Sept. 15, 1925. 1,553,461

A. NEGROMANTI

THERMOELECTRIC FABRIC AND PROCESS FOR THE MANUFACTURE OF SAME

Filed April 24, 1922

Fig. 1.

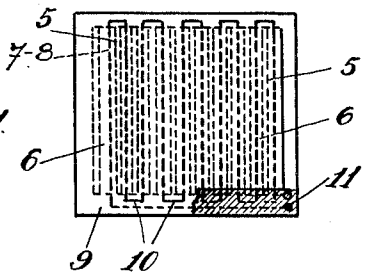


Fig. 2.

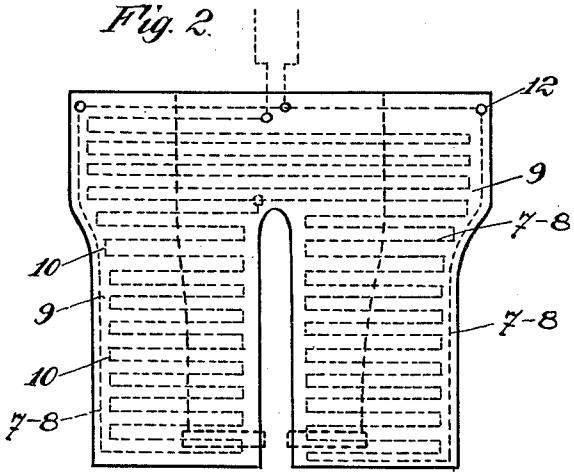


Fig. 3.

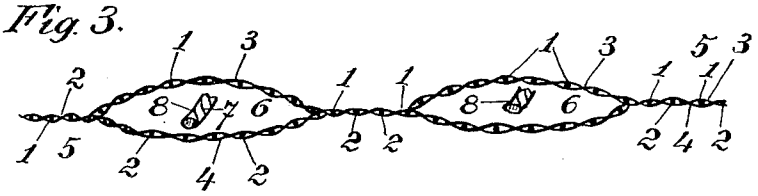


Fig. 4.

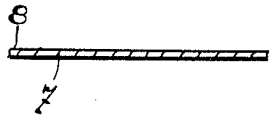
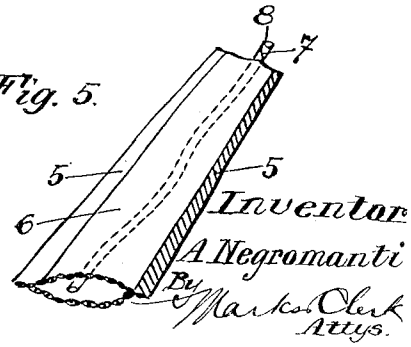


Fig. 5.



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UNITED STATES PATENT OFFICE.

ANTONIO NEGROMANTI, OF MILAN, ITALY.

THERMOELECTRIC FABRIC AND PROCESS FOR THE MANUFACTURE OF SAME.

Application filed April 24, 1922. Serial No. 556,279.

To all whom it may concern:

Be it known that ANTONIO NEGROMANTI, a citizen of the Kingdom of Italy, residing at Milan, Italy, has invented certain new and useful Improvements in Thermoelectric Fabrics and Processes for the Manufacture of Same, of which the following is a specification.

In an earlier application for Letters Patent filed April 12, 1921, Serial No. 460,850 I have described an improved electro-thermic fabric characterized by the combination of a fabric body with bare electric current conducting wires, the said improved fabric being produced directly in a loom or any other machine.

The threading of the conducting wires into the body of the fabric was done loosely simultaneously with the weaving of the fabric proper and during the time when the said fabric was subjected to elastic tension in the lateral direction.

On this tension being relaxed, the composite fabric contracted and the wire retained a sufficient degree of freedom in the tube wherein it was lodged. By that means it was possible to reduce indefinitely the diameter of the wire, because all strains of whatever nature were borne solely by the fabric proper which constituted a real protecting casing for the conducting wire. In that construction the transmission of the heat of the said wire to surrounding bodies was the more copious in view of the fact that the wire was inserted without insulation into the tubes of the fabric. In that way it was possible to produce electro-thermic fabrics having a high degree of elasticity and suppleness, since, owing to the manner of manufacture the presence of the conducting wires was not apparent. Garments made from such fabrics are excellent substitutes for ordinary garments and are adapted to serve the double purpose of an ordinary garment and a warming garment.

The present invention which is an improvement on the invention specified in the said earlier application provides an improved process according to which the conducting wires are inserted in varying lengths into the tubes which are in course of successive formation, for the purpose of producing thermo-electric fabrics in which the inserted or threaded electric wire is continuous, and which are woven to such shapes or contours as will allow of manufacturing directly in the loom or any other machine ready-made thermo-electric garments of any desired shapes, and also a fabric having a multi-tubular structure and ready for making up into thermo-electric garments.

This direct manufacture of a multi-tubular thermo-electric fabric in the loom or any other machine, is an important and essential part of the present invention.

The present invention also comprises a process for threading by hand or any other suitable means, a very fine bare conducting wire, into a previously made multi-tubular fabric and previously cut to the desired shape, the wire after threading having a certain amount of play.

In this case, however, the threading-in is effected in such a manner as to reproduce the same effects as those produced by the transverse elastic tension to which the fabric is subjected when the threading of the conducting wires into the tubes of the said fabric is effected in the machine at the same time as the formation of the said tubes.

For this purpose, there may be employed for instance, a needle of suitable length on which the conducting wire is coiled in such a manner that as the wire is uncoiled from the needle, the wire will form a tubular coil inside the tube in which it is to be inserted permanently. This arrangement is absolutely necessary in order that strains exerted in any way whatever upon the fabric proper shall not effect the actual conducting wire. This is a characteristic feature of the above described mechanical process.

With the object of imparting to the composite fabric the highest degree of elasticity, the fabric proper may be made with meshes, that is knitted. In such a case the conducting wire is wound on an elastic core. Electro-thermal garments of this nature will conform necessarily in a greater degree to the shape of the body of the wearers. The multi-tubular meshed fabric proper is formed substantially by two-plies simultaneously knit, which are at intervals intermeshed or in any way united to each other.

The said characteristic feature of the above described mechanical process may also be reproduced in many other ways. For instance: the conducting wire may be directly interknit in the meshes of a knit fabric, which is done by first knitting a certain number of rows of ordinary mesh-work, and then following this by a series of meshes

containing the conducting wire, and then resuming the ordinary knitting of the textile thread or fibre, yarn, etc. In this manner there is produced an improved composite fabric comprising alternate strips or rows of ordinary mesh-work (without the conducting wire) separated by alternate strips or rows of mesh-work interlaced by the conducting wire which latter will have a coiled form due to the meshes. The said composite fabric is then covered on one side only or on both sides with meshed fabric for the purpose of concealing and covering the conducting wire. Such covering may be produced at the time of making the electro-thermal fabric in such a manner as to produce preferably an improved composite multi-tubular fabric and that in order to render eventual reparation easier.

For the purpose of reproducing the characteristic features of the above mentioned mechanical process, we may also mechanically arrange on any ordinary fabric the conducting wire, according to a predetermined shape, by means of a sewing-machine or like, so as to make a predetermined greater length of conducting wire, correspond to a determined surface of fabric.

The stitches may be directly made of conducting wire. To the said fabric a ribbon will be stitched at intervals, thus forming a multi-tubular structure for the purpose of insulating the successive rows of stitching.

These improved fabrics may have one side composed of a textile fibre which is a good heat-conductor, such as cotton, whereas the other side may be of a textile fibre which is a bad heat-conductor, such as wool. The improved fabrics may further be provided with a cellular structure covering one or both sides, for the purpose of facilitating the transmission of heat to the body of the wearer.

The invention is illustrated in the accompanying drawings which disclose the manner of forming the fabric or garment by a loom.

In this drawing:—

Figure 1 is a plan view partly in section of a pad constructed in accordance with the invention.

Fig. 2 is a plan view of a garment blank.

Fig. 3 is a detail sectional view illustrating the tubes in the fabric and the electric current conducting wire arranged in the tubes.

Fig. 4 is a detail view of the wire wound on a textile core.

Fig. 5 is a perspective view of a fragment of one of the tubes showing the undulatory form which the conducting wire assumes in the tube through which it passes.

Referring first to Fig. 3 it may be seen that the fabric is formed of multi-plies, that is, certain of the weft threads 1 cooperate with the warp threads 3 to form an upper ply while other weft threads 2 cooperate with warp threads 4 to form the lower ply. These plies are interconnected at their edges during weaving as shown at 5. As the weaving proceeds the warp threads 3 and 4 and the weft threads for a certain number of courses will form single ply material, then during a number of subsequent courses form a double ply and so on, in the end producing a fabric or garment blank having alternate double plies or tubes 6. These tubes are in communication with one another throughout the fabric or garment blank, so that the conducting wire 7 wound on a fabric core 8 may be threaded through the continuous passageway formed by the tubes during the manufacture of the cloth or subsequent to said manufacture. As shown in Figure 5, the conducting wire 7 and its core 8 assumes an undulatory form in the tubular passageway, so that the fabric may be stretched in various directions without breaking the current conducting wire.

Fig. 1 discloses the application of this method to a heating pad and in this view 9 designates the base of the fabric and 10 designates the ends of the tubes interwoven in the base. 11 indicates terminal posts. The blank shown in Figure 2 is particularly adapted for forming trousers or the like and in this view 12 indicates a post about which the wire may be passed in extending through the garment blank.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:

1. A process of making an electrically heated structure consisting in weaving a fabric partly one-ply and partly two-ply, separating the plies of the two-ply during the weaving in order to form tubes alternately communicating at their ends, and inserting a thermic-conducting wire through said tubes.

2. A process of making an electrically heated garment including weaving a textile fabric partly one-ply and partly two-ply, separating the plies of the two-ply during the weaving in order to form a series of communicating tubes, and inserting an undulated thermic-conducting wire through said tubes while said tubes are in the process of formation.

3. An electrically heated garment including a woven textile fabric partly one-ply and partly two-ply, the plies of the two-ply being separated to form a series of communicating tubes, and an undulated thermic conducting wire extending through said tubes.

In testimony whereof I affix signature.

ANTONIO NEGROMANTI.