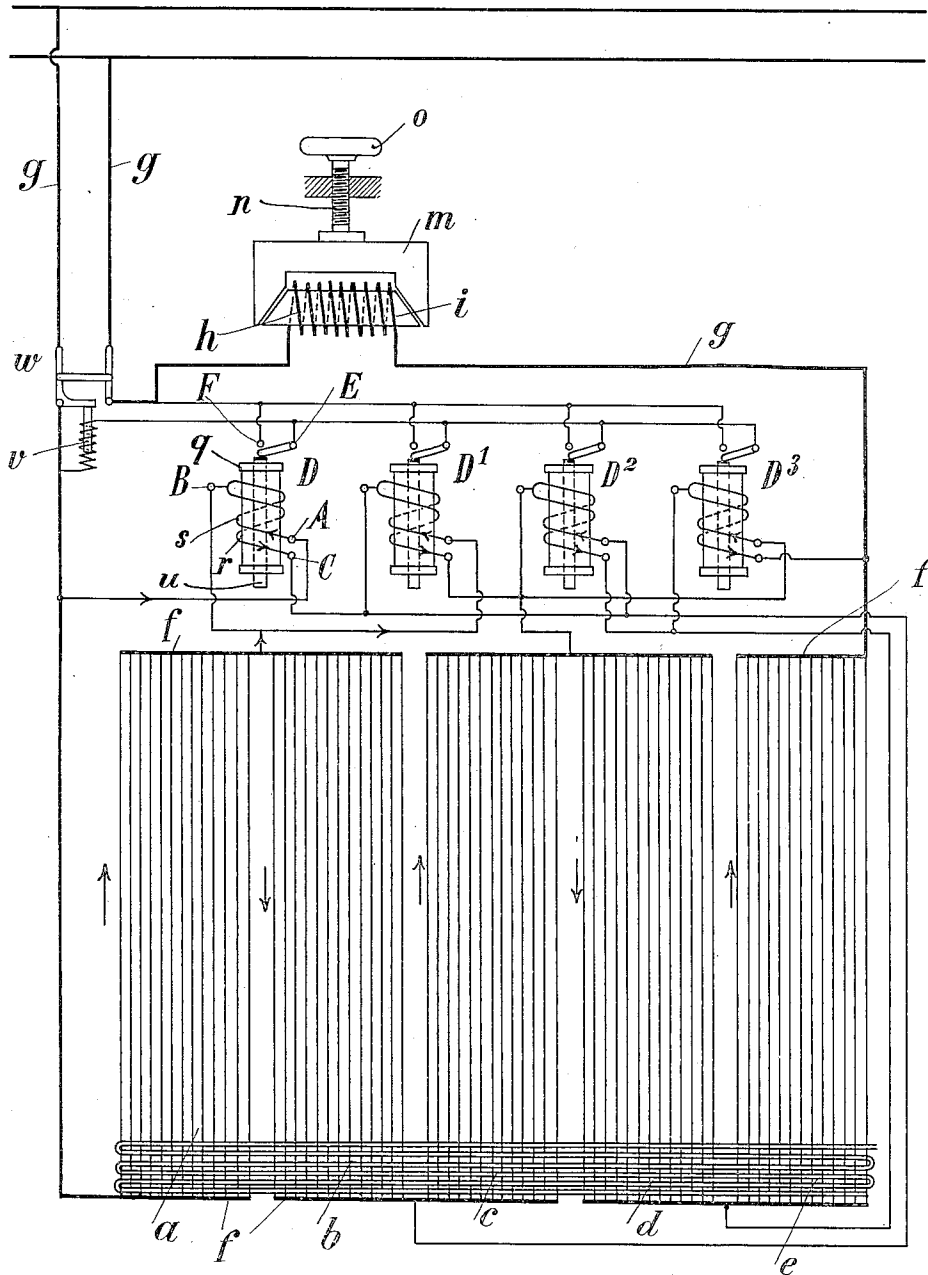


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ELECTRICAL HEATING APPARATUS.
APPLICATION FILED FEB. 25, 1907.

919,402.

Patented Apr. 27, 1909.



Witnesses

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ELECTRICAL HEATING APPARATUS.

No. 919,402.

Specification of Letters Patent.

Patented April 27, 1909.

Application filed February 25, 1907. Serial No. 359,278.

To all whom it may concern:

Be it known that I, WILHELM ERNST TRÜMLER, a citizen of the Swiss Federation, residing at Casinostrasse 20, Zurich, Switzerland, have invented certain new and useful Improvements in Electrical Heating Apparatus, of which the following is a specification.

This invention relates to an electrical heating apparatus in a woven form, consisting of non conductive textile woof and wholly or partially of heating wire for the warp threads, which are suitably arranged for connection to a source of alternating current supply. The warp is divided into elements, each one of which consists of several parallel heating wires, the ends of which are electrically connected together. The elements are connected together in series to divide the total voltage into equal parts corresponding to the number of elements so that on interruption of the current in a wire of one element, only the voltage of the element in question acts as the difference of potential in the broken heating wire. Such a heating arrangement can therefore be connected to a lighting supply of 100 to 250 volts and by the sub-division into a number of elements the total pressure may be divided into part pressures of 5 to 50 volts, which with the small section and the consequent low current in a heating wire, cannot on the breakage of a wire create a dangerous arc and ignite the textile threads. In the main lead there is inserted a regulating arrangement in the form of a choking coil with variable air gap by which the heating effect of the heating wires can be varied without appreciable loss of energy. Furthermore differential coils with two windings traversed by the current in opposite directions are connected to the heating wires so that on disturbance of the equilibrium of the partial pressures, created by breakage of a wire, short circuiting, etc., the cores are magnetized and may actuate circuit breakers inserted in the supply conductor.

In the accompanying drawings a diagrammatic view of the invention is shown.

Five elements *a*, *b*, *c*, *d* and *e* are here arranged one beside the other as an example. The separate wires of each element are connected together at both ends by cross wires *f*, while the elements themselves, by suitable connection of the cross wires *f* are connected in series to a feed wire *g*. In the feed wire *g*

is inserted a regulating apparatus in the form of a choking coil. This consists of a coil *h* inserted in the supply conductor *g*, which coil surrounds an iron core *i* consisting of the well known arrangement of iron plates insulated one from the other in order to avoid eddy currents. Above the coil *h* and the core *i* is provided a yoke piece *m* which is also constructed of iron laminations insulated one from the other. With this yoke piece is connected a screw spindle *n* directed upward, which spindle can be actuated by means of a hand wheel *o*. By rotating the hand wheel *o* the air space between the limbs of the magnet yoke *m* and the ends of the core *i* can be increased and the current strength in the coil *h* and consequently in the supply conductor *g* also increased, while in the opposite case by reducing the air space between the magnet yoke *m* and the core *i* the current strength in the coil *h* and in the supply conductor *g* is reduced. By this means the heating effect may be varied within the widest possible limits without a large loss of current.

In order to cut off the current when differences occur in the ordinarily equal part-voltages, due to disturbances in the heating wires, such as short circuits, differential coils *D*, *D'*, *D''*, *D'''* are provided which act on a cut-out. A suitable differential coil consists of a coil *q* which is vertically secured. On the coil *q* are provided two windings *r*, *s*, in the same direction of thin copper wire, arranged in such a manner that the separate turns of both windings lie next each other. The winding *r* is connected at one end to the terminal *C* and at the other end to the terminal *B*, and the winding *s* to the terminals *B* and *A*. The terminal *A* is connected to the lead *g* before the element *a*, the terminal *B* between the elements *a* and *b* on the corresponding cross wire *f* and the terminal *C* between the elements *b* and *c* on the corresponding cross wire *f*, so that between the terminals *A* and *B* the same voltage exists as between the ends of the element *a*, and in the same way between *B* and *C* the voltage between the ends of the element *b*. As the number of turns of the two windings *r* and *s* are equal, their resistances are also equal; the currents which flow through the windings *r* or *s* are therefore proportional to the difference of potential between the ends of the element *a* or between the ends of the element *b*. As long as the heating fabric is not damaged these differences of potential are alike and

consequently the currents are equal in the windings r and s . Now as will be seen from the drawing the currents in the two windings r and s flow in different directions and neutralize each other. If an interruption takes place in the element a , for example by the breaking of one or more heating wires, then the resistance in this element increases, the difference of potential between the ends of this element is consequently increased and also that between the terminals A and B so that the winding s has a stronger current flowing through it than the winding r . The action of the currents in the coil is now no longer neutral, but a magnetic field is created attracting the yoke u , which closes a contact between the terminals E and F. By making this contact a subsidiary circuit is closed which by means of a solenoid v actuates the cut-out w . The whole of the current is thereby cut off and damage to the heating fabric by over heating is avoided. The other three differential coils D^1 , D^2 and D^3 , which are connected to the wires f of the other elements, work in the same way as the coil D . Any danger by fire to the heating fabric is excluded by the use of the differential coils.

In the case of slight damage to the heating fabric this is remedied by the current in the feed conductor and in the heating fabric being reduced by means of the choking coil to such an extent that the difference of the part potentials arising from damage to heating wires, is not able to actuate the core of the differential coils and cut off the current.

In long fabrics the warp can be separated into different elements by means of cross wires running in the direction of the woof, without anything being altered in the method of connecting up.

The use of differential coils for actuating cutouts is also possible with fabrics having woof heating wires, so that in case of a wire being broken the current is at once cut off and any arc formation is immediately extin-

guished. The fabric can also be embedded in linoleum or other material of a like nature.

What I claim as my invention and desire to secure by Letters Patent is:—

1. Electrical heating apparatus consisting of a woven fabric formed of a woof of textile threads and a warp comprising heating wires in groups the individual wires of which are all connected in parallel, connections between the groups placing them in series and end connections to a source of current.

2. Electrical heating apparatus consisting of a woven fabric formed of a textile woof and a warp comprising heating wires arranged in series connected groups of wires individually in parallel, connections to an alternating current supply and an adjustable choking coil in the circuit to regulate the heating current.

3. Electrical heating apparatus consisting of a woven fabric formed of a textile woof and a warp comprising heating wires arranged in series connected groups of wires in parallel, connections to a current supply and a differential coil in the circuit, connected to the groups, and means for breaking the circuit on the unbalancing of the currents in the differential coil, substantially as and for the purposes specified.

4. Electrical heating apparatus consisting of a woven fabric formed of a textile woof and a warp comprising heating wires arranged in series connected groups of wires in parallel, connections to an alternating current supply, an adjustable choking coil in the circuit, a differential coil connected to the groups and means for breaking the circuit on the unbalancing of the currents in the differential coil, for the purposes described.

In witness whereof I have hereunto set my hand in the presence of two witnesses.

WILHELM ERNST TRÜMLER.

Witnesses:

FRITZ LARRENCE,
JOSEPH SIMON.