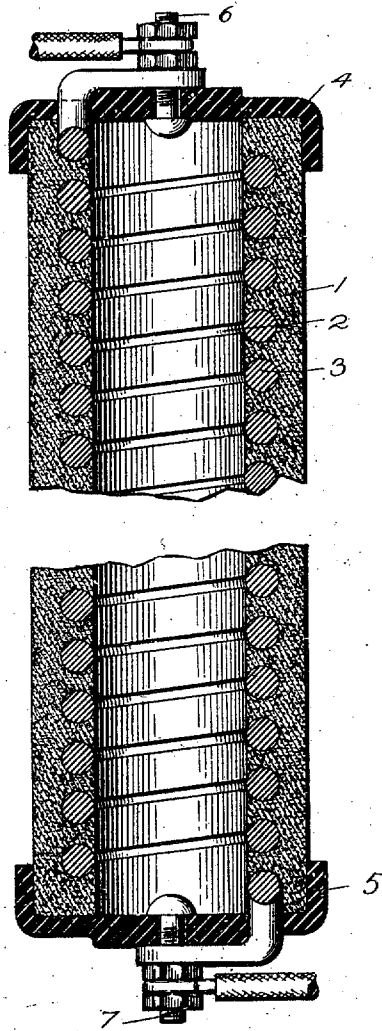


No. 869,314.-

PATENTED OCT. 29, 1907.

C. MACMILLAN.
RESISTANCE UNIT.
APPLICATION FILED DEC. 1, 1905.



WITNESSES.
W. Ray Taylor.
Allen Oxford

INVENTOR.
CAMPBELL MACMILLAN
by *Albert H. Davis*
Att'y.

UNITED STATES PATENT OFFICE.

CAMPBELL MACMILLAN, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

RESISTANCE UNIT.

No. 869,314.

Specification of Letters Patent.

Patented Oct. 29, 1907.

Application filed December 1, 1905. Serial No. 289,931.

To all whom it may concern:

Be it known that I, CAMPBELL MACMILLAN, a subject of the King of Great Britain, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Resistance Units, of which the following is a specification.

This invention relates to resistance units for electric circuits and has for its object the provision of a unit of this character which will be cheap and simple of construction, give a wide range of variation, which will withstand high temperatures and at the same time will have sufficient mechanical strength to render it safe and durable.

More specifically my invention has for its object the production of a resistance unit having a negative temperature coefficient and which is sometimes known as self-reducing resistance. Resistance units of this type are not new in the art but those produced up to the present time have usually had certain disadvantages. This type of resistance has been made both in the form of stick resistance and also in the form of a flexible conductor such as wire or ribbon. Both the flexible conductor and the stick resistance have their advantages and special uses and it is the object of my invention to combine these two forms into an automatic self-reducing resistance.

In carrying out my invention I provide a flexible conductor, preferably in the form of a spiral, and means for supporting the same in contact with a resistance material having a high negative temperature coefficient. At starting, when the unit is cold, the resistance of the unit is practically that of the spiral. As the unit heats up, however, the resistance of the material in contact with the conductor decreases and gradually short-circuits the turns of the conductor so as to automatically reduce the resistance of the unit. A unit of this character affords a wide range of adjustment, since the resistance of the metallic conductor, spacing and length of the turns may all be adjusted so as to produce the desired result. The path through the resistance of the second class from one turn of the metallic conductor to another is of comparatively large cross-section so that a very low final resistance of the material is not necessary. This construction also makes it possible to add to the mechanical strength of the stick.

In the accompanying sheet of drawings, I have shown one embodiment of my invention for purposes of illustration but it should be understood that I do not limit the invention to the particular construction or arrangement of parts shown or described, but consider my invention as broad as the scope of the claims annexed to and forming a part of this application.

The single figure of drawing represents a longitudinal section of a device embodying my invention.

Referring to the drawing, 1 is a stick of resistance

material having a negative temperature coefficient and commonly known as self-reducing resistance, since its specific resistance decreases with increase of temperature. The particular material used constitutes no part of my invention and may be of any of the well-known substances having the necessary properties. Among these substances might be mentioned magnetite and silicon, the latter being either in the cast or molded form. This stick of material I have shown for purposes of illustration in the shape of a tube provided with a spiral groove 2 although it is obvious it is not essential that this groove be on the inside of the tube, or in fact, that it be grooved at all so long as it accomplishes the object of having the turns of the conductor in contact with the resistance stick. Within the groove 2 is a spiral conductor 3 which is preferably a resistance conductor capable of withstanding a comparatively high temperature. This conductor may be wound on a mandrel and the material molded around it or any desired means may be employed for bringing the conductor into intimate relation with the material. The ends of the tube are closed by means of caps 4 and 5 which may be of fiber or any desired material secured to the ends of tube. The ends of the conductor are brought out at opposite ends of the tube through these caps secured thereto by means of bolts 6 and 7 which form terminals for connecting the unit in circuit. It will be seen that when a current is passed through this unit its resistance will be practically that of the metallic conductor which may be adjusted as desired. As the conductor heats it raises the temperature of the surrounding material which gradually reduces in resistance and short-circuits the turns of the conductor. The final resistance of the unit will be that of the surrounding material at the temperature at which it is desired that it shall be used. The cross-section of the surrounding material being large, this temperature need not necessarily be high, as a very low final specific resistance will not be required. It will be seen that by making the conducting spiral of heavy, stiff material the strength of the stick will be substantially increased. Various other methods of constructing this resistance unit will suggest themselves to one skilled in the art. Of course, it is not essential that the spiral be on the inside of the tube, nor that a particular material, or the method of arranging the same be used, the important feature being the intimate relationship between the spiral conductor and a conductor of the second class whereby the latter short-circuits the former upon increase of temperature.

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

1. A resistance unit comprising a material having a negative temperature coefficient, and a resistance conductor embedded therein.

2. A resistance unit comprising a self-reducing resistance material, and a helical resistance conductor, the turns of said conductor being in electrical contact with said material.
- 5 3. A resistance unit comprising a material having a negative temperature coefficient, and a resistance conductor having a positive temperature coefficient embedded therein.
- 10 4. A resistance unit comprising a stick of material having a negative temperature coefficient and a helical resistance conductor, the successive turns of which are in electrical contact with said stick.
5. A resistance unit comprising a molded stick of self-reducing resistance material having an electrical resistance conductor embedded therein.
6. A resistance unit comprising a molded stick of material having a negative temperature coefficient and a helical resistance conductor, the successive turns of which are supported by said stick and in electrical contact therewith.
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In witness whereof, I have hereunto set my hand this 29th day of November, 1905.

CAMPBELL MACMILLAN.

Witnesses:

BENJAMIN B. HULL.

HELEN ORFORD.