

Sept. 7, 1965

C. J. GANCI

3,205,467

PLASTIC ENCAPSULATED RESISTOR

Filed July 27, 1962

2 Sheets-Sheet 1

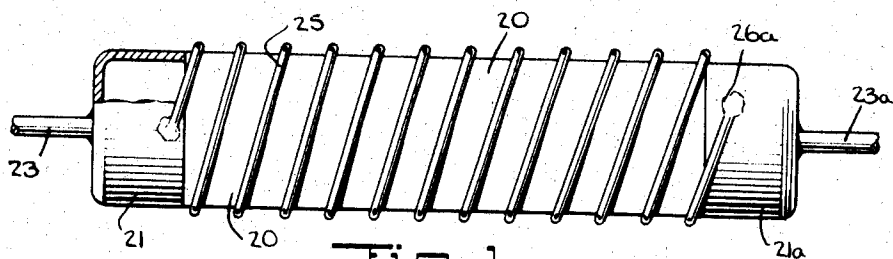


Fig. 1.

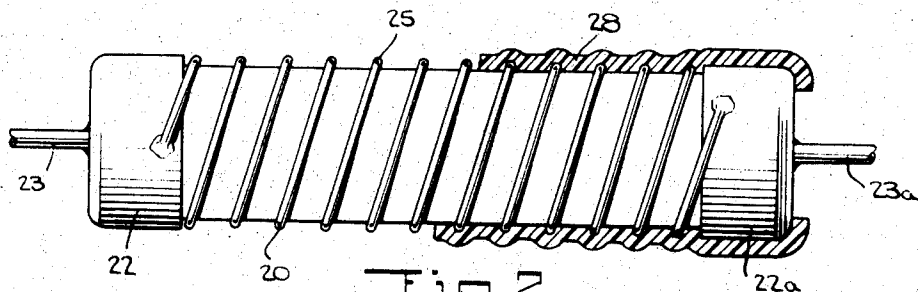


Fig. 2.

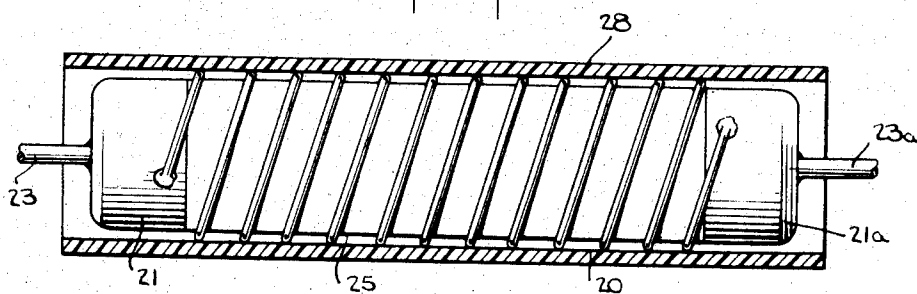


Fig. 3.

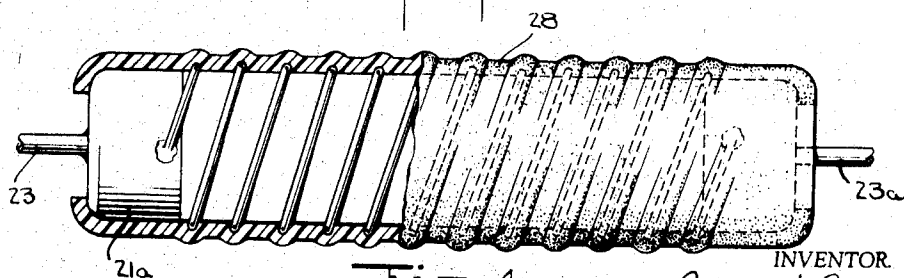


Fig. 4.

INVENTOR.
CHARLES J. GANCI

BY
Frank C. Bower
ATTORNEY

Sept. 7, 1965

C. J. GANCI

3,205,467

PLASTIC ENCAPSULATED RESISTOR

Filed July 27, 1962

2 Sheets-Sheet 2

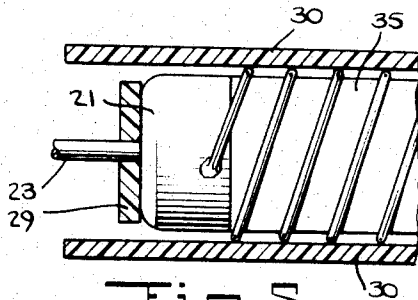


Fig. 5.

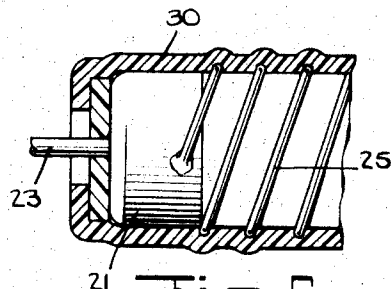


Fig. 6.

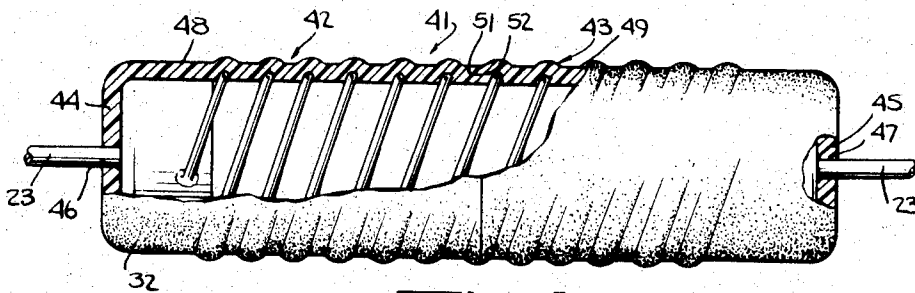


Fig. 7.

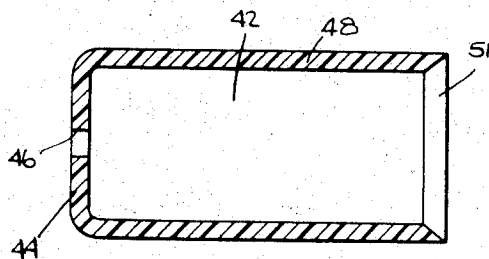


Fig. 8.

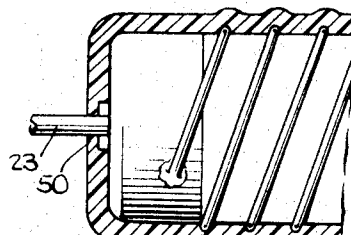


Fig. 10.

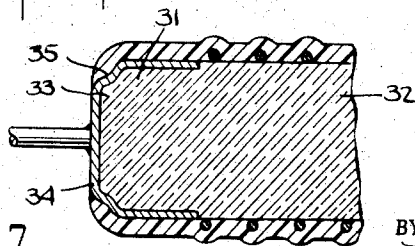


Fig. 9.

INVENTOR
CHARLES J. GANCI

BY

Frank G. Oliver
ATTORNEY

1

3,205,467

PLASTIC ENCAPSULATED RESISTOR

Charles J. Ganci, Bellerose Manor, N.Y., assignor to Ward Leonard Electric Co., Mount Vernon, N.Y., a corporation of New York

Filed July 27, 1962, Ser. No. 212,943

2 Claims. (Cl. 338-268)

This invention relates to electrical resistors and is directed particularly to the encapsulating of electrical resistors or the like of the axial type.

In this description an axial type of resistor with resistance wire wound therearound is illustrated and described. However, the invention herein is not limited to the wire wound type of axial resistor, but is applicable to axial lead type of resistors having a metal film, carbon film, tin oxide glass and the like. With these types of resistors the metallic resistive element passing the current is mounted on the outer surface of a ceramic or other suitable type of support. The resistive element is thus exposed to physical contact resulting in damage to the resistance wire or in a short circuit. The resistor should be covered by an insulating protective layer. The layer in addition to providing a protective coating should also have good heat or thermal stability to wide variations of temperature, extending down to and below sub-zero temperatures, and good dielectric strength. The layer should also be chemically resistant and protect and seal the resistive element against moisture and the like.

Since axial resistors are made in large quantities, the expense of providing this protection is important in providing a competitively priced resistor. Thus in addition to attaining the desired protective coating, the method of manufacture must be simple to perform and utilize standard materials.

An object of the invention is to encapsulate an axial lead type of electrical resistor with an insulating protective layer of high stability to heat and cold.

Another object of the invention is to provide an electrical resistor of the axial lead type with a protective insulating coating resistant to chemical action, that is simply and inexpensively mounted on the resistor.

Another object of the invention is to provide an inexpensive and easy method of providing an axial lead type of electrical resistor with a tightly fitting organic coating sealing and protecting the resistive element.

Other and further objects and advantages will be apparent from the following description taken in connection with the drawings, in which—

FIG. 1 is a side view of a wire wound resistor with recessed end caps and without an encapsulating layer;

FIG. 2 is a side view of a wire wound resistor with raised end caps and the encapsulating layer shown in section at one end thereof;

FIG. 3 illustrates an expanded cylindrical encapsulating organic sleeve on the resistor of FIG. 1;

FIG. 4 illustrates an encapsulated resistor with the organic sleeve dried and shrunk onto the resistor;

FIG. 5 illustrates a portion of an encapsulated resistor with an organic sleeve and end piece in expanded condition;

FIG. 6 illustrates a portion of an encapsulated resistor with an organic sleeve and end piece in reduced and final condition;

FIG. 7 illustrates a modification of the end cap of the resistor to recess the end of the plastic sleeve;

2

FIG. 8 illustrates an encapsulated resistor with the encapsulating layer formed of organic half members cemented together;

FIG. 9 illustrates a half portion of an encapsulating member; and

FIG. 10 illustrates a modification sealing the lead.

In FIG. 1 a conventional wire wound resistor is illustrated. The cylindrical ceramic core 20 has a center cylindrical portion for receiving the resistive element formed by a resistance wire 25 and the terminals formed by two cylindrical end portions of lesser diameter than the center portion to recess the metal caps 21, 21a. The caps are recessed so that the outer surfaces of the caps and the surface of the center cylindrical portion are even. The caps 21 and 21a are attached to the end portions of the core and have a flat end and cylindrical sides encircling the end portions. The caps may be made of any suitable metal, such as steel or metal alloy, to which the resistance wire 25 may be welded or soldered and the leads 23, 23a may be welded to extend axially in relation to the resistor. The leads may be made of copper, nickel copper alloy, or other suitable metal alloy. The leads 23 and 23a are butt welded to the flat end of the caps and the resistance wire 25 is welded or otherwise secured at 26 and 26a to the sides of the cap.

In the following description the recessed end cap form of resistor is illustrated. However, the raised end cap type of resistor, as shown in FIG. 2, may also be used, although not preferred. The resistance wire 25 is wound in accordance with standard practice and the forms shown in FIG. 1 and the other figures are for purposes of illustration. The size of the resistance wire, of course, varies depending upon the particular characteristics which are desired.

In view of the smoothness of the surface of the center portion of the core, the resistance wire is raised or protrudes above the surface. In order to protect the wire and insulate the resistor from short circuits an encapsulating sleeve is provided. In the embodiments illustrated the encapsulating sleeve may have different shapes and is formed from plastic material which permits the sleeve to have a large or small diameter depending on the physical condition of the sleeve.

In FIGS. 2 to 6 a sleeve comprising organic silicon oxygen polymers is illustrated. More specifically the sleeve comprises monomers of silicon with methyl or ethyl groups and bonded to form the polymers by the oxygen radical. Material of this type is a silicone elastomer or rubber sold under the trade name Silastic by the Dow Corning Corporation. The sleeve is provided in the form of silicone plastic tubing which has a diameter approximately half the diameter of the resistor. The sleeve is expanded into an inside diameter greater than the resistor so as to readily slide on the resistor by soaking the sleeve in a solvent, such as methylethyl ketone, toluene, xylene and benzene. The solvent acts as a dilator by entering the lattice structure of the polymers and causing the polymers to expand and thus expand the sleeve to the large diameter. The preferred solvent is methylethyl ketone because of its higher acceptable concentrations in view of its lower toxicity.

The presoaked sleeve is centrally positioned on the resistor in the expanded condition. The resistor may be vertically positioned in a mandrel and the presoaked sleeve dropped onto the resistor. The sleeve is air dried

3

to evaporate the solvent. As the solvent evaporates the sleeve shrinks against the resistor and firmly engages the resistor. The resistor and sleeve are then heated at a temperature of 500° to 650° F. for several hours. This high heat removes the final traces of solvent. This contracts the sleeve to the minimum or small dimensions and insures dimensional stability of the completed resistor. The ends of the sleeve fold around the caps of the resistor to seal the resistor. The high heat also stabilizes the resistance wire to remove stress created in the winding of the wire around the ceramic core. Load life drift is thus reduced to a negligible amount.

In the embodiment illustrated in FIGS. 5 and 6 a flat circular end piece 29 is fitted over the axial lead 23 to cover the end of the resistor. The end piece fits inside the sleeve 30 and is made of a similar material and similarly soaked in a solvent. The resistor is then dried in similar manner as previously described, resulting in the returning of the sleeve 30 to its unexpanded size. The ends of the sleeve 30 form around the ends of the resistor and overlap the end pieces to form a complete enclosure of the resistor. The end piece also presses against the axial lead 23 to form a seal at both ends. The other end of the resistor is similarly formed. The cylindrical portions cover the resistive element and the sides of the end caps and the end walls cover the ends of the caps.

In FIG. 7 a modification of the core and end cap is illustrated to provide for a recessing of the ends of the sleeve. The end portion 31 of the core 32 is stepped to form a reduced section 33. The end cap 34 is stamped in a similar shape to form an annular groove 35. The end of the sleeve 30 fits in the groove 35 to provide the resistor with rounded ends and abut the ends of the sleeve against the side of the cap to avoid the accidental rolling or lifting of the ends of the sleeve from the resistor.

In FIGS. 8 and 9 a preshaped sleeve 41 is formed in two parts 42 and 43. Each of the parts is approximately half the length of the resistor. The parts have cylindrical portions 48 and 49 encompassing the resistive element and end caps and have end walls 44 and 45 with openings 46 and 47 to pass the wire leads. The cylindrical portion 48 has a beveled end 51 complementary to the beveled end 52 of the portion 49. The two parts are slid on the resistor in opposite directions with the ends 51 and 52 overlapping.

The parts of the sleeve may be formed of the same material as the sleeves of the previous embodiment and may be similarly expanded or dilated to readily fit on the resistor without binding. Cement or adhesive, such as a silicone cement, may be applied to the surfaces 51 and 52 to secure the parts together. The resistor may be subjected to the drying process to shrink the parts on the resistor to seal the resistor. The sides of the openings 46, 47 bear against the leads 23, 23a. In FIG 10 the opening is formed by the lead piercing a thin diaphragm 50 formed in the end wall. The lead is thus sealed.

The sleeves of the foregoing embodiments may be made of a tetrafluoroethylene polymer, such as Teflon. For example, the tubular sleeve 28 is expanded by an inward physical pressure such as drawing the tubing from which the sleeve is made over an expanding die. The diameter of the sleeve may be doubled. The tubing remains in this expanded condition and is cut into sleeves of the desired length, which is preferably longer than the resistor. The expanded diameter of the tubing is greater than the diameter of the resistor to permit the easy sliding of the sleeve on the resistor. The expanded sleeve on the resistor is then heated to approximately 625° F. and the sleeve returns to its original diameter to firmly grip the resistor. The sleeve also compresses against the caps to seal the resistance wire. The finished resistor is tough, durable, heat resistant, and also chemically resistant.

4

The Teflon also acts as an insulator to isolate the resistance wire.

In the embodiment of FIGS. 5 and 6 the end piece 29 and sleeve 30 may also be made of a tetrafluoroethylene polymer. The sleeve 30 is formed and expanded in a similar manner to sleeve 28 to readily slide on the resistor. The end piece 29 may be formed from an expanded sheet of plastic and fitted over the lead 23 to position with the expanded sleeve. The sleeve and end pieces are then subjected to heat at 625° F. to contract the parts so that the sleeve tightly grips the resistor and overlaps the ends and the end pieces as illustrated to completely enclose the resistor.

Also the parts 42, 43 of FIGS. 8 and 9 may be made of the tetrafluoroethylene plastic by molding the parts and expanding them on an internal die fitting inside of the cylindrical portion. The cylindrical portion end wall of each part are expanded to easily slide on the resistor with the leads passing through the openings 46 and 47 or punching a diaphragm, as in the embodiment of FIG. 10.

The silicone elastomer or rubber has good stability between -50° C. to 200° C. and may remain within this temperature range indefinitely at either extreme without material change in the elasticity or flexibility of the plastic or changes in the other characteristics of the silicone plastic. In the shrunken condition the plastic wall of the sleeve is thin and follows the contours of the resistor. Even with the thin wall the resistors encapsulated withstand a 1000 volt "V" block test which illustrates the good dielectric strength of the sleeve. The plastic is also chemically resistant and impervious to moisture to protect the resistive element and caps against corrosion.

Similarly the polytetrafluoroethylene also has good stability over the temperature range of -70° to 200° C. and is highly resistant to chemical corrosion. Both plastics are tough and resistant to abrasion to form a firm tough coating for the resistors.

It is thus seen that tough, resistant coatings are provided that are easily mounted on the axial type of resistors. Although the described resistors are cylindrical in shape, the sleeves are readily adaptable to encapsulate other cross sectional shapes, such as elliptical, rectangular, hexagonal and the like. Plastics having the characteristics of silicone rubber and polytetrafluoroethylene may be used in place thereof.

From the foregoing description the axial type resistors are provided with an inexpensive and easily mounted coating that is tough and protects the resistor over moderate operating temperature ranges.

As pointed out in the description, various modifications and changes may be made without departing from the scope of the invention as set forth in the appended claims.

I claim:

1. An electrical resistor of the axial lead type comprising a central insulating cylindrical core having a resistive member mounted thereon and having a length greater than the width, a separable insulating sleeve of plastic material formed into two single piece parts, each part having a cylindrical portion for encircling the resistor, said cylindrical portions having overlapping sloped edges bonded and sealed by a silicone cement with said sleeve being under a contractive stress to firmly compress said cylindrical portions and end portions against and around said core and resistive member to seal and protect said resistive member against corrosion and physical impact.

2. An electrical resistor as set forth in claim 1 wherein said resistor has axially extending leads and each of said end portions has a thin diaphragm pierced by a respective lead with a respective diaphragm sealing a respective sleeve part.

5

References Cited by the Examiner

UNITED STATES PATENTS

1,905,232	4/33	Kercher et al.	338—268 X
2,282,651	5/42	Haberberger	338—275 X
2,627,011	1/53	Eaves	338—263 X
2,635,994	4/53	Tierman	338—309 X
2,640,132	5/53	Thom	338—274 X
2,647,192	7/53	Berkelhamer	338—302
2,660,653	11/53	Berkelhamer	29—155.63 X
2,698,372	12/54	Patta	338—276
2,718,576	9/55	Kratochvil et al.	338—268 X

5

10

6

2,730,597	1/56	Podolsky et al.	338—302 X
2,803,729	8/57	Kohring	338—268 X
2,942,302	6/60	Beyer	29—155.63 X
3,037,529	6/62	Hancik	174—110
3,048,904	8/62	Kohring	338—273 X
3,063,100	11/62	Kohring	338—273 X
3,093,448	6/63	Kirkpatrick et al.	264—272

FOREIGN PATENTS

1,051,692	9/53	France.
-----------	------	---------

RICHARD M. WOOD, *Primary Examiner.*

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,205,467

September 7, 1965

Charles J. Ganci

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 60, for "encricling" read -- encircling --
same line 60, for "said" read -- and --; column 5, line 11, for
"Patta" read -- Patla --.

Signed and sealed this 19th day of April 1966.

(SEAL)

Attest:

ERNEST W. SWIDER

Attesting Officer

EDWARD J. BRENNER

Commissioner of Patents