

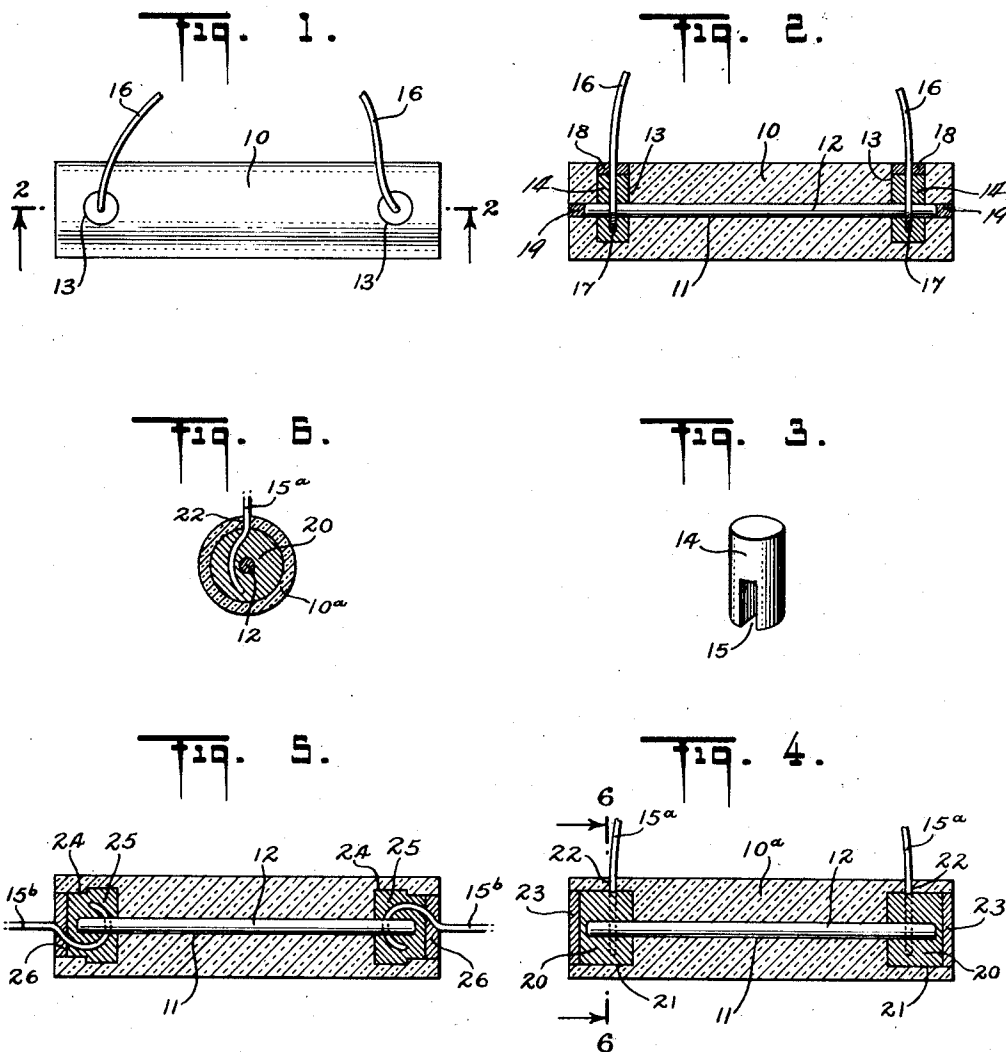
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RESISTOR

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RESISTOR

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5 Claims. (Cl. 201—63)

This invention relates to the construction of electrical resistance devices and, with regard to certain of its more specific features, to resistors for radio apparatus.

5 One object of the invention is to provide a resistor for radio use having a high power rating. Another object of the invention is to provide a construction for electrical resistance devices which is impervious to moisture. Another object of the invention is to provide a thoroughly insulated resistor. Another object of the invention is to provide a resistor having excellent heat dissipating qualities. Another object of the invention is to provide a device of the above nature 10 which is simple in construction, durable and inexpensive to manufacture.

Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts as will be exemplified in the structure to be hereinafter defined and the scope of the application of which will be indicated in the following claims.

25 In the accompanying drawing, in which are shown three of the various possible embodiments of the mechanical features of this invention,

Figure 1 is a side elevation of a resistance device constructed in accordance with the invention; 30

Figure 2 is a sectional view taken on the line 2—2 of Figure 1;

Figure 3 is a perspective view of a plug;

35 Figure 4 is a longitudinal sectional view similar to Figure 2 showing a modified form of resistance device;

Figure 5 is a longitudinal sectional view showing a further modification; and

40 Figure 6 is a cross-sectional view taken on the line 6—6 of Figure 4.

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

Referring first to Figure 1, I provide an insulating rod or tube 10 serving as a support and protector for a resistance element 12. This rod or tube 10 preferably constitutes an insulator for high frequency and for high voltage charges and nevertheless is preferably composed of a material having relatively high heat conductivity. Preferably also it is impervious to air and particularly to moisture in any form, and preferably it is strong and durable. Although there are several substances fulfilling one or more of the 55 above requirements which I might use, I prefer

to employ for the insulator 10 a ceramic such as unglazed porcelain or a substance of the nature of porcelain. The rod 10 may be generally cylindrical, or it may be prismatic, or it may have any other suitable shape.

Referring now to Figure 2, extending through the insulating rod or tube 10 is a capillary passage 11. In this passage 11 and preferably in such intimate contact with the wall thereof as to leave substantially no air space surrounding it, 5 is the resistance element 12. Preferably this resistance element 12 constitutes a glass rod or fiber coated with carbonaceous substance, such as the resistance element disclosed in my prior U. S. Letters Patent #1,832,419 granted November 17, 1931. Such a resistance element is to a high degree flexible, and has a coating of resistance material hard and firm enough to withstand the operation of forcing the rod into the capillary passage 11 without scraping off or injuring in any way the coating. Preferably the capillary passage 11 is circular in cross-section because the resistance material 12 may be more readily and accurately made of a cylindrical rod or fiber. 20

Referring to Figures 1 and 2, in a side wall of the rod or tube and near the ends thereof I form a pair of bores 13, 13. These bores intersect the capillary passage 11 and the resistance element 12 extends into and preferably through each of these bores 13, 13. 25

Referring now to Figure 3, I provide a plurality of metal plugs 14 adapted to fit in the bores 13, 13. Each plug is generally cylindrical in form and has formed therein a slot 15 at one end of a size to straddle the resistance element 12. Preferably the plugs are made of metal alloy of such a nature that, upon solidification from a molten state, it will expand to such an extent as to press firmly against the walls of the bores 13 and be compressed against the resistance element 12 without, however, fracturing the insulating rod or tube 10 or the resistance element 12, assuming the resistance element to comprise a coated glass rod or filament as described. 30

Preferably, also the alloy should be of such a nature that it will melt at a temperature low enough to facilitate the manufacture of the articles in quantity production without danger, however, of fusing in operation. The alloy also should have good flowing properties so as to conform to the minute irregularities of the ceramic or the like. The ingredients of an alloy having the above mentioned qualities in a marked de- 35

gree, which is an example merely of a preferred alloy, are as follows:—

	Per cent
5 Antimony-----	9 to 15
Tin-----	4 to 6
Lead-----	87 to 79

Other advantages of the above and similar alloys are that they will not burn the resistance coating of the resistance material 12, and they have a low coefficient of expansion while in a solid state, comparatively close to that of glass.

I now place a plug 14 in each of the bores 13 so as to locate the resistance element 12 in the slots 15. I now heat the entire article to a sufficient temperature to melt the plugs 14, and the metal then flows around the resistance element 12 and fills the bores 13, 13. The advantages of proceeding in this manner are that the metal is able to reach all parts of the bore readily, and as the ceramic is at the same temperature or an even higher temperature than the metal there is no sudden cooling on contact such as results from attempting to pour molten metal. I have found that for the filling of small bores this method of molding metal secures a more perfect casting.

While the metal is molten, I introduce into the bores 13, 13 terminal wires 16, 16. Such terminal wires are bendable and may desirably be of copper coated with tin which, having little resiliency, will assume any desired shape. Such wires are excellent conductors of electricity and have a strong affinity for alloys of the character indicated. Desirably the ends of the wires 16 that are introduced into the bores 13 are knurled or crimped as shown at 17 so that a firm union between the wires and the solidified metal may result.

In the manufacture of resistors as above described I have found it advantageous to clamp or otherwise secure the bodies 10 upon a conveyor leading into or over a furnace, and an operator may insert the terminal wires 16 when the plugs 14 have melted; the conveyor then carries the resistors beyond the heating locus and the metal quickly solidifies, whereupon the resistors may be removed or may automatically be deposited in a box or the like.

The metal alloy, upon solidifying, expands against the walls of the bores 13, 13 and becomes firmly attached to the rod or tube 10 and is compressed against the resistance element 12. The electrical connection between the resistance element 12 and the terminals 16, 16 is found to be substantially "noiseless" in an audio circuit.

After the alloy has solidified in the bores 13, 13 (and either before or after the resistors have been taken from the conveyor) moisture-proof insulating material is introduced upon the top of the metal filling the remainder of the bores, as the amount of metal used is preferably less than enough to fill the bores 13, 13. As examples of such moisture-proof insulating material I have obtained good results by using rosin, or Canada balsam. Such substance forms insulating portions 18, 18, and desirably also is introduced into the ends of the capillary passage 11 forming insulating portions 19, 19. When either rosin or Canada balsam is used, it is found that the insulating material penetrates by capillary attraction or like force into the minute spaces between the now solidified metal portions 14, 14 and the wall and bottom of the bores 13, and effectually prevents moisture from reaching the resistance element 12 and also acts as a cement to further

increase the adherence of the metal 14, 14 to the ceramic 10.

Referring now to Figure 4, a modification of the invention is shown in which molded metal portions 20, 20 are introduced into recesses 21, 21 formed in opposite ends of the insulator 10a. These molded metal portions 20, 20 may be and preferably are of the alloy above indicated or having similar characteristics. As the recesses 21, 21 are somewhat larger than the bores 13, 13 I may introduce the metal into the recesses in liquid form, although the method of using a plug and melting it in position may also be adopted. Extending into each recess 21 is a lateral bore 22 through the cylindrical wall of the ceramic 10a, and through which lateral bore extends a terminal 15a the inner end of which, embedded in molded metal 20, may be of question-mark shape as shown in Figure 6 to make a firm union between the terminal and the molded metal 20. Covering the ends of the metal 20 are layers of moisture-proof insulating material 23, 23, desirably Canada balsam or rosin, which acts to firmly cement the metal 20 to the ceramic 10a and keeps moisture from the resistance element 12 as already described. Desirably a drop of this insulating material is placed on the outside of the lateral bores 22 sealing any space between them and the wires 15a, 15a.

Referring now to Figure 5, a further modification is shown in which terminal wires 15b, preferably of the shape shown in Figure 5, are introduced directly into recesses 24 so as to project from opposite ends of the unit. The recesses 24, 24 may be undercut as indicated and any of the methods of introducing the molded metal 25, 25 already described, or any other suitable method, may be adopted. Preferably the unit shown in Figure 5 is also sealed against entrance of moisture by means of moisture-proof insulating coatings 26. By reason of the undercut portions of the recesses 24, and by reason of the shape of the terminals 15b, this unit has great strength.

The resistance devices herein described are thoroughly insulated both on sides and ends so that several resistors may be placed in close contact with each other in the apparatus in which they are used. Furthermore, they are small, light and extremely durable. The resistance coating of the resistance element 12 is in intimate contact with the substance of the insulator thus dissipating heat materially increasing the power capacity of the device. Porcelain and similar substances are good conductors of heat and give the resistors a high power rating. By uniting the terminals 15 to the resistance element with molded or cast metal within the insulator 10 a device having a small maximum diameter is obtained and thus space, which is at a premium in a radio set, is conserved. Furthermore, except for the terminals 15, there are no exposed conductive parts, and after soldering the terminals to whatever they are to be connected to in the radio apparatus, the surplus length thereof may be cut off with a pair of pliers. The resistors of the present invention are particularly adapted for mounting in gang formation.

It will thus be seen that there has been provided by this invention an article in which the various objects hereinabove set forth, together with many thoroughly practical advantages, are successfully achieved.

As many possible embodiments may be made of the above invention and as many changes

might be made in the embodiment above set forth, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawing is to be interpreted as illustrative and not in a limiting sense.

In the following claims the term "molded" is to be construed as meaning cast, liquefied in position, formed by dropping liquid upon something, or spraying with atomized substance, as the term does not in reality relate to any particular process (as used herein) but is indicative of a particular condition of metal or other substance, for from the standpoint of audio-frequency apparatus a connection made in one of the above indicated manners or in any similar manner is, in the sense of an article of manufacture, different from a mere mechanical union, in intimacy of contact and molecular condition of the parts, and so likewise is a seal or covering for insulating or keeping out moisture.

I claim:

1. In a device of the class described, a glass rod filamentary in diameter, a coating of carbonaceous resistance material on the cylindrical surface of said rod but not on the ends thereof, a right cylinder of insulating material enclosing said rod and said carbonaceous substance, the cylinder being slightly longer than the rod and the rod and the cylinder being coaxial there being a passage in the cylinder just large enough to conveniently hold the rod, bendable metal wires extending axially from opposite ends of the cylinder said wires constituting the only break in the insulation of said device, and additional more readily conductive material directly contacting the ends of the rod and the carbonaceous substance thereon and also contacting the wires and holding them in place.

2. In a device of the class described, in combination, a tubular member formed from insulating material, said tubular member having recesses in its opposite ends, the dimensions of said recesses being greater at points spaced from the ends of said tubular member, a resistor rod disposed within the bore of said member and having its end portions disposed within said recesses, metal in said recesses surrounding and embracing said end portions of said resistor rod

and engaging the walls of said recesses at said points, and wire terminals embedded in the metal of each of said recesses.

3. In a device of the class described, in combination, a tubular member formed from insulating material, said tubular member having recesses in its opposite ends, the dimensions of said recesses being greater at points spaced from the ends of said tubular member, a resistor rod disposed within the bore of said member and having its end portions disposed within said recesses, metal in said recesses surrounding and embracing said end portions of said resistor rod and engaging the walls of said recesses at said points, wire terminals embedded in the metal of each of said recesses, and an insulating substance sealing the end portions of said recesses.

4. In a device of the class described, in combination, a tubular member formed from insulating material, said tubular member having recesses in its opposite ends, the dimensions of said recesses being greater at points spaced from the ends of said tubular member, a resistor rod disposed within the bore of said member and having its end portions disposed within said recesses, metal in said recesses surrounding and embracing said end portions of said resistor rod and engaging the walls of said recesses at said points, and wire terminals having bent portions embedded in said metal.

5. In a device of the class described, in combination, a tubular member formed from insulating material having recesses formed in its opposite ends, the diameter of the inner portions of said recesses being greater than the diameter of said recesses at the ends thereof, a glass rod having a carbonaceous substance coated thereon fitting within and substantially filling the bore of said tubular member and having end portions extending into said recesses, metal filling the portions of said recesses having enlarged diameters and embracing said end portions of said rod, and wire terminals embedded in said metal and extending outwardly therefrom substantially in axial directions with respect to said tubular member.

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