Dec. 24, 1929. W. D. GRAHAM 1,741,054

ELECTRICALLY HEATED FABRIC AND THE LIKE

Filed Oct. 11, 1926 3 Sheets-Sheet 1

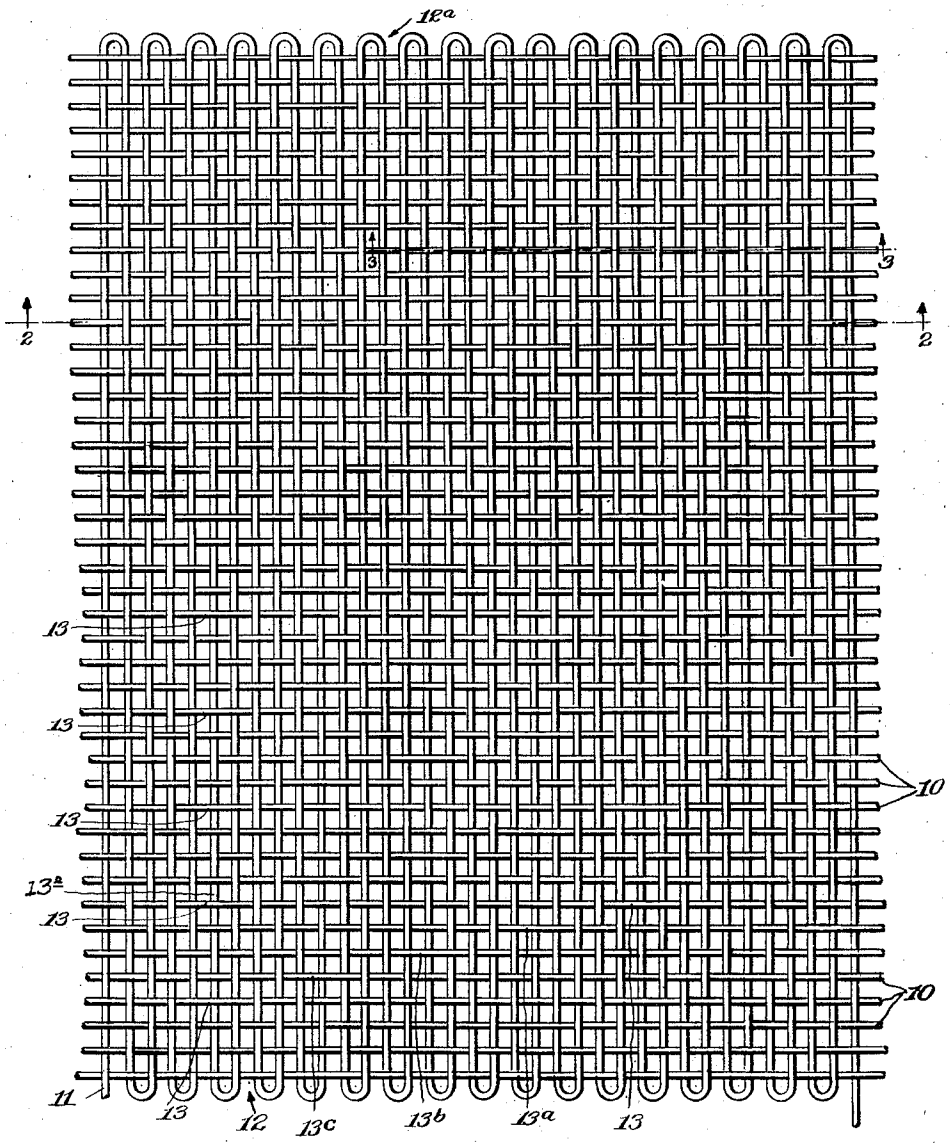


Fig. 1.

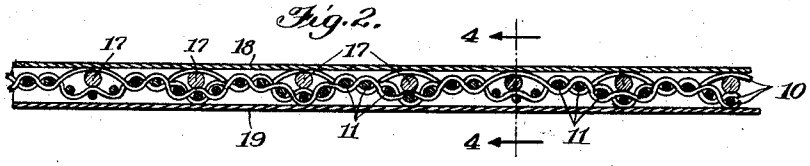
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ELECTRICALLY HEATED FABRIC AND THE LIKE

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Fig. 2.



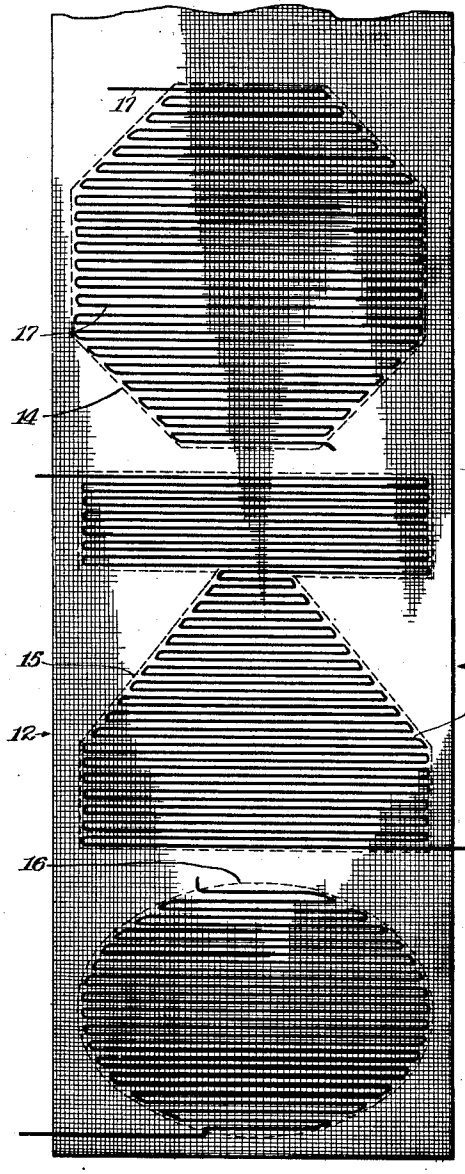


Fig. 5.

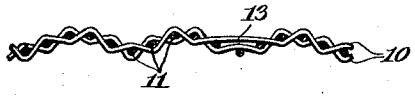


Fig. 3.

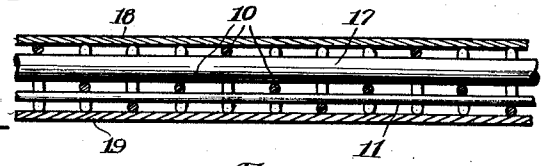


Fig. 4.

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ELECTRICALLY HEATED FABRIC AND THE LIKE

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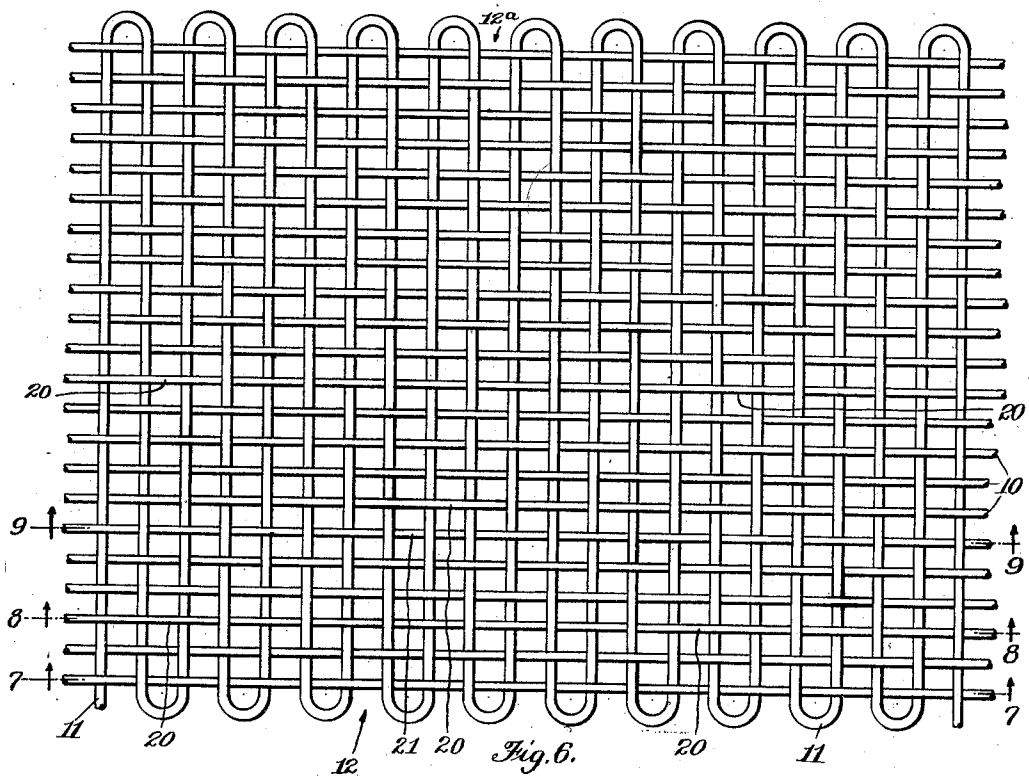


Fig. 6.

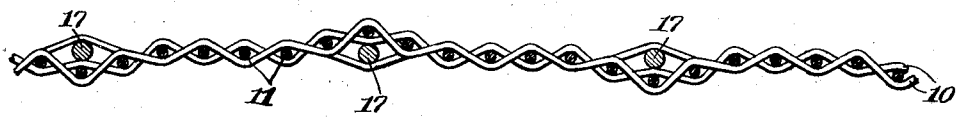


Fig. 7.

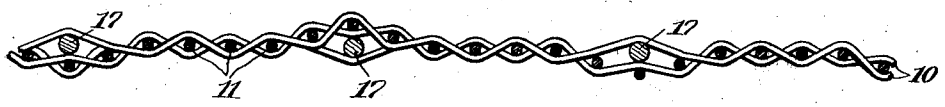


Fig. 8.

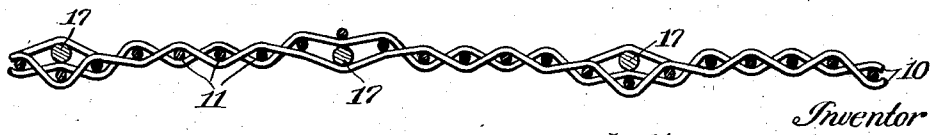


Fig. 9.

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UNITED STATES PATENT OFFICE

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ELECTRICALLY-HEATED FABRIC AND THE LIKE

Application filed October 11, 1926. Serial No. 140,882.

This invention has to do with improvements in electrically heated fabrics and the like. The invention has reference particularly to improvements in the manufacture of the fabric and the method whereby the heating wire or wires are inserted into the body of the fabric in such a manner as to accomplish the desired result.

One of the objects of the invention is to provide a woven fabric which is so constituted that the heating wire or wires may be worked into the same in order to give the desired distribution of heating effect over a fabric of whatever shape and design may be selected. For example, the article to be produced may be regular, or circular, or oval, or of numerous irregular designs; but according to the features of the present invention it is possible to distribute the heating wire or wires uniformly and in proper manner over the area of the selected pattern so as to give the desired amount of uniform heating effect all over said area.

Another feature of the invention relates to the provision of an arrangement whereby the foregoing result may be secured without the necessity of using a special set-up in the harness mechanism of the weaving machine, thus making it unnecessary to change the set-up of the loom each time that a different shape or size of article is to be produced.

In connection with the foregoing, it is a further object to make it possible to weave the fabric as a continuous strip of uniform weave and width, and thereafter very readily and easily insert the heating wire or wires into the body of the fabric so as to cover the selected design or area, so that the fabric may then be cut out around said selected design or area, which will thereupon carry the heating wires as a continuous heating unit or heating units embodied within the confines of said area. In this way it is possible to set out various designs upon the face of the woven fabric, placing said designs thereon according to such a matching as will use the material of the fabric in the most economical manner, the heating wire or wires being then worked into the fabric within the various areas as self-contained heating units. These areas may if desired then be cut out individually, and each will have its own heating wires and heating element, and at the same time the amount of fabric material used during the process will be reduced to a minimum.

Another feature of the invention relates to the provision of a fabric which is so woven as to greatly facilitate the subsequent introduction of the insulated heating wire into the weave of the fabric. This subsequent operation is performed as an operation separate and distinct from the weaving of the fabric itself.

In this connection, it is a further object to provide a fabric having loops or skip stitches therein which are uniformly located so as to facilitate the subsequent introduction of the wire by a convenient form of needle or in other manner.

A further object in connection with the foregoing is to provide a fabric which has the loops or skip stitches so distributed that the strain imposed by the introduction and presence of the wires will be uniformly distributed and thrown on to all of the different warps, or wefts instead of being concentrated on a few of them.

Other objects and uses of the invention will appear from a detailed description of the same, which consists in the features of construction and combinations of parts hereinafter described and claimed.

In the drawings,—

Fig. 1 shows a face view of a section of fabric of one weave which embodies the features of the present invention;

Fig. 2 is a fragmentary section on the line 2—2 of Fig. 1, looking in the direction of the arrows, but modified by illustrating the heating wires in place and by the presence of top and bottom coverings;

Fig. 3 is a fragmentary section on the line 3—3 of Fig. 1, looking in the direction of the arrows, prior to the introduction of the wire;

Fig. 4 is a fragmentary, transverse section on the line 4—4 of Fig. 2, looking in the direction of the arrows, but on an enlarged scale;

Fig. 5 is a length of fabric woven according to the disclosures of the present invention and having worked therein heating wires according to three different designs which have been laid out on the face of the fabric, the designs and fabric being shown more or less diagrammatically;

Fig. 6 is a fragmentary, plan view, similar to Fig. 1, but illustrating a modified form of weave in which the loops or skip stitches are brought alternately to opposite sides of the fabric; and

Figs. 7, 8 and 9 are fragmentary sections on the lines 7—7, 8—8 and 9—9 of Fig. 6, looking in the direction of the arrows, but modified by the illustration of the heating wires in place.

Referring first to the weave which is shown in Figs. 1, 2, 3 and 4, the same comprises a series of longitudinally extending warp threads 10, together with a weft 11 which is woven back and forth from the border 12 to the border 12^a. Usually this weft 11 is of relatively heavy material as compared to the warps 10, for example, jute or the like.

The weaving operation is so conducted that there are established periodical "skips" 13 in which the warps pass over (or under) more than a single weft, so as to establish "loops" wherein the warps are free of the wefts to an extent which permits the heating wire to be afterwards threaded into place.

In the particular weave illustrated in Fig. 1, the skips 13 are established at the position of every fourth warp measured across the width of the fabric, in line with each other, so that the heating wire may be afterwards threaded into the fabric by picking up these skips with a suitable needle or other tool. When the heating wire has thus been woven into place across the width of the fabric it will be supported by every fourth warp, thereby giving it ample support.

Examination of Fig. 1 also shows that each warp is so woven as to establish one of the skips 13 for every twenty weft movements, so that the loops are in line with each other lengthwise of the fabric at definite spacings, as well as being in line with each other across the fabric.

Examination of Fig. 1 also shows consecutive warps have their loops formed at consecutive positions lengthwise of the fabric. Thus there are established the rows of loops 13, 13^a, 13^b and 13^c, said rows being successively stepped in such fashion that, although the loops of each individual warp are formed at intervals of twenty wefts, still considering all of the loops of different warps, they are spaced from each other only five wefts lengthwise of the completely woven fabric.

It is thus possible, by the use of the different longitudinal warps, to establish groups of loops coming in succession and in such fashion that use is made of all of the individual warps for the establishment of loops, while at the same time avoiding the formation of loops excessively close together across the width of the fabric. Furthermore, the weave illustrated is such as to distribute the strain on all of the different warps after the heating wires have been threaded into place.

The fabric having the properly formed and located loops, is easily woven on any suitable loom, and this is readily accomplished by the use of a suitable harness arrangement, combined with the head, cam or other movement.

Usually the fabric will be woven as a continuous length and of a width appropriate for the average manufacturing conditions.

After the fabric has been woven, the different designs of heating elements which are to be made may be outlined on the surface of the woven fabric, as shown, for example, by the dotted lines 14, 15 and 16, illustrated on Fig. 5. These outlines may be readily sketched in on the surface of the woven fabric by means of colored pencils or in other convenient fashion. Furthermore, the desired outlines may be so located on the surface of the fabric as to make use of the latter to the best advantage and in the most economical manner.

In Fig. 5, the outlines 14, 15, and 16 correspond to pads which are to be octagonal, oval, or of special shape, depending on the purposes for which they are intended. Many other shapes and designs may be outlined, and I do not intend to limit the usefulness of the invention to any particular shape or design. After a particular design has been thus outlined, the heating wire 17 therefor may be threaded into the fabric by threading it back and forth across the face of the fabric and through the loops established, in the manner already explained. The back and forth threadings should terminate as nearly as possible at the limits outlined on the face of the fabric, so that after the threading operation is completed the heating wires will occupy only the area contained within the outline delimited. In this connection, the successive passes of the wire should be threaded through the successive loop rows 13, 13^c, 13^b and 13^a since these successive rows are uniformly spaced and are separated from each other by the distance lengthwise of the fabric which has been previously selected as the correct spacing of the successive passes of the wire. This arrangement will insure that the distribution of the wire within the completed article is correct to give the proper heating effect per square inch of surface. In other words, in the original weaving operation the various rows of loops 13, 13^c, 13^b and 13^a may be separated from each other lengthwise of the fabric the correct dis-

tance to insure the desired ultimate distribution of heating wire.

In Fig. 2, I have shown a cross section illustrating the heating wire 17 in place within the various loops, showing how said loops are sufficiently large to conveniently accommodate the heating wire without serious distortion of the body of the fabric. In Fig. 2, I have also shown cover sheets 18 and 19 in place against the top and bottom surfaces of the article so as to protect the heating element and the wires.

Fig. 3 shows the fabric before the wires have been threaded into place, and illustrates one of the loops 13 in its collapsed condition and before it is opened out to accommodate the wire.

It will be noted that in the fabric already explained all of the loops are formed on one side thereof. In some cases it may be desirable to establish a distribution of heating wires on both sides of the fabric, some of the wires being placed against the top surface and others against the bottom surface. In such case the loops should be formed alternately at the top and bottom surfaces of the fabric.

Such a fabric is illustrated in Fig. 6. Examination thereof will show that one of the warps has the loops 20 formed on the top surface, whereas the third succeeding warp has loops 21 formed on the bottom surface. The next warp has a loop 20 formed against the top surface of the fabric, and the fourth succeeding warp has loops 20 formed on the top surface of the fabric and in line with the loops 20 first referred to.

This arrangement is such that the successive passes of heating wire may be placed successively against the top and bottom surfaces of the fabric, as is clearly illustrated in Figs. 7, 8 and 9, which are sections of the fabric taken on the lines 7—7, 8—8 and 9—9 of Fig. 6, looking in the direction of the arrows.

It will be understood that the heating wires may be threaded into the loops of the fabric either before the various designs are cut out from the body of the fabric or afterwards; but if the fabric is cut out it should be cut out on a size somewhat larger than the actual limits of threading of the wires. This is for the purpose of avoiding unraveling of the fabric as much as possible after the designs are cut out. It will be noted, however, that when the different designs are cut out from the body of the fabric they do not have selvages around their edges, and it will also be noted that the actual threading of the wires into place is a distinct operation from the manufacture of the fabric itself. Nevertheless, the initial weaving of the fabric is performed with the definite purpose of ultimately accommodating the wires at the proper spacing and in such a manner as to insure the desired distribution of heating effect.

The fabric herein disclosed may be made of any suitable material such as cotton, wool, paper, jute, silk, or other material, and may be of any character of weave provided only that the weaving operation is so conducted as to establish the skips and loops.

Furthermore, the skips themselves may be of whatever size is desired. In the drawings the skips are shown as being formed by the passing of a weft (or warp) consecutively at the same side of three warps (or wefts). If loops of larger size are desired they may be readily established by skipping a greater number of threads. Furthermore, the weaving operation may be conducted so as to bring the skips and loops either closer together or farther apart. Ordinarily, they will be formed at regular intervals, or perhaps one half inch apart lengthwise of the fabric (that is, in the direction of the length of fabric). When all of the loops are used to support wires this will bring the wires themselves the same distance apart (for example, one half inch). The wires may however, be so introduced as to omit every other loop, thus doubling the spacing between the wires, or tripling such spacing, or increasing it in other multiples.

It will be noticed that the skips or loops appear particularly on the warps when looking at Figure 1. It is, nevertheless, also true that there are loops on the wefts, such as shown at 13ª in Fig. 1, the weft loops facing at right angles to the warp loops. These weft loops therefore may be used to accommodate wires extending lengthwise of the fabric. It is therefore understood that except as I may do so in the claims I contemplate the formation and use of loops extending in either or both directions with respect to the length of the weave.

Furthermore, the loops herein disclosed are uniformly distributed over the surface of the fabric. Any other suitable distribution arrangement may be used if desired.

The fabric herein disclosed is capable of use in a large number of ways for the support and accommodation of heating wires. These wires may be run in through the loops in an almost infinite variety of ways. For example, the wires may be run in in regular order back and forth from one end of the article to the other, thus bringing the terminals of the wires a considerable distance apart. Or these wires may be run in from one end of the article to the other end, then back again so as to bring the terminal ends close together. Many other systems of wire insertion may be used also.

Due to the fact that the wires may be inserted in almost any convenient manner it is possible to build up a large article, such as an aviator's suit, making the same of this fabric; and afterwards the heating wires may be worked into the loops in whatever

manner is desired in order to give the proper distribution of heating effect at all parts of the uniform.

May other weaves may be used besides those herein illustrated; and it will be understood that I do not intend to limit myself to the weaves illustrated except as I may do so in the claims.

I claim:

1. As a new article of manufacture a woven fabric comprising a series of longitudinally extending warps together with a transverse weft woven back and forth between the warps to form a continuous length of fabric, the weft normally passing above and below consecutive warps of each throw and there being periodical skips wherein a warp passes to the same side of two or more wefts in succession to thereby establish a series of loops in the warps, successive skips being out of line with each other to thereby break joints and thereby distribute the warp loops in the positions of the different weft throws, and a suitable outline indicated on the surface of the fabric to designate the limits of insertion of a suitable heating wire, substantially as described.

2. As a new article of manufacture a woven fabric comprising a series of longitudinally extending warps together with a transverse weft woven back and forth between the warps to form a continuous length of fabric with the weft normally passing alternately above and below consecutive warps of each throw, and there being periodically skips wherein the weave is irregular to thereby establish a series of loops in the weave, said loops being located in alignment with each other in a given direction of the fabric, and a suitable outline indicated on the surface of the fabric to designate the limits of insertion, of a suitable heating wire, substantially as described.

3. As a new article of manufacture a woven fabric comprising a series of longitudinally extending warps together with transverse weft woven back and forth between the warps to form a continuous length of fabric, the weave being irregular at periodical positions over the surface of the fabric to thereby establish a series of loops on one surface of the fabric, the loops being in alignment with each other in groups, and a suitable outline indicated on the surface of the fabric to designate the limits of insertion of a suitable heating wire, substantially as described.

4. As a new article of manufacture a woven fabric comprising a series of longitudinally extending warps together with a transverse weft woven back and forth between the warps to establish a continuous length of fabric the weave being periodically irregular to establish a series of groups of loops located in alignment with each other in one direction of the fabric, and a suitable outline indicated on the fabric surface to designate the limits of insertion of a suitable heating wire, substantially as described.

5. As a new article of manufacture a woven fabric comprising a series of longitudinally extending warps together with a transverse weft woven back and forth between the warps to form a continuous length of fabric, the weave being periodically irregular at positions in alignment with each other in one direction with respect to the fabric to thereby establish a series of groups of loops in alignment with each other all for the purpose specified, substantially as described.

6. As a new article of manufacture a continuous length of fabric comprising longitudinal warps and transverse wefts, the weave of said fabric being periodically irregular to thereby establish a series of groups of loops in alignment with each other in one direction of fabric and for the subsequent accommodation of a heating wire or the like, substantially as described.

7. The method of producing a heating arrangement or pad of desired contour which consists in first weaving a length of fabric comprising longitudinal warps and transverse wefts, the weave being so conducted as to establish a series of loops on one surface thereof, thereafter introducing the heating wire or wires into said loops to thereby attach said wires to the surface of the fabric, terminating the introduction of the wires at the desired limits in the face of the fabric, and thereafter severing the article from the body of the fabric, substantially as described.

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