Nov. 1, 1932. F. H. BULLINGER 1,885,108

TERMINAL CONNECTION AND METHOD OF MAKING THE SAME

Filed Dec. 7, 1929

Fig. 1.

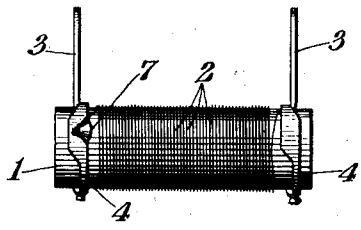



Fig. 2.

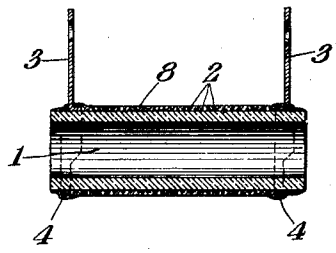



Fig. 3.

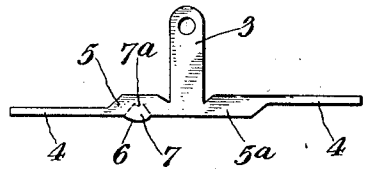



Fig. 4.

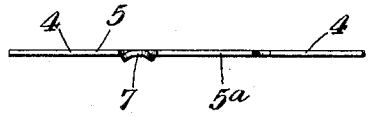



Fig. 5.

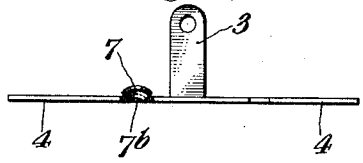



Fig. 6.

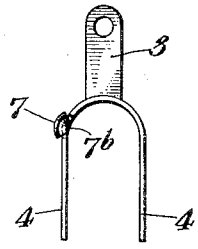



Fig. 7.

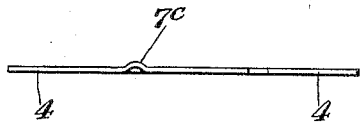
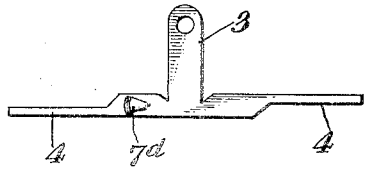



Fig. 8.




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Patented Nov. 1, 1932

1,885,108

# UNITED STATES PATENT OFFICE

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## TERMINAL CONNECTION AND METHOD OF MAKING THE SAME

Application filed December 7, 1929. Serial No. 412,310.

This invention relates to resistance devices and method of making them and particularly to resistance units wherein the resistive conductor is wound upon a tubular insulating support and provided with terminals for the convenient connection of the device in a circuit.

In devices of this character, various forms of construction have been utilized and suggested with a view to securing a convenient and dependable form of terminal and connection thereto of the resistive wire, such as by soldering and by various forms of mechanical connection.

The main object of the present invention is to provide an improved form of construction and method of making which will overcome the disadvantages of prior devices of this character, such as the breaking of the connection between the resistive conductor and the terminal, especially when the resistive conductor is of small size, during construction, and also to avoid the breaking or the impairment of the connection during the heating of the device in an oven or furnace for the purpose of maturing the insulating coating. Other objects are to accomplish this result by a form of construction which may be conveniently and economically made at low cost of labor and material and at the same time result in reducing the number of defectives in the course of manufacture to a comparatively negligible amount, while securing reliability and durability in the continued use of the device. Although the invention is particularly applicable to resistance units of tubular form, yet the invention, in some features thereof, may be applied to other forms of resistance devices and to similar situations in other forms of devices. Another object is to provide an improved form of connection which may be readily covered by the insulating coating and not form an undesirable projecting part. Other objects and advantages of this invention will be understood from the following description and accompanying drawing.

Fig. 1 is a side view of a resistive unit embodying the invention, before application of the exterior insulating coating; Fig. 2 is a longitudinal section after the insulating coating has been applied; Fig. 3 is a plan view of one form of terminal strip in development; Fig. 4 is an edge view thereof after the shearing of a portion; Fig. 5 is a similar view with the parts formed to the desired shape before application to the insulating support; Fig. 6 is an end view thereof after being further bent to partially conform to the shape of the insulating support; Fig. 7 is an edge view of a terminal strip showing a preliminary step, where the terminal is intended for use with larger size of resistive conductors; and Fig. 8 is a plan view of another terminal strip in development showing how the part to which the resistive conductor is connected may be formed within the body of the terminal strip, instead of at the edge, as in the preceding figures.

Referring to Figs. 1 and 2, a hollow tube 1 of insulating material, such as porcelain, is shown as having wound thereon the resistive conductor 2. In some cases, the insulating support may be of metal and provided with a surface covering to form an insulating ground coat over which the resistive conductor is wound. The unit is shown as carrying a terminal at each end having an extended portion 3 adapted for connection to a circuit, or to other devices, as may be desired.

Fig. 3 illustrates the terminal strip in development, being preferably made of copper, and adapted to be stamped out of said material in the form shown. It is provided with the portion 3 adapted to be bent up as shown in Figs. 1, 2, 5 and 6, and is also provided with narrow end strips 4 adapted to be twisted together at their ends, as indicated in Figs. 1 and 2, for the purpose of securely embracing the insulating support and for holding the terminal strip in fixed position thereon. Instead of twisting the ends together, they may be fastened together by a clip, or the terminal may be secured in place at the insulating support in any other suitable manner. The strip is provided with main body portions 5 and 5*a* for assisting in the security of the terminal and support of the projecting portion 3. The portion 5 is shown provided with a round projecting part 6 for forming the part to which the resistive con-

ductor is connected, converging dotted lines extending inwardly therefrom indicating where the strip is to be cut, or sheared.

In making the terminal, the blank of the form shown in Fig. 3 is cut, or preferably sheared along the dotted lines indicated in Fig. 3, forming a cut-out and bent portion 7 at the edge of the strip as shown in Fig. 4 and which is connected to the strip by a neck portion 7*a* indicated in Fig. 3. The part 7 is next bent outwardly at an angle, say of 80°, and rounded or cupped, as shown in Fig. 5, and the inner portion of the part 7 and the neck portion and part of the body portion adjoining the neck is arched outwardly as indicated at 7*b* in Fig. 5 by the inner curved lines, for the purpose hereinafter explained. This shaping of the parts is conveniently formed at the same time that the part 7 is bent outwardly by being forced against a form; or the arched formation may be imposed upon the material before the portion 7 is bent outwardly, or after the portion 7 is bent outwardly, so long as the neck portion and immediately adjoining parts thereof be arched before the part 7 is bent inwardly to complete the connection with the resistive conductor. Similarly, the rounding or cupping of the tongue or projection 7 may be done before or after the tongue is bent outwardly; and this, as well as the arching of the neck region, may be done during the initial cutting or shearing; but the shaping and bending of the parts are usually most conveniently accomplished simultaneously after the shearing.

The portion 3 is also bent up at right angles to the strip as shown in Fig. 5 and the strip curved, as shown in Fig. 6, to partially conform to the shape of the insulating tubular support. After slipping the strip over the insulating support, the ends are twisted together to firmly secure the terminal in place, as indicated in Figs. 1 and 2. An end of the resistive conductor 2 is then wound around the neck of the part 7, preferably a few turns if the wire is small, and the tongue 7 is then bent down against the insulating support to complete the terminal connection, the other end of the resistive conductor being secured to the other terminal in the same manner. The parts are then covered with an insulating coating 8, preferably of adhesive, vitreous enamel material, after which the unit is heated, or fired, in an oven, or furnace, for maturing the material to form the insulating coating. In some cases, cement, or other insulating material, may be used to form the insulating coating.

The special advantage and importance of this improvement will be appreciated by considering the action which takes place in bending down the part 7 after the resistive conductor has been wound around the neck thereof. The neck portion being arched and the body of the strip being arched back of the neck portion, it follows that when the part 7 is bent inwardly after the application of the resistive conductor, the bending first takes place mainly at the outer portion of the part 7 away from the neck, due to the neck region being greatly stiffened by its arched form. The inward movement of the tongue 7 thus does not shear, or break the conductor by tension. The action is such that in bending down the part 7, the end extremities thereof first engage the support 1. Further bending or pushing then causes the ends and edges to spread out into a more flattened engagement with the support and decrease or close up the spaces between the part 7 and the body portion of the strip. There finally takes place a pushing of the material against and around the resistive conductor towards the main body of the terminal strip, so that the turns of the conductor around the neck portion are finally compressed and embedded between the parts, as the tongue is forced against the support. This makes a firm engagement of the conductor by embedding it, without any material tendency to shear it, or break it under a tension strain. Also, when the device is later heated or fired in a furnace for maturing the insulating coating, the strain set up in the parts of the terminal strip are somewhat lessened and the parts tend to assume their original form. This results in the resistive conductor being still more firmly compressed and embedded between the parts of the strip and giving an even firmer or more tightly binding connection. This is in contradiction to some prior forms of construction, wherein the heating tends to open the joint and loosen the connection between the resistive conductor and terminal.

With the present invention, the bent down portion 7 of the strip before and after the application of the insulating coating, lies quite closely against the support 1, except for a slight bulge or hump which remains at and near the neck of the part 7, where that part had been arched. A comparatively slight arching of this neck region in the process of manufacture is ordinarily sufficient for obtaining good results; and consequently the bulge or hump in the finished article can be slight. Thus there is no objectionable projection at the connection to the resistive conductor and the coating can smoothly cover the parts. This gives a better appearance to the finished article and avoids the chance of the coating being broken away at this region during handling.

Where the resistive conductor is not a small wire, or where it is a stranded wire, the portion 7 may be cupped or curved to a greater degree and the neck region may be arched to a greater degree to provide a larger opening between the tongue or projection 7 and the body of the terminal for receiving the

conductor. In such cases, in order to better close up the gaps in the finished product and to more firmly compress and embed the conductor, an additional step may be taken in the process. This is indicated in Fig. 7 where the part 7*c* of the terminal strip which is to form the tongue or projection at the edge, is first stretched into a rounded form before this part is sheared out in order to give a greater breadth to the lip. When afterwards sheared, rounded and arched, and later pressed inwardly to compress the conductor, this extra breadth of the lip serves to much better fill the gaps and embed and surround the larger size of conductor, than if the part had not previously been stretched out.

Instead of forming the tongue or projection at the edge of the terminal, it may be formed within the body portion, as indicated in Fig. 8. Here the projection 7*d* is similarly sheared or punched out, bent or rounded and arched, as already described. After the conductor is applied, the part 7*d* is then pressed inwardly and the same binding or embedding of the conductor takes place, as previously explained. Also, the part may first be stretched, if desired, as explained with reference to Fig. 7.

Although particular embodiments of this invention have been described and a preferred process of making the same, yet various modifications may be made without departing from the scope of the invention.

I claim:

1. The method of making a connection between a sheet metal terminal and conductor which comprises upsetting a projection from the body of the terminal and curving the projection along its length in the direction of from one side of the projection to the other, placing the conductor between the projection and the body of the terminal, and bending the projection back towards its original location against the conductor.

2. The method of making a connection between a sheet metal terminal and conductor which comprises upsetting a projection from the body of the terminal and bending the inner portion of the projection along its length in the direction of from one side of the projection to the other, placing the conductor between the projection and the body of the terminal, and bending the projection back towards its original location against the conductor.

3. The method of making a connection between a sheet metal terminal and conductor which comprises upsetting a projection from the body of the terminal and bending the inner portion of the projection along its length in the direction of from one side of the projection to the other, and also similarly bending the adjoining region of the body of the terminal, placing the conductor between the projection and the body of the terminal, and bending the projection back towards its original position against the conductor.

4. The method of making a connection between a sheet metal terminal and conductor which comprises stretching the metal at a portion of the sheet metal terminal, upsetting the stretched portion to form a projection and curving the projection along its length in the direction of from one side of the projection to the other, placing the conductor between the projection and the body of the terminal, and bending the projection back towards its original location against the conductor.

5. The method of making a connection between a sheet metal terminal strip and conductor which comprises upsetting a projection from the body of the strip and bending the projection along its length in the direction of from one side of the projection to the other and similarly arching the adjoining region of the body portion, placing the conductor between the projection and the body of the strip, and bending the projection back towards its original location against the conductor.

6. The method of making a connection between a sheet metal terminal strip and conductor which comprises upsetting a projection from the body of the strip and bending the projection along its length in the direction of from one side of the projection to the other and similarly curving the adjoining region of the body portion, placing the conductor between the projection and the body of the strip, and bending the projection back towards its original location against the conductor.

7. A terminal connection comprising a sheet metal element, said element having a cutaway portion which lies substantially in the body of the sheet metal element, and a conductor held between said portion and the body of the sheet metal element, said portion projecting slightly above the body of the sheet metal element in a curved form in the direction of from one side of the portion to the other side of the portion.

8. A terminal connection comprising a sheet metal element, said element having a cutaway portion joined to said element by a neck, said portion lying substantially in the body of the sheet metal element, and a conductor held between the neck of said portion and the body of the sheet metal element, said portion projecting slightly above the body of the sheet metal element in a curved form in the direction of from one side of the portion to the other side of the portion.

9. A terminal connection comprising a sheet metal element, said element having a cutaway portion joined to said element by a neck, said portion lying substantially in the body of the sheet metal element, and a con-

ductor held between the neck of said portion and the body of the sheet metal element, said portion projecting slightly above the body of the sheet metal element in a curved form in the direction of from one side of the portion to the other side of the portion, the region of the element adjoining said neck being similarly curved.

10. A terminal connection comprising a sheet metal element, said element having a cutaway portion joined to said element by a neck, said portion lying substantially in the body of the sheet metal element, and a conductor held between the neck of said portion and the body of the sheet metal element, said portion projecting slightly above the body of the sheet metal element in an arched form in the direction of from one side of the portion to the other side of the portion, the region of the element adjoining said neck being similarly arched.

11. A terminal connection comprising a sheet metal element, said element having a cutaway portion which lies substantially in the body of the sheet metal element, and a conductor held between said portion and the body of the sheet metal element, said portion projecting slightly above the body of the sheet metal element in a curved form in the direction of from one side of the portion to the other side of the portion, the edges of said portion embedding said conductor against the body of said element.

12. A terminal comprising a sheet metal element having a cutaway portion projecting outwardly from the element and curved along its length in the direction of from one side of the projection to the other and adapted to be bent into the body portion of the element.

13. A terminal comprising a sheet metal element having a cutaway portion projecting outwardly from the element and curved along its length in the direction of from one side of the projection to the other and also the part of the element adjoining said portion being similarly curved, and said portion being adapted to be bent into the body portion of the element.

14. A terminal comprising a sheet metal element having a cutaway portion projecting outwardly from the element and joined thereto by a reduced neck and curved along its length in the direction of from one side of the projection to the other and adapted to be bent into the body portion of the element.

15. A terminal comprising a sheet metal element having a cutaway portion projecting outwardly from the element and joined thereto by a reduced neck and curved along its length in the direction of from one side of the projection to the other and adapted to be bent into the body portion of the element, the region of the element adjoining said neck being similarly curved.

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