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F. H. BULLINGER

1,932,923

RESISTANCE DEVICE

Filed Nov. 15, 1930

Fig. 1.

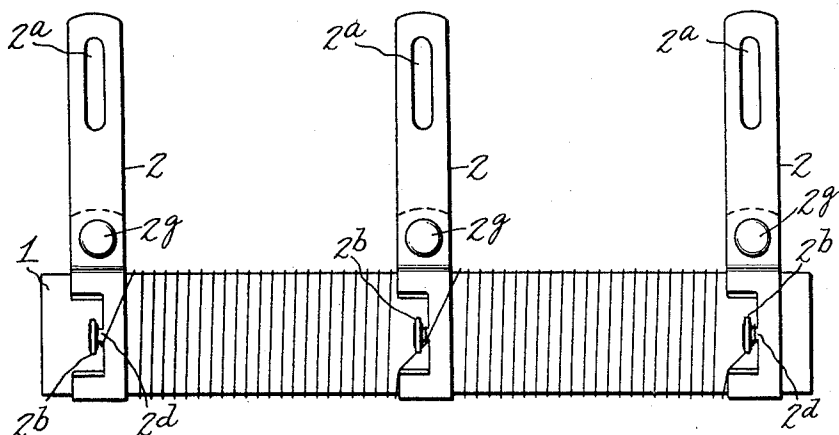


Fig. 2.

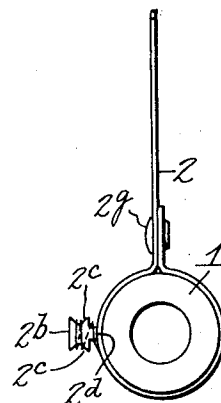


Fig. 5.

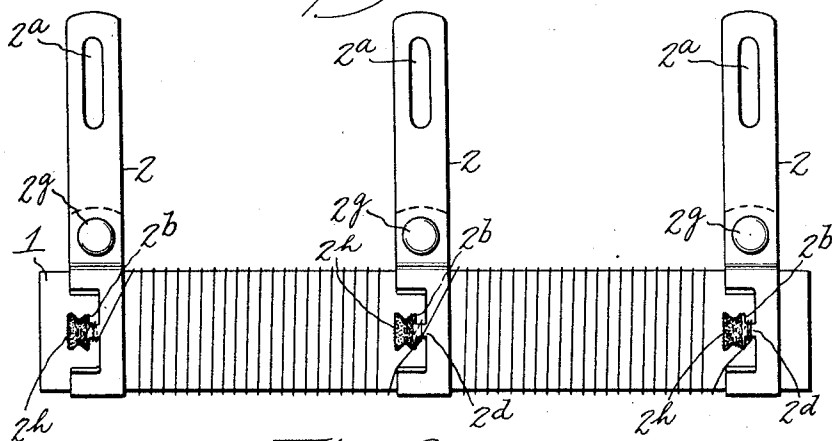


Fig. 3.

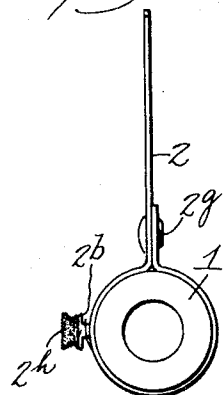


Fig. 6.

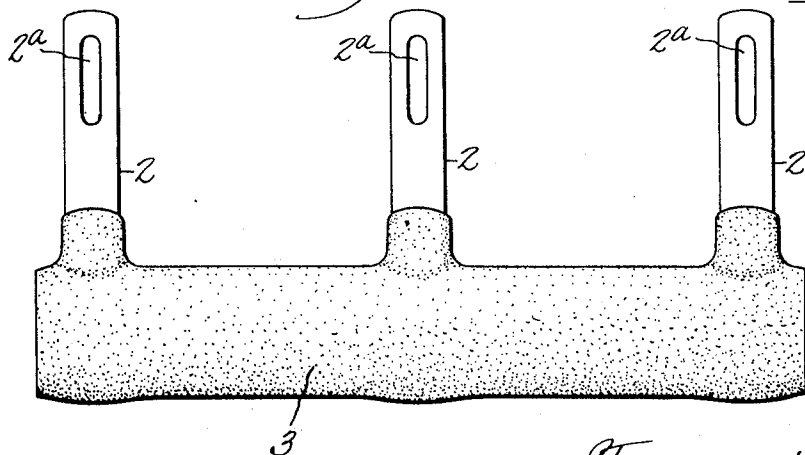
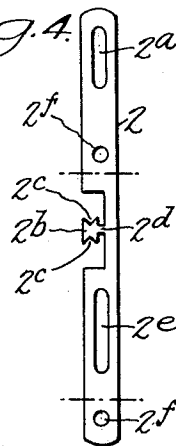


Fig. 4.



Inventor

Frederic H. Bullinger
By his Attorney
Lawrence K. Sager.

UNITED STATES PATENT OFFICE

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RESISTANCE DEVICE

Frederic H. Bullinger, Bronxville, N. Y., assignor
to Ward Leonard Electric Company, a corporation of New York

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Serial No. 495,830

5 Claims. (Cl. 201-64)

This application which relates not only to an improvement in resistance devices, but also an improved method of making the same, applies particularly to that type of resistance device wherein a resistive conductor is connected to one or more terminals and, more particularly, to such devices where the resistive conductor is covered by an insulating coating, or embedded thereby.

In resistance devices of this character, it is very important that the electrical connection between the resistive conductor and the terminals, taps, or contacts, should be perfectly formed, and dependable in future long-continued use of the device. It is also important that the connection should be such that the process of manufacturing the resistance device will not impair the electrical connection, or strain, or loosen the resistive conductor. It is further important to provide a form of construction which will permit and insure all parts lying closely to the supporting element, so that the insulating coating will well cover and protect the parts from deterioration and mechanical injury and to give, as far as possible, a smooth surface appearance.

The main object of the present invention is to fulfill the above requirements and provide an improved resistance device and method of making which will be economical in cost of manufacture and well adapted for commercial production on a large scale. Another object is to reduce to a minimum, or eliminate entirely, the number of defective devices produced during the course of manufacture, as regards the electrical connection between the terminals and the resistive conductor, or breakage of the conductor at, or near, the terminal connections. Another object is to produce a form of construction and method of making, wherein the high temperature due to firing for maturing the insulating coating, such as when a vitreous enamel coating is used, will not affect the electrical connection between the resistive conductor and the terminals; and similarly be unaffected by the heating of the device which occurs in normal usage. Other objects and advantages will be understood from the following description and accompanying drawing illustrating a preferred embodiment of the invention.

Fig. 1 is a side view of a resistance unit in an incomplete condition and at one stage of the process of making; Fig. 2 is an end view thereof; Fig. 3 is a similar end view after a further step in the process; Fig. 4 is a plan view showing

in development, the particular form of terminal used in this instance; Fig. 5 is a side view of the unit after a further step in the process; and Fig. 6 is a side view of the completed unit.

The insulating support in this instance is shown as a tube 1 of porcelain. The tube supports the various terminals 2, three being shown in this instance, one an intermediate terminal, although obviously as many of these terminals as desired may be used for the particular purpose intended. As shown by the development in Fig. 4, the terminals are formed in this instance from sheet metal and are in the form of a long strip having a perforation or slot 2a at one end provided for convenient connection to an external circuit. A mid-portion of the strip has a cut-away portion, except as to a projection 2b. This projecting element has indentations 2c opposite each other at the outer part and is connected with the main portion of the strip by a narrow part or neck 2d. The slot 2e in the strip is provided in a portion which encircles the tube and is for the purpose of permitting the insulating coating to enter therethrough and come in contact directly with the insulating support so as to more firmly hold the strip to the support. The holes 2f are for the purpose of receiving the rivet 2g when the terminal is encircled about the tubular support so as to hold the same in place, the strip being bent along the dot and dash lines indicated in Fig. 4 where the end portions come together to be fastened by the rivets, or any other securing means. Before application to the tubular support, the projections 2b of the terminals are bent outwardly at the neck 2d so as to project away therefrom. Thus, Figs. 1, 2 and 3 show these projections extending outwardly from the body of the unit and substantially at right angles thereto.

The terminals being mounted upon and secured to the insulating support 1, as already described, the conductor is connected thereto and applied as indicated in Fig. 1. Starting at the left hand terminal where the conductor passes to the right from the terminal, one end of the conductor is first wound around the projection 2b in the indentations 2c, giving the conductor one or more turns and is then passed under the neck 2d, and then passes over a portion of the terminal and around the insulating support with the desired number of turns to the next terminal. There the conductor is first passed around the neck 2d of the intermediate terminal and then around the

outer portions of the projection in the indentations 2c, and is then passed under the neck 2d, and then over a portion of the terminal strip to be again wound around the insulating support with the desired number of turns. At the right hand terminal the conductor is first passed around the neck and then in the indentations 2c with one or more turns. It will thus be seen that the conductor in passing to and from the terminals for making connection thereto lies closely to the insulating support and to main portions of the terminal strips. Thus, when the projections 2b are later bent inwardly, close to the insulating support, no appreciable strain is imposed upon the conductor at or near the terminals, or any looseness developed, because when the projections are bent inwardly, there is no appreciable movement of their necks where the conductor passes to and from the same.

With the conductor thus applied and connected to the terminals as shown in Figs. 1 and 2, a soldered connection is then made between the conductor and each of the projections 2b.

In the making of this soldered joint, there are several important factors bearing on the problem. The resistance device is often subjected in use, to temperatures which are higher than the soldering temperature of solder ordinarily used. In such cases, the heat occurring during use is likely to mature or destroy the soldered joint. Again, such solders usually contain tin or similar metal which attacks and weakens the copper, or brass, in the terminal, and such weakening is progressive with repeated heating, which further tends to impair or open the soldered connection. Furthermore, in the best forms of resistance devices where the insulating coating is in the form of an adhesive vitreous enamel coating and where coatings of similar character are used, the firing temperature for maturing the enamel coating is ordinarily quite high, being in the neighborhood of 1200° F. Consequently, if the soldered joint is of a character that the solder fuses at a lower temperature than that used in the subsequent process of manufacture, the soldered connection will be impaired or opened. In accordance with the present invention, the solder used has a fusing temperature higher than that reached in the later manufacture of the resistance device, and higher than that reached in subsequent use of the device. Under such conditions, the soldered joint will remain unimpaired. A solder suitable for the purpose is the so-called silver solder. These silver solders have very high fusing points and one should be used which has a fusing temperature higher than that used in the course of manufacture of the resistance device, or in its later use. If the maximum temperature of manufacture or use is say 1200° F., then a silver solder having a fusing point of 1300° F. would be satisfactory. Another factor affecting the problem is that such high fusing solder cannot be applied by use of a soldering iron, and the soldering is best accomplished by dipping the joints between the resistive conductor and the terminals in a bath of the fused silver solder, or other suitable soldering material. But, if it were attempted to make a soldered joint by dipping more or less of the resistive conductor and terminal into a bath of molten soldering material, various difficulties would result, particularly because so much of the parts would become heated as to cause the parts to become loosened on the support and impair the firm contact of the

terminal and resistive conductor with the support. Another difficulty is that a large amount of the soldering material would be used and the high temperature soldering material is quite expensive. A further objection results from the length of time required.

By the present invention, these difficulties in using high temperature solder are overcome, and the construction and method of operation is such that only a small part of the terminal and of the resistive conductor is immersed in the molten material of high temperature; and at the same time provision is made for preventing the heat from being conducted materially to the main portions of the resistive device. Thus, after the resistance device has progressed to the stage already described with reference to Figs. 1 and 2, the projections 2b only are then immersed in the molten high fusing soldering material; and where these are on a line, as indicated in the drawing, all of the soldered joints may be formed at one time by immersing the various projections simultaneously in the bath. This results in giving a soldered joint between the resistive conductor and the projections 2b, as indicated by the solder 2h in Fig. 3. The narrow, or restricted, neck portion 2d prevents the heat of the solder or bath from passing in any material amount to the body portions of the terminals or support; and by limiting the heating to the projection 2b, it permits the projection to be quickly heated to a high temperature in the bath so that the soldering is accomplished quickly and efficiently. The restricted neck portions likewise, in preventing any material transfer of heat to the terminals or support, result in abstracting very little heat from the molten bath. These factors are important in the commercial production of these devices, permitting the soldering to be accomplished at comparatively small cost of labor, while at the same time securing uniformity in the resulting product.

After the soldering operation, the projections 2b with the soldered joints formed thereon, are pressed inwardly toward the support, the necks 2d permitting this to be easily done. By reason of the resistive conductor passing to, or from, the terminals at the location of the necks 2d, the bending down of the projections does not impose any strain, or looseness, or cause any displacement of the resistive conductor, such as would occur if the resistive conductor passed directly to, or from, outer portions of the projections. The insulating coating material 3 is then applied over the resistive conductor and over the soldered joints and portions of the terminals which encircle the tube, after which it is matured according to the requirements of the coating material used. A vitreous enamel coating is preferable, as it firmly adheres to the parts, has high insulating qualities and is impervious to moisture. As the soldered projections are bent to lie against, or close, to the support, the finished product has a smooth external appearance and the parts are well covered and protected.

Although I have described a preferred embodiment of my invention, as regards a particular form of resistance device and a particular method, yet modifications may be made therein without departing from the invention. Supports of various characters may be used and terminals of various forms may be used, according to the

particular requirements and preference of the designer.

I claim:

1. The method of making a resistance device
5 which comprises applying the resistive conductor and terminals to an insulating support and connecting the resistive conductor to projections outwardly extending from the terminals, im-
10 mersing the projections only in a high temperature soldering bath, bending the projections toward the support, applying insulating coating material, and maturing the coating at a tem-
15 perature lower than the soldering temperature.
2. The method of making a resistance device
15 which comprises forming projections on the terminals with narrow portions connecting the projections to the main portions and having indented outer portions, applying the terminals and
20 resistive conductor to a support and guiding the conductor around said narrow portions where it approaches or leaves the terminals and wrapping it around the indented outer portions of
25 said projections, and soldering the connections at the outer portions of the projections.
3. The method of making a resistance device
30 which comprises forming projections on the terminals with narrow portions connecting the projections to the main portions, applying the terminals and resistive conductor to a support and guiding the conductor around said narrow
portions where it approaches or leaves the terminals and wrapping it around the outer por-

tions of said projections, soldering the connections at the outer portions of the projections at high temperature, bending the projections toward the support, applying insulating coating material, and maturing the coating at a temperature lower than the soldering temperature. 80

4. The method of making a resistance device which comprises forming projections on the terminals with narrow portions connecting the projections to the main portions, applying the terminals and resistive conductor to a support and
85 guiding the conductor around said narrow portions where it approaches or leaves the terminals and wrapping it around the outer portions of said projections, immersing the projections only in a high temperature soldering bath, bending the projections toward the support, applying
90 insulating coating material, and maturing the coating at a temperature lower than the soldering temperature. 95

5. A resistance device comprising an insulating support, a terminal mounted thereon, said terminal having a projection connected with
100 said terminal by a narrow neck portion, the outer portion of said projection being indented, and a resistive conductor on said support passing close to said support around said neck portion and then around the indented outer portion of
105 said projection for forming the connection between the conductor and the projection, the said connection being soldered.

FREDERIC H. BULLINGER.

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