July 22, 1930. H. PENDER 1,771,056

ELECTRICAL RESISTANCE CONSTRUCTION

Filed June 24, 1927

Fig. 1.

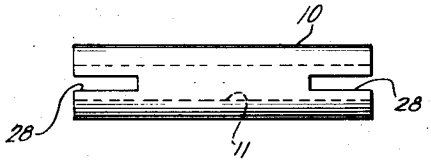


Fig. 3.

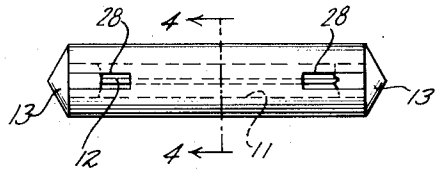


Fig. 2

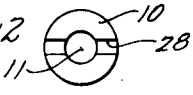


Fig. 4.

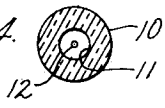


Fig. 5.

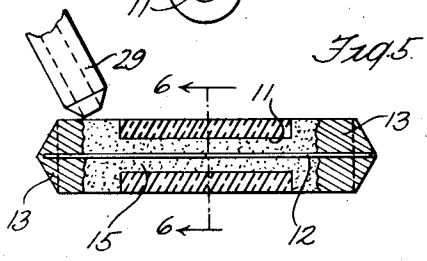


Fig. 7.

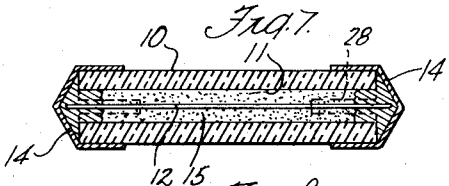


Fig. 6

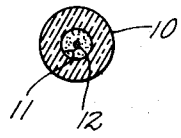


Fig. 8.

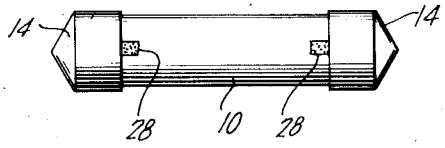
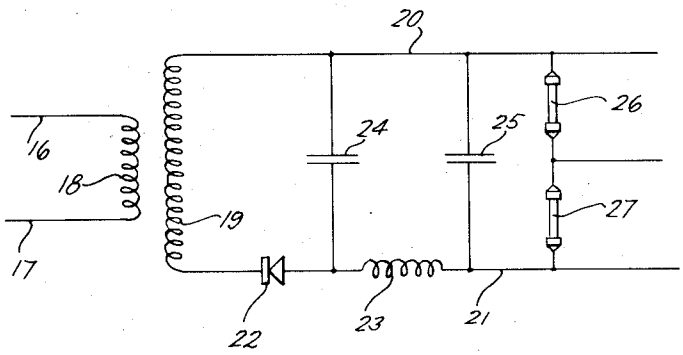


Fig. 9.



Harold Pender INVENTOR

BY

Robert S. Blair ATTORNEY

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UNITED STATES PATENT OFFICE

HAROLD PENDER, OF MERION, PENNSYLVANIA

ELECTRICAL RESISTANCE CONSTRUCTION

Application filed June 24, 1927. Serial No. 201,079.

This invention relates to the construction of electrical resistance devices. One of the objects thereof is to provide a device of the above nature which is practical and efficient in operation. Another object is to provide a device of the above nature capable of affording a high electrical resistance and particularly well adapted for use in apparatus employed in connection with radio receiving equipment. Another object is to provide a device of the above nature which is capable of carrying substantial loads and dependably withstanding severe usage. Another object is to provide a device of the above nature which is simple in construction and inexpensive to manufacture. Another object is to provide a practical art of making resistance devices of the above nature which may be carried on conveniently and with inexpensive apparatus. Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, arrangements of parts and in the several steps and relation and order of each of the same to one or more of the others all as will be illustratively described herein, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawing in which is shown one of the various possible embodiments of the mechanical features of this invention,

Figure 1 shows one member of the resistance device at an early stage in the process of manufacture;

Figure 2 is an end view of Figure 1;

Figure 3 shows the resistance device at a later stage in its manufacture;

Figure 4 is a transverse section taken as indicated by the line 4—4 in Figure 3;

Figure 5 is a longitudinal section showing the resistance device at a further stage toward completion;

Figure 6 is a section taken as indicated by the line 6—6 in Figure 5;

Figure 7 is a longitudinal section through a completed resistance device;

Figure 8 is an elevational view of the completed device, and

Figure 9 is a diagrammatic representation of an electric circuit in which the resistance device is employed.

Similar reference characters refer to similar parts throughout the several views of the drawing.

Referring now to the drawing in detail, there is shown a member 10 which serves as a support. This member 10 is of material having good electrical insulating properties and is preferably of a porous composition such, for example, as a chalk. It is found that "lavite", a porous chalk, is particularly suitable, being an insulating material and having other desired characteristics as will be pointed out hereinafter.

The supporting member 10 has formed therein a longitudinal passage extending preferably from end to end thereof and preferably taking the form of an axial passage 11, the supporting member 10 being thus, in the preferred form, tubular. Within this longitudinal passage 11 is positioned a conducting path of high electrical resistance, preferably extending through the passage, or through the supporting tube, from end to end thereof. This conducting path preferably takes the form of a film of conducting material deposited upon a suitable nonconducting surface, and the resistance element conveniently comprises a thin glass rod or a glass fiber or thread coated with a film of conducting material as described in my copending application, Serial No. 33,327, filed May 28, 1925. The high resistance element shown herein at 12 accordingly comprises a thin glass thread coated with a thin film of carbon or graphite to form thereon a conducting path, a thin film of rosin or other suitable binder being deposited exterior of the carbon film as a protection for the latter.

The resistance element 12 is supported in the passage 11 adjacent to the longitudinal axis of the supporting tube or rod 10 and out of contact with the walls of the passage. The ends thereof are embedded in a small mass of metal 13 which makes electrical connection with the conducting film. This metal 13 is

preferably a suitable alloy of comparatively high melting point such as a high melting point solder. The alloy 13, supporting the resistance element 12 at its two ends, is positioned in the two ends of the passage 11 and preferably within a pair of metal caps 14 which are fitted about the respective ends of the supporting rod 10. The alloy 13 makes electrical connection between the conducting film and the terminal caps 14 which are shaped to be received in spring clips, for example. The terminal caps 14 close the ends of the passage 11, covering the ends of the rod or tube, and they are secured to the supporting member 10 by means of any suitable adhesive such as rosin.

Within the passage 11 and in intimate contact with the resistance element 12 is a material 15 which is molded into the groove while in a plastic state and preferably after the resistance element 12 has been mounted therein as above described. This mass of material 15 thus surrounds and encloses the resistance element and is adapted to protect the resistance element from access of air thereto and to conduct away the heat generated by current flowing through the conducting film. I have found that putty is admirably suited for this purpose and particularly putty made of finely powdered chalk (calcium carbonate), ordinarily known as whiting, and linseed oil. Other materials, such as other kinds of putty, for example, white lead putty, may be employed with varying degrees of success, but the commercial high grade putty made of whiting and linseed oil is found to be particularly suitable and to achive the desired results in a highly efficient manner.

Considering now more particularly my preferred method of making this resistance device, Figure 1 shows the supporting rod or tube 10 formed in readiness to receive the other parts of the structure. At each end of the member 10 is formed by any suitable means a diametrical slot 28. The member 10 having been formed as shown in Figure 1, the resistance element 12, formed preferably as described in my above-mentioned co-pending application, is inserted into the passage 11 and is secured therein by the solder 13 at each end. The solder 13 makes electrical connection with the conducting film and supports the resistance element 12 substantially coaxially with the passage 11. Preferably sufficient of the solder 13 is employed to insure the firm support for the part 12 and, as shown in Figures 3 and 5, this solder extends a short distance into the slots 28.

The putty is now forced into the passage 11 through one or more of the openings provided by the slots 28. For the purpose of forcing the putty into position, a suitable pressure gun may be employed as indicated at 29 in Figure 5. The putty is forced into the passage 11 and tightly packed therein about the resistance element 12. Thereupon the metal caps 14 are placed in position over the ends of the device, making electrical contact with the solder 13.

Preferably, after the resistance device has been assembled as described above, it is placed in an oven and baked for a period of time at a relatively high temperature. The temperature preferably employed in the baking is in the neighborhood of 130° C., and when this temperature is employed the baking is continued for about twelve hours. As a result of this baking the putty hardens and becomes permanently set about and in intimate contact with the resistance element 12. By the heating a considerable amount of the oil is driven out of the putty and seeps out into and through the pores of the porous supporting rod or tube 10. The linseed oil remaining in the putty is largely oxidized and the resulting product forms a binder which, with the whiting, forms about the resistance element a very hard and durable mass having highly advantageous characteristics.

This resistance device is capable of affording a very high electrical resistance, for example on the order of ten megohms, or it can be made to have a much lower resistance, for example on the order of 100 ohms, and it is capable of carrying a substantial load without being harmfully affected thereby, for example, a load on the order of three or four watts. An apparatus in which this resistance device is particularly well adapted for use is a current rectifier or "B-battery eliminator" employed in radio receiving equipment and a simple form of which is illustrated in Figure 9. Referring to Figure 9, the leads 16 and 17 supply alternating current and across these leads is connected the primary 18 of a transformer. The secondary 19 of the transformer supplies current to leads 20 and 21 across which the load is connected. In this circuit is a suitable electric valve 22 such as a "Raytheon" tube and a choke coil 23, and connected across the circuit are a pair of condensers 24 and 25. Two of the resistance devices herein described are illustrated at 26 and 27 connected in series across the load circuit between the rectifier and the load. The resistance devices 26 and 27 provide a path for the continuous discharges of the condensers and hence they are required to carry a considerable electrical load, for which they are adapted as has been pointed out above.

The hardened putty 15 is substantially impervious to the passage of air and hence protects the conducting film against oxidation under the relatively high temperatures which are reached under operating conditions. The putty, also, has a very high heat conductivity so that it rapidly dissipates the generated heat. The porous nature of the supporting rod 10 is an important factor in expediting

the proper drying out of the putty, permitting seepage of a large part of the oil. It is important that the heat conducting and protective material 15 which is employed have a coefficient of expansion which is substantially equal to that of the insulating support upon which the conducting film is deposited and supported since, if the coefficient of expansion of these two parts is substantially different, repeated heating and cooling is liable to result in a cracking and disruption of the conducting film. When the conducting film is supported upon a glass member, as in the preferred construction here shown, the putty has the added great advantage that its coefficient of expansion is substantially equal to that of the glass. The operating temperature of this resistance device may reach a value in the neighborhood of 125° C. After the putty has been molded into place about the resistance element and has been allowed to stand or is baked as described, it hardens but does not become brittle and is not apt to fracture so that it forms a highly dependable and long-lived protection for the resistance element. Moreover, the characteristics of the putty are such that it is not melted or softened by the operating temperatures of the device.

As many possible embodiments may be made of the mechanical features of the above invention and as the art herein described might be varied in various parts all without departing from the scope of the invention, it is to be understood that all matter hereinabove set forth or shown in the accompanying drawing is to be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. In an electric resistance, in combination, electrical conducting means of high resistance, and a covering of putty thereover comprising a hardened mixture of whiting and linseed oil.

2. In an electric resistance, in combination, a resistance element comprising an insulating support and a film of conducting material thereon forming a conducting path of high resistance, and a mass of putty molded about said resistance element.

3. In an electric resistance, in combination, electrical conducting means of high resistance, a mass of putty packed thereabout, and a member of non-conducting and porous material by which said putty is embraced and supported.

4. In an electric resistance, in combination, an insulating support having a passage therethrough substantially from end to end, metal terminals closing the ends of said passage, conducting means of high resistance extending through said passage between said terminals, and putty molded about said conducting means.

5. In an electric resistance, in combination, an insulating support having a passage therethrough substantially from end to end, metal terminals closing the ends of said passage, conducting means of high resistance extending through said passage between said terminals and comprising a glass member having a film of conducting material thereon, and putty molded about said conducting means.

6. In an electric resistance, in combination, a resistance element comprising an insulating support and a conducting film thereon, metal terminals connected to said conducting film at the ends thereof, and putty molded about said resistance element between said terminals.

7. The herein described art of making resistance devices which consists in mounting a high resistance element upon a fragile non-conducting support and packing putty about said resistance element.

8. The herein described art of making resistance devices which consists in mounting a resistance means in a passage in a porous member, placing about said means and between it and the walls of said passage a mixture of whiting and linseed oil, and baking the resultant structure.

9. The herein described art of making resistance devices which consists in mounting a resistance means in a passage in a porous member, placing putty about said means and between it and the walls of said passage, and baking the resultant structure at a temperature on the order of 130° C.

In testimony whereof, I have signed my name to this specification this second day of June, 1927.

HAROLD PENDER.