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(54) **Woven electric heater.**

(57) The woven electric heater comprises warp (1) and weft (2) from electric current-insulating material, interwoven with formation of background (3) and selvage (4). Worked into background (3) is the weft from current-conductive material with formation of heating portions (6) and insulating strips (7). The weft (5) yarn from current-conductive material and the current-carrying strand (8) have complete insulation cover, and their contact is secured by means of commutative elements (9) fixed between the heating portions (6). The warp (1) yarn has length shrinkage with 0.01-5% at 25 to 120 degrees C, while the weft (2) yarn is manufactured from material retaining its geometrical pattern in heating conditions.

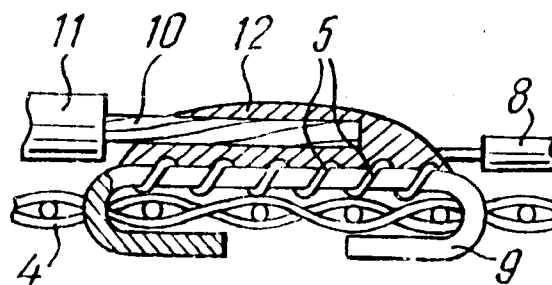


FIG. 2

The present invention relates to woven electric heaters, and may be used for heating/warming car seats, and arm-chairs, in warming pads, bed-pans, and other electric heater devices performing surface heat emission.

Known is a woven heating element (for instance, US Patent No. 2,345,300; 1941) wherein an electric current-conductive strand spirally wound over a soft core from insulating material, is worked in transverse (zigzag) directions into the fabric comprising insulating yarns.

A spiral winding of an electric current-carrying strand over a soft core substantially reduces the total length of the heating element, and thus increases the space between separate heating slivers, effecting uneven heating of individual portions thereof. Also, the heating element becomes too thick and, for that reason, rather rigid for bending. And this complicates the weaving process of the loom.

On the other hand, high resistance value of electric current-conductive strand placed between the weft yarns, turns out to be restrictive with respect to length of the heater. To have a sufficiently large electric heater, it is necessary to work the weft current-conductive strand into the fabric, forming sections subject to consequent electric interconnection.

Known also is a woven electric heater comprising warp and weft from electrical insulating material, that are interwoven with formation of background and selvage; also weft from electric current-conductive material worked into background, with formation of heating portions and insulating strips; also current-conducting strand worked into selvage along the warp yarns, which come in contact with yarns' ends of the weft from electric current-conductive material at every heating portion (for instance, US Patent No. 3,425,020; 1969).

Under the influence of higher temperatures, the textile yarns of weft and warp shrink, while the metallic wire becomes elongated. Friction at contact points of the warp yarns and the weft current-conductive strand is insufficient to hold it in its original position in fabric. Hence, the current-conductive strand of weft pulls the warp yarns apart, and extends beyond fabric in the form of loops. Or else, the loop formed in passage of the weft strand into the adjacent loophole, grows bigger. As a result, in both instances the electric current-carrying thread becomes non-insulating, and yarns are prone to short circuits.

As the contact in this construction between the electric current-conductive yarns and the current-carrying strand is secured only on account of pressure, and as the strand and the current-conductive yarn are only partly insulated, the said contact might, in the course of maintenance, fail for mechanical and thermal reasons.

Heating portions and insulating strips of the said woven electric heater are executed by the same type

of interweaving technique, that is linen. As a result, fabric density on background and selvage is different. Density on background decreases in selvage. The rarefied selvage texture brings down, in its turn, the reliability of contact between the current-carrying strand and the electric current-conductive weft.

It is an object of the present invention to create such a woven electric heater, wherein the formation of the current-conductive yarn loops on the heated fabric surface being excluded, the fabric shrinkage on weft is avoided under reduced strain in heating conditions and unaffected insulation, thus obtaining higher reliability of the woven electric heater.

For this, in a woven electric heater comprising warp and weft from electrical insulating material, that are interwoven with formation of background and selvage; also comprising weft from electric current-conductive material worked into background, with formation of heating portions; also current-carrying strand worked into selvage along the warp yarns, which come in contact with yarns' ends of weft from electric current-conductive material at every heating portion; according to this invention, the weft yarn from electric-conductive material has a complete insulation cover, the warp yarn is produced from material having 0,01-5% longitudinal shrinkage at 25-120 degrees C, the weft yarn is manufactured from material retaining geometrical patterns in heating conditions, and contact between the current-carrying strand and the weft yarn from current-conductive material is secured by commutative elements fixed between the heating portions on selvage. Background and selvage are performed by different interweaving technique; between every two adjacent weft yarns from electric-conductive material, at least four weft yarns from insulating material are worked into the heating portion in such a way that in rapport of background interweaving, the two adjacent weft yarns from electrical insulating material are overlapped by the same warp yarns, while in rapport of selvage interweaving every weft yarn from electrical insulating material is overlapped by a single warp yarn.

It is preferable to use poly-ether strand stabilized at 150-180 degrees C as the weft yarn from electrical insulating material, and employ instabilized poly-ether strand as the warp yarn.

It is preferable that the complete insulating cover of the weft yarn from electric current-conductive material is 0.15-0.45 mm thick.

It is preferable that the complete insulation cover of the weft yarn from electric current-conductive material has fibrous texture, with a multitude of extremely thin insulation material fibres embracing and also fixed to the weft yarn by means of insulating lisle thread.

It is worth having every commutative element electrically connected with the two insulation free ends of the weft yarn from electric current-conductive

material at the adjacent heating portions, and with the insulation free portion of the current-carrying strand, and the number of commutative elements equal to $(n + 1)$, where n = number of heating portions.

Specific embodiments of the invention become apparent from the following description in conjunction with drawings, in which:

Fig.1 is a partial view of the woven electric heater; Fig.2 is a cross-sectional view of a commutative element fixed on the fabric selvage, with wire connection;

Fig.3 is an enlarged view of the first embodiment of the fabric texture (a portion of the woven electric heater);

Fig.4 is a cross-sectional view of IV-IV line in Fig. 3;

Fig.5 is an enlarged view of the second embodiment of the fabric texture (a portion of the woven electric heater);

Fig.6 is a cross-sectional view of VI-VI line in Fig. 5;

Fig.7 shows the weft yarn from current-conductive material with insulating cover;

Fig.8 illustrates rapport location of the weft and warp yarns from electrical insulating material and the weft yarn from current-conductive material before heating;

Fig.9 illustrates rapport location of the weft and warp yarns from electrical insulating material and the weft yarn from current-conductive material after heating.

The woven electric heater comprises warp 1 (Fig. 1) and weft 2 from electrical insulating material, interwoven with formation of background 3 and selvage 4. Into background 3, weft 5 from electric current-conducting material, is incorporated (worked) with formation of heating portions 6 and insulating strips 7. The described embodiment contains two portions 6. Into selvage 4 along warp 1 yarns, current-carrying strand 8 is incorporated.

Weft 5 yarn from electric current-conductive material and current-carrying strand 8 have complete insulation cover, which thickness is within 0.15-0.45mm.

Warp 1 yarn is manufactured from material having length shrinkage within 0.01-5% at 25 to 120 degrees C; weft 2 yarn is manufactured from material retaining its geometrical pattern in heating conditions.

An embodiment is possible with weft 2 yarn produced from cotton effecting practically no shrinkage, and warp 1 yarn - from viscose displaying shrinkage within above limits.

Yet another embodiment is possible with employment of poly-ether strand stabilized at 150-180 degrees C, as weft 2 yarn, and use of instabilized polyether strand as warp 1 yarn.

The woven heater comprises several commutative elements 9, which number equals $(n + 1)$, where

n = number of heating portions. By means of these elements 9, contact between the weft 5 yarn and the current-carrying strand 8 is maintained.

Element 9 is represented by a clip (Fig.2) from brass and copper type electric current-conducting low-resistance material fixed on selvage 4, preferably between heating portions 6. Every commutative element 9 has electrical connection with two insulation free ends of weft 5 made of current-conductive yarn of adjacent heating portions 6, and with insulation free portion of current-carrying strand 8. Connections are arranged in such manner that electromagnetic fields evolved by current lead, are respectively compensated.

Fig. 2 also illustrates end 10 of current-carrying flex 11 and brazed joint 12 fixing the electric contact.

In the claimed woven heater, background 3 (Fig. 3, 4) and selvage 4 are performed by different interweaving technique. Incorporated (worked) into heating portion 6, between every two adjacent yarns of weft 5 from current-conducting material, in the present embodiment, are four yarns of weft 2 from insulation material. This is needed for selvage consolidation. In rapport A of background 3 interweaving, two adjacent yarns of weft 2 from electric current-insulating material are overlapped by the same yarns of warp 1. In rapport B of selvage interweaving, one yarn of weft 2 if overlapped by one yarn of warp 1.

Fabric density on weft in background is within 4-15 cm^{-1} .

In the said embodiment, weft 5 yarn from electric current-conductive material is worked into fabric by linen interweaving. Other alternatives of incorporation are possible, for instance, serge interweaving, warp reps 2/2.

To obtain the required parameters of the woven heater, at least two yarns of weft 2 (Fig.5,6) can be interspersed between weft 2 yarns worked in pairs, with identical interweaving in background 3 and selvage 4.

To obtain flexibility of weft 5 yarn from current-conductive material required in weaving, complete insulation cover of weft 5 yarn (Fig.7) has fibrous texture. It contains a multitude of extremely thin fibres 13 embracing and fixed to electric current-conductive core 14 by means of insulating lisle thread 15.

The woven electric heater operates as follows.

Switched on D.C. or A.C. supply source 16 (Fig.1), current-carrying strand 8 and current-conductive weft 5 are electrified. In case the woven electric heater is designed to warm car seats, the electric cord should be adapted to fit in a cigarette lighter socket. If used in warming pad or bed-pan, the cord must have a plug. When heated, weft 5 warms over the whole fabric, that is all warp and weft yarns 1 & 2. In as much as weft yarns 2 are manufactured from material that retains its geometrical patterns in heating conditions,

their length does not change. Meanwhile, warp yarns 1 begin to shrink when heated, because these are manufactured from shriveling material. At contact points C (Fig.8) between warp 1 yarns and weft 5 yarns from electric current-conductive material, greater friction is noticeable due to tension arising from temperature shrinkage of warp 1 yarns. Thus, the tension experienced in the process of warp 1 yarns shrinking, fastens current-carrying yarns 5 in fabric itself even more.

Also along with temperature shrinkage, reciprocal pressure develops between warp and weft yarns 1, 2, 5, bringing about transference of upper and lower warp yarns towards each other, thus increasing the curvature of weft 5 yarns (Fig.9). And by this compensation is made for thermal elongation, with even distribution along the whole of weft 5 yarn.

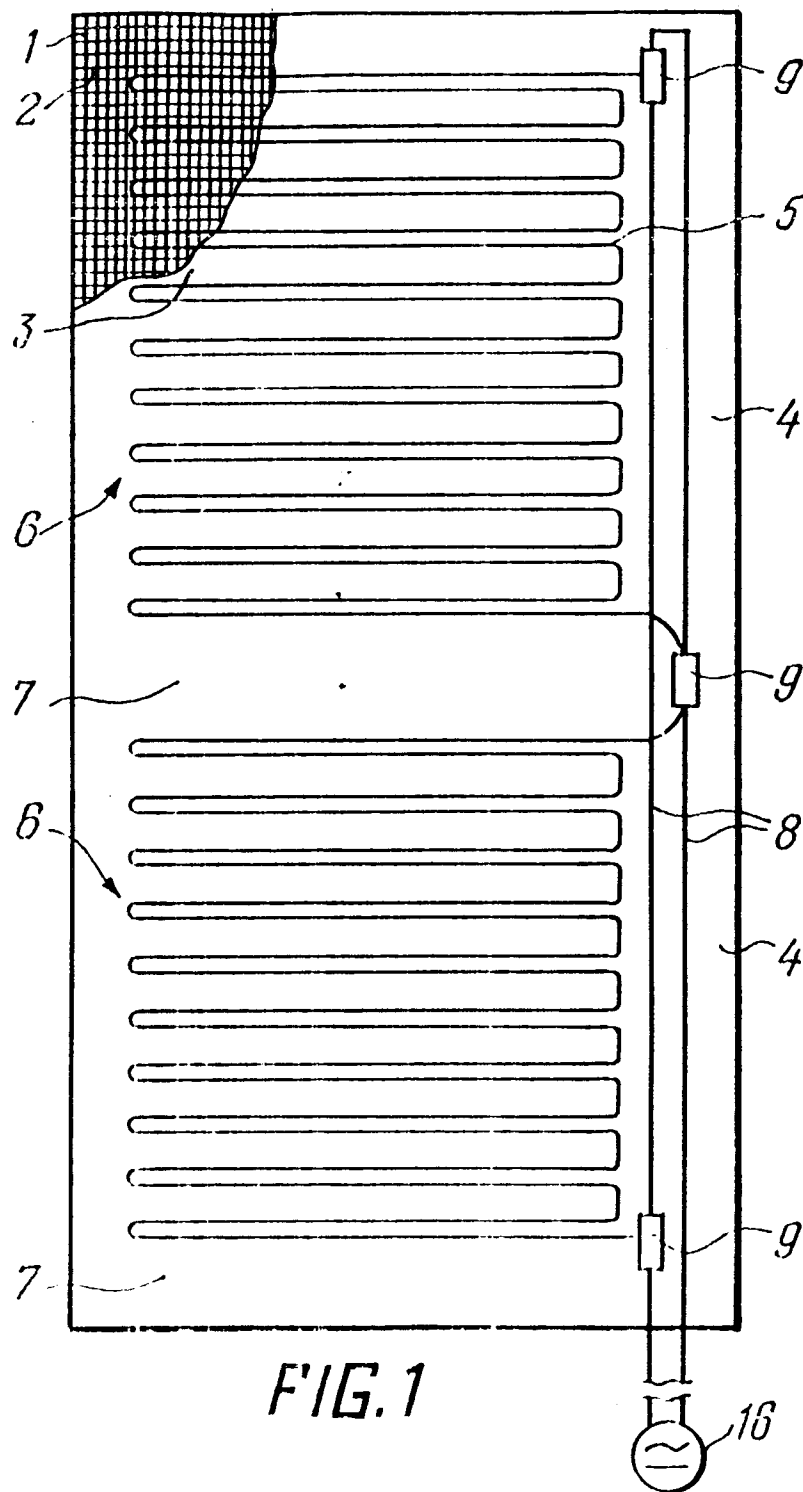
These forces become sufficient to hold electric current-conductive weft 5 in its original position, irrespective of its elongation due to heating. Thus, a reliable placement of weft 5 in fabric texture is secured, and loops formation on fabric surface is excluded.

Claims

1. The woven electric heater comprising warp (1) and weft (2) from electrical insulating material, interwoven with formation of background (3) and selvage (4); also weft (5) from electric current-conducting material worked into background (3) with formation of heating portions (6) and insulating strips (7); also current-carrying strand (8) incorporated into selvage (4) along warp (1) yarns, which come in contact with yarns' ends of weft (5) from electric current-conductive material at every heating portion (6); is distinctive in that weft yarn (5) from electric current-conductive material and current-carrying strand (8) have complete insulation cover; warp (1) yarn is manufactured from material having length shrinkage within 0.01-5% at 25 to 120 degrees C; yarn (2) is manufactured from material retaining its geometrical pattern in heating conditions; and contact between current-carrying strand (8) and weft (5) yarn from electric current-conductive material is secured by commutative elements (9) fixed between heating portions (6) on selvage (4); background (3) and selvage (4) are made by different interweaving technique; and between every two adjacent yarns of weft (5) from electric-conductive material, at least four yarns of weft (2) from insulating material are incorporated into heating portion (6) in such a way that in rapport of background (3) interweaving, two adjacent weft (2) yarns from electrical insulating material are overlapped by the same warp (1) yarns, while in rapport of selvage (4) interweaving every yarn of

weft (2) from insulating material is overlapped by a single yarn of warp (1).

2. The woven electric heater according to claim 1, distinctive in that weft (2) yarn from electrical current-insulating material is a poly-ether strand stabilized at 150-180 degrees C, and an instabilized poly-ether strand is employed as yarn of warp (1).
3. The woven electric heater according to claim 1, distinctive in that the complete insulation cover of weft (5) yarn from electric current-conductive material is 0.15-0.45 mm thick.
4. The woven electric heater according to claim 3, distinctive in that the complete insulation cover of weft (5) yarn from electric current-conductive material has fibrous texture containing a multitude of extremely thin fibres (13) embracing and fixed to electric current-conductive core (14) by means of insulating lisle thread (15).
5. The woven electric heater according to claim 1, distinctive in that every commutative element (9) is electrically connected with two complete insulation free ends of weft (5) yarn from electric current-conductive material at adjacent heating portion (6), and with complete insulation free portion of current-carrying strand (8), while the number of commutative elements equals $(n + 1)$, where n = number of heating portions.
6. The woven electric heater according to claim 1, distinctive in that at least two yarns of weft (2) from insulating material are additionally interspersed between weft (2) yarns from insulating material worked in pairs, with identical interweaving of warp (1) and weft (2) yarns in background (3) and selvage (4).
7. The woven electric heater according to claims 1 - 6, distinctive in that fabric density on weft (2) in background (3) is within $4-15 \text{ cm}^{-1}$.



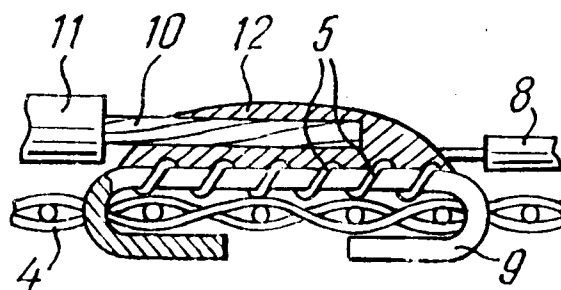
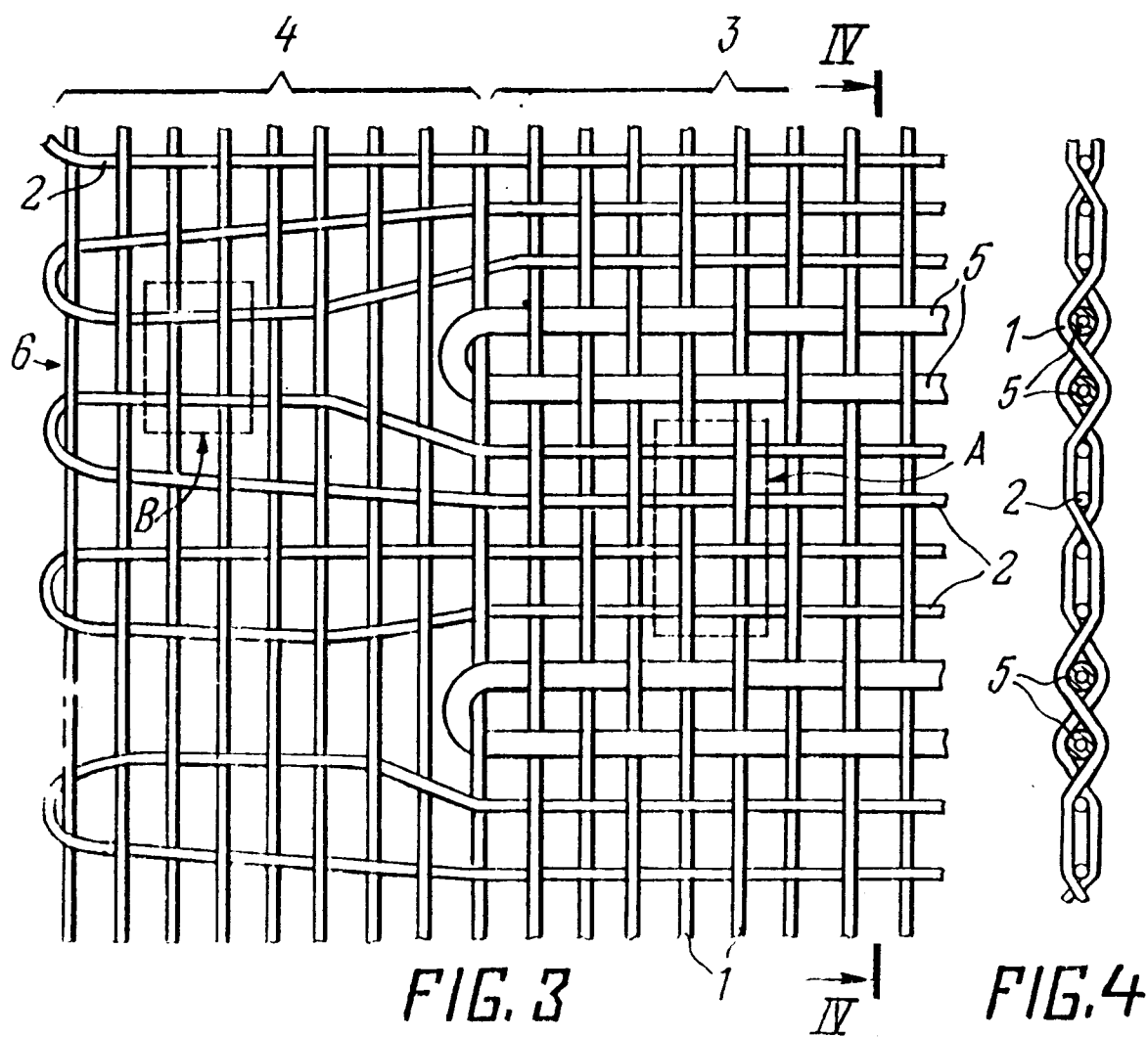
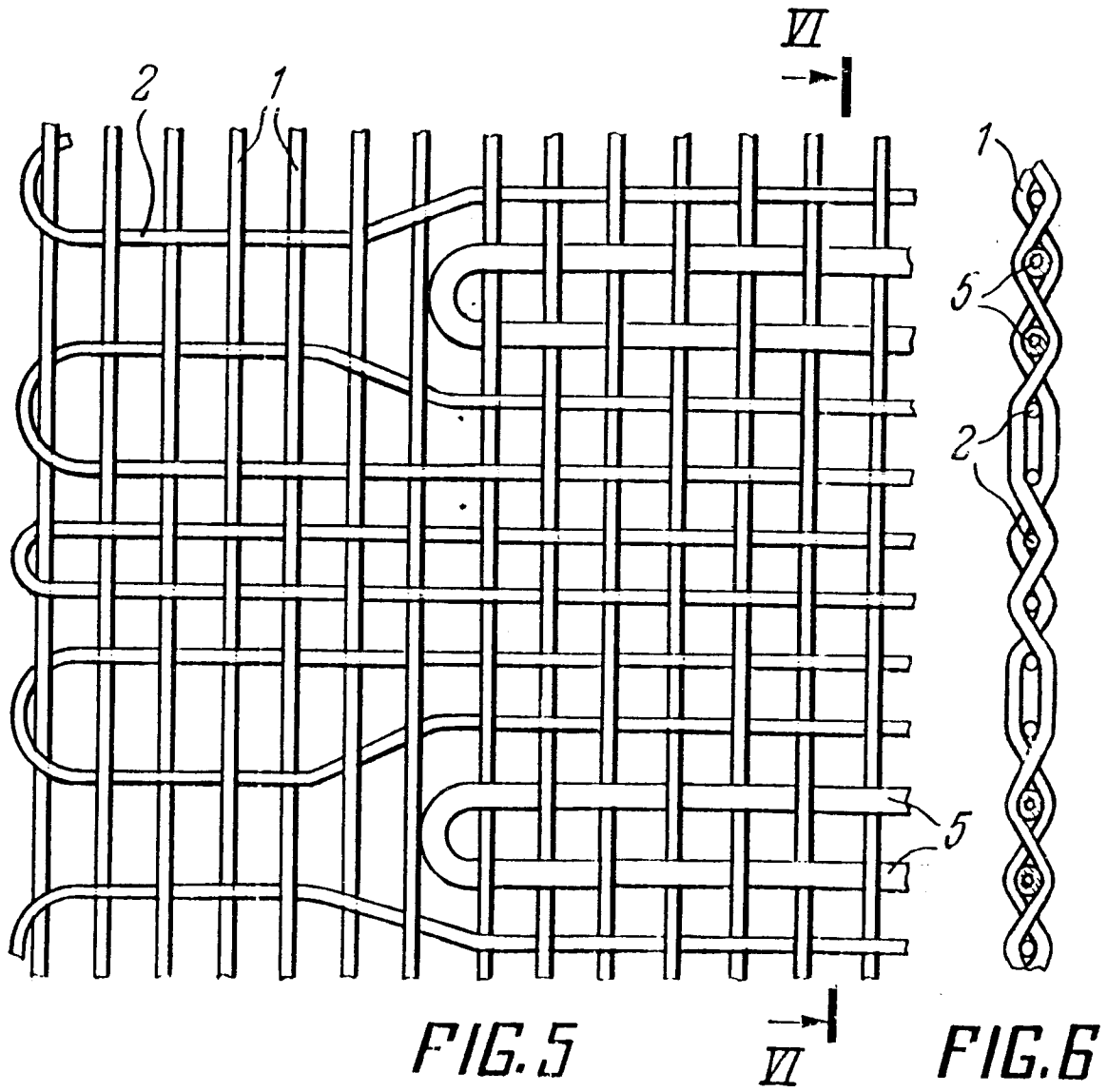


FIG. 2





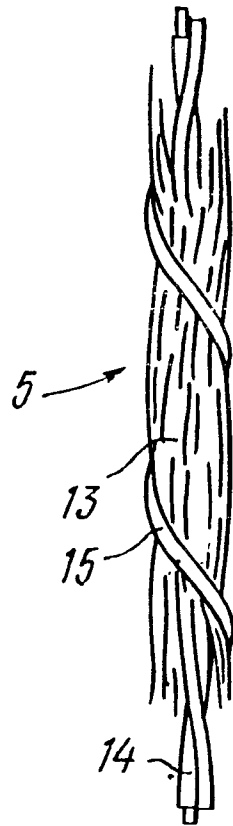


FIG. 7

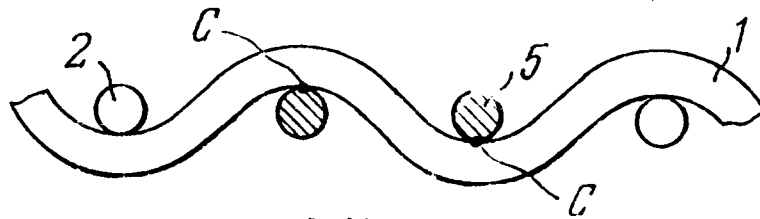


FIG. 8

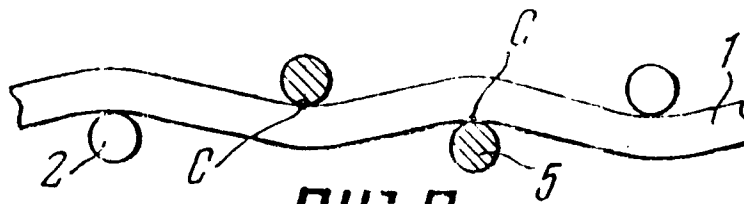


FIG. 9