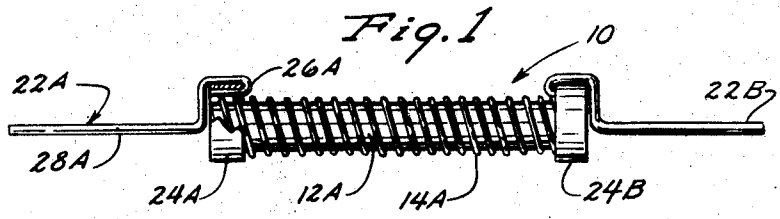
July 21, 1970 J. R. O'KEEFFE 3,521,215

RESISTOR WITH END TERMINALS

Filed Oct. 2, 1968

Fig. 1



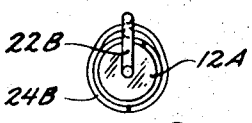


Fig. 2

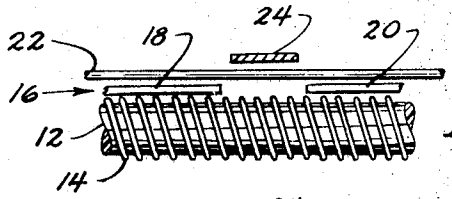


Fig. 3

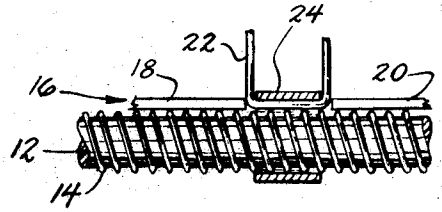


Fig. 4

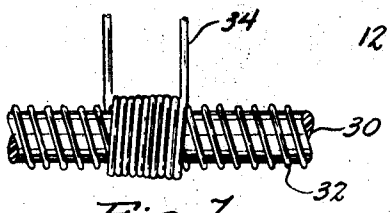


Fig. 7

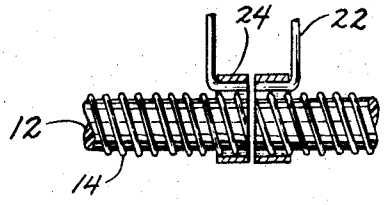


Fig. 5

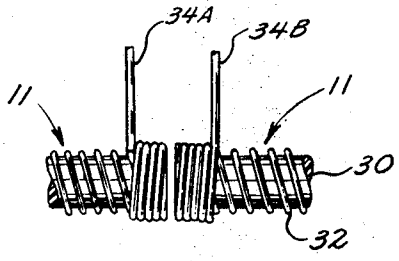


Fig. 8

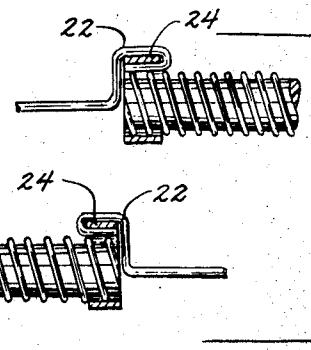


Fig. 6

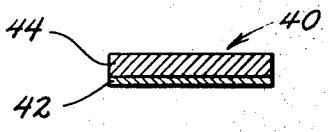


Fig. 9

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3,521,215

RESISTOR WITH END TERMINALS

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Int. Cl. H01c 1/14
U.S. Cl. 338—332 5 Claims

ABSTRACT OF THE DISCLOSURE

A resistor with an elongated core element having a resistance element on the outer surface thereof, and terminal wires secured to the ends of the resistor and engaging the outer periphery of the resistance element at the opposite ends thereof.

This invention relates to a resistor and more particularly to a resistor of the continuous wound type and the method of making the same. This invention also relates to resistors wherein the resistance means is comprised of deposited carbon, metal film or the like.

Resistors of the type disclosed herein consist generally of a core overwound with resistance wire and terminals electrically connected to the resistance wire at opposite ends of the core. The problem that the resistor industry is facing is to develop a satisfactory method of terminating the continuous wound resistors which provides good mechanical strength and electrical contact between the terminals and the resistance wire and which does not allow the resistance wire to shift on the core or to protrude from the end of the resistor. Several different methods of termination have been attempted but all have proved to be expensive and unreliable to various degrees. One method used heretofore was to weld the lead wire to the terminal. A second method used heretofore was to insert the lead wire through slits formed in the terminal. A third method used heretofore was to pinch the lead wire between the ends of the terminal stock. These three methods require that the fiber glass or the like core overwound with resistance wire be cut to length prior to the attachment of the terminal. When so cut, the core and resistance wire unravel thereby causing shorted turns, poor electrical contact, poor mechanical strength, and resistance wire protruding from the terminals. Certain of the manufacturers of resistors have attempted to solve the unraveling problem by several methods including core impregnants, insulated wire, etc. These remedial methods have also been generally unsuccessful due to their expense and unreliability.

Therefore, it is a principal object of this invention to provide a resistor wherein the core and the resistance wire do not become unraveled during the manufacture thereof.

A further object of this invention is to provide a resistor having a fiber glass core and resistance wire overwound thereon which does not become unraveled during the manufacture thereof.

A further object of this invention is to provide a resistor wherein the resistance wire does not objectionably protrude from the resistor.

A further object of this invention is to provide a resistor which has good electrical contact between the resistance wire and the terminals.

A further object of this invention is to provide a resistor which has good electrical contact between the terminals and the lead wires.

A further object of this invention is to provide a resistor which has excellent mechanical strength.

A further object of this invention is to provide a method

of making a resistor wherein the terminals are attached thereto before the core is cut to length.

A further object of this invention is to provide a machine process method of making a resistor which does not require core impregnation or other similar methods of adhering the resistance wire to the core.

A further object of this invention is to provide a method of making a resistor which provides two terminations per machine cycle.

A further object of this invention is to provide a method of making a resistor which eliminates a secondary operation to bond the lead wire to the terminal.

A further object of this invention is to provide a resistor which is economical of manufacture, durable in use and refined in appearance.

These and other objects will be apparent to those skilled in the art.

This invention consists in the construction, arrangements, and combination of the various parts of the device, whereby the objects contemplated are attained as hereinafter more fully set forth, specifically pointed out in the claims, and illustrated in the accompanying drawings in which:

FIG. 1 is a side view of the resistor with a portion thereof cut away to more illustrate the invention;

FIG. 2 is an end view of the resistor of FIG. 1;

FIG. 3 illustrates one of the initial steps in the method of making the resistor wherein the wound core and lead wire are fed into the machine in parallel paths and the terminal stock is fed perpendicularly to the lead wire;

FIG. 4 illustrates the components of the resistor after the terminal stock has been cut and crimped around the lead wire and core;

FIG. 5 illustrates the components of the resistor after the assembly has been cut through the middle of the terminal to form two assemblies;

FIG. 6 illustrates the ends of the two assemblies formed illustrating the manner in which the lead wire has been bent back over the terminal;

FIG. 7 illustrates one of the initial steps in a modified method of making the resistance wire wherein the lead wire has been wrapped around the core;

FIG. 8. illustrates the components of the resistor of FIG. 7 after the assembly has been cut through the middle of the wrapped lead wire and through the core to form two assemblies; and

FIG. 9 is a sectional view of a bimetallic terminal stock material which may be substituted for the terminal stock material of FIGS. 1–6.

The resistor of FIG. 1 is referred to by the reference numeral **10** while the resistor of FIG. 8 is generally referred to by the reference numeral **11**.

Resistor **10** is constructed by feeding an elongated core material **12** of fiber glass or the like having a resistance wire **14** overwound thereon into a machine **16**. As seen in FIG. 3, machine **16** includes spaced apart members **18** and **20**. An elongated lead wire material **22** of copper or the like is fed into machine **16** parallel to core material **12** and is spaced therefrom and an elongated strip of terminal stock **24** is fed into machine **16** transversely to core material **12** and lead wire material **22**. Core material **12**, lead wire material **22** and terminal stock **24** are fed into machine **16** simultaneously and the relationship between these components at this time is illustrated in FIG. 3. Terminal stock **24** may be comprised of a bimetallic terminal stock material **40** such as seen in FIG. 9 if desired. Terminal stock **40** is provided with a brazeable layer **42** comprised of silver solder or the like laminated onto a brass or like layer **44**.

The next step in the manufacture of resistor **10** is illustrated in FIG. 4. The terminal stock **24** is cut to the proper

length and crimped around the lead wire material **22** and core material **12** by any suitable means. The crimping of terminal stock **24** around lead wire material **22** and core material **12** causes lead wire material **22** and terminal stock **24** to be moved towards core material **12** at a point between members **18** and **20** of machine **16** thereby causing lead wire material **22** to be bent as illustrated in FIG. 4. If terminal stock **40** is used rather than terminal stock **24**, the terminal stock would be heated in a secondary operation thereby fusing or brazing layer **42** into intimate contact with the resistance wire.

The next step in the manufacture of resistor **10** is illustrated in FIG. 5. The assembly is cut through the middle of terminal stock **24** transversely to the longitudinal axis of core material **12** by any convenient means thereby forming opposite ends of two resistors **10**. Machine **16** would normally be adapted so that the other ends of the two resistors **10** would be terminated simultaneously with the termination of the ends shown and described. FIG. 6 illustrates the manner in which the lead wire material **22** is bent back over the terminals of the two resistors **10**.

The completed resistor **10** is shown in FIG. 1 and includes a core **12A** overwound with resistance wire **14A**. A terminal **24A** is provided at one end of resistor **10** and a terminal **24B** is provided at the other end of resistor **10**. A lead wire **22A** is operatively electrically connected to terminal **24A** as previously described and includes a U-shaped end portion **26A** embracing the interior surface, the inner end and exterior surface of terminal **24A**. Lead wire **22A** also includes an L-shaped portion **28A** which at first extends downwardly and thence outwardly with respect to end portion **26A** and terminal **24A** as seen in FIG. 1.

Terminal **24B** is identical to terminal **24A** and for that reason will not be described in detail. A lead wire **22B**, identical to lead wire **22A**, is electrically connected to terminal **24B** as previously described. Resistor **10** may be coated with any suitable material if desired.

With respect to FIGS. 7 and 8, the numeral **30** generally designates a core material overwound with resistance wire **32**. A lead wire material **34** is simply wrapped around core **30** as illustrated in FIG. 7. The assembly is then cut through the middle of the wrapped lead wire material (FIG. 8) by any suitable means. The cutting of the assembly results in the opposite ends of two resistors **11** being formed wherein the wrapped lead wire material serves as both a lead wire and a terminal. Normally, the termination of the opposite ends of the two resistors **11** would be accomplished at the same time as the termination of the ends shown in FIG. 8. In FIG. 8, the terminal assembly at the right end of the left resistor **11** is referred to as **34A** and the terminal assembly at the left end of the right resistor **11** is referred to as **34B**.

The advantages of the resistor **10** are as follows: (1) the invention allows machine processes which do not require core impregnation or some other method of adhering the resistance wire to the core; (2) a double width terminal stock is used which is sliced in two thereby giving two terminations per machine cycle; (3) the slicing operation occurs after termination thus eliminating frayed ends or resistance wire protruding from the terminals; (4) mechanical strength of the resistor is increased because stress imposed on the lead wire acts against the bend thereof and not on the joint; (5) the resistor is economically manufactured since a secondary operation is not required to bond the terminal to the lead wire; and (6) mechanical strength and electrical contact are further improved by use of a fusible or brazeable terminal stock (example: silver solder laminated to brass), which when heated in a secondary operation provides intimate contact with the resistance wire.

The advantages of the resistor **11** are as follows: (1) the wrapped lead wire serves as both a terminal and a lead wire; and (2) superior mechanical strength and electrical contact are realized, and further improved by use of fusable lead wire which when heated in a secondary operation provides intimate contact with the resistance wire. While the resistor has been described as including a resistance wire overwound on a core, a resistor without a resistance wire can be produced by the method described herein. Such resistors would substitute deposited carbon or a metal film or the like for the resistance wire.

It should be noted that the resistor core can be of any configuration and has been shown to be cylindrical in the drawings for sake of simplicity.

Thus it can be seen that the device and the method of making the same accomplishes at least all of the stated objectives.

Some changes may be made in the construction and arrangement of my resistor without departing from the real spirit and purpose of my invention, and it is my intention to cover by my claims, any modified forms of structure or use of mechanical equivalents which may be reasonably included within their scope.

I claim:

1. In a resistor,

a core having opposite ends and a resistance means thereon,

a flat, collar-like terminal means embracing each of the opposite ends of said core and being in electrical contact with said resistance means, each of said terminal means having inner and outer ends and parallel exterior and interior surfaces with respect to said core,

lead wires operatively electrically connected to each of said terminal means,

each of said lead wires having a substantially U-shaped end portion comprising first, second and third end portions, said first end portion being positioned between said terminal means and said resistance means and extending inwardly from the outer end of said terminal means, said first end portion being parallel to the longitudinal axis of said core and the interior surface of said terminal means, said second end portion extending from the inner end of said first end portion and embracing the inner end of said terminal means, said third end portion extending outwardly from said second end portion and embracing the exterior surface of said terminal means, said third end portion being parallel to said first end portion, said third end portion extending at least outwardly from said terminal means in a parallel relationship to the longitudinal axis of said core.

2. The resistor of claim **1** wherein each of said lead wires have a substantially L-shaped portion extending from said third end portion of said U-shaped end portion first towards the center of the end of said core and thence extending outwardly therefrom.

3. The resistor of claim **1** wherein said resistance means includes a resistance wire on said core and wherein each of said terminal means are crimped around the core to maintain said resistance wire and the lead wire on said core.

4. The resistor of claim **1** wherein said terminal means includes at least a layer of metallic fusible material at its interior surface, said fusible material being fused to said resistance means.

5. In a resistor,

a core having first and second ends,

a resistance means on said core,

a first lead wire operatively secured to said first end of said core,

a second lead wire operatively secured to said second end of said core,

said first lead having one end positioned adjacent said first end of said core and having a wrapped portion spirally extending around said core away from said one end of said core, said first lead having its other end extending outwardly from the inner end of said wrapped portion,

said second lead having one end positioned adjacent said second end of said core and having a wrapped portion spirally extending around said core away from said second end of said core, said second lead having its other end extending outwardly from the inner end of said wrapped portion.

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ELLIOT A. GOLDBERG, Primary Examiner

U.S. Cl. X.R.

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