

March 5, 1946.

R. L. HARTWELL

2,396,099

ELECTRICAL RESISTANCE AND METHOD OF PRODUCING SAME

Filed Feb. 24, 1944

Fig. 1

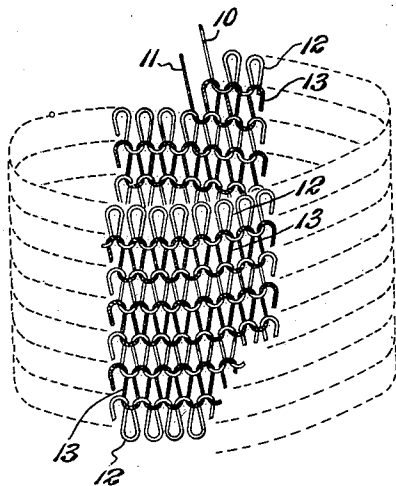


Fig. 2

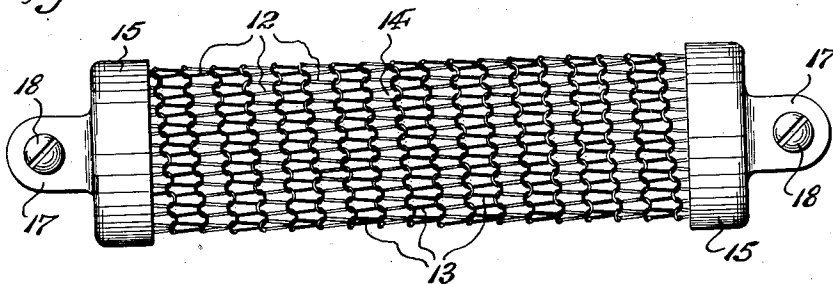
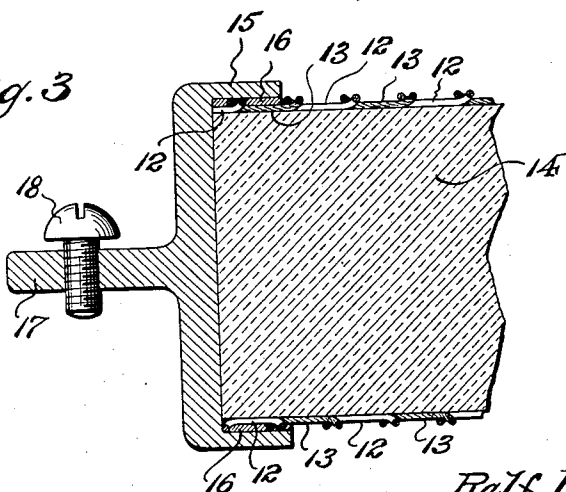


Fig. 3



INVENTOR.

BY *Ralf L. Hartwell,*
George S. Richards,
ATTORNEY.

UNITED STATES PATENT OFFICE

2,396,099

ELECTRICAL RESISTANCE AND METHOD
OF PRODUCING SAME

Ralf L. Hartwell, Orange, N. J., assignor to Metal
Textile Corporation, West Orange, N. J., a cor-
poration of Delaware

Application February 24, 1944, Serial No. 523,628

2 Claims. (Cl. 201—63)

This invention relates to improvements in core supported electrical resistances, heating elements and the like, and to a method of producing the same.

The invention has for an object to provide a novel distribution of electroconductive wire or the like of desired resistance characteristics upon and around a suitable non-conductive supporting core, in such manner as to dispose a considerable length of wire within a given area of supporting core surface, and in continuous spiral extension thereover.

The invention has for another object to provide a method of application of electroconductive wire or the like optionally to non-conductive supporting cores of either straight or curved symmetrical form or of irregular or non-symmetrical shape, whereby the applied electroconductive wire or the like automatically adjusts itself to the surface contours of the cores so as to lie snugly contiguous thereto in extension thereover and therearound.

A further object of this invention is to form and space the run of electroconductive wire or the like in a laterally waved spirally extending continuous course by knitting the wire or the like in alternate courses with a strand of non-conductive material or yarn by a tubular knitting method or machine, whereby the convolutions of the course of electroconductive wire or the like are separated and spaced by the intervening convolutions of the course of non-conductive material yarn interknitted therewith, so that the conductive wire or the like is held by the latter in desired laterally waved and spirally extending disposition; the tubular knit formation thus obtained being then drawn over a selected supporting core so as to conform itself thereto, with one or both ends of the electroconductive course electrically engaged by suitably attached terminal electrode means likewise mounted on and affixed to the core.

Other objects of this invention, not at this time more particularly enumerated, will be understood from the following detailed description of the same.

An illustrative embodiment of the invention is shown in the accompanying drawing, in which—

Fig. 1 is a perspective view of a tubular knit formation comprising alternated interknit courses of electroconductive wire or the like and non-conductive material or yarn.

Fig. 2 is a side elevational view of a core supported resistance made according to this invention; and Fig. 3 is a fragmentary longitudinal

sectional view thereof, drawn on an enlarged scale.

Similar characters of reference are employed in the aforesaid views to indicate corresponding parts.

In the production of an electrical resistance device or the like according to this invention, a run of electroconductive wire 10 and a run of a strand or yarn of electrically non-conductive material 11 are supplied alternately to the needles of a tubular knitting machine, whereby these materials are interknit in alternated convolute courses to obtain a tubular formation of predetermined diameter approximating the mean diameter of a supporting core body of a resistance device or the like to be produced. By such knitting procedure, the knit loop formations 12 of the wire courses are interlinked with and between the knit loop formations 13 of the courses of non-conductive material, whereby the wire courses not only extend in a continuous spiral path from end to end of the tubular formation, but the wire is laterally waved or zigzagged to provide a maximum length of wire along each convolution of the spirally extending course thereof. Such laterally waved disposition of the wire is maintained, at least initially, by the linkage of the knit loops or wire with those of the adjacent convolutions of the spirally extending course of the non-conductive strand or yarn.

The non-conductive strand or yarn may comprise any suitable material having sufficient dielectric strength to avoid bleed of electricity through the loop bights thereof as interlinked with the bights of the wire loops. For example, said non-conductive strand or yarn may selectively comprise glass fiber yarn, resinoid or other non-conductive plastic fiber yarn, rubber, vegetable fiber yarn, or materials of like characteristics.

A tubular knit formation, such as above described, of selected diameter and length substantially corresponding to the diameter and length of the supporting core 14 of a given resistance or like device desired to be produced, is drawn over said core so as to extend from end to end thereof, thus disposing the laterally waved course of electroconductive wire in continuous spiral or convolute extension between the end portions of said core upon and around the surface thereof.

The tubular formation having been thus applied to the core 14, terminal electrode means may be applied to one or both ends of the core supported formation in electrical connection with an end or ends of the electroconductive wire

course. Illustratively, as shown, said terminal electrode means may comprise metallic caps, ferrules or the like 15 adapted to embrace the core 14 and electrically engage contiguous portions of the electroconductive wire course of the tubular knit formation. Said cap or the like 15 may be affixed in place by any suitable form of mechanical fastening means, and, if desired, the contiguous portions of the electroconductive wire may be affixed to the same by solder 16 or similar means calculated to provide a good electrical and mechanical union between said wire and cap. The cap, ferrule or the like 15 may be provided with suitable terminal tongues 17 and cooperating screws 18 or other suitable means for connecting the resistance device in an electrical circuit in which it is desired to be included.

The material of which the supporting core 14 is made may be selected from any material which is electrically non-conductive; e. g. glass, porcelain or other ceramic material, vulcanized fiber, rubber, resinoid or like plastic materials, etc.

In some types of resistances or like devices, it may be desirable to bond the electroconductive wire constituent of the knitted mesh formation to the surface of the supporting core. This may be done in various ways, such as by utilizing an appropriate cement or adhesive. When cores of material subject to softening by heat at temperatures below the melting point of the electroconductive wire constituent of the knitted mesh formation are used, adhesion of the latter to the core surface may be obtained by heating the assembly to soften the core material so that on cooling the wire will adhere thereto; or again, with porcelain and other ceramic cores, the assembly may be glazed and fired thereby adhering the wire to the core surface. In the latter cases the non-conductive constituent of the knitted mesh formation, if destructible by heat, may be destroyed, but this will not be detrimental to the shape and disposition of the wire constituent, since the adhesion thereof to the core surface will retain its shape and disposition thereafter, and all the advantages of its formation and disposition as obtained by its initial interknit relation to the non-conductive constituent will be retained during the operations of assembly with the core, and during treatment of the latter for the adhesion of the wire thereto, until such adhesion is attained.

The knitted mesh formation which includes the spirally convolute laterally waved course of electroconductive wire, by reason of its interlinked loop formations, possesses considerable give and take stretch in all directions, while at the same time the interlinked loops are capable of relative play under applied tensional force in any direction. By reason of these characteristics, the knitted mesh formation lends itself admirably for conformable application upon and around supporting cores of various shapes, such as either straight or curved symmetrical forms, or of irregular or non-symmetrical forms; for when so applied the mesh will automatically and snugly

conform itself to any curves or irregular contours of the core without tendency to wrinkle, pleat or bulge, and consequently will lie smoothly upon the core surface while nevertheless retaining the desired laterally waved spirally extending continuous course of its electroconductive wire constituent.

The spacing between the convolute courses of the electroconductive constituent of the mesh may be desirably predetermined by the length of the knit loops of the non-conductive constituent interlinked therewith. The degree or extent of lateral wave of the electroconductive constituent of the mesh may be desirably predetermined by the length of the knit loop formation thereof.

It is realized that many changes could be made in the above described constructions, and resistances or like devices of various shapes, dimensions and detail terminal structure could be made without departing from the scope of this invention as defined in the following claims. It is therefore intended that all matter contained in the foregoing description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A resistance or like device comprising a supporting core of non-conductive material, and a tubular knit sleeve providing interknit alternated spirally extending courses respectively of a continuous electroconductive wire of desired resistance characteristics and a continuous strand of non-conductive material disposed in common plane, whereby the non-conductive course spaces and holds the spiral convolutions of the looped conductive course in separated parallel relation, said sleeve being mounted on said core in conformably and snugly engaging relation to and around its surface, the knit loops of said conductive course providing the wire thereof with a laterally waved formation along the path of its convolutions, whereby to provide a continuous running length of conductive wire substantially greater than the length of its spiral path.

2. A resistance or like device comprising a supporting core of non-conductive material, a tubular knit sleeve providing interknit alternated spirally extending courses respectively of a continuous electroconductive wire of desired resistance characteristics and a continuous strand of non-conductive material disposed in common plane, whereby the non-conductive course spaces and holds the spiral convolutions of the looped conductive course in separated parallel relation, said sleeve being mounted on said core in conformably and snugly engaging relation to and around its surface, the knit loops of said conductive course providing the wire thereof with a laterally waved formation along the path of its convolutions, whereby to provide a continuous running length of conductive wire substantially greater than the length of its spiral path, and terminal electrode means affixed to the core to which the conductive course of said sleeve is electrically connected.

RALF L. HARTWELL.