No. 729,771. PATENTED JUNE 2, 1903.

T. J. JOHNSTON.

ELECTRIC HEATER.

APPLICATION FILED FEB. 11, 1899.

NO MODEL.

Fig. 1.

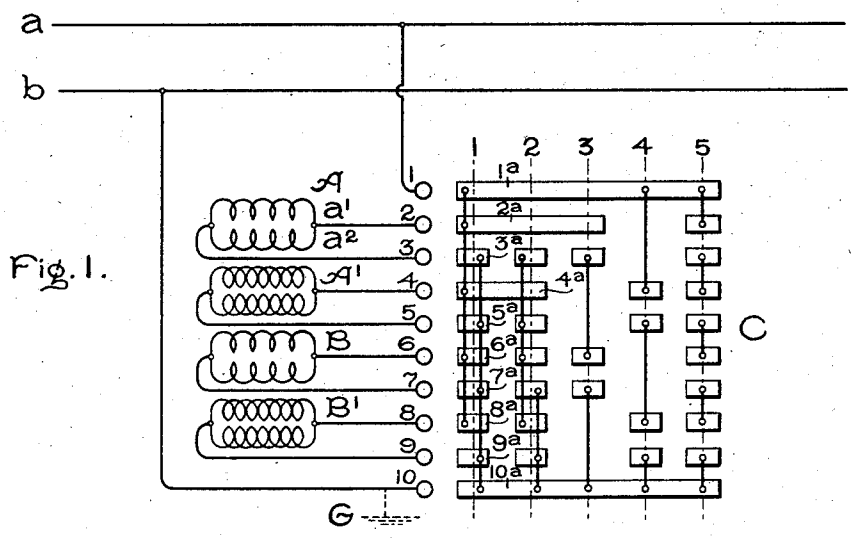
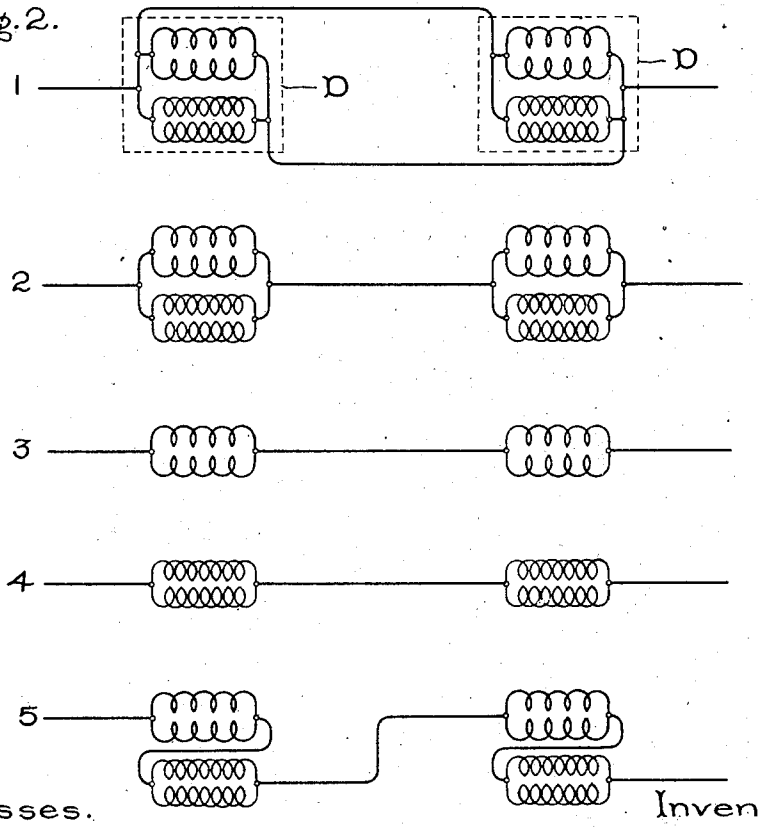


Fig. 2.



Witnesses.

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No. 729,771. Patented June 2, 1903.

UNITED STATES PATENT OFFICE.

THOMAS J. JOHNSTON, OF SCHENECTADY, NEW YORK, ASSIGNOR TO THE GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC HEATER.

SPECIFICATION forming part of Letters Patent No. 729,771, dated June 2, 1903.

Application filed February 11, 1899. Serial No. 705,246. (No model.)

To all whom it may concern:

Be it known that I, THOMAS J. JOHNSTON, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Electric Heaters, of which the following is a specification.

The present invention has relation to electric heaters, and has for its object to lessen the energy consumed in these heaters under certain conditions and to provide simple and efficient means by which the degree of heat may be regulated with precision. It also is so arranged that although employing coils in the usual way it obviates a difficulty arising from this construction with alternating currents.

Where alternating currents are used with heaters which have a number of coils, considerable inductance is created which adds to the objectionable features of the motor-load. For instance, in an alternating-current railway the inductive character of the load is such as to have detrimental effect on the distribution system, cutting down the voltage and making it difficult to run with efficiency. Under these conditions every effort should be made to lessen the inductive character of the load. Where heaters with coils are used, this would add, as already pointed out, to the difficulty; but by my invention the trouble is at least to some extent obviated. For each part of the heater I wind two coils, one of which is wound or connected in the reverse sense to the other, so that their magnetomotive forces are opposed, and thus to a considerable degree I cut down the inductance. In addition I arrange in each heater two sets of coils, one comparatively large and the other of less heating capacity, and I provide a switch by which the coils in any desired or convenient number of heaters may be connected in various relations to obtain the desired effect.

In the particular embodiment of the invention which I have diagrammatically illustrated certain definite numbers are chosen. This is for convenience of illustration, and any number of heaters or coils in each heater may be employed in the way pointed out.

The drawings annexed show in diagram combinations according to my invention, Figure 1 showing a switch connected across the mains designed to effect the combinations of the heaters, and Fig. 2 is a series of diagrams, showing the circuit combinations.

In Fig. 1, *a b* are mains which may be assumed to carry alternating current. C is the switch for connecting the heater-coils and the heaters in different combinations. A A′ are the coils of one heater and B B′ those of another. As indicated by the character of the lines in the diagram, the set of coils A is of greater capacity than A′. One half a' of the coils A is wound in reverse to the other half a^2, a similar construction being adopted with all the sets of coils. It is of course to be understood that the coils are so associated in inductive relation upon their support that their magnetomotive forces will oppose one another and cut down the self-induction of the winding where alternating currents are fed to it. Ordinarily the support is non-magnetic in character; but this need not necessarily be the case.

The switch C is provided with brushes or stationary contacts 1 to 10. The moving contacts (the switch being assumed to be cylindrical and developed in plane) are correspondingly marked 1^a, &c. There are five positions of the switch corresponding, respectively, to the circuit combinations shown in Fig. 2, numbered 1 to 5. The first combination is as shown in Diagram 1 of Fig. 2 and is effected by turning the switch so that the brushes rest upon the first row of contacts 1^a to 10^a. Current passes from contact 1 through the coils of the set A in the first heater to contact 3^a. A cross connection passes from contact 1^a to contact 4^a, thus passing current through the set of coils A′. A cross connection also supplies contact 6^a with current, and the current passes through the coils B of the second heater to contact 7^a. Similarly the contact 8^a is energized from a cross connection, passing current through the second set of coils B′ of the latter heater, thence passing to contact 10^a and brush 10. In a two-wire system this brush would be connected, as shown, to the main *b*, or, as shown in dotted lines, it might be grounded at G, where a ground return is used. This, as will be seen from the diagram, cou-

ples all the coils in both of the heaters in parallel. Of course the coils being of different resistances the current flow in the various paths in multiple would be proportioned in the usual way to the different resistances. This is the maximum heat-generating position of the switch and would be used for as long a time as is necessary to bring the space to be heated to the desired temperature, though under ordinary conditions it is unnecessary to maintain the coils in parallel, and the current flow may be cut down to just that required to keep the temperature at the desired point. For instance, in the second position of the switch (the connections of which it will be unnecessary to trace in full, as they are evident from the drawings) the two heaters would be connected in series, while their coils would be in multiple, as shown in Diagram 2 of Fig. 2. This of course would generate a less heat. Still a third combination is shown in Diagram 3, in which the coils of greater heating capacity are coupled in series and those of less capacity are cut out. A fourth is that in which the coils of less capacity are connected in series and those of greater capacity cut out, as in position 4 of the switch, while in position 5 all of the coils are connected in series, thus cutting down the current to the greatest possible degree. The use of the particular type of switch will be readily apparent. For instance, in mild weather before the car goes out the heaters would be connected as in diagram No. 1 of Fig. 2 until the car should be warmed to the desired point and then the switch would be turned to the last position, which would maintain a gentle warmth, while if the weather were severe one of the intermediate positions would be used to compensate for the increased loss of heat.

Of course while the electric car is the most obvious application of the device it might be used in any position in which an electric heater was necessary or desirable.

In the first diagram in Fig. 2 the dotted lines D indicate a case for the heater. So far as I am aware it is new to provide not only the coils of different capacity of different heaters, which may be connected in various ways, but separate heaters, which, in conjunction with their coils of different capacity, may be shifted into various combinations of series and parallel to vary the degree of heat which may be required.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The combination with a plurality of resistance devices, each consisting of coils of different current capacity, and a switch which first connects said devices in parallel, then connects them in series, then connects the coils of greater current capacity in series and cuts out the coils of less current capacity, then connects the coils of less current capacity in series and cuts out the coils of greater capacity, and finally cuts all the coils in series to obtain the lowest heating effect.

2. The combination with a plurality of electric resistance devices adapted to be traversed by alternating currents, each device comprising portions of different current capacity, and each portion of a given capacity consisting of coils wound in opposite directions in inductive relation with respect to each other on their supports; of a switch controlling all the coils of all the devices to obtain a large number of resistance effects.

3. In an electric heating system, a number of separate heaters, each containing coils of different current capacities, and a switch arranged to connect both heaters and coils in parallel or series to obtain various heating effects.

4. In a system of electric heating, a number of separate heaters, each containing different sets of coils of different current capacities, each of the sets of coils having some of its members wound to generate magnetomotive forces opposing those generated by the other coils of the same set, with a switch for connecting both sets of coils and heaters in various combinations of series, series parallel or parallel, to generate different amounts of heat as desired.

In witness whereof I have hereunto set my hand this 9th day of February, 1899.

THOMAS J. JOHNSTON.

Witnesses:

B. B. HULL,

EDWARD WILLIAMS, Jr.