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(54) Circular knitting machine for manufacturing socks, stockings or the like, with an improved knitting forming cam set.

57 The present invention relates to a circular knitting machine with improved knitting forming cam set. The knitting forming cam set comprises, proximate to a feed (5) of the machine, a knitting forming cam (6) with a lower profile (7) forming a descending portion (7) immediately after the feed (5), which can engage the heel (3a) of the needles (3) which are raised to take up the thread so as to lower them and cause the forming of the loops of knitting. A counter-cam (8) is provided proximate to the end of the descending portion (7) of the knitting forming cam (6) and faces the knitting forming cam (6) in a downward region; the countercam (8) delimits the lowering of the needles (3) after taking up the thread. The countercam (8) is slidably supported with respect to the knitting forming cam (6) along a sliding direction in which a component is parallel to the needle cylinder axis. The machine is provided with a pneumatic cylinder for controllably actuating the countercam (8) to move the countercam (8) along the sliding direction toward or away from the knitting forming cam (6).

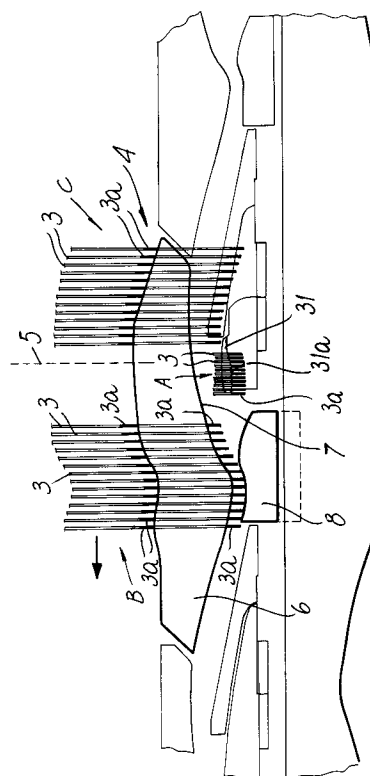


Fig. 5

The present invention relates to a circular knitting machine for manufacturing socks, stockings or the like, with an improved knitting forming cam set.

As is known, in circular knitting machines for manufacturing stockings, the movement of the needles, which are located inside axial grooves defined on the lateral surface of the needle cylinder, is produced by cams which are located around the needle cylinder and form paths engageable by the heels of the needles protruding radially from the needle cylinder.

The cams have ascending and descending portions which, when the needle cylinder is rotatably actuated about its own axis with respect to the cams, produce a reciprocating movement of the needles which engage said cams, this movement leading to the forming of the loops of knitting.

More particularly, upstream of each feed or drop of the machine there is at least one cam with an ascending portion which raises the needles in order to move them so that they take up the thread dispensed by appropriate thread guides located proximate to the upper end of the needle cylinder. Directly after the feed or drop there is a cam with a descending portion which lowers the needles, causing the forming of a new loop which is linked to the previously formed loop, released by the needle.

In the various types of knitting, one set of needles must take up the thread dispensed at one feed, while another set of needles is kept inactive at the same feed. The needles which must knit at the feed being considered are moved, by means of sub-needles actuated by appropriate selection devices, so that their heel is at such a level as to engage the ascending portion of the cam located upstream of the feed, whereas the needles which must not knit are retained or moved so that their heel passes below said cam. In practice, the sub-needles cause the transfer of the heels of the needles from one path to another among the various paths defined by the cams which are located around the needle cylinder.

The cam which is located immediately after a drop or feed of the machine and causes the lowering of the needles is termed "knitting forming cam", since this cam, by causing the lowering of the needles which have taken up the thread at the drop or feed, causes the forming of the new loops of knitting.

Said knitting forming cam is generally vaguely shaped like a triangle with the base directed upward, so as to have a lower profile with a descending portion located immediately after the feed proximate to which it is arranged.

Below the knitting forming cam there is a countercam which delimits the lowering of the needles after taking up the thread. In many kinds of ma-

chine, the knitting forming cam and the associated countercam are fixed to a same block which can be moved parallel to the axis of the needle cylinder so as to allow to vary the extent of the lowering of the needles after thread takeup and thus to vary the length of the loops, i.e. the tightness of the knitting.

The needles which do not knit at a feed are not raised upstream of said feed, but their heel is kept at such a level as to pass between the knitting forming cam and the associated countercam.

In some types of knitting, the needles which do not knit at a feed arrive so that their heel is below the passage defined between the knitting forming cam and the countercam, colliding against the profile of the countercam, which is specifically filleted to convey the heel of these needles through said passage. However, in some kinds of knitting the presence of the countercam is superfluous for delimiting the lowering imparted to the needles, since two-heel needles are used; these needles engage both the upper profile and the lower profile of the knitting forming cam and are thus guided directly by the knitting forming cam both in their ascending and descending movements. A typical example of knitting of this type is the knitting of highly elastic threads, such as for example threads commercially known by the trade mark LYCRA.

The impact of the heel of the inactive needles against the countercam does not have appreciable effects in machines with a low needle cylinder rotation speed, but can have destructive effects on the needles in fast machines. In modern sock- and stocking-making machines which can reach high actuation speeds, rapid wear both of the heels and of the countercam due to these impacts and, at the maximum attainable speeds, breakage of the tip of the needles due to the recoil arising from these impacts have in fact been observed.

The aim of the present invention is to solve the above problem by providing a circular knitting machine with an improved knitting forming cam set which permits the machine to operate, without drawbacks, at speeds which are significantly higher than the operating speeds of known machines.

Within the scope of this aim, an object of the present invention is to provide a machine wherein collision is avoided between the heels of the needles which do not knit at a feed or drop and the countercam of the knitting forming cam arranged proximate to said feed.

Another object of the present invention is to provide a machine with an improved knitting forming cam set without producing bulk problems and without preventing the possibility of adjusting the density of the knitting.

This aim, these objects and others which will become apparent hereinafter are achieved by a

circular knitting machine for manufacturing socks, stockings or the like, with improved knitting forming cam set, comprising a needle cylinder rotatable about a substantially vertical needle cylinder axis; a plurality of axial grooves defined on the lateral surface of said needle cylinder, each one of said axial grooves accommodating a needle which is slidable along a direction parallel to the needle cylinder axis; said needle having at least one heel protruding radially from the needle cylinder and being engageable with cams which laterally face the needle cylinder and define paths engageable by the heels of the needles during the rotation of the needle cylinder about said axis with respect to said cams; said cams comprising, proximate to at least one thread feed, a knitting forming cam provided with a lower profile defining a descending portion immediately after the feed of the thread which can engage the heel of the needles which are raised to take up the thread to lower them so as to form the loops of knitting; a countercam provided proximate to the end of said descending portion of the knitting forming cam and facing said knitting forming cam in a downward region; said countercam delimiting the lowering of the needles after taking up the thread; characterized in that said countercam is slidably supported with respect to said knitting forming cam along a sliding direction having a component parallel to the needle cylinder axis; means for actuating said countercam being provided, which can be activated by control to move said countercam along said sliding direction toward or away from said knitting forming cam.

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

figure 1 is a perspective view of the knitting forming cam set of the machine according to the present invention;

figure 2 is a top plan view of the knitting forming cam set of figure 1;

figure 3 is a schematic sectional view of figure 2, taken along the plane III-III, with the cam set laterally facing the needle cylinder;

figure 4 is a schematic sectional view of figure 2, taken along the plane IV-IV, with the cam set laterally facing the needle cylinder;

figure 5 is a flat-projection view of a portion of the cam skirt of the machine according to the invention, proximate to a feed or drop, seen from its side directed toward the needle cylinder.

With reference to the above figures, the machine according to the present invention, only partially shown for the sake of simplicity, comprises, in

a manner known per se, a needle cylinder 1 which is rotatably actuatable about its own vertically arranged axis 1a, and has a plurality of axial grooves 2 on its lateral surface. A needle 3 is slidably arranged inside each groove 2 and is provided with at least one heel 3a which protrudes radially from the needle cylinder 1 to engage within paths defined by cams 4 arranged around the needle cylinder.

Proximate to at least one feed or drop of the machine, the position of which is schematically shown in figure 5 by the line designated by the reference numeral 5, there is a knitting forming cam set which includes a knitting forming cam 6.

Said knitting forming cam 6 is vaguely shaped like an inverted triangle and defines, with its lower profile, a descending portion 7 arranged immediately after the feed 5 along the direction of the movement of the needles during rotation of the needle cylinder 1 with respect to the cams. The descending portion 7 causes, in a known manner, a lowering of the needles which have taken up the thread at the feed 5 so that they form new loops of knitting linked to the previously formed loops which are released by the needles.

Proximate to the end of the descending portion 7 there is a countercam 8 which faces the lower vertex of the knitting forming cam 6. Said countercam 8 delimits the lowering of the needles which have taken up the thread at the feed 5 and, between the knitting forming cam 6 and the countercam 8, there is a passage through which both the needles which have taken up the thread at the feed 5 and the needles which have been excluded from knitting at said feed pass.

According to the present invention, the countercam 8 is slidably supported along a sliding direction 9 which is parallel to the axis 1a of the needle cylinder, with respect to the knitting forming cam 6, and there are means for actuating the countercam 8 activable by control to move the countercam 8 along the direction 9 toward or away from the knitting forming cam 6.

Furthermore, both the knitting forming cam 6 and the countercam 8 can slide rigidly together, by control, along the sliding direction 9 to vary the extent of the descent of the needles which have knitted at the feed 5 and thus to vary the tightness of the knitting.

More particularly, the knitting forming cam 6 and the countercam 8 are mounted on a block 10 fixed to the supporting structure 11 of the machine laterally to the needle cylinder 1.

The block 10 has a base 12 from which two shoulders 13 and 14 and an upright 15 rise; the shoulders are parallel to the axis 1a and are mutually opposite, whereas the upright is arranged transversely to the shoulders 13 and 14. The two

shoulders 13 and 14, together with the upright 15, define a sliding seat which is open upwardly and towards the needle cylinder 1 and in which a first slider 16 is inserted; said slider protrudes from the shoulders 13 and 14 towards the needle cylinder 1 with a portion 16a to which the knitting forming cam 6 is fixed. The first slider 16 can slide parallel to the axis 1a along the shoulders 13 and 14 and along the upright 15, to which it is coupled by means of a pivot 17 passing through a slot 18 defined in said upright and elongated in a direction which is parallel to the axis 1a to allow the sliding of the slider 16.

Inside the first slider 16 there is a sliding seat 19 which is open upwardly and in which a second slider 20 is slidably inserted parallel to the axis 1a; said second slider is provided with a portion 20a protruding from the seat 19 toward the needle cylinder 1 below the portion 16a of the first slider 16. The countercam 8 is fixed to the portion 20a of the second slider 20.

The means for actuating the countercam 8 advantageously comprise a first fluid-dynamic actuator, for example a pneumatic cylinder 21, which is mounted on the base 12 of the block 10 and acts on the end of a lever 22 which is pivoted, with an intermediate portion, to the first slider 16 and faces, with its other end, the upper end of the second slider 20. The action performed by the pneumatic cylinder 21 on the second slider 20 is aimed at spacing the countercam 8 below the knitting forming cam 6 and is contrasted by elastic return means constituted by a spring 23 which is interposed between the second slider 20 and a plate 24 which is fixed to the base 12 of the block 10.

Advantageously, there is a second fluid-dynamic actuator, for example another pneumatic cylinder 25, which is mounted on the base 12 of the block 10 and acts on the end of another lever 26 pivoted to the shoulder 14 with an intermediate portion and faces, with its other end, the upper end of the first slider 16. The action performed by the pneumatic cylinder 25 on the slider 16 is aimed at lowering the first slider 16 rigidly together with the second slider 20, and is contrasted by elastic return means constituted by a spring 27 which is fixed to the base 12 of the block 10 and acts, with its upper end, on the pivot 17 which is rigidly coupled to the first slider 16.

Conveniently, there are first adjustable stroke limit means which are interposed between the first slider 16 and the second slider 20 to delimit the minimum distance between the knitting forming cam 6 and the countercam 8. Said first stroke limit means comprise a screw 28 which passes through the portion 16a of the first slider 16 and protrudes below it with its tip 28a, thus defining an upper support for the underlying portion 20a of the sec-

ond slider 20.

The maximum mutual approach of the knitting forming cam 6 and of the countercam 8 is adjusted by screwing or unscrewing the screw 28.

The screw 28, in addition to acting as stroke limit, also transmits the action performed by the lever 26 on the first slider 16 to the second slider 20, lowering the sliders 16 and 20 together and thus lowering the knitting forming cam 6 and the countercam 8 during knitting density adjustment.

There are also second adjustable stroke limit means which delimit the sliding of the first slider 16 with respect to the block 10. Said second stroke limit means simply comprise a screw 29, which can be screwed in the upper end of the shoulder 13 and defines, with its collar 29a, a stop element for the rise of the first slider 16, and by another screw 30, which can be screwed in the upper end of the first slider 16 and defines, with its collar 30a, a stop element which engages the upper end of the upright 15 at the end of the lowering of the first slider 16.

Advantageously, upstream of the knitting forming cam 6 along the direction of motion of the needles with respect to the cams there is an auxiliary cam 31 movable by control, in a per se known manner, along a radial direction of the needle cylinder 1 from a disengagement position, in which it is spaced laterally to the needle cylinder so as to not interact with the heels of the needles, to an engagement position, in which it is closer to the needle cylinder so as to engage the heels of the needles, and vice versa. Said auxiliary cam 31 has a lower profile defining a descending portion 31a which can engage the heel of the needles which do not knit at the feed 5 so as to lower them if said needles have been accidentally raised due to the tension applied by the knitting or due to transit over previous cams.

The lowering action performed by the auxiliary cam 31 is such as to move the heels of the needles which do not knit at the feed 5 to a level which is below the lower end of the knitting forming cam 6.

The operation of the knitting forming cam set in the machine according to the present invention is as follows.

When knitting is to be performed in which the presence of the countercam 8 is superfluous as shown in figure 5, illustrating a set of needles A which does not knit at the feed 5 and which is located between two sets of needles B and C having two heels and knitting at the feed 5, the pneumatic cylinder 21 is actuated; by lowering the countercam 8, said cylinder avoids collision of the heels of the needles of the set A against the countercam 8.

The presence of the auxiliary cam 31, which lowers any needles of the set A which have been raised accidentally, also avoids the collision of the heels of the needles of set A against the descending portion 7 of the knitting forming cam 6.

In practice it has been observed that the machine according to the present invention fully achieves the intended aim since, by virtue of the movable condition of the countercam and of the knitting forming cam, it can reach high actuation speeds even when performing knittings which, in conventional machines, prevent the reaching of high speeds due to the risk of breakage or damage of the needles.

The machine thus conceived is susceptible to 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.

In practice, the materials employed, as well as the dimensions, may be any according to the requirements and the state of the art.

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 signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

Claims

1. Circular knitting machine for manufacturing socks, stockings or the like, with improved knitting forming cam set, comprising a needle cylinder rotatable about a substantially vertical needle cylinder axis; a plurality of axial grooves defined on the lateral surface of said needle cylinder, each one of said axial grooves accommodating a needle which is slidable along a direction parallel to the needle cylinder axis; said needle having at least one heel protruding radially from the needle cylinder and being engageable with cams which laterally face the needle cylinder and define paths engageable by the heels of the needles during the rotation of the needle cylinder about said axis with respect to said cams; said cams comprising, proximate to at least one thread feed, a knitting forming cam provided with a lower profile defining a descending portion immediately downstream of the feed of the thread which can engage the heel of the needles which are raised to take up the thread to lower them so as to form the loops of knitting; a countercam provided proximate to the end of said descending portion of the knitting forming cam and facing said knitting forming cam in a

downward region; said countercam delimiting the lowering of the needles after taking up the thread; characterized in that said countercam is slidably supported with respect to said knitting forming cam along a sliding direction having a component parallel to the needle cylinder axis; means for actuating said countercam being provided, which can be activated by control to move said countercam along said sliding direction toward or away from said knitting forming cam.

2. Machine according to claim 1, characterized in that said knitting forming cam and said countercam can slide, by control, rigidly together along a direction which is substantially parallel to the axis of the needle cylinder in order to adjust the tightness of the knitting.

3. Machine according to claims 1 and 2, characterized in that it comprises a block which is rigidly associated with the supporting structure of the machine and slidably supports, along a direction which is substantially parallel to the needle cylinder axis, a first slider which is rigidly associated with said knitting forming cam, said first slider slidably supporting, along a direction which is substantially parallel to the needle cylinder axis, a second slider which is rigidly associated with said countercam.

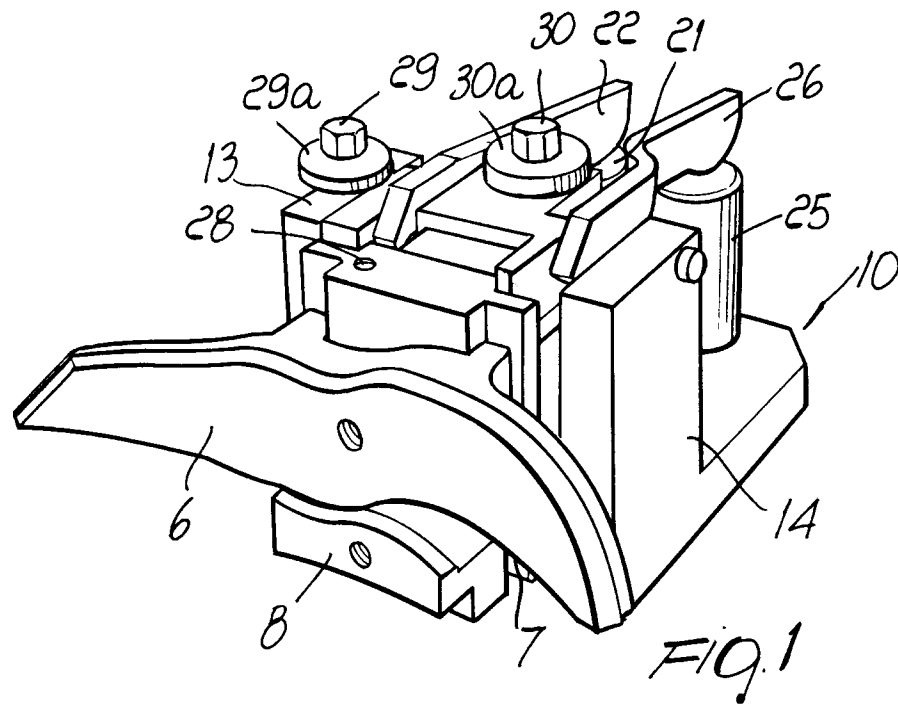
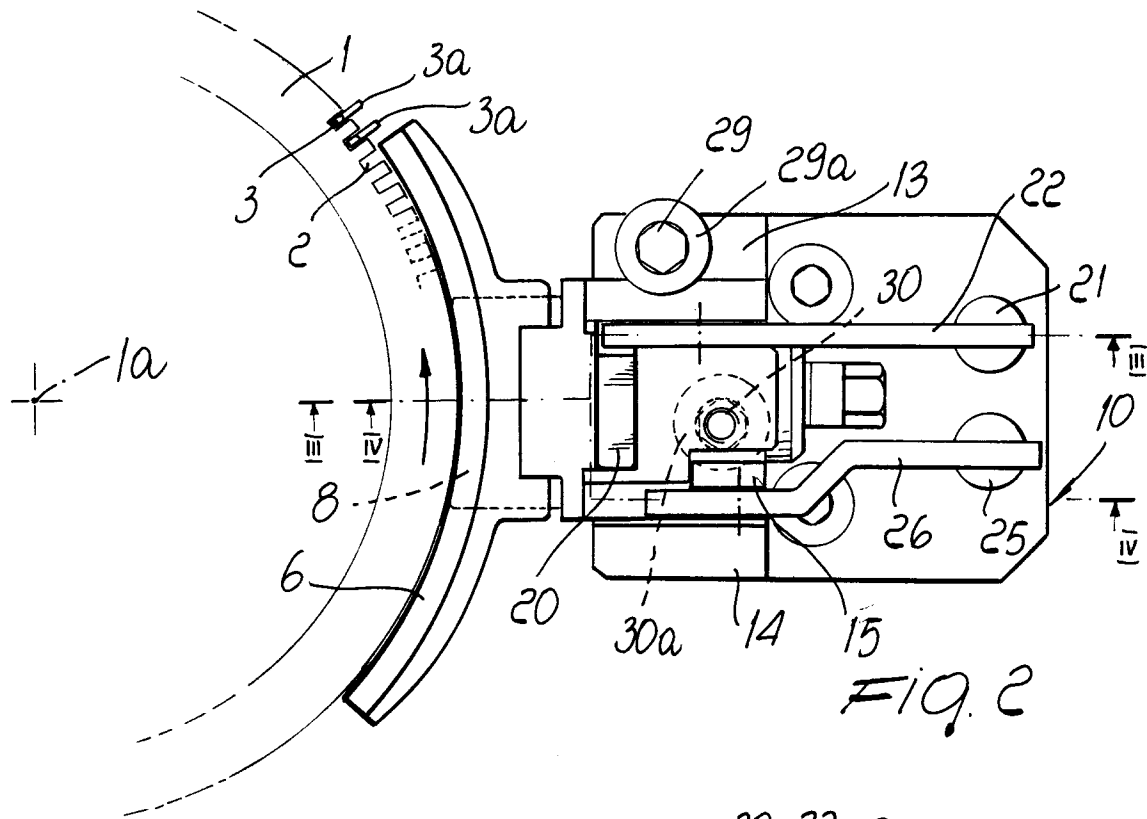
4. Machine according to one or more of the preceding claims, characterized in that said actuation means comprise a first fluid-dynamic actuator mounted on said block and acting on said second slider to move it parallel to said sliding direction in contrast with elastic return means which are interposed between said second slider and said block and elastically contrast the movement of said second slider in the direction in which it produces the spacing of said countercam from said knitting forming cam.

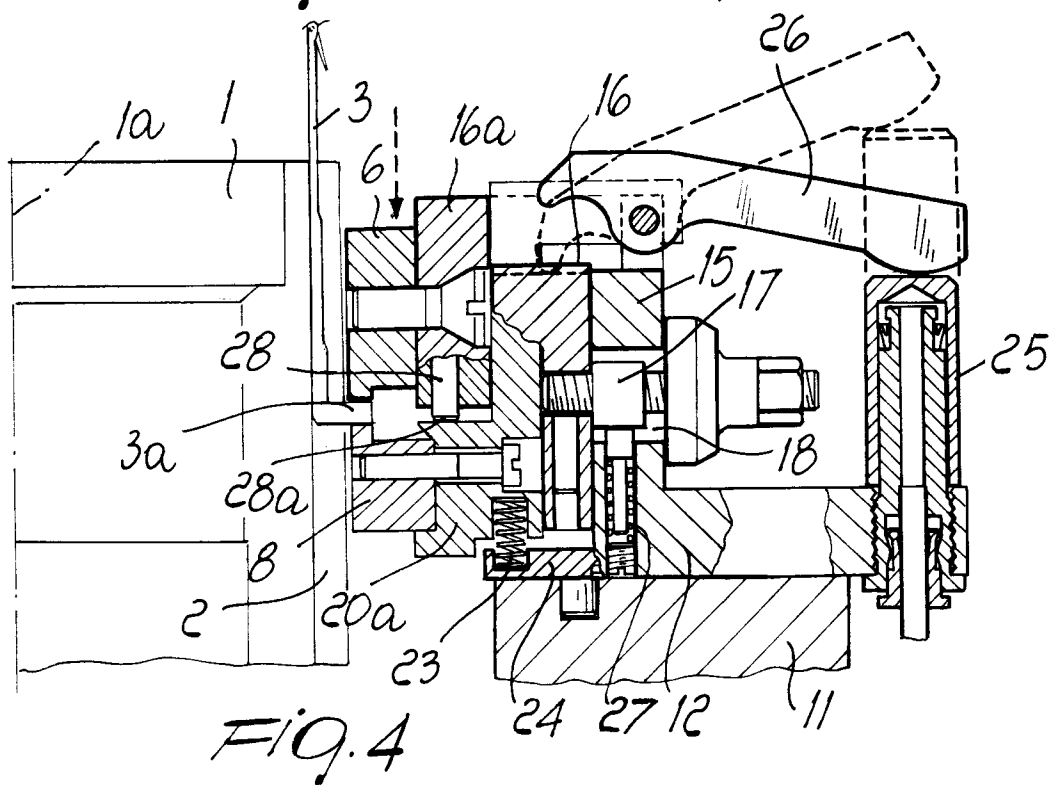
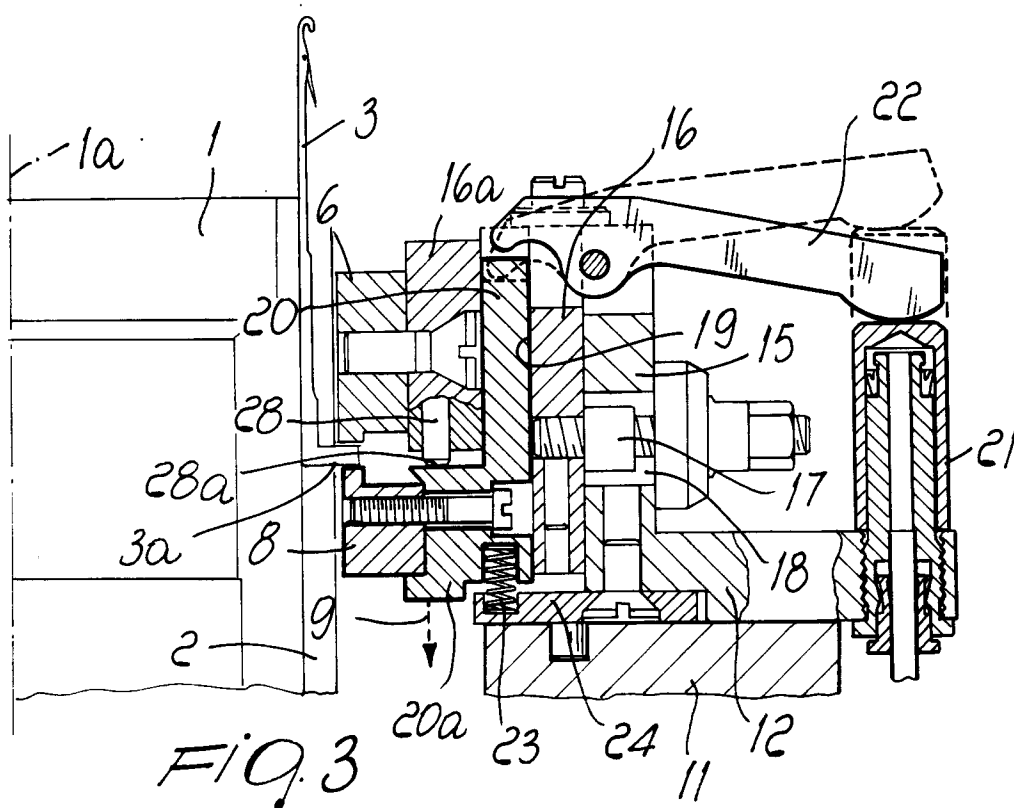
5. Machine according to one or more of the preceding claims, characterized in that it comprises a second fluid-dynamic actuator which is mounted on said block and acts on said first slider to move said first slider and said second slider rigidly together along a direction which is substantially parallel to the axis of the needle cylinder in contrast with elastic return means which are interposed between said first slider and said block.

6. Machine according to one or more of the preceding claims, characterized in that it comprises first adjustable stroke limit means which

are interposed between said first slider and said second slider to delimit the minimum distance between said knitting forming cam and said countercam.

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7. Machine according to one or more of the preceding claims, characterized in that it comprises second adjustable stroke limit means which delimit the movement of said first slider parallel to the axis of the needle cylinder. 10
8. Machine according to one or more of the preceding claims, characterized in that said first fluid-dynamic actuator is connected to said second slider by means of a lever which is pivoted to said first slider with an intermediate portion. 15
9. Machine according to one or more of the preceding claims, characterized in that said second fluid-dynamic actuator is connected to said first slider by means of a lever which is pivoted to said block with an intermediate portion. 20
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10. Machine according to one or more of the preceding claims, characterized in that upstream of said knitting forming cam, according to the motion of the needles with respect to said cams, there is an auxiliary cam which is movable, by control, along a direction in which a component is radial to the needle cylinder, from a disengagement position, in which it is spaced laterally with respect to the needle cylinder so as to not interfere with the needle heel, to an engagement position, in which it is closer to the needle cylinder so as to engage the needle heel, or vice versa, said auxiliary cam having a lower profile with a descending portion which can engage the heel of the needles which do not knit at said feed to lower them below the lower end of said knitting forming cam facing said countercam. 30
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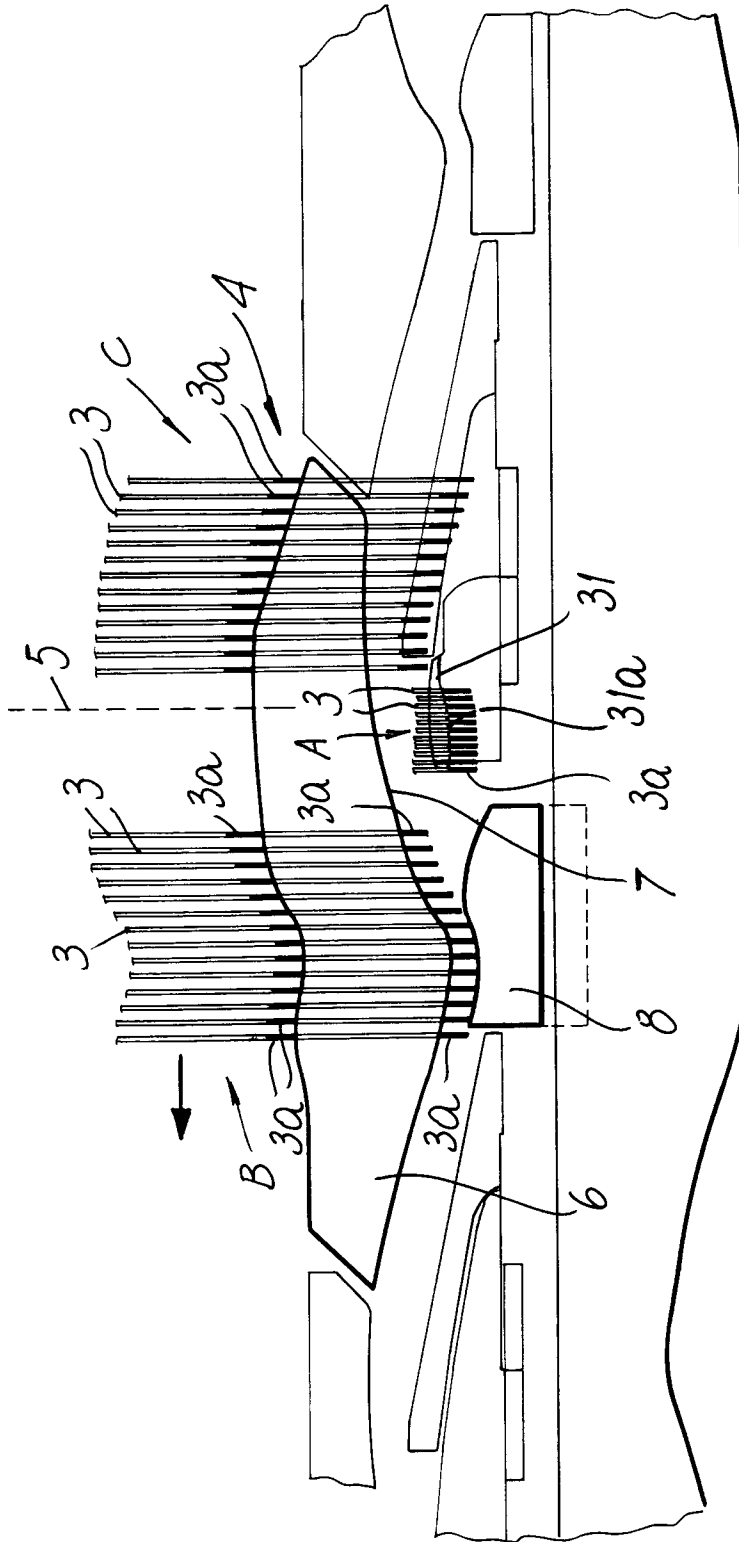


FIG. 5