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THERMAL FABRIC

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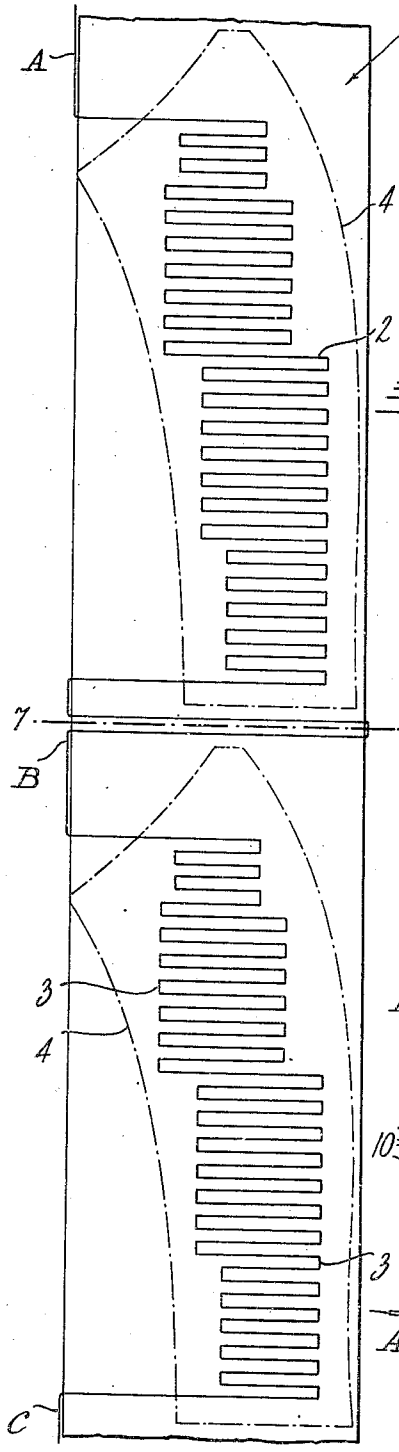


Fig. 1

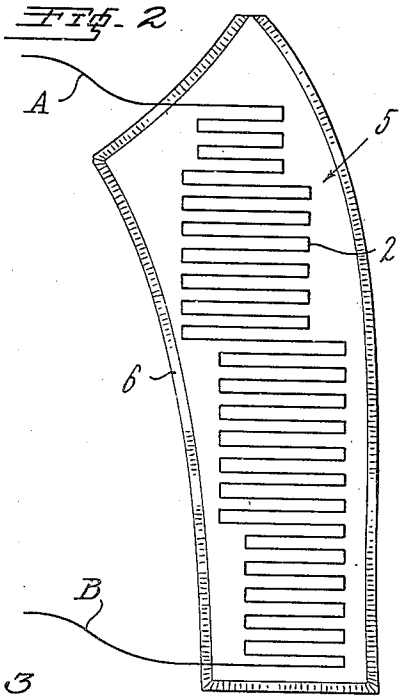


Fig. 2

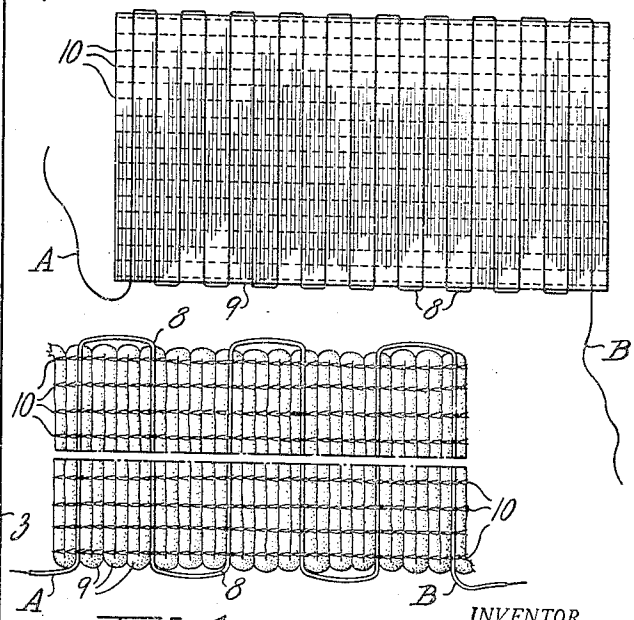


Fig. 3

Fig. 4

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THERMAL FABRIC

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4 Claims. (Cl. 66—163)

The present invention relates to thermal textiles of the type in which a heating element consisting of a conductive wire or strand is knitted as part of the fabric itself. More particularly, it contemplates the provision of a knitted fabric from which heating pads, garments, blankets, rugs, and the like, may be fashioned, the fabric being capable of being cut to pattern of the garment or other article as desired without breaking the circuit necessary to deliver the temperature for the purpose for which the article is intended.

Electrical heating pads and similar articles are well known in the art and in some cases the electrical wires forming the heating circuit are actually embodied in the textile. Often, however, in articles of this sort, the textile forms a mere foundation upon which the wires are sewed as an independent element, and the whole is enclosed in a slip or casing of some suitable fabric. Articles of this sort may include heating pads, blankets, floor rugs, or warming garments for use by aviators at high altitudes.

It is generally desirable in utilizing thermal fabrics of the kind described for fashioning heating appliances that different regions or zones of the device should have means for controlling the delivery of different degrees of temperature to the user. For instance, in an aviator's heated garment, it may be desirable to have greater temperature in the back and over the front of the body than in the sleeves or legs, and mittens and shoes adapted to be electrically connected with the arms or legs of such a garment should generally be capable of delivering adequate temperature to keep these extremities warm even at very low temperatures.

To accomplish efficient heat control in garments, pads and other heating articles, it has previously been necessary to include various devices such as rheostats, thermostats, and the like, in the circuits of the garment, pad, blanket, etc., and sometimes these are even embedded in the fabric itself.

It is an object of the present invention to provide a thermal fabric capable of being fashioned into a garment, pad, blanket, mat or other similar article having capacity for delivering a desired temperature without the use of auxiliary heat controlling apparatus such as thermostats, rheostats and the like.

It is a further object of the present invention to provide a textile fabric into which the heating element is knitted as an integral part of the fabric but which may be cut, tailored or otherwise fashioned without breaking the continuity of the wire forming the heat circuit.

It is a further object of the invention to provide such a fabric so knitted that various circuits are provided which are capable of delivering different temperatures to different parts of the article, and heat control is effected by the number and length of wire turns laid in to the inch of length of the fabric and by bridging and splitting the amount of current and voltage supplied.

It is a further object to provide a thermal fabric having the woof composed of yarn and wire forming the heating element bound together by warp threads of cotton, linen, silk, or the like knitted through the woof.

According to the present invention, a fabric is fashioned by means such as knitting in which the woof is composed of yarn of wool, chenille and the like. Into and as part of the woof is worked a resistance wire, preferably stranded and insulated preferably with a resinous material though fibrous coverings are generally sufficiently effective for insulation. The warp may be composed of thread of cotton, silk or the like if a tight fabric is desired; or it may also be of yarn if a looser fabric is more adaptable to the purpose in view. The fabric yardage is made up of panels, each panel containing a wire pattern which is continuously repeated in other panels, which are separated by "headers" and which may be cut through without severing the wire circuit pattern.

A knitted fabric of the invention may be made in the following manner: A length of yarn may be laid in the woof, as, for instance, before the needles of a knitting machine. The needles engage the warp threads forming knots around the length of yarn thread laid in the woof. This operation is repeated for a predetermined number of turns of threads, or "kicks," as they are termed, of the yarn and then the wire properly insulated is laid in. A given "kick" of the wire may extend wholly across the fabric or only partially across according to the use for which the fabric is intended. The wire is knitted in by the warp threads in the same manner as the yarn. The length and diameter of the wire, its composition and the number of strands control the temperature of the fabric without the use of auxiliary devices.

The invention further contemplates the provision of yardages of the fabric into which a resistance wire is knitted in a predetermined pattern that is suitable for delivering adequate heat to a particular part of a garment or other article

designed to provide heat. I use the term "yardage" to indicate an indefinite length of material of a width sufficient to contain the wire pattern with sufficient unwired margin to permit cutting and fashioning the particular article intended. Thus, for example, a yardage of fabric containing the heating element of one side of a sleeve of an aviator's heating jacket may be knitted with the wire running continuously through the whole length of the yardage in a pattern repeated over and over again in panels, each of a length suitable for fashioning a sleeve. Similarly, a wire pattern for the back or front of a jacket may be knitted in panels into the fabric. In each of these panels, however, the wire occupies an area of the fabric that is more or less centered in the width of the material, leaving an unwired space on either side of the circuit pattern that can be cut through without severing the wire. The yardage may be manufactured in long lengths containing material sufficient for a large number of articles and may be rolled into a bolt and supplied in this manner to the trade.

In the drawing to which reference is now made, the invention is illustrated as it is applied to an aviation heating garment and to a rectangular heating pad or the like although it is to be understood that a pad or blanket heating element may be of another shape than rectangular.

Fig. 1 represents a part of a yardage of the fabric of the invention having knitted therein a pattern of resistance wire that is adapted to the fashioning of one side of a sleeve, the pattern being repeated in successive panels of which two are shown.

Fig. 2 shows one side of a sleeve fashioned from the fabric of Fig. 1.

Fig. 3 illustrates one panel of a knitted fabric adapted for use in a heating pad, blanket or the like of rectangular shape.

Fig. 4 is a detail showing the method of knitting, there being six "kicks" of chenille to one "kick" of wire.

Referring now to Fig. 1, a broken length of yardage of the knitted fabric of the invention is illustrated. The fabric 1 is composed preferably from chenille yarn and insulated wire preferably stranded, and may be fashioned on appropriate machines in indefinite lengths. Into the woof of this fabric a continuous wire is laid in in a continuously repeated pattern, two panels being shown in the figure with the wire pattern repeated at 2 and 3. Both yarn and wire are bound together by knitting the warp threads through them. Between each panel containing the pattern "headers" are knitted, i. e., portions of the fabric in which the wire is brought out to the full width of the fabric, as shown at A, B and C. Patterns 4 of one side of a sleeve of an aviation garment is indicated in dotted lines on each panel, from which it will be seen that the wire pattern lies wholly within the dotted sleeve pattern and when the panels of the fabric are severed on the line 7—7 and the panels are then cut to the sleeve pattern, the wire remains unbroken except at the "headers" A, B and C.

In Fig. 2 is shown one side of a sleeve 5 as cut on one of the patterns 4 of Fig. 1. It will be observed that the wire arrangement 2 is wholly contained within the sleeve 5 except that the wires from the "headers" A and B have been stripped from the fabric to act as "pigtails" or leads to other parts of the circuit in the body portions of the garment and indirectly to a source of current. The edge of the sleeve is bound as at 6 to prevent the fabric from fraying after the sleeve is cut.

It will be evident that the sleeve side illustrated will be adapted to deliver a predetermined temperature and that this temperature will be determined by the total length of the wire, the material of the wire and its diameter or in the case of a stranded wire the number of strands and size of the wire in the strands. On a knitting machine the chenille yarn is fed to the needles and a predetermined number of turns of yarn are laid and knitted in, and then one turn of wire. These turns or "kicks" may be greater or less in number in accordance with the amount of wire to be included in the circuit. The greater the number of "kicks" of chenille, the less will be the number of "kicks" of wire, and consequently the less will be the amount of heat delivered.

The wire is fed to the needles in the same manner as the yarn. However, in the pattern shown in Fig. 1, the wire occupies only a middle region of the fabric. This wire pattern is effected by blocking the wire feeding mechanism so that the wire feed movement will be less in either direction across the fabric than the feed movement of the yarn.

In Fig. 3 is shown a panel of the fabric of the invention cut to rectangular shape for use as a pad or blanket in which the wire 8 coated with a suitable insulation is extended through the entire width of the material and the headers A and B are shown stripped to form "pigtails" to be connected to a source of supply of electric current.

Fig. 4 is a detail of the fabric of the invention showing the yarn and wire somewhat enlarged for clarity with the center of the panel broken away. As represented in Figs. 3 and 4, there are six "kicks" of chenille yarn 9 to one "kick" 8 of the insulated wire. The whole is bound together by the knitted warp threads 10.

While Figs. 3 and 4 are shown chiefly for the purpose of illustrating the method of knitting, a fabric such as illustrated in these figures may be used to form part or all of a garment, heating pad, blanket, mat or rug, and a wire pattern may be worked in in a manner suitable to the amount of heat to be delivered. In all the figures it will be understood that the turns or "kicks" of yarn and wire from the woof of the fabric and that they are bound in by knitting the warp threads through them.

The pattern will vary in yardage designed for particular purposes. For instance, if the material is designed for furnishing sleeves, jacket backs, or the sides of the front of the jacket, the wiring will be laid in in lengths suitable for furnishing the required heat for the part and in a pattern such as to permit cutting and fashioning the particular portion of the garment desired. The wire pattern will ordinarily be centered in the width of the fabric with unwired portions that may be cut into the desired shape.

Having thus described my invention, what I claim is:

1. A thermal fabric comprising a woof of chenille yarn and insulated wire bound together by knitted warp threads, said wire being knitted in a pattern to provide a heating element and said pattern repeated continuously throughout the length of said fabric.

2. A thermal fabric comprising a woof of yarn and resistance wire bound together by knitted warp threads, the yarn threads having a plurality of turns to each single turn of wire and said wire being laid in in a pattern centered in

said fabric and continuously and connectedly repeated throughout the length of said fabric, the number and length of the turns of said wire being determined by the degree of temperature desired, and unwired portions of fabric outside said wire pattern that may be cut through and fashioned to a desired shape without cutting the wire of said pattern except at spaces between said patterns.

3. A thermal fabric comprising a woof of yarn and wire bound together with knitted warp threads, said wire being laid in in a pattern adapted to provide a heating element for a part of a garment and adapted and arranged to co-operate with other thermal fabrics similarly knitted but with differing wire patterns adapted to provide heating elements for other parts of garments to be tailored into complete garments with electrical circuits capable of delivering, when energized, different temperatures to different parts of said garments, said fabrics being knitted in yardages of indefinite lengths and each of said wire patterns being repeated connectedly and continuously in successive panels throughout the length of said yardage.

4. A thermal fabric comprising a woof of yarn and wire bound together with knitted warp threads, said wire being laid in in a pattern with electrical circuits capable of delivering, when energized, predetermined temperatures to said pattern, said fabric being knitted in yardages of indefinite lengths and said wire pattern being repeated connectedly and continuously in successive panels throughout the length of said yardage, the connecting wires between patterns being woven into the spaces between panels.

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