

No. 829,174.

PATENTED AUG. 21, 1906.

E. SCHATTNER.
RESISTANCE UNIT.

APPLICATION FILED MAR. 31, 1904

Fig. 1.

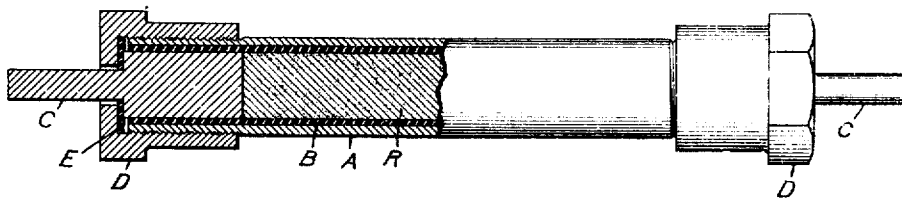
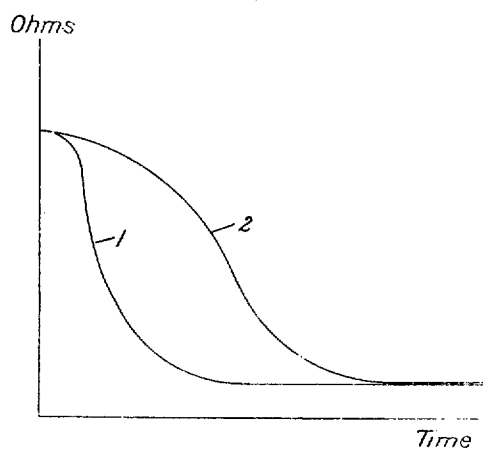


Fig. 2.



Witnesses:

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UNITED STATES PATENT OFFICE.

ERNEST SCHATTNER, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

RESISTANCE UNIT.

No. 829,174.

Specification of Letters Patent.

Patented Aug. 21, 1906.

Announcement filed March 31, 1904. Serial No. 200,881.

To all whom it may concern:

Be it known that I, ERNEST SCHATTNER, 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.

My invention relates to resistances for electric circuits; and its object is to provide a novel form of resistance unit which shall be simple, economical, and durable, which shall possess to a high degree the characteristics of reducing its ohmic resistance as it becomes heated, and which shall possess such rate of decrease as may be desired.

Certain substances possess a negative temperature coefficient resistance—that is, they decrease in ohmic resistance when heated. Such substances may be termed “self-reducing” resistances, particularly when the heat is the result of current traversing the substance. Certain substances possess this characteristic to such an extent that they may be used in place of hand-operated resistances in electric circuits where it is desirable that the resistance shall be great when current is first applied and shall then be gradually reduced. This is the case with the circuits of electric motors, and the use of such a material as a starting resistance for an electric motor is described in the application of C. P. Steinmetz for United States Letters Patent, Serial No. 44,067, filed January 21, 1901.

Among the substances possessing negative temperature resistance coefficients magnetite possesses the self-reducing characteristic to a marked degree and is thus particularly well suited for use as a starting resistance for electric motors and for similar purposes. In starting an electric motor it is desirable that the full-load current should be admitted to the motor at starting and that the resistance should decrease at such a rate that the full-load current will continue to flow through the motor while the motor is accelerating from rest to full speed.

I have discovered that pure magnetite reduces its resistance very rapidly, the result being that when pure magnetite is used too small a current is admitted to the motor for obtaining the maximum torque at starting, or if the resistance is reduced sufficiently to

secure proper starting-current the resistance of the magnetite decreases more rapidly than the counter electromotive force of the motor rises, and consequently too much current is admitted to the motor before it has reached full speed. I have found that the rate of decrease of resistance with magnetite may be varied by mixing with the magnetite other substances and that the rate of resistance decrease may be predetermined by the amount and nature of the substance incorporated with the magnetite. By this means I am able to improve the characteristics of a magnetite resistance. Furthermore, when magnetite is made up in stick form it cracks and disintegrates with frequent applications of current, and consequently makes bad contact and crumbles away. In order to secure durability, this source of depreciation must be guarded against. I avoid the tendency to disintegrate by forming the resistance from finely-pulverized magnetite and inclosing the same under compression in an airtight receptacle.

In the accompanying drawings, Figure 1 represents a self-reducing resistance unit formed in accordance with my invention, and Fig. 2 is an explanatory diagram.

Referring first to Fig. 2, 1 represents a curve, showing the rate of decrease of pure magnetite when traversed by an electric current. It will be seen that the slope of the curve is quite abrupt, and as a result the resistance decreases faster than is desirable with a motor starting under a load. Fig. 2 shows the rate of decrease of a resistance formed of magnetite mixed with a substance such as silicate—for example, mica. It will be seen that the slope of the curve is much less than that of curve 1, and as has been already said, the slope may be varied by varying the amount of silicate mixed with the magnetite.

In Fig. 1, A represents a metal tube lined with insulating material B, such as mica or asbestos. R represents the resistance material formed of finely-pulverized magnetite and finely-pulverized mica mixed in proper proportions to secure the rate of decrease desired. C C represent metal plugs, by means of which the resistance material may be compressed within the tube and which also act as terminals for the resistance unit. D D represent caps, tapped to be screwed onto

the tube A and to force the plugs C inward, compressing the resistance material. Caps D are insulated from the plug C by the mica washers E.

5 The process of manufacture is as follows: The magnetite and mica are finely pulverized and mixed in the desired proportions. The insulated tube is nearly filled with the mixture, the plugs C are then inserted at the ends
10 and forced inward by the caps D, thereby compressing the powdered resistance material into a compact mass. The resistance material as thus mixed and compressed possesses a very high resistance, acting as an insulator. In order to give the resistance material its proper characteristics, it is necessary that the tube be heated to a temperature at which the mixture softens, the particles both of the magnetite and silicate uniting
20 with each other producing a crystalline structure. This process is aided by connecting the tube while it is being baked to a source of current, so that as soon as the resistance drops sufficiently the current will pass through the material and heat it up considerably more than the heat applied from outside does. After that it is advisable to let the unit cool and thereupon apply a sudden and heavy current for a few seconds, thereby effecting what I believe to be crystallization of the material. The character of the slope in the curve of resistance changes with reference to time may be altered by changing the proportion of admixed materials. I have found that silicates, and especially those of a heat refractory nature, are good for my purpose, but do not limit the use to any particular material or compound, though, as a rule, they should be conductors
40 of the second class—that is to say, they should be non-conductors when cold. Magnetite is a conductor of the first class and partakes also of the nature of conductors of the second class. Therefore a compound of two such substances may be made having a wide range of resistance characteristics, and my invention comprehends a wide field of selection.

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

1. As a new article of manufacture, a resistance consisting of an insulated tube containing a mixture of a pulverized conductor of the first class with a pulverized conductor
55 of the second class, thereby effecting a resistance unit having a negative temperature-resistance coefficient.

2. As a new article of manufacture, a self-reducing resistance unit consisting of pulverized magnetite combined with a pulverized
60 conductor of the second class.

3. As a new article of manufacture, a re-

sistance unit consisting of a pulverized material having a negative temperature-resistance coefficient intimately combined with a flux. 65

4. As a new article of manufacture, a resistance unit consisting of pulverized magnetite intimately combined with a pulverized silicate.

5. As a new article of manufacture, a resistance unit consisting of an air-tight insulated tube containing a compound having a predetermined negative resistance gradient composed of two conductors having different temperature-resistance coefficients. 75

6. As a new article of manufacture, a resistance unit consisting of an air-tight insulated tube containing an intimately-related mixture of two conductors of the first and second class, respectively. 80

7. As a new article of manufacture, a resistance unit consisting of an insulated tube containing a pulverized material having a negative temperature-resistance coefficient combined with a flux and having terminal
85 plugs adapted to compress said material, and air-tight insulated caps adapted to press said plugs upon said material.

8. As a new article of manufacture, a resistance unit consisting of an insulated tube containing pulverized magnetite combined with a pulverized silicate and having terminal plugs adapted to compress said magnetite, and air-tight insulated caps adapted to press
95 said plugs upon said magnetite.

9. As a new article of manufacture, a self-reducing resistance unit consisting of pulverized magnetite combined with a flux.

10. As a new article of manufacture, a self-reducing resistance unit consisting of pulverized magnetite combined with a pulverized
100 silicate.

11. A self-reducing resistance material consisting of an agglomerate of a conductor having a negative temperature coefficient, and a refractory binder. 105

12. A self-reducing resistance material consisting of an agglomerate of a conductor having a negative temperature coefficient and a fluxing material of higher resistance. 110

13. A self-reducing resistance material consisting of a partially-welded agglomerate of a conductor having a negative temperature coefficient, and a refractory material having a higher resistance. 115

14. A resistance material consisting of a partially-welded agglomerate of magnetite and a silicate.

In witness whereof I have hereunto set my hand this 29th day of March, 1904.

ERNEST SCHATTNER.

Witnesses:

BENJAMIN B. HULL,
HELEN ORFORD.