April 19, 1938. A. H. SCHAFER 2,114,458

RESISTANCE DEVICE

Filed Aug. 13, 1936

FIG. 1

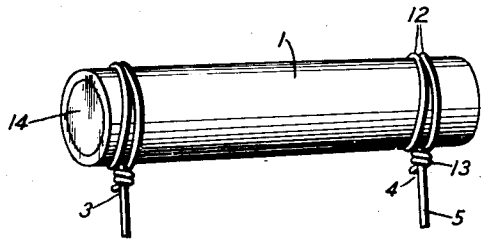


FIG. 2

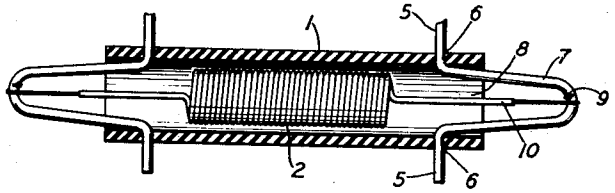


FIG. 3

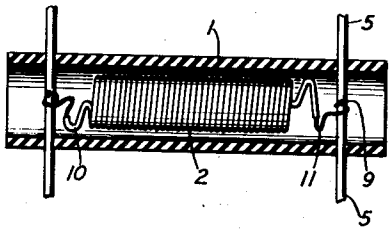


FIG. 4

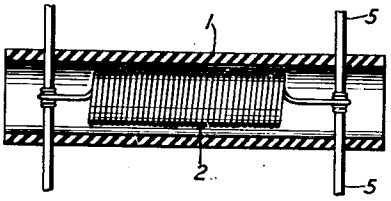
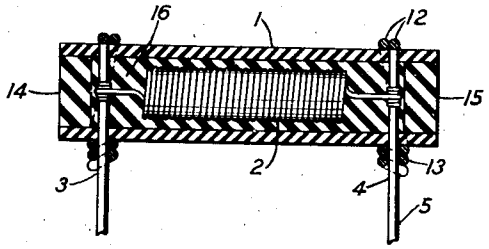


FIG. 5



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2,114,458

RESISTANCE DEVICE

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3 Claims. (Cl. 201—63)

The invention relates to resistance devices and more particularly to resistance devices of the type in which a resistance element is enclosed in a protecting casing.

The object of this invention is to provide terminal means in a resistance device of the type above mentioned.

A feature of the invention resides in a terminal which embraces the protecting casing and which has a portion extending transversely through the casing and into engagement with the resistance element.

Another feature resides in a novel method of attaching the terminal to a resistance element and of forming the terminal on the protective casing.

In the drawing,

Fig. 1 is a view in perspective of a resistance device in a tubular casing and with the terminals applied;

Fig. 2 is a side view, partly in section, of the device shown in Fig. 1 and illustrating a step in its development;

Fig. 3 is a view similar to Fig. 2 but showing a further step in development;

Fig. 4 is a view similar to Fig. 3 but showing a still further step in development; and

Fig. 5 is a side view, partly in section, of the device shown in Fig. 1.

In electrical resistance devices of the type in which a resistance wire is enclosed in a casing to protect the resistance device from moisture, or other injurious agencies, it has been difficult to find a suitable terminal structure and connection arrangement in which the points of connection between ends of the resistance wire and terminals applied on the outside of the casing are sufficiently protected to prevent breaking of the wire at the points of connection to the terminals. It is common practice, for instance, to apply band type terminals to ends of a casing and to bring ends of a resistance wire enclosed in the casing outward through apertures in the casing and to connect the ends of the resistance wire to the band type terminals. Since the points of connection between the ends of the resistance wire and the terminals in such cases are on the outside of the casing, severance of the wires at the points of connection frequently occurs unless some protective covering is applied over the points of connection. Also where terminal bands are applied to the outside of a protective casing some means or arrangement must be provided to prevent movement of the band terminals relative to the casing.

In this invention the terminal extends transversely through the casing and around the outside of the casing and the point of connection between an end of the resistance wire and an associated terminal is located within the casing.

To describe the invention in detail, reference will now be had to the drawing in which like parts of the figures are identified by the same numerals and in which, 1 is a tubular casing of insulating material, 2 is a coiled wire of resistance material, and 3 and 4 are terminals applied to end portions of the tubular casing 1.

The terminals 3 and 4 are each formed from a suitable length of wire of conducting material. As shown in Fig. 2 a suitable length of wire 5 is passed through aligned apertures 6—6 which extend transversely through the tubular casing 1 at one end portion of the casing. When the wire 5 is being placed in position in the aligned apertures 6—6 in the tubular casing 1, the wire 5 is substantially straight and extends transversely across an end portion of the tubular casing 1 so that the end portions of the wire 5 extend radially outward of the tubular casing 1. The wire 5, as will be subsequently explained, is later formed to make the terminal 4 shown in Figs. 1 and 5. After the wire 5 is placed in the aligned apertures 6—6, the portion of wire 5 which extends transversely across the inner portion of the tubular casing 1 is drawn outward through an end of the casing to form a U-shaped portion 7 so that the closed end of the U-shaped portion 7 extends outward beyond an end of the tubular casing 1. The bending of the wire 5 to form the U-shaped portion 7 is done to facilitate the making of an electrical connection between the wire 5 and an end portion 8 of the coil 2 of resistance wire, the end portion 8 extending longitudinally of the axis of the tubular casing 1 and outwardly from an end of the casing a sufficient distance to meet the closed end of the U-shaped portion 7. The end portion 8 is then suitably connected to the closed end of the U-shaped portion 7 of the wire 5. To make the required electrical connection, the extreme end of the end portion 8 may be wrapped around the closed end of the U-shaped portion 7 or may be soldered thereto at 9 or may be wrapped around and soldered to the wire 5 at the point indicated.

If the coil 2 is made of a comparatively fine gauge resistance wire, a suitable lead wire may be provided between the end 8 and the closed end of the U-shaped portion 7 of the wire 5, the lead wire being electrically connected to the end 8 of the resistance coil 2 and to the closed end of the

U-shaped portion 7. The coil 2 of resistance wire may be of any required type, that is to say, it may be a bare wire, a wire having an oxidized outer surface, a wire helically coiled on a cord of insulating material, an enamel coated wire or a wire having some other covering of insulating material. It is obvious that if a bare wire is used the turns in the coil should be suitably spaced apart to prevent short circuiting of the various turns in the coil. Since the type of wire used is simply a matter of choice and not important to this invention, it will be assumed for the sake of clearness of description, that the wire has an insulating coating 10 and that the insulating coating 10 has been removed from the extreme end of the end portion 8 and that the bared end of the wire is electrically connected to the closed end of the U-shaped portion 7 of the wire 5.

After the electrical connection has been made between the end of the resistance coil 2 and the wire 5, the two free ends of the wire 5 are pulled outward relative to the tubular casing 1 and in opposite directions to eliminate the U-shaped portion 7 and to bring the point of connection between the resistance coil 2 and the wire 5 entirely within the tubular casing 1. When this is done the wire 5 will be straight as shown in Fig. 3 and the point of connection 9 between the wire 5 and the associated end of the resistance coil 2 will have moved into the tubular casing 1. It will be noted that when the point of connection 9 has been moved into the tubular casing 1, there is a slack portion 11 in the end portion of the resistance wire. To take up the slack portion 11, the wire 5 is twirled until the slack portion 11 of resistance wire 2 is wound upon the wire 5 as shown in Fig. 4. To form the terminal 4 the upper end portion of the wire 5 is then wrapped around the tubular casing 1 to form the loops 12 shown in Figs. 1 and 5 and then wrapped around the lower end portion of the wire 5 a sufficient number of times as shown at 13 to hold the loops 12 securely clamped around the tubular casing 1. In wrapping the wire 5 around the tubular casing 1 it is preferable to wrap it around at least one and one-half times. The lower end of the wire 5 serves as an extending portion suitable for connection to the wire of a circuit in which the resistance device is to be used. It will be readily seen that the wire 5 has become the terminal 4 shown in Figs. 1 and 5. The terminal 3 shown in Figs. 1 and 5 as being on the opposite end of the tubular casing 1 to that occupied by the terminal 4 is formed in its respective place in the same manner as the terminal 4.

After the terminals 3 and 4 have been formed as above described, the ends of the tubular casing 1 are closed by means of plugs 14 and 15. The plugs 14 and 15 are made of insulating material and completely close up the ends of the tubular casing 1 to prevent the entrance of moisture or other injurious agencies to the interior of the tubular casing 1. In some cases it may be found advisable to further protect the resistance coil 2 by filling the tubular casing 1 with some suitable insulating compound.

In Fig. 5 a filling 16 of insulating compound is shown as applied to the interior of the tubular casing 1. The filling 16 of insulating compound completely encloses the resistance coil 2 and the points of connection between the ends of the resistance coil and the portions of the terminals 3 and 4 which extends transversely through the tubular casing 1 and serves to seal the points where the wire of the terminal passes through the apertures 6—6 in the tubular casing 1. The plugs 14 and 15 are shown in contact with the filling 16 of insulating compound and it is obvious that the plugs may be placed in position while the insulating compound is in a plastic condition so that the plugs 14 and 15 will be securely held in place by the filling 16 of insulating compound, when the compound hardens.

It may be found advisable for economy in manufacture to completely fill the tubular casing 1 with the insulating compound, and thus make unnecessary the use of the plugs 14 and 15. If no filling of insulating compound is required, the plugs 14 and 15 may be secured in place by means of cement or in some other manner found adaptable for the purpose.

What is claimed is:

1. A method of attaching a terminal to a resistance element enclosed in a protective casing and of forming the terminal on the protective casing comprising thrusting an end of a wire transversely through the casing, drawing an intermediate portion of the wire outward from an end of the casing, attaching a resistance element in the casing to the drawn out portion of wire, pulling the wire ends to draw the drawn out portion of wire back into the casing, winding a portion of the wire around the outer surface of the casing and fastening portions of the wire together on the outside of the casing.

2. A method of attaching a terminal to a resistance element enclosed in a protective casing and of forming the terminal on the protective casing comprising thrusting an end of a wire transversely through the casing, drawing a portion of the wire in the form of a loop outward from an end of the casing, attaching a resistance element in the casing to the loop of wire, pulling the wire ends to eliminate the loop, axially turning the wire to take up on the wire any slack in the resistance element adjacent the point of connection between the resistance element and the wire, winding a portion of the wire around the outer surface of the casing and fastening portions of the wire together on the outside of the casing.

3. In a resistance device comprising a tubular casing and a resistance element enclosed in said tubular casing, a terminal comprising a wire having a free end portion extending radially of said tubular casing, a portion extending transversely through said tubular casing and connected at a point within the tubular casing to said resistance element, a portion of said resistance element being wound around said wire, and a portion of said wire wrapped at least one and one-half times around the outside of said casing and anchored to the free end portion of said wire to clamp the turns of said wire to the casing.

ARTHUR H. SCHAFER.