

Sept. 27, 1932.

E. H. HORSTKOTTE

1,879,253

TELLURIUM RESISTOR FOR REFRIGERATORS

Filed March 3, 1930

Fig. 1.

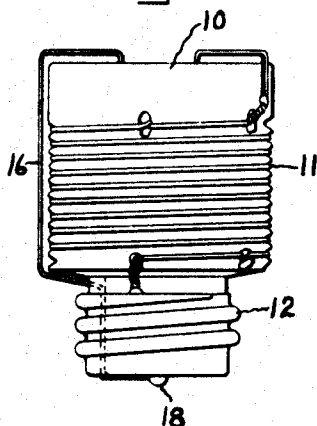


Fig. 2.

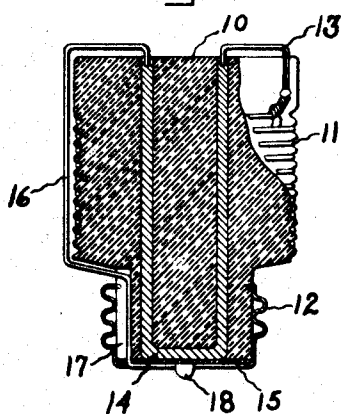
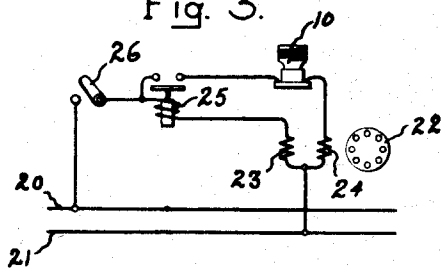


Fig. 3.



Inventor:
Edward H. Horstkotte
by *Charles E. Muller*
His Attorney.

UNITED STATES PATENT OFFICE

EDWARD H. HORSTKOTTE, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

TELLURIUM RESISTOR FOR REFRIGERATORS

Application filed March 3, 1930. Serial No. 432,720.

My invention relates to electrical resistors and provides an improved resistor of the so-called self-reducing type; that is, one which has such a high negative temperature coefficient that its initial resistance is reduced to a relatively low value when its temperature is raised as by the heating effect of a current passing therethrough. My present invention is an improvement over the device set forth and claimed in application No. 384,756, to Clifford A. Nickle, filed August 9, 1929, and assigned to the same assignee. This application has since matured to Patent 1,847,888.

In a device of this character it is highly desirable to have a unit which may be readily inserted in a circuit or removed therefrom so that replacement is made quite an easy process. Tellurium is an ideal material for a resistor having a negative temperature coefficient. Due to the inability to draw this material into a resistor wire with any degree of success, it has been found necessary to cast it within a mould such as a base of insulating material. The materials usually used for this purpose, however, permit the tellurium to heat up too rapidly. Porcelain was finally selected because due to its heat storage capacity it will absorb some of the heat which otherwise would tend to heat the tellurium and thus reduce its resistance too rapidly. It has been found however that when tellurium alone is used as a resistor, and is cast within a porcelain base, the tendency of the resistor is to still drop in resistance too quickly for many practical purposes. Again if the circuit in which the self-reducing resistor is placed is opened and immediately closed, if the resistor has a low value of resistance due to heat from current carried for an appreciable length of time, it will of course fail in its function of limiting the initial current through the circuit. Some means, therefore, is desirable for providing a minimum value of resistance for such a resistor. Another desirable feature of resistors of this type is compactness which means that the length of the resistor as well as its diameter should be of a minimum dimension.

It is a general object of my invention to

provide various improvements in a resistor of the self-reducing type.

An object of my invention is to provide a minimum value of resistance for a self-reducing resistor.

These and other objects will appear hereinafter.

In the preferred embodiment of my invention I provide a base of insulating material which supports a tellurium resistor within the base and a resistor of a substantially fixed value on the surface, the tellurium resistor and the fixed resistor being placed in series. The arrangement of the resistors upon the base results in a compact unit. A screw means is mounted upon the base making the device readily replaceable as a unit by being screwed into a socket cooperating with said screw means. The tellurium has a natural characteristic such that upon being heated by a current flowing therethrough the value of the resistance decreases. The purpose of the second resistor in series with the tellurium resistor is to provide a minimum value of resistance for the resistor unit.

My invention will be better understood from the following description when considered in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

Fig. 1 shows a side view of my invention; Fig. 2 shows a cross section thereof; Fig. 3 shows the application of my invention to a motor circuit.

Referring to Fig. 1 the resistor consists of a base 10 of insulating material provided with grooves therein in which the resistor 11 is wound. The base of the resistor is provided with the screw member 12 which will fit a screw socket.

In Fig. 2 it will be seen that the base 10 has provided therein a U-shaped passageway which is filled with a self-reducing resistor material such as tellurium. This self-reducing resistor element 14 is connected in series with the other resistor 11 by means of the member 13. The other end of the resistor 11 is connected to the screw threaded member 12, as shown in Fig. 1. The resistor 11 has a

substantially constant value under substantially all operating conditions. Thus, if due to a large current flowing through the tellurium resistor 14, its value should be decreased to a large extent, the minimum resistance of the resistor unit will always be greater than the value of the resistor 11 the value of which is substantially constant. It will be noted that by providing a U-shaped passageway within my insulating base 10, I provide a longer resistor unit of tellurium than could otherwise be obtained by merely using a single passageway through the resistor base 10 from end to end.

Connected to the button member 18 and insulated from the resistor 14 by means of the insulating element 15 is the element 16 connected to the other end of the resistor 14. A slot 17 in the member 10 permits the element 16 to pass by the screw member 12 without contact therewith. It will thus be seen that a circuit is completed from the screw member 12 through the resistor 11, connecting means 13, resistor 14, connecting means 16 to the button member 18. The screw member 12 and the button member 18 make this unit readily applicable to a socket.

In Fig. 3, the application of my invention to an electric control circuit for a motor is shown. It will be evident, of course, that my self-reducing resistor may be used in other circuits. In the circuit shown in Fig. 3, a split phase motor is provided with a starting winding 24, a running winding 23, and a rotor 22. The self-reducing resistor 10 is connected in series with the starting winding 24 to limit the starting current there-through. In series with the running winding 23 is the electroresponsive device 25 which provides a circuit through the starting winding to start the motor. The switch 26 is for the purpose of connecting the motor across the lines 20 and 21. Of course, when the switch 26 is closed, the running winding 23 and electroresponsive device 25 are simultaneously energized thus causing the electroresponsive device 25 to close its contacts to energize the starting winding 24 to start the motor. The combination of a resistor unit comprising a fixed resistance and a self-reducing variable resistance, and a split-phase motor as disclosed in Fig. 3, is not a part of my invention but is disclosed and claimed in a copending application of Christian Steenstrup, Serial No. 438,858, filed March 25, 1930, and assigned to the same assignee as the present invention.

In the operation of my device in the case of high or medium applied voltages, the value of the resistor is such that the current flowing through the starting winding is sufficient to start the motor but is still limited to a value which is not objectionable to cause flickering of the lights and the like. Thus, the units

provide a proper value of resistance in the case of normal and high applied voltages.

In the case of a low applied voltage, the current flowing through the starting winding may be insufficient to provide a starting torque to start the motor. As the current continues to flow through the resistor unit, the heat causes the resistance of the tellurium resistor 14 to reduce. This permits more and more current to flow through the starting winding until such a value of resistance is reached by the tellurium resistor that the resistor unit provides a resistance of such a value that a proper amount of current may flow therethrough to start the motor. It is understood that the above operation occurs quickly.

It will thus be seen that my device works equally well on low, high and normally applied voltages to provide a current which is not objectionable. The unit is compact and readily replaceable.

The embodiment of the invention illustrated and described herein has been selected for the purpose of clearly setting forth the principles involved. It will be apparent, however, that the invention is susceptible of being modified to meet the different conditions encountered in its uses and I, therefore, aim to cover by the appended claims all modifications within the true spirit and scope of my invention.

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

1. A self-reducing resistor unit for electric circuits having a base of insulating material provided with a passage therein, a tellurium resistor filling said passage, said base having relatively high heat storage capacity for preventing a rapid decrease in resistance of said tellurium when said resistor unit is in use, and a resistor of substantially constant value in series with said first tellurium resistor and supported on the outside of said base whereby the unit is limited to a predetermined minimum value of resistance.

2. A self-reducing resistor unit for electric circuits comprising a base of insulating material having a passage therein, a tellurium resistor filling said passage, said base having the characteristic of absorbing heat from said resistor to prevent rapid decrease in resistance when said unit is in use, a second resistor having a substantially fixed resistance in series with said tellurium resistor, said second resistor being supported on the outside of said base.

3. A self-reducing resistor unit comprising a base of insulating material having a passage therein, a tellurium resistor filling said passage, said base having heat storage capacity whereby a rapid decrease in resistance of said tellurium is prevented when said unit is in use, and a resistor of fixed value in series therewith and supported by said base, a screw

means for said unit removably supporting said unit within a screw socket, and electrical connecting means between said screw means and said resistors whereby when said unit is mounted within an electric socket said resistors will be electrically connected to said socket.

4. A self-reducing resistor unit comprising a porcelain base of relatively high heat storage capacity having a U-shaped passage therein, a tellurium resistor filling said passage, a resistor having a substantially fixed resistance supported on the outside of said base and connected in series with said tellurium resistor, a screw means for said unit for removably supporting said unit within a screw socket, and electrical connecting means between said means and said resistors whereby when said unit is mounted within an electric socket said resistors will be electrically connected to said sockets.

5. A self-reducing resistor unit comprising a base of insulating material, a tellurium resistor within said base extending from end to end of said base and of substantially U-shape the ends thereof terminating in the surface of said base at one end thereof, a resistor having a substantially fixed resistance supported on the outside of said base and connected in series with one end of said tellurium resistor for providing a minimum limit of resistance for said unit, a screw means mounted at the other end of said base in which said tellurium resistor terminates, said fixed resistor being connected to said screw means and a contact-making means mounted at the same end of said base with said screw means but insulated from said screw means and means for electrically connecting the other end of said tellurium resistor to said contact-making means.

In witness whereof, I have hereunto set my hand this 1st day of March, 1930.

EDWARD H. HORSTKOTTE.