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W. H. WOODFORD

REGULATING CONDUCTOR FOR ELECTRIC HEATERS

Original Filed Aug. 11, 1920

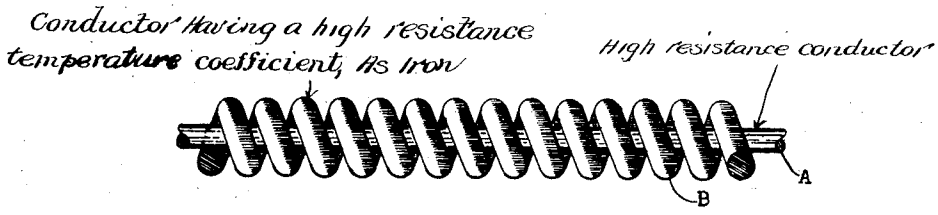


Fig. 1.

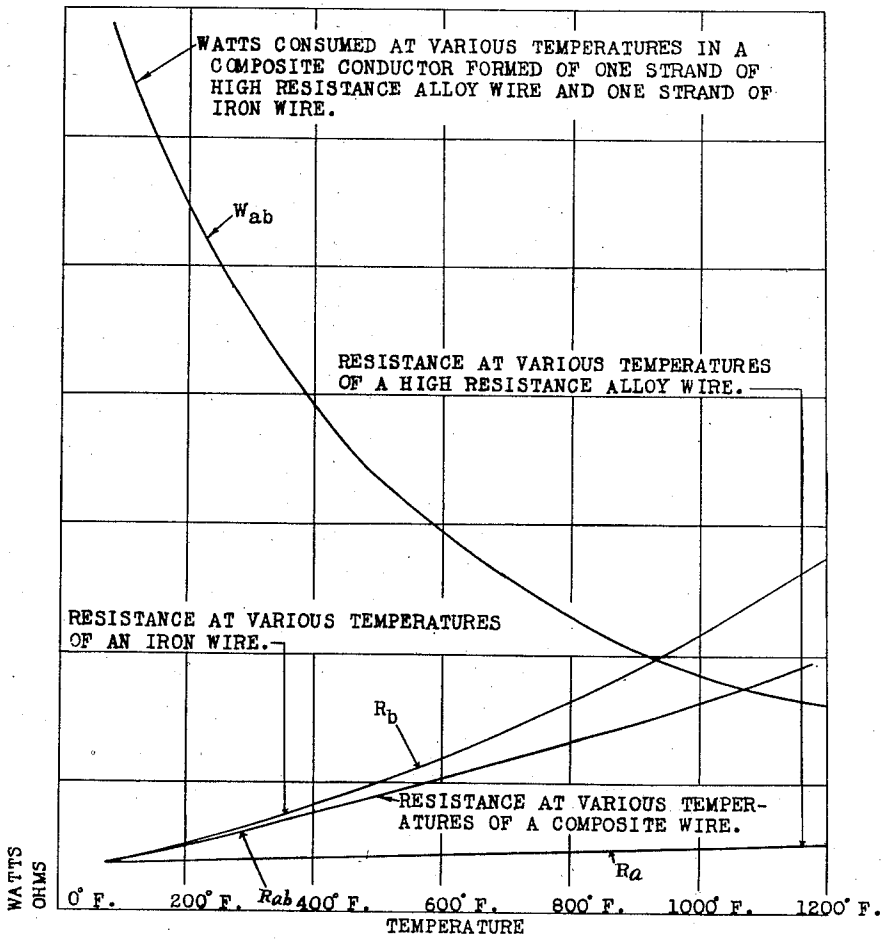


Fig. 2.

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UNITED STATES PATENT OFFICE.

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REGULATING CONDUCTOR FOR ELECTRIC HEATERS.

Application filed August 11, 1920, Serial No. 402,756. Renewed January 23, 1924.

To all whom it may concern:

Be it known that I, WATSON H. WOODFORD, a citizen of the United States, residing at Bridgeport, in the county of Fairfield and State of Connecticut, have invented certain new and useful Improvements in Regulating Conductors for Electric Heaters, of which the following is a specification.

This invention relates to electric heaters such as electric irons, soldering irons, water and room heaters, utensils, etc., and has for an object the provision of an improved conductor for such devices. A further object is to provide a conductor so constructed that the heat developed decreases with increase in temperature, whereby the heater is rapidly brought up to working temperature and this temperature is then automatically maintained.

Other objects and advantages will appear later.

Fig. 1 shows a section of conductor illustrating the invention and Fig. 2 shows graphically the characteristics of the conductor of the present invention as compared with the characteristics of other conductors.

It is desirable to so construct electric heaters that the resistance is relatively low at low temperatures but considerably higher at high temperatures. Such heaters will quickly come up to working temperature and will be automatically maintained at this temperature on account of the regulating effect of the conductor.

It has been proposed heretofore to secure this result by employing a heating conductor of iron which has a very high positive resistance temperature coefficient. These attempts were apparently unsuccessful because not enough space is available in such electrically heated devices to permit of the use of a sufficient length of the proper sized wire; this for the reason that the resistance of iron is quite low and its permissible working temperature is likewise low. Such high resistance alloys as nickel-steel, nickel-chromium, etc., have a negligible temperature coefficient and therefore cannot be used for regulation. In an application for United States Patent S. N. 402,276, filed August 9, 1920, by myself jointly with Herbert V. Leckie is disclosed a conductor consisting of an iron wire used in series with a high resistance conductor having a negligible temperature coefficient. Such a conductor will have sufficient regulating effect while also furnishing sufficient resistance to enable it to be used in the small space available.

After considerable experiment it has been discovered that an excellent conductor for this purpose can be made by using a high resistance conductor having a negligible temperature coefficient in parallel with a conductor having a high positive temperature coefficient such as iron. In the drawing the letter A indicates a high resistance conductor of any suitable material such as an alloy of nickel and steel or nickel and chromium or other alloy, while the letter B indicates a conductor having a high positive coefficient such as iron. While these conductors may be kept insulated with respect from each other, it has been found satisfactory to twist the conductors one upon the other. As a greater length of iron wire is usually needed the iron wire may be coiled upon the alloy wire as shown. Although this would seem to make the two conductors in effect a single conductor it has been found that they obey the well-known laws of shunt circuits. This is probably due to the fact that the electrical potential between the two conductors at any point is negligible, particularly when the pitch of the coil is constant throughout its length. Referring to Fig. 2 the curve R_a indicates graphically the change of resistance of a conductor of high resistance material as the conductor A through a temperature range of from about 75° Fahr. to 1200° Fahr. From this it will be seen that the resistance increases somewhat with temperature but that this effect is quite negligible, amounting to only about 45% over the entire range. The curve R_b shows the change of resistance of an iron wire over the same temperature range amounting to about 650%. The curve R_{ab} illustrates the change of resistance over the same temperature range of a conductor made according to the present invention and consisting of the conductors A and B in parallel. The dimensions of the conductors have been so chosen that their resistance at normal temperatures is the same, as is apparent from the curves. The increase in resistance is about 360%. It is less than that of iron taken alone but greatly in excess of the resistance increase of the alloy taken alone. This increase has been found quite sufficient for regulating purposes and not so excessive

as to cause too large a current flow when the heater is cold.

The curve W_{ab} shows the variation in watts consumed by the composite conductor at various temperatures, showing a rapid decrease in higher temperature.

An important advantage inherent in this construction is the fact that the conductor is continuous and it is not necessary to form joints in the conductor within the heater. Such joints are difficult to make and frequently cause short circuits and other troubles in the use of the heater. A further advantage is that this composite conductor can be made up in any quantity and later cut off in suitable lengths to be incorporated into the heater. By coiling the one upon the other, as shown, the proprtionate length and thickness of the wires can be varied to suit requirements. However, when once wound the proportion of the lengths of the two types of conductor is fixed and will be the same for any length. Thus it will be a simple matter to provide each heater with just the correct length of each kind of wire which is of great importance where such heaters are made in large quantities.

With one wire wound upon the other the two are in close thermal relation. At the working temperature the alloy wire develops nearly all the heat developed in the heater. The iron wire is therefore vary near the heat source which results in particularly responsive regulation. Another advantage is that a much greater area is available for dissipating the heat.

While winding one wire upon the other has been found to have many advantages it is to be noted that other ways of carrying out the invention may be employed and these are intended to be comprehended within the meaning and range of equivalency of the following claims:—

1. A heating conductor for electric heaters comprising a high resistance conductor having a low resistance temperature coefficient and a conductor in parallel therewith having a high positive resistance temperature coefficient.

2. A heating conductor for electric irons comprising a high resistance conductor having a low resistance temperature coefficient and an iron conductor in parallel therewith.

3. A heating conductor for electric heaters comprising a nickel steel conductor and a conductor in parallel therewith having a high positive resistance temperature coefficient.

4. A heating conductor for electric heaters comprising a nickel steel conductor and an iron conductor in parallel therewith.

5. A heating conductor for electric heaters comprising a high resistance conductor having a low resistance temperature coefficient and a conductor in parallel therewith having a high positive resistance temperature coefficient, one of said conductors being coiled upon the other.

6. A heating conductor for electric heaters comprising a high resistance conductor having a low resistance temperature coefficient and a conductor in parallel therewith having a high positive resistance temperature coefficient said last named conductor being coiled upon the first named conductor.

7. A heating conductor for electric heaters comprising a high resistance conductor having a low resistance temperature coefficient and a conductor in parallel therewith having a high positive resistance temperature coefficient, one of said conductors being coiled upon the other, the pitch of said coil being constant.

8. A heating conductor for electric heaters comprising a high resistance conductor having a low resistance temperature coefficient and a conductor in parallel therewith having a high positive resistance temperature coefficient said last named conductor being coiled upon the first named conductor, the pitch of said coil being constant.

In witness whereof I have signed my name hereto this 6 day of Aug., 1920.

WATSON H. WOODFORD.