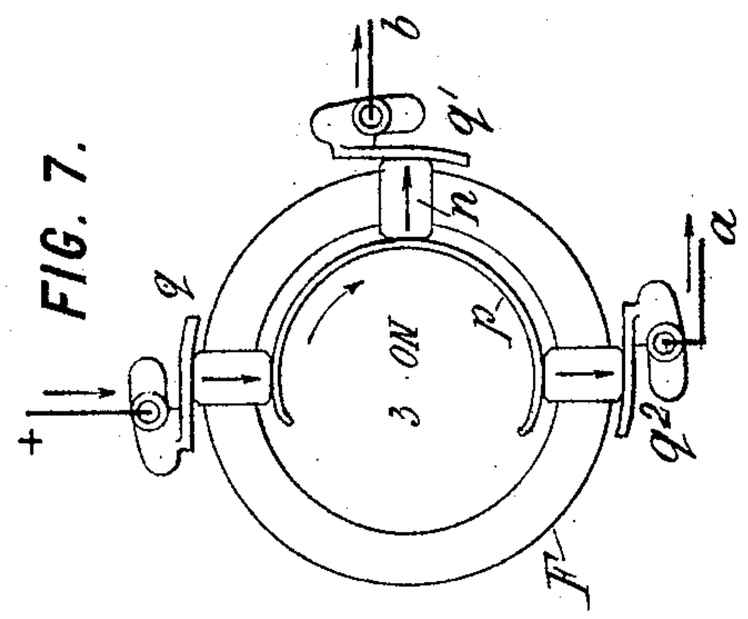


FIG. 6.

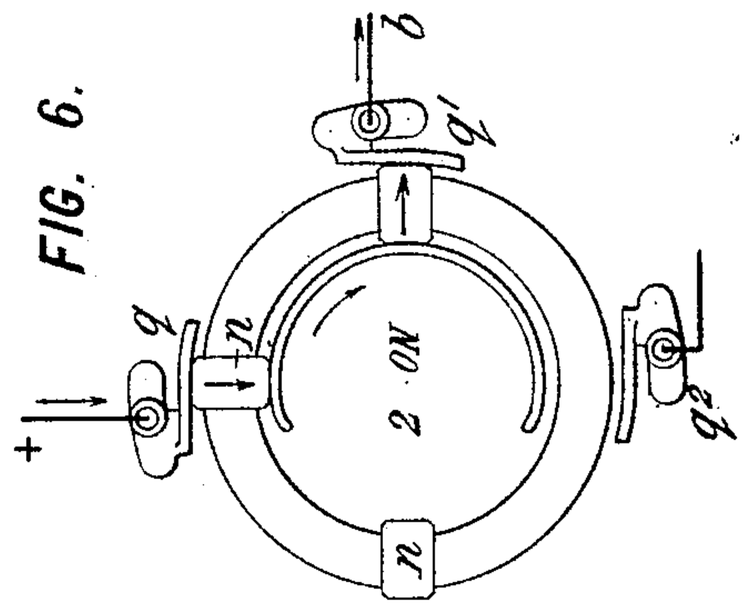


FIG. 5.

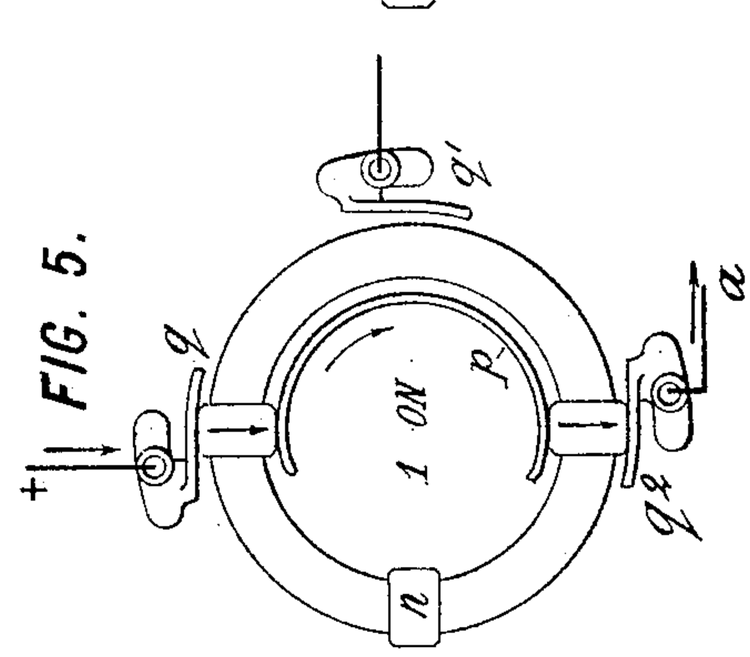
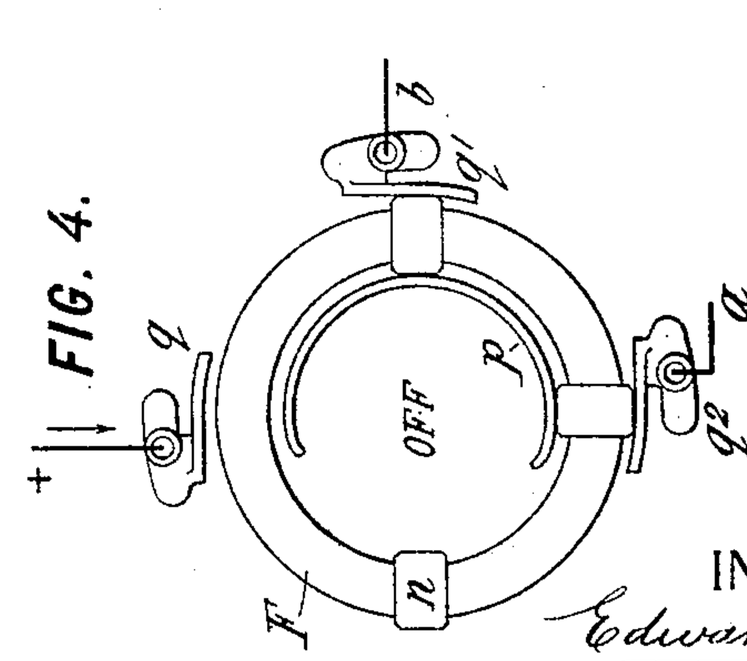


FIG. 4.



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No. 639,170. Patented Dec. 12, 1899.

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MEANS FOR CONTROLLING ELECTRIC HEATERS.

(Application filed Mar. 10, 1897.)

(No Model.) 3 Sheets—Sheet 2.

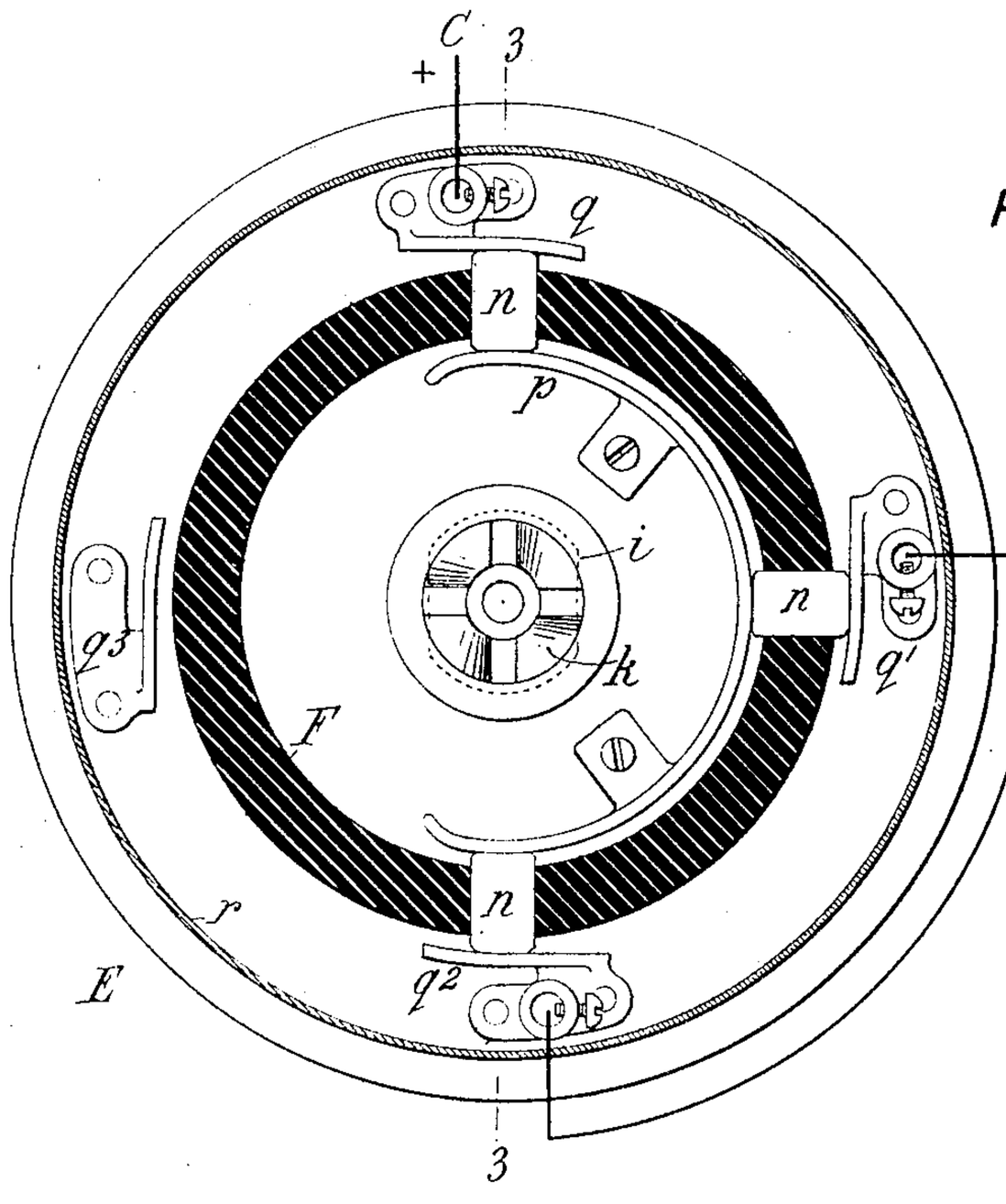


FIG. 2.

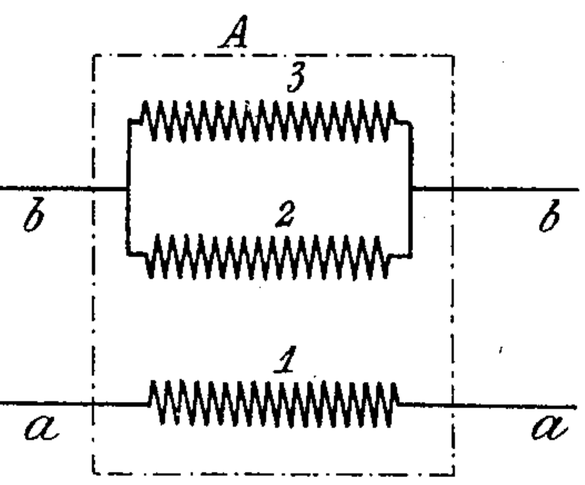


FIG. 8.

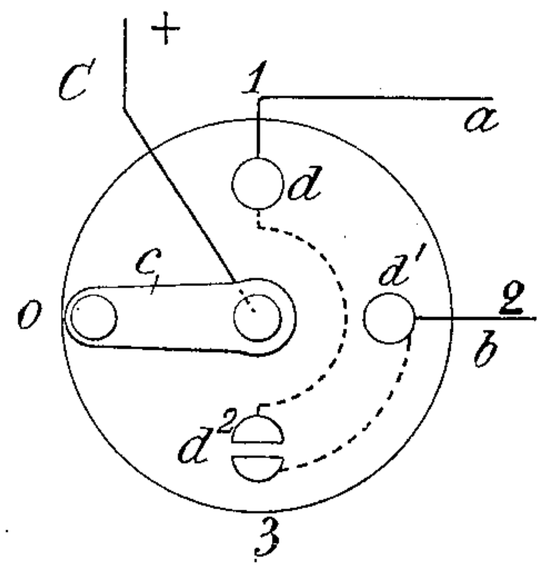
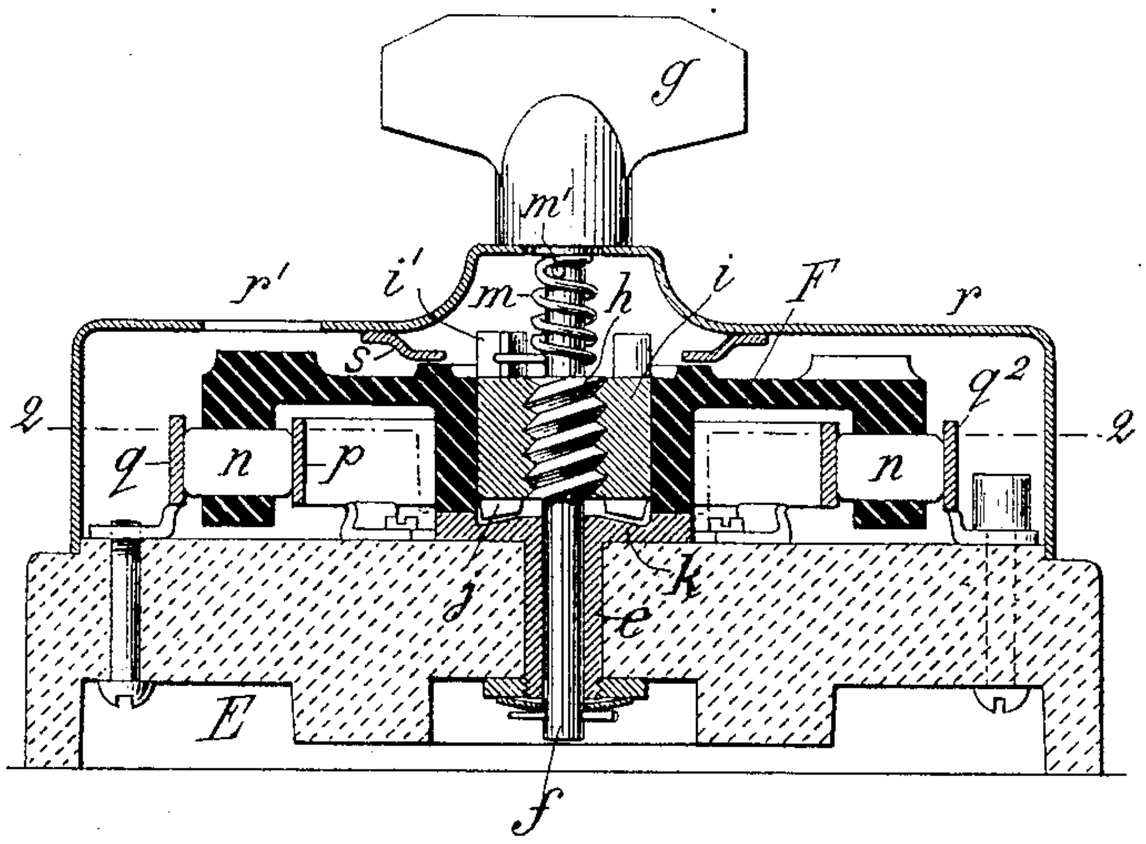


FIG. 3.



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No. 639,170. Patented Dec. 12, 1899.

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MEANS FOR CONTROLLING ELECTRIC HEATERS.

(Application filed Mar. 10, 1897.)

(No Model.) 3 Sheets—Sheet 3.

FIG. 9.

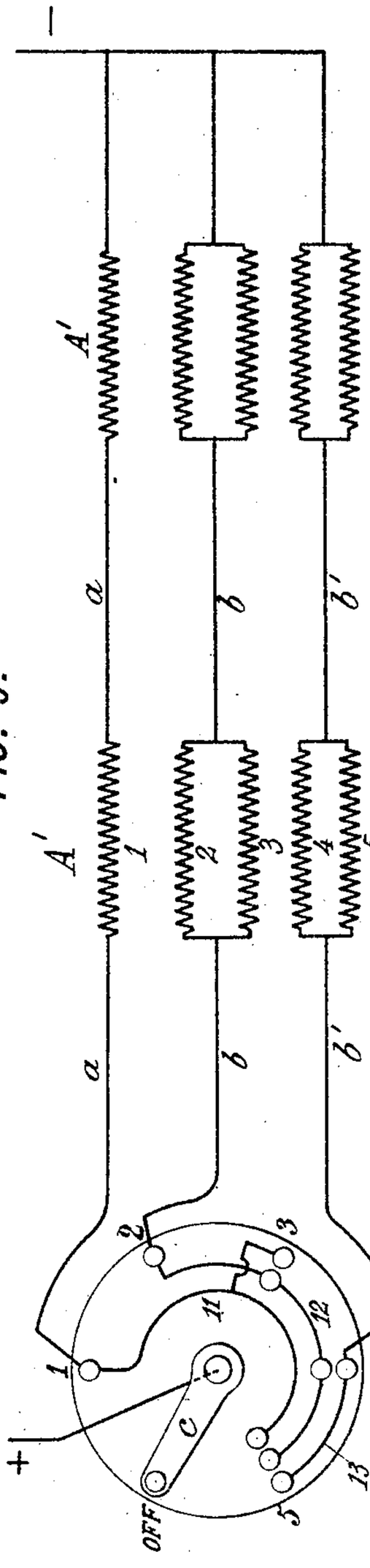

FIG. 10.

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UNITED STATES PATENT OFFICE.

EDWARD E. GOLD, OF NEW YORK, N. Y.

MEANS FOR CONTROLLING ELECTRIC HEATERS.

SPECIFICATION forming part of Letters Patent No. 639,170, dated December 12, 1899.

Application filed March 10, 1897. Serial No. 626,750. (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 Switches for Controlling Electric Heaters, of which the following is a specification.

This invention relates to switches or controllers for electric heaters having a multiplicity 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 the controller and three heaters with their circuit connections. Figs. 2 and 3 are sections on a large scale of the switch or controller, Fig. 2 being a section on the line 2 2 of Fig. 3 and Fig. 3 a transverse section on the line 3 3 in Fig. 2. Figs. 4 to 7 are diagrams showing the four different positions of the switch. Fig. 8 shows a modified switch. The preceding figures show a switch adapted for heaters having three coils. Figs. 9 and 10 show the switch or controller as adapted for heaters having, respectively, five and six coils.

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 in Fig. 2 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 heating 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 may be introduced one or more electric heaters. In case of a plurality of heaters their coils numbered 1 are all connected in series on the wire *a*, and their coils 2 and 3 are 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 diagram Fig. 8, 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 0 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 connected 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 de-

termined 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.

The simple switch shown in Fig. 8 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. I have adopted the mechanical features of one switch which is well known upon the market in connection with the electrical grouping which is peculiar to my invention, the result being the production of the switch shown in Figs. 2 to 7, which I will now explain.

In Figs. 2 and 3, E is a base of porcelain or other insulating material in the center of which is fixed a bushing *e*, through which turns a spindle *f*, having a knob *g* fastened on its outer end and being formed with an enlargement *h*, having screw-threads of steep pitch. At each side of these threads is a block or hub *i*, having ratchet teeth or projections *j* on its lower side, which engage fixed ratchet teeth or notches formed in the upper face of a disk or flange *k*, preferably formed integral with the bushing *e*, and thereby fastened immovably to the base E. A spring *m*, preferably coiled around on the spindle, is engaged at one end by a pin *m'* on the spindle and its other end engages a pin or post *i'* on the block *i*. In operation the turning of the knob *g* compresses the spring and increases its forward thrust upon the block, while the screw-threads *h* gradually lift the block until finally they raise its teeth *j* sufficient to free them from the ratchet-teeth *k*, whereupon the block flies forward under the impulse of the spring, at the same time running down the screw-threads *f*, and hence traveling downward or backward, so that its teeth *j* are in the plane of the ratchet-teeth *k*, and completing a quarter-revolution they again abut upon these fixed ratchet-teeth, and the block is thereby stopped. Thus each time the knob *g* is turned a quarter around power is first stored up in the spring and the block *i* is then released and flies forward a quarter-revolution. A disk F, of insulating material, is carried by the block *i* in its rotative movements, but does not participate in the axial movements of the block, due to the screw-threads *h*. To this end the block is shaped, for example, as shown by dotted lines *i* in Fig. 2, being flattened on opposite sides and fitting a socket in the disk of like shape, so that it may move in axial direction in said socket without moving the disk, but in its rotative movements shall carry the disk with it. Consequently the disk is caused to execute a rapid quarter-revolution each time the knob is turned.

The disk F carries three conducting-blocks *n n* of metal. These are conveniently arranged radially, as shown in Fig. 2, by being passed through a deep flange on the disk, which flange alone is in section in Fig. 2. Inside this annular flange is fixed a conducting-strip of preferably spring metal *p*, so that as the conducting-blocks are carried around by the revolving movement of the disk their inner ends rub against this strip. Outside of the disk are placed four equidistant spring-contacts or metal brackets *q*, *q'*, q^2, and q^3, the latter being a blind contact, which may be omitted, if desired. 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 conducting-strip *b* extends for approximately half the circumference, so that when the switch is in the position shown in Fig. 2 this strip forms an electric communication between the three blocks *n n*. The result of this arrangement is shown in Figs. 4 to 7. In the position shown in Fig. 4 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 (shown in Fig. 5) one block *n* touches the opposite contact q^2, and consequently the current flows from the former contact through the first block, then around through the strip *p* and through the second block to the contact q^2, and thence by wire *a* to a coil No. 1 of the heater. This corresponds to position No. 1 in Fig. 8. In the next forward movement the switch is brought to the position shown in Fig. 6, wherein the upper block *n* touches the contact *q* and the right-hand one touches the contact *q'*, so that the current entering at the former passes through the intermediate strip *p* and passes out at the latter to the wire *b*, and hence to the two coils Nos. 2 and 3 of the heater. This answers to position No. 2 in Fig. 8. In the next position, which answers to No. 3 in Fig. 8 and which is shown in Fig. 7 and also in Fig. 2, all three of the blocks *n* are in contact with all three of the contact-pieces *q*, *q'*, and q^2, so that the current enters by the upper block, passes around by the strip *p*, and divides, part passing through the right-hand block to the contact *q'*, and thus by wire *b* to coils Nos. 2 and 3, while part passes by the lower block and contact q^2 to wire *a*, and thus to coil No. 1, so that all three coils of the heater are in circuit.

The switch is provided with an inclosing shell or casing *r*, having at one side an opening *r'*, through which may be seen marks on the disk F indicating the position of the switch—as, for example, in Fig. 1 the figure "2" is visible, indicating that the switch is in the position shown in Fig. 6, where two coils

are in circuit. The disk F is kept in place by being seated on one side against the raised flange of the ratchet *k* and at the other side by coming in contact with a flange *s* or other annular projection or guiding-surface formed on the interior of the cap.

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 diagram in Fig. 9, 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. 8, 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. 10 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 number 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, 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 3 are an example) is within the principle of my invention.

I make no claim in my present application to the system of controlling electric heaters which is hereinbefore explained, as this system forms the subject of an application filed November 9, 1899, Serial No. 736,320, which constitutes a division of my present application. My present application is designed to cover the switch or controller for use in such system or for analogous uses. This controller is applicable for giving three degrees of heat by four equal movements of the switch in a complete revolution or for giving other numbers of gradations by correspondingly different numbers of movements in a complete revolution.

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

1. A rotary switch for controlling electric heaters movable to a plurality of positions by equal fractions of a complete revolution, comprising a plurality of stationary contact-terminals less in number than said movements, spaced apart at angular intervals equal to the

extent of such movements, and adapted for connection with a main and a plurality of branch circuit-conductors, combined with a rotary part having contacts angularly arranged relatively the same as said stationary terminals, so that in one position the rotary and stationary contacts coincide, said rotary contacts connected electrically so that when touching the stationary terminals they establish electrical connection between the terminals so touched, whereby the switch in different rotative positions connects the main-circuit terminal with none, one, another, or with two or all said branch-circuit terminals.

2. A rotary switch for controlling electric heaters, movable to four positions, comprising three stationary contact-terminals arranged at intervals of ninety degrees apart, and adapted for connection with a main and two branch circuit conductors, and a rotary part bearing three contacts arranged at intervals ninety degrees apart, and adapted to touch said stationary terminals, whereby in four successive positions the movable contacts connect the stationary main terminal first with one only of the stationary branch terminals, second with only the remaining branch terminal, third with both said branch terminals, and fourth with neither thereof, said movable contacts being operatively connected electrically together, substantially as set forth.

3. A controlling-switch for an electric heater comprising a rotatable member, conducting-pieces carried thereby, a stationary conductor rubbed by said pieces and connecting two or more of them together according to their positions, and three (or more) stationary contact-terminals touched by said pieces and connected respectively to the main conductor and to two or more wires leading to the resistant conductors of the heater.

4. A controlling-switch for an electric heater comprising a rotatable member F, conducting-pieces $n\ n\ n$ carried thereby, a stationary conductor p rubbed by said pieces and adapted to touch all of them in one position, and stationary contact-terminals q, q' and q^2 adapted for connection respectively with the main conductor and the branch wires leading to the heater.

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

EDWARD E. GOLD.

Witnesses:

THOMAS F. WALLACE,

FRED WHITE.