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A. HAYNMAN

2,879,361

RESISTOR

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Fig. 1

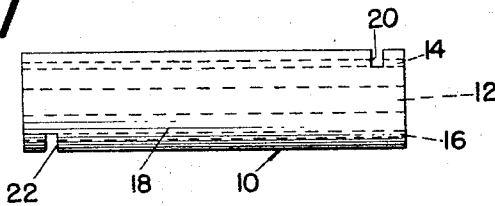
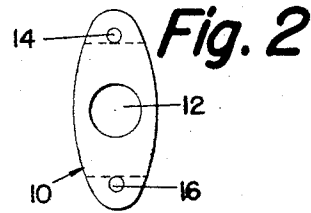


Fig. 3

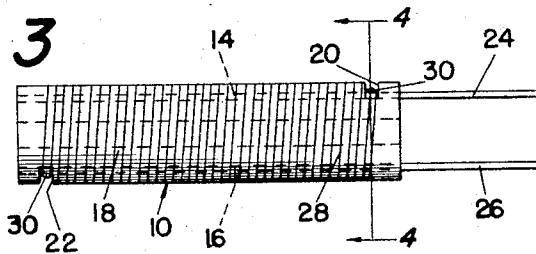
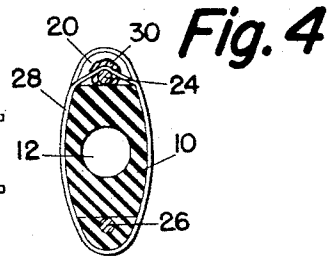


Fig. 5

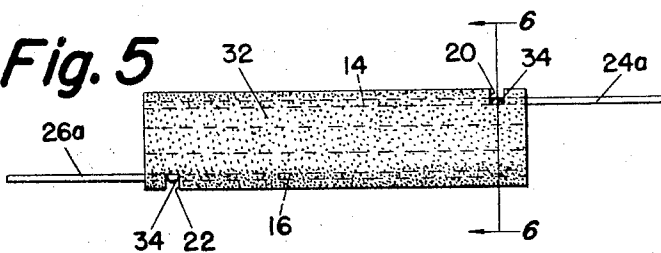
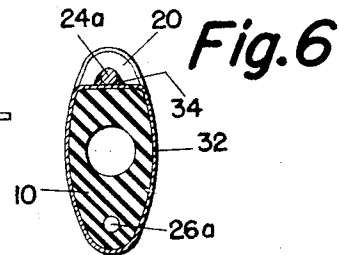


Fig. 7

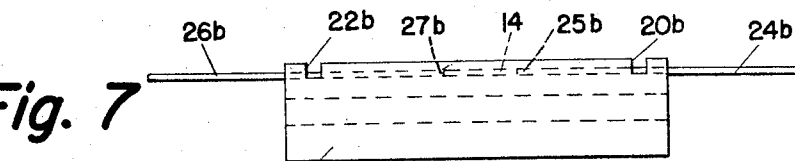
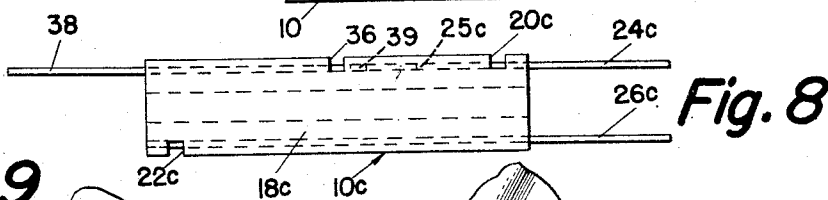


Fig. 9

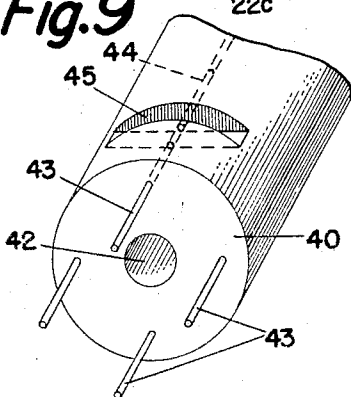
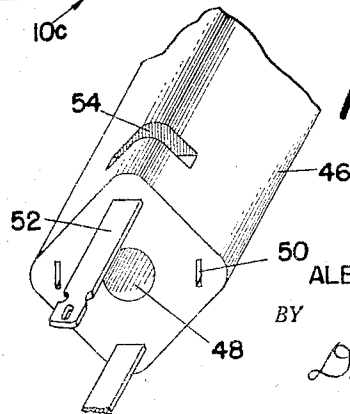


Fig. 10



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2,879,361

RESISTOR

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11 Claims. (Cl. 201—63)

My invention relates to the construction of an electrical resistor and more particularly to a termination for the resistor.

In general, electrical resistors comprise a core of an electrical insulating material, such as a ceramic or plastic, a resistance material either in the form of a metal wire helically wound along the surface of the core, or a film of a resistance material such as carbon or a metal coated on the surface of the core, terminals of an electrically conducting metal attached to the end portions of the resistance material, sometimes additional terminals attached to the resistance material at various points intermediate its end portions, and a protective insulating coating covering the resistance material. The construction of the terminals and the method of attaching them to the resistance material have presented many problems in the manufacture of such resistors.

In the wire wound type resistor, the terminals are usually soldered, welded or brazed to the resistance wire to provide a good electrical connection therebetween. However, prior to soldering or welding, it is a common practice to tie the resistance wire to the terminal or to a lug or projection on the terminal to maintain the resistance wire tightly wound on the core during the soldering or welding operation. This tie-on operation is both difficult and time consuming and therefore an expensive operation. Other problems arise from the fact that it is generally desirable to provide the connection between the resistance wire and the terminal on or along the surface of the core so that it is only necessary to provide the protective coating on the wound surface of the core. Since the terminals are of a much heavier material than the resistance wire, they will bulge through the protective coating unless the coating is made unnecessarily thicker. Also, to prevent cracking of the protective coating during operation of the resistor, it is necessary that the thermal coefficient of expansion of the coating material be substantially the same as that of the resistance wire and the terminals. It is difficult enough to match the coefficient of expansion of two different materials such as that of the protective coating and the wire, but it is even more difficult to also match that of the material of the terminals. Some wire wound resistors include additional terminals attached to the resistance wire between the end terminals to permit the obtaining of various resistance values from the single component. For such components not only do the previously discussed problems prevail but there is the additional problem of designing the additional terminals and the method of attaching them to the resistance wire so that the terminals do not short out too many turns of the wire and so that the terminals do not interfere with the winding of the wire on the core member.

For the film type resistor the terminals are usually attached to the core and the resistance material film either by metal caps telescoped over the ends of the coated core or by metal bands clamped around the core

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or by wires inserted into central holes in the ends of the core and connected to the film by an electrically conducting cement or solder. The first two types of terminals raise the problem of bulges in the protective coating while the third type requires additional protective coating material around the ends of the core. The same problems arise with the film type resistor as with the wire wound resistor in providing additional intermediate terminals.

It is therefore the object of my invention to provide a resistor construction wherein the resistance material is simply and easily connected to any desired number of terminals. Another object of my invention is to provide a wire wound resistor wherein the resistance wire is automatically connected to the terminals during the winding of the resistor. It is a further object of my invention to provide a resistor construction wherein the terminals can be easily and simply connected to the resistance material at any point therealong. It is still a further object of my invention to provide a resistor construction in which the terminals and their connections to the resistance material are below the surface of the core member. Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the features of construction, combinations of elements and arrangement of parts which will be exemplified in the constructions hereinafter set forth, and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawing in which:

Figure 1 is a side elevation view of the core element for the resistor of my invention;

Figure 2 is an enlarged end view of the core shown in Figure 1;

Figure 3 is a side elevation view of a wire wound resistor made in accordance with my invention;

Figure 4 is an enlarged sectional view of the wire wound resistor taken along line 4—4 of Figure 3;

Figure 5 is a side elevation view of a film type resistor made in accordance with my invention including a modification of the terminal arrangement;

Figure 6 is an enlarged sectional view of the film type resistor taken along line 6—6 of Figure 5;

Figure 7 is a side elevation view showing another modification of the terminal arrangement;

Figure 8 is a side elevation view showing still another modification of the terminal arrangement;

Figure 9 is a perspective view of a portion of a modification of the core element; and

Figure 10 is a perspective view of a portion of another modification of the core element including a modification of the terminal.

Referring to the drawing in which like numerals identify similar parts throughout, Figures 1 and 2 show an elongated core member 10 of my invention made of an electrical insulating material such as a plastic or ceramic which core can be used to make either a wire wound or film type resistor. The core 10 is shown to be substantially elliptical in transverse cross section (Fig. 2) and provided with a central longitudinally extending hole 12 which may be used in mounting the resistor. The core 10 also has a pair of small diameter holes 14 and 16 extending longitudinally therethrough just beneath the outer surface 18 thereof. The holes 14 and 16 are preferably located in the sharply rounded corners of the elliptical core for reasons which will be obvious later. A pair of longitudinally spaced transverse slots 20 and 22 are provided in the outer surface 18 of the core 10, each being across one of the sharply rounded

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corners. Slot 20 extends to hole 14 while slot 22 in the opposite corner extends to hole 16.

Figures 3 and 4 show the wire wound resistor of my invention which comprises the core 10, shown in Figures 1 and 2, having a pair of wire terminal members 24 and 26 of an electrically conducting metal inserted into holes 14 and 16 respectively until they cross slots 20 and 22 respectively. The terminal members 24 and 26 are preferably secured in the holes 14 and 16 by a friction fit. A resistance wire 28 is helically wound on the core surface 18 substantially from end to end thereof. Where the resistance wire winding 28 passes each of the slots 20 and 22, one or more turns of the wire extend in the slot across and preferably in contact with the portion of the terminal members 24 and 26 exposed at the bottom of the slots to provide an electrical connection therebetween (Figure 4). To ensure the electrical connection between the resistance wire 28 and the terminals 24 and 26 and to secure the winding on the core 10, the resistance wire 28 is soldered at 30 to each of the terminals 24 and 26 within the slots 20 and 22. The protective insulating covering (not shown) can then be coated over the core surface 18 and the resistance winding 28. Since the connections between the resistance wire 28 and the terminals 24 and 26 are in the slots 20 and 22, there are no projections above the winding to bulge through the protective coating. Also, since the terminals are not exposed along the core surface, there is no problem of matching the coefficient of expansion of the covering to that of the terminals to prevent cracking of the covering.

Figures 5 and 6 show the film type resistor of my invention in which the core element 10 is coated with a film 32 of an electrical resistance material. The material may be carbon or a metal having the desired resistance characteristics which is applied on the core by any desired method such as painting or spraying or deposited thereon by either pyrolytic deposition or evaporation in a vacuum. The film 32 extends into slots 20 and 22 to cover the bottom surfaces thereof as shown in Figure 6, or the sides of the slots, or all the surfaces thereof. Terminal 24a extends into hole 14 from one end of core 10 until it crosses slot 20 and terminal 26a extends into hole 16 from the other end of core 10 until it crosses slot 16. By having slots 20 and 22 extend to the bottom of holes 14 and 16 respectively and inserting the terminals 24a and 26a after resistance film 32 is applied to core 10, the terminals will automatically contact the film when they are inserted to provide the electrical connection therebetween. However, a cement 34 of an electrical conducting material may be applied in the slots between the terminals and the film to ensure the electrical connection therebetween (Figure 6). A protective coating (not shown) may then be applied around the resistor.

Although the wire wound resistor shown in Figures 3 and 4 has both terminals extending from the same end of the core 10, it may have the terminals extending from opposite ends of the core in the same manner as the film type resistor shown in Figures 5 and 6. Likewise the film type resistor may have both terminals extending from the same end thereof instead of from opposite ends as shown. Figure 7 shows another terminal arrangement which can be used for either the wire wound or film type resistor in which both slots 20b and 22b are across the same corner of core 10 and extend to hole 14. Terminals 24b and 26b extend into hole 14 from opposite ends of core 10 until they cross the closest slot. Care must be taken in inserting the terminals 24b and 26b so that their inner ends, 25b and 27b respectively, do not contact each other and thereby short out the unit. This may be prevented by inserting the terminals by means of an apparatus which automatically limits the distance each terminal is inserted or by providing two separate blind end holes extending from opposite ends of the core instead of the single through hole.

This method of attaching the terminals to the resist-

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ance material is particularly advantageous when it is desired to provide the resistor with additional terminals tapped into the resistance material intermediate the end terminals. Figure 8 shows such an arrangement in which the resistor comprises a core 10c having a pair of terminal members 24c and 26c extending from one end thereof and connected to the resistance material in slots 20c and 22c respectively in the same manner previously described. A third transverse slot 36 is provided in the core surface 18c intermediate slots 20c and 22c, and a third terminal 38 extends through the core 10 and across the third slot 36 where it is likewise connected to the resistance material. Care must be taken that the end 39 of terminal 38 does not contact the end 25c of terminal 24c. When used in a wire wound resistor as the resistance wire is helically wound on the core 10 at least one turn thereof will automatically extend into slot 36 and across and in contact with terminal 38. Thus there is provided an intermediate terminal which is easily and simply connected to the resistance material without substantially affecting the resistance value of the unit or in the case of the wire wound type without interfering with the winding of the wire on the core. Any number of additional terminals may be provided by inserting the terminals into both ends of the core and by spacing the terminals around the circumference of the core. The location of the transverse slot which exposes the terminal to the resistance material determines the resistance value tapped off by the terminals.

Although the core 10 is shown to be elliptical in transverse cross-section, it may be of any shape desired. For example, Figure 9 shows a core 40 circular in cross-section having a central mounting hole 42, terminals 43 fitting into a plurality of longitudinally extending terminal holes 44 spaced circumferentially around and slightly beneath the surface thereof and a transverse slot 45 extending to one of the holes 44. Figure 10 shows a substantially rectangular core 46 with rounded corners having a central mounting hole 48 and a longitudinally extending terminal hole 50 located in each corner thereof. Terminal holes 50 are rectangular to receive flat strip terminals 52. The flat terminals 52 can be used instead of the round wire terminals in any of the modifications previously described. A transverse slot 54 extends to one of the terminals 52. Cores having a configuration providing sharply rounded corners are preferred since they permit shorter transverse slots and in the wire wound type resistor ensure proper contact of the terminal by the resistance wire as the wire extends around the corner.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A resistor comprising the combination of a core of electrical insulating material having a hole extending longitudinally from one end and slightly beneath the surface thereof, a transverse slot in the surface of said core extending to said hole, a terminal within said hole and extending across said slot, and resistance material on the surface of said core and extending in said slot to electrically contact said terminal.

2. The combination as set forth in claim 1 in which said resistance material comprises a wire helically wound on the surface of said core with a portion thereof ex-

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tending in said slot across and in electrical contact with said terminal.

3. The combination as set forth in claim 1 in which said resistance material comprises a film coating the surface of said core and at least one surface of said slot.

4. A resistor comprising the combination of a core of electrical insulation material having a hole extending longitudinally from end to end thereof and slightly beneath the surface thereof, a pair of longitudinally spaced transverse slots in the surface of said core extending to said hole, a pair of spaced apart terminals in said hole, one of said terminals extending across one of said slots and the other terminal extending across the other slot, a resistance material on the surface of said core and extending in said slots to electrically contact said terminals.

5. A resistor comprising the combination of a core of electrical insulation material having a pair of spaced apart longitudinally extending holes therein slightly below the surface thereof, a pair of longitudinally spaced transverse slots in the surface of said core, one of said slots extending to one of said holes and the other slot extending to the other hole, a terminal in each of said holes extending across the slots, a resistance material on the surface of said core and extending in said slots to electrically contact said terminals.

6. The combination as set forth in claim 5 in which the holes both extend from one end of said core and the terminals project from said holes beyond said end.

7. The combination as set forth in claim 5 in which the holes extend from opposite ends of said core and the terminals project from said holes beyond said ends.

8. A resistor comprising the combination of a core of electrical insulating material having a transverse cross-section providing at least one longitudinally extending sharply rounded corner, a longitudinally extending hole

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in said core slightly below the surface of said corner, a transverse slot in the surface of said core across said corner and extending to said hole, a terminal in said hole and extending across said slot, a resistance wire helically wound on the surface of said core with a portion of said wire extending in said slot across and in contact with said terminal.

9. A resistor comprising the combination of a core of an electrical insulating material having a transverse cross-section providing at least two longitudinally extending sharply rounded corners, a pair of longitudinally extending holes in said core, one of said holes being slightly below the surface on one of said corners and the other hole being slightly below the surface of the other corner, separate transverse slots extending across the surface of each corner to the hole therebeneath, a terminal in each of said holes and extending across the slot, and a resistance wire helically wound on the surface of said core with portions of said wire extending in said slots and in contact with said terminals.

10. The combination as set forth in claim 9 in which the cross-section of said core is substantially elliptical.

11. The combination as set forth in claim 9 in which the cross-section of said core is substantially polygonal.

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