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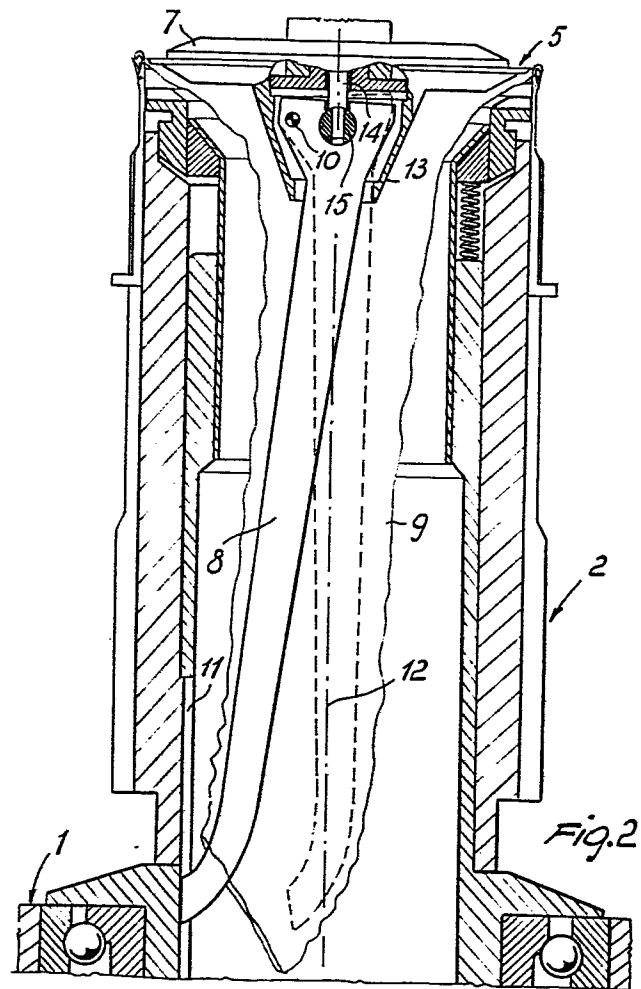
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⑤④ **A cylinder-and-dial circular knitting machine particularly for knitting hosiery.**

⑤⑦ In a circular knitting machine of the cylinder and dial type, specially useful for knitting hosiery, the dial (5) is driven rotatively through a link rod (8) provided in the cylinder (2) interior and being rotatively rigid with the dial (5). The link rod (8) is journaled about an axis perpendicular to the machine axis (12), and has a bottom end engageable with a longitudinal inner groove (11) of the cylinder (2). An actuating rod (14), which is journaled with its bottom end to the link rod (8) and axially displaceable, permits the link rod (8) to be shifted between a position of engagement with the cylinder (2) and a position of disengagement therefrom, whereat the knitted fabric (9) may be discharged from the machine. In the engagement position, the fabric (9) is laid progressively onto the link rod (8) which, accordingly, will also drive the fabric (9) rotatively.



"A CYLINDER-AND-DIAL CIRCULAR KNITTING MACHINE
PARTICULARLY FOR KNITTING HOSIERY"

This invention relates to a cylinder-and-dial circular knitting machine particularly for knitting hosiery, of a type wherein the needle cylinder and dial are made rotatively rigid together by means of a connection rod located inside the cylinder, the connection rod being rotatively connected to the dial and movable between a position of engagement with the cylinder and a position of disengagement from the cylinder, whereat the knitted fabric can be discharged from the machine.

A machine of this general type is disclosed in European Patent Appln. N. 82103667.0 filed on April 29, 1982 by this same Applicant. The rod, which is arranged to extend coaxially with the needle cylinder and dial, is movable axially between said two positions by an air-operated means located above the machine. The rod has a chamfered lower end adapted to penetrate an axial bore in an entrainment element rigid with the cylinder, and to pressure engage with a cross pin partly inserted in said bore, so as to establish a rigid cylinder-to-dial connection. While knitting, the tubular knitted fabric is deposited progressively onto the entrainment element, being held there by the rod which remains inside the fabric tube. Disengagement of the rod from the entrainment element enables the fabric to be released and slide down along an incline of the entrainment element.

This system of rotatively engaging the dial with the cylinder advantageously affords the elimination of the traditional mechanisms of the gear type for rotating

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the dial which mechanism, owing to progressive wear of the teeth, do not allow an accurate timing of the cylinder and dial to be maintained for long times, that is, true alignment of the needles in the two structures
5 is lost after a certain time of operation.

On the other hand, the machine of the cited patent application has shown some practical disadvantages, owing in part to the length of the rod inside the cylinder being required to permit the formation
10 of a certain quantity of tubular fabric before the same can be held on the entrainment element. That length may bring about some difficulties when removing the rod for cylinder checking or servicing purposes. Also the type of engagement with the entraining element
15 may result in the product jamming with the members engaged. Knitting requirements would make a thinner rod desirable, although excessive thinning thereof could jeopardize the positive nip between the rod and entrainment element, thus no longer ensuring an
20 accurate timing of the dial and cylinder on account of the excessively small surface areas of mutual engagement. Further, disengagement and raising of the rod to enable the knitted fabric to be discharged, as well as renewed engagement for the subsequent knitting,
25 require a relatively long time, which results in the reduction of the machine output rate.

Known from US Patents No.s 1,361,291 and 1,459,446 are circular knitting machines incorporating devices operative to make the needle cylinder rigid with the
30 dial, wherein the coupling rod instead of engaging directly with an entraining element attached rigidly

to the needle cylinder, controls through its axial movement two arms which are journalled, about an axis perpendicular to the cylinder axis, to a tubular element surrounding the rod in the cylinder interior and being rotatively rigid with the dial. The rod-arms connection is in the form of an articulated parallelogram. In one position of the rod, the two arms take a downwards sloping position of disengagement from the cylinder to permit the fabric discharging, and in the other position, take a radial position and engage with teeth rigid with the cylinder inner wall to drive the dial with the cylinder.

These devices have the drawback of occupying a large space inside the needle cylinder at the center area thereof, owing to the presence of the tubular element which guides the rod, which makes the downward movement of the knitted fabric being formed the more difficult. Moreover, the fabric, in resting on the two substantially radially extending arms in the position of engagement with the cylinder, substantially cuts off the suction which is normally exerted from below on the fabric being knitted. Due to the complex construction of the inner structure and the provision of a number of structural elements and pivot pins, the fabric may be easily snarl and a smooth formation of the knitted fabric may be jeopardized.

It is a primary object of this invention to provide a circular knitting machine of the type indicated above, which can overcome the limitations and practical disadvantages set forth above, while

retaining the advantages of that type of rod connection between the cylinder and dial, with a simpler, less bulky, and more rapidly actuatable structure.

5 A further object of the invention is to provide a machine as indicated, which can advantageously do without so-called anti-twist devices, that is devices effective to prevent twisting of the fabric with respect to the cylinder as the knitted fabric is being
10 formed.

 These and other objects, such as will be apparent hereinafter, are achieved by a circular knitting machine of the type specified in the preamble, which is characterized in that the connection rod is
15 journalled on the dial structure about an axis perpendicular to the axis of the dial and needle cylinder and has a substantially longer length than the diameter dimension of the needle cylinder, said connection rod being movable between a disengagement position
20 substantially coaxial with said needle cylinder and a position of engagement with a longitudinal groove in the needle cylinder interior.

 Advantageously, with a machine as above, the rod is no longer required to perform an axial stroke, but
25 just a short oscillation to move from one position into the other, which affords a significant reduction in operation time, as well as a reduction in the downtime connected with the discharging of the knitted fabric. The axial rest position of the rod allows
30 retention of the advantages afforded by the machine

according to the cited patent application in connection with removal of the rod through the top to gain access to the machine interior, but with the added advantage that the rod may now be made shorter, thereby the rod has a shorter removal stroke and consequently a shorter load-bearing structure on top of the machine. The engagement of the rod end with the cylinder groove makes the provision of a special entrainment element in the machine unnecessary and ensures a more positive timing because the engagement is led back to a lever arm in a ratio of nearly 1:1 to the cylinder. The absence of the entrainment element, moreover, favors the fabric discharging, which can take place more rapidly. The engagement position, whereat the rod is inclined with respect to the axial direction, advantageously provides a stop for the downwardly moving fabric which, being set to rest on the rod while being knitted, is driven rotatively by the rod itself, thereby there is no risk of snarling taking place, and this without resorting to any auxiliary means.

When compared to US Patents No.s 1,361,291 and 1,459,446, the advantage becomes apparent that in the cylinder inside, where the fabric is knitted and conveyed downwards, there is provided but the connection rod, and no other bulky structures. Owing to the rod being journalled directly on the dial, there is no danger of the fabric snarling, since the rod journalling area is located outside of the area affected by the fabric being knitted. Nor is there

any danger of the suction being cut off, because the fabric arranges itself along the inclined connection rod engaged with the cylinder. It should be noted that a mere transfer of the journalling points of the engagement arms of said two US patents from the tubular element to the dial structure would result in a useless device, because it would allow no fabric formation, the fabric being at once held back in the fabric knitting area.

According to a preferred embodiment of the invention, the axis of rotation of the connection rod is located offcentered with respect to the axis of the cylinder and dial, thereby the rod actuation between said two positions may simply occur by shifting axially an actuation rod extending coaxially with the machine and being journalled at the bottom directly on the connection rod, without utilizing any articulated parallelogram type of arrangement.

Further features and advantages of the invention will be more clearly understood from the following detailed description of a preferred, though not exclusive, embodiment thereof, given herein by way of example only with reference to the accompanying drawings, where:

Figure 1 is a diagrammatic, partly sectional, view of a machine according to the invention;

Figure 2 is an enlarged scale axial section view of the needle cylinder and dial on that same machine; and

Figure 3 is an axial section through the upper portion of the machine of Figure 1, on the same scale as Figure 2.

5 With reference to the accompanying drawings, a cylinder-and-dial circular knitting machine according to the invention, as particularly useful in hosiery applications, comprises, in a manner known per se, a stationary structure 1 which carries rotatively a needle cylinder 2 driven by means of a driveshaft 3
10 via a bevel gear pair 4. Located above the cylinder 2 is a dial 5, carried rotatably on a non-rotatable supporting structure 6, which structure also supports a plate 7 controlling needles or hooks of the dial 5, not shown.

15 For rotatively driving the dial 5, there is provided a connection rod 8 extending inside the cylinder 2 and being rotatively connected to the dial 5 and movable between a position of engagement with the cylinder 2 and a position of disengagement from
20 the cylinder 2 whereat the knitted fabric 9 may be discharged from the machine.

According to the invention, the connection rod 8 is journaled on the structure of the dial 5 about an axis 10 which is perpendicular to the axis of the
25 dial 5 and needle cylinder 2 and has a substantially greater length than the diameter of the cylinder 2, the connection rod 8 being movable between a disengagement position substantially coaxial with the cylinder 2 (position shown in Figure 1) and an engagement

position with a longitudinal groove 11 inside the cylinder 2 (position shown in full lines in Figure 2).

Advantageously, the lower end of the rod 8, which is intended for engagement with the groove 11, is slightly bowed progressively toward the groove, so as to generate a curved bearing line for the tubular knitted fabric 9 in the engagement position, as shown in Figure 2. The rod 8 is preferably flattened in a plane perpendicular to the pivot axis 10.

In the embodiment shown, the pivot axis 10 of the connection rod 8 is offcentered relatively to the axis 12 of the machine, i.e. does not contain the axis 12. This feature enables the rod 8 to be actuated in a specially simple fashion. In fact, the body 13 of the dial 6, which has the traditional crater-like shape penetrating the cylinder 2 and is of hollow construction at the portion inserted into the cylinder 2 and open at the bottom for the rod 8 to pass there-through, is penetrated by the lower end of an actuation rod 14 which extends coaxially with the machine and is connected to the upper portion of the connection rod 8 through a swivel joint 15 whose axis is parallel to the pivot axis 10 of the rod 8. The upper end of the rod 8 is advantageously enlarged in a plane perpendicular to the pivot axis 10 and is accommodated between parallel surfaces of an entrainment body 13a, directed perpendicularly to the axes 10 and 15. The entrainment body 13a, to which the rod 8 is ultimately journalled, is carried rigidly by the rod 14 and is rigid with the body 13 of the dial 5,

internally thereto, thereby the rotation of the rod 8 about the axis 12 of the machine results in a corresponding rotation of the dial 5.

5 The actuation rod 14 extends upwards through the non-rotatable structure 6, being passed loosely through a bushing 16 made rigid and coaxial with the body 13 and being supported rotatably, through bearings 17, by the upper portion 18 of the structure 6. The rod 14 is made rigid, at its upper end, with
10 a support block 19 which is, in turn, carried rotatably by the piston rod 20 of a piston 21 moving in a small chamber 22 defined in the upper portion of the structure 6 and being closed at the top by a closure element 23. Interposed between the latter and the
15 piston 21 is a spring 24 biasing the piston 21 downwards. Below the piston 21, the chamber 22 may be connected, through a conduit 25, to a pressurized fluid source, not shown. A valving arrangement, also not shown, allows the pressurized fluid, in particular
20 air, to be supplied into the chamber 22, and the air to be exhausted from said chamber to an exhaust system at a preset time, as will be explained hereinafter.

To gain access to the interior of the cylinder 2,
25 such as for servicing purposes or to set up the knit-work, the whole structure of the dial 5 and the non-rotatable structure 6 is supported raisably in the direction of the axis 12 of the machine by a distance at least equal to the length dimension of the connection
30 rod 8 by means of an arm 26 made rigid with a sleeve

27, which sleeve can slide axially along a fixed vertical guide 28 the length whereof is selected to allow the connection rod 8 to be shifted outside the cylinder 2. A variety of arrangements may be used to displace the arm 26. In the embodiment illustrated, the guide 28 has a longitudinal groove 29, wherein a peg 30, rigid with the sleeve 27, can slide and is directed perpendicularly to the guide 28. Provided in the groove 29 are mutually spaced apart notches 31, whereinto a dog 32, pivoted to one end of a small control lever 33, may be inserted, said control lever being journaled on the sleeve 27 about an axis perpendicular to the sleeve own axis. A spring 34 acting on the end of the lever 33 opposite to that carrying the dog 32, tends to hold the dog 32 in engagement with one of the notches 31. Thus, it becomes possible to hold the supporting structure of the dial 5, and the dial itself, and the connection rod 8 suspended at different heights when the machine is inoperative, so as to gain access as required to the interior of the cylinder 2.

It may be appreciated that the relatively short length of the connection rod 8, corresponding substantially to that of the needle cylinder 2, also enables the overall height of the guide 28 to be kept limited, while ensuring full accessibility to the cylinder interior with the rod 8 fully drawn out.

Of course, raising of the structure of the dial 5 could also be accomplished through a pneumatic means, such as that described in the patent application initially cited.

It will be understood from the foregoing that in the normal condition of operation of the machine, as the dial 5 is required to rotate in timed relationship with the cylinder 2, the chamber 22 is not under pressure and the spring 24 urges the piston 21, and hence the rod 14, downwards into a position whereby the rod 8 takes its inclined position of engagement with the cylinder 2. On completion of the knitwork, fluid under pressure is introduced into the chamber 22, thereby the piston 21 is raised to abut against the lower edge of the closure element 23, and the rod 14 is also slightly raised enough to bring the rod 8 into the substantially axial disengagement position of Figure 1. Thus, the fabric 9 is allowed to drop freely and suction discharged from the machine. The involved time periods are specially short, thanks to the very small stroke of the actuation rod 14, and there is no danger of the fabric 9 being caught by an entrainment element. It should be noted that thanks to the arrangement and length dimension provided for the connection rod 8, a very short angular stroke length may be provided, and accordingly, a very short time period, to move from the engagement position into the disengagement one, contrary to the devices of the cited US patents, wherein the stroke length of the engagement arms is much longer.

The absence of auxiliary antitwisting means affords considerable savings along with a simplified construction.

It has been found that with some particular yarn

types, it is even possible to achieve a higher quality for the product than for a comparable product knitted on a machine equipped with a conventional antitwist device, where the fabric tends to
5 be distorted by the continuously applied suction force. On the contrary, with the inventive machine, the fabric is laid and piled onto the rod end in a far softer fashion. Further, with a machine according to this invention, rotational speeds of
10 1200 rpm have been easily achieved in the knitting of stockings.

It should be also noted that the engagement between the lower end of the rod 8 and groove 11 occurs between relatively large surfaces, and hence
15 with optimum assurance of the cylinder-dial timing.

The invention described hereinabove is, of course, susceptible of many modifications and variations without departing from the true scope of the instant inventive concept. Thus, as an example,
20 the rotation axis of the rod 8 could also intersect the machine axis, and the control of the rod 8 could be provided through a vertical actuation rod not coaxial with the cylinder 2. The shape of the rod 8 may be different from that illustrated.

CLAIMS

1 1. A cylinder-and-dial circular knitting machine
2 particularly for knitting hosiery, wherein the needle
3 cylinder (2) and dial (5) are made rotatively rigid
4 together by means of a connection rod (8) located
5 inside the cylinder (2), said connection rod (8) being
6 rotatively connected to the dial (5) and movable.
7 between a position of engagement with the cylinder
8 (2) and a position of disengagement from the cylinder
9 (2), whereat the knitted fabric (9) can be discharged
10 from the machine, characterized in that the connection
11 rod (8) is journalled on the dial structure about an
12 axis (10) perpendicular to the axis of the dial (5)
13 and needle cylinder (2) and has a substantially long-
14 er length than the diameter dimension of the needle
15 cylinder (2), said connection rod (8) being movable
16 between a disengagement position substantially coaxial
17 with said needle cylinder (2) and a position of en-
18 gagement with a longitudinal groove (11) in the needle
19 cylinder (2) interior.

1 2. A machine according to Claim 1, characterized
2 in that said connection rod (8) is journalled about an
3 offcentered axis (15) relatively to the machine
4 axis (12).

1 3. A machine according to either Claim 1 or 2,
2 characterized in that for controlling said connection
3 rod (8) there is provided an actuation rod (14) jour-
4 nalled at the lower end thereof directly to said con-
5 nection rod (8) about an axis (15) parallel to the
6 pivot axis (10) of said connection rod (8), said ac-

7 tuation rod (14) extending through said dial (5) and
8 being movable axially between two positions to which
9 said two positions of said connection rod (8) corres-
10 pond.

1 4. A machine according to Claim 3, characterized
2 in that said connection rod (8) is journaled to an
3 entrainment body (13a) made rigid with the dial (5)
4 body on the inside thereof and being carried rigid-
5 ly by said actuation rod (14).

1 5. A machine according to either Claim 3 or 4,
2 characterized in that said actuation rod (8) is carried
3 rotatably by the piston rod (20) of a piston (21) set
4 movable in a chamber (22) defined in a non-rotatable
5 structure (6) above the dial (5), said piston (21)
6 being subjected at the top to the action of a spring
7 (24) tending to move said actuation rod (14) into the
8 position corresponding to the position of engagement
9 of said connection rod (8) with the needle cylinder
10 (2), below said piston (21) said chamber (22) being
11 selectively connectable to a source of a pressurized
12 fluid and to an exhaust system.

1 6. A machine according to one or more of the
2 preceding claims, characterized in that the lower
3 end of said connection rod (8) is slightly bowed
4 toward the needle cylinder (2) to define a bearing
5 line for the fabric (9) being knitted.

1 7. A machine according to one or more of the
2 preceding claims, characterized in that said connec-
3 tion rod (8), said dial (5), and the supporting struc-
4 ture for said dial (5) can be raised axially by a

7 distance at least equal to the length of said connection
8 rod (8) to move said connection rod (8) outside said
9 cylinder (2).

1 8. A machine according to Claim 7, characterized in
2 that said connection rod (8), said dial (5) and the
3 supporting structure for the dial (5) are positiona-
4 ble at different heights by the engagement of a dog
5 (32), carried on said supporting structure, in mutual-
6 ly spaced apart notches (31) of a fixed vertical
7 guide (28).

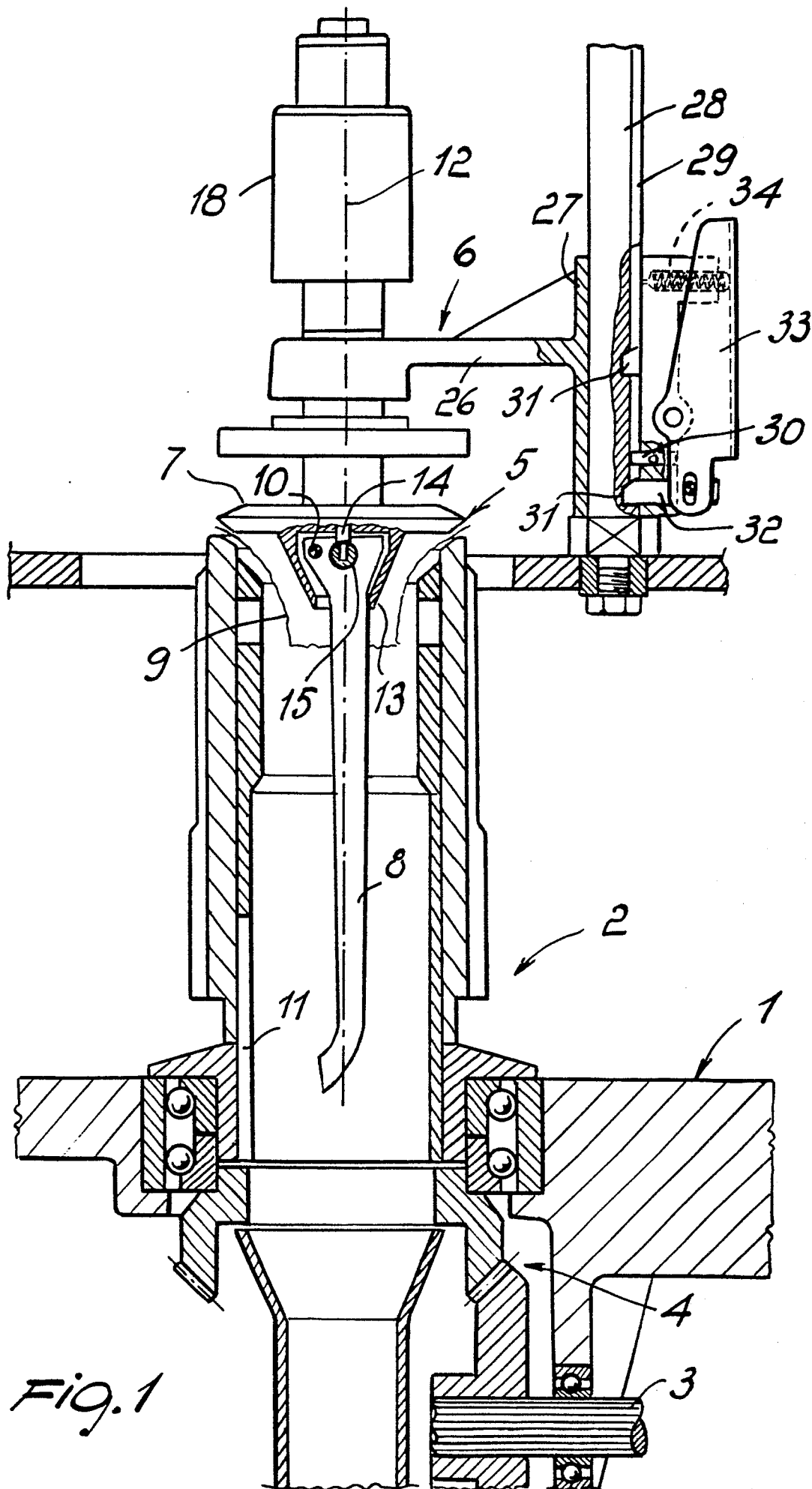
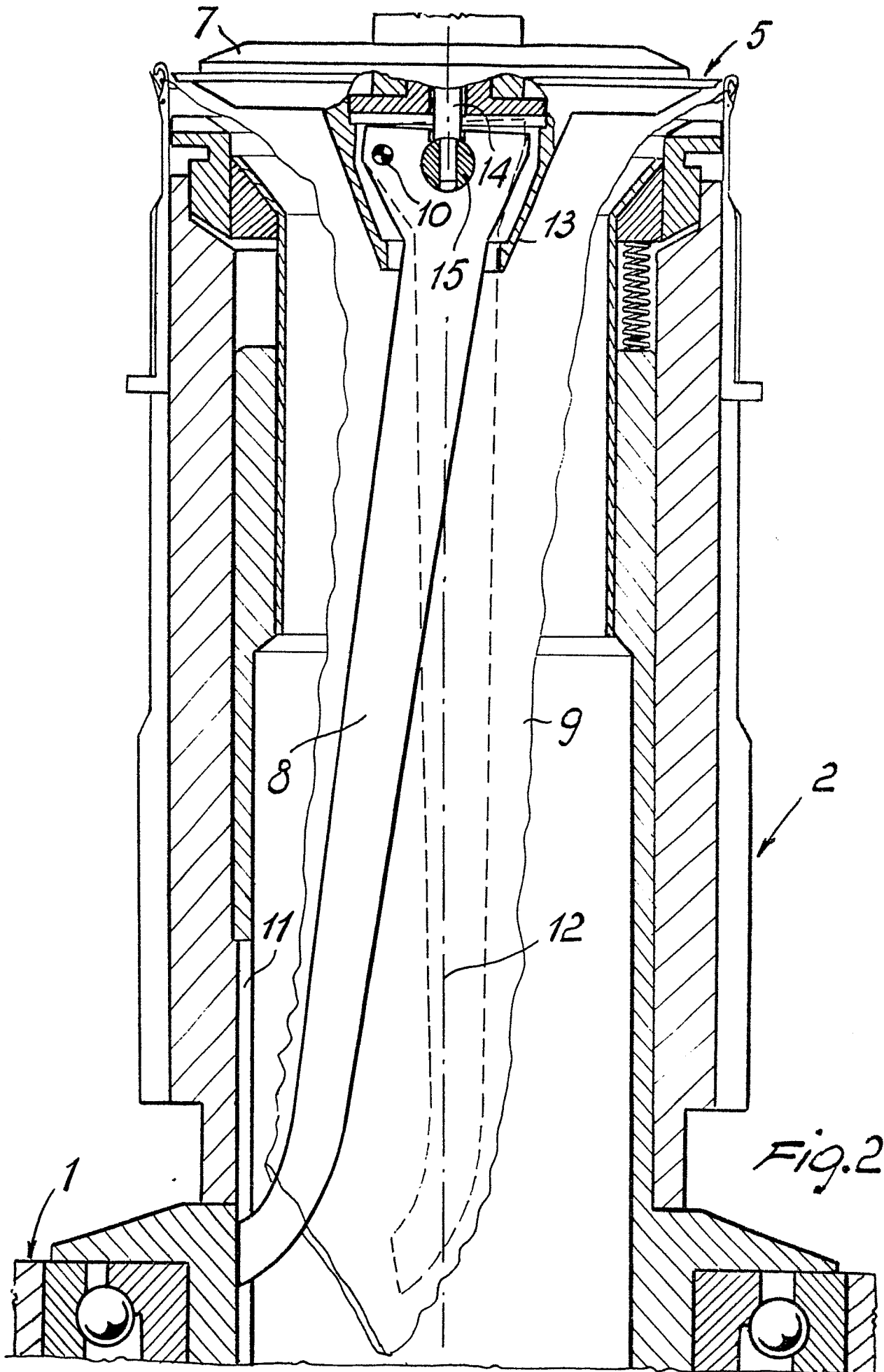


FIG. 1



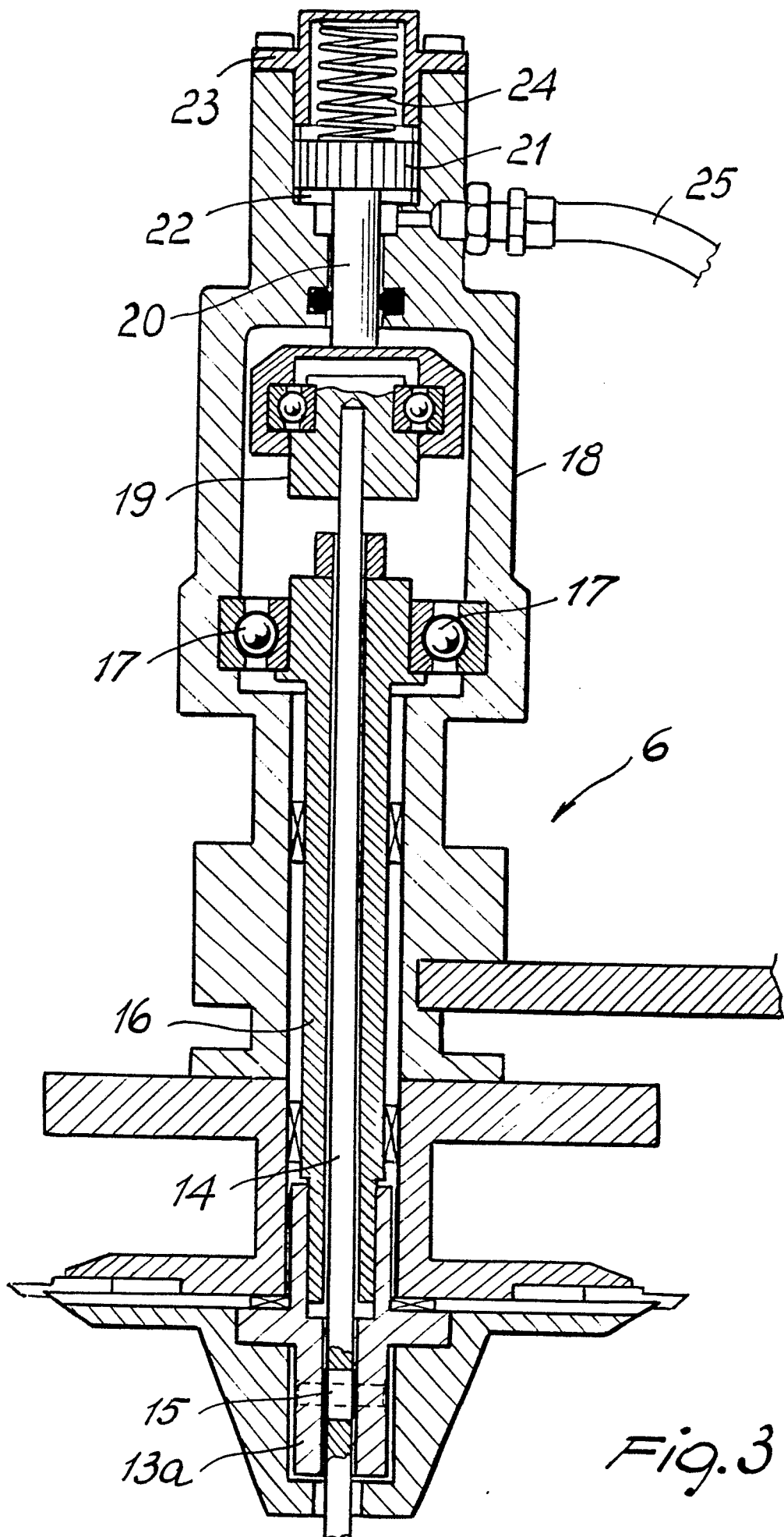


Fig. 3