Dec. 24, 1957 J. H. KOHLER 2,817,738

PRECISION RESISTOR

Filed April 27, 1955

Fig. 1.

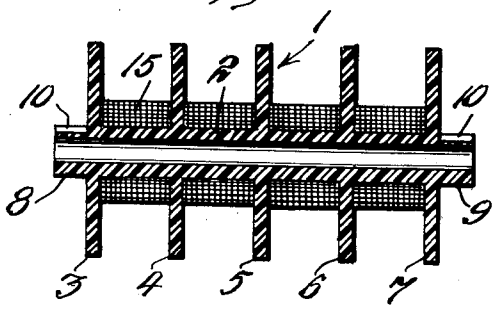


Fig. 2.

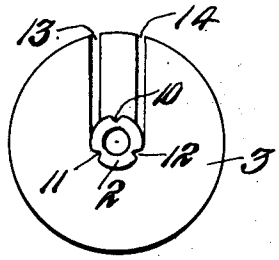


Fig. 3.

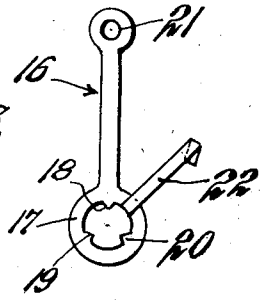


Fig. 4.

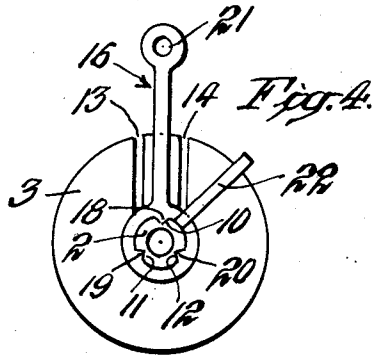
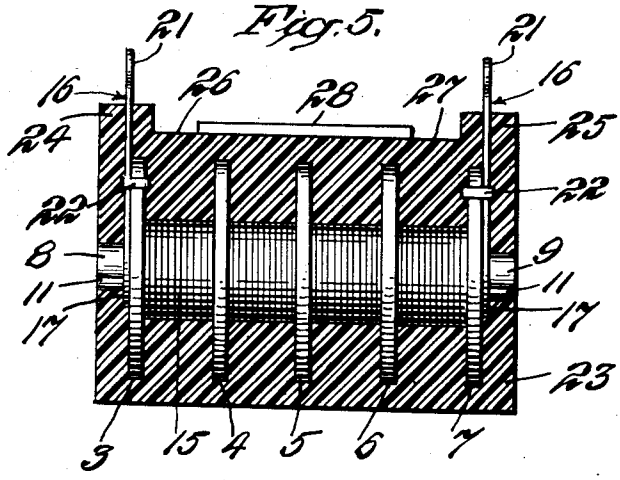


Fig. 5.



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PRECISION RESISTOR

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5 Claims. (Cl. 201—64)

The present invention relates to a precision resistor and more particularly to an encased wire type precision resistor.

Encased or encapsulated wire type precision resistors are employed in connection with D. C. amplifiers, computing systems, low speed linear sweep generators, multivibrators and other precision mechanisms requiring very low resistance tolerances of, for example, plus or minus 1% or better. The resistors are required to exhibit excellent stability and durability in view of the exactitudes necessary for critical response mechanisms such as electronic computating systems, and the like.

For mass production purposes resistors of the deposited film type have been proposed and employed, since manufacture thereof is considerably simplified in comparison with the wound wire type resistors. However, it has been found that such deposited film type resistors are not suitably stable especially under certain operating conditions which subject the thin deposit film to molecular changes which deleteriously affect the resistor stability. Otherwise, the film is subject to breakage due to differences in coefficient of expansion between the film and its support.

While wire wound resistors do not possess such disadvantages, they are more difficult to manufacture. Apart from the manufacturing aspect, wire wound resistors as heretofore provided are still short of optimum function with regard to stability and precision response.

Conventional encased or encapsulated wire wound resistors are made by providing a hollow cylindrical core of plastic or other insulating or dielectric material, for example in the form of a bobbin or spool, upon which the wire is wound. Spaced terminals are connected to the ends of the wire and the windings are encased or encapsulated, for example, by molding a plastic encasement about the cored wire leaving the terminals exposed. In the molding process a pouring gate is employed in the forming of the encasement, said pouring gate being positioned between the terminals. Upon setting of the plastic, the encased resistor is removed and the encasement is characterized by a continuous substantially rough raised ridge or raised body between the terminals and constitutes the shortest path between the terminals. The pouring gate is always employed to provide an excess of encasing material since the plastic shrinks on setting. In view of the shrinkage, the top of the raised ridge or raised body, which is formed by the excess plastic, has an uneven concave surface. Under humid conditions or temperature conditions associated with the ambient atmosphere, the raised ridge or bar is subjected to the condensation of moisture thereon. In view of the concavity and uneveness of the ridge surface, the moisture is retained in the shortest path between the resistor terminals and constitutes a conductive path. Such a conductive path is detrimental to the resistance stability. For example, if the resistor is rated at 1 megohm resistance, the conductive path between the terminals, occasioned by the condensed moisture, will

vary the rated figure, and instead of having a stable 1 megohm rating, the resistance will have a value below the rated resistance. It will be apparent that such nonstability will deleteriously affect the operation of especially highly sensitive apparatus.

Apart from the above, manufacturers of conventional wire wound precision resistors are confronted with a tedious assembling problem in connection with the positioning of the terminals in parallel alignment and spaced laterally along the axis of the wire coil or the bobbin or spool core. The terminal member consists of a flat ring or apertured plate with a terminal arm or post radiating outwardly therefrom. The ring is usually cemented onto the outer spool or bobbin flanges, or an auxiliary washer is used to hold the terminal ring portion against the outer spool flanges with the axially spaced terminal arms in parallel alignment. In the cementing operation or the application of the washer, the axial alignment of the terminal posts or arms is not assured unless extreme care is exercised to avoid movement of the arms, which movement takes the terminal arms out of alignment. Also, during the handling of the wire wound core prior to molding, the connection of the wire to the terminal arm is subject to breakage upon movement of the terminal arm, since the wire is generally of very small diameter and limited tensile strength.

It is an object of the present invention to provide an encased wire-type resistor. It is another object to provide an encased wire-type precision resistor characterized by high electrical stability and durability. It is a further object of the present invention to provide a precision resistor of a structure wherein any internal strains or the causes thereof are easily ascertained. It is still another object of this invention to provide a bubble-free encasement for the resistor herein contemplated in order to obtain an encasement free of heat sinks which tend to break down the encasement. It is a still further object to provide a precision resistor characterized by excellent electrical continuity, high mechanical strength, and an improved surface structure between the spaced terminals thereof. Other objects of the present invention will become apparent from the description hereinafter following and the drawings forming a part hereof, in which—

Fig. 1 is a cross-sectional view of a wire wound bobbin,

Fig. 2 is an end view of the bobbin of Fig. 1,

Fig. 3 is an elevational view of a terminal member according to this invention,

Fig. 4 is an end view showing the terminal member of Fig. 3 applied to the bobbin of Figs. 1 and 2, and

Fig. 5 is an elevational side view of a completed precision resistor according to this invention.

The present invention deals with an encased wire wound precision resistor comprising an improved encasement structure adapted to provide high resistor stability and freedom from susceptibility to extraneous conditions affecting resistance stability, constructed to provide a means for easily ascertaining internal strains detrimental for optimum operability, and otherwise constructed to provide accurate assembly of the component parts.

Referring to Fig. 1, the precision resistor assembly is initiated by providing a spool and preferably a bobbin **1** composed of a substantially transparent material, e. g. transparent or translucent plastic material, comprising a tubular or cylindrical core **2** provided with a plurality of axially spaced fins, for example fins **3**, **4**, **5**, **6** and **7**, with the core **1** extending beyond the outermost fins, e. g. fins **3** and **7**, on both ends of the bobbin to provide terminal hubs **8** and **9** on both ends of the bobbin. The hubs **8** and **9** are provided with radial spaced notches **10**, **11** and **12**, and, preferably, the fins are provided with slots **13** and **14** from the periphery thereof to the core substantially as illustrated by Fig. 2 so that a wire

winding **15** may, by means of said slots, be alternately wound in opposite directions on the core between the said fins. It is apparent from the drawings that the slots **13** and **14** are cut through the fins so as to be in tangential relationship with the core **2**. This is an important embodiment because otherwise, e. g. when the slot is normal to the core axis, the thin coat of insulation on the single wire crossing the slot from one winding to another along the core is subject to wear by the wire turns rubbing against the single cross-over wire and the single wire rubbing against the wall of the fin. With the tangential slot, the single cross-over wire lies only in the slot until it contacts the core and does not press against the wall of the fin, whereby the said cross-over wire is not subject to rubbing by the subsequent winding on the core section. Prior to, or subsequent to the winding of the wire **15** in the core **2**, a terminal post **16** is positioned in both hubs **8** and **9** in abutment with the outermost fins or flanges **3** and **7**, as illustrated by Fig. 3.

The terminal member **16** is constructed to particularly cooperate with the notches **10, 11** and **12**, and comprising an apertured flat plate or flat ring **17** with the terminal post **16** extending outwardly therefrom with spurs or teeth **18, 19** and **20** directed toward the center of said ring **17** and dimensioned to engage the notches **10, 11** and **12** as illustrated by Fig. 4. The notches may be formed by forcing the ring **17** onto the hubs so that the teeth **18, 19** and **20** cut into said hubs forming said notches. The post or arm **16** is placed advantageously with an aperture **21** in an end portion thereof to facilitate the connection of a wire conductor to the post **16**. With the above described cooperating notches and spurs, it is apparent that the terminal post is mechanically immobilized in an exact position, e. g. in spaced lateral parallel alignment along the axis of the core **2**. Furthermore, the mechanical immobilization secures the terminal post against movement during the subsequent assembly of the resistor. Either prior to or subsequent to the positioning of the terminal post onto the hubs **8** and **9**, a wire is wound on the bobbin in core between the fins and preferably wound in one direction between one pair of fins and in an opposite direction between another pair of fins with the continuous wire passing through the slots **13** or **14**. In order to assure accurate continuity and a secure electrical connection between the wire winding **15** and a terminal member **16**, a conductive metal strip **22** is welded to the ring **17** as shown by Figs. 3 and 4, and the free end of which is bent over upon itself to grip an end of the winding **15** therebetween to provide a mechanical lock as well as a supplemental weld or solder lock after being so mechanically locked.

Having secured the terminal posts **16** on the hubs **8** and **9** adjacent the fins **3** and **7**, and mechanically interlocked as above described in electrical connection with the winding **15**, the wire bobbin is provided with a substantially cylindrical and transparent molded casement **23**, e. g. a plastic casement, provided with terminal plastic lugs **24** and **25** extending outwardly therefrom about the terminal posts **16** and reinforcing the said terminal posts.

In order to eliminate the possibility of a moisture conductive path between the terminal posts **16**, at least a part of the casement surface between the terminals **16** is provided with a smooth surface and preferably a convex surface coinciding or corresponding with the periphery of the casement as at **26** and **27**. The pour gate remnant or raised ridge **28** may or may not be eliminated as long as the smooth surface **26** or **27** is present since such smooth surface precludes the possibility of moisture retention thereon and interrupts an irregular surface between the terminal posts so that no continuous conductive moisture path can form between the terminals.

The above described resistor construction assures high quality production, offers complete visibility of the interior, e. g. windings, connections, terminals, etc., resulting from the use of the transparent plastic encapsulating material. This feature assists materially in precluding service failures due to internal strains. The bobbin, the material filling the spaces between the spaced fins of the wound bobbin, and the material encapsulating and embedding the wound and filled hobbin in the form of a molded substantially cylindrical casement, are preferably of the same material assuring compatibility and adherence of the materials to each other. No moisture path at the joining of the materials is possible. If momentarily overheated due to high current surges, no cracks or fissures will appear, due to the various parts having the same coefficient of expansion and the encasement being a bubble-free encasement.

It is apparent that modifications of the resistor herein described are contemplated within the scope of the appended claims and that the illustrations are representative of the structural features within the scope of the invention.

What I claim is:

1. An electrical resistor comprising a longitudinal core, a wire winding on said core, end portions of said core being free of said winding, notches on said free ends spaced along the periphery of said free ends, a pair of terminal members, said terminal members comprising a ring member with an arm extending outwardly therefrom, a tooth member on said ring projecting inwardly thereof, said tooth members engaging said notches, said winding being electrically connected to said terminal members, and a substantially transparent material encasing said winding and said rings.

2. A resistor according to claim 1, comprising lug members extending outwardly of said material and embedding a portion of said arms, and a smooth surface on said material between said lugs.

3. A resistor according to claim 1, wherein said surface is a convex surface and said material is of a substantially cylindrical form.

4. A resistor according to claim 1, wherein said core and said encasement are composed of substantially transparent plastic.

5. A resistor according to claim 1, comprising a conductive metal strip welded to said ring and electrically connected to said winding.

References Cited in the file of this patent

UNITED STATES PATENTS

2,286,161	Rights et al.	June 9, 1942
2,407,171	McFarren	Sept. 3, 1946
2,547,405	Mitchell et al.	Apr. 2, 1951
2,586,609	Burke	Feb. 19, 1952
2,647,192	Berkelhamer	July 28, 1953
2,668,867	Ekstein	Feb. 9, 1954