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(54) Circular knitting machine with flip-over half-dial

(57) A circular knitting machine with flip-over half-dial, comprising a needle cylinder (2) which can be actuated so as to rotate about its own axis (2a) and a half-dial (3) provided with elements (5) for engaging the yarns or loops of knitting. The half-dial (3) can flip over about a diametrical axis (4) of the needle cylinder (2) in order to face, with the engagement elements (5), the needles (6) of one half of the needle cylinder (2) or the needles (7) of the other half of the needle cylinder (2). The half-dial (3) is arranged inside the needle cylinder (2) and is pivoted, about the diametrical axis (4), to a supporting element (13) which is coupled to the needle cylinder (2) for joint rotation about its axis (2a). A pusher (8) is provided which acts on command on the half-dial (3) for its rotation about the diametrical axis (4) through an angle of less than 90° and for its engagement with an abutment (9) which is suitable to complete the flipping of the half-dial (3) following the rotation of the half-dial (3), together with the needle cylinder (2), with respect to the abutment (9).

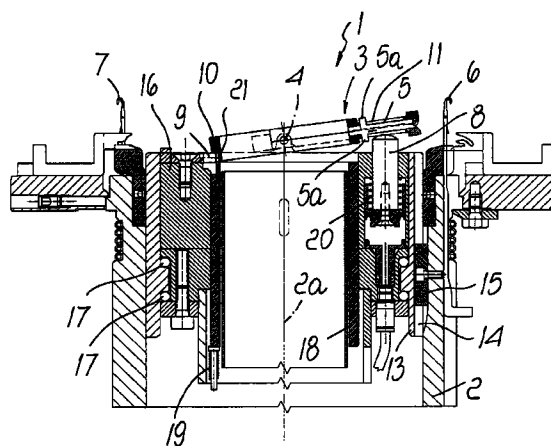


FIG. 2

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Description

[0001] The present invention relates to a circular knitting machine particularly for hosiery, with flip-over half-dial, particularly for producing tubular items closed at one of their longitudinal ends.

[0002] Conventional circular hosiery knitting machines have a flip-over half-dial which is arranged proximate to the upper end of the needle cylinder and is provided with means for engaging the yarns or loops of knitting. Said half-dial can be flipped over about a diametrical axis of the needle cylinder in order to face, with the engagement means, the needles of one half of the needle cylinder or the needles of the other half of the needle cylinder, so as to transfer the loops of knitting formed on the needles of one half of the needle cylinder to the needles of the other half of the needle cylinder, in order to allow to close, at one of its longitudinal ends, the tubular knitted item being formed.

[0003] In particular, EPA No. 98105734.2 of March 30, 1998 by the same Applicant discloses a circular hosiery knitting machine with a flip-over half-dial which is accommodated inside the needle cylinder of the machine proximate to its upper end, i.e., proximate to the needle work area.

[0004] During testing, this machine has been found to be susceptible of modifications mainly for improving the flip-over mechanism of the half-dial.

[0005] The aim of the present invention is accordingly to provide a circular knitting machine provided with a flip-over half-dial, having a half-dial flip-over mechanism which allows to flip the half-dial over without interrupting the production cycle of the machine.

[0006] Within the scope of this aim, an object of the invention is to provide a circular knitting machine with flip-over half-dial in which the half-dial does not substantially hinder the passage of the item being formed inside the needle cylinder.

[0007] Another object of the invention is to provide a circular knitting machine which, by not requiring an interruption of the production cycle in order to flip the half-dial over, can achieve a productivity which is comparable with that of conventional types of circular knitting machine which do not allow to close the item at one of its longitudinal ends.

[0008] This aim, these objects and others which will become apparent hereinafter are achieved by a circular knitting machine with flip-over half-dial, comprising a needle cylinder which can be actuated so as to rotate about its own axis and a half-dial provided with means for engaging the yarns or loops of knitting; said half-dial being able to flip over about a diametrical axis of the needle cylinder in order to face, with said engagement means, the needles of one half of the needle cylinder or the needles of the other half of the needle cylinder; means being provided for flipping said half-dial over about said diametrical axis; characterized in that said half-dial is arranged inside the needle cylinder and is

pivoted, about said diametrical axis, to a supporting element which is rigidly coupled to said needle cylinder in the rotation about its axis; said flip-over means comprising a pusher which acts on command on said half-dial for its rotation about said diametrical axis through an angle of less than 90° and for its engagement with an abutment which is adapted to complete the flipping of said half-dial following the rotation of said half-dial, together with the needle cylinder, with respect to said abutment.

[0009] 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 sectional view of the portion of the machine related to the upper end of the needle cylinder, taken along a plane which passes through the needle cylinder, in one operating condition of the half-dial;

Figure 2 is a view, similar to Figure 1, of the machine with the half-dial at the beginning of its flipping motion;

Figure 3 is a view, similar to the preceding figures, of the machine with the half-dial during its flipping motion;

Figure 4 is a view, similar to the preceding figures, of the machine with the half-dial approximately half-way along its flipping motion;

Figure 5 is a view of a detail of a portion of the half-dial, illustrating the movement of the half-dial with respect to the abutment that completes its flipping motion.

[0010] With reference to the above figures, the machine according to the invention, generally designated by the reference numeral 1, comprises a needle cylinder 2 which can be rotationally actuated about its own axis 2a with respect to the supporting structure of the machine.

[0011] Inside the needle cylinder 2, proximate to its upper end, there is a half-dial 3 which can flip over about a diametrical axis 4 of the needle cylinder in order to face one half or the other of the needle cylinder 2.

[0012] The half-dial 3 is provided with engagement means 5 for engaging and retaining loops of knitting or yarns knitted by the needles 6 of one half of the needle cylinder and for transferring them, by flipping over about the diametrical axis 4, to the needles 7 of the other half of the needle cylinder 2.

[0013] The machine has means for flipping the half-dial 3 over about the diametrical axis 4; said flip-over means, according to the invention, comprise a pusher 8 which acts on command on the half-dial 3 in order to make it rotate, about the diametrical axis 4, through an angle of less than 90° and so as to achieve its engage-

ment with an abutment 9 which is adapted to complete the flip-over motion of the half-dial 3 about the diametrical axis 4 as a consequence of the rotation of said half-dial 3, together with the needle cylinder 2, about the axis 2a, with respect to the abutment 9.

[0014] The half-dial 3 is substantially composed of an annular body 10 which is arranged internally and coaxially to the needle cylinder 2 and has, on one half of the extension of its lateral surface, a semiannular expanded region 11 which accommodates the engagement means 5, which can be constituted, in a per se known manner, by hooks which can be actuated in a radial direction with respect to the needle cylinder 2 in order to engage and retain the loops of knitting or the yarns knitted by the needles 6 of a first half of the needle cylinder 2 and to transfer said loops or yarns to the needles 7 of the other or second half of the needle cylinder 2.

[0015] The annular body 10 is pivoted about the diametrical axis 4 to a supporting element which is rigidly coupled to the needle cylinder 2 for rotation about the axis 2a.

[0016] Said supporting element is constituted by a hollow cylindrical body 13 which is arranged coaxially inside the needle cylinder 2 and has, on its outer lateral surface, an axial slot 14 in which a key 15 engages; said key is fixed to the inner surface of the needle cylinder 2. In this manner, the cylindrical body 13 is rigidly coupled to the needle cylinder 2 for rotation about the axis 2a, but can be moved, parallel to the axis 2a, with respect to the needle cylinder 2.

[0017] A likewise cylindrical and hollow support 16 is arranged inside the cylindrical body 13 and lies coaxially to the needle cylinder 2. The support 16 is supported, with bearings 17 interposed, by the cylindrical body 13 so that the cylindrical body 13 can rotate jointly with the needle cylinder 2 with respect to the support 16, which instead remains motionless as regards the rotary motion applied to the needle cylinder 2. The support 16 can in any case perform a translatory motion together with the cylindrical body 13 and parallel to the axis 2a of the needle cylinder 2.

[0018] The half-dial 3 rests, with its annular body 10, on a hollow cylinder 18 which is arranged coaxially inside the support 16. The hollow cylinder 18 is rigidly coupled to the support 16 as regards rotation about the axis 2a; i.e., it remains fixed while the needle cylinder 2 and the cylindrical body 13 rotate about the axis 2a, but it can perform a downward translatory motion, parallel to the axis 2a with respect to the support 16, in contrast with the action of elastic means constituted by springs 19 which support it. The function of the hollow cylinder 18 is to support the annular body 10 of the half-dial 3, keeping the half-dial in a plane which is substantially perpendicular to the axis 2a, and to allow the half-dial 3 to flip over, about the diametrical axis 4, by moving downward in contrast with the action of the springs 19, as will become apparent hereinafter.

[0019] The pusher 8 is mounted on the support 16,

and the abutment 9 is likewise mounted on the support 16. Preferably, the abutment 9 is located diametrically opposite with respect to the position occupied by the pusher 8. The pusher 8 is arranged below the plane of arrangement of the half-dial 3 and acts on the lower face of the semiannular expanded region 11.

[0020] The pusher 8 is conveniently constituted by the piston of a fluid-driven cylinder 20, for example a single-acting pneumatic cylinder, formed inside the support 16.

[0021] The abutment 9 is constituted by a pin which is fixed to the support 16 and is orientated so that its axis lies radially with respect to the annular body 10. Said pin 9 is arranged below the plane of arrangement of the annular body 10 in the normal or flipped-over position, i.e., except during the transient flipping-over step, and faces the lateral surface of the annular body 10.

[0022] A passage 21 is formed in the lateral surface of the annular body 10, preferably in its outer lateral surface, and can be engaged by the pin 9 as a consequence of the partial rotation of the half-dial 3 produced by the pusher 8, so as to allow the pin 9 to pass onto the upper side of the annular body 10, completing the overturning of the half-dial 3, as will become apparent hereinafter.

[0023] Preferably, the passage 21 is constituted by a slot formed in the outer lateral surface of the annular body 10, in a median position of the region that is not occupied by the expanded portion 11, and lies at an angle with respect to the upper face and lower face of the annular body 10.

[0024] The cylindrical body 13 can move, through actuation means which are not illustrated for the sake of simplicity, inside the needle cylinder 2 and parallel to the axis 2a, so as to allow to arrange the half-dial 3 at the upper end of the needle cylinder 2, when transferring the knitted loops or yarns from the needles 6 of the first half of the needle cylinder to the needles 7 of the second half of the needle cylinder, or to allow to arrange the half-dial 3 in at a lower level than the upper end of the needle cylinder 2 when this transfer is not required.

[0025] The operation of the knitting machine according to the invention, in transferring knitted loops or yarns from the needles 6 of one half of the needle cylinder 2 to the needles 7 of the other half of the needle cylinder is as follows.

[0026] For transferring knitted loops or yarns from the needles 6 of a first half of the needle cylinder 2 to the needles 7 of the other half of the needle cylinder 2, the half-dial 3, by taking advantage of the fact that the cylindrical body 13 can perform a translatory motion along the axis 2a, is placed at the upper end of the needle cylinder 2 (Figure 1). At this point the engagement means, constituted by the hooks 5, are partially extracted from the half-dial 3 and are placed between the needles 6 of the first half of the needle cylinder 2, for example by means of cams which face, in an upward region, the expanded portion 11 and act on the heels 5a of the hooks 5. In this manner the engagement means engage

portions of the loops knitted by the needles 6 which, when retracted into the half-dial 3, retain said loop portions.

[0027] While the loops are thus engaged and retained, when the expanded portion 11 lies above the pusher 8, the pusher 8 is actuated, causing the half-dial to rotate about the diametrical axis 4 through an angle of less than 90° which is in any case sufficient to produce the engagement of the pin or abutment 9 with the slot or passage 21 (Figure 2). As a consequence of this engagement, together with the fact that the half-dial 3 rotates together with the needle cylinder 2 about the axis 2a with respect to the pin 9, the pin 9 lies on the upper face of the annular body 10 (Figure 3).

[0028] By continuing the rotation of the half-dial 3 together with the needle cylinder 2 about the axis 2a due to the fact that the pin 9 is arranged above the annular body 10, a complete overturning of the half-dial 3 occurs, which once it has been turned over again has the annular body 10 arranged above the pin 9.

[0029] The overturning of the half-dial 3 is allowed by the downward elastic yielding of the hollow cylinder 18.

[0030] Once overturning has been completed, the expanded portion 11, with the engagement means 5, faces the needles 7 of the second half of the needle cylinder. The engagement means 5 are then actuated in a per se known manner, for example in a manner similar to the one described in the above mentioned EPA No. 98105734.2, so as to release the previously retained loops onto the needles 7 of the second half of the needle cylinder 2.

[0031] In order to overturn the half-dial 3 again, it is sufficient to actuate the pusher 8 again, which in the meantime has been moved to the inactive position, when the expanded portion 11 lies above said pusher 8.

[0032] Once the loops have been transferred, the half-dial 3, by taking advantage of the fact that the cylindrical body 13 can move along the axis 2a, can be moved into a recessed position inside the needle cylinder 2.

[0033] In practice it has been observed that the machine according to the invention, thanks to the particular half-dial flip-over mechanism, fully achieves the intended aim, since it can transfer the knitted loops of knitting or yarns from the needles of one half of the needle cylinder to the needles of the other half of the needle cylinder without interrupting the production cycle.

[0034] Another advantage of the machine according to the invention is that it allows to utilize all of the inside of the annular body of the half-dial for the passage of the item being formed.

[0035] The machine 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.

[0036] In practice, the materials employed, as well as the dimensions, may be any according to requirements and to the state of the art.

[0037] The disclosures in Italian Patent Application No. MI98A001233 from which this application claims priority are incorporated herein by reference.

[0038] 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 flip-over half-dial, comprising a needle cylinder (2) which can be actuated so as to rotate about its own axis (2a) and a half-dial (3) provided with engagement means (5) for engaging the yarns or loops of knitting, said half-dial (3) being able to flip over about a diametrical axis (4) of the needle cylinder (2) in order to face, with said engagement means (5), the needles (6) of one half of the needle cylinder (2) or the needles (7) of the other half of the needle cylinder (2); flip-over means (8) being provided for flipping over said half-dial (3) about said diametrical axis (4); characterized in that said half-dial (3) is arranged inside the needle cylinder (2) and is pivoted, about said diametrical axis (4), to a supporting element (13) which is rigidly coupled to said needle cylinder (2) for joint rotation about its axis (2a); said flip-over means comprising a pusher (8) which acts on command on said half-dial (3) for its rotation about said diametrical axis (4) through an angle of less than 90° and for its engagement with an abutment (9) which is suitable to complete the flipping of said half-dial following the rotation of said half-dial (3), together with the needle cylinder (2), with respect to said abutment (9).
2. The machine according to claim 1, characterized in that said half-dial (3) comprises an annular body (10) with a semiannular expanded portion (11) which is connected to half of its lateral surface and accommodates said engagement means (5), said annular body (10) being arranged coaxially in the needle cylinder (2).
3. The machine according to claims 1 and 2, characterized in that said pusher (8) is mounted on a support (16) which is arranged inside the needle cylinder (2) and is coupled to the supporting structure of the machine so as to remain motionless during rotation of the needle cylinder (2) about its own axis (2a).
4. The machine according to one or more of the preceding claims, characterized in that said pusher (8) is arranged below the plane of arrangement of said

half-dial (3), in the normal or flipped position, and acts on the face of said semiannular expanded portion (11) of the half-dial (3).

5. The machine according to one or more of the preceding claims, characterized in that said abutment (9) is fixed to said support (16) of said pusher (8).
6. The machine according to one or more of the preceding claims, characterized in that said abutment comprises a pin (9) which is directed radially with respect to said annular body (10), said pin (9) being arranged below the plane of arrangement of said half-dial (3) in the normal or overturned position and facing the lateral surface of said annular body (10).
7. The machine according to one or more of the preceding claims, characterized in that said pin (9) is arranged in a region which lies diametrically opposite said pusher (8) relative to the axis (2a) of the needle cylinder (2).
8. The machine according to one or more of the preceding claims, characterized in that said pin (9) can engage a passage (21), formed in the lateral surface of said annular body (10), following the rotation about said diametrical axis (4) produced by said pusher (8), in order to pass onto the upper side of said annular body (10), completing the flip-over of the half-dial (3) about said diametrical axis (4).
9. The machine according to one or more of the preceding claims, characterized in that said pin (9) faces the outer lateral surface of said annular body (10), and in that said passage (21) is formed on the outer lateral surface of said annular body (10) that is not occupied by said semiannular expanded portion (11).
10. The machine according to one or more of the preceding claims, characterized in that said passage (21) is formed in an intermediate region of the portion of the outer lateral surface of said annular body (10) that is not occupied by said semiannular expanded portion (11).
11. The machine according to one or more of the preceding claims, characterized in that said passage (21) is constituted by a slot which is formed in the outer lateral surface of said annular body (10) and lies at an angle with respect to the upper face and lower face of said annular body (10).
12. The machine according to one or more of the preceding claims, characterized in that said supporting element (13) of the half-dial (3) and said support (16) of the pusher (8) can move on command, with

respect to the needle cylinder (2), in a direction which is substantially parallel to the axis (2a) of the needle cylinder (2).

13. The machine according to one or more of the preceding claims, characterized in that said pusher (8) is constituted by the piston of a fluid-driven cylinder (20).

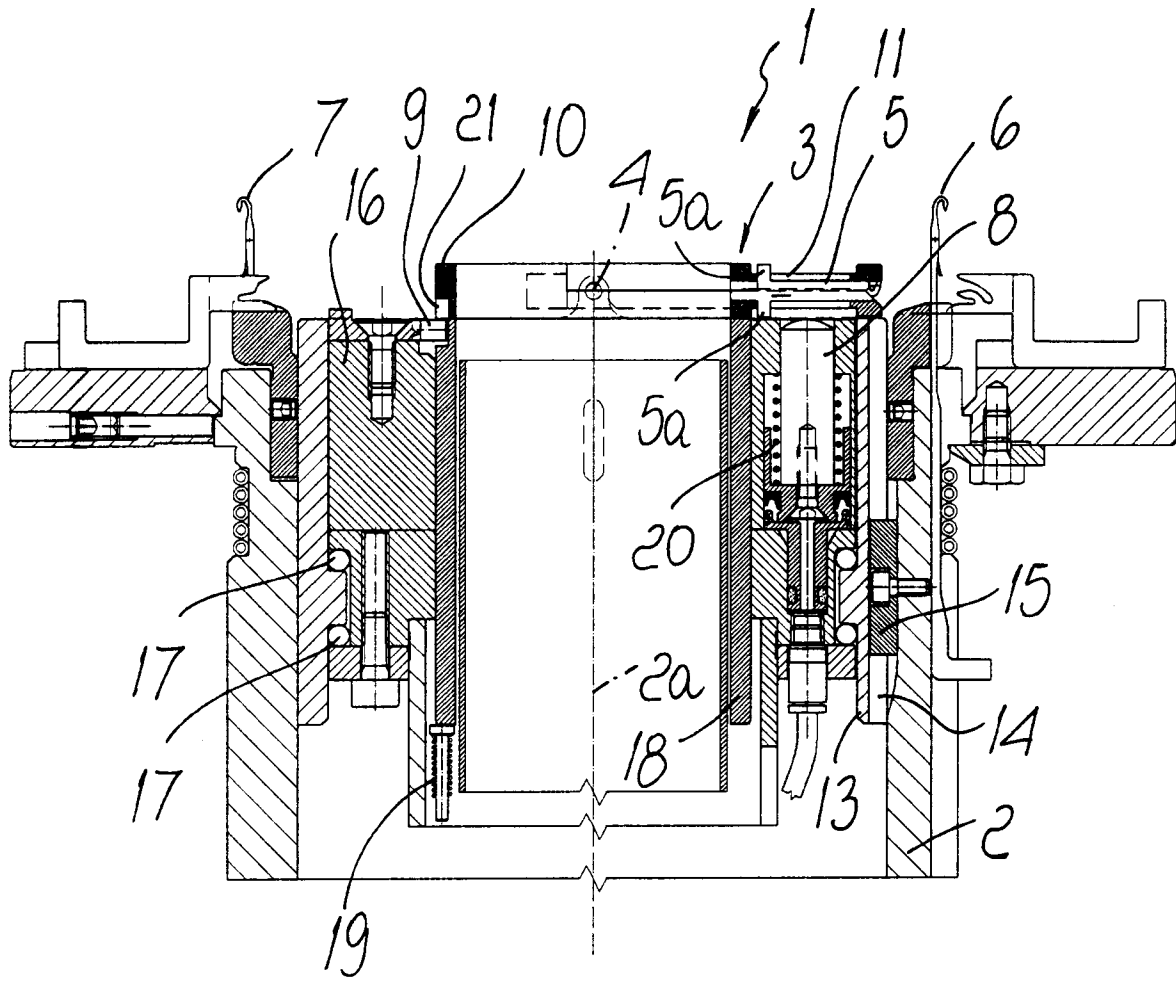


Fig. 1

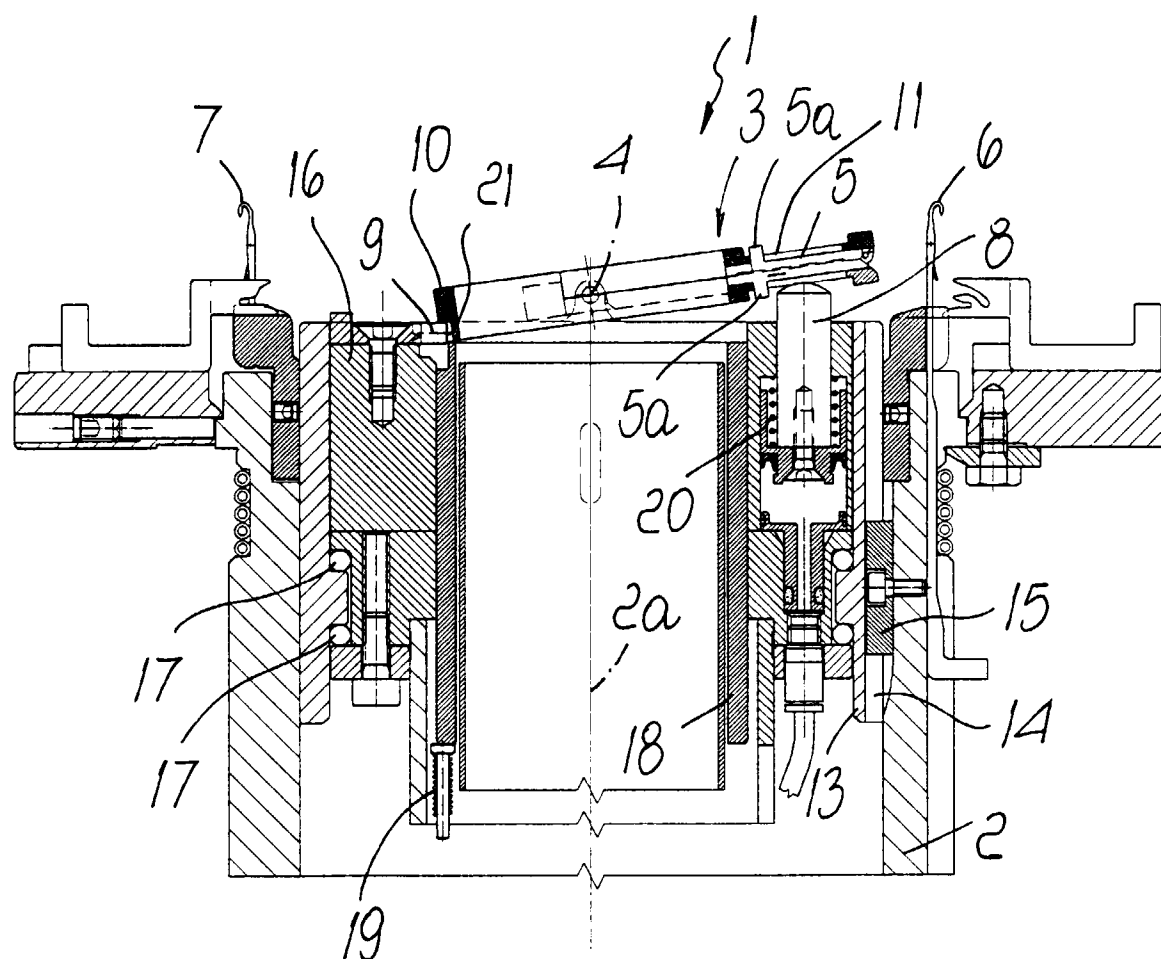


Fig. 2

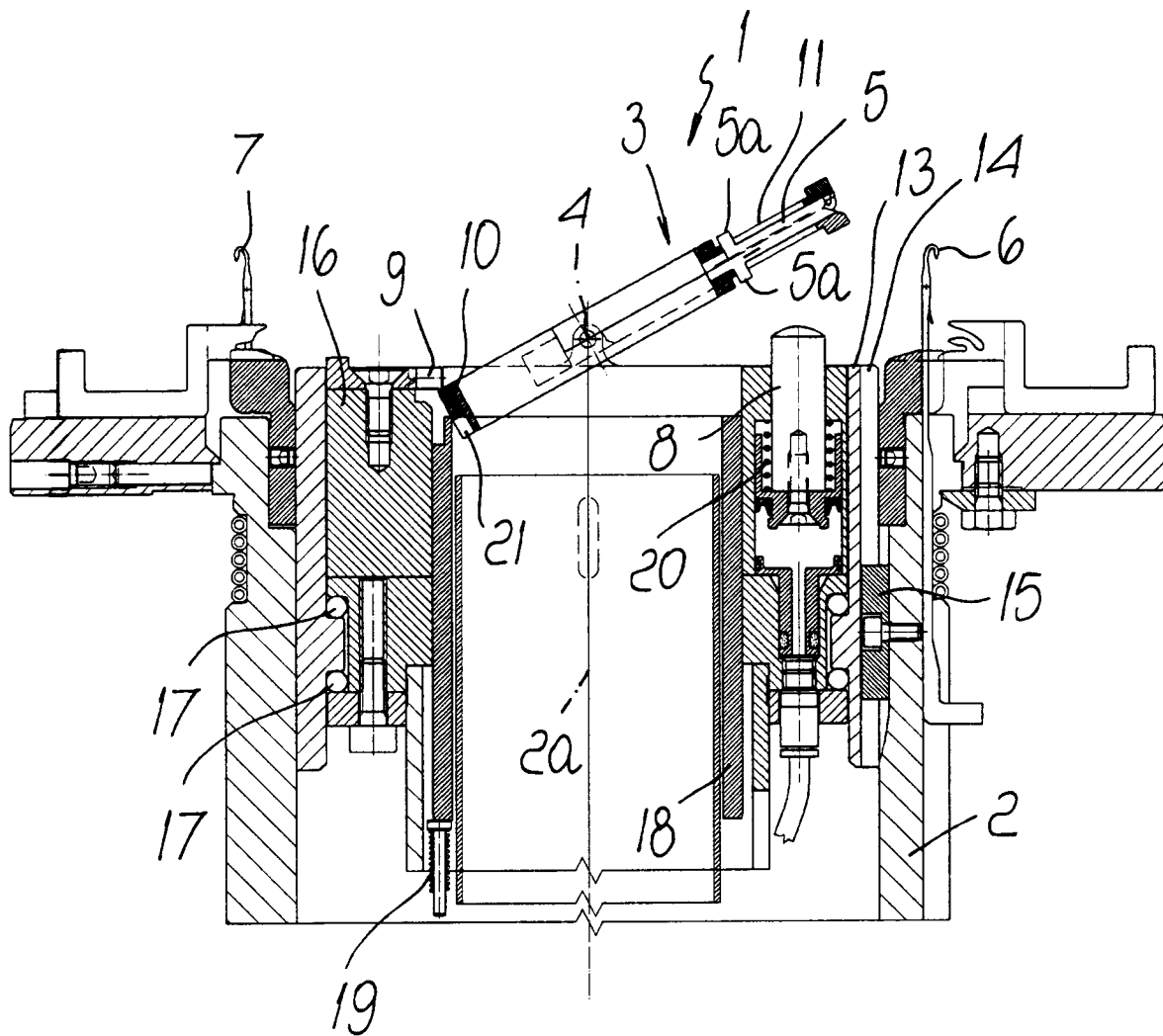


Fig. 3

