March 31, 1942. A. H. SCHAFER 2,278,045

RESISTANCE DEVICE

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FIG. 1

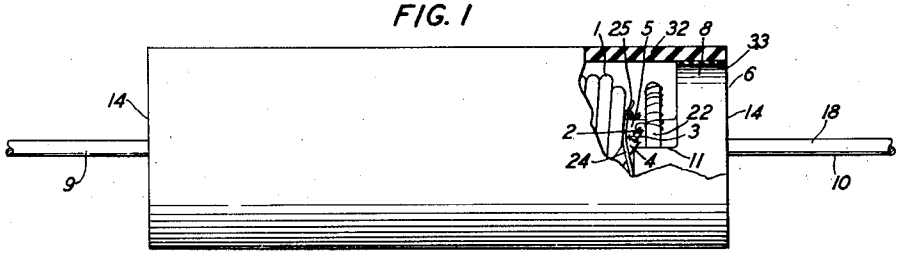

FIG. 2

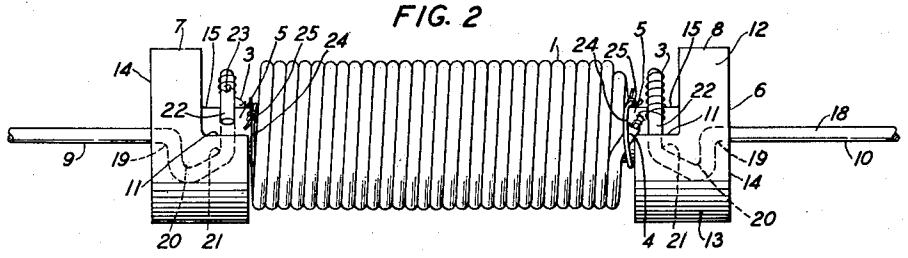

FIG. 3

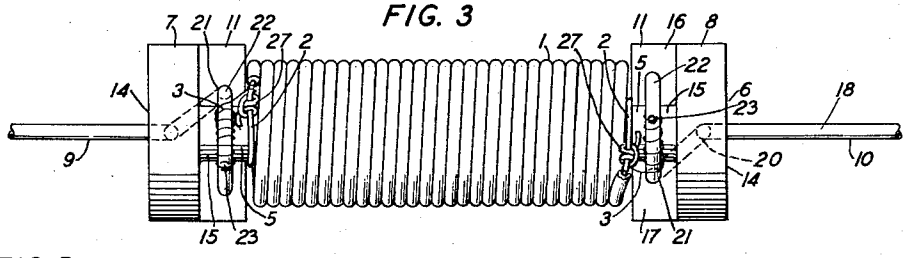

FIG. 5

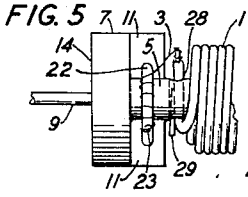

FIG. 4

FIG. 6

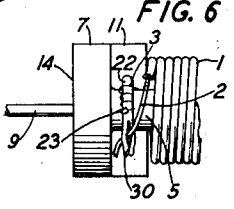

FIG. 7

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FIG. 8

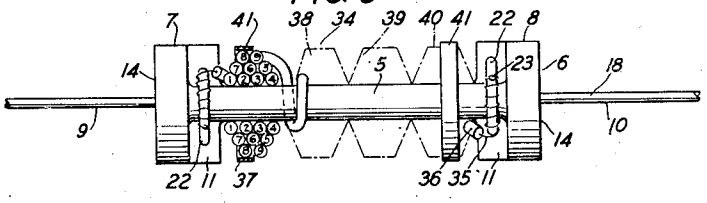


FIG. 9

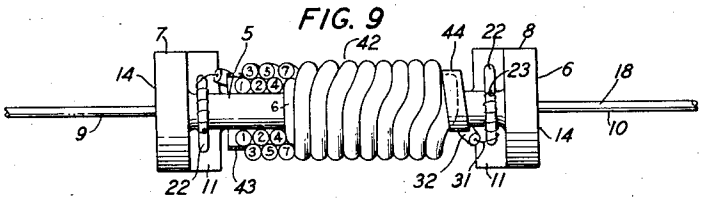


FIG. 10

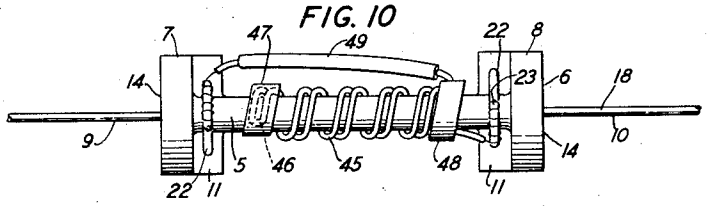
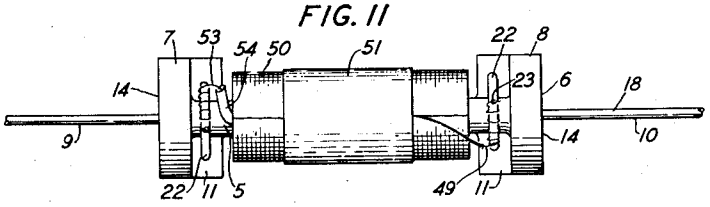


FIG. 11



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UNITED STATES PATENT OFFICE

2,278,045

RESISTANCE DEVICE

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Application April 17, 1940, Serial No. 330,024

3 Claims. (Cl. 201—63)

This invention relates to electrical resistance devices and more particularly to resistance devices comprising an electrical resistance element and a support therefor.

The object of the invention is to provide a resistance device of improved structure.

A feature of the invention resides in a support for a resistance wire element.

Another feature resides in the structure and arrangement of a terminal member mounted on the support.

Another feature resides in a casing combined with the support.

Other features reside in the forms and arrangements of resistance wire elements and their manner of arrangement on the support.

In the drawings,

Fig. 1 is a side view, partly in section, of a complete resistance device embodying the invention;

Fig. 2 is a side view of the resistance device, shown in Fig. 1, minus the casing;

Fig. 3 is a top view of the structure shown in Fig. 2 but having ends of the resistance wire secured in a different way from that shown in Fig. 2;

Fig. 4 is a view in perspective of the structure shown in Fig. 2, but having ends of the resistance wire secured in a way different from either Figs. 2 or 3;

Figs. 5, 6 and 7 show end portions of the support, a portion of a wire winding thereon and with modifications in the arrangements for holding ends of the wire winding in place. Figs. 5, 6 and 7 are drawn on a reduced scale relative to Figs. 1, 2, 3 and 4; and

Figs. 8, 9, 10 and 11 show modifications of the device shown in Fig. 3, the modifications residing in the particular forms of winding and arrangements of the resistance wire on the support. Figs. 8, 9, 10 and 11 are drawn in reduced scale relative to Fig. 3.

In electrical resistance devices in which the resistance element comprises a resistance wire of relatively fine gauge it is common practice to provide some means for directly supporting the fine gauge resistance wire. The resistance wire in some cases is helically wound on a cord of insulating material and in other cases the resistance wire is woven through a warp of insulating threads. The resistance element in the former case is known as a mandrelated filament resistance. In the latter case the resistance element is commonly called a woven wire-type resistance. In another form of relatively fine wire resistance, the resistance wire may be provided with an outer covering of insulating material to insulatingly protect the resistance wire and strengthen the structure. The fine gauge resistance wire elements of the types above mentioned may be found in some cases to be too delicate or too flimsy to be directly connected into an electrical system or to be used without some substantial means of support.

In the present invention means are provided for supporting and protecting the resistance element and terminal means for the resistance element are provided on the support. The invention in one of its forms also provides a woven wire-type resistance having relatively low inductance, the low inductance being because of the particular form of weave. The woven wire type resistance element per se is covered in a divisional application of this case Serial No. 411,454, filed September 19, 1941.

In Figs. 1, 2, 3, 4, 5, 6 and 7, a mandrelated filament resistance element 1 comprising a cord 2 of insulating material, a relatively fine gauge resistance wire 3 wound helically on the cord 2 and an insulating covering 4 applied over the wire 3 is helically wound on the barrel portion 5 of the spool-type support 6. The support 6 comprises the barrel portion 5 and spaced spoolheads 7 and 8, the spoolheads 7 and 8 being made of molded insulating material and formed or located on opposite ends of the barrel portion 5. Although it is not necessary to the practice of this invention to have the barrel portion 5 made of insulating material, a practical and convenient way of making the support is to make it entirely of molded insulating material. The insulating material used in forming the spoolheads 7 and 8 or the entire support 6 is a matter of choice and may be, for instance, a hard rubber composition, ceramic material, a phenol condensation product or a synthetic resinous product such, for instance, as cellulose acetate.

The spoolheads 7 and 8 are identical in structure and the description of one will therefore suffice for both. A terminal 9 is supported in the spoolhead 7 and a terminal 10, alike in structure to the terminal 9, is supported in the spoolhead 8. Since the terminals 9 and 10 are alike in structure, a description of one will be sufficient to an understanding of the form and arrangement of the other. The spoolhead 8 is much larger in diameter than the diameter of the barrel portion 5 of the spool-type support 6 and is thicker in one portion than in the other. The difference in thickness is provided by mak-

ing the inner face of the spoolhead in the form of a step. The form of the spoolheads 7 and 8 is shown particularly well in Fig. 2 in which the step 11 on the inner face of the spoolhead 8 is provided about half-way down the inner face of the spoolhead. The upper portion 12 of the spoolhead is about half the thickness of the lower portion 13. The outer face 14 of the spoolhead is a plane surface. It will be seen that a portion 15 of the barrel portion 5 of the spool extends in semicylindrical form about the surface of the step 11 and that the step 11 is transversely divided by the portion 15 into two step portions 16 and 17 as shown in Fig. 3, the step portions 16 and 17 being each in the same plane as the other.

The terminals 9 and 10 may be made of wire or any other conducting material found suitable for the purpose. To simplify the description of the form and arrangement of the terminals, and not in the sense of limiting the invention to any particular material, it will be assumed that the terminals are made of wire of about No. 18 gauge AWG. A suitable length of the wire is left straight to provide an outer portion 18, the wire is bent downward at 19 as shown in Fig. 2 so that when the wire is located in required position in the spoolhead, a portion of the wire will extend below the level of the step 11. The wire is then bent at 20 to extend laterally relative to the portion 18 and upward beneath the portion 17 of the step 11. From a point directly below the portion 17 of the step 11, the wire is bent at 21 at about 100 degrees to extend upward through the portion 17 of the step 11. The portion 22 of the wire is left extending above the step 11 to provide a relatively long inner end portion of the terminal 10 to which an end of the resistance wire 3 may be electrically connected. The terminals 9 and 10 when formed, as described, are secured in the respective spoolheads 7 and 8 preferably by molding the spoolhead about the bent portions of the terminal. This may be done in a convenient and obvious manner by placing the terminal so that the bent portions above mentioned lie within a suitable mold for the spoolhead portion and then casting the spoolhead in required form, the portions 18 and 22 of the terminal being arranged outside the mold during the casting operation.

The mandrelated filament resistance element 1 is wound helically on the barrel portion 5 of the spool-type support 6. End portions of the resistance wire 3 are electrically connected to the terminals 9 and 10. Electrical connection is made by winding a portion of the resistance wire 3 helically around the portion 22 of the terminal, the portion of the resistance wire 3 wound on the portion 22 of the terminal being bared of any insulating covering and preferably being first unwound from the insulating cord 2. To insure good electrical connection of the wire 3 to the terminal 10 and to prevent unwinding of the wire 3 from the portion 22 of the terminal, the wire 3 is secured to the portion 22 of the terminal by means of solder 23. To prevent unwinding of the resistance element 1 from the support 6 and to prevent the application of unwinding or breaking strain to the portion of the resistance wire wound on the portion 22 of the terminal, a cord 24 may be applied over a portion of the resistance element and around the barrel portion 5 of the support 6 as shown in Fig. 1, the cord 24 being tied to itself as shown at 25. In some cases the end of the cord 2 may be tied to the portion 22 of the terminal as shown at 26 in Fig. 4 to prevent unwinding of the resistance element from the support 6 and to prevent the application of any unwinding or breaking strain being applied to the point of connection between the wire 3 and the terminal. Another way in which unwinding of the resistance element from the support 6 may be prevented is to wind a portion of the cord 2 around the barrel portion 5 and tie the cord in place as shown at 27 in Fig. 3. Instead of tieing the cord in place the cord may be secured by means of cement or a piece of adhesive tape. The portion 22 of the terminal extending above the step portion 17 of the spoolhead is bent in a relatively long sweep bend over the semicylindrical portion 15 of the barrel portion 5 of the support 6. This arrangement has a tendency to somewhat tighten the turns of the wire 3 on the portion 22 of the terminal and brings the portion 22 of the terminal below the top of the spoolhead. It is to be noted that the portion 22 of the terminal is disposed directly above the step 11 of the spoolhead and is, therefore, outwardly offset from the inner face of the lower portion of the spoolhead. Also, that the portion 22 is spaced from the inner face of the upper portion of the spoolhead. The arrangement is such that when an end of the resistance wire is wound around the portion 22 of the terminal and the wire and the terminal are thus electrically connected to each other, the point of connection between the parts is sufficiently spaced from other parts of the wire winding as to require no separate covering of insulating tape or other insulating material directly around the point of connection of the wire and the terminal.

In Fig. 5 a transverse aperture 28 is provided in the barrel portion 5 of the spool. The resistance element 1 is threaded through the aperture 28 and is staked therein by means of a wedge 29 which is thrust into the aperture 28 alongside the element 1. The end of the wire 3 is wrapped around the portion 22 of the terminal and is held in electrical connection therewith by solder 23.

In Fig. 6 the free end of the portion 22 of the terminal is longitudinally split at 30 and is pinched about the cord 2 of the resistance element 1. The end portion of the conductor wire 3 is helically wrapped around the portion 22 of the terminal and is held in electrical connection therewith by solder 23.

In Fig. 7 the free end of the portion 22 of the terminal is made tubular at 31 to receive an end of the resistance element 1, the end of the resistance element 1 being thrust into the tubular portion at 31 and the tubular portion of the terminal being then squeezed about the end portion of the resistance element 1 to electrically connect the resistance element to the portion 22 of the terminal.

A tubular casing 32 is provided, as shown in Fig. 1, as an outer casing for the structures above described. The casing 32 is of sufficient length to span the spoolheads 7 and 8 and cover the resistance element 1 wound on the support 6. The casing 32 is made of such internal diameter as to closely fit the spoolheads 7 and 8 and is preferably cemented as shown at 33 to the spoolhead. The portion 18 of the terminal extends outward from the outer face of the spoolhead and provides a suitable portion of the terminal for connecting the resistance unit into an electrical system. The casing 32 may be, in some cases, simply a covering of wax or other insulat-

ing material applied as an over-all covering to the resistance unit.

The resistance units shown in Figs. 8, 9, 10 and 11 have the same spool-type support and the same terminal structure and arrangement as the resistance units above described. The resistance elements and the manner of winding them on the spool-type support 6 are different in Figs. 8, 9, 10 and 11 from the resistance units shown in the preceding figures. The parts common to Figs. 1 to 11, inclusive, are identified by the same numbers throughout and since these parts have already been described, no further description is required.

In Fig. 8 the resistance element 34 comprises a resistance wire 35, covered with insulating material 36. In some cases the resistance element 34 may comprise a mandrelated filament resistance wire. The resistance element 34 is wound on the barrel portion 5 of the spool-type support 6 so that groups 37, 28, 39 and 40 of turns of the resistance wire are formed on the support 6. Each group of turns comprises four lower turns of wire around the barrel portion 5 of the support 6, three turns of wire applied over the top of the four lower turns and set into the grooves cooperatively formed by the lower turns and two upper turns of the same wire applied over the top of the three turns and set into the grooves cooperatively formed by the turns in the second layer. After the first group 37 is formed, the same wire is then wound in like manner to form the groups 38, 39 and 40. The group winding arrangement is employed to keep down to a relatively low level the distributed capacitance and inductance found in ordinary forms of wire wound resistance devices. The number of winding groups and the number of turns in each layer will depend on the resistance value or type of resistance unit required. To maintain the wire in the group formation shown, a holding ring 41 is provided around the two top turns of wire in each group. The holding ring may be a piece of adhesive tape applied over the two top turns of the resistance winding. The ends of the resistance wire wound on the support 6 are electrically connected to the terminals 9 and 10 in the same manner as set forth in the description of Figs. 1 to 4, inclusive. The structure shown in Fig. 8 may be provided with a covering of insulating material or be encased in a tubular casing 32 (not shown in this figure) but corresponding to the casing 32 shown in Fig. 1.

In Fig. 9 a resistance wire 42 such as referred to in the description of Fig. 8 is wrapped around the barrel portion 5 of the support 6 so that the first and even numbered turns following thereafter lie side by side on the barrel portion 5 of the support 6 and constitute a lower layer winding. The odd numbered turns are wound over the top of the first and even numbered turns and lie in the grooves cooperatively formed by the turns in the lower layer. A ring 43 is provided around the first turn and the beginning of the winding to hold this end of the winding in place. A ring 44 is also provided around the last turn and the end of the winding to hold this end of the winding in place. The rings 43 and 44 may be made, for instance, of adhesive tape. The ends of the resistance wire 42 are electrically connected to the terminals 9 and 10 in the same manner as set forth in the description of Figs. 1 to 4, inclusive. The structure shown in Fig. 9 may be provided with a covering of insulating material or be encased in a tubular casing, not shown in this figure, but corresponding to the casing 32, shown in Fig. 1.

In Fig. 10 a resistance wire 45 generally insulated, of the type referred to in Figs. 8 and 9 is wound bifilar in one or more layers on the barrel portion 5 of the spool-type support 6. The closed end 46 of the winding is encircled by a holding ring 47 to prevent unwinding of this end of the wire winding from the support 6. The open end of the winding is encircled by a holding ring 48 to prevent unwinding of the wire 45 from the support 6. The holding rings 47 and 48 may be made, for instance, of adhesive tape. One of the wire ends is electrically connected to the terminal 10, the other wire end is brought back across the bifilar winding and is electrically connected to the terminal 9. The portion of wire extending over the bifilar wound portion is enclosed in a sleeve 49 of insulating material. The ends of the wire 45 are electrically connected to the terminals 9 and 10 in the same manner as set forth in the description of Figs. 1 to 4, inclusive. The structure shown in Fig. 10 may be provided with an insulating coating or be encased in a tubular casing, not shown in this figure, but corresponding to the casing 32 shown in Fig. 1.

In Fig. 11 a woven wire type resistance element 50 is wrapped around the barrel portion 5 of the spool-type support 6. A holding ring 51 extends around an outer portion of the resistance element 50 to prevent unwrapping of the resistance element from the support. The holding ring 51 may be, for instance, a suitable length of adhesive tape applied around an outer portion of the resistance element.

As shown in Fig. 11, one end of the resistance wire 53 in the resistance element 50 is connected to the terminal 9. This end is shown as being the inner end of the resistance element 50 and may be provided with a sleeve 54 of insulating material to insulatingly protect the wire 53 at the point of its passage from the woven resistance element 50 to the terminal 9. The other end of the wire 53 which may also be provided with insulating sleeving is the outer end of the resistance element 50 and is electrically connected to the terminal 10. The electrical connections of the wire 53 to the terminals may be made in the manner and forms described with reference to Figs. 1 to 7. The structure shown in Fig. 11 may be provided with an insulating coating or be encased in a tubular casing, not shown in the figure, but corresponding to the casing 32 shown in Fig. 1.

The resistance elements in some cases may be coated or impregnated with moisture-proof material such as wax, paint, lacquer, varnish, asphalt compound, etc. The coating may be a relatively thin layer or may be in sufficient quantity to fill all voids in the casing 32.

What is claimed is:

1. In a resistance device comprising an electrical resistance element and a spool type support for said element, a spoolhead on said support, said spoolhead being abruptly thickened to provide a step on the inner face of said spoolhead, said step being located at right angles relative to the axis of said spoolhead and extending to the periphery of said spoolhead, a terminal, a bent portion on said terminal embedded in the thickened portion of said spoolhead and a curved portion on said terminal extending from said step and in spaced relation with the inner face of

said spoolhead and electrically connected to said resistance element.

2. In a resistance device comprising an electrical resistance wire and a spool type support for said wire, a molded spoolhead on said support, said spoolhead being abruptly thickened to provide a step on the inner face of said spoolhead, said step being located at right angles relative to the axis of said spoolhead and extending to the periphery of said spoolhead, a terminal, a bent portion on said terminal molded into the thickened portion of said spoolhead, a long sweep curved portion on said terminal extending outwardly from said step and in parallel spaced relation with the inner face of the unthickened portion of said spoolhead, and a portion of said resistance wire helically coiled around said curved portion and electrically connected to said curved portion of said terminal.

3. In a resistance device comprising a spool-type support and a spoolhead on said support, a terminal supported in said spoolhead, a long sweep curved portion on said terminal extending from said spoolhead, a resistance element wound on said support and comprising a cord of insulating material and an electrical resistance wire wound helically on said cord, a tied thread binding an end portion of said element to said support and a portion of said resistance wire wound helically on said long sweep curved portion of said terminal and electrically connected to said terminal.

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