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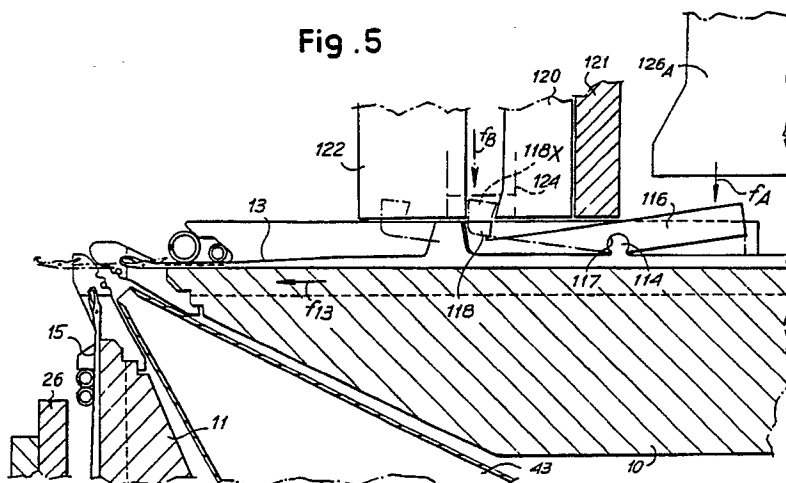
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(54) **Mechanism for selecting and controlling the needles of knitting machines, and needle for said mechanism.**

(57) The needles (13; 15) have no heels interacting with the stitch-forming cams; a laminar selector or jack (116) which is co-planar with each needle is accommodated in the same sliding channel as the needle and articulated to the needle by shaped portions (114, 117) for angular displacements with

respect to the needle and in the same plane as the latter, said jack or selector possessing at least one heel (118) capable of projecting and retracting relative to the channel in order to be active and inactive, respectively, relative to the stitch-forming cams.

Fig. 5



The invention relates to knitting machines in general, and to those for stockings and tights (panty-hose) in particular.

An object of the invention is to provide selection and control of the needles such as to avoid, so far as possible, stressing the stitch-forming threads, and hence to reduce the risk of breakage, particularly during stages in which the needle is inactive and engages a stitch. Another object of the invention is to provide a selection and control of the needles which requires a relatively limited space, which is fundamental in the case of radially arranged needles. These and other advantages will become apparent from the text which follows and from the drawings relating thereto.

A knitting machine having at least one bar of needles formed by a bed having sliding channels side by side and with substantially parallel edges for the guidance of the laminar body of the needle which can slide in each channel, according to the invention comprises, in combination: needles having no heels interacting with the stitch-forming cams; a laminar selector or jack co-planar with each needle, accommodated in the same channel and articulated to the needle for the purposes of angular displacements with respect to the needle and in the same plane as the latter, said jack or selector possessing at least one heel capable of projecting and retracting relative to said bed, in order to be active and inactive, respectively, relative to the stitch-forming cams.

In practice the jack or selector is articulated to the needle by means of a link created by complementary shaped portions, with a recess and a projection, having arcuate profiles.

The jack or selector may be extended to form a rocker arm, with the articulation at an intermediate position, and possess the heel at one end while the opposite end is able to project from the channel in order to receive a pushing control tending to cause said opposite end to be inserted into the channel and to make the heel project.

In order to act on each oscillating selector, the machine may comprise an oscillating trigger, one of whose arms is controlled by an individual electromagnet; a plurality of ranks of electromagnets may be provided for the selectors of the same bar, the space available for each magnet thus being greater than the space permitted by the gap between contiguous needles.

The machine may further comprise, in the same needle channel, a slidable selector having an inclined profile capable of acting on said opposite end, in order to lower it.

A further subject of the invention is a needle for a knitting machine comprising - as a replacement for the heel interacting with the stitch-forming cams - a laminar selector or jack coplanar with the

needle, capable of being accommodated in the same channel as the needle, and articulated to the needle for the purposes of angular displacements relative to said needle and in the same plane as the latter, said jack or selector possessing at least one heel capable - with the angular displacements of the jack or selector - of emerging and retracting in order to be, respectively, active with respect to the stitch-forming cams and inactive with respect to the latter.

In practice said jack or selector is articulated to the needle by means of a link created by complementary shaped portions, with a recess and a projection, having arcuate profiles; said jack or selector is extended to form a rocker arm, with the articulation at an intermediate position, and possesses the heel at one end while the opposite end is able to project from the channel in order to receive a pushing control tending to cause said opposite end to be inserted into the channel and to make the heel project.

The invention will be better understood by following the description and the attached drawing, which shows a practical, non-limiting embodiment of said invention. In the drawing:

Fig. 1 shows a complete general axial section through a machine;

Figs. 2, 3 and 4 show diagrammatically the status of the machine during the formation of four bodies and in the exchanges of thread between the two bars in the formation of the eight legs;

Figs. 5, 6 and 7 show sectional details of the bar of the plate, of both bars and of the bar of the cylinder;

Figs. 8 and 9 show components for the selection of the needle selectors, on the counter-rotating apparatuses and on fixed parts;

Figs. 10, 11, 12 and 13 show the shells of the selection cams of the two needle bars, respectively in two operating states;

Fig. 16 shows the working zone with the needles of the two bars activated and crossed, in the states for starting the toes and closing the crutch zone;

Fig. 17 shows, diagrammatically, a thread exchange state during the production of the body;

Fig. 18 shows an electromagnetic embodiment of the control for the selection of the needles.

Fig. 1 shows a generic section of the machine which serves principally to illustrate the entirety of the mechanical construction. The fixed structure is in the various parts designated 1. Via a central element 3 and an annular element 5, the structure 1 supports a plate-type bar 10 and a cylinder-type bar 11 for the needles 13 and 15 respectively. 17 designates the motor, which transmits the movement via toothed belts to the pulley 19 mounted on the movement intake shaft 20. The rotary intake

motion is then transmitted to two cylindrical gears 21 and 22. The gear 22 transmits the motion to a toothed wheel 23 which is mounted on a large bearing 24 supported by the structure 1; the wheel 23 supports an apparatus 26 rotating continuously about the cylinder 11, counter-clockwise in the example. The apparatus 26 bears the selection cams for the oscillating selectors for the needles 15 described below, and rotates about the cylinder 11, which is fixed. The gear 21 transmits the motion, via an idle intermediate gear composed of two coaxial, solid gears 25- for the purpose of reversing the direction of rotation - to a gear 26 coupled for rotation to a central shaft 27 which rotates counter-clockwise (opposite to the direction of motion of the toothed wheel 23). Fixed to the upper end of the shaft 27 is a discoidal support 28 which will rotate in the opposite direction to that of the unit 26, and with it a ring 29 mounted on a bearing 30 carried by the upper part of the central portion 3 of the structure 1. The ring 29 in turn carries an apparatus 32 rotating about a cylinder 9 fixed to the plate 10 and grooved in order to accommodate oscillating selectors for the needles 13, described below; said apparatus 32 bears control cams for said selectors.

The shaft 27, which transmits the motion to the apparatus 32 bearing the cams of the plate, is also mobile in the axial direction, in order to be able to raise the plate 10 with the associated cylinder 9; the vertical raising of the shaft 27 in fact causes the raising of the disk 28 which, by means of the ring 29 via the bearing 30, entrains a disk 34 fixed to a sleeve 35, which, sliding on the central guide support 3 of the structure 1, raises the plate 10 with the associated cylinder 9. The normal positioning of the shaft 27 is given by its support - via a thrust bearing 36 and a disk 37 - on a plane 1A of the structure. The raising of the shaft 27 and hence of the plate 10 is obtained by means of a pneumatic cylinder/piston system 38 when the slight lifting of a few tenths of a millimeter is needed, which lifting is necessary - as is known - during the execution of the so-called elastic double border. A much greater raising of the plate 10 (by the order of about 100 millimeters), on the other hand, is used when it is desired to inspect the machine between the two bars, on stopping said machine; such raising is obtained by means of a further pneumatic cylinder/piston system 39 which, also entraining with it the cylinder/piston system 38, raises the disk 3 and the entire set comprising the plate 10.

A superstructure 1C supports thread unwinding apparatuses 463, which are carried by a discoidal member 40, mounted to rotate by means of supports 41. The threads coming from the unwinding apparatuses 463 are guided by a ring 458, before

being gripped by the needles; this ring 458 is supported by the superstructure 1C via arms 1E. Supports 1F of the fixed structure 1 support cutting and retaining pincers 483, which serve to restrain and present the threads coming from the unwinding apparatuses 463.

Said arms 1E and/or other supports such as those 1G connected to the fixed structure 1 bear fixed selection groups, such as those 225, which are disposed outside the two counter-rotating apparatuses 26 and 32.

Suction ports 43, each of which extends along an arc of needles responsible for the formation of a complete article, open within the cylinder 11, between the latter and the edge of the plate 10; these ports 43 extend as pneumatic ducts 43A for suction air currents responsible for the pneumatic tensioning of the articles being formed and for the pneumatic transporting of the detached articles.

The various assemblies can be controlled by mutually synchronized actuators and motors. The various motors are controlled by programs capable of ensuring timely variations in speed, specifically speed reductions for particular stages, such as the beginning, the closing of the crutch and the exclusion of any feeds at the start of the formation of the body, and at other stages.

Other assemblies of the machine are described and better illustrated by the description which follows and by the other figures of the attached drawing.

With reference to the prior machine, the parts which constitute the members forming the stitch, that is to say the points of the needles and the sinkers, are substantially identical in the present machine. In a specific but non-limiting manner, the solution chosen is that having fixed sinkers as in Fig. 20 of the prior patent. The parts which differ in the present machine are:

- 1) the part of the needle (called the heel) which acts on the cams that provide its movement;
- 2) the means of selection of the needles, since particular oscillating selectors have been adopted, or alternatively a direct electronic selection system;
- 3) the selection control means, which are controlled by an electronic system with an electro-pneumatic servo-system;
- 4) the cams which act to raise and lower the needles for the formation of the stitch, since these are disposed in sets for two thread feeds and are all fixed on the respective continuously rotating apparatus, with the exception of the small upward movements of the stitching cams to regulate the length of the stitch;
- 5) the thread feed system.

As previously stated, the present machine is a circular machine of large diameter having a circum-

ference such as to be able to accommodate a plurality of articles, such as pairs of tights, each having a body and two legs. In the description which follows the example taken - without limitation - will be that of a machine which simultaneously produces four garments, although embodiments can also be envisaged for the simultaneous production of a different, preferably even, number of articles.

In Fig. 2, C1 - C2 - C3 - C4 designate the cross-sections of the bodies of the four pairs of tights, separated by empty spaces along the two circular needle bars which form them. Fig. 3 shows the cross-sections of the legs of the four pairs of tights, designated G1X, G1Y - G2X, G2Y - G3X, G3Y - G4X, G4Y, these also being separated by empty spaces. Fig. 3 shows, again diagrammatically, the four sets of cams generically designated 46, for the cylinder, drawn on the outside, and the four sets of cams generically designated 47 for the plate, drawn on the inside, carried by the two counter-rotating apparatuses 26 and 32. It may also be noted in Fig. 3 that the sets of cams are synchronized in their rotation, so as to cross in the empty spaces between one and another of the four garments. In Fig. 4 it can be seen that the sets of counter-rotating cams can also cross in the crutch zone during the manufacture of the legs, that is to say in the space between the legs G1X and G1Y, in the space between the legs G2X and G2Y, and so on, that is to say in the eight spaces visible in Figs. 3 and 4. Therefore both the empty spaces which are between one pair of tights and another, and the crutch zone of each pair of tights, must have a circumferential aperture such as to contain the circumferential width of the double sets of cams 46 and 47, which are intended to control the needles of the bar forming the outer zones of the tubular articles being formed and, respectively, the bar forming the internal zone of said tubular articles. Each set 46 receives two feed threads, which pass to a set 47 and again to a set 46 and so on, to form successive half-rows with the needles of the bar of the cylinder and with those of the bar of the plate.

The garment which it is desired to manufacture is diagrammatically shown in Figs. 14 and 15. Starting with the toes of the feet, these are formed by starting with closure rows A, C, D, B, comprising all the needles intended to form the leg, shown by the section G1X, G1Y, etc., in Fig. 3; immediately afterwards the toes are shaped with a profile such as to round the angles thereof. For this purpose, with particular reference to Fig. 15 and Fig. 16, a number of complete rows of stitches A, C, D, B are formed which are common to both bars (that is to say, are formed simultaneously with needles of the plate and with needles of the cyl-

inder) to form the closure of the toes; these rows A, B, C, D go from A to B, that is to say they comprise all the needles intended to form the foot of the stocking and the ankle, and are made by supplying the thread simultaneously to the two bars, with the needles crossed as indicated in Fig. 16. Subsequently, rows P of tubular knitting are formed, that is to say first on one bar and then on the other, but these will be of short and gradually increasing length; a start will be made, for example, with the central section C-D of Fig. 15, the length of the successive rows (P) being increased at both ends in a symmetrical manner, the frequency of increment being selected as a function of the profile of the shape which it is desired to obtain. The result will thus be that the sections AC and DB assume a curvature of the type shown in Figs. 14 and 15.

Subsequently, in the situation shown in Figs. 3 and 4, a tubular section of constant width is made, which will form the foot part and the lower part of the leg; said section is shown by BE in Fig. 14. After this section, in order for the garment to be easily put on, it is necessary for the leg to be widened. This can be achieved along the section E-F in Fig. 14, the length of the stitches of the rows of knitting produced in this section being gradually increased; the widening may also, and more efficiently, be achieved if, in addition to what has been said, the number of needles at work is gradually and constantly increased during the formation of the section E, F, with successive insertions of needles at the ends of the working arcs of needles, on each of the two bars simultaneously or alternately. When the section EF has been completed on both legs, work proceeds from the situation in Figs. 3 and 4 to that in Figs. 2 and 17, two of the four feed groups 46 in the section of the cylinder and two of the four feed groups 47 in the section of the plate being withdrawn from operation; that is to say, work progresses from the state shown in Fig. 3 to that shown in Fig. 17. In this position, the needles which are between the two legs, that is to say the zone called the crutch of each garment, are introduced into operation, this zone being shown in Figs. 14 and 17 by the section F-H. With the elimination of two of the sets 46 and 47, the associated feeds are also withdrawn; there therefore remain only four of the eight feeds. Said needles of zones F-H are introduced all at once on each bar, alternating 1:1, and with the needles of the two bars being staggered and crossed (Fig. 16) to form, in the sections F-H, closure rows of the type described for the toes. Advantageously, it is possible to control, together with the needles of the section FH, also one or two contiguous needles of the faces which have prepared the legs; this avoids the formation of eyelets at the edges of the section FH. Thereafter,

a tubular fabric is begun on the face K-L, that is to say, also comprising the needles which belong to the zones of the legs, producing a tube as wide as the entire garment and forming what is called the body. The body is shown in Fig. 14 by the section L-M. Thereafter, a finishing section, such as an elastic strip, is created in the section M-N; this strip may be formed by a double fabric turned over on the line MM and obtained by knitting in or interweaving an elastic yarn of a rather high yarn count. The textile structure of this double border is already known to those skilled in the art.

In order to implement the rows of connecting stitches along the initial closure lines ACDB of the ends and along the lines F, H of the crutch with crossed needles 13 and 15 (Fig. 16) of the two bars 10 and 11, it is possible to adopt the method more specifically indicated below. By selecting 1:1, the needles 15 of the cylinder 11 are raised, no thread being supplied. This having been done, the needles 13, selected 1:1 and staggered relative to the needles 15A which remain raised, are progressively raised and lowered; and at the same time the thread taken from needles 13A is fed to form the stitches on the stems of the needles 15A, which are kept raised. Subsequently, the thread is supplied to the needles 15A, which are lowered to form a stitch. A subsequent row is then formed with the needles 13. This procedure may be repeated before formation of the tubular fabric begins.

The machine explained here, capable of producing four pairs of tights simultaneously, will be equipped with four sets of double feeds for the needles of the cylinder and with four sets for the needles of the plate, for a total of eight feeds in each case.

From Fig. 3 - which shows the situation for the weaving of the legs - it is apparent that, from the initial position shown, after the sets of cams have completed 1/8 of a rotation (in opposite directions), the latter come to cross in the crutch zone of the garment as in Fig. 4. The abovementioned crossing is not possible when work is in progress on the weaving of the bodies, as shown in Figs. 1 and 17, since needles are in operation in the crutch zone. It is for this reason that, for the formation of the body, the machine must operate with only two sets of cams for the cylinder and two sets for the plate, and hence with two feeding threads instead of with four for each of the garments being worked upon; the number of feeding and stitch-forming cams is thus reduced to four for the cylinder and to four for the plate, as shown in Fig. 17.

Fig. 5 shows the section of the bars of the present circular machine in the operating zone of the needles, and, more extensively, the section of the plate 10, while that of the cylinder 11 is shown only in the working zone; as already stated, the two

bars form the grooves for the radial sliding of the needles 13 of the plate and the longitudinal grooves for the sliding of the needles 15 of the cylinder.

The needle 13 of the plate 10 is formed, in the part which acts on the thread, in a conventional manner, with beak and tongue; the stem of the needle, however, is different from traditional stems in that it possesses a protuberance 114 of circular profile. The protuberance 114 serves as a support and articulation for a small oscillating selector or jack 116, which, for this purpose, is provided in an intermediate position with a cavity 117 having the same circular profile and hence being able to engage with and oscillate upon the projection 114 of the body of the needle 13, needle 13 and jack 116 always remaining connected since they are held within the sliding channel of the needle. In its anterior part the oscillating jack 116 forms a heel 118, which is intended to act together with cams 120, 121, 122 for the centrifugal and centripetal radial control of the needle. The heel 118 is shown in Fig. 5 projecting in the active position 118X in order to be controlled by the cams 120, 122, and it can be pushed into, and hence completely counter-sunk in, the sliding channel of the needle by the action of a pusher strip 124 which acts on the upper edge of the heel, as a result of which the cams 120 and 122 do not act thereon. When the jack has oscillated and the heel 118 is projecting in position 118X, the cams 120 and 122 can act thereon, and by means of their profiles displace it in the centrifugal direction f13 or in the centripetal direction; with this movement imparted to the heel 118, by means of the connection on the pivot 114, the jack 116 also entrains with it the needle 13, producing the necessary travel for the gripping of the thread and the formation of the stitch. The unit formed by the needle 13 and the oscillating jack 116 can therefore be brought into operation or excluded, the heel 118 being raised or lowered by action in accordance with the arrow fA and with the arrow fB respectively. Exclusion, in accordance with fB, is achieved with the strip 124 sketched in Fig. 5 which acts when the needle is in a centripetally retracted (lowered) position of rest, to which it is restored by a cam such as the cam 122. The raising of the heel 118 by action in accordance with fA is implemented by selection members described hereinafter. The plate 10 (like the cylinder 11) is fixed, and the cams 120, 122 and the strip 124 are carried by the apparatus which rotates in continuous motion. The raising of the heel 118, as a result of control by cams such as the cams 120 and 122, is provided for by selection members consisting of other oscillating jacks 126, of the type having two rows of teeth, shown in Fig. 6. These jacks 126 are accommodated in grooves in the body 9 which is

fixed to the plate 10 and are held there by springs 128 which permit them to oscillate about an intermediate bearing point. Each of the jacks 126, with its own heel 126A, can act in accordance with fA on the corresponding jack 116 in order to make the heel 118 project. Each jack 126, which is mounted perpendicularly to the jack 116, possesses two sets of selection teeth 126B and 126C, one above and the other below the bearing and oscillation point. The lower set of teeth 126C serves to activate the jack in that, as a result of pressure by means of selection levers on the present teeth 126C, the jack 126 enters into the lower part of the channel and leaves the upper part thereof, engaging with its own thrust heel 126D on the cam 130, which has a profile such as to lower the said jack to act in accordance with fA. The teeth 126B of the upper part serve only to make partial cancellations of selections previously made by acting on the teeth 126C of the lower part. The jacks 126 of the plate are seated in cuts made in the cylinder 9 which is superimposed on and fixed to said plate 10, as a result of which each jack 126 moves, when it is lowered, into a suitable position for pressing, in accordance with fA, on the radially inner part of the small oscillating jack 116.

A similar system is provided for selections in the cylinder 11, with oscillating selection jacks 132 mounted in the same plane as the needles 15 of the cylinder, to each of which there corresponds (as in the case of the needles 13) an oscillating jack 136 with heel 138, similar to the jack and heel 116, but mounted in the same groove as the needle 15 and the jack 132. Cams, such as the cams 140, 329, 381, interact with the heels of the jacks 136 for the purposes of raising and, respectively, lowering. The oscillating action of the jack 136 to make it project the heel 138 is achieved by sliding the jack 132 upwards, in accordance with fA1, as a result of which an inclined plane 132A of the jack 132 acts on the edge of the jack 136 when said jack 132 is raised, in accordance with fA1, from the position in which it is situated in Fig. 6 to the position in Fig. 7; for the selection of the jacks 132 (and hence of the needles 15), there are provided the two sets of teeth 132B and 132C, and a heel 132D on which a cam 144, similar to the cam 130, can act.

Figs. 6 and 7 also show a number of groups of selection levers which are carried by the two counter-rotating apparatuses 26 and 32, and which act - in various circumferentially spaced positions, as stated below - on sets of teeth 126B, 126C, 132B, 132C for the purposes of selection; the groups of selection levers project from the respective mechanisms 148, 150, 152, 154, one of which - representing all - is illustrated in Figs. 8 and 9, in order to act on oscillating jacks such as the jacks

126 and 132 to thrust them towards the inside of the respective sliding and oscillating channels.

Fig. 8 shows a plan view of a mechanism such as the mechanism 152, having a group of selection levers 217, in which a lever 217 is shown as it performs the action of thrusting the selectors 132 towards the bottom of the sliding channels in the cylinder 11. The levers 217 of the group of levers of the mechanism 152 are mounted on a pin 219 about which they can oscillate, being stressed by the springs 220; the whole is mounted on a support plate 221 which is fixed to the appropriate rotating apparatus which carries the cams for controlling the sliding of the selected needles; hence, the groups of selection levers 217 rotate within the cylinder, thus being capable of engaging all the selector jacks 132 (and analogously for the jacks 126). A series of triggers 222, stressed by springs 223, are also mounted on said plate 221 and act with one tooth in each case to engage the corresponding selection levers 217 when the latter are excluded, moving them away from the cylinder, by means of the action of a trigger 224 which can move the selection levers from the position shown in Fig. 8 to that shown in Fig. 9. The active position (Fig. 8) of the selection levers can be set by adjusting an eccentric paw 121A mounted on the plate 121.

The single or multiple means which control the selection levers of the mechanisms 148, 150, 152, 154 are means mounted on fixed supports 225 (cf. Fig. 9) combined with the arms 1F (Fig. 1) and acting on the triggers 122 which pass in front of them. These means comprise levers 226 oscillating about a pin 227, which levers, if selectively thrust in accordance with f228 as indicated in Fig. 9 towards the cylinder and towards the trajectory of the selection levers, can cause the respective levers 222 to rotate in a manner such as to release the selection levers 217. The latter, which are stressed by the springs 220, select the selectors 132. Clearly, the levers 226 are equal in number to the levers 217 (and this applies for all the mechanisms 148, 150, 152, 154) and in the same plane as the latter, in a manner such as to be able to act on each thereof. Each of the levers 226 is controlled by a pneumatic cylinder 228 which intervenes, via solenoid valves which in turn are excited by an electronic program, against the action of a spring 230. The profiles of the levers 226 ensure a gradual action on the appropriate triggers 222 for the release and activation of the selection levers 217.

In order to exclude selection levers, such as the levers 217, the trigger 224 is acted upon in accordance with f224, in a manner such as to couple the selection levers with the respective levers 222. In order to control the trigger 224, an arm

232 is provided which is held in a projecting position by a spring 234 but which can be selectively actuated by a strip 236 articulated at 238 to the fixed structure (such as the support 225) and pushed by a pneumatic actuator 240 similar to the actuator 228, against the action of an opposing spring.

The selection of the needles, by means of the small oscillating jacks 116 and 136, can also be achieved with other systems, described below.

Fig. 10 shows a diagram with the development of the cams acting on the cylinders 132, 136 of the needles of the cylinder, in order to move the needles. The relative motion of the heels is shown by fT, but in practice it is the cams which slide in the opposite direction.

In the upper part are situated the cams which act on the heels 138 in order to raise and lower the needles 15, and in the lower part are situated the cams for the oscillating selectors 132.

The cams for the needles 329 - 330 - 331 - 332 - 333 act via the heel 138 of the small oscillating jack 136 only when the latter is rotated in a manner such that its heel 138 projects from the sliding channel of the needle and hence can engage with the abovementioned cams, along the line 334. When the heel 338 of the jack 336 is shielded in the sliding channel, it does not interact with the cams 329 to 333 and will remain at the level of the line 334, and the corresponding needle will remain lowered and will not grip thread. Oscillation of the jack 136 in order to cause the heel 138 to project - as stated above - is obtained by any raising of the selector 132, which is brought back into the lowered position by a double leveling cam 334 acting on a central heel 132F of the jack 132. The raising of the jack 132 takes place when the jack has been oscillated in a manner such as to have its lower part projecting from the cylinder, and hence the heel 132D can engage with said cam 144, or with other cams 336, 337. The cam 144, raising the selector 132, produces the rotation of the jack 136 and hence contact between its heel 138 and the cam 329, the consequence of which is the raising of the cam and of the corresponding needle. The cam 336 is able to bring about the raising of the needle with the cam 330. The cam 337 is able to bring about the raising of the needle with the cam 332. The selection levers (such as the levers 217 in Figs. 8 and 9) capable of causing the selectors 132 to engage with the raising cams 144, 336, 337 are: the levers of the group 317 for the cam 144; the levers of the group 338 for the cam 336; the levers of the group 339 for the cam 337. The levers of the group 318 serve to exclude the jacks 132 from the active position.

The cams 329, 330, 331 for the needles of the cylinder form the first feed and are dependent

upon the cams of the selectors 144 and 336 with the respective groups of levers 317, 318 and 338. The cams 332 and 333 for the needles of the cylinder form the second feed, and are dependent on the cam 337 with the group of levers 339. The cams 329, 330 and 332 are lifting cams, and the cams 331 and 333 are lowering cams for the formation of the stitches. The first and second feeds must be fed with two different threads, for normal working. Cams 329 and 331 are also shown in Figs. 6 and 7.

In the upper part of Fig. 10 can be seen the profiles 340 and 341 which represent the travel of the point of the needles, when these are raised respectively by the cams 329 and 332, and lowered respectively by the cams 331 and 333.

The thread entrainment means are represented by hooks 342 and 343 for the first and second feeds respectively (with the relative movement of the heels and of the needles in accordance with fT, but in fact with a reverse movement of the cams). The broken lines 344 and 345 show the position of the threads fed to the needles by the thread-guide hooks 342 and 343.

Fig. 11 shows a diagram of the development of the cams acting on the heels of the selectors 116, 126 for the needles 13 of the plate 10, analogously to Fig. 10, but with some of the parts, shown in zone R, in fact requiring to be rotated through 90°, the needles 13 being horizontal instead of vertical like the selectors 126; moreover their arrangement is in fact curved, as outlined by the line LP which indicates developments of the cams and of the circular trajectories about the center and axis of the plate. The top part of the diagram shows the cam 130 and those which act on the heels 126D of the selectors 126, to press them down, the assembly as a whole being inverted in that the selectors 126 have to be pushed downwards to act with the end 126A on the selector 116. The profiles 384 align the heels 126F and hence the selectors 126, which move in accordance with fP with respect to the cams (the cams, however, really being in motion in the reverse direction). The sets of triggers 368, 389, 388, 367 correspond in terms of function to the sets 318, 339, 338, 317. The cams 120, 122 (also illustrated in Figs. 5 and 6), 380, 382, 383 correspond to the cams 329, 331, 330, 332, 333; a cam (120 or 382) is also shown at 120 in Figs. 5 and 6. 349 and 350 designate feed hooks for the yarn, analogous to the hooks 342 and 343 and capable of catching the yarns previously entrained by the hooks 342 and 343 to present them in accordance with the lines 344 and 345. The passage of the yarns from one of the appropriate hooks to the other occurs in the manner described below, at the end of the formation of stitches with one bar and in order to start the formation of

stitches with the other bar.

Apart from the different orientation of the parts in zone R, the diagram of Fig. 11 for the plate is entirely similar - including the functional aspect - to that of Fig. 10 relating to the cylinder.

The machine is equipped with double cam systems (329-331; 332-333; 120-122; 382-383) in order to move the needles on the two feeds, each of which has its own means of thread entrainment. These double systems can be converted to single systems, each representing a single feed, which supplies two threads of different yarn counts, in order to produce patterned knitted fabric of the type called "slip stitch" which is known in the art.

The present machine therefore has the capacity to process two different types of yarn on the components of two feeds, forming - on the two bars of needles - a fabric having two continuous helical rows intercalated one with the other; this serves to produce a product which is known in the art and comprises alternating rows of thread (of so-called Nylon) with a left-hand twist (S) and another thread with right-hand twist (Z). This capability is useful in order to make a second product, which is known in the art, comprising alternating rows of thread of untwisted Nylon and another of elastic thread such as that known as Lycra, or the like, an elasticized garment thus being obtained.

The machine, however, as mentioned, is also suitable for the weaving of another product which is known in the art, that having a patterned stitch with a slip-stitch pattern. This fabric is likewise produced using two threads, which in this case are of the same type (conventional Nylon), but of different yarn count. The pattern is obtained by supplying to the needles the two threads in the same feed, that is to say with a selective raising (by means of the selection cams 329 and the cams 332 for the remaining needles) and a single lowering (with the cams 333); hence the structure of the cams acting on the needles has to be slightly modified for the purpose. Since for each set of pairs of feeds of the type described initially there are two hooks 342-343 and 349-350 (one for each feed) for entraining and feeding the threads, it is necessary to use both of them to feed a single feed, that is to say to cause both the threads to be grasped by the needles with selective raisings and a single lowering of the needles.

This problem is solved by eliminating one of the two lowering cams, namely the stitch forming cams 331, 333, 122, 383, and thus converting each set to a single feed. The two cam arrangements initially described for the cylinder in Fig. 10 and for the plate in Fig. 11 will thus be modified as in Fig. 12 for the cylinder and Fig. 13 for the plate, in which the cams 331 and 122 respectively can be seen to have been eliminated.

It is known in the art how the slip-stitch pattern is produced, a thread of relatively high yarn count first being grasped by a number of needles, raised in accordance with a deliberate selection (which represents the pattern), and then, at a second, angularly delayed point, the other, finer thread will be grasped by all the needles. In the present machine this is achieved, with reference to Fig. 12, which shows the cams of the cylinder, by raising a number of needles, in accordance with the selection preselected on the cam 329, which needles describe the trajectory 340 and grasp the thread 344, while the remaining needles are raised with the cam 332 along the trajectory 341. The selection referred to above, which implements the desired pattern, is produced by the group of levers 317 or by the combination of the group of levers 317 and 318, which cause the selectors to rise on the cam 144 and consequently the needles on the cam 329. The remainder of the selectors rise on the cam 337 by means of a single lever of the set 339; in this case, a single lever is sufficient, since all the remaining selectors must be raised without any selection being necessary. The corresponding needles will rise on the cam 332, their points following the trajectory 341, and will grasp the thread 345. The thread 344 supplied first, and grasped by the needles first raised, will not be grasped by the needles raised subsequently, since the coarse thread will pass behind them, in accordance with a known method.

The formation of the pattern in the needle bar of the plate is entirely analogous to that described above for the cylinder, and the diagram for the cams is that of Fig. 13, where the absence of the cam 122 is apparent.

As already stated, the machine simultaneously produces a plurality of articles, in the present example four articles. When a thread breaks, in relation to an article being formed, continuation of the work is excluded in that zone of formation of the fabric, which can be achieved by virtue of the selection option offered by the mechanisms described. In particular, the outward movement of the heels 118 and 138 is excluded, and any damage to the tongues of the inactivated needles is avoided.

It is worthy of note that the arrangement described makes it possible to employ needles which are not directly provided with heels, while the heels 118 and 138 can be retracted in order to avoid any action on the needles. This prevents any stress on the stitches engaged by inactive needles, which undergo no residual lowering movement, the control cams for the needles, and specifically those for lowering the needles, remaining fixed. This arrangement avoids stress on the stitches and excludes the consequent risk of breakage of the thread, as well as avoiding the necessity of dis-

placeable cams for the control of the needles.

In order to feed the threads, mobile entrainment means are provided which are connected to the counter-rotating apparatuses 26 and 32 of the cams of the cylinder and the cams of the plate. The thread is entrained in one direction by one of said means, which is activated, and is then released (when the latter is inactivated) in order to be entrained in the opposite direction by the other entrainment means, which in turn has been activated and arrives in the opposite direction. In this way - for each tubular article being formed - the alternating feed movement of the threads is achieved, in one direction for one bar and in the opposite direction for the other bar, without having any members which move with an alternating motion.

In the machine forming the subject of the present invention, the means of entraining the threads, that is to say the hooks in Figs. 10 to 13, achieve said situation described above of avoiding the alternating motion with mechanical means. The design of said members is of a particular type, various sets of pairs of feeds being provided (see Figs. 18 to 20) which are to supply mutually different yarns; therefore the entrainment means have to be capable of working in cooperation with other members for sorting the threads in order to ensure that the same thread is fed first to each bar, followed by the other thread, the direction of weaving being reversed on the two bars.

The part of the thread entrainment means which is in direct contact with said thread is a head formed in the shape of a hook which is designated with numbers 342 and 343 in Figs. 10 and 12, respectively for the first of the two feeds and for the second, in the case of the cylinder. In Figs. 11 and 13, 349 and 350 designate the hooks for the feeds of the same two yarns to the needles of the plate.

Other mechanisms of the machine which are not relevant to the present invention are described in other simultaneous application by the same inventors and the same proprietor (corresponding to Italian Pat. Appln. N.9357 A/89).

As an alternative to what is envisaged in Figs. 5 to 7, the selection of the needles - which is obtained by means of the oscillation of the small jack 116 or 136 mounted on the needle itself - instead of by the oscillating jacks 126 and 132 can be performed by other means of an electromagnetic type described hereinafter. Fig. 18 shows diagrammatically an example of a selection system in which each of the jacks 116 and 136 is caused to oscillate by its own trigger, which is moved by its own electromagnet; this in turn is activated by an electronic programmer which is synchronized with the rotation of the machine, i.e. of the two

counter-rotating apparatuses carrying the sets of cams for displacing the needles.

In the case of the selection of the needles of the plate 10, the means for oscillating each jack 116 is a trigger 577 which also comprises the arm 577A and has as its fulcrum the round portion 578. The arm 577A can be attracted by the small magnet 580 as a function of the work cycle program in order to cause the entire trigger 577A-577 to pivot about the fulcrum 578. In this manner the arm 577 is lowered and presses down the tail of the jack 116 with the consequence of causing the heel 118 to emerge so as to cause the needle 13 to be actuated by the cams. The abovementioned triggers 577 are all mounted in the cuts on the periphery of a wheel 582 fixed to the plate 10, and are held by an elastic belt or spring 579.

Since the machine in question is designed principally for high degrees of fineness, and hence the distance between the needles is small, the room available for the electromagnets 580 is also small, and these could never - in view of their thickness - be accommodated between one needle and another. It will therefore be expedient to stagger them over two or more rows, as shown in Fig. 18. The triggers 577 will therefore be of two or more types, having arms 577A of different orientation; in the example of Fig. 18 a trigger 577, having the arm 577B for an electromagnet 581 will be inserted between two triggers 577 having an arm 577A for a respective magnet 580.

An analogous solution is adopted for the selection of the needles 15 of the cylinder 11, where a trigger 583 is able to depress the jack 136 and may have the arm 583A, and alternates with another trigger having the arm 583B, in order to cooperate with the respective electromagnets 585 and 586 disposed in two different ranks.

This selection system has the advantage - as compared with that initially described - of having a much more reduced bulk of the two counter-rotating apparatuses 26 and 32, this being limited merely to the cams acting upon the needles, without the selectors of Figs. 8 and 9. The dimensions of the cylinder 11 and of the body 582 above the plate 10 are also reduced as compared with those of the cylinder 11 in the previous example and of the cylinder 9 above the plate. The part which relates to the selection of the needles is completely static, with the exception of the small oscillation of the triggers 577 and 583.

Claims

1. A mechanism for selecting and controlling the needles of knitting machines having at least one bar of needles formed by a bed having sliding

channels side by side and with substantially parallel edges for the guidance of the laminar body of the needle which can slide in each channel, characterized in that it comprises, in combination: needles (13; 15) having no heels interacting with the stitch forming cams; a laminar selector or jack (116;136) co-planar with each needle, accommodated in the same channel and articulated to the needle for the purposes of angular displacements with respect to the needle and in the same plane as the latter, said jack or selector possessing at least one heel (118, 138) capable of projecting and retracting relative to said bed, in order to be active and inactive, respectively, relative to the stitch-forming cams.

2. The mechanism as claimed in the preceding claim, wherein said jack or selector (116, 136) is articulated to the needle by means of a link created by complementary shaped portions, with a recess (117) and a projection (114), having arcuate profiles.

3. The mechanism as claimed in any preceding claim, wherein the jack or selector (116, 136) is extended to form a rocker arm, with the articulation at an intermediate position, and possesses the heel (118, 138) at one end while the opposite end is able to project from the channel in order to receive a pushing control tending to cause said opposite end to be inserted into the channel and to make the heel project.

4. The mechanism as claimed in claim 3, which comprises - in order to act on each oscillating selector (116, 136) - an oscillating trigger one of whose arms is controlled by an individual electromagnet; a plurality of ranks of electromagnets being provided for the selectors of the same bar.

5. The mechanism as claimed in any preceding claim, which further comprises, in the same channel, a slidable selector (132) having an inclined profile (132A) capable of acting on said opposite end, in order to lower it.

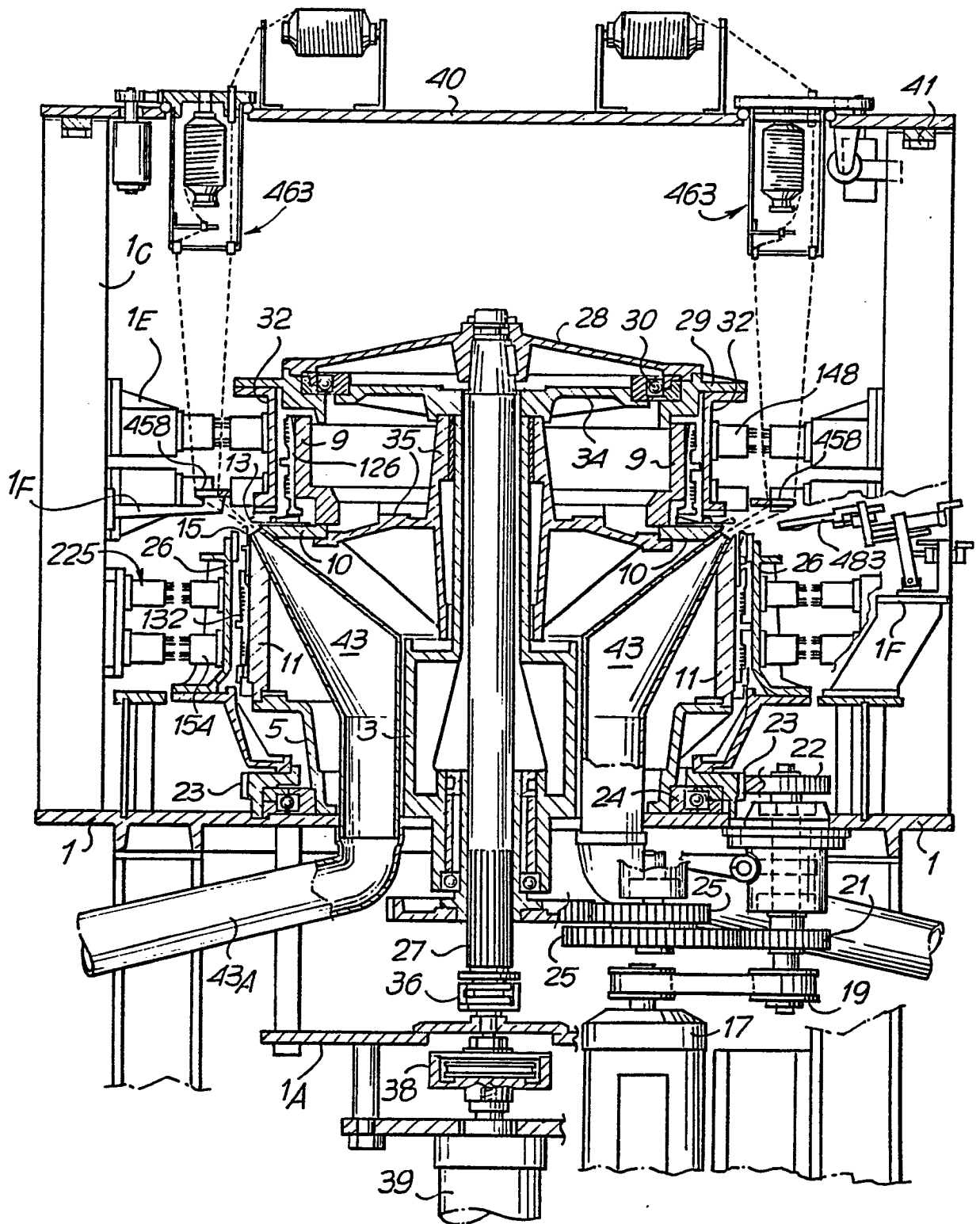
6. A needle for a knitting machine, comprising - as a replacement for the heel interacting with the stitch-forming cams - a laminar selector or jack (116; 136) coplanar with the needle, capable of being accommodated in the same channel as the needle, and articulated to the needle for the purposes of angular displacements relative to said needle and in the same plane as the latter, said jack or selector possessing at least one heel (118, 138) capable - with the angular displacements of the jack or selector - of emerging and retracting in order to be, respectively, active with respect to the stitch-forming cams and inactive with respect to the latter.

7. The needle as claimed in claim 6, wherein said jack or selector (116, 136) is articulated to the needle by means of a link created by complemen-

tary shaped portions, with a recess (117) and a projection (114), having arcuate profiles, said jack or selector (116, 136) being extended to form a rocker arm, with the articulation at an intermediate position, and possessing the heel (118, 138) at one end while the opposite end is able to project from the channel in order to receive a pushing control tending to cause said opposite end to be inserted into the channel and to make the heel project.

8. A knitting machine having at least one bar of needles formed by a bed having sliding channels side by side and with substantially parallel edges for the guidance of the laminar body of the needle which can slide in each channel, characterized in that it comprises a mechanism for selecting and controlling the needles according to any of claims 1 to 4.

Fig. 1



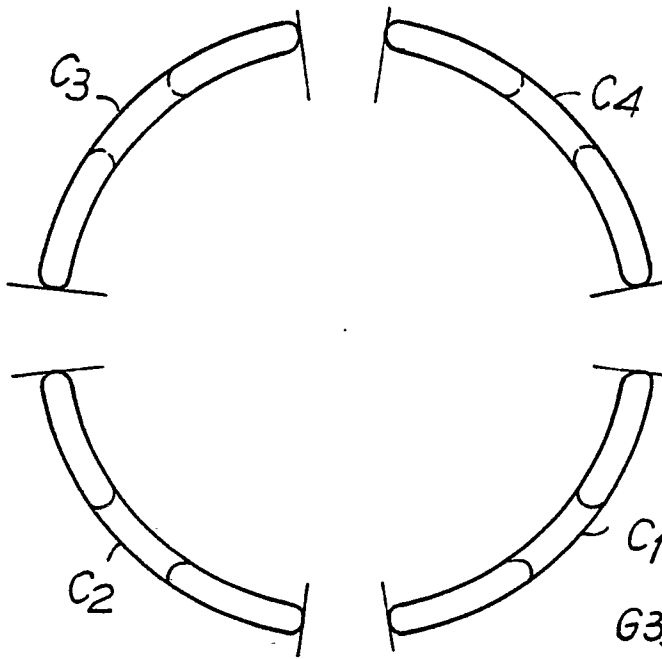


Fig. 2

Fig. 3

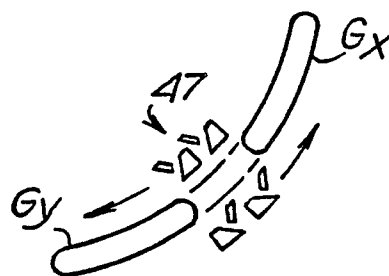
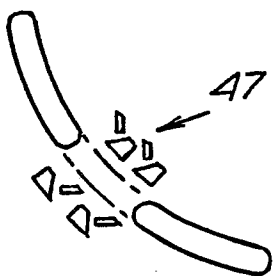
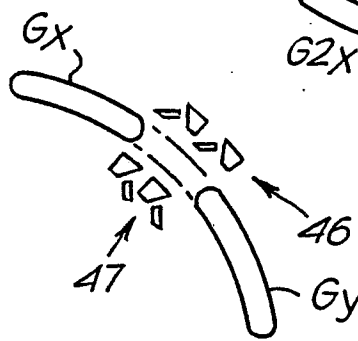
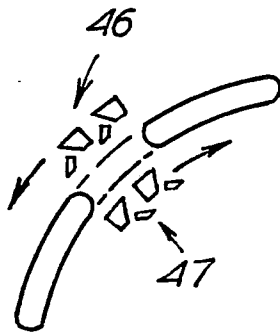
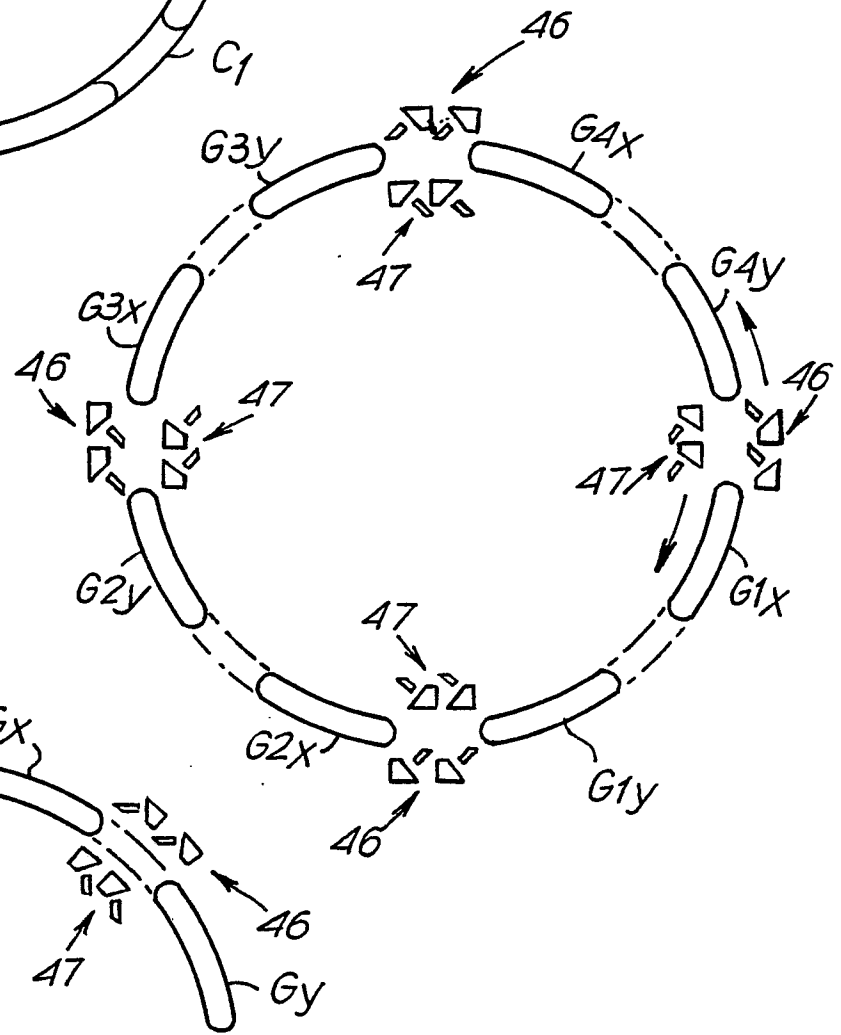


Fig. 4

5.
6.
7.

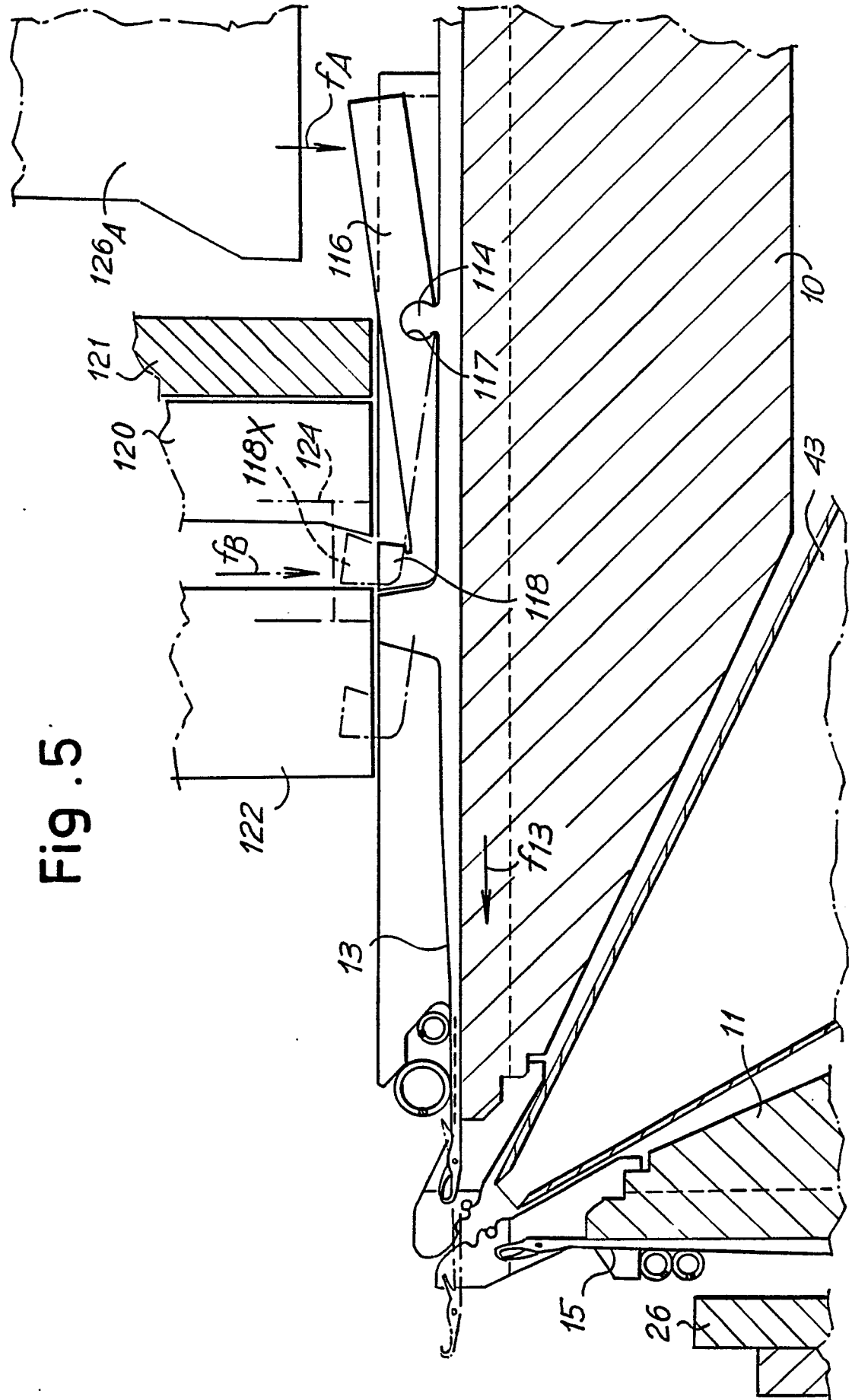
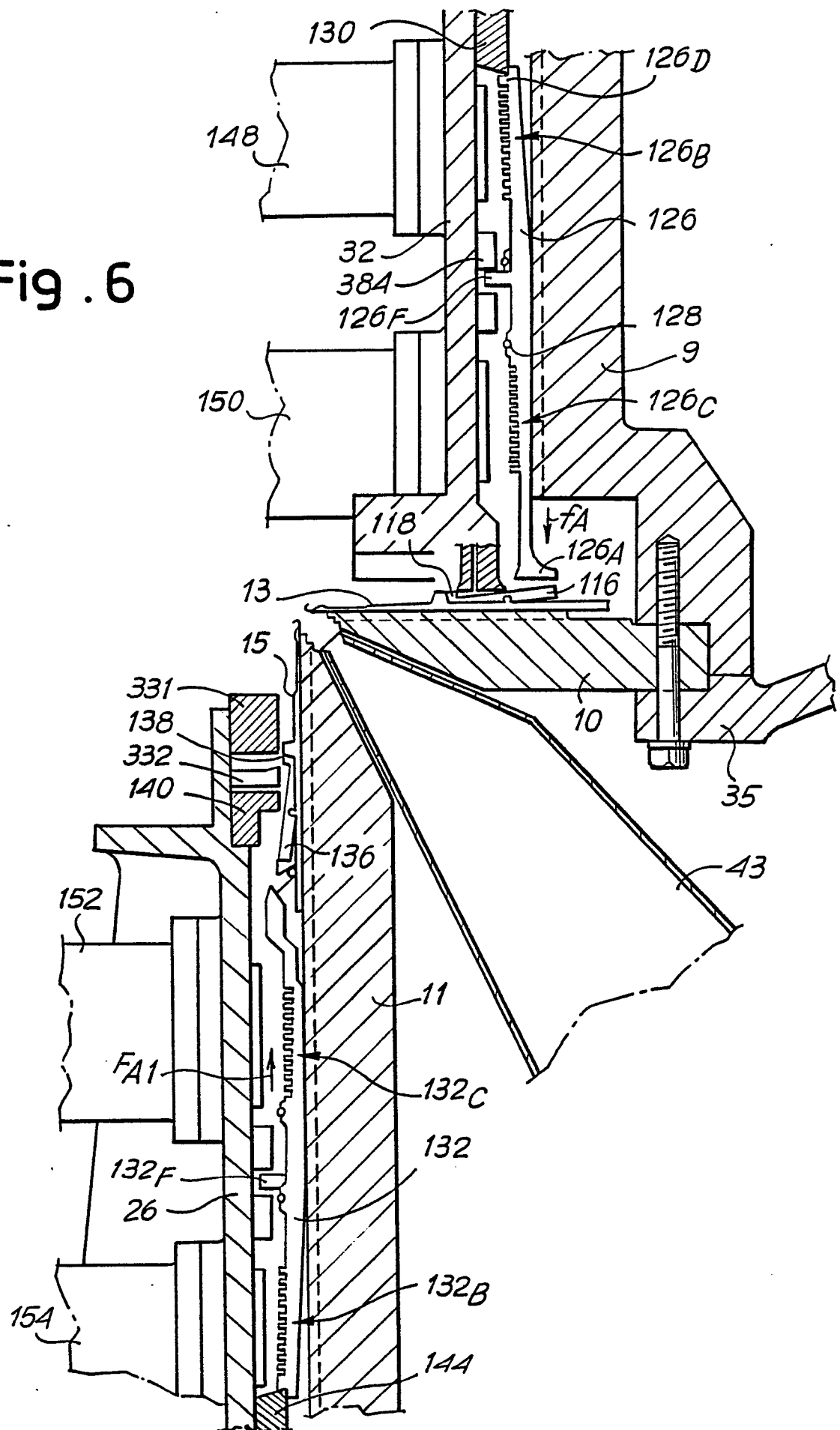


Fig . 6



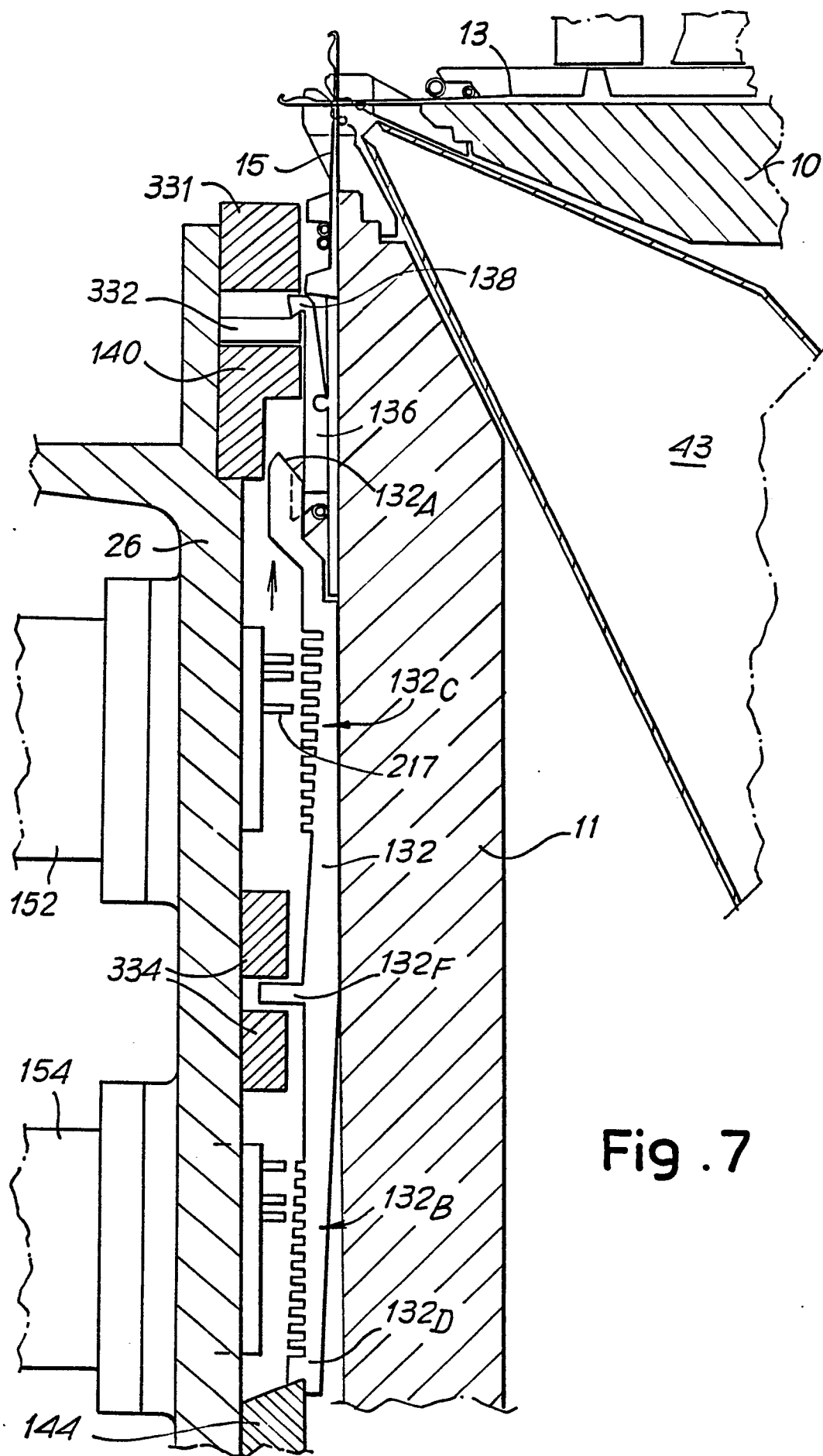


Fig . 7

Fig . 8

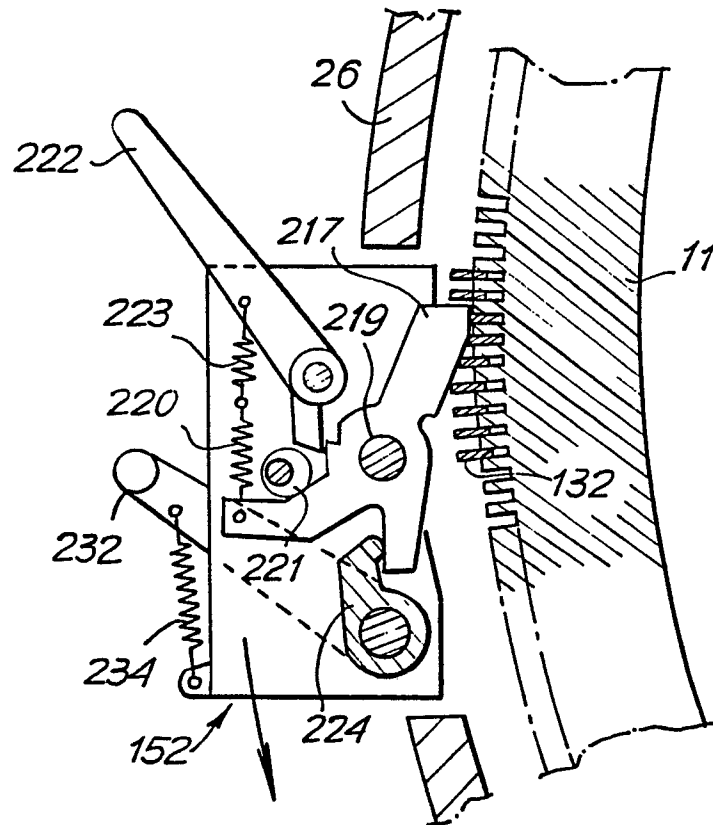


Fig .9

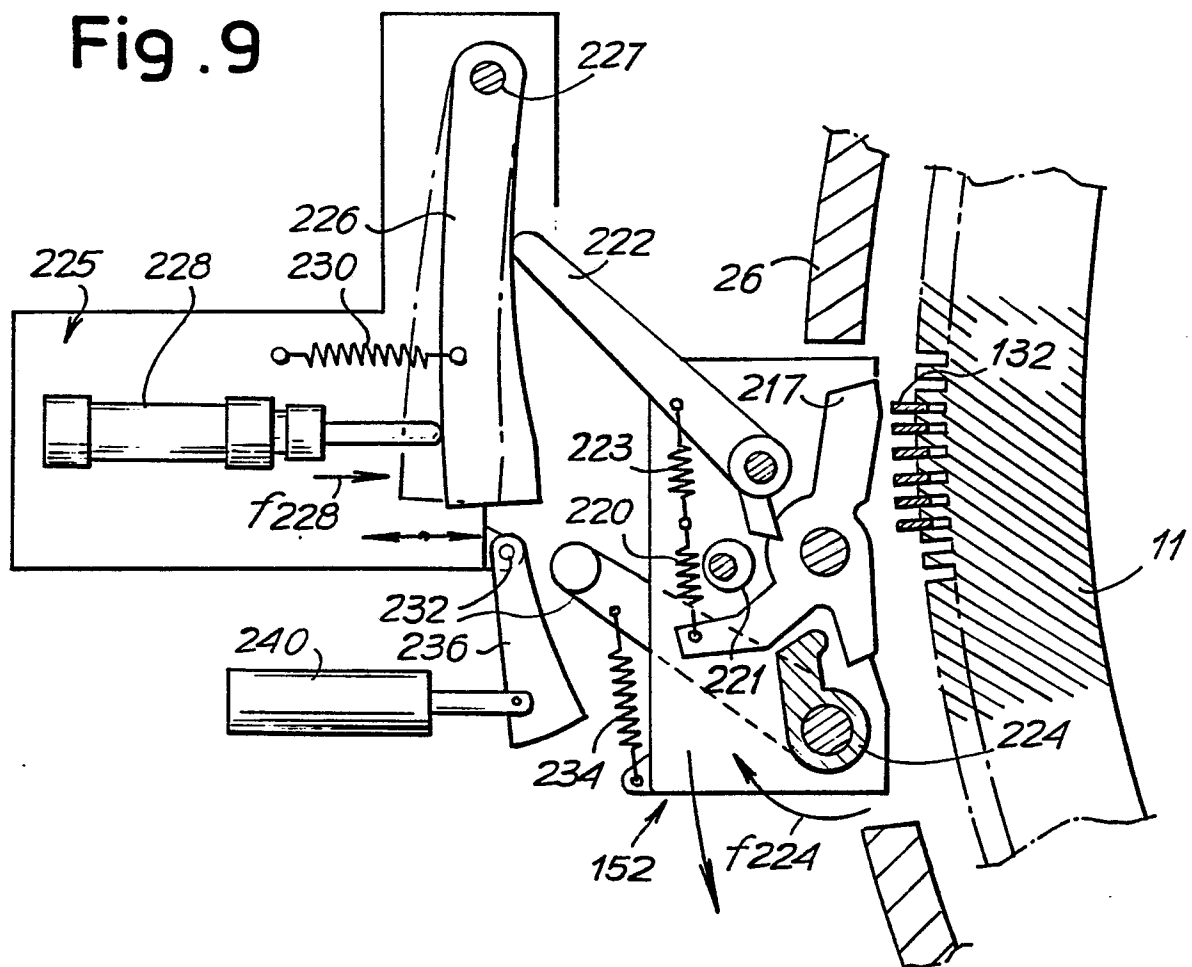


Fig .10

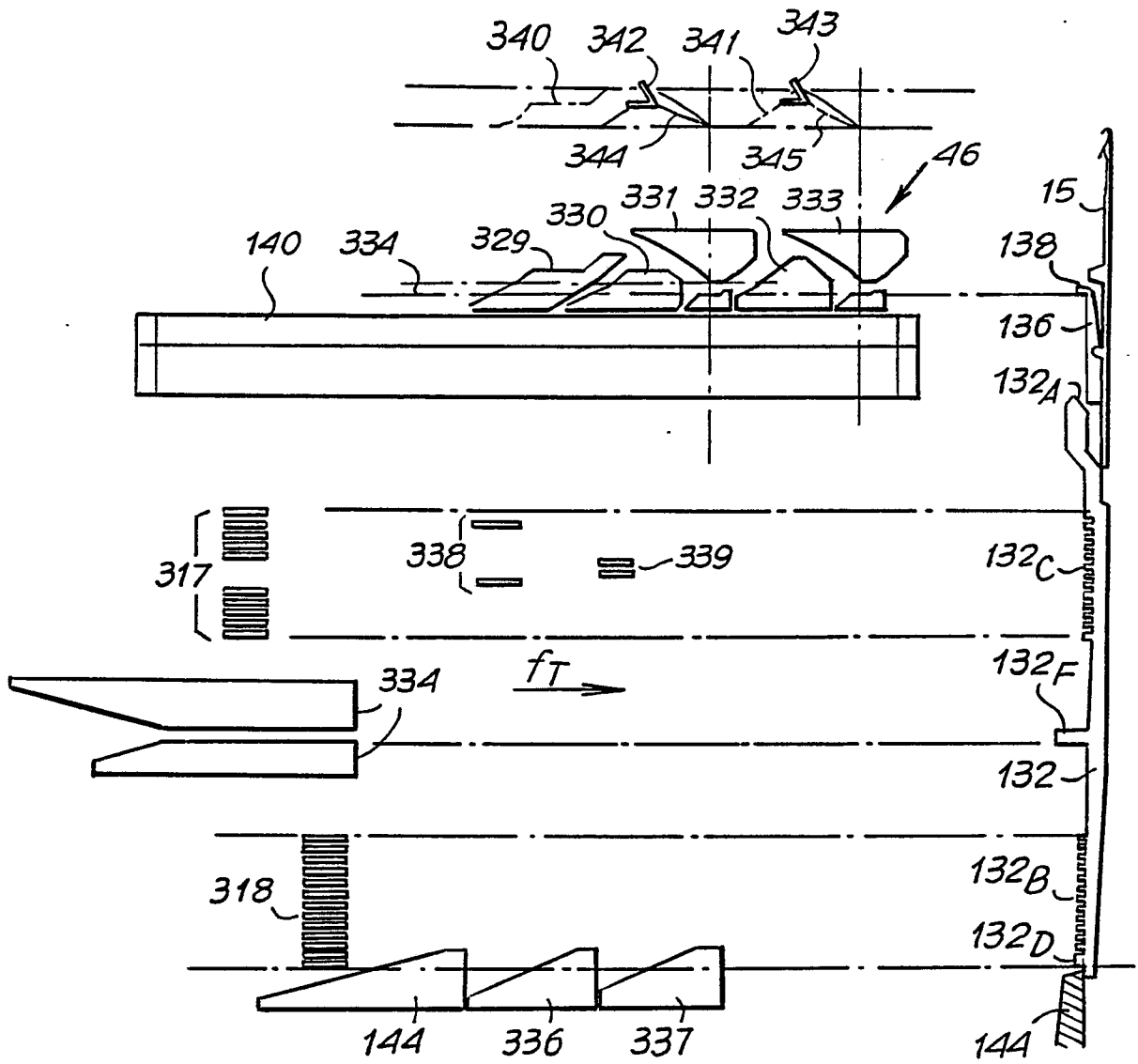


Fig. 11

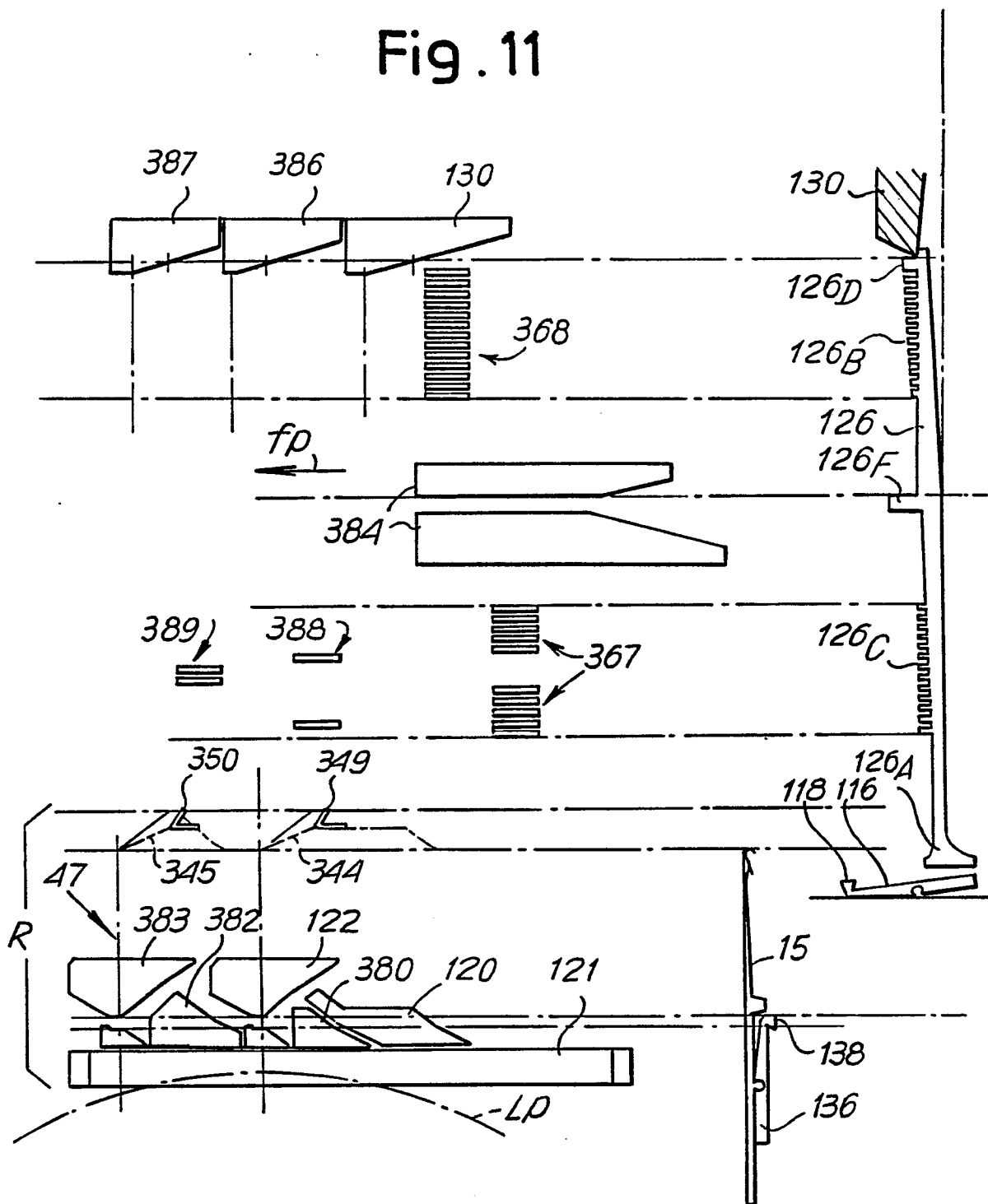


Fig. 12

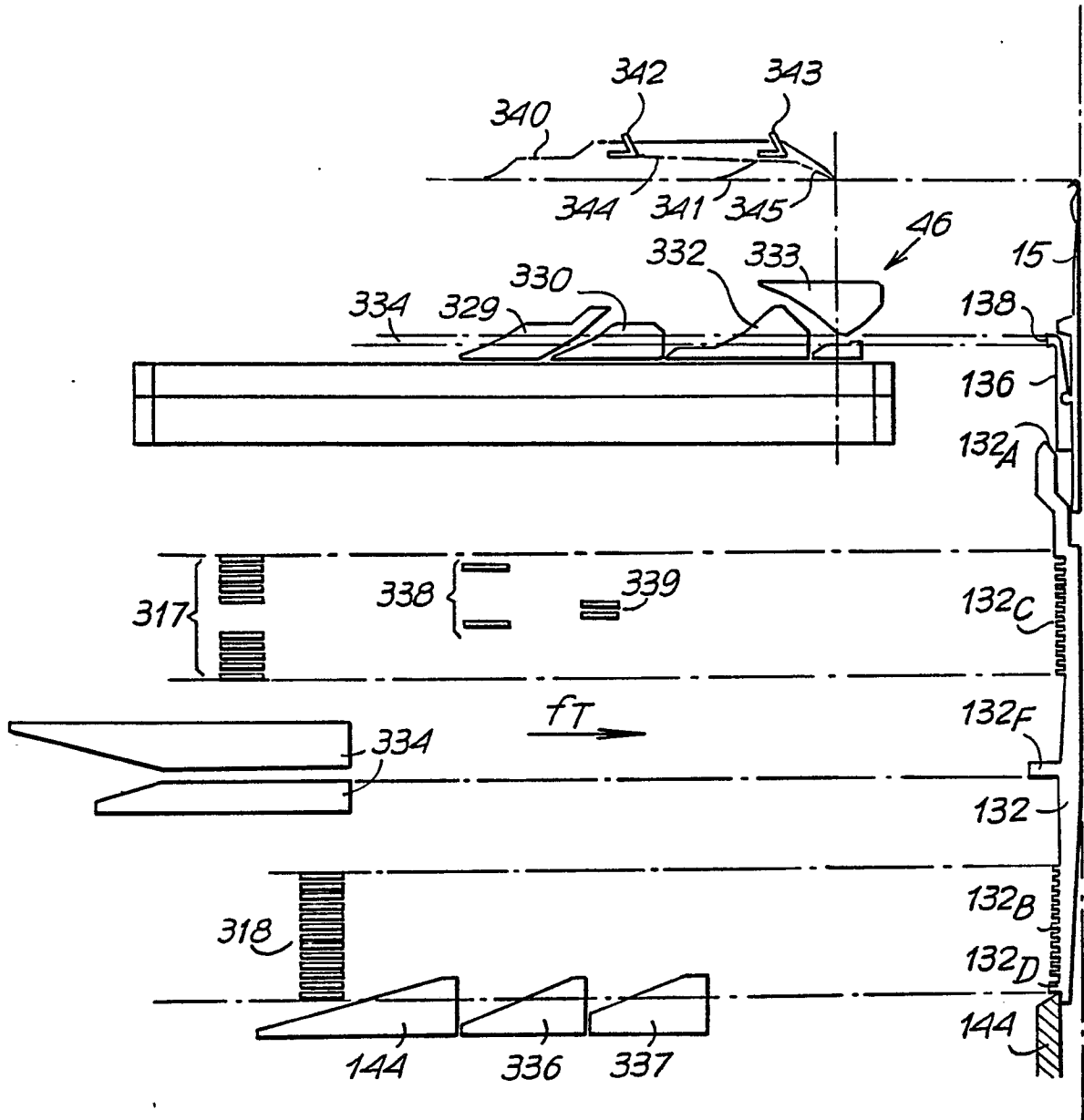
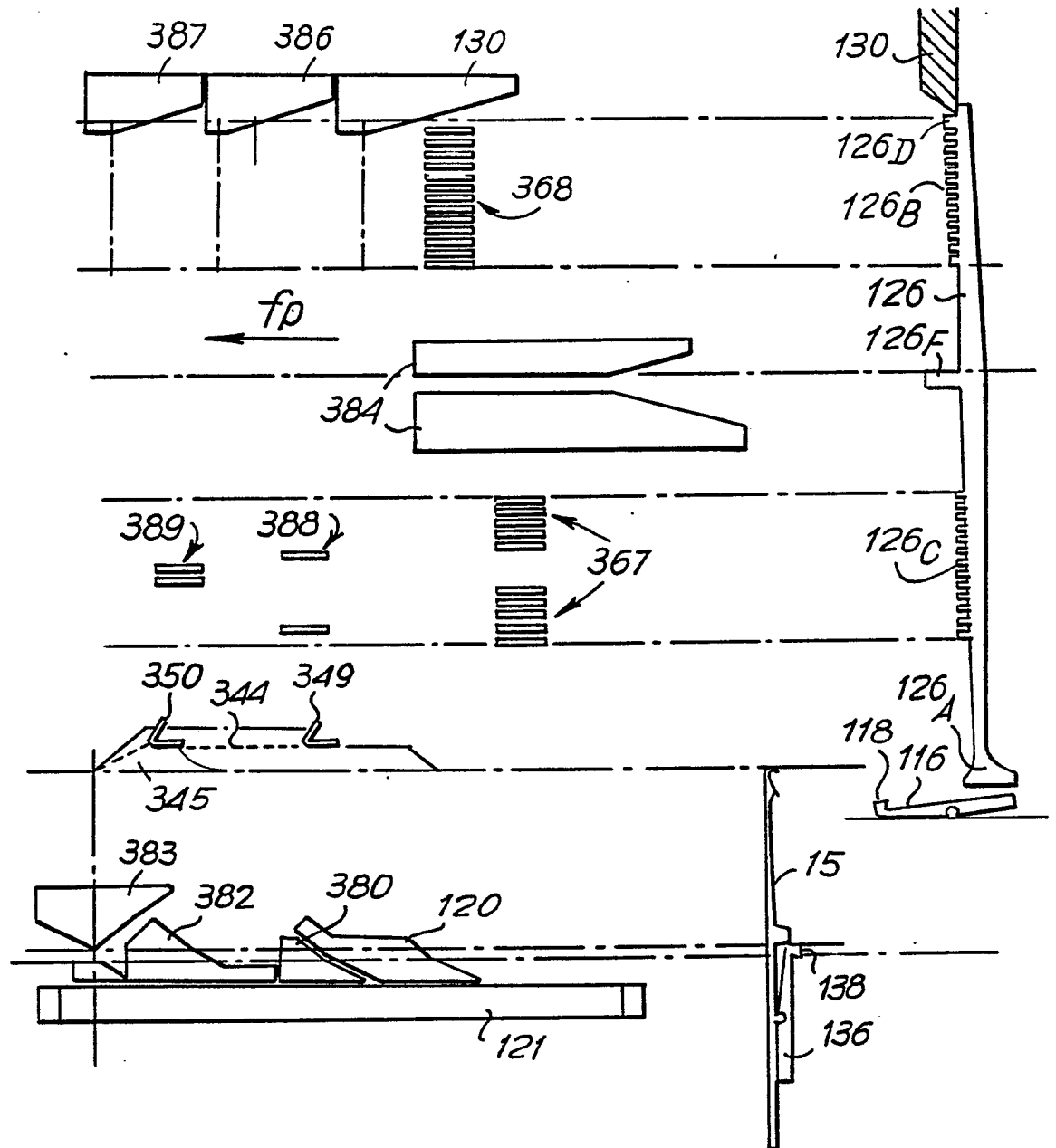


Fig .13



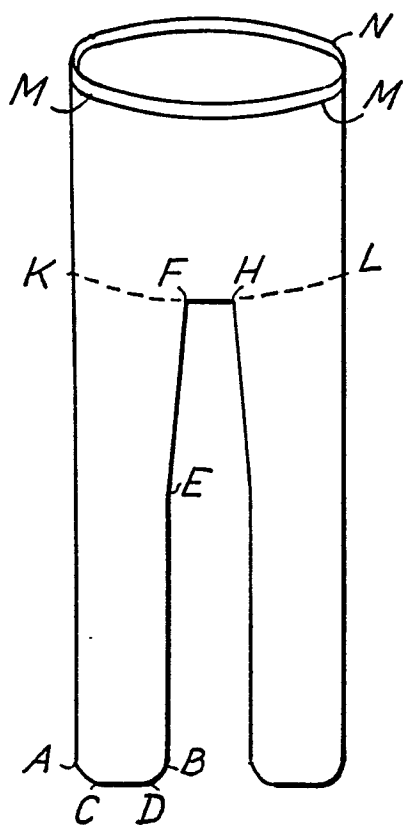


Fig. 14

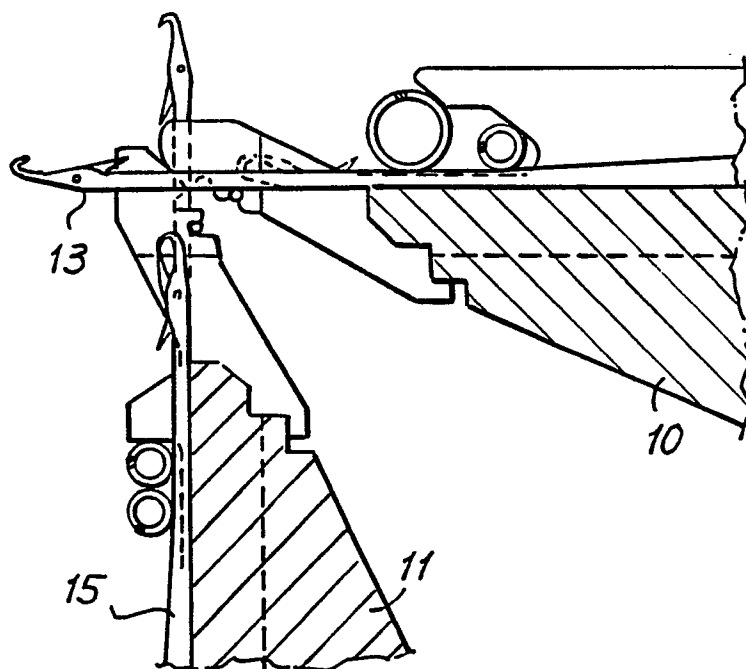


Fig. 16

Fig. 15

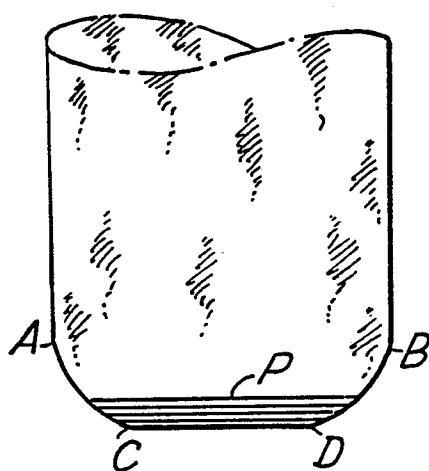


Fig. 17

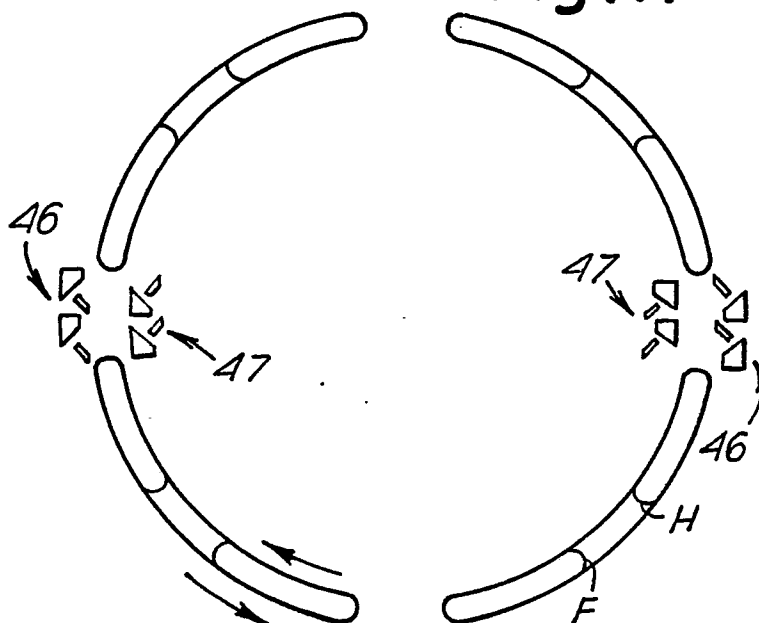


Fig. 18

