

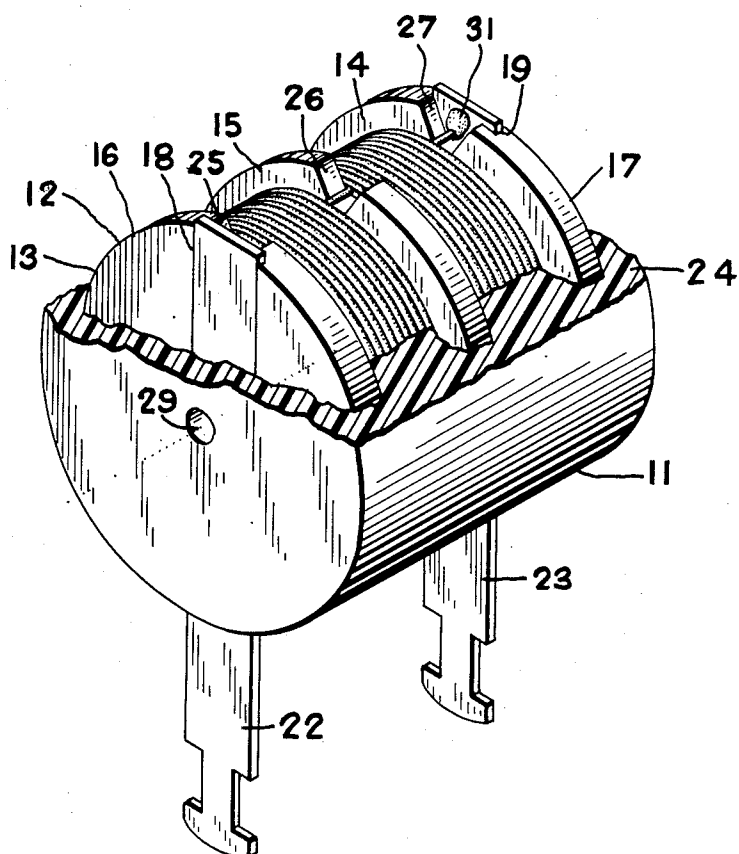
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BOBBIN RESISTOR

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BOBBIN RESISTOR

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The present invention relates to a new and improved type of bobbin resistor.

Prior to the present time, it has been customary to form bobbins for wound wire resistors of various resinous materials. Because of the pressures to which these wound resistors are placed both during the winding operation and during the subsequent molding steps, the various parts of the bobbin have had to be made relatively thick, and further, the windings within the sections of the bobbin have at times not been as large as has been desirable for many applications because of the inability of small wound sections of this type to dissipate the heat generated within them, especially after they have been encased within a protective resin layer. The windings in bobbin resistors of this type are usually made in a multitude of sections in order to achieve satisfactory voltage distribution.

It is an object of the instant invention to overcome many of the above and related disadvantages of the presently constructed bobbin type resistance elements. Further objects of the invention, as well as the advantages of it will be apparent from this specification, the appended claims, and the accompanying drawing in which there is shown a partially sectional view of a mounted bobbin resistor in accordance with the teachings of the instant invention.

Briefly, the new bobbin resistor in the present invention differs from the prior art by the use of a bobbin formed of a cheap, light, and highly heat-conductive metal, such as for example, aluminum, which is coated with a firmly adherent relatively thick dielectric inorganic oxide layer. The preferred metal meeting the above qualifications is, of course, aluminum, which can be formed with a comparatively thick oxide film by a number of established procedures known to the art, such as for example, anodic oxidation. Also preferred are the known aluminum alloys such as aluminum-silicon, which can be effectively oxidized or otherwise furnished with a high dielectric strength relatively thin insulating coating. Other materials can, however, be used satisfactorily.

Perhaps the invention will be best understood with reference to the accompanying drawing wherein there is shown a molded bobbin resistor 11 consisting of a metal bobbin 12 provided with end flanges 13 and 14 a center flange 15, all three of these flanges extending from a center hollow cylindrical core (which is not shown in the drawing). Both the core and all three of the flanges pictured are formed in a single unitary piece, and are oxidized as by anodic oxidation. Any number of flanges can be used upon a single core depending upon the resistance value of the final bobbin resistor being manufactured and the voltage distribution desired.

Both of the end flanges 13 and 14 are provided on their outer surfaces 16 and 17 with recessed slots 18 and 19, respectively, in which there are fitted flat rod-like terminal prongs 22 and 23 which project beyond the physical confines of the molded casing 24 placed around the entire resistance assembly per se. Wound resistance wire, such as the wire made in accordance with U. S. Patent No.

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2,495,630, granted January 24, 1950, and U. S. patent application Serial No. 149,867, filed March 15, 1950, now Patent No. 2,650,975, granted September 1, 1953, is wound upon the bobbin 12 between the individual flanges 13, 14 and 15 as shown, and is attached to these terminal prongs 22 and 23 as with solder 31. Terminal prongs 22 and 23 are coated by a thermoset insulating material as by molding, and thereafter inserted into the recessed slots 18 and 19. The slots are of such physical dimensional characteristics that they allow the terminal prongs to be inserted from either end and once in position cannot be moved axially with respect to the bobbin. For convenience in manufacturing, all three of the flanges 13, 14 and 15 are provided with substantially V-shaped notches 25, 26 and 27, respectively, through which the wire used for the individual windings is carried across these flanges. After assembly the entire unit is normally encased in a resin protective material 24 using conventional molding techniques. A center opening 29 connecting with the center opening of the bobbin (not shown) is provided within this outer casing 24 in order to aid in cooling the unit. The center opening 29 is substantially larger than that provided in the bobbin so as to allow sufficient insulation (provided during the application of the casing 24 as by molding) between the prongs 22 and 23 and the periphery of the opening. This avoids danger of shorting or leakage. The unit is more effectively cooled when the interior surface of the bobbin is oxide free and intimately in contact with a mounting or heat dissipation means inserted through center opening 29 and the center opening of the bobbin.

As previously mentioned, aluminum type alloys furnish the preferred metal for utilization with this device. The aluminum is preferably formed in a boric acid type electrolyte so as to provide a nonporous surface of high dielectric strength. As an example of this an aluminum casting was formed to 600 V. D. C. with an initial current density of 40 amps per square centimeter in an aqueous boric acid electrolyte containing approximately 20% by weight boric acid. Where the molding pressures are excessive it is preferred to use an aluminum alloy of high tensile strength, such as aluminum silicon alloys. The restriction on the alloy is that it readily forms an insulating film, and for this reason high concentrations, that is over about 5%, of the material alloyed with the aluminum is undesirable when this alloying material is not readily susceptible to oxidation, as discrete particles of the nonoxidizable substance will result during formation and greatly lower the insulating characteristics of the film. When the alloy is a solid solution no such difficulty as that above occurs. Other types of suitable aluminum alloys, in which the alloying ingredients allow satisfactory formation, are aluminum-magnesium, aluminum-manganese, aluminum-copper, and aluminum-nickel. Additionally, alloys containing two or more components not susceptible to ready oxidation should have all these components maintained preferably at a total concentration below about 5%. Alloys such as aluminum-titanium, aluminum-hafnium, aluminum-tantalum, and others, both components of which are susceptible to oxidation to produce electrically nonconductive products, are excellent materials and will have the desired rigidity.

An additional feature, which is particularly valuable where the resistor is subject to rough handling or exposure, is that the molded casing can withstand greater stress forces when the casing is of a material which intimately bonds itself to the formed insulation strata of the enclosed bobbin. It has been noted that the phenol-formaldehyde, urea-formaldehyde, melamine-formaldehyde, and aniline-formaldehyde resins apparently bond themselves to the oxide coating so well that they show a greater resistance to external forces when molded around the

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resistor than they do by themselves. This decreases the ingress of moisture through minute fissures that usually develop upon rough handling of the resin. These molding materials can contain fillers such as aluminum oxide which even further improve the bonding to the bobbin.

It will at once be apparent to those skilled in the art that the new construction herein specified is highly advantageous in that smaller, stronger bobbins can be used. By way of example, bobbins according to the present invention can have a flange with a thickness of from about $\frac{1}{16}$ to $\frac{1}{32}$ of an inch. This in turn makes possible the production of smaller resistors meeting the requirements of many exacting applications. The herein described invention is capable of several modifications and alterations. Such modifications are to be considered as part of the invention concept insofar as they are defined by the appended claims.

What is claimed is:

1. An electrical resistor having a compact resistor bobbin comprising an elongated core with a plurality of outwardly projecting integral flanges, each between about $\frac{1}{32}$ and $\frac{1}{16}$ inch thick and defining between them resistance-winding-receiving grooves, said bobbin being a single mass of aluminum coated on its external surfaces with an in situ formed adherent insulating oxide layer, with electrical resistance windings in the grooves, the combination being encased in an in situ cured resin of the class consisting of phenol-formaldehyde, urea-formaldehyde, melamine-formaldehyde and aniline-formaldehyde resins.

2. An electrical resistor having a compact resistor bobbin comprising an elongated core with a plurality of outwardly projecting integral flanges, each between about $\frac{1}{32}$ and $\frac{1}{16}$ inch thick and defining between them resistance-winding-receiving grooves, a center opening in said core forming a thermal outlet from within said bobbin,

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said bobbin being a single mass of aluminum coated on its external surfaces with an in situ formed adherent insulating oxide layer, with electrical resistance windings in the grooves, the combination being encased in an in situ cured resin of the class consisting of phenol-formaldehyde, urea-formaldehyde, melamine-formaldehyde and aniline-formaldehyde resins.

3. An electrical resistor having a compact resistor bobbin comprising an elongated core with a plurality of outwardly projecting integral end flanges, each end flange having a transverse prong-receiving slot in its end face and being between about $\frac{1}{32}$ and $\frac{1}{16}$ inch thick, said flanges defining between them resistance-winding-receiving grooves, a central support-receiving passageway with an uncoated surface in said core providing a thermal outlet from within said bobbin, terminal prongs slidably fitted in said slot having openings aligned with the core passageway but of larger size, said bobbin being a single mass of aluminum coated on its external surfaces with an in situ formed adherent insulating oxide layer, with electrical resistance windings in the grooves, the combination being encased in an in situ cured resin of the class consisting of phenol-formaldehyde, urea-formaldehyde, melamine-formaldehyde and aniline-formaldehyde resins.

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