May 4, 1937. H. L. BRADLEY 2,079,369

INSULATED RESISTANCE UNIT

Filed Oct. 9, 1935 3 Sheets-Sheet 1

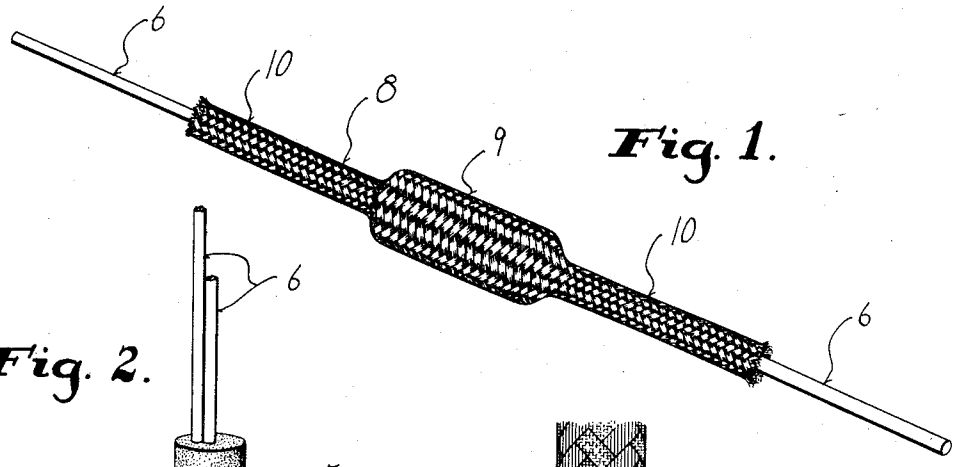

Fig. 1.

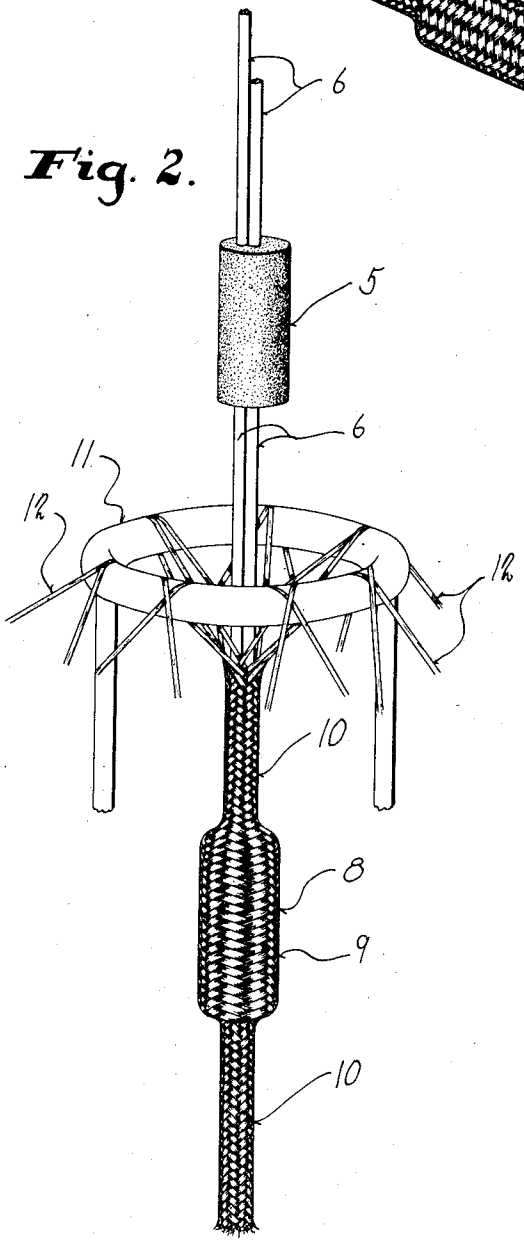

Fig. 2.

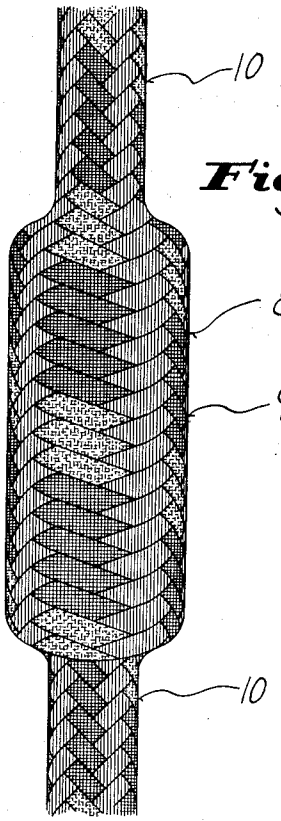

Fig. 3.

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INSULATED RESISTANCE UNIT

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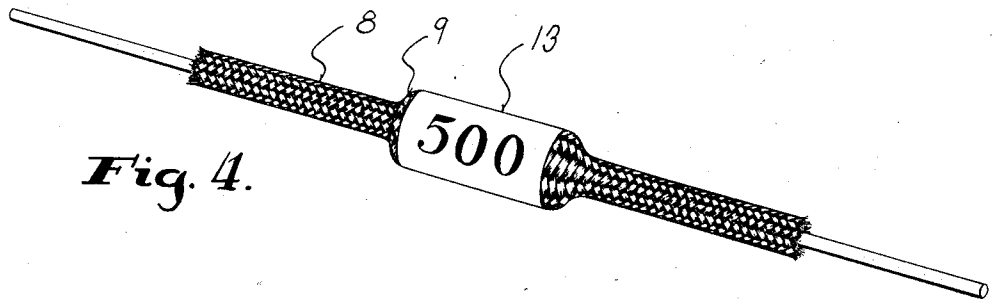

Fig. 4.

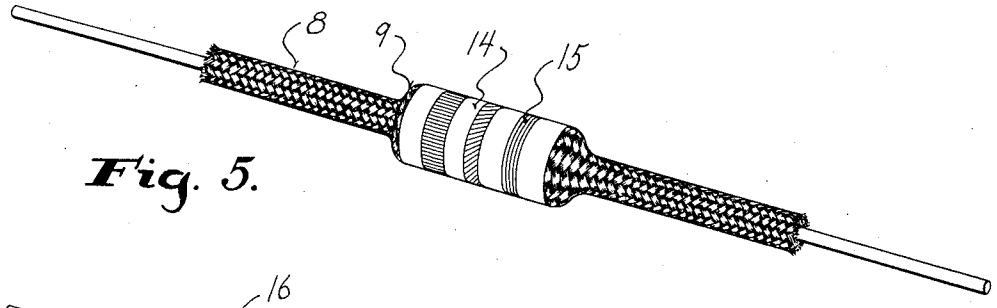

Fig. 5.

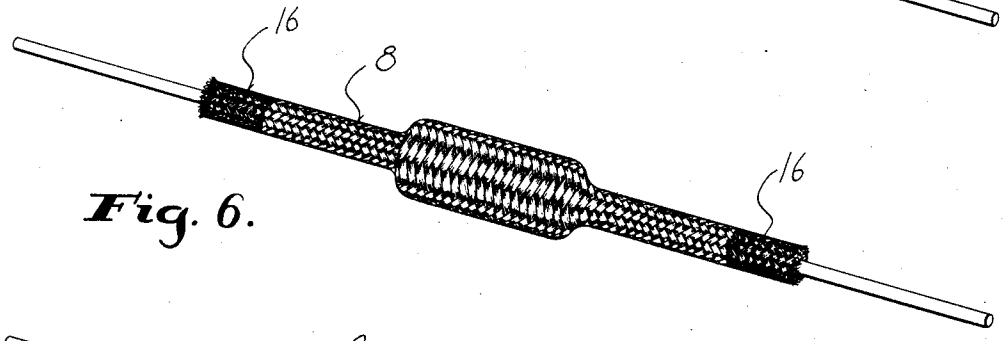

Fig. 6.

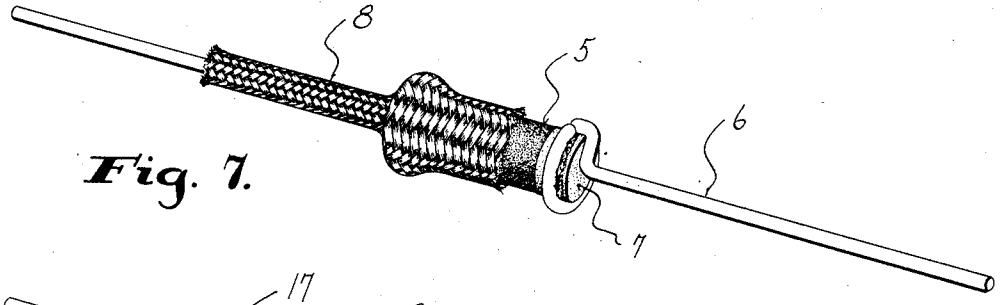

Fig. 7.

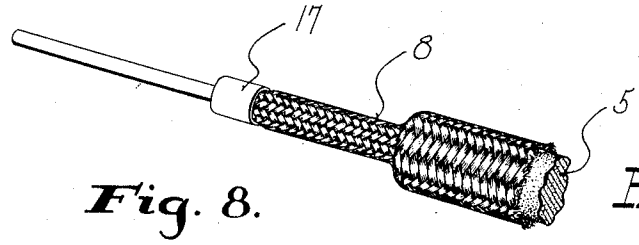

Fig. 8.

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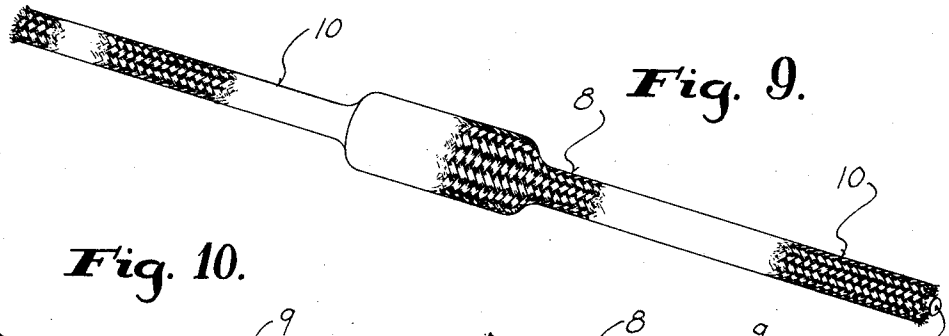
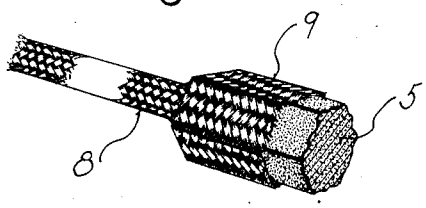


Fig. 9.

Fig. 10.



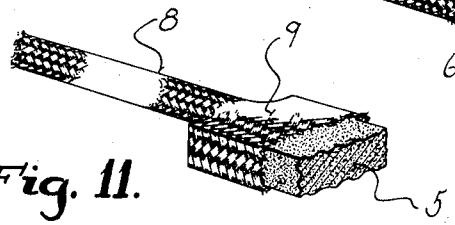
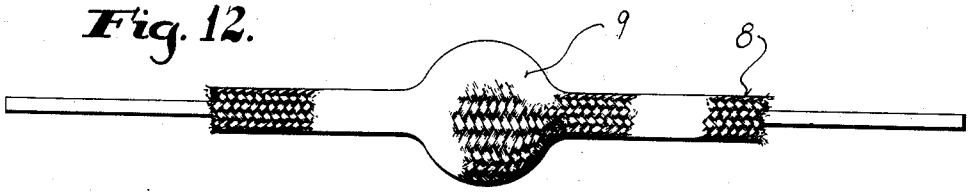
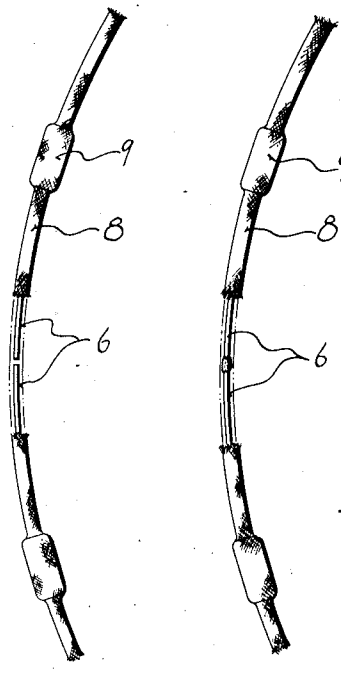


Fig. 11.

Fig. 12.





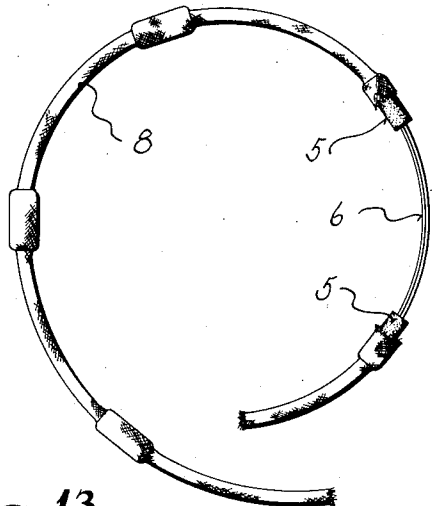


Fig. 13.

Fig. 14.

Fig. 15.

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Patented May 4, 1937 2,079,369

UNITED STATES PATENT OFFICE

2,079,369

INSULATED RESISTANCE UNIT

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Application October 9, 1935, Serial No. 44,226

4 Claims. (Cl. 201—63)

This invention relates to electrical resistance units, and particularly to the type used in radio receiving apparatus. These units comprise a resistance element, terminals for the element, and wire leads fixed to the terminals for connecting the unit in an electric circuit. In some instances, there are no terminals as such, the wire leads being attached directly to the ends of the resistance element.

The resistance element may be of the wire wound type or the lumped molded type in which the element consists of a body molded or otherwise formed of resistance material, and while the invention is equally applicable to the wire wound unit, only the lumped type of unit has been shown.

In view of the importance of fixed resistances in radio receivers, the industry has set high standards in the matter of accuracy and stability of resistance units. Coupled with these requirements is an increasing demand for smaller overall dimensions and lower cost. Meeting these specifications, especially the item of cost, taxed the ingenuity of the manufacturer of resistance units to the utmost and left an exceedingly slim margin of profit.

But this is not the full extent of the manufacturer's problem. The small space available in the modern receiver for its wiring has introduced another difficulty. The unit must now be insulated.

So that this problem can be fully appreciated, it is pointed out that if the unit is to be effectually insulated the wire leads for connecting the unit in a circuit must be insulated as well as the resistance element. Obviously, the leads must be flexible. Hence, the insulation for the leads must not interfere with their flexibility and the insulating value of whatever insulating medium is employed must not be destroyed by the flexing of the leads. Also, to enable the rapid attachment of the wire leads to the circuit terminals by the cheap labor usually employed for the assembly of radio receivers, the insulation for the leads must be of such nature that the proper length of lead can be instantly and easily exposed or bared. This is necessitated by reason of the fact that the distance between the circuit terminals to which the wire leads are to be soldered varies so that the standard length of bare lead may be insufficient.

Furthermore, any insulation which is provided must be a permanent part of the unit so that as an article of sale, the resistor with its insulation is one complete and composite unit, and above all, the insulation must be inexpensive and capable of practical application to the unit at a low cost.

A poll of the heretofore known methods of providing insulation in the electrical art quickly reveals the inefficacy of these past methods when applied to present requirements. Of all past schemes of providing insulation suitable for a fixed resistance unit, the method of dipping the unit in enamel or some other similar insulating substance and then baking it, is the one most commonly used. This method, however, does not solve the problem.

It is a known fact that enamel or varnish suitable for insulating purposes will not flow properly to cover sharp corners. Hence, the degree of insulation afforded by this method is indefinite and not reliable. Also, regardless of how the insulating enamel or varnish is applied, it is impossible to accurately determine the length of lead covered. Moreover, a baked-on enamel or varnish insulation interferes with the flexibility of the leads and is cracked off in the necessary handling of the unit and by the bending of the leads during the installation of the unit.

Besides coating the unit with enamel or insulating varnish, in some past instances a fabric insulation has been used, but in these past uses of this form of insulation the fabric covering extended only over the resistance element and not over the leads or terminals. This form of insulation has been practically restricted to wire wound units, and generally the terminals of the unit were utilized to hold the fabric covering in place.

Another form of insulation for fixed resistance units consisted of a tube of ceramic material encasing the resistance element of the unit with overhanging end portions extending out over the terminals of the unit, the ceramic shell being held in place by the terminals. The deficiency of this manner of providing insulation as well as that of the fabric covered resistance element in the wire wound type is obvious. In both instances, the wire leads were entirely bare.

In addition to the above noted methods of providing insulation for resistance units heretofore used, manufacturers of radio receivers and radio repairmen often slipped a length of so-called "spaghetti" tubing insulation over both the resistance element and the lead wires of the unit where it was absolutely necessary to provide complete insulation for the entire unit including the wire leads.

The impracticability of this manner of provid-

ing insulation is apparent. While it covered both the resistance element and the wire leads and also the terminals (if the unit had them), the insulation was not a permanent part of the unit and hence could not answer the present requirements. However, this latter manner of providing insulation, while but a makeshift was the best solution to the problem of a completely insulated resistance unit which the skilled worker could produce.

These expedients comprise substantially the entire extent of the heretofore known ways of providing insulation for fixed resistance units, but clearly they left the problem of providing a permanently and completely insulated fixed resistance unit comprising a resistance element with leads attached thereto unsolved. In each of these past attempts there were deficiencies which precluded them from providing a satisfactory and complete solution to the problem, but the industry, although it recognized and appreciated the desirability and need for a completely insulated unit in which the insulation was a permanent part of the unit and flexible to permit the necessary flexing of the leads, contented itself with these "half measures" in the belief that a satisfactory complete insulation could not be had.

It is thus the primary object of the present invention to provide a fixed resistance unit which is completely insulated and in which not only the resistance element of the unit but also its terminals and leads are covered with a suitable insulation.

Another requirement which the trade has imposed upon the manufacturer of resistance units is that the units be clearly marked as to resistance value and tolerance.

Hence, it is another object of this invention to provide insulation for a fixed resistance unit and its leads, the inherent characteristics of which are such that the insulation itself may be utilized to provide the necessary code marking.

Another object of this invention is to provide an insulating covering for fixed resistance units having adjustable portions covering the wire leads of the unit, the adjustment referred to being endwise to enable an additional length of wire lead to be quickly and easily bared.

The above and other objects which will appear as the description proceeds are attained through the use of a braided insulating sheath enclosing the entire unit including the terminals and leads.

It has been found that through the use of a conventional textile braiding machine, the general construction of which is well known, it is possible to form a braided sheath about a resistance unit, including its terminals and wire leads, which has all the qualifications of a good insulation at an exceptionally low cost.

In this manner, continuous production can be maintained by feeding the uncovered units which consist of a resistance element with wire leads attached to the ends thereof directly or through terminals, into the braiding machine in endwise succession. The braiding machine is so adjusted and operates in such a manner that the braided fabric sheath is formed to fit snugly about the resistance element of the unit regardless of what its shape may be, and substantially closely about the wire leads. The result is a resistance unit having an insulating covering fitted to the contour of the resistance element to be held thereby against displacement while at the same time the insulating covering for the leads is adjustable to permit the proper length of lead to be instantly bared.

The individual threads comprising the insulating sheath for ordinary purposes are of cotton or rayon. In the event a higher insulating factor is desired, the threads may be coated with rubber, and while generally a single sheath affords adequate protection, special conditions and requirements may be easily met by providing two layers of braided material.

Moreover, the individual threads of which the insulating sheath is braided may be of different colors and arranged in such relationship as to provide the desired marking for the unit, or a single color combination may be employed and the necessary indicia for determining the resistance value and tolerance of the unit may be provided by other means applied to the braided sheath.

The accompanying drawings, which form a part of this specification, illustrate several complete examples of the physical embodiment of the invention in its preferred and modified forms constructed according to the best modes so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a perspective view of a fixed resistance unit illustrating the preferred embodiment of the invention in which the resistance element is of the lumped type and has a cylindrical shape with the wire leads projecting from the ends thereof;

Figure 2 is a perspective view showing the method of braiding the insulating sheath continuously about the units as they are fed in endwise succession into a braiding machine;

Figure 3 is an enlarged detail view illustrating the use of threads of different colors to indicate the resistance value of the unit;

Figures 4 and 5 are perspective views of resistance units constructed in accordance with this invention and showing different methods of indicating the resistance value thereof;

Figure 6 is a perspective view of a unit showing one manner of indicating the tolerance of the unit as by applying the indicating means to the ends of the insulating material;

Figure 7 is a perspective view of a resistance unit of slightly modified construction with part of its insulating sheath removed to show a different method of attaching the wire leads to the resistance element;

Figure 8 is a perspective view of part of a resistance unit showing another manner of indicating tolerance;

Figure 9 illustrates a slightly modified embodiment of the invention with the leads entirely insulated;

Figures 10, 11, and 12 are perspective views showing the application of the invention to resistance units of different shapes;

Figure 13 shows a length of connected units as they leave the braiding machine and having their leads overlapped;

Figure 14 shows how the units may be joined in endwise spaced relation by the insulating sheath; and

Figure 15 is a view similar to Figure 14 but showing the units welded together so that the composite structure forms one continuous conductor with spaced high resistance portions all insulated by one continuous sheath.

Referring now more particularly to the accompanying drawings in which like numerals indicate like parts throughout the several views, the numeral 5 designates the body or resistance element of a resistance unit of the lumped type.

The body or resistance element may be molded of any suitable material and preferably has a substantially cylindrical shape.

Attached to the opposite ends of the body 5 are flexible wire leads 6. The manner in which the leads 6 are secured to the body forms no part of this invention. They may be attached by having a portion thereof embedded in the body 5, or, as shown in Figure 7, the wire may be looped about and soldered to terminal caps 7 on the ends of the unit. The terminal caps 7 may be provided by spraying molten metal directly onto the body 5.

Enclosing the complete unit, including its terminal portions and all or a portion of the wire leads, is a braided insulating sheath 8. This sheath has a central portion 9 which snugly fits the contour of the resistance element or body 5 and end portions 10 in which the leads 6 or a part thereof are disposed. These end portions 10 may terminate short of the extreme ends of the leads 6, as specifically shown in Figure 1, or as shown in Figure 9, may extend to the extreme ends of the leads so that the leads are entirely covered.

Regardless of the shape or configuration of the body 5, which as shown in Figures 10, 11, and 12, may take any suitable form, the central portion 9 of the insulation closely hugs the body and by virtue of the abrupt change in size at the juncture of the body and its leads, the insulation is held against endwise movement on the body. Where the body takes a cylindrical shape, which has been found most preferable, and also with the globular shaped body shown in Figure 12, the insulation is free to rotate about the body, but in no event is it movable endwise on the body.

In this connection, it is to be noted that where the body is of polygonal shape in cross section, as shown in Figures 10 and 11, the ends of the body have more or less sharply defined corners which the insulation covering grips so that in these forms of the invention no relative motion is permitted between the insulation covering and the body of the unit.

In all instances, the end portions 10 of the insulation are freely movable along the leads to permit an additional length of lead to be instantaneously bared where desired for purposes of attachment to a circuit terminal, and as will be readily apparent, bending of the leads is in nowise interfered with nor is the insulation which the covering provides affected by the bending of the leads.

The method of forming the insulation about the units is illustrated in Figure 2. As here shown, the uncovered units are fed down through the ring 11 of a conventional textile braiding machine in endwise succession and as they move through the ring, the insulation is braided thereabout. The units may be fed into the machine in exact endwise succession, that is, with the ends of their adjacent leads just contacting or slightly spaced, or they may be first joined by butt welding the ends of their leads so as to provide one continuous unbroken chain which is continuously fed into the braiding machine.

It has been found desirable, however, to feed the units into the braiding machine with their leads overlapping, as shown in Figure 2, and the end of the lead of one unit abutting against the body of the other so as to maintain a definite spaced relationship between the units equal to the length of one lead wire.

As the units are fed down through the ring 11 of the braiding machine, the individual threads 12 are braided by the functioning of the machine into a continuous sheath enclosing the units. The specific construction of the braiding machine forms no part of this invention and has, therefore, not been shown, and furthermore, any type of braiding machine capable of braiding a tubular fabricated structure may be employed. The machine is so adjusted that the end portions 10 of the insulating sheath fit closely the overlapped leads 6 so that when the units are separated, the end portions 10 are quite free on the leads.

As the braiding continues along and over the leads to the point where the body 5 is about to be covered, the ring 11 is caused to shift downwardly by any suitable mechanism set in motion by a trip finger (not shown) actuated by the body of the just covered unit as it passes the finger so that the pitch of the braiding is reduced and also the rate of feed is reduced with the result that the weave is kept close even though a larger diameter sheath is being braided.

At the completion of a central portion 9, the diameter of the braided sheath is abruptly reduced and the ring 11 is restored to its initial position so as to again cause the machine to braid at a steeper angle. Concomitantly with the restoration of the ring to its initial position, the speed of the feed is also increased to what it was.

The output of the weaving machine is a continuous strand of connected units, as shown in Figure 13, and if desired, the units held together by the continuous braid which forms the insulation therefor may be rolled up on spools and sold in this manner, or the individual units may be separated by cutting the braid at a point intermediate two adjacent bodies. Cutting the fabric covering of the type shown in Figure 13 at this point automatically exposes one-half of the length of each wire lead as shown in Figure 1.

If the units are fed into the braiding machine in endwise spaced relationship, that is, with the ends of their adjacent leads in juxtaposition, but not connected, the product of the braiding machine is as shown in Figure 14. This product may also be rolled up and sold on spools or may be cut into individual units and when so cut the leads are completely covered, as shown in Figure 9.

By welding the ends of the leads together as shown in Figure 15, the product of the braiding machine is a continuous chain of resistance units, or in other words, an insulated electrical conductor having spaced portions of high resistance which may be sold in any desired length to be cut into shorter lengths of any number of connected units by the purchaser.

Code marking the units is effectually provided for by using threads of different colors in such relationship to each other that the result is an insulating sheath composed of certain definite colors arranged in a certain definite manner to provide proper marking for the resistance value of the unit. In Figure 3, a unit coded in this fashion is illustrated. A combination of three colors is employed in this instance.

The predominant color is red and longitudinal black stripes are provided with dots or small areas of yellow therein. By reference to the proper code chart, the resistance value of the unit provided with an insulating sheath colored in this manner can be readily determined.

The resistance value of the unit may also be shown by indicating numerically its resistance

in ohms upon a paper sleeve 13 which may be glued to the central portion 9 of the insulation, as shown in Figure 4, or, if desired, a paper sleeve 14 having differently colored bands 15 delineated thereon, as shown in Figure 5, may be employed.

Inasmuch as the resistance units are sold on the basis of resistance value tolerance, it is also preferable that this tolerance be indicated on the unit. The present invention lends itself admirably to this additional indicia, and in Figure 6 one manner of indicating tolerance is shown. As here shown, the extreme ends 16 of the end portions of the insulation are colored or otherwise set apart from the rest of the unit in accordance with a proper code developed for the representation of tolerances.

In place of applying coloring matter directly to the fabric of the insulation, a metal band 17, as shown in Figure 8, may be employed for the purpose of indicating tolerance. The provision of such a band also has the advantage of binding the end portion of the insulation closely to the lead wire, but of course without interfering with its adjustability along the lead wire, and of providing a neat appearance for the ends of the insulation.

From the foregoing description taken in connection with the accompanying drawings, it will be readily apparent to those skilled in the art, that this invention provides a resistance unit which has many advantages. Of primary importance is the fact that the unit is completely insulated. Not only is the resistance element covered, but also its terminals (if it has such) and the wire leads are provided with insulation. The attainment of this desirable result in the practical manner and at the nominal cost which the invention makes possible is another important item.

Other important advantages of the invention reside in the fact that the insulation in nowise interferes with the flexibility of the leads and is itself not affected by bending of the leads, and that it forms a permanent part of the unit although the end portions which cover the leads are readily adjustable along the leads to permit an additional length of lead to be exposed when necessary.

Also, by its inherent nature, the insulation provides coding for determining the resistance value of the unit, and it will not trap moisture. Any moisture which does penetrate under the insulation is freely expelled through the pores thereof.

Furthermore the appearance of the unit is materially enhanced which adds considerably to its salability.

While in the preceding specification, several embodiments of the invention have been shown and specifically described and in each instance a lumped type of resistor is shown, it is to be understood that the inventive concept is not to be restricted to this type of resistance unit. A wire wound unit having a resistance element with wire leads attached thereto also comes within the scope of this invention.

The invention further embraces the provision of an insulating covering for capacitors and inductors of the type now supplied to the radio industry. These capacitors and inductors are constructed similar to the resistance units illustrated in that they comprise a body portion with wire leads projecting from opposite ends thereof. Thus, as to their relationship to the insulating covering, such capacitors and inductors have the same characteristics as resistance units.

It is further desired to point out that while in the embodiments illustrated and described, only a single layer of fabric insulation is provided and the insulating sheath lies directly against the body of the unit, it is possible without deviating from the scope of the invention to provide an insulation of double thickness for special purposes with both layers composed of either the same material or of different materials, and to also provide the body of the unit under the fabric covering with means for either circulating air or with some other manner of providing heat insulation where high temperatures are apt to be developed by the unit.

What I claim as my invention is:

1. An insulating enclosure for electrical units of the type described having a body and wire leads projecting from opposite ends thereof, the body having a substantially greater transverse dimension than the diameter of the wire leads, said enclosure comprising a braided sheath having a body covering portion fitted to the body and integral small diameter end portions over the wire leads, the threads of the body covering portion having a flat pitch and the threads of the end portions having a steep pitch so that the entire sheath has a uniformly close weave.

2. As an article of manufacture an insulated resistance unit comprising a resistance element with wire leads extending from the ends thereof, the resistance element having a substantially greater transverse dimension than the diameter of the wire leads, and a fabric sheath covering the resistance element and extending over the wire leads, said sheath consisting of a medial portion fitted to the resistance element and integral small diameter end portions over the wire leads, the entire sheath being braided and all portions thereof having a uniformly close weave.

3. As an article of manufacture an insulated resistance unit comprising a resistance element with wire leads extending from the ends thereof, the resistance element having a substantially greater transverse dimension than the diameter of the wire leads, and a fabric sheath covering the resistance element and extending over the wire leads, said sheath consisting of a medial portion fitted to the resistance element and integral small diameter end portions over the wire leads, the entire sheath being braided, and the threads of the medial portion having a flat pitch and the threads of the small diameter end portions having a steep pitch so that the entire sheath has a uniformly close weave.

4. As an article of manufacture, an insulated resistance unit comprising a resistance element with wire leads extending from the ends thereof, the resistance element having a greater transverse dimension than the diameter of the wire leads, and a fabric sheath covering the resistance element and extending over the wire leads, said sheath consisting of a medial portion fitted to the resistance element and integral small diameter end portions over the wire leads, the entire sheath being braided, and the threads of the medial portion having a lesser pitch than the threads of the small diameter end portions so that the entire sheath has a uniformly close weave.

HARRY L. BRADLEY.