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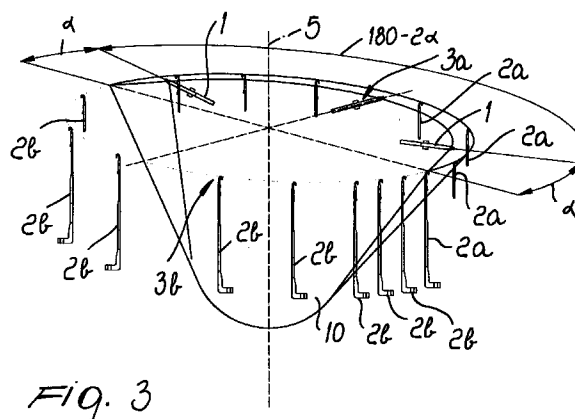
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(54) Method for forming hosiery items or tubular knitted items having a closed end with a circular hosiery knitting machine

(57) A method for producing hosiery items or tubular knitted items having a closed end with a circular hosiery knitting machine provided, proximate to the needle work area, with a transfer element which faces one half of the needle cylinder and is provided with thread takeup elements (1) which can be actuated radially to the needle cylinder and are suitable to engage the thread or threads fed by at least one feed of the machine, in the region between two contiguous needles. The transfer element is able to turn over about a diametrical axis (7) of the needle cylinder. The method consists in performing a first step, during which the needle cylinder is actuated with n oscillations about its own axis (5) with an oscillation angle of substantially 180° , in order to cause the passage, in front of a thread feed of the machine, of a first half (3a) of the needle cylinder which is faced by the transfer element. During this first step, the corresponding thread takeup elements (1) that are arranged in a sector that is less than 180° wide are extracted from the transfer element and $1/n$ of the needles (2a) of the first half (3a) of the needle cylinder are lifted into the active position at each oscillation and are then lowered after taking up the thread or threads, which rests or rest on the takeup elements (1) extracted from the transfer element. A second step is then performed during which the previously extracted takeup elements are retracted into the transfer element so as to retain the thread that is rested on them. Then a third step, during which heel knitting is performed with the

needles of the first half (2a) of the needle cylinder (3a), and a fourth step, during which the transfer element is turned over about the diametrical axis (7) and made to face the second half (3b) of the needle cylinder, are performed. During a fifth step, the thread or threads retained by the takeup elements (1) and the knitted loops are transferred from the needles (2a) of the first half (3a) of the needle cylinder that are arranged laterally to the sector of the transfer element to the needles (2b) of the second half (3b) of the needle cylinder. Finally, the machine is actuated so as to complete the item as a continuation of the previous processes.



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Description

The present invention relates to a method for forming hosiery items or tubular knitted items having a closed end with a circular hosiery knitting machine.

Methods are known for closing the end of hosiery items or tubular items in general directly on the circular hosiery knitting machine used to produce said items.

In particular, European Patent Application No. 96111186.1 in the name of the same Applicant discloses a method which uses a single-cylinder circular machine having, at the upper end of the needle cylinder, a half-dial which faces one half of the needle cylinder and is provided with elements for taking up the thread which can be actuated in a direction which is radial to the needle cylinder and are suitable to engage the thread or threads fed at a feed of the machine, in the region between two contiguous needles. Said half-dial can be turned over, about a diametrical axis of the needle cylinder, in order to face the other half of the needle cylinder. This method comprises a first step, during which the needle cylinder is actuated with n oscillations about its own axis with an oscillation angle of substantially 180° in order to move the needle cylinder half faced by the half-dial so that it passes in front of a feed of the machine. During the oscillations, the takeup elements are extracted radially with one of their ends from the half-dial towards the needles of the machine, and at least one thread is dispensed at said feed, lifting into the active position, at each oscillation, $1/n$ of the needles of said needle cylinder half which are uniformly spaced from each other, varying the needles that are moved into the active position in the subsequent oscillation or oscillations and lowering the needles after taking up the thread or threads, resting on the takeup elements. Then a second step is performed during which the takeup elements are retracted into the half-dial, retaining the thread or threads rested thereon. In a third step, heel knitting is performed with the needles of said needle cylinder half. In a fourth step, the half-dial is turned over about the diametrical axis and is arranged so as to face the other half of the needle cylinder. Then a fifth step is performed during which the thread or threads held previously by the takeup elements are transferred to the needles of the other half of the needle cylinder. Finally, in a sixth step, the machine is actuated so as to complete the tubular item as a continuation of the previously performed knitting.

The half-dial used to perform the method according to the above cited patent application covers an angle of substantially 180° about the axis of the needle cylinder and has a grip element, substantially constituted by a hook, for each one of the needles of one half of the needle cylinder. During the execution of the first step of the method, the hooks of the half-dial are all extracted from the half-dial, so that each one arranges itself between two contiguous needles of one half of the needle cylinder.

In this way, the thread dispensed during the oscillations of the needle cylinder about its own axis, during the execution of the first step of the method, rests on all the hooks of the half-dial and remains engaged with them at the end of the second step.

As a result, when the half-dial is turned over about a diametrical axis of the needle cylinder, the stitch that is stretched over the hooks located proximate to the two lateral ends of the half-dial and the needles located proximate to the lateral ends of the needle cylinder half with which heel knitting was performed in the third step is subjected to a relatively intense stretching.

Particularly if the heel knitting, which forms the end of the item, has been performed with a reduced number of rows, this stretching can be excessive, causing the item to break at said regions.

Italian Patent application no. BO96A-00533 in the name of the same Applicant discloses another method for manufacturing hosiery items or tubular items in general having a closed end with a single-cylinder circular machine. The method disclosed in this Italian patent application comprises at least one first step, during which the needle cylinder is rotated alternately about its own axis to form a pouch with heel knitting, or end, using a set of needles located in one half of the needle cylinder, and a second step, during which the needle cylinder is actuated with a continuous motion to form a tubular portion of the item. Before beginning the second step, at least one of the initial rows of knitting formed during the first step, which at the end of the first step is inside the needle cylinder and is arranged along a chord which lies between the two end needles of the set of needles used during the first step, is engaged, through an auxiliary element which is hook-shaped, starting from one of the two end needles, and gradually moved above the needles located in the other half of the needle cylinder and knitted in by them with the first row of knitting formed at the beginning of the second step.

This method, which is extremely simple to perform, solves the above-mentioned problem with reference to the method according to European patent application No. 96111186.1, however, it entails the drawback that the row of knitting carried by the hook-shaped element onto the needles of the other half of the needle cylinder can have an arrangement that differs from the radial direction that is ideal for transfer, causing a rather inaccurate knitting-in of said row on the needles of the other half of the needle cylinder and thus leading to a result that is not fully satisfactory.

The aim of the present invention is to solve the above described problems by providing a method which allows to produce hosiery items, or tubular items, having a closed end with a circular hosiery knitting machine, leading to a result, in the closure of the end of the item, which is fully satisfactory both technically and aesthetically.

Within the scope of this aim, an object of the present invention is to provide a method that can be

adopted without problems even if the end of the item is formed with a reduced number of rows.

This aim, these objects and others which will become apparent hereinafter are achieved by a method for producing hosiery items or tubular items having a closed end with a circular hosiery knitting machine provided, proximate to the needle work area, with a transfer element facing one half of the needle cylinder and is provided with thread takeup elements which can be actuated radially to the needle cylinder and are suitable to engage the thread or threads fed by at least one feed of the machine, in the region between two contiguous needles; said transfer element being able to turn over about a diametrical axis of the needle cylinder, characterized in that it comprises: a first step, during which the needle cylinder is actuated with n oscillations about its own axis with an oscillation angle of substantially 180° , in order to cause the passage, in front of a thread feed of the machine, of a first half of the needle cylinder with said transfer element arranged so as to face it, and during which the corresponding thread takeup elements that belong to a sector that is less than 180° wide are extracted from said transfer element and $1/n$ of the needles of said first half of the needle cylinder are lifted into the active position at each oscillation, varying the needles that are moved into the active position in the subsequent oscillation or oscillations and lowering the needles after taking up the thread or threads, which rests or rest on the extracted takeup elements of said sector of the transfer element; a second step, during which the previously extracted takeup elements are retracted into said transfer element, retaining the thread that is rested on them; a third step, during which heel knitting is performed with the needles of said first half of the needle cylinder; a fourth step, during which said transfer element is turned over about said diametrical axis and made to face the second half of the needle cylinder; a fifth step, during which the thread or threads retained by the takeup elements extracted during said first step is or are passed to the needles of the second half of the needle cylinder, which face said takeup elements, and during which the loops of the first row or rows knitted during said first step are transferred, by means of an auxiliary element, from the needles of said first half of the needle cylinder that are arranged laterally to said sector of the transfer element to the needles of the second half of the needle cylinder, which are arranged laterally to said sector of the transfer element after it has turned over; and a sixth step, during which the machine is actuated so as to complete the item as a continuation of the previous processes.

Further characteristics and advantages of the invention will become apparent from the following detailed description of a preferred but not exclusive embodiment of the method according to the invention, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

figure 1 is a view of a hosiery item with a closed toe, produced with the method according to the invention;

figure 2 is an enlarged-scale view of a portion of the item at the toe closure;

figure 3 is a schematic view of the end of the third step of the method according to the invention;

figures 4 and 5 are schematic views of the fifth step of the method according to the invention.

With reference to the above figures, the method according to the invention is meant to be performed with a circular hosiery knitting machine, for example a single-cylinder circular machine having, proximate to the needle work area, a transfer element which is constituted for example, as described in European patent application No. 96111186.1, by a half-dial which faces one half of the needle cylinder and has thread takeup elements constituted for example by hooks which can be actuated radially with respect to the needle cylinder and are suitable to engage the thread or threads fed by at least one feed of the machine in the region between two contiguous needles. Said transfer element can be turned over about a diametrical axis of the needle cylinder.

In the figures of the accompanying drawings, the transfer element has not been illustrated for the sake of clarity; as mentioned, said transfer element can be constituted by a half-dial of the type described in the prior above-cited patent application; only some of the takeup elements, constituted by hooks 1, have been illustrated. Likewise, the needle cylinder has not been illustrated and only some of the needles 2a of a first half 3a of the needle cylinder and some of the needles 2b of the second half 3b of the needle cylinder have been shown.

In practice, said half-dial has a number of hooks 1 which is equal to, or smaller than, the number of needles of one half of the needle cylinder. The angular spacing of the various hooks 1 is such that each hook 1 is positioned between two contiguous needles of the needle cylinder.

As mentioned, the hooks 1 can be equal in number to the needles of one half of the needle cylinder, or their number may be smaller, in that two regions of the half-dial that are located proximate to its lateral ends and cover an angle α may be without hooks 1, as will become apparent hereinafter.

In a first step of the method, the transfer element, or half-dial, faces the first half 3a of the needle cylinder and is actuated, together with the needle cylinder, with n oscillations about the axis 5 of the needle cylinder with an oscillation angle of substantially 180° , so that the first half 3a of the needle cylinder passes entirely in front of a feed of the machine whereat one or more threads are fed according to requirements.

During this first step, the takeup elements or hooks 1 of the transfer element are extracted radially from said transfer element so as to be arranged between two contiguous needles 2a of the first half 3a of the needle cyl-

inder. It should be noted that takeup elements or hooks 1 belonging to a sector of the transfer element that is narrower than 180° are extracted. More particularly, if the transfer element has no hooks 1 at the two end sectors that cover an angle α , all the hooks 1 are extracted; or, if the transfer element has takeup elements or hooks 1 over its entire extension, i.e., along substantially 180° around the axis 5 of the needle cylinder, the hooks that belong to the end sectors which cover an angle α are kept retracted.

In practice, the takeup elements or hooks 1 located in a sector of the transfer element that covers an angle of substantially $180^\circ - 2\alpha$ around the needle cylinder axis 5 are extracted, as shown in figures 3 to 5.

The sector that covers an angle $180^\circ - 2\alpha$ is distributed symmetrically with respect to the diameter of the needle cylinder that is perpendicular to the diametrical axis 7 about which the transfer element is turned over.

At every oscillation of the needle cylinder and of the transfer element about the axis 5, $1/n$ of the needles 2a of the first half 3a of the needle cylinder are lifted into the active position, varying, at each oscillation, which needles 2a are moved into the active position, according to the method already described in European patent application No. 96111186.1.

As a clearer example, assuming that three oscillations of the needle cylinder occur about the axis 5, during the first oscillation the first, fourth, seventh needles and so forth of the first half 3a of the needle cylinder are lifted into the active position; during the second oscillation, the second, fifth, eighth needles and so forth are lifted into the active position; during the third oscillation, the third, sixth and ninth needles and so forth are lifted into the active position; and so forth. At each oscillation, the needles 2b, after taking up the thread, are lowered so as to form a loop of knitting with the thread or threads fed at the feed being considered and the thread, between two contiguous needles moved into the active position, rests on the takeup elements or hooks 1 that are extracted from the transfer element.

It should be noted that during this first step all the needles 2a of the first half 3a of the needle cylinder are moved into the active position and that the thread or threads fed at the feed being considered, laterally to the sector that covers an angle of $180^\circ - 2\alpha$, is or are taken up and knitted in by the needles 2a of the first half 3a of the cylinder of the needles located laterally to said sector.

The thread or threads fed during the n oscillations is, or are, always the same thread or threads. Said thread may be an elastic thread.

Preferably, the number of oscillations is between 1 (in that the needle cylinder might be actuated, during this first step, with a simple forward stroke with a 180° rotation about its own axis) and 5.

During a second step, the takeup elements or hooks 1 are retracted into the transfer element, so as to retain the thread or threads rested on said takeup ele-

ments.

During a third step, the needle cylinder is rotated alternately about the axis 5a so as to perform, with the needles 2a of the first half 3a of the needle cylinder, heel knitting which will constitute the end 10 of the item 11.

During a fourth step, the transfer element or half-dial is turned over about the diametrical axis 7 so as to face the second half 3b of the needle cylinder.

During a fifth step, the takeup elements or hooks 1 are extracted radially from the transfer element and the needles 2b of the second half 3b of the needle cylinder, which face said takeup elements 1, are lifted and then lowered, while the takeup elements 1 are again retracted into the transfer element, as described in the prior European patent application No. 96111186.1, so as to transfer the thread or threads retained by the takeup elements 1 to the needles 2b of the second half 3b of the needle cylinder that face said takeup elements.

During this fifth step, by means of an auxiliary element, for example, a hook-shaped element 6 of the type described in Italian patent application no. BO96A-00533, the loops of the first row or rows knitted during the first step are passed from the needles 2a of the first half 3a of the needle cylinder that are located laterally to the sector that covers an angle of $180^\circ - 2\alpha$, to the needles 2b of the second half 3b of the needle cylinder that are located, after the overturning of the takeup element performed in the fourth step, laterally to the sector that covers an angle of $180^\circ - 2\alpha$. Said needles are raised so as to engage the loops that are taken up and carried by the hook element 6.

At the end of this fifth step, the perimetric region of the heel-knit portion or end 10 is therefore engaged both with the needles 2a of the first half 3a of the needle cylinder and with the needles 2b of the second half 3b of the needle cylinder.

Finally, a sixth step is performed wherein the machine is actuated so as to complete the tubular item as a continuation of the previous processes, in a per se known manner which is not described for the sake of simplicity.

Owing to the fact that during the overturning of the transfer element to perform the transfer of the thread or threads retained by the takeup elements or hooks 1 the item is released by the takeup elements or hooks 1 proximate to the overturning axis, excessive stretching of the knitting in this region is effectively avoided even if the heel knitting or end is formed with a reduced number of rows.

Moreover, owing to the fact that the two regions of the item that are taken up and transferred by the hook element have a small extension and to the fact that the portion of the item that is arranged between said two regions, during the actuation of the hook element, is engaged with the needles 2b of the second half 3b of the needle cylinder, high precision is achieved in the engagement and transfer of the loops that belong to

these two regions. In figures 1 and 2, said two regions have been designated by the reference letter B, while the region of the item 11 that is transferred by means of the takeup elements or hooks 1 of the transfer element, i.e., the region that lies between the regions B, has been designated by the reference letter A. Merely for the sake of greater clarity, the regions B have been shown in thicker lines than the region A.

In practice, it has been observed that the method according to the invention fully achieves the intended aim, since it allows to produce hosiery items or tubular items with a closed end directly on the circular machine used to produce them, with a result that is fully satisfactory both technically and aesthetically.

The method thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept; all the details may furthermore be replaced with other technically equivalent elements.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A method for producing hosiery items or tubular knitted items having a closed end with a circular hosiery knitting machine provided, proximate to the needle work area, with a transfer element which faces one half of the needle cylinder and is provided with thread takeup elements which can be actuated radially to the needle cylinder and are suitable to engage the thread or threads fed by at least one feed of the machine, in the region between two contiguous needles; said transfer element being able to turn over about a diametrical axis of the needle cylinder, characterized in that it comprises: a first step, during which the needle cylinder is actuated with n oscillations about its own axis with an oscillation angle of substantially 180° , in order to cause the passage, in front of a thread feed of the machine, of a first half of the needle cylinder with said transfer element arranged so as to face said needle cylinder first half, and during which the corresponding thread takeup elements that belong to a sector that is less than 180° wide are extracted from said transfer element, and $1/n$ of the needles of said first half of the needle cylinder are lifted into the active position at each oscillation, varying the needles that are moved into the active position in the subsequent oscillation or oscillations and lowering the needles after taking up the thread or threads, resting on the extracted takeup elements of said sector of the transfer element; a second

step, during which the previously extracted takeup elements are retracted into said transfer element, retaining the thread that is rested on them; a third step, during which heel knitting is performed with the needles of said first half of the needle cylinder; a fourth step, during which said transfer element is turned over about said diametrical axis and made to face the second half of the needle cylinder; a fifth step, during which the thread or threads retained by the takeup elements extracted during said first step is or are passed to the needles of the second half of the needle cylinder, which face said takeup elements, and during which the loops of the first row or rows knitted during said first step are transferred, by way of an auxiliary element, from the needles of said first half of the needle cylinder that are arranged laterally to said sector of the transfer element to the needles of the second half of the needle cylinder, which are arranged laterally to said sector of the transfer element after it has turned over; and a sixth step, during which the machine is actuated so as to complete the item as a continuation of the previous processes.

2. A method according to claim 1, characterized in that said sector is arranged symmetrically with respect to the diameter of the needle cylinder that lies at right angles to said diametrical axis.
3. A method according to claim 1, characterized in that the number of oscillations of said first step is substantially between 1 and 5.
4. A method according to one or more of the preceding claims, characterized in that the thread or threads fed during the oscillations of the needle cylinder during said first step is or are always the same thread or threads.
5. A method according to one or more of the preceding claims, characterized in that the thread fed during said first step is an elastic thread.
6. A method according to one or more of the preceding claims, characterized in that said auxiliary element is constituted by a hook which is actuated radially to the needle cylinder in order to take up and transfer the loops of said first row or rows.

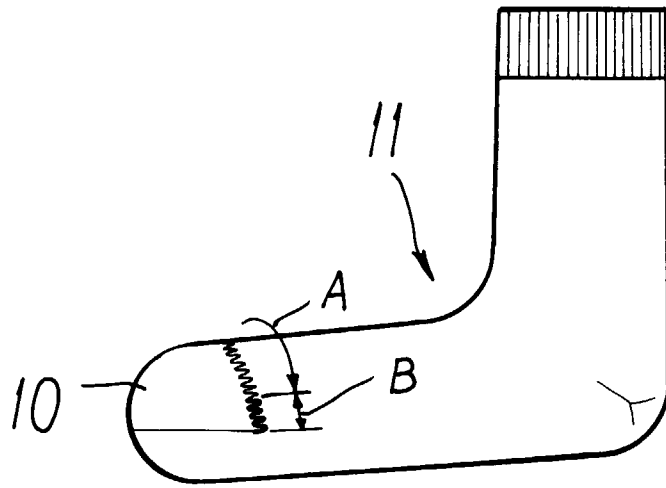


Fig. 1

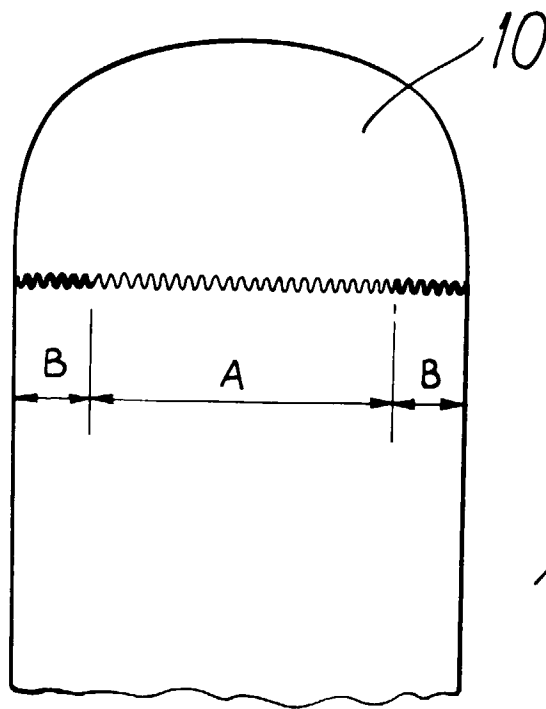


Fig. 2

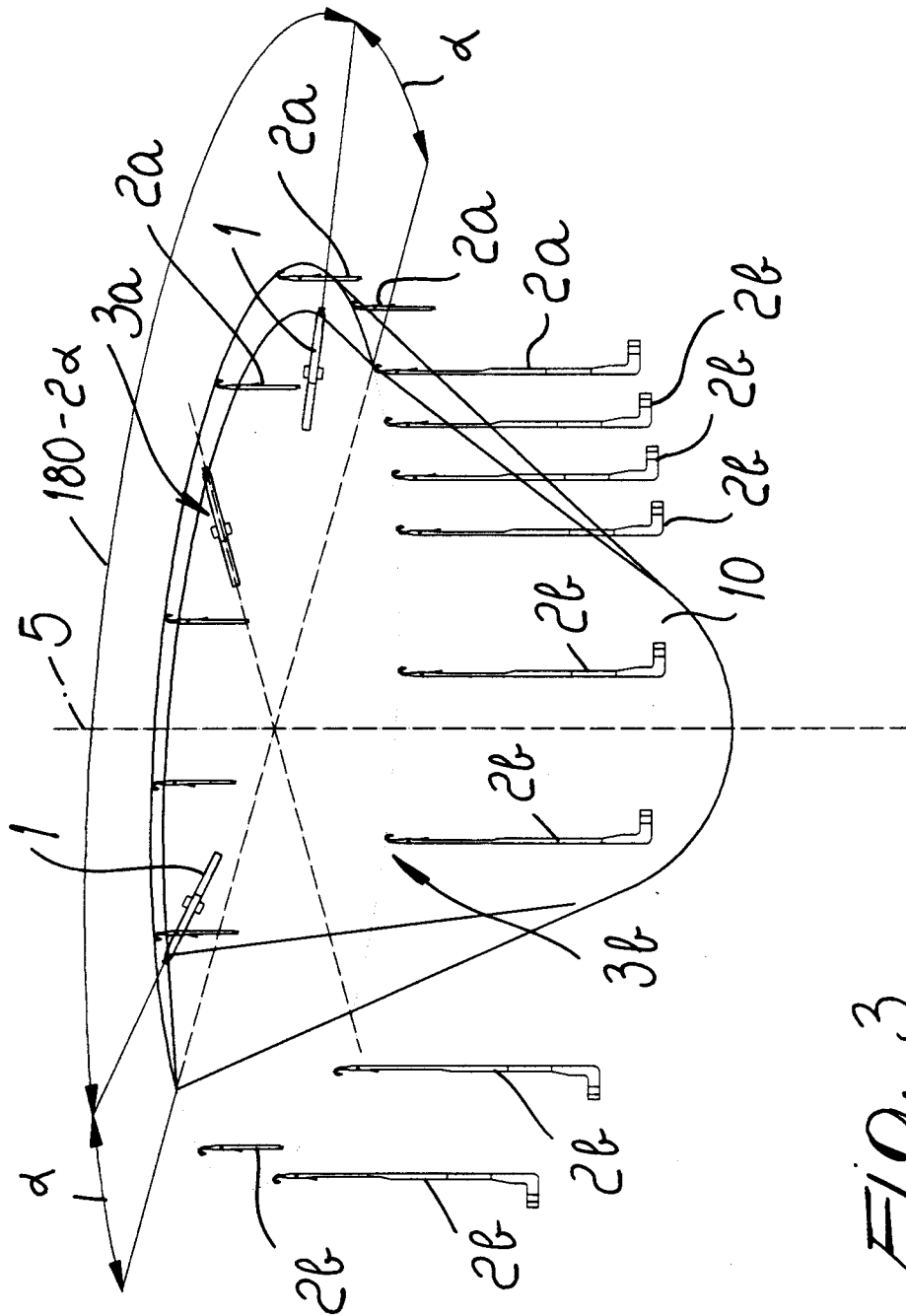


Fig. 3

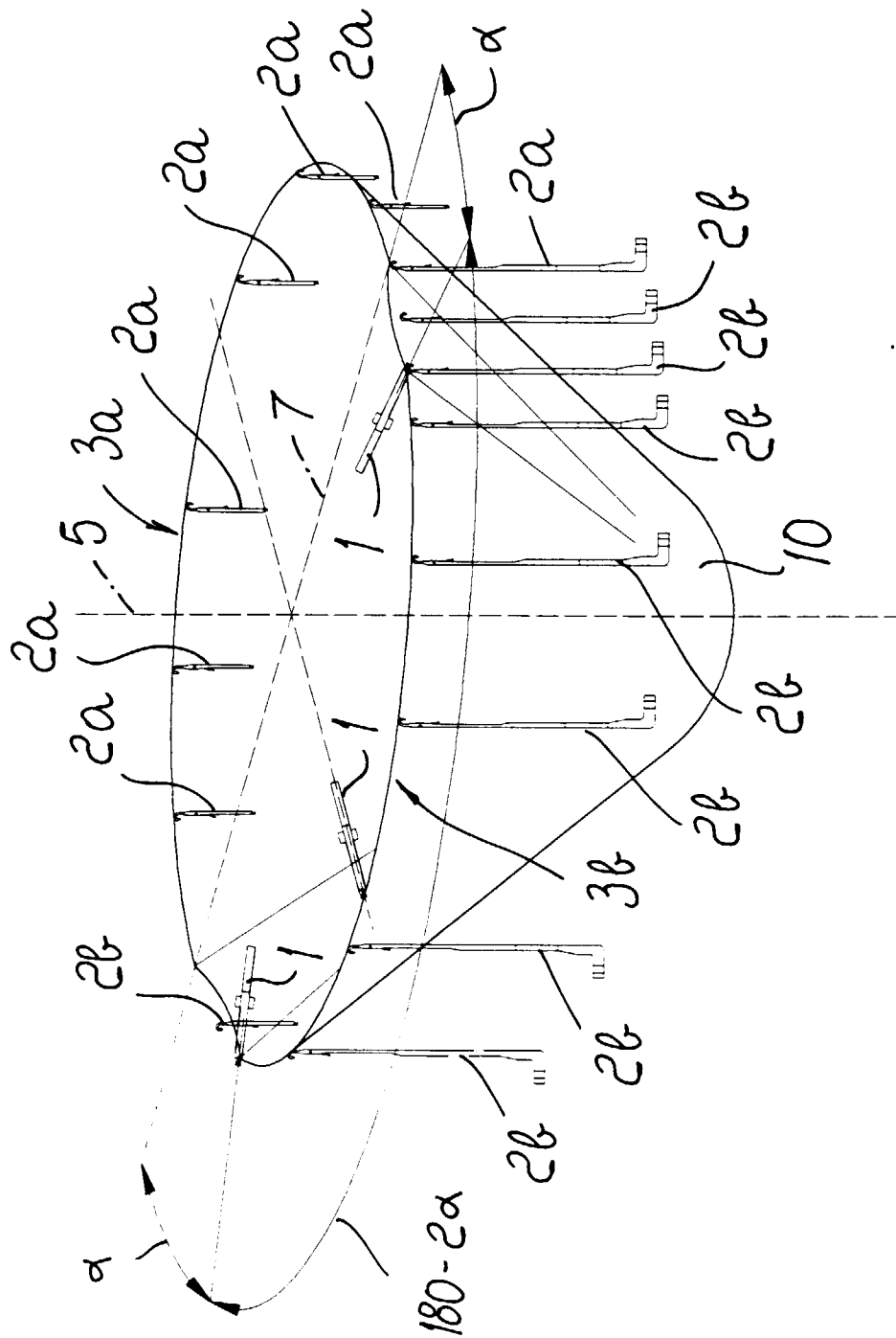


Fig. 4

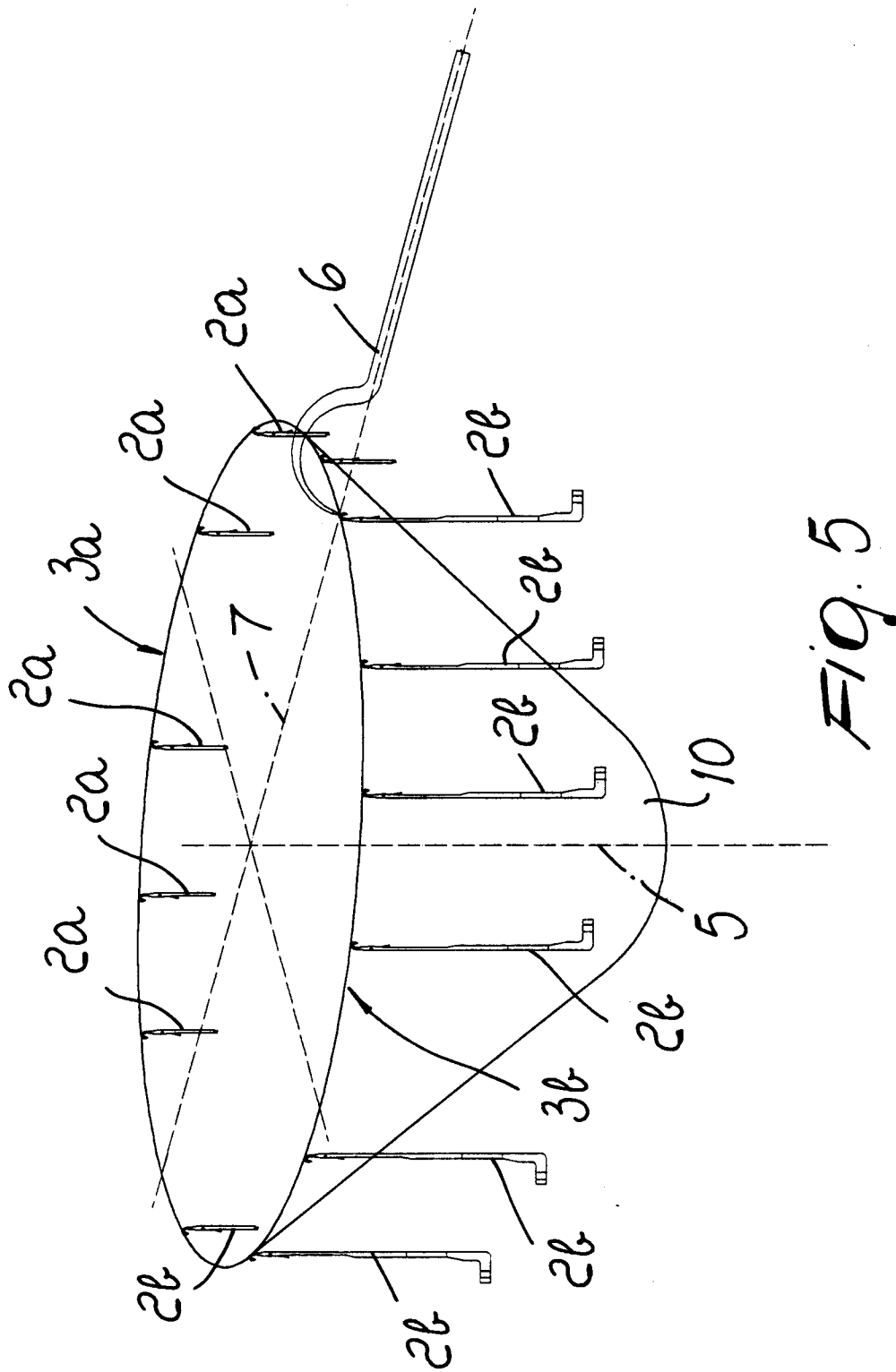


Fig. 5