

Nov. 8, 1949

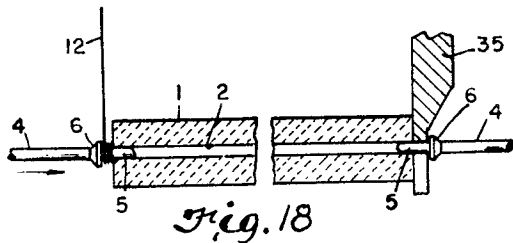
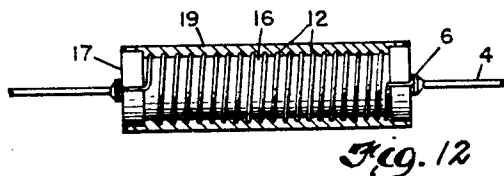
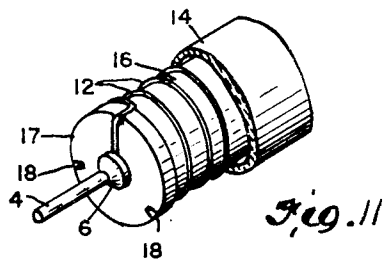
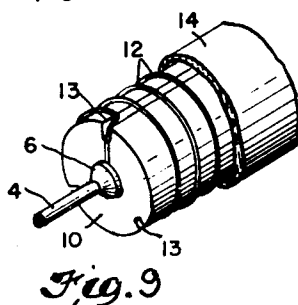
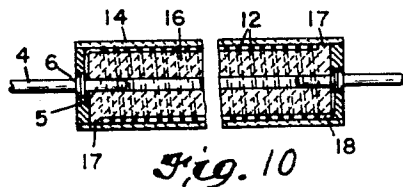
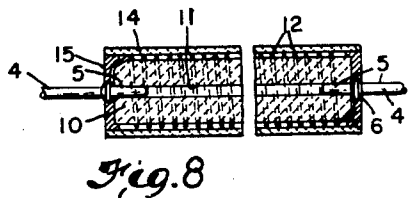
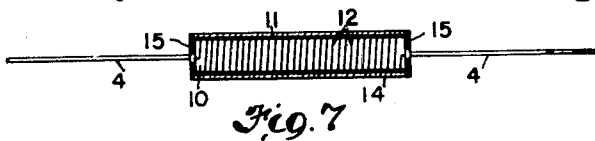
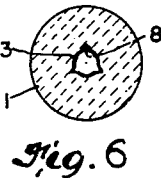
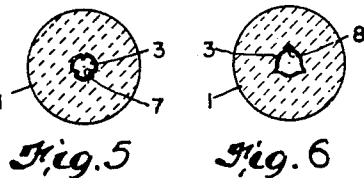
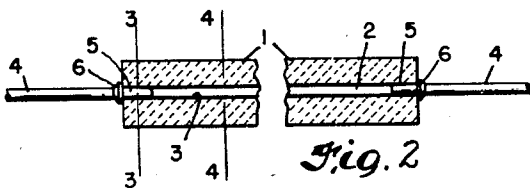
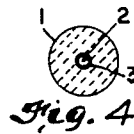
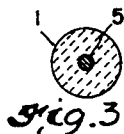
W. M. KOHRING

2,487,057

RESISTANCE UNIT AND METHOD OF MAKING SAME

Filed Feb. 23, 1946

2 Sheets-Sheet 1



INVENTOR.
WILBUR M. KOHRING

BY

Oberlin & Limbach
ATTORNEYS

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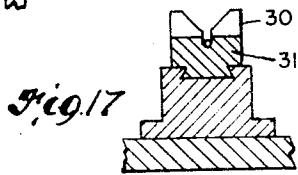
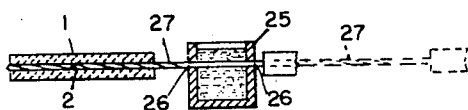
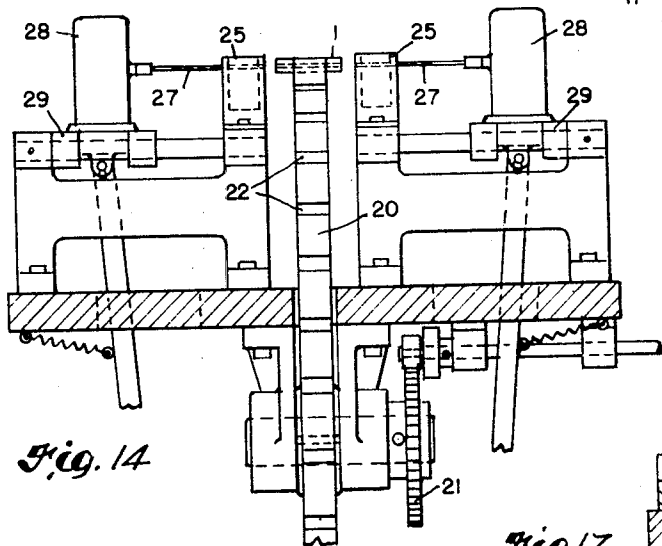
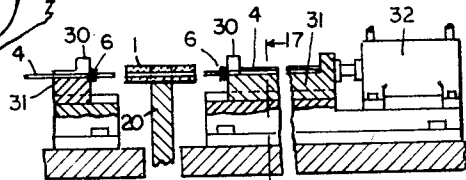
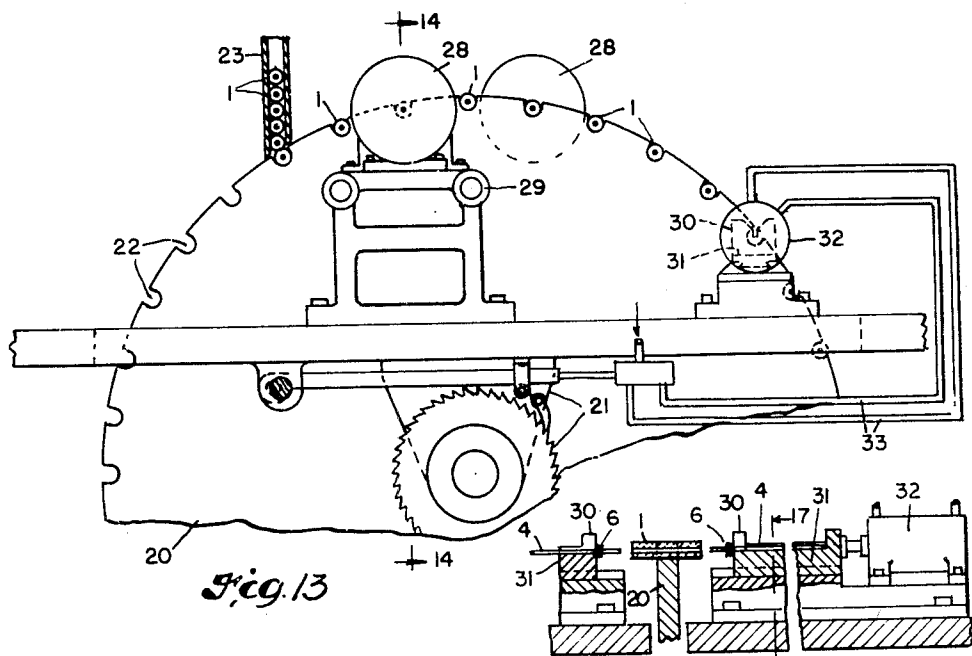
W. M. KOHRING

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RESISTANCE UNIT AND METHOD OF MAKING SAME

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2 Sheets-Sheet 2



INVENTOR.

WILBUR M. KOHRING

BY

Oberlin & Limbach
ATTORNEYS

UNITED STATES PATENT OFFICE

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RESISTANCE UNIT AND METHOD OF
MAKING SAME

Wilbur M. Kohring, Lakewood, Ohio

Application February 23, 1946, Serial No. 649,559

3 Claims. (Cl. 201-64)

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The present improvements while relating generally to resistance units, irrespective of their application, have more particular regard to resistance units such as are utilized in communication and signalling systems, both wire and radio, in which the electric currents involved are of relatively low amperage.

Great numbers of such units are, for example, required in connection with modern radio transmitting and receiving equipment so that the cost thereof is of important consideration. At the same time it is quite essential that such resistance units should be of sturdy construction, not subject to deterioration in use, and capable of convenient installation.

Accordingly, one principal object of the present invention is to provide a unit which will be of exceedingly simple construction and yet be capable of standing up under severe conditions of use. A further object is to provide a unit which is adapted for manufacture by automatic or semi-automatic methods, thus permitting quantity production and corresponding reduction in cost.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims.

The annexed drawing and the following description set forth in detail certain methods and products exemplifying the invention, such disclosed procedures and products constituting, however, but several of various applications of the principle of the invention.

In said annexed drawings:

Fig. 1 is a side elevation of one form of my improved resistance unit;

Fig. 2 is a longitudinal central section thereof on a somewhat larger scale;

Figs. 3 and 4 are transverse cross-sections thereof on the same scale as that of Fig. 2, the planes of such sections being indicated by the lines 3-3 and 4-4 respectively on said figure;

Figs. 5 and 6 are cross-sectional views both taken on the plane indicated by the line 3-3 on Fig. 2, but on a still larger scale in order to better illustrate certain modifications which may be employed in order better to secure the terminals of the unit to the body member;

Fig. 7 is partly a side elevation and partly a sectional view of a modification of the unit;

Fig. 8 is a central longitudinal section of such modified form;

Fig. 9 is a perspective view of one end of such modified unit with portions broken away in order better to illustrate the construction;

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Fig. 10 is likewise a central longitudinal section of still another modified form of my unit;

Fig. 11, like Fig. 9, is a perspective view of one end of such unit with a portion thereof broken away;

Fig. 12 is a central longitudinal section of still another modified construction of my unit;

Fig. 13 is a side elevation, more or less diagrammatic in character, of an apparatus designed for use in assembling resistance units of the forms illustrated in Figs. 1 to 6 inc.;

Fig. 14 is a transverse sectional view of such apparatus, the plane of the section being indicated by the line 14-14 Fig. 13;

Fig. 15 is a view of a detail of the apparatus as shown in Fig. 14 but showing a different operative position of certain parts of the apparatus;

Fig. 16 is a transverse sectional view of another portion of the apparatus, the plane of the section being indicated by the line 16-16 on Fig. 13;

Fig. 17 is a transverse view of the portion of the apparatus illustrated in Fig. 16, the plane of the section being indicated by the line 17-17 on said figure; and

Fig. 18 is a view, more or less diagrammatic in character, illustrating the manner of assembling certain of the parts that enter into the several modified forms of the unit shown in Figs. 7 to 12 inc.

Referring to the form of resistance unit illustrated in Figs. 1 to 6 inc., the body 1 thereof consists of a tubular member of insulating material such as molded resin, porcelain or other ceramic material, the size of said member, and more particularly the superficial area of the axial bore 2 that extends therethrough, being varied to suit the requirements for which the unit is designed. The surface in question has applied thereto (Fig. 2) a thin coating 3 of graphite, amorphous carbon, or like conducting material. The latter may be applied in various ways, for example in the form of a paste made by intermixing such graphite or the like with a suitable vehicle, such as a liquid resin, varnish or similar binder. While such coating composition may be applied in any suitable manner, as by dipping or spraying, it will preferably be applied in the manner and using the apparatus hereinafter described so as to insure uniformity in the coating with correspondingly close limitation of the specific resistance which such coating will provide when connected with the terminals 4, 4 of the unit.

The latter, which will consist of any suitable metal, preferably comprise short lengths of wire, the inner ends 5 whereof have a diameter slight-

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ly larger than that of bore 2 in the body of the unit. Such terminals 4 are also preferably, although not necessarily, formed with integral upset shoulders 6 spaced a short distance from the inner ends thereof so as to insure the correct location of such ends when the terminals are inserted in the body, or in other words, insure uniformity in the longitudinal extent of the coating 3 which lies between and electrically connects such ends. As a result the resistance afforded by such coating may be accurately gauged.

In order to insure a firm connection between the ends 5 of terminals 4 where they are thus fitted into the bore 2 of the body of the unit, such bore may be formed with angular longitudinally extending ribs 7, as illustrated in Fig. 5, or with similar longitudinally extending angular grooves 8, as illustrated in Fig. 6. Accordingly, remembering that the diameter of such terminal ends is equal to or slightly greater than that of the bore, when the former are forcibly inserted into the latter the metal composing the terminals will either be cut by the ribs 7 or forced into the grooves 8 so as to provide a very firm, serrated connection between the two parts in question. It will be understood that the coating 3 as initially applied to the bore 2 extends substantially to the respective ends thereof, and the terminals when thus forced into position in the body of the unit will necessarily have good electrical contact with such coating.

Before describing the preferred method for assembling the parts of the resistance unit described above, it will be convenient to describe the several modified forms illustrated in Figs. 7 to 12 inc.

In the form shown in Figs. 7, 8 and 9 a tubular body 10, similar to body 1 is employed, and terminals 4, identical with those previously described and inserted in the same manner in the bore 11 of such body, are utilized. However, instead of applying a graphite or other coating to the interior surface of such bore in order to provide the desired resistance connection between such terminals, a fine wire 12 is wound helically about the outer cylindrical surface of said body, the ends of the wire being secured to the respective terminals 4 by being wound closely therearound adjacent the shoulders 6 thereon prior to such terminals being forced into their final positions in the body. The convolutions of the wire 12 are of course spaced a sufficient distance apart to avoid any electrical connection therebetween, and in order that they will be held in place the body 11 is formed with one or more notches 13 so that the wire at the corresponding end may be engaged in one such notch (see Fig. 9). In order further to insure against displacement of the convolutions of wire 12 a cylindrical sheath 14 of insulating material is slipped over the same. Such sheath (see Fig. 8) extends a short distance beyond each end of body 10 and the space between such projecting ends and the shoulders 6 on terminals 4 is filled in with plastic insulating material 15, thus providing in effect a close fitting case for the assembled unit, in its entirety.

The form of the device illustrated in Figs. 10 and 11 differs from that just described merely in that the body 16 of the unit is formed at each end with an enlarged head or flange 17 in which notches 18 are provided to catch and hold the corresponding end of the wire 12. The construction otherwise, including the manner in which the unit as a whole is encased, is exactly the same

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as in the form shown in Figs. 8 and 9 and the same reference numerals are applied to corresponding parts.

Fig. 12 illustrates a further modification of the form of the device shown in Figs. 10 and 11 in that instead of fitting a sheath 14 over the unit a layer 19 of insulating plastic material is applied directly to the outer surface of the body 16 so as to completely fill the space between the heads 17 and embed the convolutions of the wire 12 that is helically wound upon such body. If desired, such plastic material may also be applied to the ends of the body so as to encase the same, together with the shoulders 6 on the respective terminals 4, in the same manner as is illustrated in Figs. 7 and 8.

As previously indicated, my improved resistance unit, and particularly the forms thereof illustrated in Figs. 1 to 6 inc., are readily adapted for automatic or semi-automatic assembly, and in Figs. 13 to 17 inc. there is diagrammatically shown an apparatus for carrying out such manufacture. The main element of such apparatus consists of a rotatable disc 20 to which intermittent rotative movement may be imparted, as by means of a pawl and ratchet mechanism 21, the amount of each such movement corresponding with the distance between a series of equally spaced transverse grooves 22 provided in the peripheral surface of said disc. The width of the latter is somewhat less than the length of the body 1 of the particular unit to be assembled, and as the disc rotates successive such bodies are supplied to successive slots 23 from a chute 23 or other suitable feed mechanism. As shown in Fig. 13, the bodies are thus fed to the slots as they approach their uppermost position in the course of rotation of the disc so that said bodies will remain under gravity where placed, and so be carried by the disc into position to be operated upon by the successive instrumentalities which will now be described.

Located at a suitable distance beyond the station where the bodies are thus supplied to the disc, and likewise themselves spaced a suitable distance apart, are the two similar mechanisms illustrated in Figs. 14 and 15 whereby the coating is applied to the interior bores of the bodies. These mechanisms are identical except that one operates from one side and the other from the opposite side of the body 1 as the latter is brought into alignment therewith. Each such mechanism comprises a stationary container 25 in which is maintained a body of the liquid coating composition, such container (see Fig. 15) having apertures 26 in its respective side walls which are aligned with the bore 2 of the body 1 when brought in proper position in relation to the mechanism by the step-by-step rotation of disc 20. Extending through such apertures 26 is a rotatable fluted rod which may conveniently consist of a twist drill of proper length and of a diameter such as will permit it to enter the bore 2 of body 1 and leave just sufficient space for a coating of desired thickness to be applied to the surface of such bore. Each such drill-like element 27 is connected with a small electric motor 28 which is mounted for reciprocable movement transversely of disc 20. It will be understood that suitable operative connections, which need not be described in detail, are provided between a slide 29 which carries each such motor and corresponding drill and the disc 20, so that the reciprocating movement of the drills will be properly timed in relation to the step-by-step ro-

tative movement of said disc to bring a body 1 successively in alignment with a drill located first opposite one end and then opposite the other end of said body. Thereupon the drills, while rapidly rotating, are advanced through the liquid composition in the corresponding containers 25 into and through the bore 2 of body 1. As a result a very uniform application of the coating material to the surface of such bore is obtained.

The remaining operation, that of inserting the terminals 4, is carried out by the mechanism illustrated in Figs. 16 and 17 which may be located at any point beyond the station occupied by the last of the two coating mechanisms. However, as shown in Fig. 13, such location should be adjacent the upper portion of the disc so that the bodies 1 successively brought into operative relation thereto will still remain in place in the transverse grooves 22 in the disc. The mechanism in question comprises simply two similar jaws or holders 30 mounted on transversely reciprocable slides 31, one on one side and the other on the other side of the disc. Each such jaw or holder is formed to receive a corresponding terminal 4 and engage the shoulder 6 thereon. The terminals are thus inserted in the jaws or holders when the latter are in their retracted positions. Thereupon when a body 1 is brought into alignment with the terminals thus held, the two slides are simultaneously moved toward each other, by means of picker and cylindrical actuators 32 controlled through suitable connections 33 which effect such operation in timed relation to the step-by-step movement of the disc 20. Upon retraction of the slides the terminals thus inserted in the inoperative ends of the body are left properly placed and firmly secured thereto so that upon the further rotation of the disc the body may be discharged therefrom. Such discharge will occur by the body simply dropping out of the slot when the latter reaches the proper inclination.

The modified construction of resistance unit illustrated in Figs. 7 to 12 does not lend itself so readily to automatic assembly. However, in Fig. 18 there is illustrated one convenient method for effecting assembly of such unit. As there shown, the terminals 4 are initially inserted only part way into the bore 2 of body 1 so as to leave the shoulders 6 on said terminals spaced a short distance from the respective ends of the body. A forked member 35 is then inserted between the shoulder on one such terminal and the adjacent body end, while the end of the wire 12 is wound around the opposite terminal adjacent the shoulder thereon. Next, such last-mentioned terminal is forced into its final position, thus firmly securing the end of the wire in place. Then the wire is wound upon the body so as to provide the requisite number of turns, and upon withdrawing member 35 it is finally wound around the other terminal adjacent the shoulder thereon. Such last-mentioned terminal is then forced into its final position and this portion of the assembly operation is completed.

As previously indicated, the provision of the

upset shoulders 6 on the terminals 4 is desirable inasmuch as they serve as stops to limit the inward movement of the terminals when inserted in the bore of the insulating body 1 and thus determine accurately the longitudinal extent of the coating of resistance conducting material applied to the surface of such bore. Furthermore, such shoulders facilitate the insertion of the terminals by means such as have been hereinbefore described. However, absent such shoulders, the terminals may still be inserted by other means which will control the extent to which they enter the respective ends of the bore and thus equally accurately gauge the longitudinal extent of the intervening coating which constitutes the resistance element in the unit.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the product and method herein disclosed, provided the step or steps stated by any of the following claims or the equivalent of such stated step or steps be employed.

I therefore particularly point out and distinctly claim as my invention:

1. A resistance unit comprising a tubular member of insulating material, resistance conducting material applied in the form of a coating to the surface of the bore of said member, and wire terminals inserted in the respective ends of said member and electrically connected with said resistance material, said terminals having serrated engagement with such bore.

2. A resistance unit comprising a tubular member of insulating material, resistance conducting material applied in the form of a coating to the surface of the bore of said member, and wire terminals inserted in the respective ends of said member and electrically connected with said resistance material, said terminals having serrated engagement with such bore and having shoulders adapted to contact with the corresponding ends of said member and act as stops.

3. In the manufacture of resistance units of the type wherein a coating of resistance conducting material is applied to the interior of a tubular member of insulating material, the step which comprises inserting into and withdrawing from the bore of said member, first one end then the other thereof, a rotating fluted rod carrying such material.

WILBUR M. KOHRING.

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