(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 454 196 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **91200643.4**

(51) Int. Cl.[5]: **D04B 9/56**, D04B 9/20

(22) Date of filing: **22.03.91**

(30) Priority: **30.03.90 IT 1989790**

(43) Date of publication of application:
30.10.91 Bulletin 91/44

(84) Designated Contracting States:
AT BE CH DE DK ES FR GB GR LI LU NL SE

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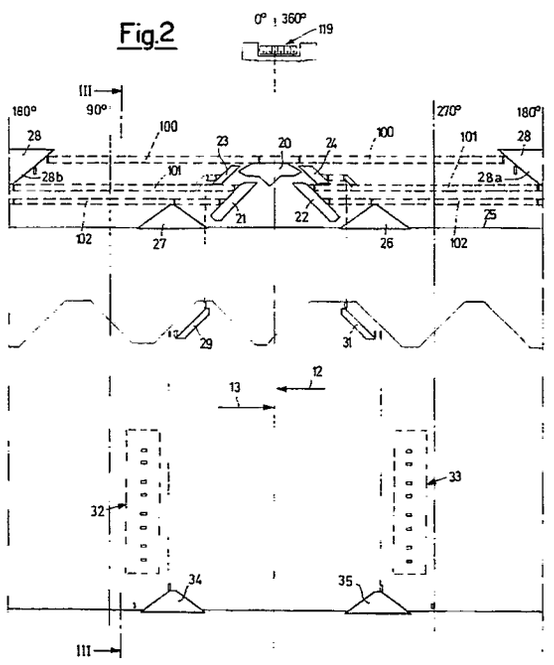
(54) Circular knitting machine for manufacturing stockings, socks and the like.

(57) A circular knitting machine for manufacturing stockings, socks or the like is proposed in which the heel and toe of the stocking or sock are formed without the aid of pickers, by using two selection actuators associated with the yarn feed and loop formation point in which the heel and toe are formed, said actuators and suitable cams being used to move out of operation those needles selected during the narrowing and widening stages. A lowering cam is provided opposite the yarn feed and loop formation point to return to a high working track, towards the end of each revolution of the cylinder when under reciprocating movement, those needles which have already been moved into inactivation by the selection actuators.

Fig.2



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This invention relates to a circular knitting machine for manufacturing stockings, socks and the like.

The term "circular knitting machine" indicates herein any type of circular knitting machine, whether of single or multi-cylinder, or of one or more feeds (yarn feed and loop formation point), able to manufacture ladies' stockings, men's socks or the like. For simplicity, reference will be made exclusively to single cylinder machines hereinafter.

As is well known to any expert of the art, and thus not requiring detailed description, a single cylinder circular knitting machine comprises substantially a fixed frame within which the so-called needle cylinder is suitably supported rotatable about its axis and comprises axial peripheral tricks in which latch needles, possibly jacks, and selector elements are inserted. Rigid with the upper part of the needle cylinder there is the sinker ring, the radial grooves of which carry the sinkers which cooperate with the needles in forming the knitted fabric.

The needle cylinder is surrounded by a skirt comprising the so-called cambox, formed from a series of cams which induce the upward and downward movements of the needles and possible jacks within the respective peripheral tricks of the needle cylinder. The machine also comprises a certain number of yarn guides at each feed, ie yarn feed and loop formation point, and is provided with suitable mechanisms for causing the needle cylinder to rotate either continuously in one direction or to reciprocate in opposite directions during certain stages of the formation of the stocking or sock, and for controlling certain mobile cams of the cambox, the yarn guides and all those machine parts which do not occupy a fixed position during operation.

In modern machines provided with selection systems for executing patterns in the formed knitted fabric, selector elements are associated with the needles and so-called actuators in the form of electromagnetic devices are provided which, when activated by electrical pulses originating from a central electronic programming unit, are able to act selectively on the selector elements to cause the respective needles and/or the possible jacks to interfere or not interfere via their butts with the cams of the cambox.

The present invention, which relates to a circular knitting machine of the aforedescribed type as totally known in the art, refers in particular to that device or group of machine elements and members which operates during the construction of the heel and toe of the stocking or sock.

During the construction of these parts of the stocking or sock only one half of the cylinder needles operate, the cylinder being driven with reciprocating rotation, ie one 360° revolution in one direction followed by one 360° revolution in the opposite direction. To inactivate the required half of the needles during these stages, one half of the needles are provided with a long butt and the other half with a short butt. In addition, the cambox comprises appropriate cams which can be controlled so that they act on only one half of the needles in order to inactivate this half of the needles during the last cylinder revolution under continuous rotary motion. For example, these cams can be such as to act only on the long-butt needles and not on the short-butt needles, to raise all the long-butt needles to a level such that they can no longer interfere with the stitch formation cams and thus be inactivated, with the last formed loops being retained on their shafts. It should be noted that the continuous rotary motion of the cylinder is normally anticlockwise about its axis. In forming the heel and toe of a stocking or sock, in which, as stated, the needle cylinder is rotated clockwise followed by anticlockwise, a stage known as the "narrowing stage" followed by a stage known as the "narrowing and widening stage" occur. In the narrowing stage, during each clockwise and anticlockwise cylinder revolution one left needle and respectively one right needle of that half of the needles remaining in operation are inactivated, ie are raised to the level of the needles which have already been inactivated, ie to the level of the long-butt needles in the described case.

The term "left needles" as used herein indicates those needles which have remained activated, ie in the case considered those short-butt needles lying within the cylinder peripheral region extending 90° leftwards (or clockwise) from the centre line of said short-butt needles, whereas "right needles" are those short-butt needles which lie within the opposite region extending 90° from said centre line.

The narrowing stage proceeds until only about one third of the short-butt needles, ie those within the region extending between 30° to the left and 30° to the right of the centre line of the short-butt needles, remain in operation.

At this point the narrowing and widening stage begins, in which during each clockwise and anticlockwise cylinder revolution one short-butt needle is again inactivated whereas two short-butt needles are returned to operation. This stage continues until all the short-butt needles have returned to operation.

The needle cylinder then returns to continuous rotation and the long-butt needles are returned to operation.

In the traditional art, to inactivate the short-butt needles during the two stages involved in the formation of the heel and toe of stockings and socks

and to return the inactivated needles to operation, special members known as pickers associated with the cambox cans are used. These comprise two lateral narrowing pickers, one left and one right, associated with the left and right knocking-over cams respectively, plus a central widening picker. These pickers are very delicate moving members, subject to wear and frequent malfunction, and in addition to not allowing high operating speed during heel and toe construction they cause frequent needle breakage.

Previous attempts to dispense with these pickers in the formation of stocking and sock heels and toes on circular knitting machines have not been successful, in that it has so far not been possible without using said pickers to form the knitted fabric in the heel and toe part of the stocking or sock in a perfectly equal manner, as is obtained when using the pickers. It has been found particularly difficult without the central picker to effect the widening, ie the return to operation of those needles which had been previously inactivated, during which stage both the central picker and the two lateral pickers are in operation in the traditional art, as already stated, in order to ensure the formation of a correct knitting weave without the formation of holes.

The technical problem which it is the object of the present invention to solve is therefore, in general terms, to enable, in a circular knitting machine for the manufacture of stockings, socks and the like, the heel and toe of the stocking or sock to be formed in an exactly equal manner as in the traditional art, but by using instead of the lateral and central pickers other machine members such as suitable cams in combination with the selection system, these not being subject to the disturbances and problems suffered by the pickers.

This problem is solved according to the invention in that with that feed of the machine in which the narrowing and widening are effected during the heel and toe formation there are associated two selection actuators positioned before and after the feed with respect to the cylinder rotation direction and arranged to cause individual needles to rise, selectively and with the aid of cams, to a high inactivation track during the rotation of the needle cylinder when under reciprocating rotary motion, there being provided in a region substantially opposite said feed a lowering cam which is arranged to act, during both the cylinder anticlockwise and clockwise rotary motion, on the inactivated needles in the high track to cause them to descend to a high working track.

Said lowering cam can be positioned within a region between 150° and 210° from the machine feed, although normally it is positioned about 180° from it. This lowering cam is used primarily during the narrowing and widening stage, ie during the stage in which those needles which during the previous narrowing stage had been inactivated have now to be returned to operation, however the lowering cam can also be in its working state during the narrowing stage. In the first case, ie in which the lowering cam is to be used only during the narrowing and widening stage, the cam must be controllable so that it can be moved from an inactive position to an active position and vice versa, whereas in the second case it can be fixed in the active position.

The lowering cam provided according to the invention in practice replaces the central or widening picker of traditional machines, in the sense that as the selection system is unable to lower the needles situated out of operation in the high position, said lowering cam is able at each alternate cylinder revolution to cause those inactivated needles in the high position to descend into the high operating track, the selection system then returning the desired number of needles into the high inactivation position, as required.

It should be noted that according to the invention the heel and toe of the stocking or sock can be formed either with that half of the needles with long butts, leaving all the short-butt needles inactivated in the low position, or with that half of the needles with short butts. In this latter case other movable raising cams are associated with said lowering cam to the left and right of it, to move the long-butt needles into the high inactivation position during the formation of the heel and toe of the stocking or sock. As stated, the needle selection system is used in the formation of the heel and toe of the stocking or sock, this system comprising associating a selector element with each needle and using electromagnetic actuators cooperating with these selector elements. Such selection systems are known. The selector elements, which are of the known art, can be of various constructions. In particular, each selector element can consist of a single part which on one side cooperates with the actuator and on the other side acts directly on the respective needle. However, the selector element can also consist of more than one part, in which one part cooperates with the actuator and another part acts on the respective needle either directly or via an interposed jack. For the purposes of the present invention single-part or multi-part selector elements with or without an interposed jack are used. In the embodiments described hereinafter reference is made to two possible selector element constructions.

The electromagnetic actuators are also known and can be of various constructions. They will therefore only be described and illustrated in a general manner.

Embodiments of the invention are described in

greater detail hereinafter with reference to the drawings, to better clarify the structural and operational characteristics of the present invention.

In the drawings:

Figure 1 is a schematic plan view of the needle cylinder, with an indication of the position of the cams and actuators concerned in the formation of the heel and toe of a stocking or sock;

Figure 2 shows the development of the cambox skirt with the cams concerned, the position of the actuators being indicated schematically;

Figure 3 is a longitudinal section on the line III-III of Figure 2 showing the right half of the needle cylinder, the cambox cams having been removed;

Figure 4 is a section analogous to that of Figure 3 but with different selector elements; and

Figure 5 is a view analogous to Figure 2, showing the development of a modified embodiment of the cambox skirt.

Only those parts of the circular knitting machine which are essential for a complete understanding of the invention are shown on the drawings, it being understood that all the remaining non-illustrated parts can be of traditional known-art construction as well known to the expert of the art.

With reference to Figures 1 to 3, the single-cylinder circular knitting machine comprises, in the considered embodiment, a needle cylinder indicated schematically by 10, mounted rotatable about its axis 11 within a frame, not shown, and arranged to be rotated either with continuous motion in the direction (anticlockwise or outward) indicated by the arrow 12, or with reciprocating motion in the sense of one revolution in the direction of the arrow 12 and the next revolution in the direction (clockwise or return) indicated by the arrow 13 and so on, about its axis 11.

In the embodiment shown in Figure 3, the needles 15, jacks 16 and selector elements are contained from the top downwards in peripheral tricks 14 of the needle cylinder 10, each needle 15 being provided with a long or short butt 15a, and each jack 16 with a butt 16a. In the case considered, each selector element consists of a spring part 17 with a butt 17a designed to act on the respective jack 16, and a part 18 pivoted at 18b and retained by a spring 18c, the part 18 being provided with a plurality of teeth 18a for cooperation with electromagnetic actuators, described hereinafter.

In the case illustrated by way of example, the machine is provided with only one yarn feed and loop formation point (feed), the relative yarn guides 19 being indicated schematically in Figure 2. Several feeds may be provided, in known manner, but that shown is a feed assigned to the formation of the heel and toe of a stocking or sock.

The cambox skirt, shown in development in Figure 2, is rigid with the machine frame and comprises in known manner for the feed in question an upper central cam 20, a left knocking-over cam 21 and a right knocking-over cam 22. To the left and right of the upper central cam 20 there are disposed respectively a left raising cam 23 and a right raising cam 24, there being provided on a ring 25 a left raising cam 27 and a right raising cam 26 which can be partially inserted such that when inserted they act only on the long-butt needles, and allow the short-butt needles to pass along the ring 25. All the cams described up to this point are designed to act on the butts 15a of the needles 15.

At about 180° from the feed, the cambox comprises a further lowering cam 28, comprising a left flank 28a and a right flank 28b, and arranged to cause those needles which have been brought to a track 100 above the level of the upper central cam 20 to descend to a high working track 101 which interferes with the cams 21 and 22. The cam 28 also therefore acts on the butts 15a of the needles 15.

To act on the butts 16a of the jacks 16, the cambox comprises a left raising cam 29 and a right raising cam 31.

Finally, to act on the butts 17a of the parts 17 of the selector elements there are provided a left raising cam 34 and a right raising cam 35. These cams can act on the parts 17 of the elements only if their butt 17a projects from the cylinder 10, ie if said parts 17 are not pressed elastically into the relative tricks of the cylinder which holds them. To select the desired needles, two electromagnetic actuators, namely a left actuator 32 and a right actuator 33, are associated with the feed. Each actuator is provided in known manner with a certain number of levers, such as the lever 32a, equal to the number of teeth 18a provided in the parts 18 of the selector elements, each lever 32a being moved by a respective electromagnet, when energized, into a radial activated position from an inclined deactivated position assumed by the lever 32a when its electromagnet is not energized. If during the rotation of the cylinder a selector element passes in which the part 18 is provided with a tooth 18a at the level of the lever 32a, this latter swivels said part 18 about the pivot 18b in the sense of urging it the relative part 17 into the cylinder trick (see Figure 3) to thus move its butt 17a out of the range of action of the raising cam 34 or 35. The result is that the part 17 of this selector element is not made to rise. In contrast, if the actuator lever is in its deactivated rest position, the part 18 of the selector element having the tooth 18a at the level of said lever is not urged, the relative spring part 17 remaining with its butt projecting from the cylinder, with the result that said part 17 of the selec-

tor element can be made to rise by the cam 34 or 35. The operation of these selector elements and electromagnetic actuators is known and therefore does not need further explanation. The electrical pulses for energizing or de-energizing the actuator electromagnets originate from a central electronic unit, not shown, comprising a programmer.

Starting from a vertical line at 0° (or 360°) at the yarn guides 19 of the considered feed, Figure 2 shows by means of other vertical lines at 90°, 180° and 270° the four sectors into which the cambox skirt is divided.

For clarity of representation the dimensions and positions of the various cams shown are not perfectly to scale. However, in the schematic plan view of Figure 1, the arrangement of the various cams at the periphery of the cylinder 10 is shown more correctly and to scale.

It should be noted that the cambox can comprise further cams, not shown, which however do not require mention in the description of operation of the machine during the formation of the heel or toe of the stocking or sock.

In Figure 1 that 180° peripheral region of the cylinder 10 comprising the short-butt needles 15 is indicated by the semicircle 36, while the semicircle 37 indicates that 180° peripheral region of the cylinder 10 comprising the long-butt needles 15. The cylinder 10 is shown in Figure 1 in an angular position in which the centre line 38 of the peripheral region 37 comprising the long-butt needles is in front of the lowering cam 28 opposite the feed. Of these long-butt needles, those within the 90° peripheral region of the cylinder going clockwise (leftwards) from the centre line 38 will be called hereinafter "left needles" for brevity, whereas those within the 90° peripheral region going anticlockwise (rightwards) from the centre line 38 will be known as "right needles".

Using the aforedescribed elements of the circular knitting machine, the heel or toe of a stocking or sock is formed in the following manner.

On termination of the continuous rotary motion of the cylinder 10, ie after the formation of the leg or foot of the stocking or sock, the cams 20, 21, 22, 23 and 24 are moved into their working position, if not already in this position. The cams 26 and 27 are partially inserted so as to act only on the long-butt needles, the short--butt needles being discarded by leaving them in a low non-working track. The cams 29 and 31 are also inserted to act on the jacks 16, and the cams 34 and 35 are inserted to act on the selector elements selected by the actuators as already described. The actuators 32, 33 are activated, ie the electromagnets of all their levers 32a are energized by signals originating from the central electronic unit.

Under these conditions the narrowing stage can commence, with reciprocating rotary motion of the cylinder 10.

This reciprocating motion begins with a first revolution of the cylinder 10 in the clockwise or return direction (in accordance with the arrow 13). The cam 27 allows the short-butt needles to pass without raising them, but raises all the long-butt needles onto the cam 21 which causes them to rise into their loop forming state towards the upper central cam 20, from which the needles are lowered to reach the right knocking-over cam 22. Subsequently, those long-butt needles which have operated are raised by the cam 26 onto a low working track 102. During this first revolution of the cylinder 10 under reciprocating motion, a first narrowing of the active long-butt needles is effected by inactivating the first left needle. To achieve this, the lever 32a of the actuator 32 corresponding to the tooth 18a of the part 18 of the selector element relative to this needle is deactivated, so that its part 17 is raised by the cam 34 to move the respective jack 16 into interference with the cam 29 (see dashed line in Figure 2). This then raises the selector 16 and the respective needle 15 into interference with the cam 23. This cam then moves the first left long-butt needle to a level such that the needle is able to rise above the central cam 20 to the track 100 and hence out of operation. However, towards the end of this first (return) revolution of the cylinder under reciprocating motion, said left needle inactivated by the actuator 32 encounters the left flank 28a of the lowering cam 28, which returns the needle in question onto the high working track 101.

During the second revolution of the cylinder 10 under reciprocating motion , this being an anticlockwise or outward revolution (in accordance with the arrow 12), the long-butt needles reach the low working track 102 to encounter the cam 22, which raises them into loop formation towards the central cam 20, by which these needles are lowered to reach the left knocking-over cam 21. Those needles which have operated are then raised by the cam 27 to the low working track 102. However, during this second revolution of the cylinder 10 under reciprocating motion, a second long-butt needle has to be inactivated, this time the first right needle, and in addition the first left needle which during the previous reciprocating (return) revolution did not operate but which on termination of this previous revolution had been moved to the high working track 101 by the lowering cam 28 also has to be inactivated. This is achieved by the actuator 33, by deactivating its respective levers to cause the parts 17 of relative selector elements to rise on the cam 35 and hence cause the respective jacks 16 to interfere with the cam 31. In this manner the first right needle and the first left needle are raised

by the cam 24 to a level such as to be able to rise to the track 100 above the central cam 20 and hence out of operation. Towards the end of this second (outward) revolution of the cylinder under reciprocating motion, the first already inactivated right needle encounters the right flank 28b of the lowering cam 28, which returns it to the high working track 101, whereas the first left needle, which no longer encounters the lowering cam 28, remains high in the track 100 above the central cam 20.

The third reciprocating revolution of the cylinder now takes place, this being a new clockwise return revolution (in the direction of the arrow 13). During this revolution a third long-butt needle has to be inactivated, namely the second left needle. As stated, at the end of the preceding second reciprocating revolution, the first left needle had remained inactivated in the high track 100, whereas the first right needle had been transferred to the high working track 101. Consequently, during this third revolution the second left needle has to be inactivated and the first right needle again inactivated, using for this purpose respective deactivated levers 32a of the actuator 32 in the already described manner. However, towards the end of this third (return) revolution of the cylinder under reciprocating motion, the first and second left needle which during this revolution have not operated again encounter the left flank 28a of the lowering cam 28, which returns them to the high working track 101, whereas the first right needle, which no longer encounters the lowering cam 28, remains high in the track 100 above the central cam 20.

During the subsequent fourth revolution of the cylinder 10 under reciprocating motion, this again being an outward revolution, a fourth long-butt needle has to be inactivated, namely the second right needle, while the other remaining long-butt needles remain under loop formation. It has been stated that at the end of the preceding third revolution the first two left needles which had not operated were transferred to the high working track 101, whereas the first right needle (which had also not operated) had remained in the high track 100 above the central cam 20. Consequently, during this fourth revolution said first two left needles have to be again inactivated and the second right needle also inactivated, using relative deactivated levers of the actuator 33. Towards the end of this revolution, in which neither the first two left needles nor the first two right needles have operated, these latter encounter the lowering cam 28 to be moved to the high working track 101, whereas the first two left needles no longer encounter the cam 28 and thus remain in the track 100 above the central cam 20.

During the fifth reciprocating revolution, this being a return revolution, deactivated levers 32a of the actuator 32 inactivate the third left needle and again inactivate the two first right needles which had remained in the high working track 101 at the end of the fourth revolution. Thus five long-butt needles do not operate during the fifth revolution, at the end of which the first three left needles are in the high working track 101 and the first two right needles are inactivated in the track 100 above the central cam 20.

From the aforegoing it is apparent that during each successive revolution of the cylinder when under reciprocating motion, a further long-butt needle is inactivated and therefore does not operate, so that the total number of long-butt needles which do not operate within a revolution is equal to the number of reciprocating revolutions of the cylinder from the commencement of the narrowing stage.

However, on termination of each clockwise or return revolution of the cylinder, those left needles which have not operated during this revolution are returned by the cam 28 to the high working track 101, and only the right needles which have not operated during that revolution remain inactivated in the high track 100, whereas on termination of each anticlockwise or outward revolution of the cylinder, those right needles which have not operated during this revolution are returned by the cam 28 to the high working track 101, and only the left needles which have not operated during that revolution remain inactivated in the high track 100.

The long-butt needle narrowing stage proceeds in the described manner during subsequent reciprocating revolutions of the cylinder until only about one third of the long-butt needles remain in operation, namely those within the central part, around the centre line 38, of the 180° peripheral region, indicated by 37 in Figure 1, of the cylinder 10. The narrowing stage terminates with a clockwise or return revolution of the cylinder 10, with those left needles which have not operated during this revolution being returned by the cam 28 to the high working track 101, and those right needles which have not operated during that revolution remaining inactivated in the high track 100. As the narrowing stage begins with a return revolution and terminates with a return revolution of the cylinder, it is clear that the total number of long-butt needles which do not operate during the last revolution of the narrowing stage is an odd number, and of these long-butt needles which have not operated there is one left needle more than the number of right needles.

The narrowing and widening stage then commences with an anticlockwise or outward revolution of the cylinder. During this first revolution of the stage in question the actuator 33 operates with its levers, and as during the last return revolution of the narrowing stage, as stated, the number of right needles which did not operate was one less than

the number of left needles which did not operate, this missing right needle is inactivated by deactivating the relative lever of the actuator 33. In addition during this outward revolution, again using relative deactivated levers of the actuator 33, those left needles which at the end of the preceding return revolution had been returned to the high working track 101 have also to be inactivated. However as during this first revolution of the narrowing and widening stage the total number of long-butt needles to operate is to be increased by one, the total number of left needles to be inactivated must be two less than the number of left needles which at the end of the preceding return revolution had been transferred to the high working track 101. Thus on termination of the first outward revolution of the narrowing and widening stage, two left needles more and one needle less will have operated than in the last return revolution of the narrowing stage, and the situation will be such that all the left needles which have not operated will be inactivated in the high track 100, whereas all the right needles which have not operated will be returned by the cam 28 to the high working track 101.

During the second cylinder revolution of the stage under consideration, which is a clockwise or return revolution, the actuator 32 operates, and by corresponding deactivated levers 32a inactivates one left needle more than the number of left needles which did not operate during the preceding revolution, whereas of those right needles which had been returned to the high working track 101, all except two are again inactivated. Thus two more long-butt needles operate during this second revolution of the stage under consideration, namely one left needle and one right needle.

This stage continues with successive reciprocating revolutions of the cylinder 10 until all the long-butt needles have been returned to operation, after which the machine returns to continuous anticlockwise rotary operation of the cylinder, the formation of the heel or toe of the stocking or sock being complete. It is apparent that in the narrowing and widening stage, during each anticlockwise or outward revolution of the cylinder one right needle is inactivated and two left needles are activated, whereas during each clockwise or return revolution one left needle is inactivated and two right needles are activated. In this manner a perfect knitting formation is obtained.

This result is achieved according to the invention without using traditional pickers, and in particular without the central or widening picker, by virtue of the fact that during the narrowing and widening stage at the end of each reciprocating revolution of the cylinder, that group of inactivated needles of which during the next revolution in the opposite direction two needles have to be activated has already been returned to a high working track 101 by the particular lowering cam 28, so that the increase in the number of needles to operate during the next revolution is achieved in practice by an inactivation operation carried out on a smaller number of needles. In other words, by proceeding in this manner special members such as the traditional central picker are not required for returning two needles to operation during each reciprocating revolution.

It is also apparent that the lowering cam 28 provided for this purpose according to the invention as a replacement for the central picker is essential only during the narrowing and widening stage, whereas it is not essential during the preceding narrowing-only stage. Consequently according to a modification this lowering cam 28 located substantially opposite the yarn feed and loop formation point (feed) could be made inactive during the initial narrowing-only stage in the formation of the heel and toe of the stocking or sock, and be activated only during the second narrowing and widening stage.

In the embodiment heretofore described, the selector elements of the selection system each consist of two parts, with a jack inserted between one of these parts and the relative needle.

In a further embodiment, selector elements each consisting of only one part can be used. Such an embodiment is shown in Figure 4, in which the selector element is indicated by 117. This selector element 117 is provided with a butt 117a corresponding to the butt 17a of the part 17 of the selector element of Figure 3, and is also provided with a tooth 117b corresponding to the tooth 18a of the part 18 of the initially considered selector element. The selector element 117 also comprises a butt 117c, corresponding to the butt 16a of the jack 16, which in this embodiment is not provided as the selector element 117 acts directly on the relative needle 15.

The operation of this embodiment is identical to that already described. The butts 117a of the selector elements 117 are arranged to cooperate with the cams 34 and 35, their teeth 117b are arranged to cooperate with the levers of the actuators 32 and 33, and their butts 117c are arranged to cooperate with the cams 29 and 31 of the cambox.

In a further embodiment, which is not illustrated but is similar to Figure 3, the selector elements can each consist of two parts, one for cooperating with the actuators 32 33, and the other for acting in this case directly on the respective needle without the interposition of a jack. This latter part of the selector element must be provided with a butt, such as the butt 117a of Figure 4, to cooperate with the

cams 34 and 35, and with a butt, such as the butt 117c of Figure 4, to cooperate with the cams 29, 31, and the first part must be provided with a tooth such as the tooth 117b of Figure 4, to cooperate with the levers of the actuators 32, 33. Up to now the case has been considered in which the heel and toe of the stocking or sock is formed with the long-butt needles, the short-butt needles being discarded and not operating during this procedure.

However by adding certain mobile raising cams and possibly lowering cams to those already described, which remain structurally and operationally unchanged, the heel and toe can be formed using the short-butt needles, and discarding the long-butt needles. This facility is described by way of example with reference to Figure 5, which corresponds to Figure 2 and in which parts equal to those already described are indicated by the same reference numerals.

As shown in Figure 5, within the cambox, namely to the side of the flanks 28a and 28b of the lowering cam 28, there are a further four movable raising cams and lowering cams. Specifically, to the side of the flank 28a of the cam 28 there are provided two spaced-apart raising cams 41 and 42, of which the cam 42 starts from a point lower than the low working track 102 and the cam 41 starts from a point lower than the high working track 101, whereas to the side of the flank 28b of the cam 28 there are provided a further two cams 40 and 43, the first being a raising cam and the second a lowering cam. The cam 40 also starts from a point lower than the high working track 101. These four cams 40 to 43 are in an inactive non-operating position during the continuous anticlockwise motion of the cylinder (arrow 12), ie during the formation of the leg and foot of the stocking or sock.

During the last revolution of the continuous anticlockwise or outward movement of the cylinder, before commencing the formation of the heel or toe of the stocking or sock, namely before the long-butt needles reach the feed, the raising cam 42 is made to partially enter into a position in which it acts only on the long butts, allowing the short butts to grazingly pass them. Consequently only the long-butt needles are moved upwards out of operation into the track 100 above the central cam 20 by the cam 42.

On termination of this last revolution of the cylinder when under continuous outward movement, ie when all the long-butt needles have been moved into inactivation, the cam 42 is returned to its inactive position, whereas the lowering cams 40 and 41 are partially entered into a position such as to act only on the long butts and allow the short butts to grazingly pass them. It should be noted that these two cams 40 and 41 terminate upwards, as does the raising cam 42, at the level of the upper edge of the central cam 20, to move the long-butt needles to the track 100 out of operation.

At this stage the formation of the heel or toe of the stocking or sock begins, with reciprocating rotary movement of the cylinder 10. The narrowing stage and the narrowing and widening stage of this procedure are carried out in an identical manner to that already described, but with the difference that the heel and toe of the stocking or sock are now formed by the short-butt needles, during the whole of this procedure that half of the needles with long butts being inactivated. This is achieved by the two raising cams 40 and 41, of which the first 40 moves the long-butt needles upwards out of operation during the clockwise or return revolution of the cylinder (arrow 13), whereas the second 41 moves the long-butt needles upwards out of operation during the anticlockwise or outward revolutions (arrow 12). Neither of the cams 40 and 41 acts on the short-butt needles.

It should be noted that in this version one half of the needles, ie the long-butt needles which do not participate in the formation of the heel and toe of the stocking or sock, are moved out of operation into the track 100 (above the central cam 20) by the cams 40 and 41, whereas in the initially described version in which that half of the needles not participating in this procedure were the short-butt needles, said short-butt needles were kept inactivated in the low position by the cams 26 and 27 which do not act on the short butts.

On termination of the formation of the heel or toe of the stocking or sock, ie at the beginning of the first revolution of the cylinder under clockwise or outward continuous movement, the two raising cams 40 and 41 are moved into their inactive positions, whereas the lowering cam 43 is entered to move into normal operation all the long-butt needles which were inactivated during the formation of the heel or toe of the stocking or sock. The cam 43 is then also returned to its inactive position and normal continuous rotary movement of the cylinder recommences, with all its needles operating.

Instead of using a special lowering cam such as the cam 43 to return all the long-butt needles to normal operation, the lowering cam 28 could be used for this purpose.

Claims

1. A circular knitting machine for manufacturing stockings, socks or the like, comprising at least one cylinder rotatable about its axis with continuous or reciprocating motion and containing peripheral axial tricks, in each of which at least a needle and a selector element are inserted, one half of the circumferential cylinder tricks

containing long-butt needles and the other half containing short-butt needles, a skirt with a series of cams arranged to act on the needles and on the selector elements, at least one yarn feed and loop formation point with yarn guides, and electromagnetic actuators arranged to act on the selector elements for the purpose of needle selection, characterised in that with said at least one yarn feed and loop formation point there are associated two selection actuators (32, 33) positioned before and after the yarn feed and loop formation point with respect to the direction of rotation of the cylinder (10) and arranged to cause individual needles (15) to rise, selectively and with the aid of cams (34, 35, 29 , 31, 23, 24), to a high inactivation track (100) during the rotation of the cylinder (10) under reciprocating rotary motion, there being provided in a region substantially opposite said yarn feed and loop formation point a lowering cam (28) which is arranged to act, during both the cylinder anticlockwise and clockwise rotary motion, on the inactivated needles (15) in the high track (100) to cause them to descend to a high working track (101).

2. A machine as claimed in claim 1, characterised in that the lowering cam (28) lies within a region between 150° and 210° from the yarn feed and loop formation point.

3. A machine as claimed in claim 1, characterised in that the lowering cam (28) is movable on command from an active position to an inactive position and vice versa.

4. A machine as claimed in claim 1, in which selector elements are used each consisting of a first part cooperating with the selection actuators, and a second part acting on the relative needle either directly or via an interposed jack, characterised in that with the selection actuators (32, 33) there are associated cams (34, 29; 35, 31) for said second parts (17) of the selector elements and for the possible interposed jacks (16), and cams (23; 24) for the needles (15), and which during the anticlockwise and clockwise movement of the cylinder (10) cause said second parts (17) of the selector elements, the possible jacks (16) and the selected needles (15) to rise in order to move these latter into the high track (100) out of operation.

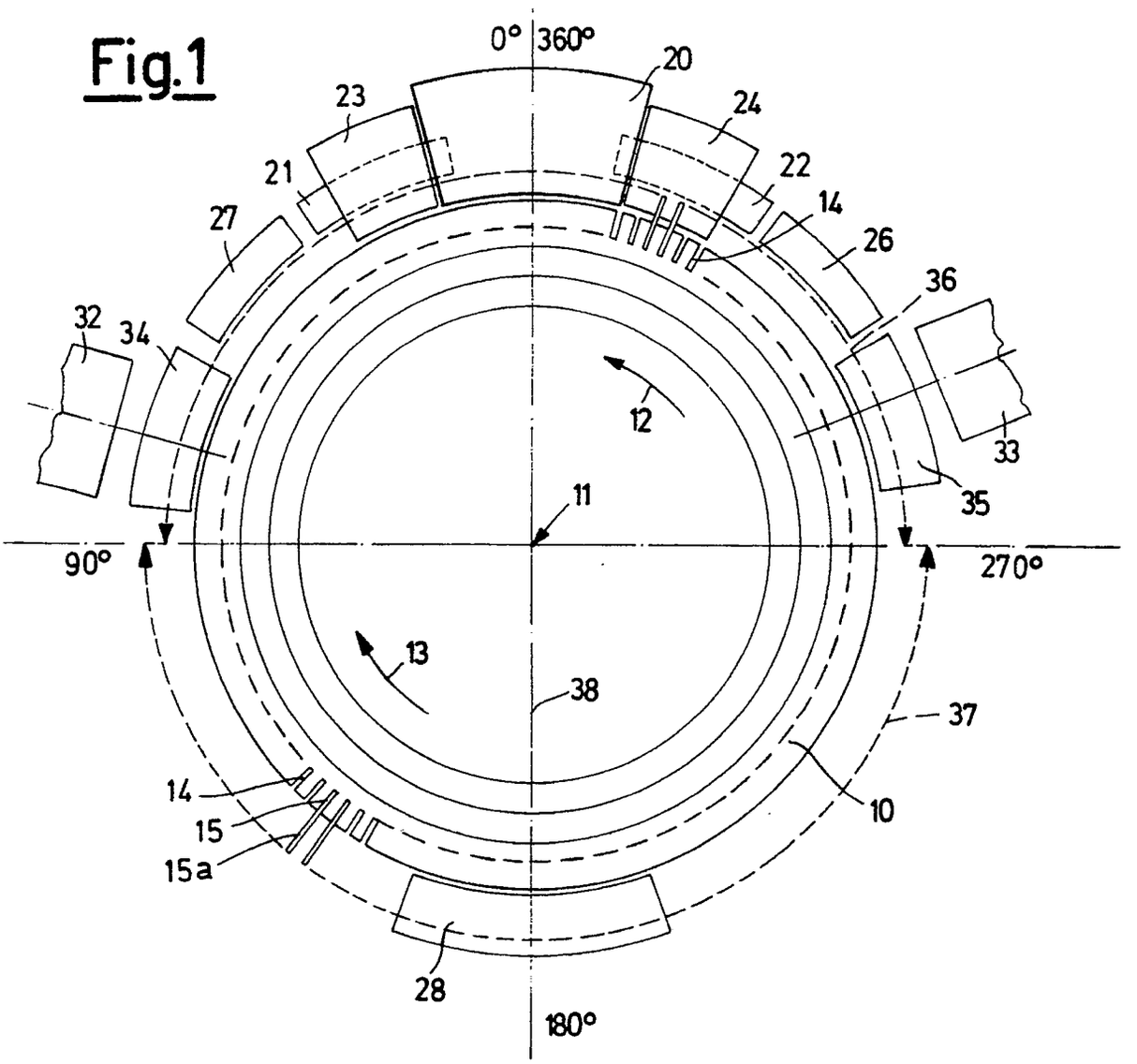
5. A machine as claimed in claim 1, in which selector elements are used each consisting of a single part acting directly on the relative needle, characterised in that each selector element (117) is provided with two butts (117a and 117c) positioned at different heights to cooperate with raising cams (34, 29; 35, 31), and with a tooth (117b) to cooperate with the selection actuators (32, 33), raising cams (23, 24) being provided to raise the selected needles (15) to the track (100) out of operation.

6. A machine as claimed in claim 1, characterised in that before and after the yarn feed and loop formation point with respect to the direction of rotation of the cylinder, there are provided cams (26, 27) which can be partly inserted to act only on the long-butt needles (15).

7. A machine as claimed in claim 1, characterised in that to the sides of the flanks (28a, 28b) of the lowering cam (28) there are provided supplementary cams, namely to the side of that flank (28a) facing the direction of anticlockwise movement of the cylinder (10) two spaced apart raising cams (41, 42) terminating upperly at the level of the high inactivation track (100), and of which one (42) starts from a point lower than a low working track (102) and the other (41) starts from a point lower than the high working track (101), and to the side of that flank (28b) of the lowering cam (28) facing the direction of clockwise movement of the cylinder (10) a raising cam (40) also terminating at the level of the high inactivation track (100) and starting from a point lower than the high working track (101), said supplementary cams (40-42) being individually movable on command from an inactive position to a partially active position in which they act only on the long-butt needles (15).

8. A machine as claimed in claim 7, characterised in that to the side of that flank (28b) of the lowering cam (28) facing the direction of clockwise movement of the cylinder (10) there is also provided a lowering cam (43) which starts from the high inactivation track (100) and is movable on command from an inactive position to a partially active position in which it acts on the long-butt needles (15).

Fig.1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26
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23
21
27
32
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12
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11
35
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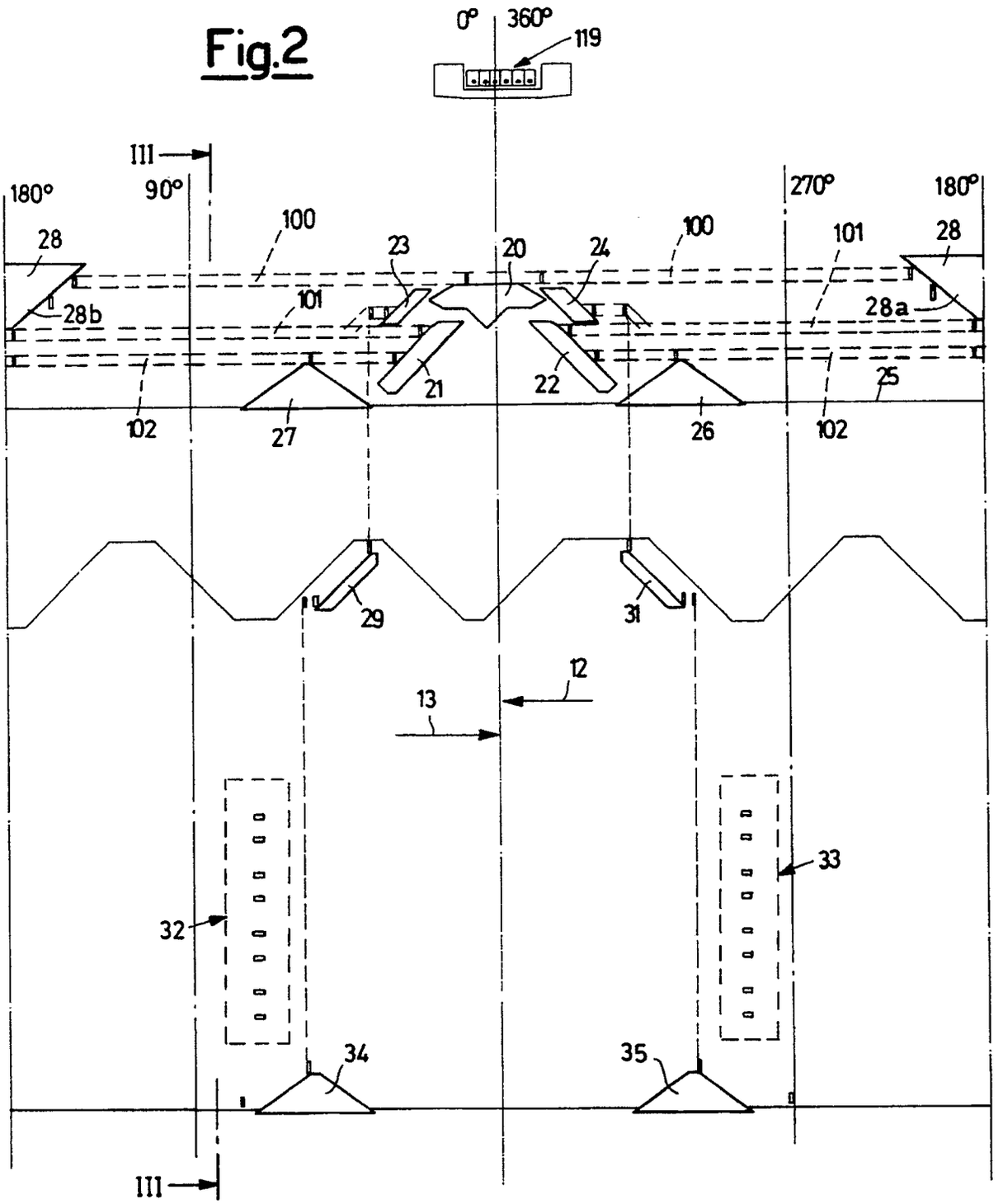
38
37
14
15
15a
10
28
180°

Fig.2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III

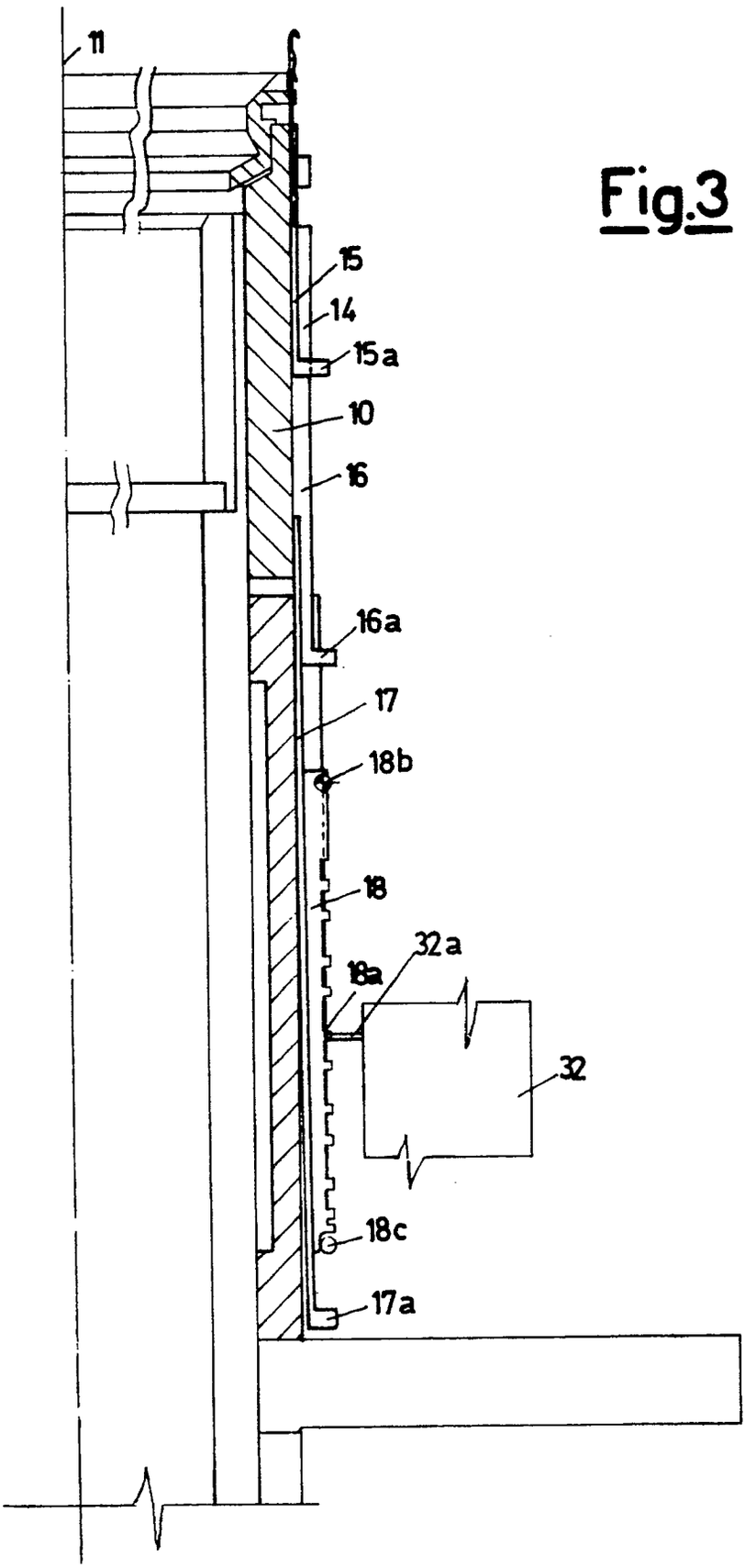


Fig.3

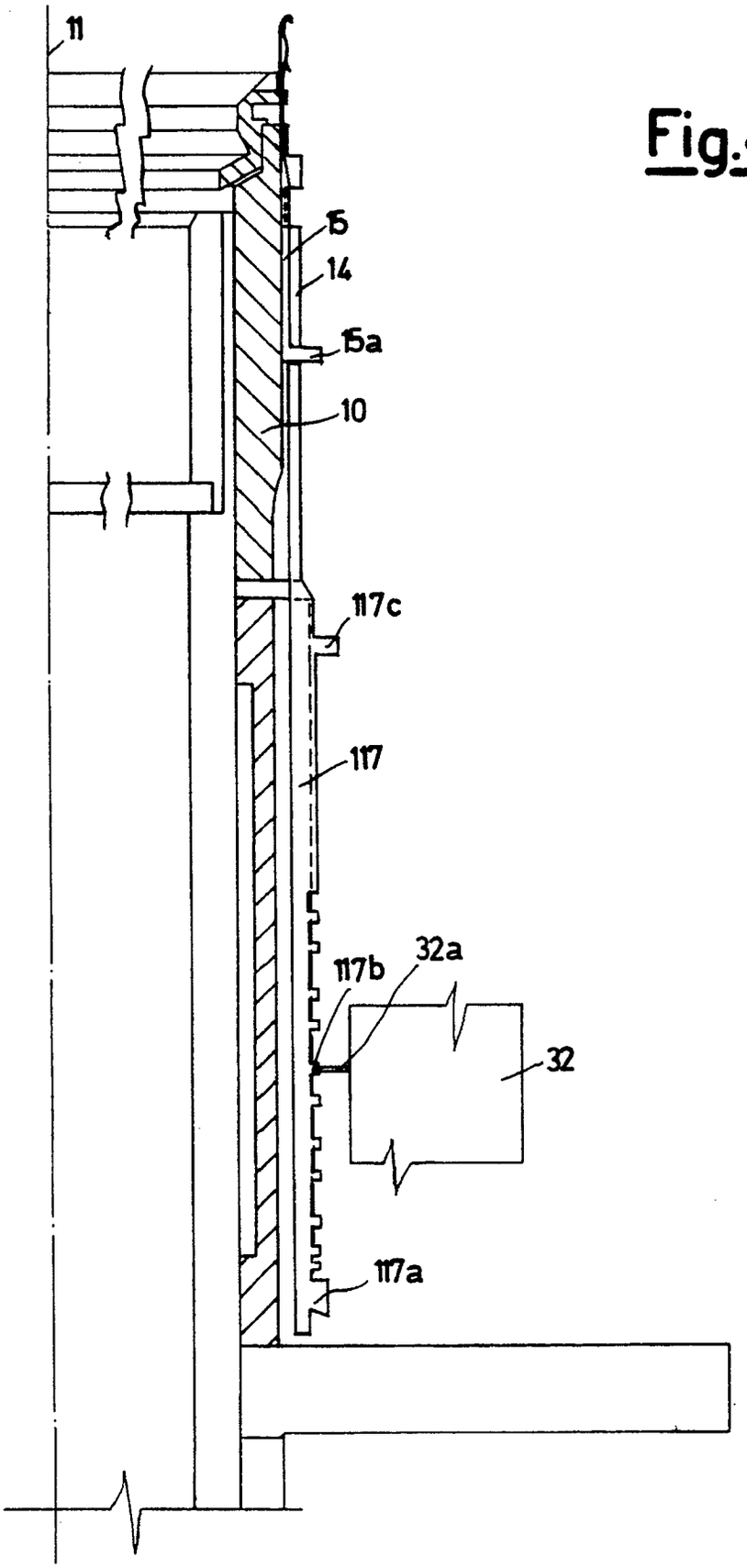
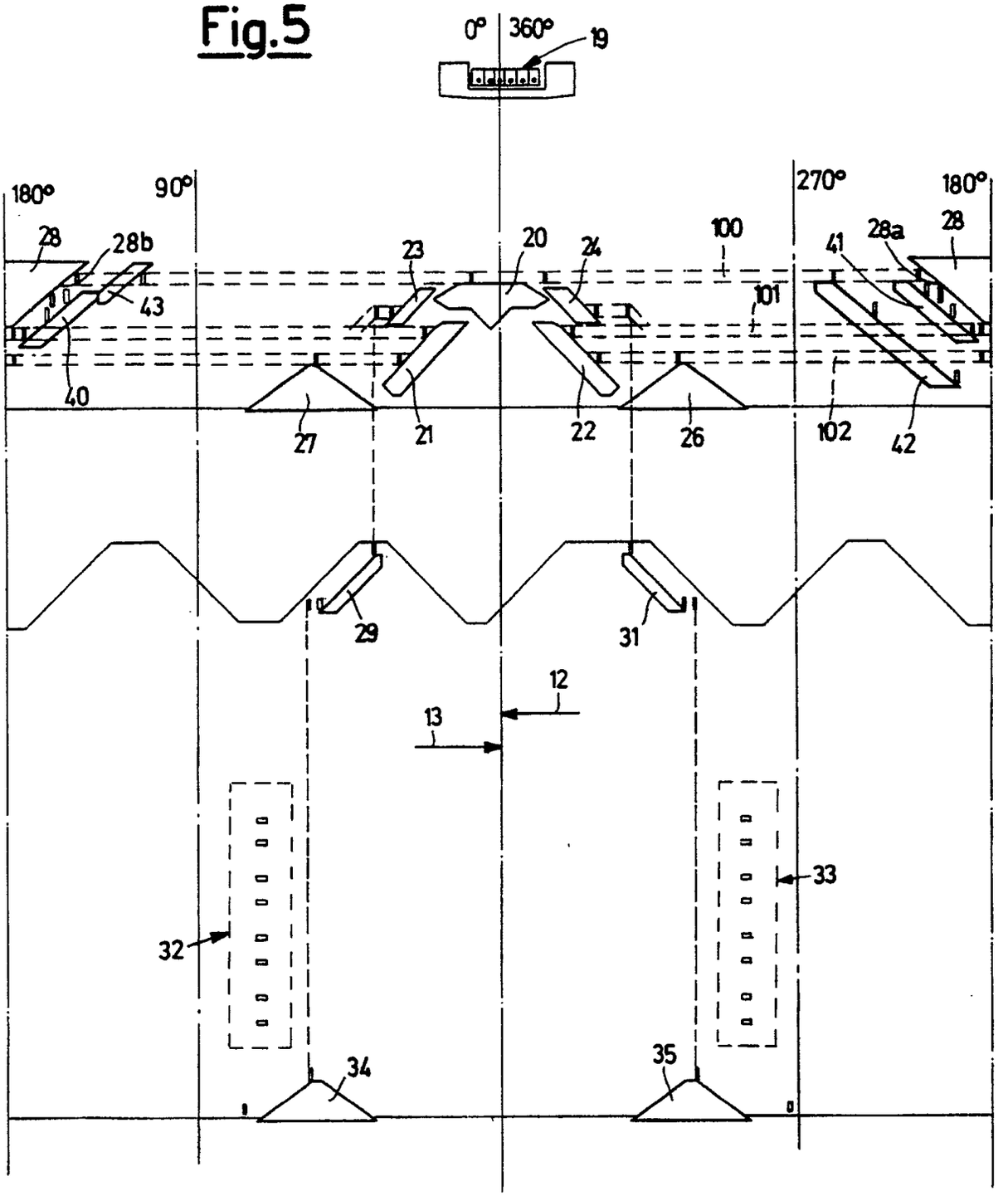


Fig.4

Fig.5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