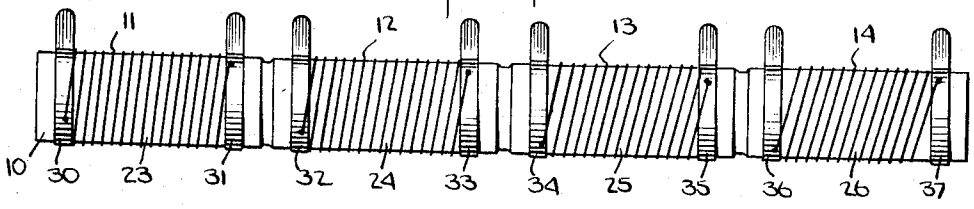
Nov. 22, 1966 C. J. GANCI 3,286,327

METHOD OF MANUFACTURING ELECTRICAL RESISTORS

Filed July 27, 1962

Fig. 1.



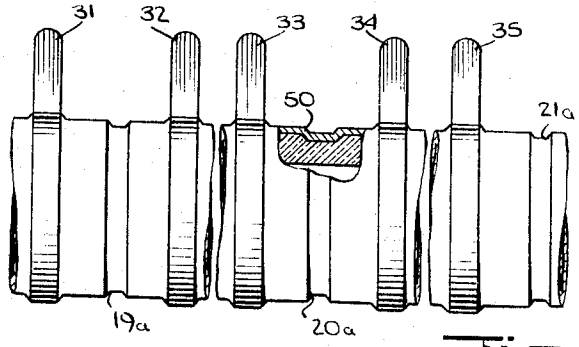
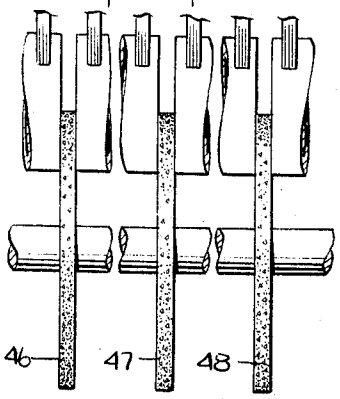


Fig. 2.

Fig. 4.



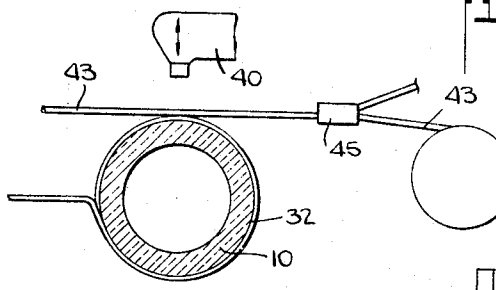


Fig. 5.

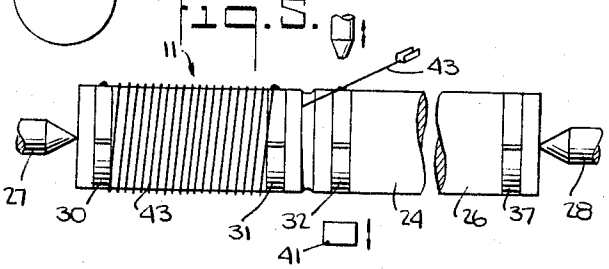
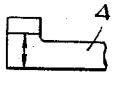


Fig. 6.



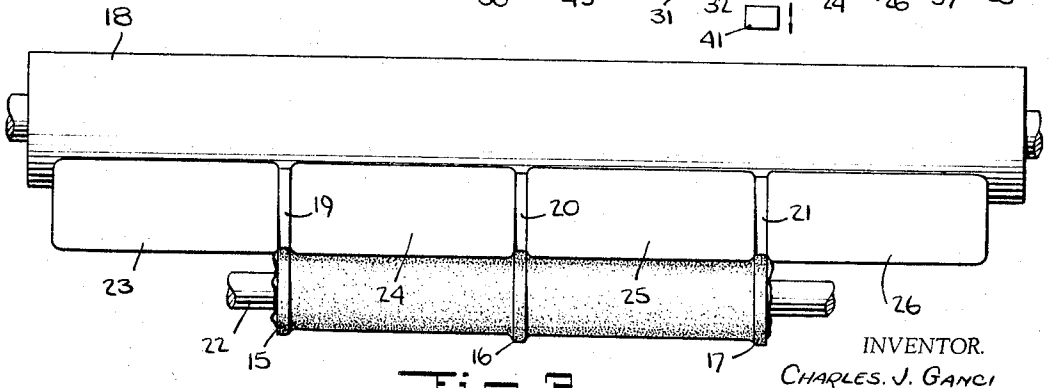


Fig. 3.

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METHOD OF MANUFACTURING ELECTRICAL RESISTORS

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5 Claims. (Cl. 29—155.68)

This invention relates to methods of manufacture of electrical resistors axially formed on an insulating core.

The electrical resistor to which this invention is directed has an inner axial core of an insulating material, such as a ceramic or plastic used as electrical insulators, and a resistive element axially formed, such as a helically wound resistance wire fastened to terminals at the ends of the resistor.

An object of the invention is to simplify the manufacture of such resistors by reducing the manipulative steps requiring hand operation.

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

FIG. 1 illustrates a plurality of uncoated resistors formed on a single core;

FIG. 2 is an enlarged view of two resistors with a vitreous enamel coating;

FIG. 3 illustrates the core of FIG. 1 mounted on a grinder to form the annular grooves;

FIG. 4 illustrates a ceramic cutting wheel for cutting the core into individual separate resistors; and

FIGS. 5 and 6 diagrammatically illustrate the attachment and forming of the resistance wire on the core.

The core **10** may be made of a ceramic or plastic material and have any desired length to accommodate a plurality of electrical resistors, such as resistors **11** to **14**. In the case of a cylindrical core, it may be mounted in a centerless grinder with a core supporting roll **18** and a plurality of longitudinal grinding members **15** to **17** mounted on a shaft **22** for grinding the annular grooves **19**, **20** and **21** in the core to divide the core into resistor bases **23**, **24**, **25** and **26** subsequently severed into separate resistors. The core is cleaned of dust particles and mounted in a wire winding lathe between centers **27** and **28**. Instead of grinding the grooves **19**, **20**, **21**, the grooves may be formed in the tubular member prior to the firing of the core. The metal or metal alloy terminals are than mounted in pairs **30**, **31**; **32**, **33**; **34**, **35**; and **36**, **37** properly spaced on the bases **23**, **24**, **25** and **26**, respectively, in any conventional manner. The formation of these grooves is optional and may be omitted. The purpose of the pre-grooving is to form rounded edges on the finished resistor.

The resistance wire **43** is supplied from the spool **44** through a guide **45** across the top of the core **10**. The resistance wire **43** is welded to the terminals, as illustrated in connection with terminal **32** in FIGS. 5 and 6, or otherwise fastened by winding on a projecting ear of the terminal and soldering. In the case of welding, the wire **43** is drawing across the top of the terminal with the terminal positioned between the electrodes **40** and **41**. The electrodes may be mounted and operated in any convenient and conventional manner during the welding operation so that the electrode **40** moves down to engage the resistance wire **43**, while the electrode **41** moves up to engage the terminal **32**. The wire **43** is then welded to the terminal **32** and the electrodes **40** and **41** are retracted from the resistor. After the welding step the electrodes are moved so as to clear the tab of the rotating terminals.

As illustrated in connection with the resistor **11**, after the resistance wire **43** is secured to the lead terminal the core is rotated to wind the resistance wire on the respective core, and at the end of the winding the resistance wire is drawn across the trailing terminal and spot welded as described in connection with terminal **32**.

Thus the resistors **11** to **14** may be successively formed on the single core **10** without the removal of the core from the winding machine.

After all of the resistors are formed on the bases, the resistors as a unit on the core **10** go through the various finishing operations, such as cementing, inorganic or organic painting, vitreous enameling, terminal cleaning, tinning resistance measurement, marking and the like. Thus as illustrated in FIG. 2 the resistors will have an enamel coating **50** with grooves **19***a*, **20***a*, **21***a* formed in the coating between the resistors. After the resistors are completed, the core **10** with the resistors is fixedly mounted in a cutting machine having diamond abrasive or grinding wheels **46** to **48** for each groove **19***a*, **20***a*, **21***a*. The grinding wheels have grinding edges **46***a* through **48***a* to sever the tubular core **10** into individual resistors by passing through the core and are cooled with water. Other cutting means may be used, such as hot electrical wire cutters.

In the preferred embodiment of the invention grooves **19***a*, **20***a*, **21***a* are formed in the core. However, the grooves may be omitted and the resistors formed in a similar manner and severed as described in connection with the preferred embodiment.

A vitreous enamel coating has been illustrated and described. However, other types of coatings may be used, such as organic, silicone, Teflon, silicate cements, hydrosilicate cements, phosphate cements, oxychloride cements, or the like. Also, silicone cements, Teflon bonded cements or the like may be used.

The advantage of this structure and method of manufacture is the easy handling of a plurality of resistors by the manipulation of a single core. Thus in the winding of the resistive elements the core is passed along as the resistive elements are wound thereon and secured to the respective terminals. There are no additional movements required in setting each individual resistor down and picking up the next, and in the operations such as resistance measurement, cementing, inorganic or organic painting, enameling, terminal cleaning, tinning resistance measurement, etc. By having a plurality of resistors on one core it is possible to reduce the number of manipulative movements for these various operations and reduce the cost of manufacture of the resistors.

I claim:

1. A method of manufacture of electrical resistors comprising forming a straight core, fastening a number of terminals at longitudinally predetermined spaced intervals on said core and longitudinally arranged in pairs, said core having a clear portion between pairs, mounting resistive wire elements around said core between respective pairs of terminals and attaching and terminating said elements thereto to form a plurality of longitudinally spaced resistors with said clear portions therebetween, forming a solid insulating protective coating on said core to cover said resistive wire elements and severing said core between the terminals of adjacent resistors to form individually separate resistors.

2. A method of manufacture of electrical resistors comprising forming a straight core having an outer surface, forming grooves around said core in said outer surface and longitudinally spaced along the core to define subsequently severed bases, fastening longitudinally arranged pairs of terminals on said bases between said

grooves, mounting resistive wire elements between pairs of terminals and attaching and terminating said elements thereto to form a plurality of longitudinally spaced resistors, forming a solid insulating protective coating on said core to cover said resistive wire elements and forming inwardly rounded contours at the respective annular grooves to provide the finished core with rounded edges, and severing said core into individual resistors by grinding means passing through said core at said grooves.

3. A method as set forth in claim 2 wherein in the step of forming said core ceramic materials are used, and in the step of forming said coating applying a vitreous enamel frit and firing said frit to form a vitreous enamel coating.

4. A method as set forth in claim 2 wherein said core is made of a solid organic material.

5. A method as set forth in claim 2 wherein said coating comprises a cement.

References Cited by the Examiner

UNITED STATES PATENTS

1,904,487	4/1933	Lyon et al.	29—155.62
2,247,869	7/1941	Beers	29—155.68
2,596,325	5/1952	Cerny	29—155.68
2,628,300	2/1953	Berkelhamer	29—155.7
2,887,558	5/1959	Tally	29—155.69
2,972,726	2/1961	Boykin	29—155.68
2,976,509	3/1961	McFaddan	29—155.69 X
3,078,550	2/1963	Rakowski	29—155.63

FOREIGN PATENTS

11,993	5/1914	Great Britain.

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