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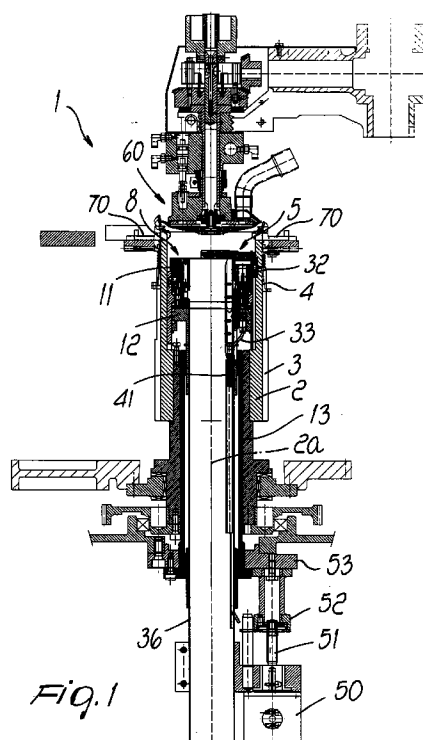
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(54) Circular knitting machine with device for transferring loops of formed knitting from needles of one needle cylinder half to needles of the other needle cylinder half

(57) A circular knitting machine with a device for transferring or carrying loops of knitting formed by the needles of one half of the needle cylinder to the needles of the other half of the needle cylinder (2), comprising at least one needle cylinder (2) which can be rotated about its own axis (2a) and a device (5) for transferring or carrying loops formed by the needles (4) of one half of the needle cylinder (2) to the needles (4) of the other half of the needle cylinder (2). The device (5) comprises a half-dial (6) which is provided with take up elements (26) for taking up the threads or loops and the take up elements (26) can move on command along radial directions with respect to the half-dial (6) in order to take up and retain or release the threads or loops. The half-dial (6) can be turned over about a diametrical axis (7) of the needle cylinder (2) in order to face, by way of the take up elements (26), the needles (4) of one half of the needle cylinder (2) or the needles (4) of the other half of the needle cylinder (2). The half-dial (6) is accommodated inside the needle cylinder (2).



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Description

The present invention relates to a circular hosiery-knitting machine with a device for transferring or carrying loops of knitting formed by the needles of one half of the needle cylinder to the needles of the other half of the needle cylinder, particularly for producing tubular items which are closed at one of their longitudinal ends.

Circular hosiery-knitting machines are known for producing items which are closed at their end directly on the hosiery-knitting machine, thus avoiding the need to subject the item to subsequent sewing or looping to close the end.

European patent application no. 96111186.1 in the name of the same Applicant disclosed a method for forming closed-toe hosiery with a single-cylinder circular machine which has, at the upper end of the needle cylinder, a half-dial which can be turned over about a diametrical axis. The half-dial has a plurality of hooks which can move, along directions which are radial to the needle cylinder, within slots formed for this purpose in the half-dial. The tip of the hooks can be extracted from the half-dial so that each one arranges itself between two contiguous needles of one half of the needle cylinder in order to receive the thread that is dispensed at a feed or drop of the machine and is knitted by the needles of the needle cylinder half between which the hooks are arranged. The method described in this patent application comprises a first step, during which the needle cylinder is actuated with n oscillations about its own axis with an oscillation angle of substantially 180° , so as to move the needle cylinder half faced by the half-dial so that it passes in front of a feed or drop of the machine. During these oscillations, the takeup elements, i.e., the hooks, are extracted radially with one of their ends from the half-dial towards the needles of the machine, and at least one thread is dispensed at the machine feed being considered, lifting into the active position and uniformly mutually spaced, at each oscillation, $1/n$ of the needles of the needle cylinder half that faces the half-dial, and further varying the needles that are moved into the active position in the subsequent oscillation or oscillations and lowering the needles after taking up the thread or threads, which rests or rest on the takeup elements. In a second step, the takeup elements are retracted towards the half-dial, retaining the thread or threads rested thereon. In a third step, heel knitting is performed with the needles of the needle cylinder half that faces the half-dial. In a fourth step, the half-dial is turned over about its diametrical axis and is arranged so as to face the other half of the needle cylinder. In a fifth step, the thread or threads held by the takeup elements is or are transferred to the needles of the other half of the needle cylinder, and in a sixth step the machine is actuated so as to complete the item as a continuation of the previously performed knitting.

Other methods for manufacturing closed-toe hosiery in any case use a half-dial which can be turned

over about a diametrical axis, as disclosed for example in Italian patent no. 676,845, or a half-ring which is arranged around the needle cylinder proximate to its upper end and can also be turned over about a diametrical axis, as disclosed for example in Italian patent application FI93A-128. Said half-ring is also provided with a plurality of hooks which are accommodated in radial slots and can be extracted from the half-ring to transfer the loops of knitting from the needles of one half of the needle cylinder to the needles of the other half of the needle cylinder.

Depending on the method that is followed, the function of the half-dial or half-ring is to simply retain and carry loops, knitted by the needles of one half of the needle cylinder, to the needles of the other half of the needle cylinder, or to transfer loops from the needles of one half of the needle cylinder to the needles of the other half of the needle cylinder.

In any case, in the machines proposed so far, the half-dial or half-ring for performing these operations are arranged outside the needle cylinder at its upper end.

This arrangement causes problems and drawbacks, since the presence of the half-dial and of its hooks produces an additional bulk in the needle work area and can be a hindrance in performing particular knitting processes.

This is the case, for example, of terry knitting. Special sinkers are in fact usually used for this knitting which are arranged inside the sinker ring, located at the upper end of the needle cylinder. The actuation of the sinkers to produce terry knitting can interfere with the actuation of the hooks of the half-dial; therefore, in order to follow a method of the type disclosed in European patent application 96111186.1, it is necessary to renounce terry knitting at the beginning of the forming of the item. In practice it is necessary to knit the initial rows of knitting without terry stitches and this entails producing items which are not fully satisfactory from an aesthetic point of view.

The aim of the present invention is to solve the above problems, providing a circular hosiery-knitting machine with a device for transferring or carrying loops of knitting formed by the needles of one half of the needle cylinder to the needles of the other half of the needle cylinder so as to be able to produce, in particular, items which are closed at one of their axial ends, without penalizing, owing to the presence of said device, other possible knittings of the machine.

Within the scope of this aim, an object of the invention is to provide a machine with a device which in particular does not hinder the actuation of the sinkers in terry knitting.

Another object of the invention is to provide a machine with a device for transferring or carrying loops which, when not used, is not a hindrance in the needle work area.

Another object of the invention is to provide a machine which provides high precision and reliability in

operation.

This aim, these objects and others which will become apparent hereinafter are achieved by a circular hosiery-knitting machine with a device for transferring or carrying loops of knitting formed by the needles of one half of the needle cylinder to the needles of the other half of the needle cylinder, said machine comprising at least one needle cylinder which can be rotated about its own axis and a device for transferring or carrying loops formed by the needles of one half of the needle cylinder to the needles of the other half of the needle cylinder, said device comprising a half-dial which has means for taking up the threads or loops, said takeover means being movable on command along radial directions with respect to said half-dial in order to take up and retain or release said threads or loops, said half-dial being able to turn over about a diametrical axis of the needle cylinder in order to face, through said takeover means, the needles of one half of the needle cylinder or the needles of the other half of the needle cylinder, characterized in that said half-dial is accommodated inside said at least one needle cylinder.

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

Figure 1 is a schematic axial sectional view of a machine according to the invention;

Figure 2 is an axial sectional view of a portion of the machine, taken along a different plane with respect to Figure 1;

Figure 3 is an enlarged-scale view of a detail of Figure 1;

Figure 4 is a partially sectional top plan view of the half-dial and of part of the supporting element on which it is mounted;

Figure 5 is a schematic sectional view of Figure 2, taken along the plane V-V;

Figure 6 is a schematic sectional view of Figure 2, taken along the plane VI-VI;

Figure 7 is a schematic sectional view of Figure 2, taken along the plane VII-VII;

Figure 8 is a schematic sectional view of Figure 2, taken along the plane VIII-VIII;

Figure 9 is an axial sectional view of a portion of the machine, related to the actuation means for turning over the half-dial;

Figures 10 to 16 are schematic views of the operating sequence of the machine in performing a method for producing an item which is closed at a longitudinal end.

With reference to the above figures, the machine according to the invention, generally designated by 1, comprises, in a per se known manner, a needle cylinder

2 which can be rotationally actuated about its own axis 2a and has, on its curved surface, a plurality of axial slots 3 inside which the needles 4 are accommodated.

The machine according to the invention also comprises a device, generally designated by 5, for transferring or carrying loops of knitting formed by the needles of one half of the needle cylinder to the needles of the other half of the needle cylinder. Said device comprises a half-dial 6 provided with means for taking up the threads or loops; said takeover means can move on command along radial directions with respect to the half-dial 6 in order to take up and retain or release the loops of knitting or the threads that compose loops of knitting.

The half-dial 6 can be turned over about a diametrical axis 7 of the needle cylinder 2 in order to face, through the above takeover means, the needles of one half of the needle cylinder or the needles of the other half of the needle cylinder.

According to the invention, the half-dial 6 is accommodated inside the needle cylinder 2.

More particularly, the half-dial 6 is mounted on a supporting element 8 which is accommodated inside the needle cylinder 2 and can move on command along the axis 2a of the needle cylinder.

The supporting element 8 is composed of an outer cylinder 9 which is arranged internally and coaxially to the needle cylinder 2.

The external cylinder 9 has, along its skirt, an axial slot 10 coupled to a key which is correspondingly provided inside the needle cylinder 2 so that the outer cylinder 9 of the supporting element 8 is constantly connected, in its rotation about the axis 2a, to the needle cylinder 2 though maintaining the ability to perform a translatory motion along the axis 2a.

The supporting element 8 also comprises an inner cylinder which is arranged internally and coaxially to the outer cylinder 9 and is divided into two parts which are designated by 11 and 12.

The part 11 of the inner cylinder faces, with one of its flat surfaces, the half-dial 6 and faces, with its other flat surface, the part 12 which is connected to the cylinder support 13 or to the supporting structure of the machine, allowing only a translatory motion along the axis 2a, without the possibility to rotate about said axis 2a.

A connecting pin 14 is interposed between the part 12 and the part 11, as shown in particular in figure 2, and rotationally connects the part 11 to the part 12. More particularly, the pin 14 is accommodated in an adapted seat 15 formed in the part 11 and is pushed by a spring 16 toward the part 12, in which a corresponding seat 17 for the end of the pin 14 is provided.

At the seat 17, in the part 12, there is a pneumatic cylinder provided with a piston 18, whose stem can pass through the seat 17, disengaging the pin 14 from said seat 17 and thus disengaging, as regards rotary motion about the axis 2a, the part 11 from the part 12.

In practice, when the pin 14 is engaged with the

seat 17, the part 11 is rigidly coupled to the part 12 and rotation of the part 11 about the axis 2a is prevented, while when the piston 18 of said pneumatic cylinder is actuated, disengaging the pin 14 from the seat 17, the part 11 is free to rotate about the axis 2a, as will become apparent hereinafter.

A magnetic coupling is provided between the part 11 and the outer cylinder 9 and is constituted for example by permanent magnets 20 or ferromagnetic plates which are arranged on the inner curved surface of the outer cylinder 9 and by ferromagnetic plates 21 or permanent magnets arranged on the outer curved surface of the part 11, which face the permanent magnets 20, so as to establish a magnetic coupling between the outer cylinder 9 and the part 11 of the inner cylinder. The extent of this coupling is such that it is effective only when the pin 14 is disengaged from the seat 17, i.e., when the part 11 is disengaged from the part 12 of the inner cylinder.

The half-dial 6 covers approximately 180° around the axis 2a and is substantially symmetrical to a diametrical plane, designated by 23, of the needle cylinder which is arranged at right angles to the diametrical axis 7, as shown in particular in figure 4.

The half-dial 6 is further pivoted, by means of a pair of pivots 25a and 25b and about the diametrical axis 7, to two shoulders 24a and 24b of the outer cylinder 9 which rise in two diametrically opposite regions of its flat surface which supports the half-dial 6.

The take-up means for the loops or the thread comprise a plurality of hooks 26 which are slidingly accommodated in suitable radial slots formed in the half-dial 6.

Each hook 26 is provided with an upper heel 26a and a lower heel 26b which protrude respectively in an upward region and in a downward region from the half-dial so as to face and engage, according to the position assumed by the half-dial 6 in turning over about the diametrical axis 7, actuation cams which are arranged on the flat surface of the part 11 of the inner cylinder that is directed towards the half-dial 6.

The actuation cams comprise an extraction cam 30, which is shaped so as to produce a movement of the hooks 26 along the corresponding slots of the half-dial 6 in the opposite direction with respect to the axis 2a of the needle cylinder, and retraction cams 31, which are shaped so as to move the hooks 26 in the opposite direction.

The extraction cam 30 and the retraction cams 31 can move on command parallel to the axis 2a, for example by means of pneumatic cylinders 32 which are accommodated inside the part 11 and are fed by means of ducts 33 which are connected to the part 12 of the inner cylinder, so that said cams can be activated, i.e., moved into a position in which they interfere with the lower or upper heels of the hooks 26, and deactivated, i.e., moved into a position in which they do not affect the heels of the hooks 26.

The hooks 26 preferably occupy an arc of the half-

dial 6 which is arranged symmetrically with respect to the diametrical plane 23 and preferably covers an angle of less than 180° about the axis 2a.

The supporting element 8 and the half-dial 6 have, around the axis 2a of the needle cylinder, a recess 34, 35 to allow the passage of the item.

In the case of a single-cylinder machine, it is possible to fix the suction hose 36 of the item to the supporting element 8 at the recess 35.

The means that turn over the half-dial 6 about the diametrical axis 7 are conveniently constituted by a step motor 37 which is associated with the suction hose 36, as shown in detail in figure 9, and which by means of a bevel gear pair 38 and 39, moves a Bowden cable 40 which slides inside a sheath 41, reaching a pivot 42 which is arranged in an intermediate region of the extension of the half-dial 6, whereto it is coupled by means of a fork-like element 43.

More particularly, a bevel gear 38 is keyed on the output shaft of the step motor 37 and meshes with the bevel gear 39, which is supported, so that it can rotate about its own axis, by a frame 45 which is fixed to the suction hose 36 and also supports the step motor 37. Coaxially to the bevel gear 39 there is provided a female thread 46 with which an externally threaded secondary shaft 47 engages; said secondary shaft is fixed to the end of the Bowden cable 40 that is opposite to the end that engages the half-dial 6.

The movement of the supporting element 8 and therefore of the half-dial 6 along the axis 2a is produced, in a similar manner, by means of a step motor 50 which is mounted on the suction hose 36 and engages, by means of its output shaft 51, which is externally threaded, a female thread which is formed in a block 52 which is fixed to the supporting structure 53 of the machine. In practice, the actuation of the step motor 50 moves the suction hose 36 and therefore the supporting element 8 along the axis 2a of the needle cylinder.

It should be noted that though the device for transferring or carrying the loops formed by the needles of one half of the needle cylinder to the needles of the other half of the needle cylinder has been described with reference to a single-cylinder circular machine which can have, above the needle cylinder, a dial 60 of a conventional type, it can in any case also be installed on a double-cylinder circular machine and accommodated in the lower needle cylinder or preferably in the upper needle cylinder.

The operation of the machine according to the invention is now described with reference to the method according to European patent application 96111186.1.

At the beginning of the production of the item, the half-dial 6, through the actuation of the step motor 50, is moved from the inactive position, shown in figure 10, to the needle work area 4, as shown in figure 11, and the needle cylinder 2 is actuated with n oscillations about its own axis 2a.

During these n oscillations, the extraction cam 30 is

moved into the active position, so as to make the hooks 26 protrude from the half-dial 6, thus placing the tip of each hook between two contiguous needles of a first half of the needle cylinder which passes in front of a feed or drop of the machine, taking up the thread that is dispensed at said feed or drop.

The dispensed thread is taken up by the needles 4 and rests on the tip of the hooks 26, as already described in the above cited patent application, to which reference is made for the sake of completeness.

During the n oscillations, $1/n$ of the needles are raised into the active position, varying, at each oscillation, the set of needles raised into the active position, as described in said patent application.

At the end of these n oscillations, the extraction cam 30 is deactivated and the retraction cams 31 (figure 12) are activated sequentially.

The n initial oscillations can be limited to a single oscillation, i.e., to a single outgoing motion, in one direction, of the needle cylinder 2 about its own axis 2a.

Directly after the n oscillations, which as mentioned can be limited to a single oscillation, heel knitting begins; following the partial or full retraction of the hooks 26 into the half-dial 6, said knitting can be produced with terry stitches by using the appropriately provided sinkers 70.

It should be noted that thanks to the use of multiple retraction cams 31, which modulate the retraction of the hooks 26, the first row of knitting loaded onto said hooks 26 is not stressed excessively.

Then, when the hooks 26 have been retracted into the half-dial 6 so as to firmly retain the portion of the loops of the first row that rests thereon, the half-dial 6 is moved along the axis 2a so as to arrange itself below the needle work area, while the needle cylinder 2 continues to be actuated with an alternating motion about its axis 2a in order to complete the heel knitting that forms the tip 80 of the item, as shown in particular in figure 13.

During this step, the part 11 can optionally be disengaged from the part 12, so as to minimize wear between of the parts of the half-dial 6 and the part 11 of the supporting element 8.

Then, by actuating the step motor 37, the half-dial 6 is turned over about the diametrical axis 7, making the half-dial 6 face the needles of the other half of the needle cylinder (Figure 14).

After the overturning action, the extraction cam 30 and one or more retraction cams 31 are actuated sequentially so as to transfer the loop portions retained by the hooks 26 to the needles 4 of the other half of the needle cylinder, so that the portion 80 of the item, formed earlier, is peripherally engaged by the needles of the two halves of the needle cylinder (Figures 15 and 16).

At this point, again through the actuation of the step motor 50, the half-dial 6 is lowered into the needle cylinder 2 and the knitting of the item is continued in a per se

known manner.

It should be noted that during the passage of the loops of knitting from the hooks of the half-dial 6 to the needles of the other half of the needle cylinder it is also possible to use a hook to complete the passage of the row portions located directly to the side of the half-dial 6 if said half-dial covers less than 180° about the axis 2a, as described in a co-pending patent application.

In practice, the item obtained at the end of the knitting process is closed at its tip or longitudinal end.

Though the operation of the device for transferring or carrying loops from the needles of one half of the needle cylinder to the needles of the other half of the needle cylinder has been described mainly with reference to the execution of the process according to European patent application 96111186.1, it can in any case be used to perform other conventional types of knitting process, such as for example the process described in Italian patent no. 676,845.

In practice, it has been observed that the machine, with the device according to the invention, fully achieves the intended aim, since it allows to produce hosiery, or tubular items in general, which are closed at the tip or longitudinal end, without preventing the possibility of particular kinds of knitting adjacent to the closed tip.

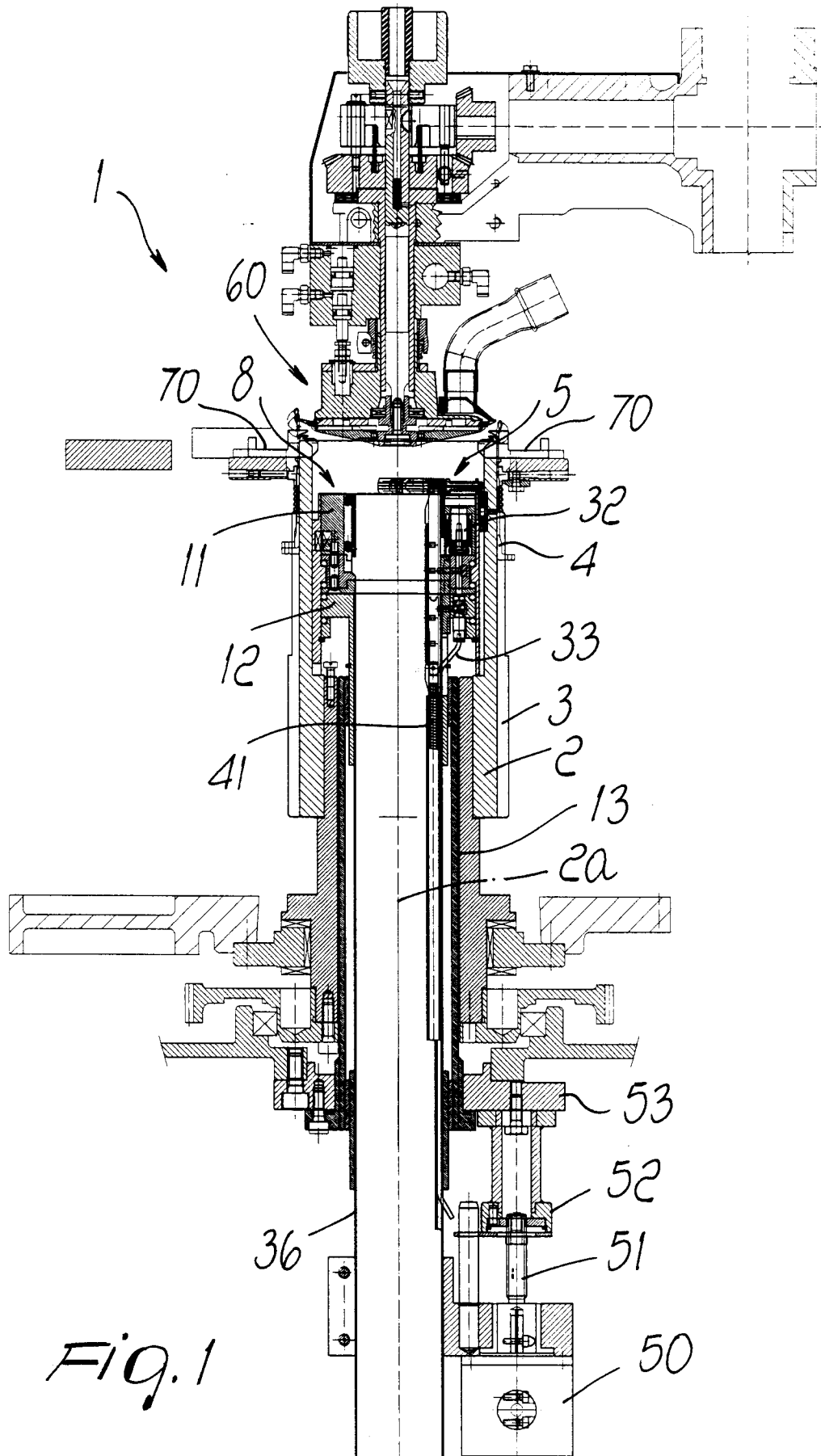
The device thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept; all the details may also be replaced with other technically equivalent elements. In practice, the materials employed, as well as the dimensions, may be any according to requirements and the state of the art.

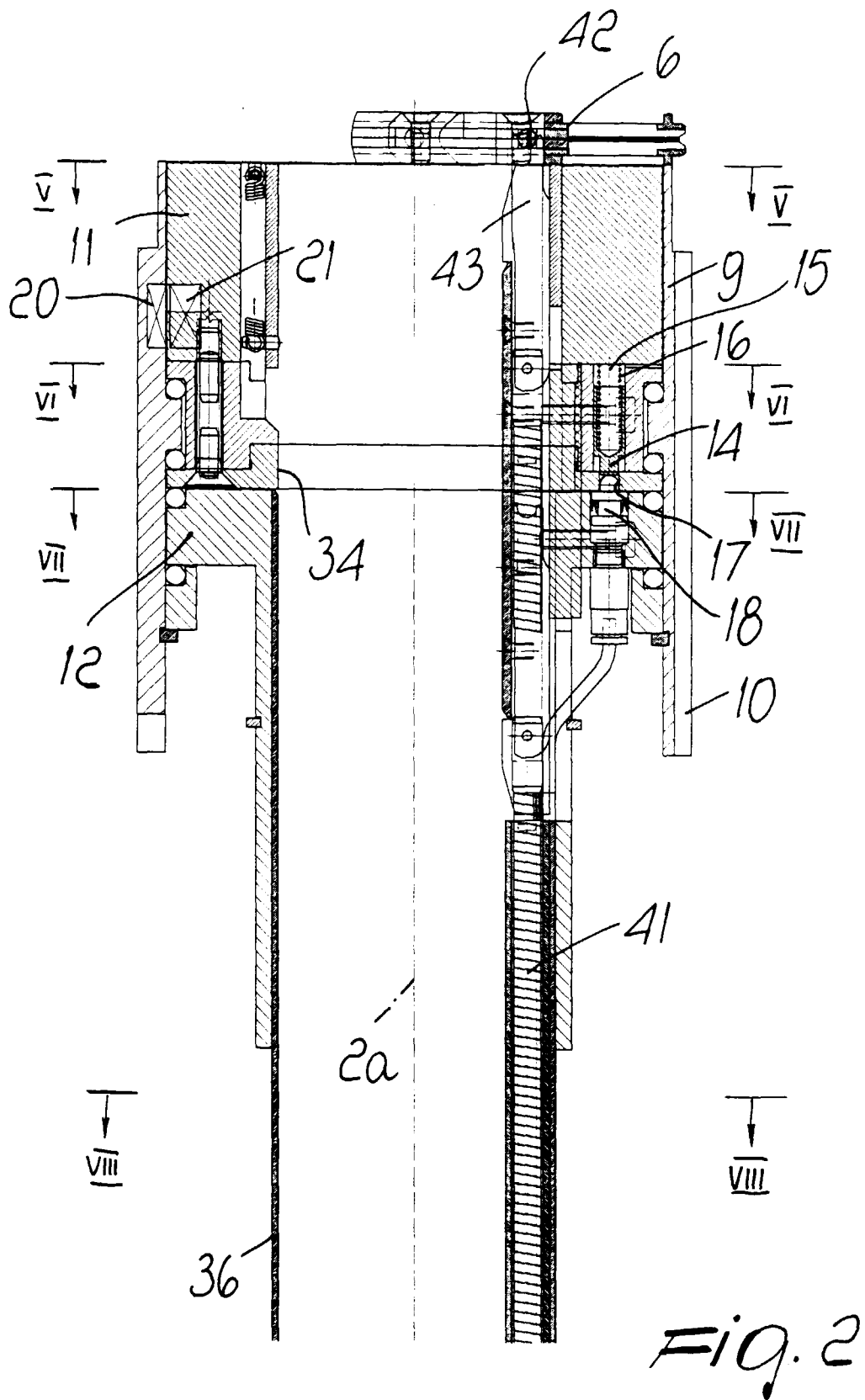
Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified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

Claims

1. A circular knitting machine with a device for transferring or carrying loops of knitting formed by the needles of one half of the needle cylinder to the needles of the other half of the needle cylinder, comprising at least one needle cylinder (2) which can be rotated about its own axis (2a) and a device (5) for transferring or carrying loops formed by the needles (4) of one half of the needle cylinder (2) to the needles of the other half of the needle cylinder (2), said device (5) comprising a half-dial (6) which has means (26) for taking up the threads or loops, said takeup means (26) being movable on command along radial directions with respect to said half-dial (6) in order to take up and retain or release said threads or loops, said half-dial (6) being able to turn over about a diametrical axis (7) of the needle

- cylinder (2) in order to face, by virtue of said take-up means (26), the needles (4) of one half of the needle cylinder (2) or the needles (4) of the other half of the needle cylinder (2), characterized in that said half-dial (6) is accommodated inside said at least one needle cylinder (2). 5
2. A machine according to claim 1, characterized in that said half-dial (6) is rigidly coupled to said needle cylinder (2) in rotating about its own axis (2a). 10
 3. A machine according to claim 1, characterized in that said half-dial (6) is mounted on a supporting element (8) which is accommodated inside said at least one needle cylinder (2) and can move on command along the axis (2a) of the needle cylinder (2). 15
 4. A machine according to one or more of the preceding claims, characterized in that said half-dial (6) and said supporting element (8) have, around the needle cylinder axis (2a), a recess (34, 35) for the passage of the item. 20
 5. A machine according to one or more of the preceding claims, characterized in that the region of said half-dial (6) that is occupied by said take-up means (26) has, around the needle cylinder axis (2a), a symmetrical shape with respect to a diametrical plane (23) which is perpendicular to said diametrical axis (7) and a width of less than 180°. 25 30
 6. A machine according to one or more of the preceding claims, characterized in that said take-up means comprise hooks (26) which are slidably accommodated in radial slots formed in said half-dial (6), said hooks (26) having heels (26a, 26b) which protrude upward and downward from said slots to engage, when said half-dial (6) is in one of the two possible positions produced by its overturning in either direction about said diametrical axis (7), hook actuation cams (30, 31) which are arranged on said supporting element (8). 35 40
 7. A machine according to one or more of the preceding claims, characterized in that said hook actuation cams (30, 31) can be activated or deactivated on command. 45
 8. A machine according to one or more of the preceding claims, characterized in that said supporting element (8) comprises an outer cylinder (9) which is arranged coaxially inside the needle cylinder (2), rotates rigidly therewith about its axis (2a), and can perform a translatory motion along said axis (2a), said outer cylinder (9) supporting said half-dial (6) so that it can oscillate about said diametrical axis (7). 50 55
 9. A machine according to one or more of the preceding claims, characterized in that said supporting element (8) comprises an inner cylinder which is arranged internally and coaxially to said outer cylinder (9); said inner cylinder having said hook actuation cams (30, 31) on its flat surface directed toward said half-dial (6); said inner cylinder being rigidly associable with the supporting structure (53) of the machine in order to remain motionless during the rotation of the needle cylinder (2) about its own axis (2a).
 10. A machine according to one or more of the preceding claims, characterized in that said inner cylinder is divided into two parts: a first part (12) which is prevented from rotating about the axis (2a) of the needle cylinder (2) and a second part (11) which supports said actuation cams (30, 31) and is associable on command, as regards rotation about the axis (2a) of the needle cylinder (2), with said first part (12) or with said outer cylinder (9).
 11. A machine according to one or more of the preceding claims, characterized in that said supporting element (8) is associated with the duct (36) for aspirating the item which is arranged inside the needle cylinder (2).
 12. A machine according to one or more of the preceding claims, characterized in that it comprises a step motor (50) which actuates the movement of said supporting element (8) along the axis (2a) of the needle cylinder (2).
 13. A machine according to one or more of the preceding claims, characterized in that it comprises a step motor (50) which actuates the overturning of said half-dial (6) about said diametrical axis (7).





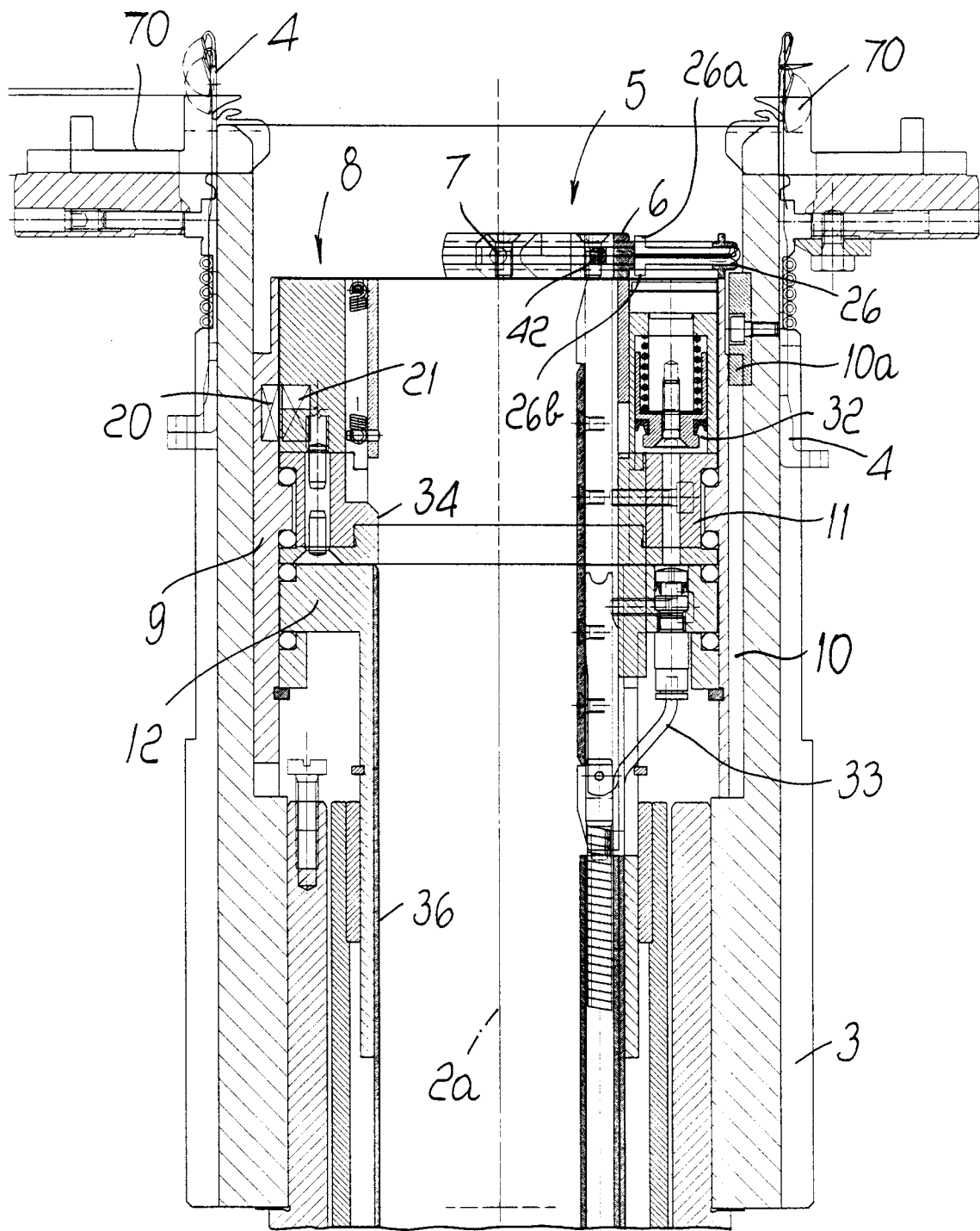


FIG. 3

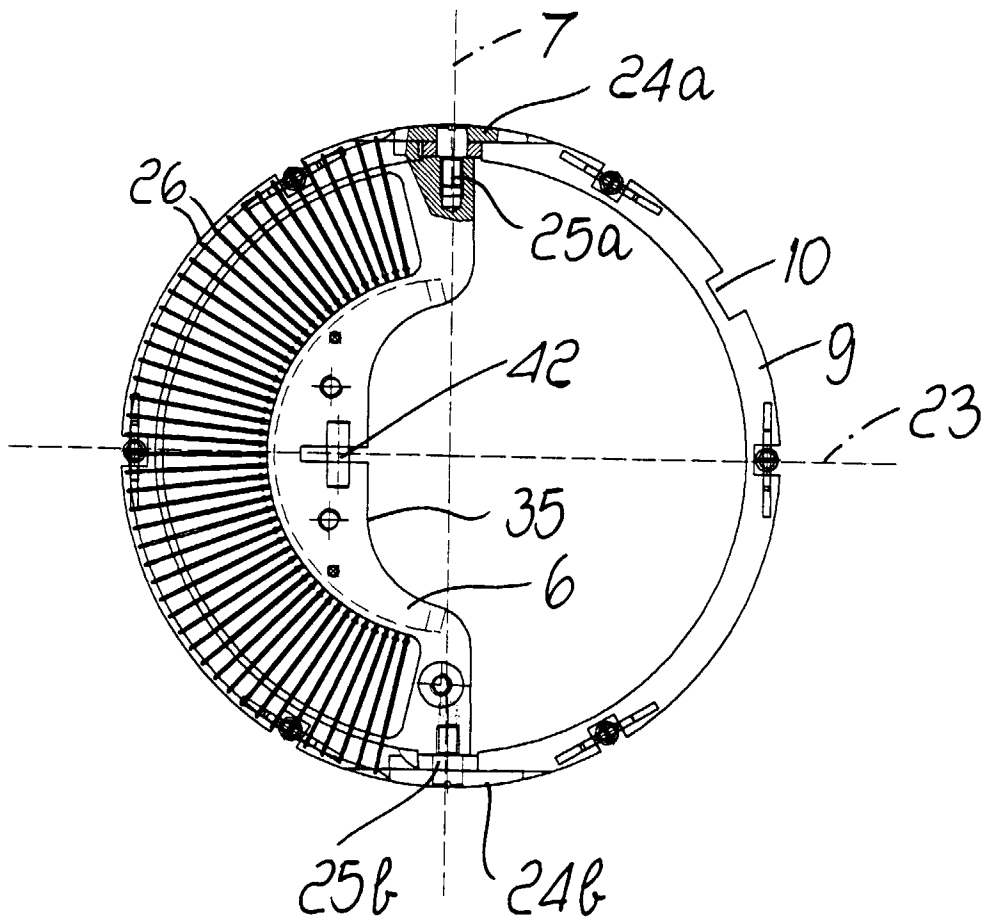


FIG. 4

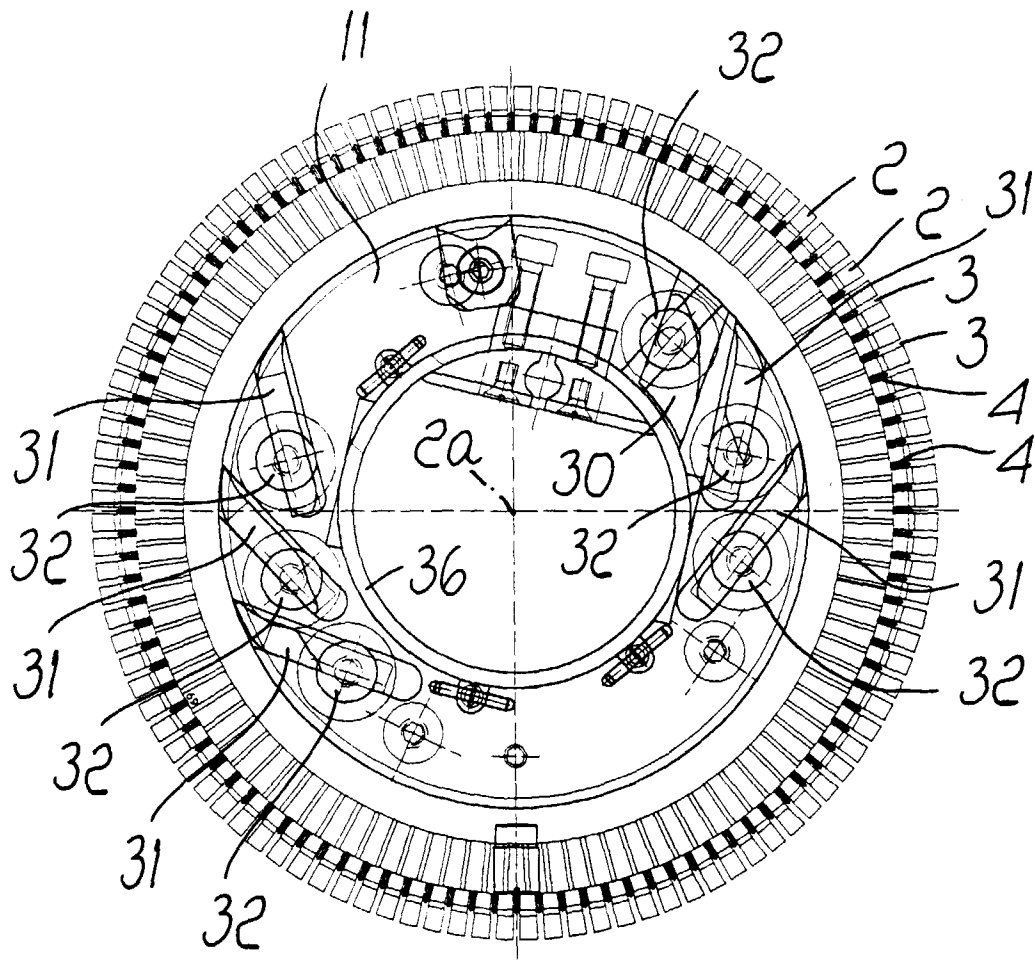


Fig. 5

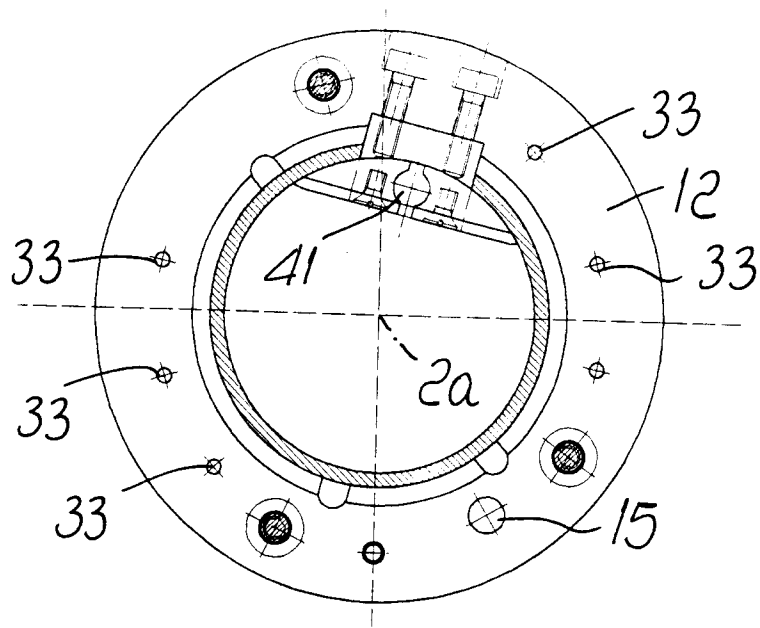


FIG. 6

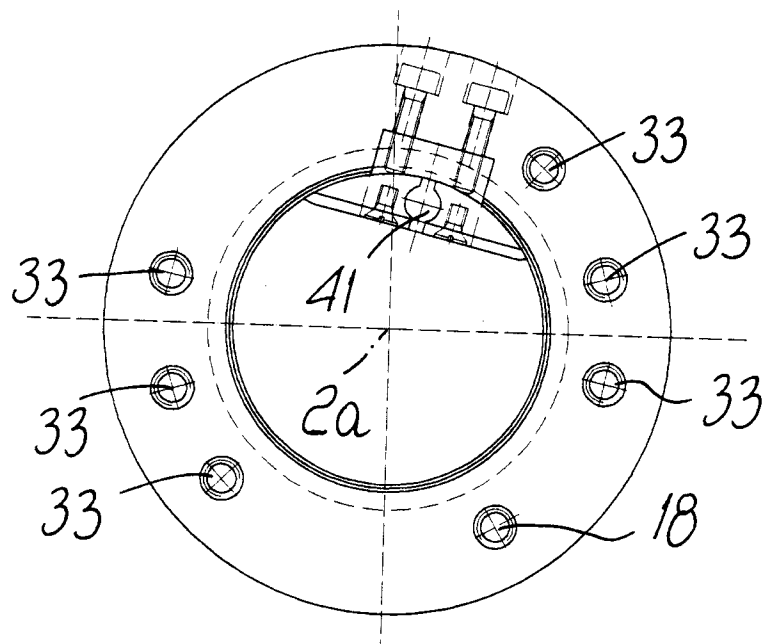


FIG. 7

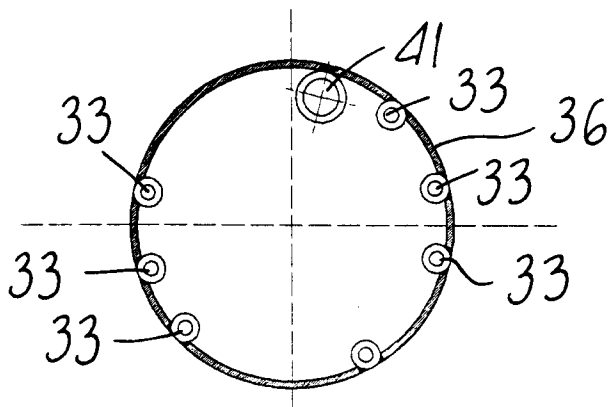


FIG. 8

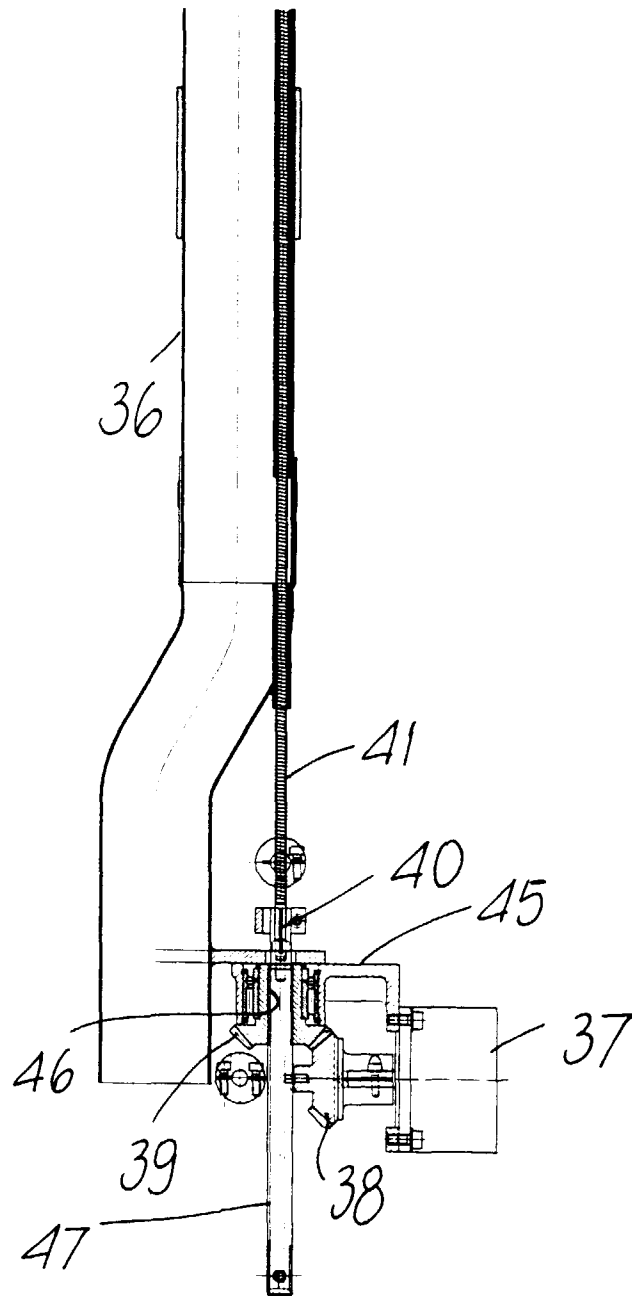


Fig. 9

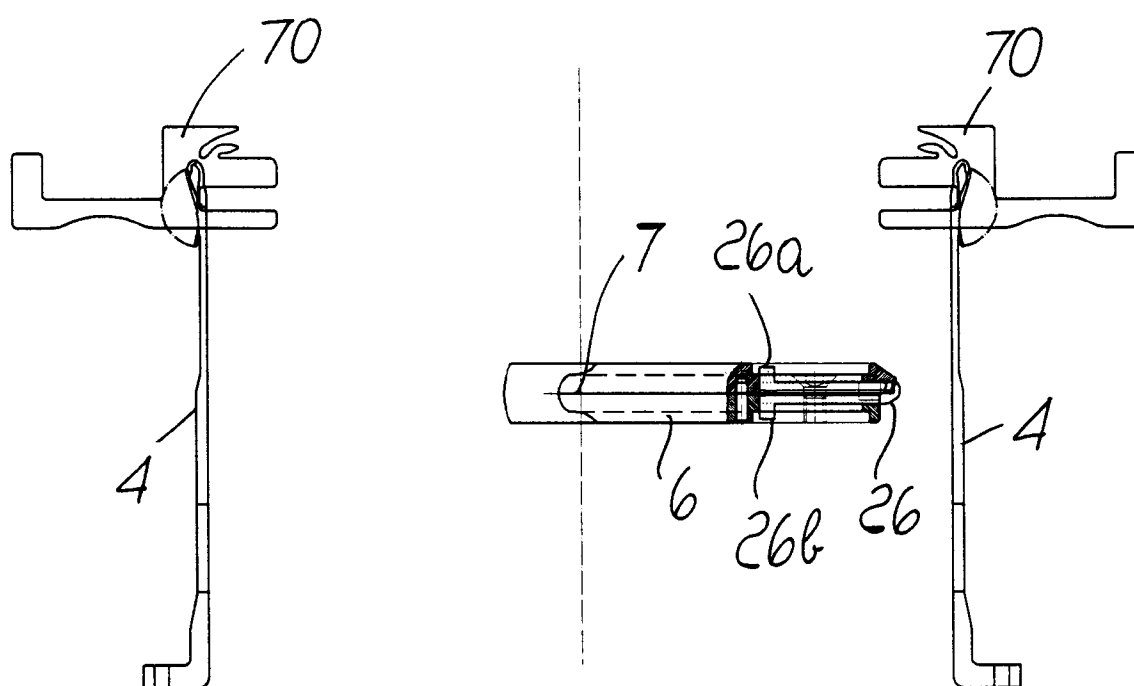


Fig. 10

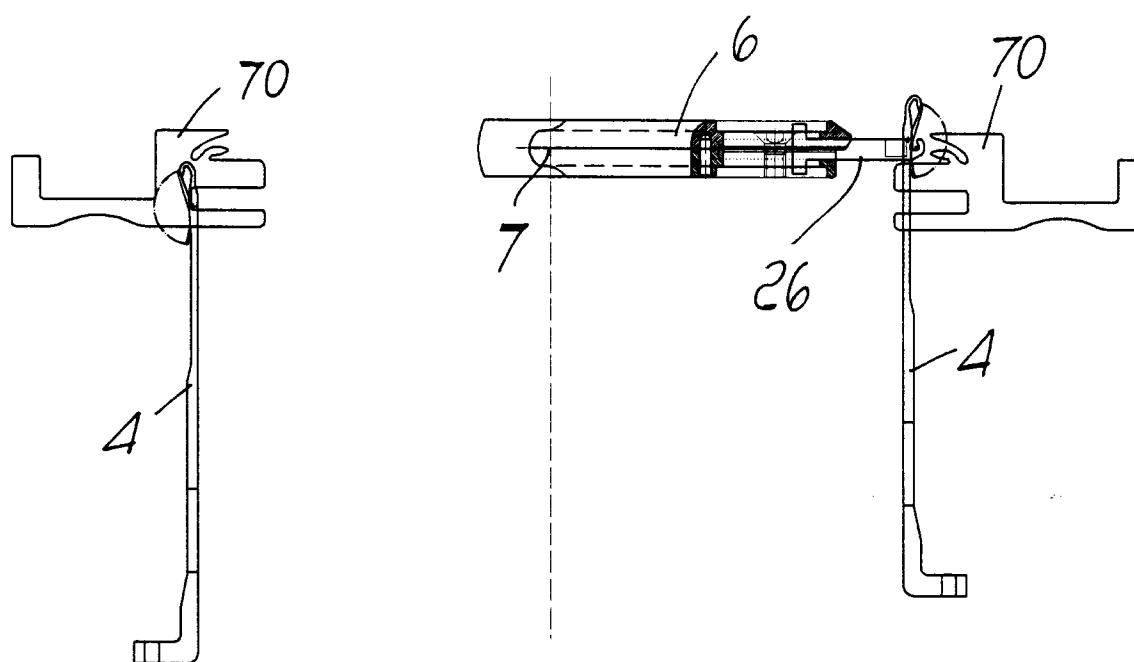


Fig. 11

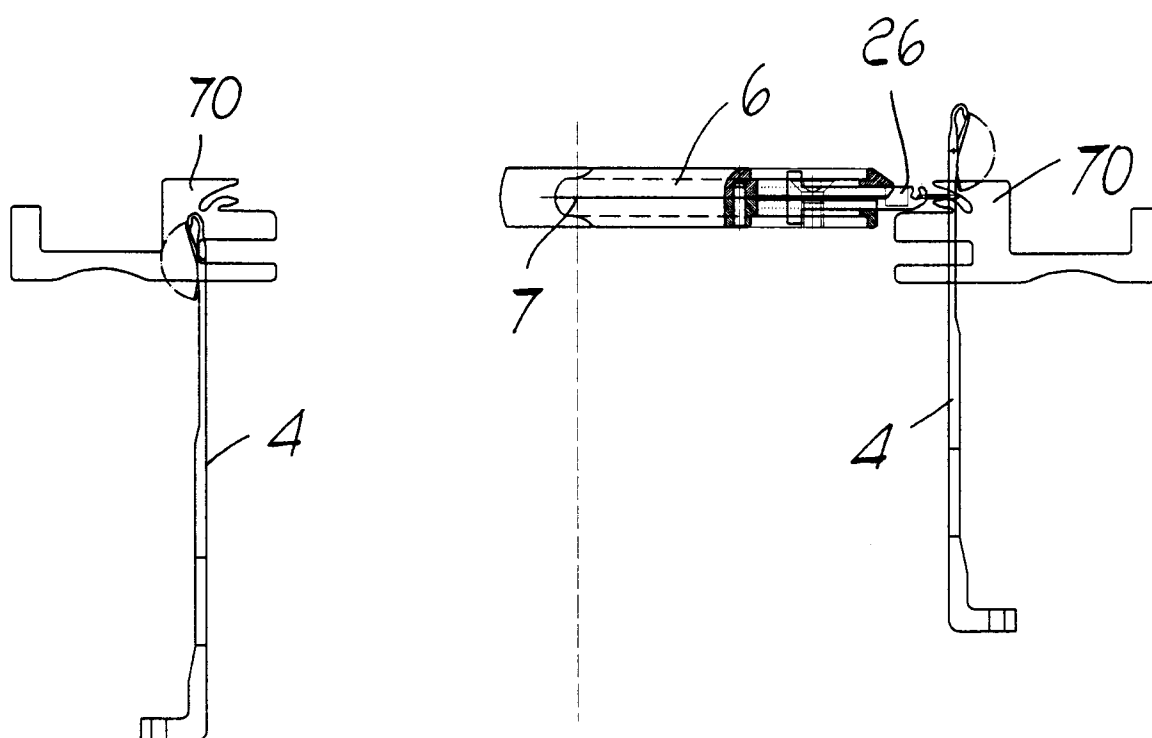


Fig. 12

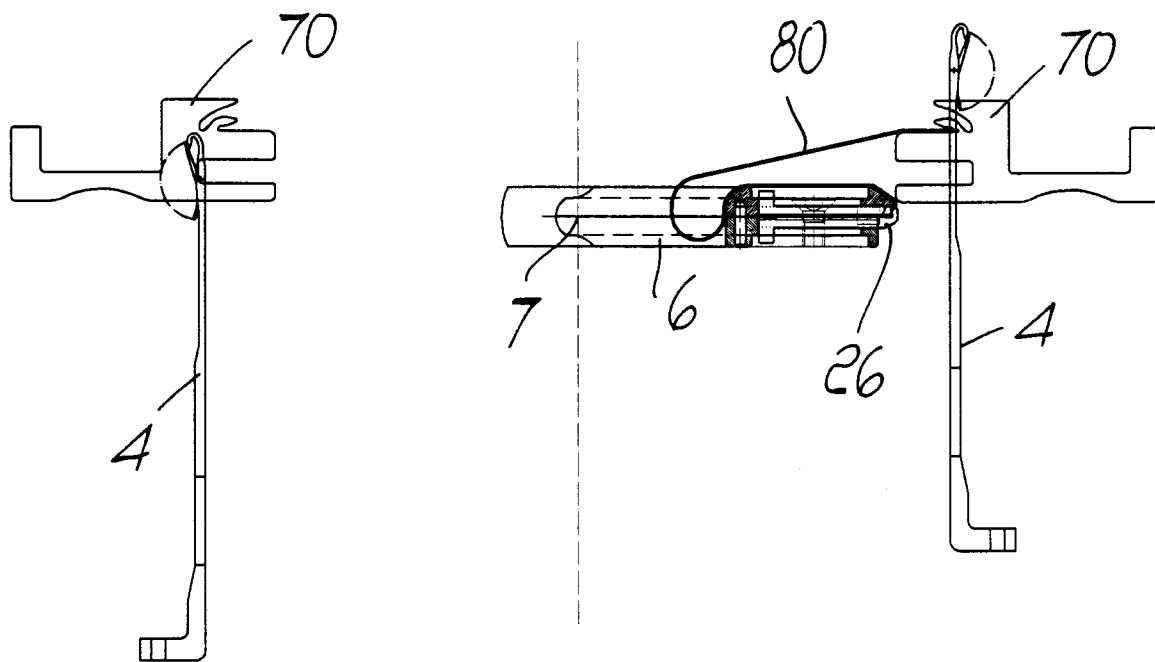


Fig. 13

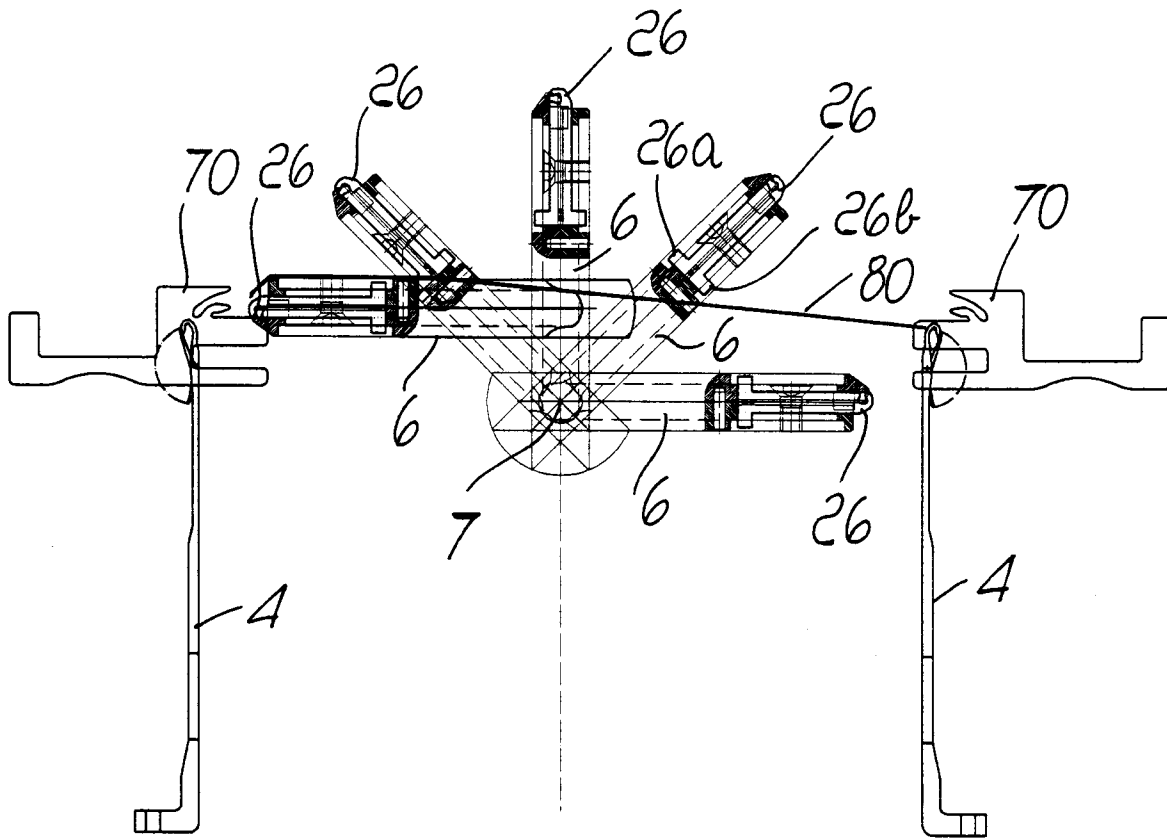


Fig. 14

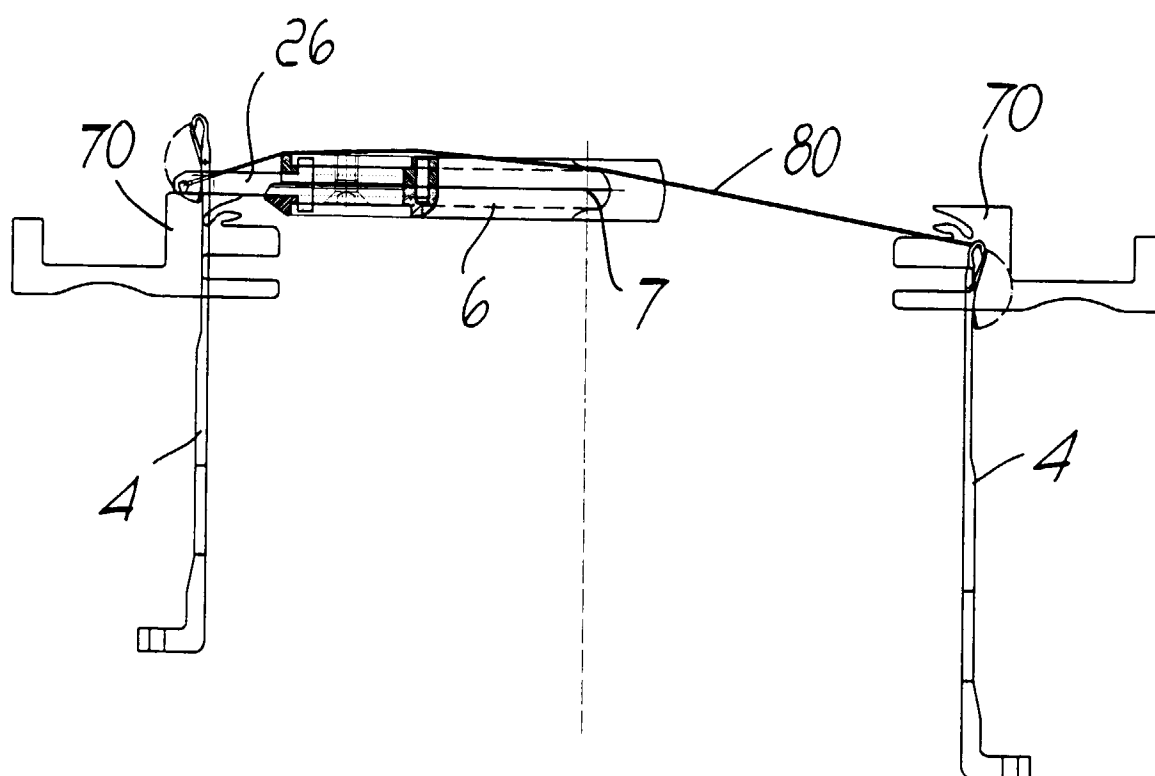


Fig. 15

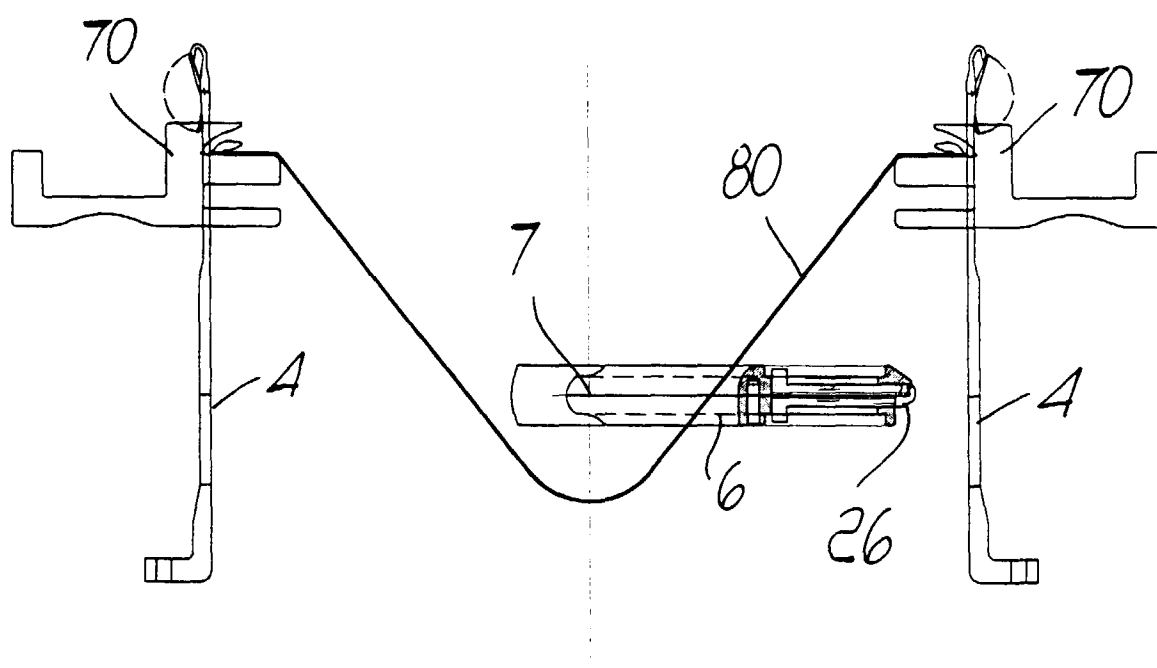


Fig. 16