May 13, 1952 J. J. CERNY 2,596,325

METHOD OF MAKING ELECTRICAL RESISTORS

Filed Sept. 20, 1947 2 SHEETS--SHEET 1

Fig 1

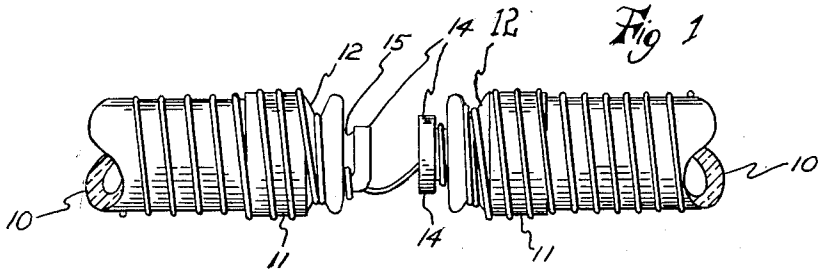


Fig 2

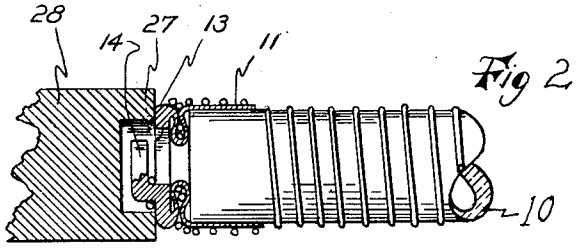


Fig 3

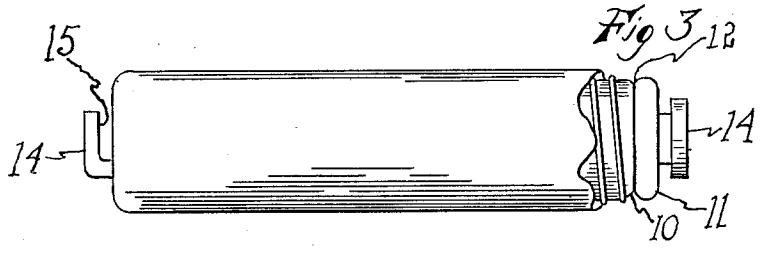
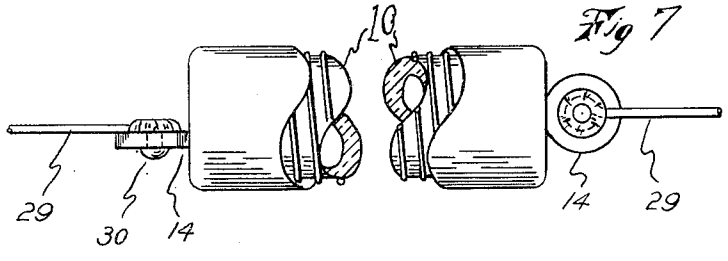


Fig 7



INVENTOR.
Joseph J. Cerny
BY John J. Brezina
Att'y

May 13, 1952 J. J. CERNY 2,596,325

METHOD OF MAKING ELECTRICAL RESISTORS

Filed Sept. 20, 1947 2 SHEETS--SHEET 2

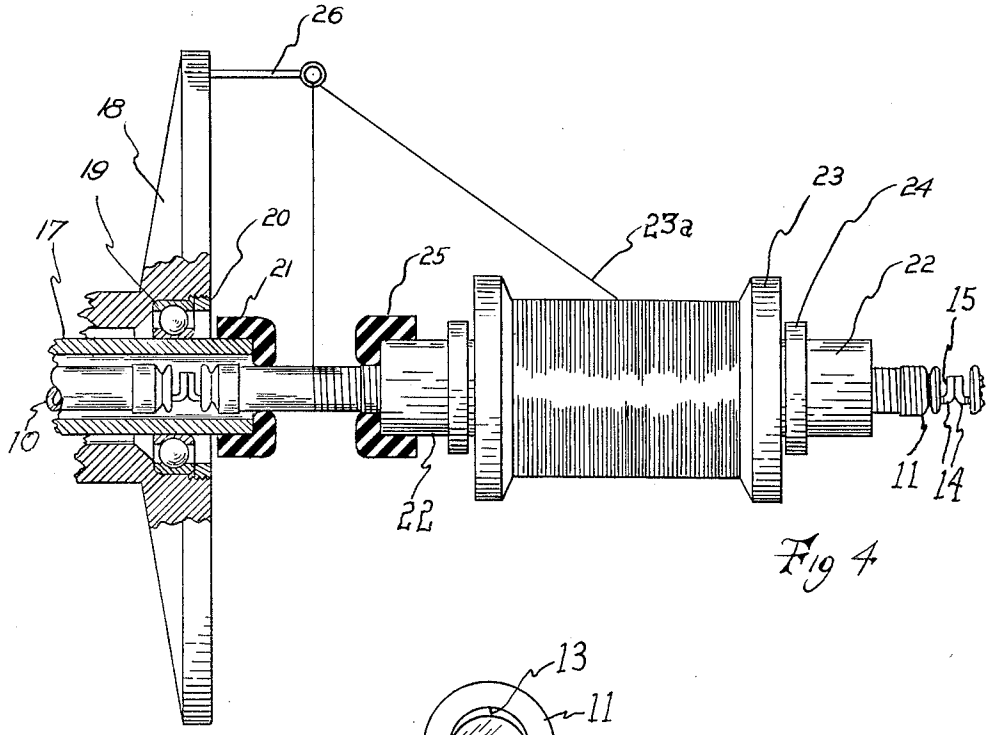


Fig 4

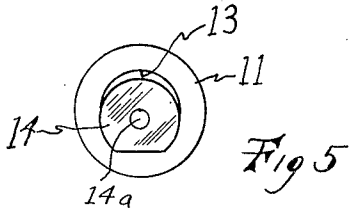


Fig 5

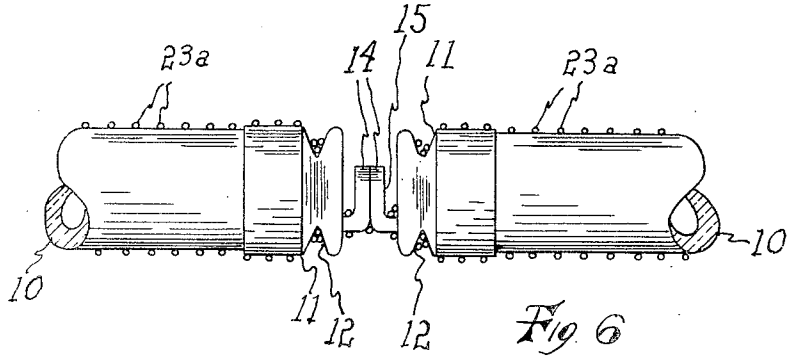


Fig 6

INVENTOR.
Joseph J. Cerny
BY John J. Brezina
Att'y

Patented May 13, 1952

2,596,325

UNITED STATES PATENT OFFICE

2,596,325

METHOD OF MAKING ELECTRICAL RESISTORS

Joseph J. Cerny, Chicago, Ill.

Application September 20, 1947, Serial No. 775,296

2 Claims. (Cl. 29—155.5)

1

This invention is directed to novel resistors, particularly of the type adapted for use in a wide variety of electrical devices, electrical apparatus, electrical circuits and appliances. It is primarily directed to a novel method or process of more quickly and economically manufacturing portable resistor units and to resulting novel resistors.

It is an important object of my invention to provide resistors which have an elongated rounded or cylindrical body of non-conductive material, on the ends of which are metal end caps or heads, each of which has integral elements, said anchoring elements having connected thereto projecting wire or bar terminals whereby the resistors may be easily and quickly electrically connected to the desired parts.

A further object and accomplishment of my invention is the provision of resistors adapted to be connected in electric circuits which include an elongated body, collapsed metal end caps having integral bent projected lugs which provide the means for quickly and easily connecting terminal wires or bars thereto, said end caps having intermediate portions thereof recessed and extending inwardly and containing a part of the convolutions of the resistance wire spirally wound about said body and about said end caps, said annularly recessed positions being collapsed so as to impinge portions of the resistance wire therein.

A further object and accomplishment of my invention is a provision of a novel method of more quickly manufacturing resistors for electric circuits in which the initial forms of the resistors include elongated portions with annularly channelled metal end caps thereon, and which method provides for feeding either manually or mechanically, in a continuous path, a plurality and unlimited number of said resistors so that the spiral winding of the resistance wire by mechanical means may be continuous and virtually without interruption during the longitudinal feeding of a number or a train of resistors positioned in end-to-end relation, thereby eliminating the need of manually fastening the resistance wire at the beginning and starting ends of the resistor, and also eliminating the stopping of the wire winding means when the wire has reached the opposite end of the resistor core, and also eliminating the need of manually cutting the wire and securing such end at the opposite end of each core body upon completion of winding of each resistor.

My novel construction and method herein described provides for continuously winding spirally upon a large number of cores or resistance wire in the desired spaced-apart relation so that the spirally wound resistance wire continues without interruption to be wound over and about the end members of the resistor and around the terminal anchoring elements of said members while a large number of said cores are either manually or mechanically moved in end-to-end relation through a space about which the resistance wire will be wound in the desired manner. This method eliminates stoppages of the wire winding at the end of each resistor core.

2

A further object and accomplishment is the provision of the novel construction of resistors in which a continuously wound resistance wire, after winding about the resistor core, will be quickly and easily secured on the ends of said resistors, and the end member on the resistors collapsed to secure the wire ends, thereby eliminating manual soldering and similar manual securing steps.

Other and further important objects of my invention will be apparent from the following descriptions and amended claims.

One embodiment of my invention is illustrated in the accompanying drawing bearing numbers of reference referred to in the accompanying specification.

Fig. 1 is an elevational view of two adjacent segments of two resistor cores, illustrating a spirally wound wire mounted thereon and around the adjacent end caps and around the terminal anchoring members and continuing from one to the other thereof.

Fig. 2 is a partial elevational view of segments of one resistor after the wire has been mounted thereon and the wire has been cut beyond the terminal elements, and illustrating a die having a cylindrical end portion pressing against the metal end caps and with the channelled positions of the end caps collapsed so as to impinge some of the convolutions in the angular channel thereon.

Fig. 3 is an elevation of a partially completed resistor with parts of the protective coating and covering broken away having with illustration one collapsed end portion.

Fig. 4 is a partial elevational view of a mechanism which permits the practice of the method of manufacture herein described.

Fig. 5 is an end view of one of the end caps, illustrating the outwardly struck and projecting anchor member at the end thereof.

Fig. 6 is an elevational view of segments of two resistors partially completed, and illustrating a resistance wire spirally wound about the segments of the core bodies and continuing around

the end channel of the adjacent end caps and around the terminal anchoring members formed integral with said end caps, only said wires being shown in cross-section.

Fig. 7 is a partial elevational view with intermediate parts broken away, illustrating a completed resistor having the connecting bars mounted on the end anchoring elements thereof.

Referring to the drawings, reference numeral **10** designates a cylindrical or rounded core, or body, made of suitable non-conductive material and which varies in a wide range of sizes according to the sizes of resistors required in numerous installations. The opposite ends of the core **10** are cut off evenly and square, as indicated, and metal end caps or end members **11** are securely mounted about the two opposite ends of each core **10**. Such securance and mounting may be, for example, by frictional engagement, as such end caps are made of a size so as to snugly and firmly fit over the ends of each core.

Each of the end caps **11** is formed with a relatively deep annular groove, channel or recess **12** outwardly of the annular flange of each end cap and inwardly of the end portion of each end cap. The end wall of each end cap is punched outwardly with a suitable die to provide an end opening **13** and an angularly bent hook or lug **14**, whose outer portion will be offset with respect to the remaining part of the end wall of said cap and which end portion will preferably be disposed substantially parallel to the plane of the end wall of the cap. This provides a groove or recess **15** between the lugs or anchoring elements **14** and the main end portion of each said end cap, as illustrated in Figs. 1, 2 and 3.

The next step is to wind and mount the resistance wire upon and about the core and around and about the end caps and said anchoring lugs **14**. While this may be done either manually or with the aid of a rotatable gripping element which grips the core body with end caps thereon, and while guiding the wire so that it will be wound in spaced-apart relation, I have devised a novel method of winding resistance wire continuously upon a plurality of core bodies which are moved in a closed linear path and simultaneously held against rotation while the wire is wound thereabout. I have illustrated this method in Figs. 4 and 6, which I will now describe.

Referring to Fig. 4, numeral **17** designates a metal cylinder or sleeve which is suitably secured in a horizontal position. Numeral **18** designates a wheel which is journalled on the end portion of the sleeve **17** by means of a suitable bearing **19**, said bearing being secured in the passaged hub portion of said wheel **18** by a lock nut **20**. A yieldable rubber bushing **21** is mounted on the end of sleeve **17**, the same having a passage of a size to permit pressing therethrough of core bodies to be wound with resistance wire, though also frictionally engaging such core bodies to prevent their rotation during the winding step.

Numeral 22 designates a metal tube or cylinder which is supported (by means not shown) co-axially with cylinder **17** and a short distance therefrom, and on which is removably journalled in the desired position a spool 23 containing resistance wire 23*a* by means of retaining bushings or nuts 24. The end of tube 22 nearest cylinder **17** has mounted thereon a yieldable and removable inwardly flanged rubber bushing 25, whose annular flange is adapted to frictionally engage the resistor cores as the same are moved and pressed therethrough in the described manner. It is to be understood that the sizes of the cylinder **17**, tube **22**, and bushings **21** and **25** may be varied, these being easily replaceable, to agree with the size of resistors being manufactured.

The cylinder **17** is of sufficient length so that a number of cores may be fitted and moved therein in end-to-end relation. The wheel **18** carries a projecting passage arm **26** which has an eyelet in the end thereof and through which the resistance wire is threaded so that such wire may be extended to the area between the bushings **21** and **25**, as indicated in Fig. 4.

The train of cores which are placed in end-to-end relation in cylinder **17** is moved either manually or by mechanical means (not shown) at a substantially uniform rate of speed to cause the resistance wire to be wound in the desired spaced-apart relation on the cores. As the first core of a series projects through the bushing **21**, the end of the resistance wire is wound by hand about the terminal lug **14** of such first core. Thereupon, the operator will rotate or set in motion the wheel **18** and at the same time push the train of cores at a uniform speed through the cylinder **17**, causing the wire **17** to be wound upon the first core as well as on each successive core pushed through the bushings **21** and **25**. During the wire winding, the frictional engagement of the annular flanges of bushings **21** and **25** will prevent rotation of the cores being moved therethrough. As the "rear" and end cap of each core passes through the path and position in which the wire is wound, the wire will continue to be wound around the flange of the end cap and one or more convolutions of the wire will be wound into the annular channel and groove of the end cap and will continue to be wound around the shank portion of the terminal lugs **14**, as illustrated in Figs. 1 and 6.

When the resistance wire is wound around the "rear" end cap and the terminal lug thereof, as stated, the frictional engagement of bushing **25** will prevent rotation of such core, and as the wire continues to be wound without interruption of the rotation and of the forwarding of the train of cores, the wire will continue to be first wound about the lug of the forward end cap of the next succeeding core, and continue being wound around the annular channel of the forward end cap and around the main body of the core, as illustrated; this while such core is held against rotation by the frictional engagement of the bushing **21**. This cycle of winding continues as the train of cores is pushed through the cylinder **21** and through said bushings, and through the tube **22**. The train of cores emerging from the outlet end of the tube **22** will be connected together by a segment of spirally wound wire which extends from one end of the terminal lug to the adjacent terminal lug **14** of the adjacent core, and this segment will then be cut to separate the individual core bodies with wire wound thereon.

After the core bodies have the wire wound thereon, as has been described, and the same have been separated, I mount each of the core bodies in a suitable holding means (not shown) and press a die **28**, such as shown at the left of Fig. 2, which has a projecting annular flange **27** against the annular periphery of each end cap so as to collapse the intermediate portion of the end cap in the manner illustrated in Fig. 2. This collapsing has the novel advantage of impinging and securing inside the annular groove or channel those convolutions of the resistance wire which have been wound in such channel, this result-

ing in quickly and easily securing the two opposite end portions of the spirally wound wire **23***a* in such end caps. This has the advantage of eliminating the time-taking and costly step of soldering the wire to the end caps.

The extreme ends of the resistance wire have been wound around the shank portions of the lugs **14**, and this also secures such extreme end portions of the wire on the ends of said end caps. Thereupon the terminal lugs **14** are preferably bent in an outward direction substantially perpendicular to the end faces of the end caps, for example as illustrated in Fig. 7, and a relatively short metal wire or bar **29** is secured to each of the two apertured terminal lugs **14** of each resistor. Such securance of terminal wire **29** may be accomplished in a variety of means, although I prefer the use of an eyelet or rivet **30**, which is passed through the hole **14***a* of each terminal lug **14** and through a hooked or eyelet portion of the terminal wire, the eyelet being spread in the usual manner, as illustrated at the left of Fig. 7.

The metal end caps may be mounted at any desired position on the ends of the core body, that is, the lugs **14** of such end caps may extend in any direction and be in different directions from each other, for example as illustrated in Fig. 7.

I apply a suitable non-conductive covering or coating upon the core bodies with the resistance wire and end caps thereon; for example, using material such as porcelain enamel, which when dried and baked, effectively, protects the resistor over its entire length and leaves only the terminal lugs **14** and the connected terminal wires projecting therefrom. Such enamel coating has high heat conductivity and quickly dissipates the heat developed in the resistor element.

In the manufacture of previous conventional presently known resistors, I have found that a least seventy-five percent of the final cost represents labor expense. My novel method herein described accomplishes the important factor of cutting the labor time per resistor to less than one half of that required in making presently known resistors by presently known convenient methods. This consequently decreases materially the cost of the final product.

The present invention has been described herein more or less as to details, yet it is to be understood that the invention is not to be limited thereby, as changes may be made in the arrangement and proportion of parts and equivalents may be substituted without departing from the spirit and scope of the invention.

I claim:

1. In a method of making resistors for electrical circuits, the steps of substantially, uniformly moving a train of resistor cores in end-to-end relation in a continuous passage; mechanically winding a resistance wire spirally on the outer surface of each of said core bodies as each moves through a plane in which a spindle is moving and moves out of said passage, temporarily retaining said core body from rotation as it moves through the plane of wiring, and continuing said winding from one core body to the other as the cores are successively moved through said plane, simultaneously pushing each already wired core body through a second passage while retaining said cores from rotation, thence cutting the segments of the wires extending from one core body to the other; and thence securing the portions of the spirally wound wire at the opposite ends of each core body.

2. In combination, in the making of electrical resistors, mounting two annularly recessed end caps on the opposite ends of a non-conductive core body; moving a train of resistor cores having said end caps mounted thereon, in end-to-end relation in a continuous path and through a pair of spaced apart passages so that each core body bridges said passages; mechanically winding a resistance wire spirally around each core body while same is in the bridging position, while preventing a rotation of said core bodies by yieldably holding said bodies in the second of said passages, and continuing said winding from one core body to the other as the core members are successively pushed through said bridging position; cutting the segments of the wires extending from one core body to the other, securing the opposite end of each core to the opposite end cap of each core body; collapsing the end caps to impinge the resistance wire therein.

JOSEPH J. CERNY.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,690,452	Manent	Nov. 6, 1928
1,830,084	Byorndal	Nov. 3, 1931
1,885,108	Bullinger	Nov. 1, 1932
1,887,683	Heintz	Nov. 15, 1932
1,950,623	Owston	Mar. 13, 1934
2,020,001	Schellenger	Nov. 5, 1935
2,061,516	Frese	Nov. 17, 1936
2,355,611	Veley	Aug. 15, 1944
2,393,548	McCoy	Jan. 22, 1946
2,487,057	Kohring	Nov. 8, 1949

FOREIGN PATENTS

Number	Country	Date
372,095	Great Britain	May 5, 1932