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MI2011A000313 1 March 2011 (01.03.2011) IT(71) Applicant (for all designated States except US): **SAN-
TONI S.P.A.** [IT/IT]; Via Carlo Fenzi, 14, 25135 Brescia
(IT).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **LONATI, Ettore**
[IT/IT]; Via Sott'acqua, 32, 25082 Botticino (IT).
LONATI, Fausto [IT/IT]; Via Mediana, 12, 25123 Bres-
cia (IT). **LONATI, Tiberio** [IT/IT]; Via Sera, 24, 25123
Brescia (IT).(74) Agent: **MODIANO, Micaela**; Modiano & Partners, Via
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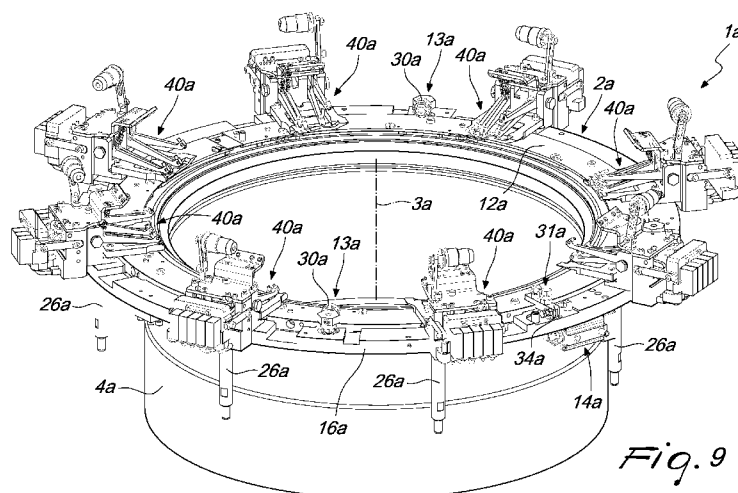
(54) Title: CIRCULAR HOSIERY KNITTING MACHINE WITH HIGH STITCH FORMING PRECISION AND HIGH OPERAT-
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Fig. 9

(57) Abstract: A circular hosiery knitting machine with high stitch forming precision and high operating versatility. The machine (1, 1a) comprises a supporting structure (2, 2a) and a needle cylinder (4, 4a) which is oriented so that its axis (3, 3a) is substantially vertical and is provided, on its lateral surface, with a plurality of axial slots (5, 5a), each of which accommodates a needle (6, 6a) which can be actuated with a reciprocating motion along the corresponding axial slot (5, 5a). A sinker ring (7, 7a) is arranged around the upper end of the needle cylinder (4, 4a), is coaxial to the needle cylinder (4, 4a) and is provided with a plurality of radial slots (8, 8a), each of which accommodates a sinker (9, 9a), which can move with a reciprocating motion along the corresponding radial slot (8, 8a). Each sinker (9, 9a) is provided with a heel (10, 10a) which protrudes upward from the corresponding radial slot (8, 8a) and can engage at least one path defined in a sinker cover (12, 12a), which faces in an upper region the sinker ring (7, 7a). The needle cylinder (4, 4a) is actuatable with a rotary motion about its own axis (3, 3a) with respect to the supporting structure (2, 2a) and the sinker cover (12, 12a). The machine (1, 1a) comprises means (13, 13a) for adjusting the position of the sinker cover (12, 12a) on a plane which is substantially perpendicular to the axis (3, 3a) of the needle cylinder (4, 4a) with respect to the supporting structure (2, 2a) and means (14, 14a) for varying the angular position of the sinker cover (12, 12a) around the axis (3, 3a) of the needle cylinder (4, 4a) with respect to the supporting structure (2, 2a).



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CIRCULAR HOSIERY KNITTING MACHINE WITH HIGH STITCH FORMING PRECISION AND HIGH OPERATING VERSATILITY

The present invention relates to a circular hosiery knitting machine with high stitch forming precision and high operating versatility.

5 As is known, in hosiery knitting machines the knockover sinkers, commonly termed sinkers, cooperate with the needles in forming stitches. The sinkers are arranged between the needles of the machine and have the function of defining a resting surface for the yarn supplied to the needles while they are forming a new loop of knitting and then of tensioning the
10 loop of knitting against the shank of the needle while it is being moved to pick up the yarn in order to form a new loop of knitting, so as to produce assuredly the opening of the tab or tongue of the needle while the old loop of knitting is lowered on the shank of the needle.

 In circular hosiery knitting machines, the sinkers are accommodated
15 individually inside a radial slot defined in the sinker ring, which is fixed coaxially to the needle cylinder proximate to its upper end. Each sinker is arranged between two contiguous needles and is provided with at least one heel which protrudes upwardly from the corresponding slot of the sinker ring. Such heel engages in paths defined by cams which are connected to a
20 sinker cover which faces the sinker ring in an upward region. The paths defined by such cams are shaped so as to produce, as a consequence of the actuation of the needle cylinder with a rotary motion about its own axis with respect to the sinker cover, a movement of the sinkers along a radial direction, in the corresponding slot, with respect to the needle cylinder.

25 In medium-diameter circular machines for manufacturing knitted articles without lateral seams, also known as knitting machines of the seamless type, which, as is known, are derived conceptually from circular hosiery knitting machines, and in small-diameter circular machines for making socks and stockings, which provide tubular articles often with
30 shapes obtained by varying the density of the knitting from one row to the

next and sometimes even along a same row of knitting, there is the need to vary the actuation of the sinkers during the production of the article.

This need is met by providing at least part of the cams mounted in the sinker cover so that they can move by way of the action of actuators which
5 can be actuated by the electronic control and monitoring element that supervises the operation of the machine and/or by providing the sinker cover so that it can be rotated, through arcs of preset extent, by means of other actuators, which also can be actuated by the control and monitoring element, so that the paths defined by the cams can be offset in advance or
10 with a delay from one kind of knitting to another, according to the requirements.

Generally, in these types of machine the sinker cover rests on the sinker ring, with the optional interposition of bearings, so that the sinker ring can rotate, jointly with the needle cylinder, about the needle cylinder
15 axis with respect to the sinker cover, which is connected, for example by means of the above mentioned actuators, to the supporting structure of the machine.

In practice, in these machines the sinker cover is supported by the needle cylinder and during the fine-tuning of the machine its position can be
20 "centered" adequately with respect to the needle cylinder.

The centering of the sinker cover performed with respect to the needle cylinder suffers the drawback of not ensuring high precision, since the needle cylinder, being a constantly moving element, often with high rotation rates, during the operation of the machine can alter the position of the sinker
25 cover also with respect to such needle cylinder.

Even small variations of the position of the sinker cover can cause unwanted variations of the tension of the stitches with respect to the tension that is preset in the program followed by the control and monitoring element that supervises the operation of the machine, reducing knitting precision.

30 These variations lead to the provision of products of poor quality and

are intolerable in knitting that requires high precision and regularity in the forming of the stitches.

In medium- and large-diameter circular knitting machines, the sinker cover is assembled and coupled to the supporting structure of the machine.

5 In these machines it is still possible to vary the angular position of the sinker cover around the axis of the needle cylinder with respect to the supporting structure, but only manually and when the machine is stopped, since it is first necessary to remove the elements that lock the sinker cover to the supporting structure of the machine. In medium- and large-diameter

10 circular knitting machines, therefore, it is not possible, or it is at least not economically convenient, to vary the way in which the sinkers are actuated during the provision of an article. This fact renders medium- and large-diameter circular knitting machines scarcely flexible in use.

The aim of the present invention is to solve the above mentioned

15 problems, by providing a circular hosiery knitting machine that ensures high knitting precision and at the same time has a high operating versatility that is capable of meeting the most disparate production requirements.

Within this aim, an object of the invention is to provide a machine that ensures high regularity in the forming of the stitches.

20 Another object of the invention is to provide a machine in which the operations for fine-tuning the sinker cover are extremely simple and quick.

Another object of the invention is to provide a machine that can perform a wider range of knitting than what can be performed with medium- and large-diameter circular knitting machines of the known type.

25 Another object of the invention is to provide a machine that has high reliability in operation and that can be manufactured with competitive costs.

This aim, as well as these and other objects which will become better apparent hereinafter, are achieved by a circular hosiery knitting machine, comprising a supporting structure and a needle cylinder which is oriented so

30 that its axis is substantially vertical and is provided, on its lateral surface,

with a plurality of axial slots, each of which accommodates a needle which can be actuated with a reciprocating motion along the corresponding axial slot; a sinker ring being arranged around the upper end of said needle cylinder, being coaxial to said needle cylinder and being provided with a plurality of radial slots, each of which accommodates a sinker, which can move with a reciprocating motion along the corresponding radial slot; each sinker being provided with a heel which protrudes upwardly from the corresponding radial slot and can engage at least one path defined in a sinker cover, which faces in an upper region said sinker ring; said needle cylinder being actuatable with a rotary motion about its own axis with respect to said supporting structure and said sinker cover, characterized in that it comprises means for adjusting the position of said sinker cover on a plane which is substantially perpendicular to the axis of the needle cylinder with respect to the supporting structure and means for varying the angular position of the sinker cover around the axis of the needle cylinder with respect to the supporting structure.

Further characteristics and advantages of the invention will become better apparent from the description of two preferred but not exclusive embodiments of the machine according to the invention, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figures 1 to 6 are schematic views of the machine according to the invention in the first embodiment, more precisely:

Figure 1 is a top plan view of a portion of the machine, with some elements omitted for the sake of greater clarity;

Figure 2 is a schematic sectional view of Figure 1, taken along the line II-II;

Figure 3 is a perspective view of an enlarged-scale detail of Figure 2;

Figure 4 is a schematic sectional view of Figure 1, taken along the line IV-IV;

Figure 5 is a perspective view of an enlarged-scale detail of Figure 4,

with some elements omitted for the sake of greater clarity;

Figure 6 is a schematic sectional view of Figure 1, taken along the line VI-VI;

Figures 7 to 13 are schematic views of the machine according to the invention in the second embodiment, more precisely:

Figure 7 is a perspective view of a portion of the machine according to the invention, with some elements omitted for the sake of greater clarity;

Figure 8 is a view of an enlarged-scale detail of Figure 7;

Figure 9 is a perspective view of the same portion of the machine shown in Figure 7, but seen from a different angle;

Figure 10 is a view of an enlarged-scale detail of Figure 9;

Figure 11 is a top plan view of the portion of machine shown in Figure 7;

Figure 12 is a sectional view of Figure 11, taken along the line XII-XII;

Figure 13 is a sectional view of Figure 11, taken along the line XIII-XIII with the yarn finger assemblies omitted for the sake of simplicity.

With reference to the figures, the machine according to the invention, shown only partially for the sake of simplicity and generally designated in the two embodiments by the reference numerals 1, 1a, comprises a supporting structure 2, 2a which supports, so that it can rotate about its own axis 3, 3a, which is oriented vertically, a needle cylinder 4, 4a.

On the lateral surface of the needle cylinder 4, 4a a plurality of axial slots 5, 5a is provided, each of which accommodates a needle 6, 6a which can be actuated, in a per se known manner, with a reciprocating motion along the corresponding axial slot 5, 5a in order to form knitting.

Around the upper end of the needle cylinder 4, 4a a sinker ring 7, 7a is provided, which is coaxial to the needle cylinder 4, 4a and is jointly connected thereto in rotation about its axis 3, 3a. In the sinker ring 7, 7a there is a plurality of radial slots 8, 8a, each of which accommodates a

knockover sinker 9, 9a, referenced hereinafter as sinker for the sake of brevity.

The radial slots 8, 8a are angularly offset around the axis 3, 3a with respect to the axial slots 5, 5a, so that each radial slot 8, 8a lies between two
5 contiguous axial slots 5, 5a.

The sinkers 9, 9a are provided with at least one heel 10, 10a which protrudes upwardly from the sinker ring 7, 7a and engages at least one path defined by cams 11, 11a which are connected to a sinker cover 12, 12a. The sinker cover 12, 12a has an annular plan shape and is arranged above and
10 coaxially with respect to the sinker ring 7, 7a.

The path defined by the cams 11, 11a supported by the sinker cover 12, 12a has portions that approach and portions that move away with respect to the axis of the sinker cover 12, 12a, so as to produce, as a consequence of the rotation of the sinker ring 7, 7a, integrally with the needle cylinder 4, 4a,
15 about the axis 3, 3a, with respect to the sinker cover 12, 12a, the reciprocating motion of the sinkers 9, 9a along the corresponding radial slot 8, 8a, which, by means of this movement, assist the needles 6, 6a in forming the stitches, as already explained above.

The needle cylinder 4, 4a can be actuated, in a per se known manner,
20 with a rotary motion about its own axis 3, 3a, jointly with the sinker ring 7, 7a, with respect to the supporting structure 2, 2a and the sinker cover 12, 12a.

The machine according to the invention comprises means 13, 13a for adjusting the position of the sinker cover 12, 12a on a plane which is
25 substantially perpendicular to the axis 3, 3a of the needle cylinder 4, 4a, and the adjustment means 13, 13a are interposed between the sinker cover 12, 12a and the supporting structure 2, 2a. In this manner, adjustment of the position of the sinker cover 12, 12a is performed by using as a reference the supporting structure 2, 2a, which is a fixed element, and therefore higher
30 adjustment precision is achieved, improving the precision in the actuation of

the sinkers 9, 9a and consequently the quality of the knitting. Moreover, the machine according to the invention comprises means 14, 14a for varying the angular position of the sinker cover 12, 12a around the axis 3, 3a of the needle cylinder 4, 4a with respect to the supporting structure 2, 2a.

5 In the first embodiment, the sinker cover 12 is supported by the needle cylinder 4 and can rotate on command, in a manner which is similar to what occurs in known circular hosiery knitting machines of the seamless type, about its own axis, which, when the sinker cover 12 is centered correctly, coincides with the axis 3, with respect to the supporting structure
10 2.

In the first embodiment, the means 14 for varying the angular position of the sinker cover 12 can be constituted by actuators of a known type, such as for example a step motor which is mounted on the supporting structure 2 and drives a gear which is engaged with a toothed sector which is fixed to a
15 peripheral region of the sinker cover 12, or, as indicated schematically in Figure 1, by a fluid-operated cylinder 15, which is connected by means of its body to a supporting ring 16 which is fixed to the supporting structure 2 and is connected, by means of the stem of its piston, to a region of the sinker cover 12, or by other mechanical or electrical actuators of a known type.

20 In the first embodiment, the sinker cover 12 rests on the sinker ring 7, optionally with the interposition of bearings which are not visible in the figures, and is locked axially with respect to the sinker ring 7 by means of sealing rings 17 which face the lower face of the sinker ring 7 and are supported by pivots 18 which are integral with abutments 19 which face the
25 upper face of the sinker ring 7 proximate to its peripheral rim. In this manner, the sinker cover 12 is coupled bilaterally, along an axial direction, to the sinker ring 7, which can in any case rotate, jointly with the needle cylinder 4, about its own axis 3 with respect to the sinker cover 12.

The adjustment means 13, in the first embodiment, comprise
30 adjustment columns 39, which have a vertical axis, are mutually angularly

spaced around the axis 3 of the needle cylinder 4 and are fixed, by means of their lower end, to a lower annular element 20 which is arranged around the needle cylinder 4 and is fixed to the supporting structure 2.

Each adjustment column 39 is connected, by means of its upper end,
5 to a support 21 which is fixed to the supporting ring 16.

The adjustment columns 39 have, proximate to their upper end, a portion 22 which is eccentric with respect to the axis 23 of the adjustment columns 39. A bearing 24 is mounted around the eccentric portion 22 and the adjustment column 39 makes contact, by means of such bearing, with a
10 portion of the lateral surface of the sinker cover 12.

In practice, in order to adjust the position of the sinker cover 12 on a plane which is perpendicular to the axis 3 of the needle cylinder 4, the adjustment columns 39 are rotated about their own axis 23 so that their eccentric portion 22, by means of the bearing 24, causes the desired
15 movement, along a direction which is perpendicular to the axis 23 and therefore to the axis 3, of the sinker cover 12 with respect to the supporting ring 16 and therefore with respect to the supporting structure 2. Once the adjustment has been performed, the adjustment columns 39 are locked with respect to the lower annular element 20 by tightening the screw 25, which
20 connects them to the lower annular element 20.

The supporting ring 16 is arranged around the needle cylinder 4 and can be constituted by the supporting ring of the yarn fingers, which are not illustrated in this first embodiment and with which the machine is provided.

The supporting ring 16 is fixed to the lower annular element 20 by
25 means of supporting columns 26 which are parallel to the adjustment columns 39.

In the second embodiment, the sinker cover 12a is supported by the supporting structure 2a.

More precisely, the sinker cover 12a is supported by the supporting
30 ring 16a of the yarn fingers 40a of the machine, which in turn is supported

by the supporting structure 2a.

The supporting ring 16a is fixed to the upper end of supporting columns 26a, which have a vertical axis and are mutually angularly spaced around the axis 3a of the needle cylinder 4a. The lower end of the supporting columns 26a is fixed, by means of screws 25a, to a lower annular element 20a, which surrounds the needle cylinder 4a and is fixed to the supporting structure 2a. The upper end of the supporting columns 26a is fixed to the supporting ring 16a by means of other screws 27a.

The means 13a for adjusting the position of the sinker cover 12a on a plane which is perpendicular to the axis 3a of the needle cylinder 4a, in the second embodiment, comprise adjustment columns 39a, which have a vertical axis 23a, are angularly mutually spaced around the axis 3a of the needle cylinder 4a and are fixed to the supporting ring 16a by means of a nut 28a, which is screwed onto their lower end.

Each one of the adjustment columns 39a has, along its extension, a portion 22a which is eccentric with respect to the axis 23a and on which a bearing 24a is fitted. The adjustment column 39a makes contact with a region of the outer lateral surface of the sinker cover 12a by means of the bearing.

In order to adjust the sinker cover 12a on a plane which is perpendicular to the axis 3a of the needle cylinder 4a, the adjustment columns 39a are rotated about their own axis 23a so that their eccentric portion 22a, by means of the bearing 24a, causes the desired movement, along a direction which is perpendicular to the axis 23a and therefore to the axis 3a, of the sinker cover 12a with respect to the supporting ring 16a and therefore with respect to the supporting structure 2a. Once the adjustment has been performed, the adjustment columns 39a are locked with respect to the supporting ring 16a by tightening the nut 28a.

The sinker cover 12a is locked axially with respect to the supporting ring 16a. More particularly, the sinker cover 12a rests, with its lower face,

on the supporting ring 16a and each one of the adjustment columns 39a supports, by means of a pivot 29a whose axis is oriented radially with respect to the axis 3a, a bearing 30a which rests on the upper face of the sinker cover 12a, preventing it from rising with respect to the supporting
5 ring 16a.

The means 14a for varying the angular position of the sinker cover 12a around the axis 3a of the needle cylinder 4a with respect to the supporting structure 2a, in the second embodiment, comprise an actuator 37a, which is interposed between the supporting structure 2a and the sinker
10 cover 12a and can be actuated in order to produce a rotation of the sinker cover 12a about the axis 3a with respect to the supporting structure 2a through an angle of preset breadth.

In the embodiment shown in Figures 7 to 13, the actuator 37a is constituted by a fluid-operated actuator, which is connected by means of its
15 body to the supporting ring 16a and by means of the stem of its piston to the sinker cover 12a, but other types of actuator, for example of the known mechanical or electromechanical kind, can be used.

Conveniently, means are provided for delimiting the rotation arc of the sinker cover 12a about the axis 3a with respect to the supporting
20 structure 2a. Such delimiting means comprise stop abutments 31a with adjustable position, which are interposed between the sinker cover 12a and the supporting structure 2a. More particularly, the stop abutments 31a comprise screws 32a, 33a, which are connected to the two opposite sides of an arm 34a which is fixed to the sinker cover 12a and is oriented radially
25 with respect to the axis 3a.

The screws 32a, 33a face pins 35a, 36a which are fixed to the supporting ring 16a.

By screwing or unscrewing the screws 32a, 33a, i.e., by varying their portion that protrudes from the arm 34a and which, as a consequence of the
30 rotation of the sinker cover 12a about the axis 3a, engages against the

corresponding pin 35a or 36a, the extent of the arc of the possible rotation of the sinker cover 12a about the axis 3a with respect to the supporting structure 2a and to the needle cylinder 4a is changed by way of the action of the actuator 37a, as shown in particular in Figure 10.

5 It should be noted that the actuation of the actuator 37a in order to vary the angular position of the sinker cover 12a around the axis 3a with respect to the supporting structure 2a and to the needle cylinder 4a can also be performed during the operation of the machine, i.e., while the needle cylinder 4a is rotating about its own axis 3a with respect to the supporting
10 structure 2a of the machine during the formation of an article.

Substantially, in the machine according to the invention the adjustment of the position of the sinker cover 12, 12a on a plane which is substantially perpendicular to the axis 3, 3a of the needle cylinder 4, 4a, instead of being performed with respect to the needle cylinder 4, 4a, is
15 performed, by means of the adjustment columns 39, 39a and the corresponding eccentric portions 22, 22a, with respect to a fixed reference system which is constituted by the supporting structure 2, 2a of the machine. In this manner, the position of the sinker cover 12, 12a is not affected by the vibrations, thermal variations and deformations of the needle cylinder 4, 4a
20 that can occur during the operation of the machine. Moreover, in the machine according to the invention it is possible to vary the angular position of the sinker cover 12, 12a about the axis 3, 3a with respect to the supporting structure 2, 2a and to the needle cylinder 4, 4a during the operation of the machine, achieving the result of being able to vary the
25 manner in which the sinkers are actuated from one row of knitting to the next and even during the formation of a same row of knitting in order to meet the most disparate knitting requirements.

In practice it has been found that the machine according to the invention fully achieves the intended aim, since the higher precision in the
30 placement of the sinker cover and the possibility to vary the angular position

of the sinker cover during the formation of the articles make it possible to achieve a higher quality of the finished product and a higher operating flexibility, extending the range of knitting that can be performed.

The machine thus conceived is susceptible of numerous modifications
5 and variations, all of which are within the scope of the appended claims. All the details may further be replaced with other technically equivalent elements.

In practice, the materials used, as well as the dimensions, maybe any according to requirements and to the state of the art.

10 The disclosures in Italian Patent Application No. MI2011A000313 from which this application claims priority are incorporated herein by reference.

Where technical features mentioned in any claim are followed by
reference signs, those reference signs have been included for the sole
15 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 hosiery knitting machine (1, 1a), comprising a supporting structure (2, 2a) and a needle cylinder (4, 4a) which is oriented so that its axis (3, 3a) is substantially vertical and is provided, on its lateral surface, with a plurality of axial slots (5, 5a), each of which accommodates a needle (6, 6a) which can be actuated with a reciprocating motion along the corresponding axial slot (5, 5a); a sinker ring (7, 7a) being arranged around the upper end of said needle cylinder (4, 4a), being coaxial to said needle cylinder (4, 4a) and being provided with a plurality of radial slots (8, 8a), each of which accommodates a sinker (9, 9a), which can move with a reciprocating motion along the corresponding radial slot (8, 8a); each sinker (9, 9a) being provided with a heel (10, 10a) which protrudes upward from the corresponding radial slot (8, 8a) and can engage at least one path defined in a sinker cover (12, 12a), which faces in an upper region said sinker ring (7, 7a); said needle cylinder (4, 4a) being actuatable with a rotary motion about its own axis (3, 3a) with respect to said supporting structure (2, 2a) and said sinker cover (12, 12a), characterized in that it comprises means (13, 13a) for adjusting the position of said sinker cover (12, 12a) on a plane which is substantially perpendicular to the axis (3, 3a) of the needle cylinder (4, 4a) with respect to the supporting structure (2, 2a) and means (14, 14a) for varying the angular position of the sinker cover (12, 12a) around the axis (3, 3a) of the needle cylinder (4, 4a) with respect to the supporting structure (2, 2a).

2. The machine according to claim 1, characterized in that said sinker cover (12) is supported by said needle cylinder (4).

3. The machine according to claim 1, characterized in that said sinker cover (12a) is supported by said supporting structure (2a).

4. The machine according to one or more of the preceding claims, characterized in that said sinker cover (12a) is supported by a supporting ring (16a) of the yarn fingers (40a), which is connected to said supporting

structure (2a).

5 5. The machine according to one or more of the preceding claims, characterized in that said adjustment means (13, 13a) comprise adjustment columns (39, 39a), which are mutually spaced angularly about the axis (3, 3a) of said needle cylinder (4, 4a) and are each interposed, with an eccentric portion (22, 22a) thereof, between a portion of the outer lateral surface of said sinker cover (12, 12a) and a portion of said supporting structure (2, 2a); said adjustment columns (39, 39a) being rotatable about their own axis (23, 23a), which is oriented parallel to the axis (3, 3a) of said needle cylinder (4, 4a), for a movement of said sinker cover (12, 12a) with respect to said supporting structure (2, 2a) on a plane which is perpendicular to the axis (3, 3a) of said needle cylinder (4, 4a).
10

 6. The machine according to one or more of the preceding claims, characterized in that said means (14, 14a) for varying the angular position of said sinker cover (12, 12a) comprise an actuator (15, 37a), which is interposed between said supporting structure (2, 2a) and said sinker cover (12, 12a) and can be actuated in order to actuate a rotation of said sinker cover (12, 12a) about said axis (3, 3a) of the needle cylinder (4, 4a) with respect to said supporting structure (2, 2a) through an angle of preset
15 breadth.
20

 7. The machine according to one or more of the preceding claims, characterized in that it comprises means (31a) for delimiting the arc of the possible rotation of said sinker cover (12a) about the axis (3a) of the needle cylinder (4a) with respect to said supporting structure (2a).

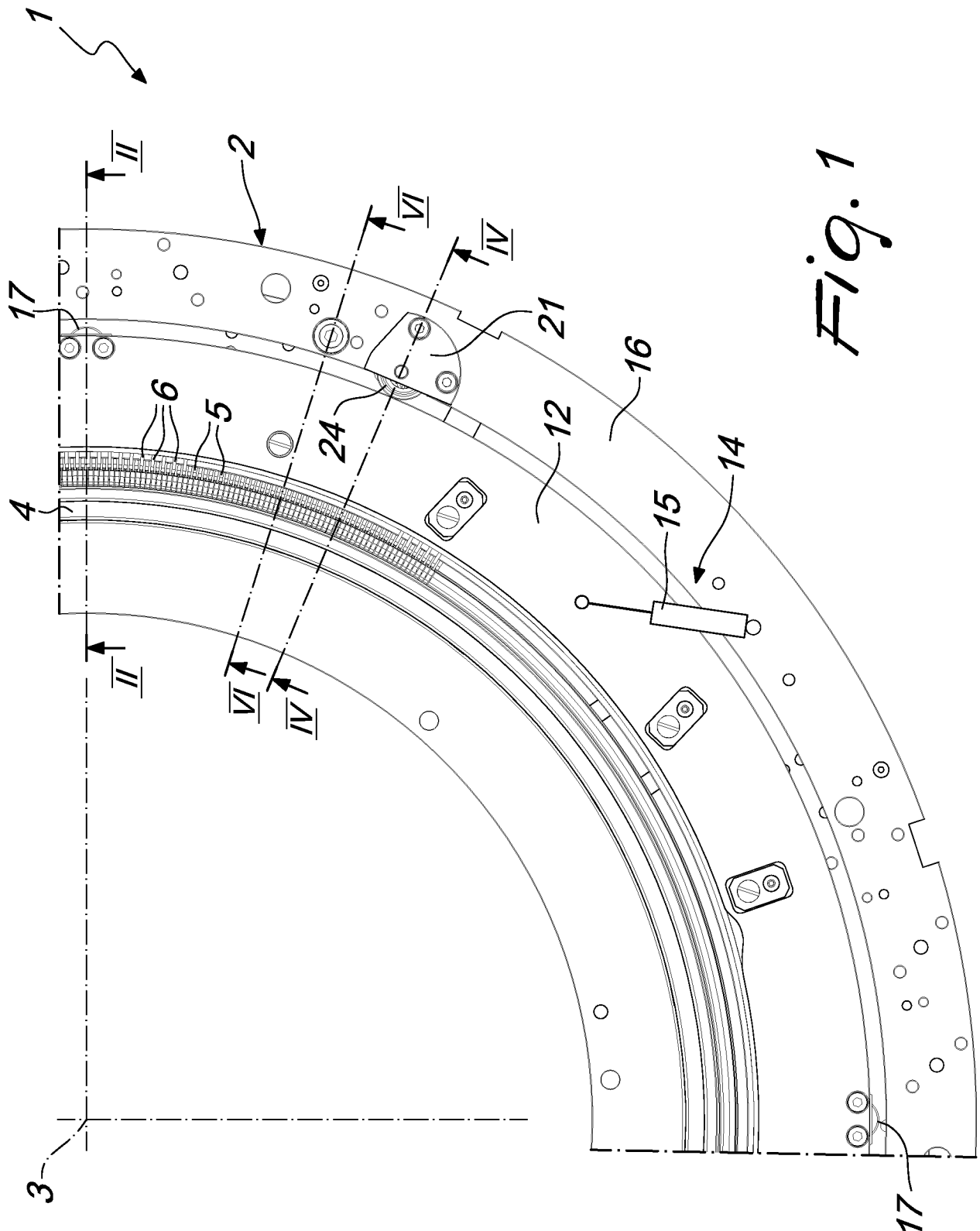
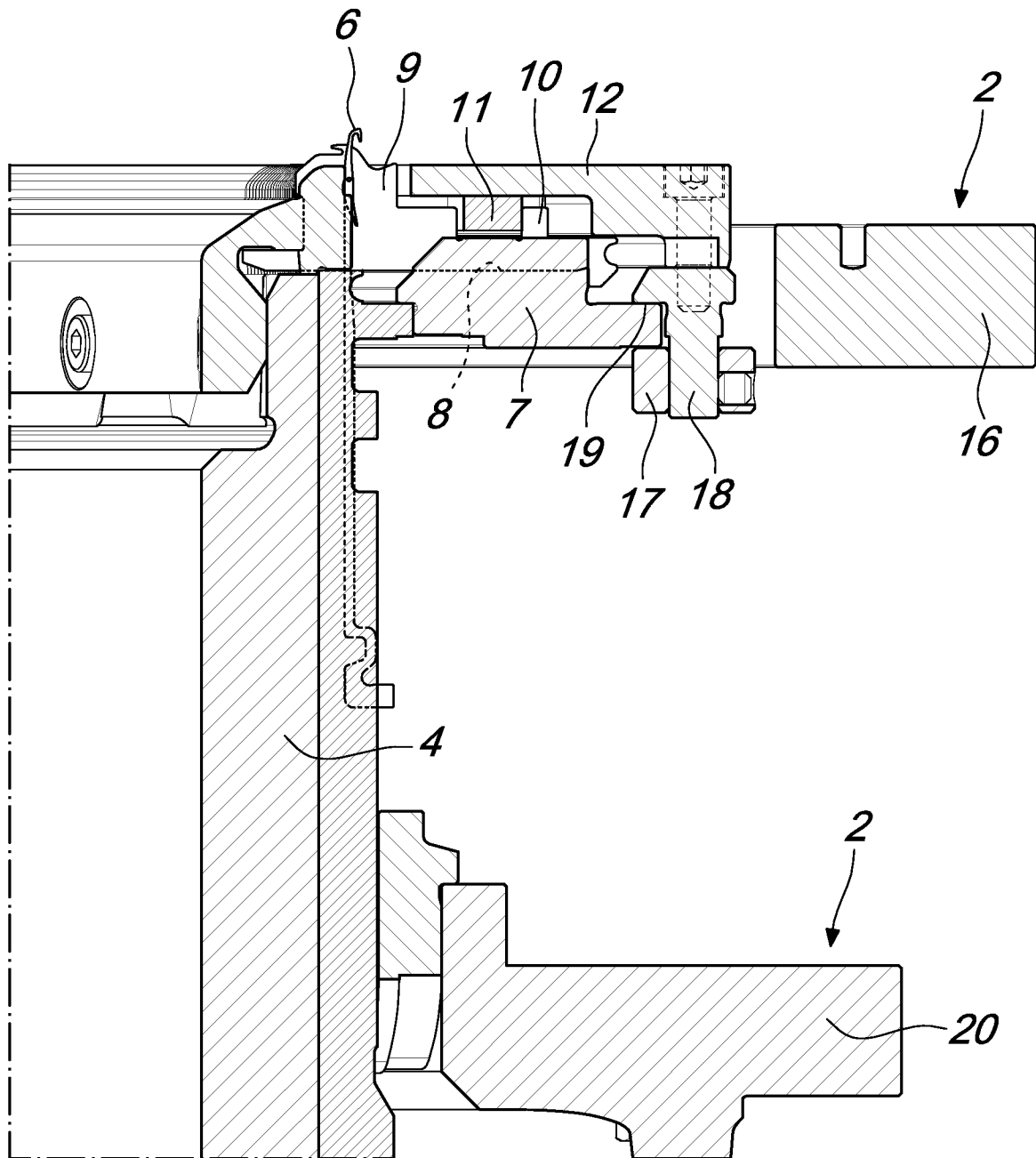


Fig. 1

*Fig. 2*

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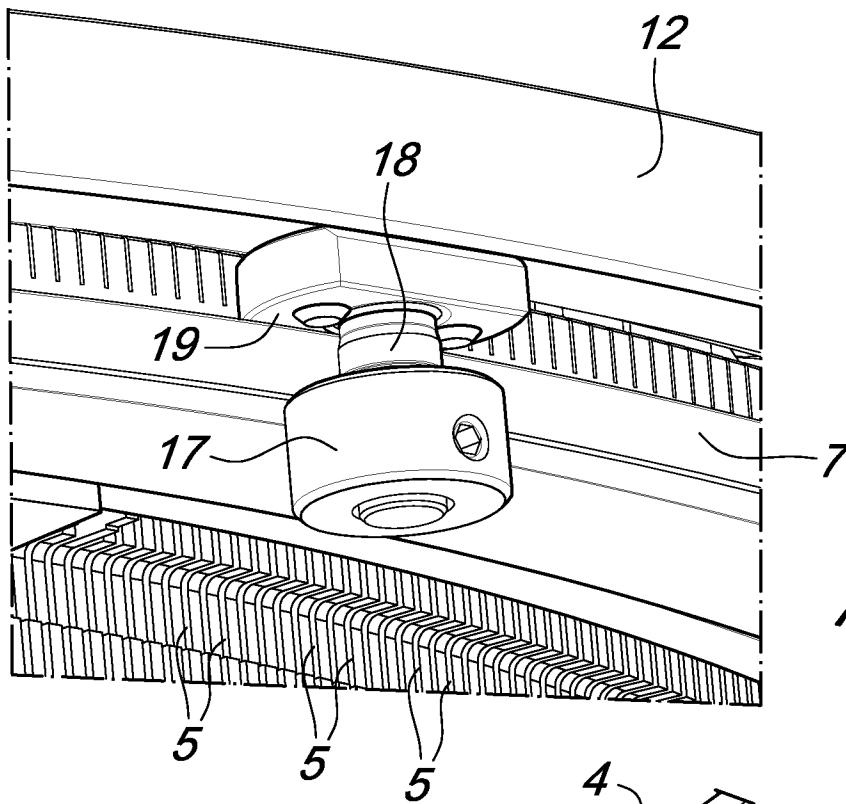
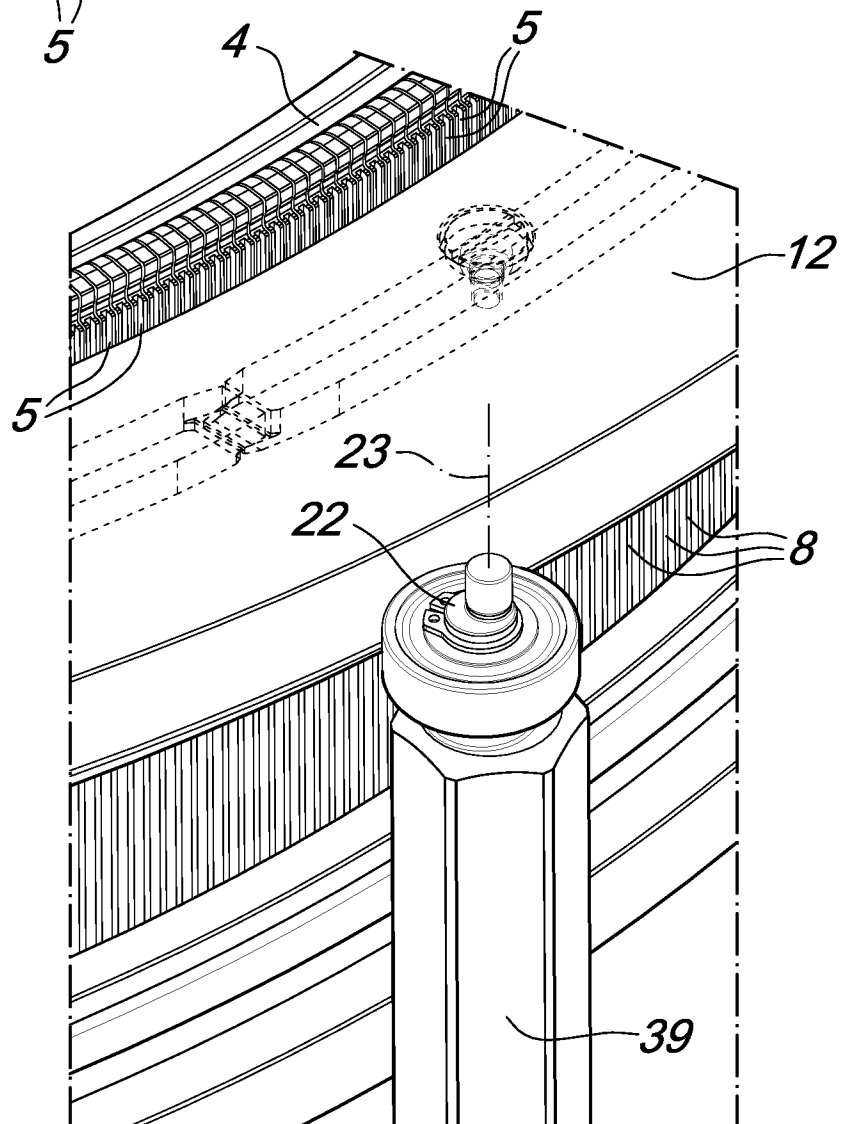
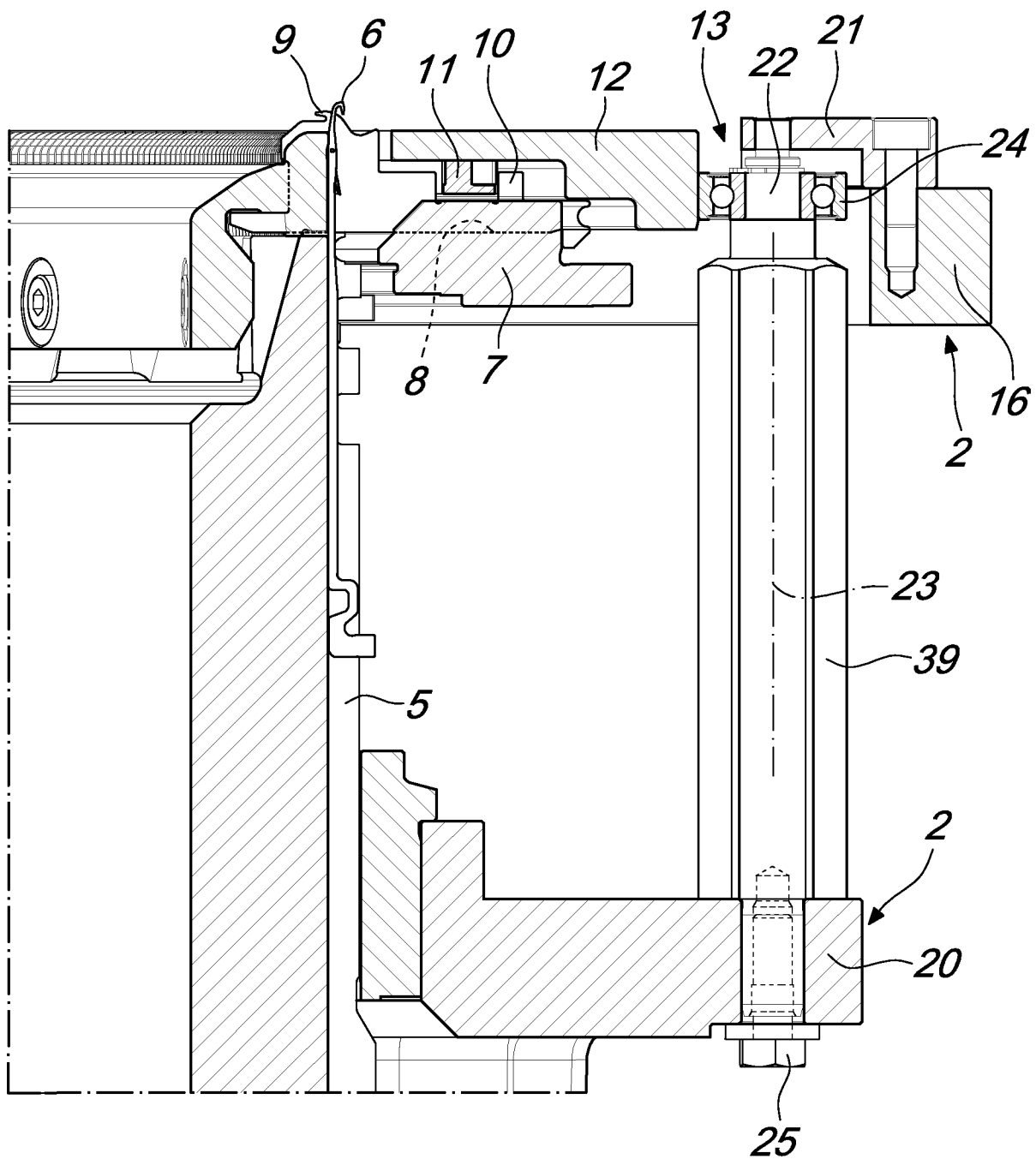


Fig. 5



*Fig. 4*

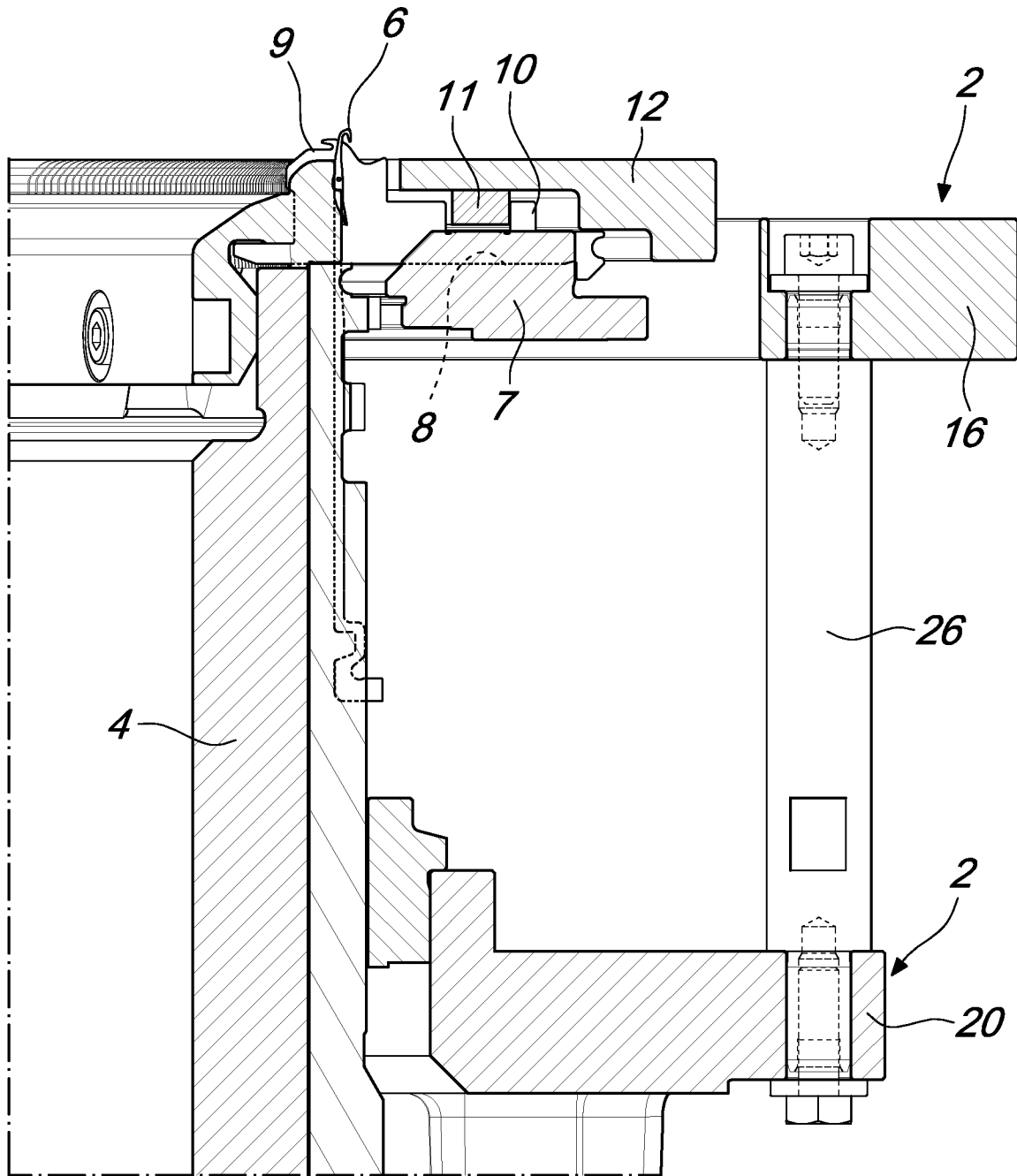
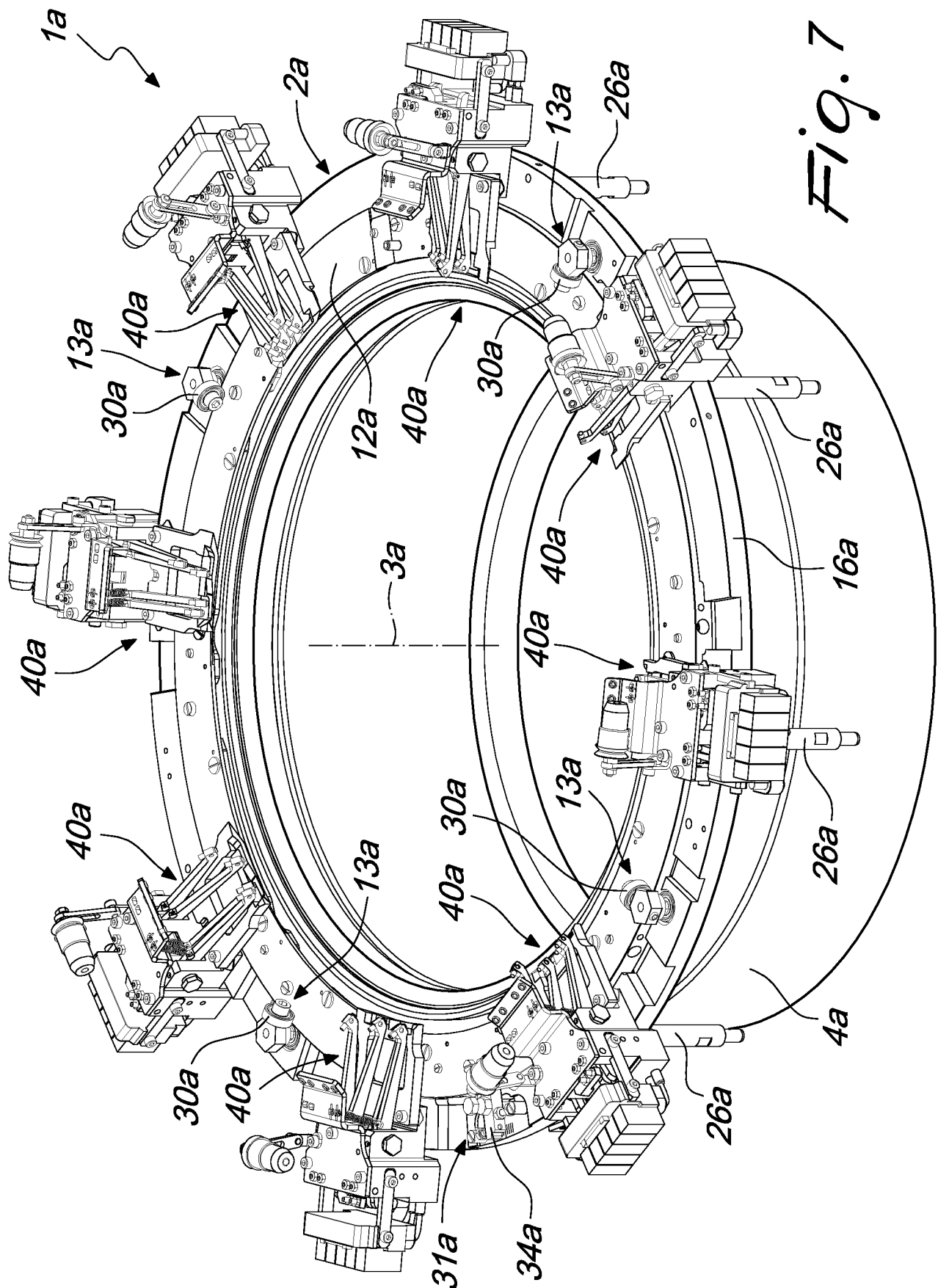


Fig. 6



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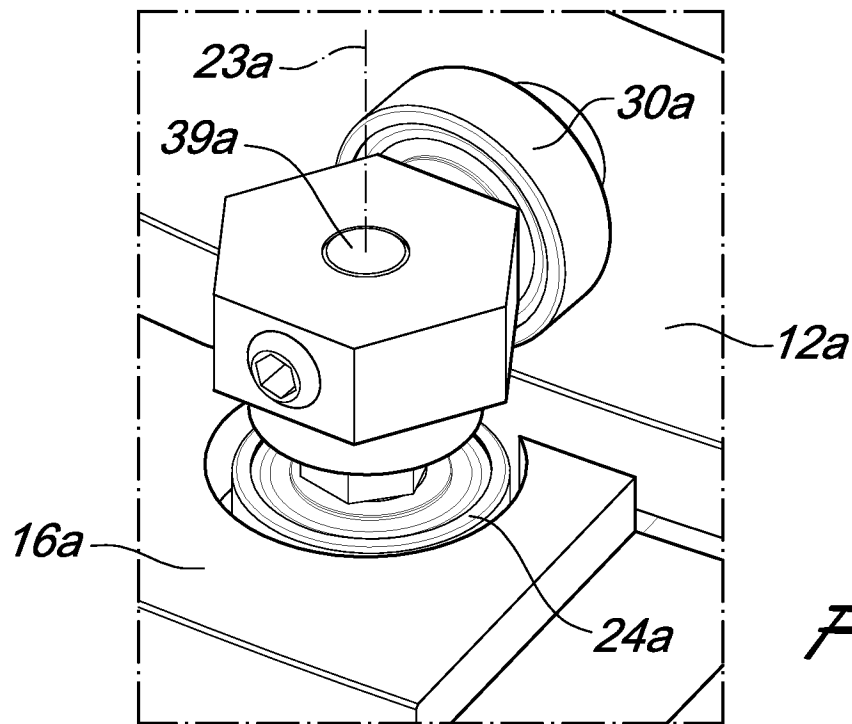


Fig. 8

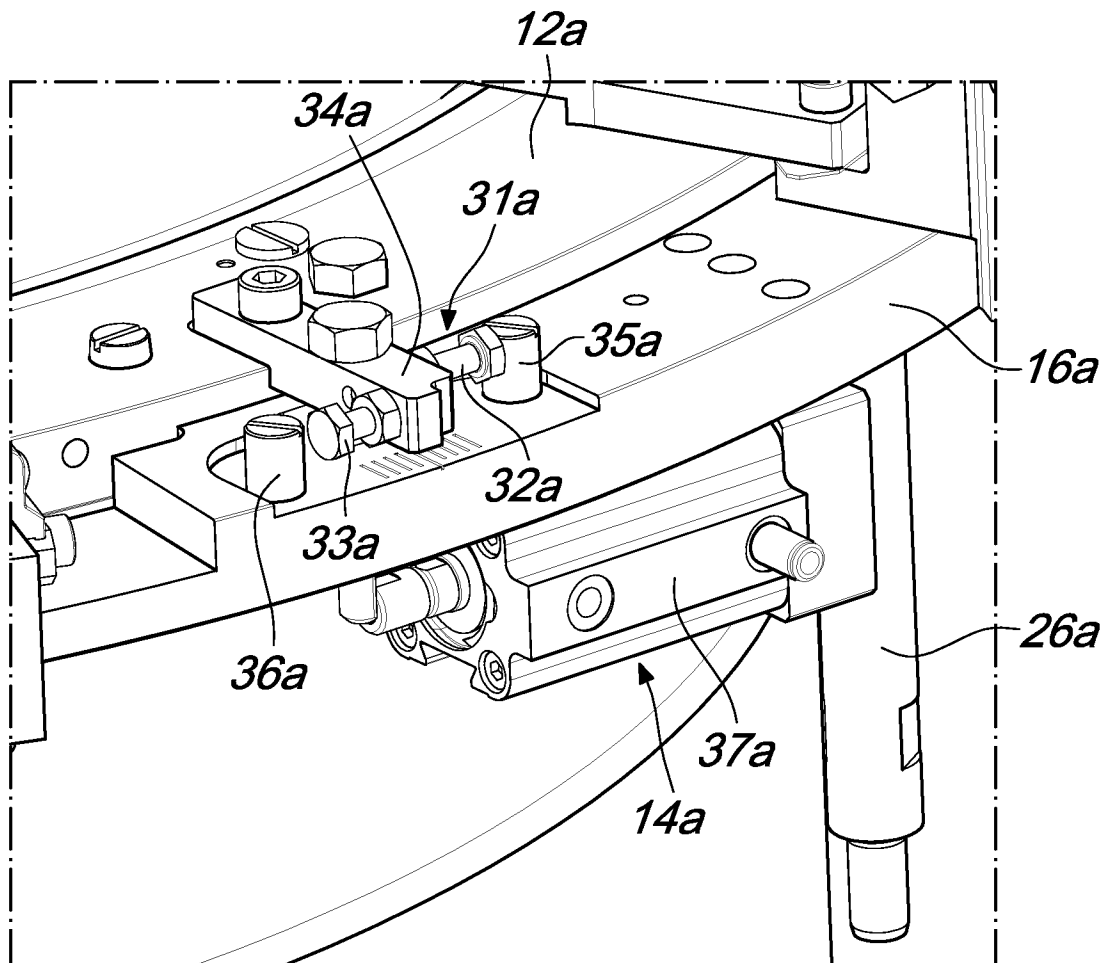
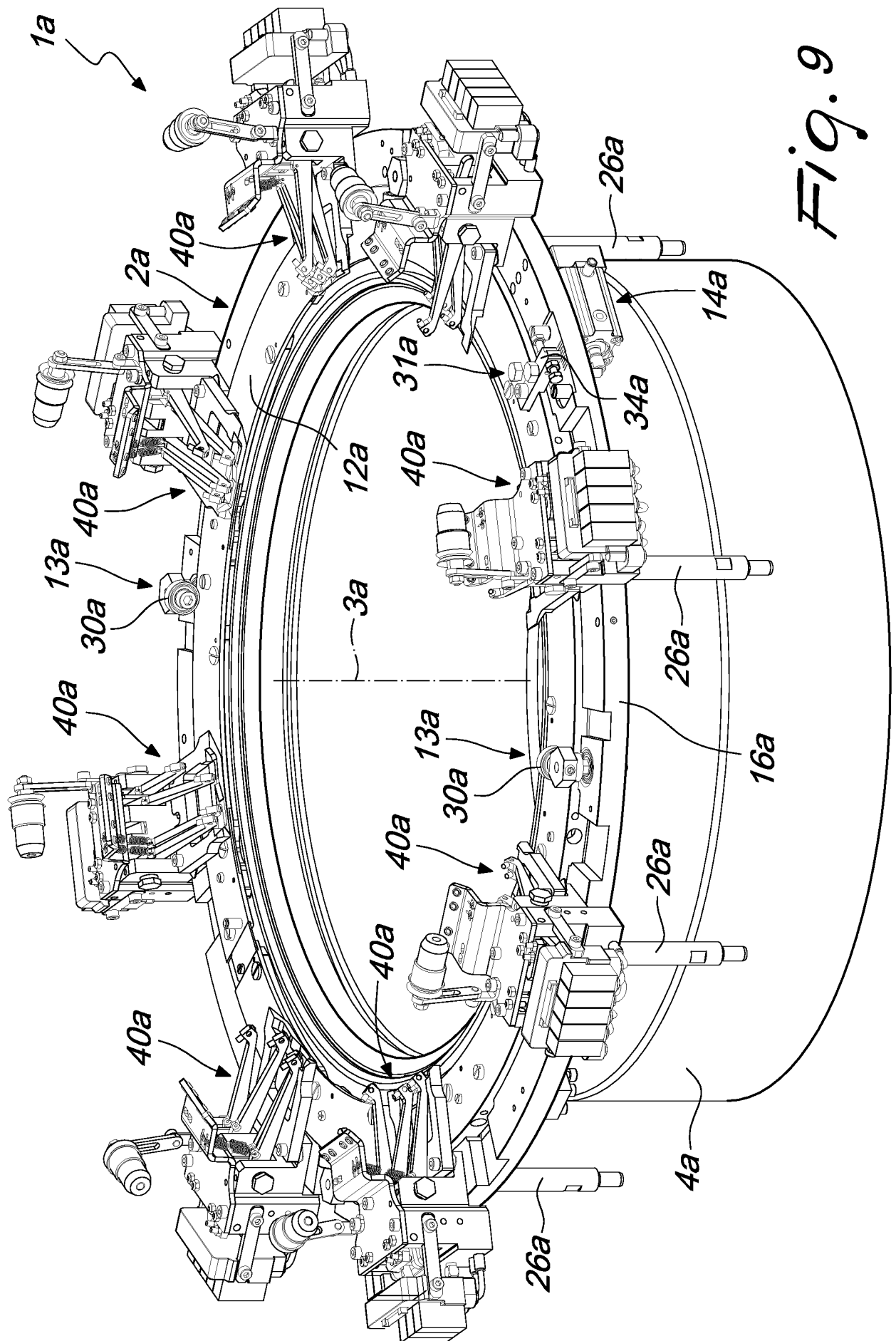


Fig. 10



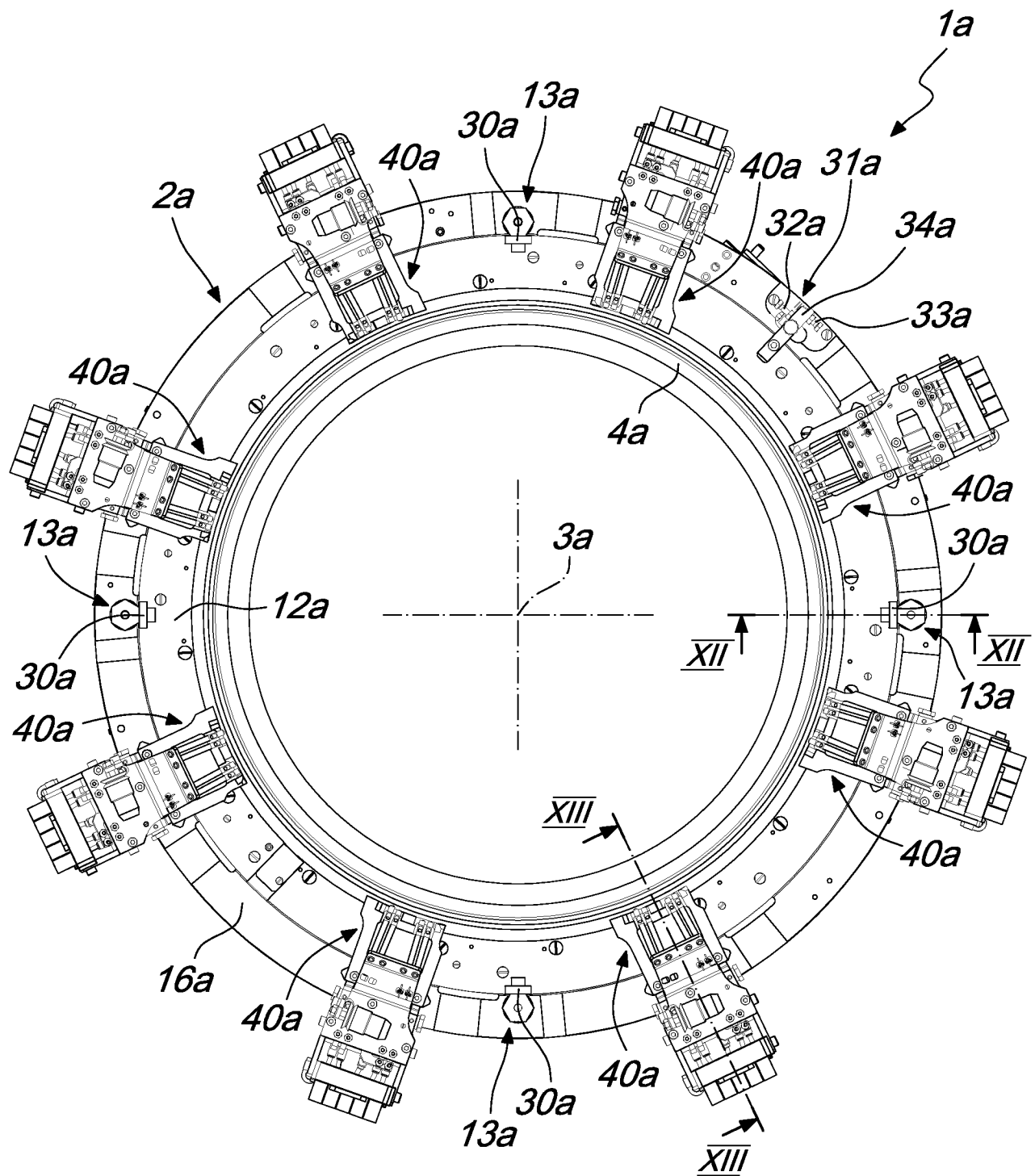
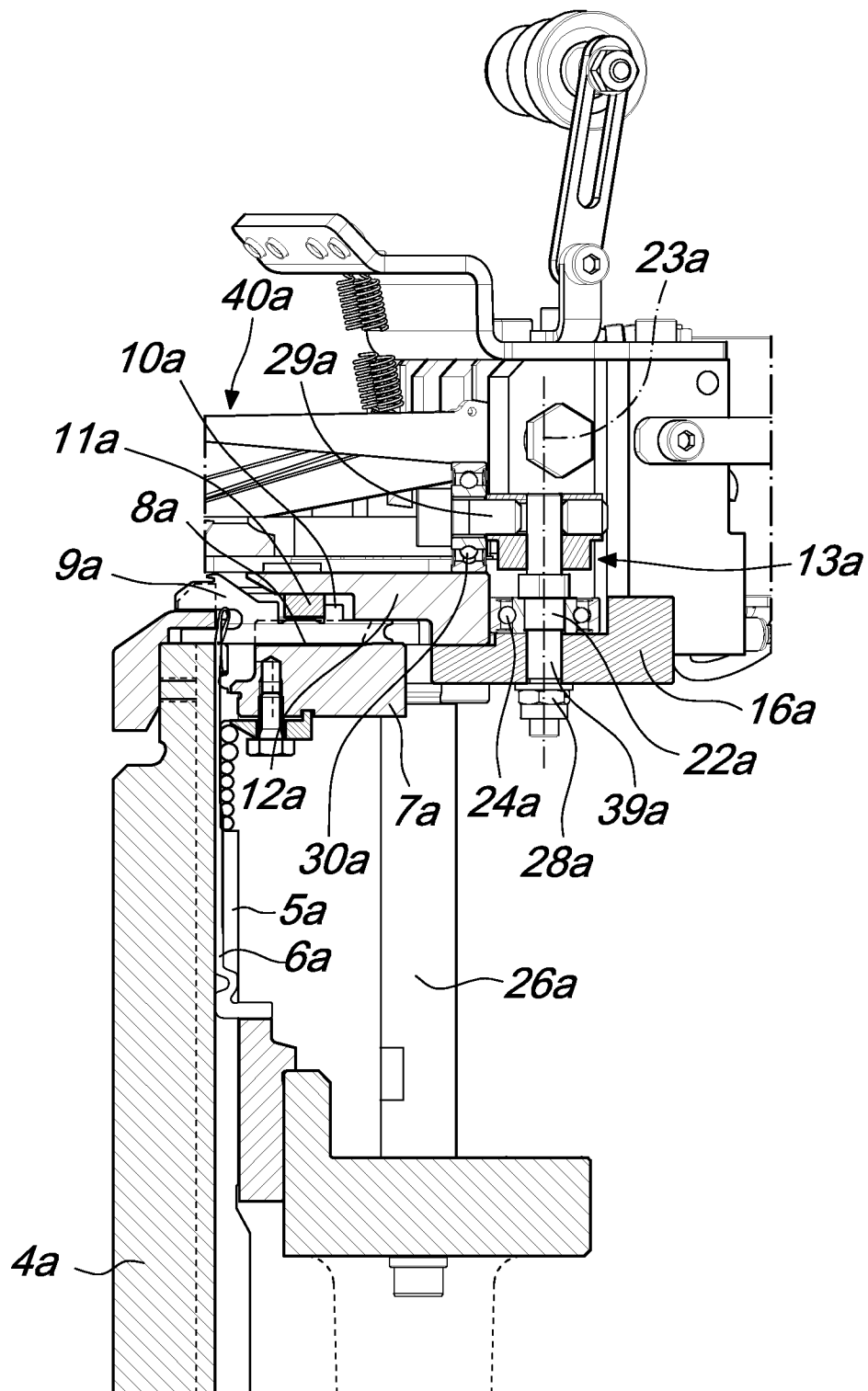


Fig. 11

*Fig. 12*

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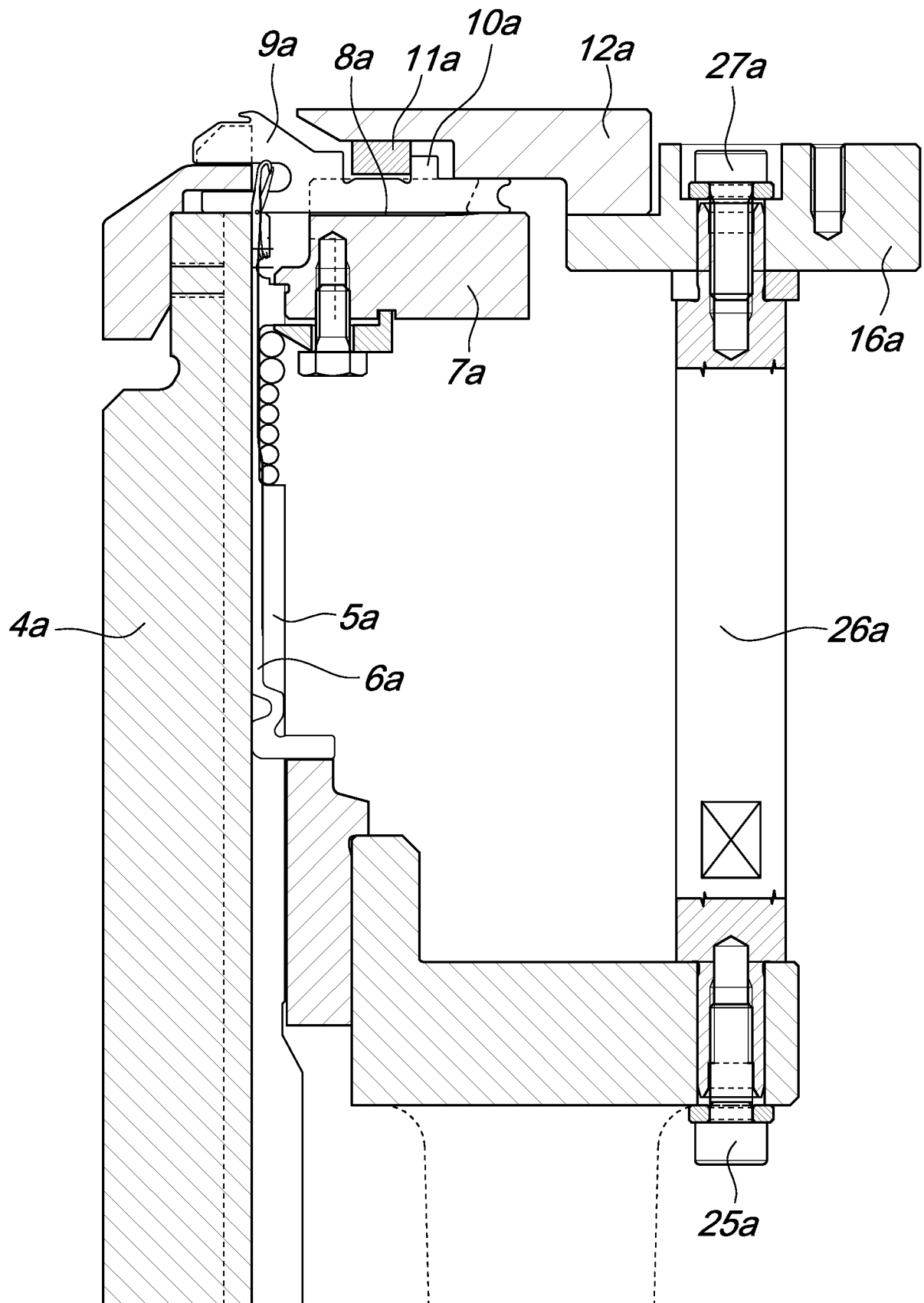


Fig. 13