

Sept. 7, 1965

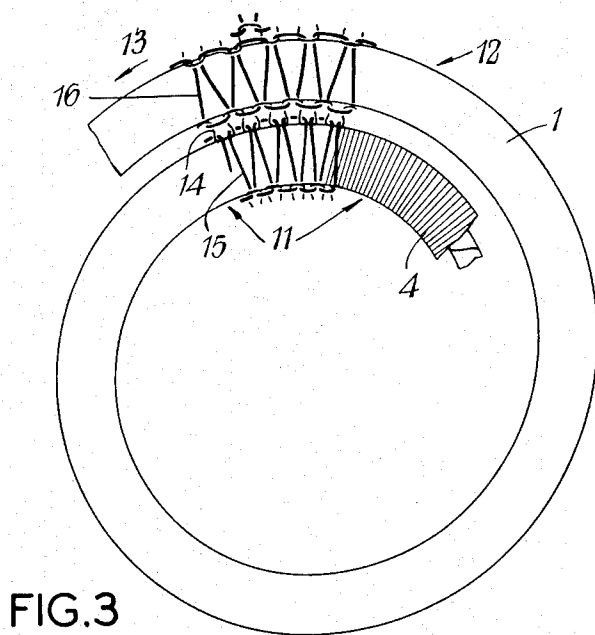
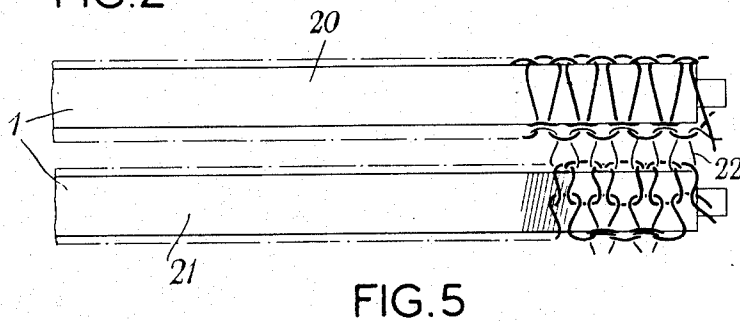
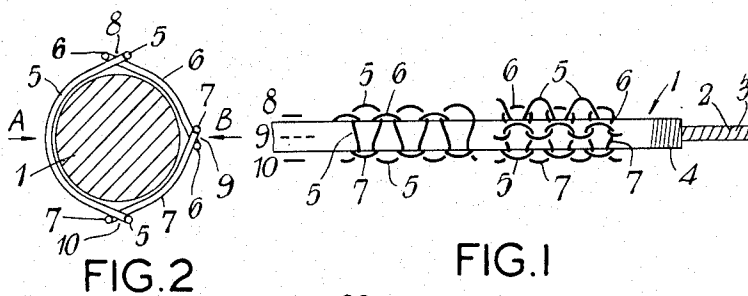
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3,205,341

FLEXIBLE ELECTRIC HEATING DEVICE

Filed March 4, 1963

2 Sheets-Sheet 1



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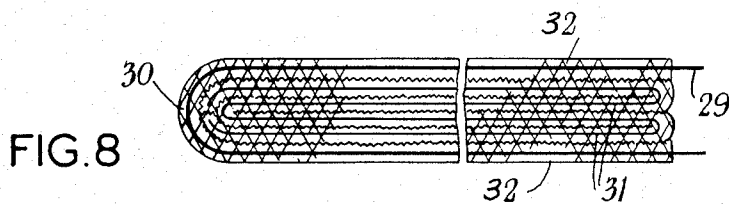
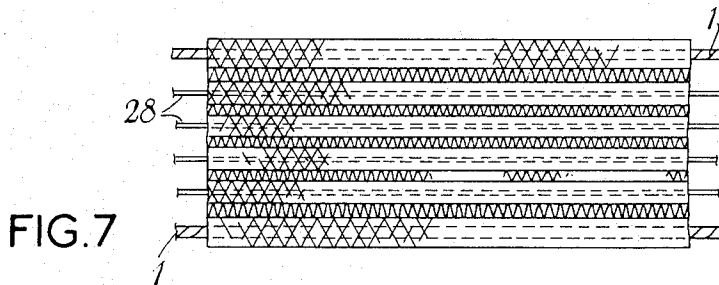
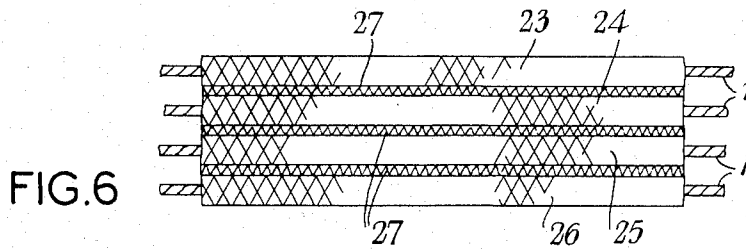
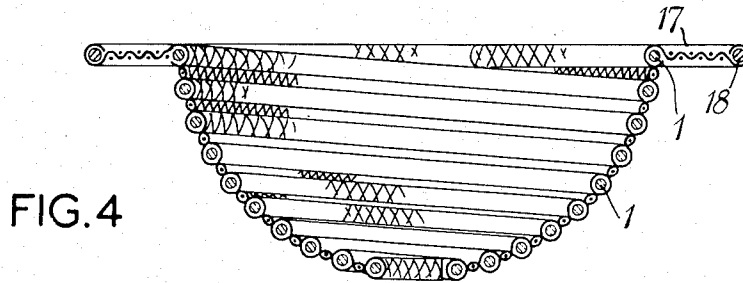
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FLEXIBLE ELECTRIC HEATING DEVICE

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5 Claims. (Cl. 219—528)

This invention relates to a flexible electric heating device.

For a better understanding of the invention and to show how it may be carried into effect, reference will now be made to the accompanying drawings, in which:

FIGURE 1 illustrates an electric heating element with interlocking loops formed around it,

FIGURE 2 shows by means of an enlarged diagrammatic end view the loops around the element,

FIGURE 3 illustrates a stage in the construction of a flexible cup-shaped structure or pocket incorporating the heating element, the loops being shown only diagrammatically,

FIGURE 4 shows the complete cup-shaped structure or pocket in cross-section,

FIGURES 5 to 8 show different heating devices in the form of broad strips or sheets.

FIGURE 1 shows an electric heating element 1 consisting of resistance wire 2 wound on a core 3, consisting of a cord made from glass threads and covered with a helical wrapping 4 of glass threads.

FIGURES 3 and 4 are concerned with a flexible cup-shaped structure or pocket which incorporates the electric heating element 1 of FIGURE 1 and within which a flask or other vessel may be inserted in order to heat the vessel. To make this structure, a length of the resistance element 1 is fed into an "overlock" or "overlocking" machine such as is used to provide a non-fraying edge in the manufacture of underwear. The machine has four needles and is loaded with four lengths of yarn consisting of glass threads and is operated so that three of the lengths of yarn produce interlocking loops around the element 1 as shown in FIGURES 1 and 2, in which parts of the three lengths of yarn are referenced 5, 6 and 7 respectively. FIGURE 1 shows to the left the loops as seen looking in the direction of the arrow A in FIGURE 2 and to the right the loops as seen looking in the direction of the arrow B. Three lines 8, 9 and 10 of points of interlinking between the lengths of yarns extend along the element and are unequally spaced around its circumference. The yarn of the length 5, for example, if of sinuous formation and extends from an interlinking point in the line 8 half-way round the element to an interlinking point in the line 10 and back again to an interlinking point in the line 8 and so on. The loops made from the length of yarn 5 are longer than the remainder. When a convenient length of the element, say two or three inches, has been covered with interlocking loops in this way, the part 11 which was first covered with the loops is bent round to lie alongside the part 12 which has just been covered with the loops to form a circle as shown in FIGURE 3. The three lengths of yarn 5, 6 and 7 are used to make more loops on the heating element, progressing in the direction of the arrow 13 in FIGURE 3, but here the fourth length of yarn 14, is also used and it forms loops which interlock with the loops (referenced 15 in FIGURE 3), which have already been formed from the length of yarn 5 on the part 11 of the element and with the loops (referenced 16 in FIGURE 3) which are being formed from the length of yarn 5 on the element.

By continuing in the manner described above a flat

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spiral of the required diameter is obtained. However, the tension of the heating element being fed into the overlocking machine is so varied throughout the operation that when the flat circular sheet produced by the described process is removed from the machine, in which it is restrained, it adopts the shape of a cup, shown in FIGURE 4. In this figure the reference 17 represents a knitted band of glass yarns with no heating element in it and 18 represents a support wire secured to the outer edge of the band 17.

In the process described above, a narrow band with the heating element running down its centre is continuously produced and at the same time one side of the band is joined to the opposite side of a part of the band which was produced earlier. Instead of this, however, as the band is being made in its spiral formation, one edge of a separate strip of knitted or otherwise formed fabric comprising interlocking loops may be simultaneously joined to the radially outermost side of the band and the opposite edge of the strip is then joined to the inner edge of the band as the next turn thereof is being made by interlocking loops. By interposing such a strip, of constant or varying width, between successive turns of the band in only one or more parts of the spiral, or by using a strip of varying width throughout the spiral, the heat produced per unit area of the pocket may be varied as desired. This result could also be attained by so making the heating element that its resistance per unit length is not the same throughout its length.

A suitable machine for carrying out the process described above is an overlock machine which is made mainly for overseaming, serging and hemming of garments by Union Special Machine Company of Chicago 10, U.S.A., and called by them "Union Special Thirty Nine Five's" or "Union Special Class 39500." The process can also be carried out on a twin needle flat bed sewing machine, for example one made by the Singer Sewing Machine Company.

It is well known to make a cup-shaped structure of knitted or woven glass yarns and subsequently to attach an electric heating element to it, so that it takes the form of a spiral around it, by a separate hand stitching operation. As compared with this, the process described above with reference to FIGURES 1 to 4 affords a considerable saving in time and hence in production costs.

In the example illustrated in FIGURE 5, one band 20 is first made by forming interlocking loops of glass yarn around a heating element 1 which is constructed as described with reference to FIGURE 1. The number of lengths of glass yarn employed and hence the number of lines of interlinking points extending along the element, is three as before. Then a second band 21 is made and simultaneously attached to the band 20, using three lengths of yarn to form interlocking loops around the element of the band 21 and a further length of yarn 22 to form loops interlocking the loops of the two bands. The showing of the loops on the bands 20 and 21 corresponds to the left and right-hand halves, respectively, of FIGURE 1. By proceeding in this way, a heating device in the form of a broad strip or a sheet can be obtained.

FIGURE 6 shows a heating device in the form of a broad strip consisting of four bands 23 to 26, formed one at a time, and joined together by interlocking loops represented by the reference 27. Each band contains a heating element 1. By contrast, FIGURE 7 shows a heating device consisting of six bands of which the outer two contain heating elements 1 and the inner four contain spacer members 28, which may simply be glass cords, around which loops are formed in exactly the same way as they are around the heating elements. FIGURE 8 shows a heating device in the form of a broad

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strip similar to that of FIGURE 7 but in which the two outer bands are replaced by one single band 32 containing a single heating element 29, there being a reverse bend 30 in this band at one end of the heating device. The bands between the two parts of the band 32 contain spacer members 31.

It will be understood that in a heating device constructed as described above heating elements and spacer members may be used as appropriate to obtain any desired distribution of heat dissipation over the area of the heating device. If there are more than one length of heating element, these can be joined together in any desired series, parallel or series-parallel arrangement.

The distance between adjacent stretches of heating element, and hence the distribution of heat dissipation, can be varied by the use of the spacer members, by varying the diameter of the heating element and/or the spacer members, by varying the tension of the yarns and by varying the rate of feed of the heating element and/or the spacer members into the machine.

I claim:

1. A flexible electric heating device comprising an elongated electrical conductor, loops of yarn extending transversely around said conductor and throughout the length thereof, said conductor having portions disposed adjacent to and spaced apart from each other, and a series of loops of yarn separate from said first named loops and extending between the loops of yarn of said adjacent conductor portions, said series of loops being formed of a continuous length of yarn extending along the longitudinal dimension of said adjacent conductor portions and across the space between said portions to interlock said portions together.

2. A flexible electric heating device comprising an elongated electrical conductor, a plurality of series of

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loops of yarn extending transversely of said conductor wholly therearound and extending throughout its length, said loops being formed by a plurality of continuous lengths of said yarn, each separate length of yarn having its loops interlocked with the adjacent loops, said conductor having portions thereof disposed adjacent each other in spaced apart relationship, and a further series of loops of yarn separate from said continuous length of yarn extending between and interlocked with said interlocking loops of yarn on said adjacent spaced conductor portions, said further series of loops being formed of a continuous length of yarn extending along the longitudinal dimension of said adjacent conductor portions.

3. The heating device of claim 2 wherein said adjacent conductor portions are disposed in a spiral configuration.

4. The heating device of claim 2 wherein said adjacent conductor portions are disposed spirally in a cup-like configuration to form a heating device.

5. The heating device of claim 2 wherein said adjacent conductor portions are disposed parallel to each other and in the same plane to provide a flat strip.

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