(19) Europäisches Patentamt
European Patent Office
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(11) **EP 3 736 453 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
11.11.2020 Bulletin 2020/46

(51) Int Cl.:
F15B 15/26 *(2006.01)*

(21) Application number: **20167221.9**

(22) Date of filing: **31.03.2020**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **06.05.2019 IT 201900006566**

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(54) CYLINDER WITH A ROD-LOCK DEVICE

(57) The present invention relates to a pneumatically or hydraulically actuated cylinder (1; 100), comprising a cylinder liner (2) and a cylinder piston (5). The cylinder liner (2) is delimited at the ends by a front head (3b) and by a rear head (3a) so as to form a cylinder chamber (4). The cylinder piston (5) is provided with a rod (6), is housed in the cylinder chamber (4) and can be actuated by means of a control fluid so as to move in a translational manner along an axis of translation (X). The cylinder (1; 100) is equipped with a rod-lock device (7) comprising a rod-lock piston (8) that extends between a first end (8a) and a second end (8b). The rod-lock piston (8) is slidingly housed in a fluid-tight manner in a rod-lock piston seat (9) made in one of either the front (3b) or rear (3a) head. The rod-lock piston seat (9) extends in a direction that is orthogonal with respect to the axis of translation (X). A rod engagement through hole (10) is made in the rod-lock piston (8), through which the rod (6) passes.

By means of the control fluid, the rod-lock piston (8) can move in a translational manner at least from an active position in which the rod is axially locked, to an inactive position in which the rod (6) can slide freely into the rod engagement hole (10). The rod-lock piston seat (9) is in fluidic communication with the cylinder chamber (2) so that the control fluid acting on the rod-lock piston (8) causes, following the passage of the rod-lock piston from the active position to the inactive position, the translational movement of the cylinder piston (5) in the cylinder chamber (4).

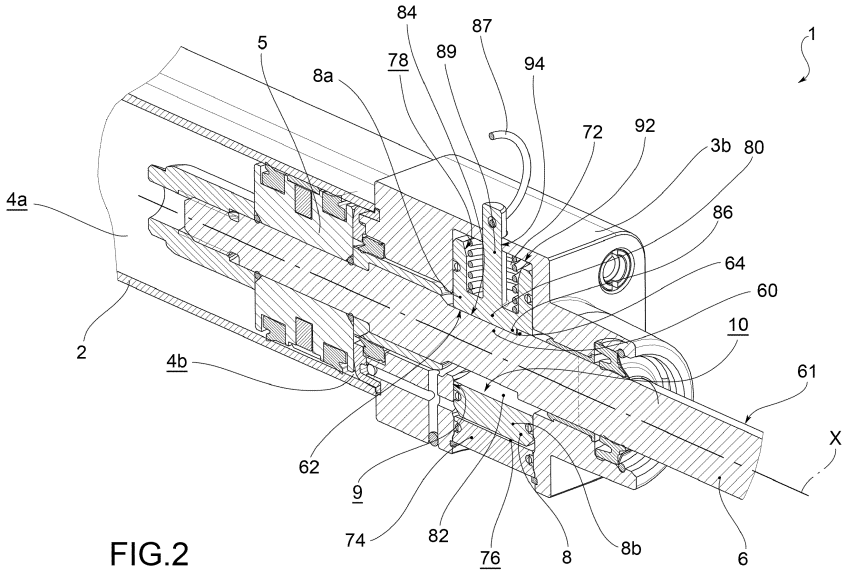

FIG.2

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Description

[0001] The present invention relates to a pneumatically or hydraulically actuated cylinder provided with a rod-lock device.

[0002] The rod-lock is a mechanical device that is to be attached to a cylinder and makes it possible to lock the rod when the cylinder is not pressurized. In other words, when actuated, the rod-lock device opposes the sliding movement of the rod in the cylinder, blocking the stroke thereof.

[0003] Rod-locks are used when the rod, to which a static load is axially applied, needs to stay locked in a particular position along the stroke of said rod. Examples of cylinders to which rod-locks are attached are lifting cylinders in freight elevators.

[0004] Rod-lock devices are already known that are attached to cylinders and consisting of a system of two opposite jaws which, under the action of suitably dimensioned springs, block the stroke of the rod. By means of these pneumatically or hydraulically actuated rod-lock devices, it is possible to position the rod at the end-of-stroke, or at intermediate points, irrespective of the level of pressure of the cylinder.

[0005] However, the rod-lock devices currently available on the market are actuated by means of a pneumatic, or hydraulic, circuit, which is independent of the pressurization circuit for the front and/or rear chambers of the cylinder.

[0006] In some embodiments, the rod-lock devices according to the prior art are devices that are attached to the front head of the cylinder after said cylinder has been produced. Therefore, these rod-lock devices are sold separately to the cylinder and are only attached to the front head when necessary.

[0007] In this case, the rod-lock device, which is provided separately to the cylinder, is therefore an accessory that, in addition to an increase in the costs of the automation system, involves installation operations that require the plant to be stopped and specialized technicians to intervene.

[0008] In some known embodiments, the rod-lock devices are attached to the front of the head of the cylinder and therefore increase the overall axial dimensions of the cylinder. In other embodiments, the rod-lock devices are radially attached to a head, increasing the overall radial dimensions of the cylinder. These radial rod-lock devices require the head to be provided for coupling to the rod-lock such that the rod-lock can then engage with the rod, or the head needs to be mechanically operated in order to allow the rod-lock to be fastened to the head such that the rod-lock is then able to engage with the rod and block the stroke thereof.

[0009] In addition to requiring a dedicated pneumatically or hydraulically supplied circuit, these rod-lock devices disadvantageously increase the overall axial and/or radial dimensions of the cylinder and can create problems when the available space is limited.

[0010] The object of the present invention is to propose a pneumatically or hydraulically actuated cylinder that is provided with a rod-lock device and is able to overcome the drawbacks discussed above with reference to the cylinders of the prior art.

[0011] Said object is achieved by a pneumatically or hydraulically actuated cylinder according to claim 1. The dependent claims describe preferred embodiments of the invention.

[0012] The features and the advantages of the cylinder according to the invention will in any case become clear from the following description of preferred embodiments thereof, which are given by way of non-limiting example and with reference to the attached drawings, in which:

Fig. 1 is a perspective view of separate components of a pneumatically or hydraulically actuated cylinder according to one embodiment;

Fig. 2 is a perspective axial sectional view of an end portion of the cylinder;

Fig. 3 is a perspective transverse sectional view at the level of the head that houses the rod-lock device;

Fig. 4 is a perspective axial sectional view of an end portion of the cylinder along a section plane different to that in Fig. 2;

Fig. 5 is a perspective view of the cylinder according to the embodiment in Fig. 1;

Fig. 6 is an axial sectional view of an end portion of the cylinder in one variant embodiment; and

Fig. 7 is a perspective view of the cylinder in the second embodiment.

[0013] In said drawings, 1; 100 indicates, as a whole, a pneumatically or hydraulically actuated cylinder according to the invention.

[0014] In the continuation of the description, elements that the various embodiments shown in the drawings have in common are indicated by the same reference numerals.

[0015] In one embodiment, the cylinder 1; 100 is pneumatically or hydraulically actuated and comprises a cylinder liner 2 and a cylinder piston 5.

[0016] The cylinder liner 2 is delimited at the ends by a front head 3b and by a rear head 3a so as to form a cylinder chamber 4.

[0017] The cylinder piston 5 is provided with a rod 6, is housed in the cylinder chamber 4 and can be actuated by means of a control fluid so as to move in said cylinder chamber 4 along an axis of translation X.

[0018] The cylinder 1; 100 is provided with a rod-lock device 7 comprising a rod-lock piston 8 that extends between a first end 8a and a second end 8b. The rod-lock piston 8 is slidingly housed in a fluid-tight manner in a rod-lock piston seat 9 made in one of either the front head 3b or rear head 3a. The rod-lock piston seat 9 extends in a direction that is orthogonal with respect to the axis of translation X.

[0019] A rod engagement through-hole 10 is made in

the rod-lock piston 8, through which the rod 6 passes.

[0020] By means of the control fluid, the rod-lock piston 8 is translatable at least from an active position, in which the rod is axially locked, to an inactive position, in which the rod 6 can freely slide into the rod engagement hole 10.

[0021] The rod-lock piston seat 9 is in fluidic communication with the cylinder chamber 2 such that the control fluid acting on the rod-lock piston 8 causes, following the passage of the rod-lock piston 8 from the active position to the inactive position, the translational movement of the cylinder piston 5 in the cylinder chamber 4.

[0022] In the continuation of the description, the term "slotted" means elliptical or generally oval and the term "oblong" means a shape that is defined by two semi-circumferences connected tangentially to one another by means of two rectilinear and parallel segments.

[0023] The terms "front" and/or "frontal", together with their adverbs "at the front" and/or "to the front" mean the end of the cylinder that is proximal to the end where the rod leaves. Vice versa, the term "rear" and its adverb "at the rear" mean the end of the cylinder that is distal from the end where the rod leaves.

[0024] "Axial" and "axially" mean the longitudinal extension direction of the cylinder, that is the direction defined by the axis of translation X of the rod. Vice versa, the term "transverse" and the derivatives thereof mean a direction that is orthogonal to the axis of translation X of the rod, that is a direction that is orthogonal to the discharge and/or return stroke of the rod.

[0025] In accordance with one aspect of the invention, the rod-lock piston 8 is equipped with rod locking means 80 suitable to interact with corresponding counter-locking means 60. The counter-locking means are made in at least one axial portion 66 of the rod 6 so as to lock the rod in at least one predetermined axial position. The engagement between said locking means and said counter-locking means defines the active position in which the rod 6 is axially locked, while the disengagement between said locking means and said counter-locking means defines the inactive position.

[0026] For example, the at least one axial portion 66 is made along the lateral surface 61 of the rod 6.

[0027] Optionally, the rod engagement hole 10 is a slotted or oblong hole, which is delimited by a hole wall 82 from which at least one rod engagement portion 84 internally protrudes, said rod engagement portion 84 projecting from the inside of the hole wall 82 so as to form, together with the hole wall 82, a step 86 that defines the locking means 80.

[0028] Preferably, the counter-locking means 60 comprise at least one lowered portion 62 of the rod 6 and said lowered portion defines a coupling undercut 62 suitable to be axially engaged by the step 86. The axial engagement between the step and the coupling undercut defines the active axial locking position of the rod 6.

[0029] In accordance with one aspect of the invention, the lowered portion 62 is a portion of the rod 6 that has a smaller diameter than the diameter of the rod 6.

[0030] Optionally, the rod-lock piston is made of a material having a low coefficient of friction, for example polyacetal resin.

[0031] According to one aspect of the invention, the rod-lock device 7 is influenced elastically to remain in the active rod locking position.

[0032] Preferably, the elastic element 72 is housed between a bottom wall 92 of the rod-lock piston seat 9 and the first end 8a of the rod-lock piston 8. Said elastic element 72 is suitable to act on the rod engagement portion 84 so as to cause the rod-lock piston 8 to move in a translational manner from the inactive position to the active position.

[0033] Preferably, the elastic element is a coil spring.

[0034] Optionally, the rod-lock piston 8 is provided with a tang 89 that protrudes from the front or rear head so as to be accessible from the outside in order to move the rod-lock piston from the active position to the inactive position.

[0035] Preferably, a closing cap 74 is sealingly housed in the rod-lock piston seat 9 that, in cooperation with the second end 8b of the rod-lock piston 8, forms a rod-lock piston actuation chamber 76. The pressurized control fluid is pumped into said rod-lock piston actuation chamber 76, which causes the rod-lock piston to move in a translational manner from the active axial locking position of the rod to the inactive position.

[0036] In accordance with one aspect of the invention, the closing cap 74 is held in the seat by a circlip.

[0037] In accordance with one aspect of the invention, a pneumatic supply hole 30; 300 that is in fluidic communication with the rod-lock piston actuation chamber 76 by means of a primary supply duct 31; 310 is made in the head of the piston in which the rock-lock piston 8 is housed. The rod-lock piston actuation chamber 76 is, in turn, in fluidic communication with the cylinder chamber 4 by means of a secondary supply duct 32.

[0038] Preferably, the pneumatic supply hole 30; 300 extends along a pneumatic hole axis Y in a direction that is orthogonal to the axis of translation X.

[0039] Optionally, the primary supply duct 31 is inclined with respect to said pneumatic hole axis Y.

[0040] Optionally, the secondary supply duct 32 is in fluidic communication with a shock absorber device 36 of the piston end-of-stroke.

[0041] In another variant in accordance with Fig. 6 and 7, the head in which the rod-lock piston is housed has a main portion that houses the rod-lock device and has an axial extension that is significantly smaller than a head of the cylinder, as described above and with reference to Fig. 1-5. However, an axial projection extends from the above-mentioned main portion that houses the rod-lock device, in which projection a pneumatic supply hole 300 is made. A primary supply duct 310 extends horizontally from the supply hole 300 to the rod-lock piston actuation chamber 76. In accordance with the embodiment shown in Fig. 6, the axis of the rod-lock piston seat 9, the axis of translation X and the pneumatic hole axis Y lie on

the same imaginary plane.

[0042] In view of the fact that the cylinder is a mechanical component that is axially symmetrical with respect to the axis of translation X and that it is substantially hollow, since the cylinder liner 2 defines a cylinder chamber 4 that is delimited at its ends by the front 3b and rear 3a heads, the term "internal" and its derivatives are intended to mean the region of space that is surrounded by the cylinder liner. Similarly, the phrase "towards the inside" or the like is intended to mean a direction oriented towards or approaching the axis of translation X.

[0043] Optionally, a recess 78, in which a portion of the elastic element 72 is housed is made, in the first end 8a.

[0044] Optionally, a bottom hole 94 is made in the bottom wall 92, in which a tang 89 that protrudes from the first end 8a of the rod-lock piston 8 is slidingly received. Said tang 89 comprises an end tang portion 89a that protrudes transversally from the front head 3b, or from the rear head 3a, with respect to the axis of translation X. Actuation means 87 for moving the rod-lock device may engage the end tang portion 89a.

[0045] For example, should the rod-lock piston 8 malfunction, it is possible to move it manually by operating the actuation means 87 so as to shift the rod-lock piston from the active position to the inactive position.

[0046] In one variant, the actuation means 87 comprise a ring.

[0047] For example, the tang 89 may protrude from a base wall of the recess 78 and at least part of the elastic element 72 may be housed in the recess 78 so as to receive the tang 89 in its interior.

[0048] Optionally, the secondary supply duct 32 comprises a first arm 32a, which extends along a shock-absorbing seat axis Y' that is orthogonal to the axis of translation X, and a second arm 32b that intersects the first arm 32a and is parallel to said axis of translation X.

[0049] Optionally, a shock-absorbing seat 34 is made in the first arm 32a, in which a shock absorber device 36 may be housed.

[0050] Optionally, the cylinder piston 5 is slidingly housed in a fluid-tight manner in the cylinder chamber 4 and the cylinder chamber 4 is divided into a rear chamber 4a and into a front chamber 4b by means of said cylinder piston 5. The cylinder functions as described below.

[0051] The control fluid is pumped into the rear chamber 4a (or front chamber 4b) so as to actuate the discharge stroke (or the return stroke) of the rod 6. The rod may freely slide into the rod engagement hole 10 so as to keep the rod-lock piston 8 in the inactive position.

[0052] The rod-lock piston 8 can pass from the inactive position to the active position, in which rod locking means 80 engage with counter-locking means 60.

[0053] Optionally, the engagement between the means 80 and the counter-locking means 60 is caused by at least partially decreasing the compressive force acting on the elastic element 72, which allows the locking means 80 to engage with the respective counter-locking means 60.

[0054] The control fluid stops being pumped into the rear chamber 4a (or front chamber 4b) when the rod 6 is locked by the mutual engagement between the means 80 and counter-locking means 60.

[0055] In order to shift the rod-lock piston from the active position to the inactive position, the control fluid may be pumped through a pneumatic supply hole 30; 300 so as to reach and fill the rod-lock piston actuation chamber 76. By filling the rod-lock piston actuation chamber 76, the pumping fluid may bring about the compression of the elastic element 72, causing the disengagement of the locking means 80 from the counter-locking means 60, and move the rod-lock piston 8 back into the inactive position.

[0056] The control fluid continues to be pumped such that the control fluid may reach the front chamber 4b (or rear chamber 4a) that is in fluidic communication with the rod-lock piston actuation chamber 76, and may actuate the return stroke (or discharge stroke) of the rod 6, keeping the rod-lock piston 8 in the inactive position.

[0057] Innovatively, the pneumatically or hydraulically actuated cylinder provided with the rod-lock device achieves the proposed object.

[0058] Advantageously, the same control fluid is used to move both the rod-lock piston and the rod. In other words, the fluidic communication between the rod-lock piston seat and the cylinder chamber both allows the rod-lock piston to move from the active position to the inactive position and the cylinder piston to move in a translational manner in the cylinder chamber.

[0059] Advantageously, it is possible to use just one circuit for pumping the control fluid in order to supply fluid for both the axial sliding motion of the rod and the transverse translational movement of the rod-lock piston.

[0060] Advantageously, the overall dimensions of the cylinder provided with the rod-lock device are comparable to the overall axial and radial dimensions of a cylinder according to the prior art that does not comprise a rod-lock.

[0061] Advantageously, the rod-lock piston, being centrally passed through by the rod, makes full use of the dimensions and the geometry of the head, without increasing the overall radial or axial dimensions of the head.

[0062] Advantageously, being made of a material having a low coefficient of friction, the rod-lock piston facilitates the sliding movement of the rod engagement portion in contact with the rod.

[0063] Advantageously, actuation means are provided for moving the rod-lock piston from the active position to the inactive position in the event that the circuit for pumping the control fluid fails or malfunctions.

[0064] Advantageously, when the rod engagement portion reaches the lowered portion, the elastic element causes the radial engagement of the rod engagement portion in the lowered portion and the axial engagement of the step with the coupling undercut. In other words,

the elastic element causes the translational movement from the inactive position to the active rod locking position.

[0065] In order to meet contingent requirements, an expert in the field may make modifications and adaptations to all the embodiments of the cylinder according to the invention and could substitute elements with other functionally equivalent elements without departing from the scope of the following claims. Each of the features described as belonging to a possible embodiment may be formed independently of the other embodiments described.

Claims

1. Pneumatically or hydraulically actuated cylinder (1;100), comprising a cylinder liner (2) delimited at the ends by a front head (3b) and a rear head (3a) so as to form a cylinder chamber (4), and a cylinder piston (5) housed in the cylinder chamber (4) and actuatable by means of a control fluid so as to move in said chamber along an axis of translation (X), the piston (5) being further equipped with a rod (6), the cylinder (1;100) being equipped with a rod-lock device (7) comprising a rod-lock piston (8) extending between a first end (8a) and a second end (8b), said rod-lock piston (8) being slidably and fluid-tightly housed in a rod-lock piston seat (9) obtained in one of the front (3b) or rear (3a) heads and extending in a direction orthogonal with respect to the axis of translation (X), in the rod-lock piston (8) there being obtained a rod engagement through hole (10) penetrated by the rod (6), the rod-lock piston (8) being translatable by means of the control fluid at least from an active axial locking position of the rod to an inactive position, wherein the rod (6) is freely slidable within said rod engagement hole (10), wherein the rod-lock piston seat (9) is in fluidic communication with the cylinder chamber (2) so that the control fluid acting on the rod-lock piston (8) causes, following the passage of the rod-lock piston (8) from the active position to the inactive position, the translation of the cylinder piston (5) into the cylinder chamber (4).

2. Cylinder according to claim 1, wherein the rod-lock piston (8) is equipped with rod locking means (80) suitable to interact with corresponding counter-locking means (60) obtained in at least one axial portion (66) of the rod (6) so as to lock the rod in at least one predetermined axial position, the engagement between said locking means and said counter-locking means defining the active axial locking position of the rod (6), the disengagement between said locking means and said counter-locking means defining the inactive position.

3. Cylinder according to any one of the preceding claims, wherein the rod engagement hole (10) is a slotted or oblong hole delimited by a hole wall (82) from which protrudes internally at least one rod engagement portion (84), said rod engagement portion (84) projecting internally from the hole wall (82) so as to form, with the hole wall (82), a step (86) defining the locking means (80).

4. Cylinder according to claims 2 and 3, wherein said counter-locking means (60) comprise at least a lowered portion (62) of the rod (6) defining a coupling undercut (64) suitable to be axially engaged by the step (86) so as to define the active axial locking position of the rod (6) .

5. Cylinder according to any one of the preceding claims, wherein the rod-lock device (7) is influenced elastically to remain in the active rod locking position.

6. Cylinder according to the preceding claim, wherein an elastic element (72) is housed between a bottom wall (92) of the rod-lock piston seat (9) and the first end (8a) of the rod-lock piston (8), said elastic element (72) being suitable to act on the rod engagement portion (84) so as to cause the translation of the rod-lock piston (8) from the inactive position to the active position.

7. Cylinder according to any one of the preceding claims, wherein the rod-lock piston (8) is equipped with a tang (89) protruding from the front or rear head so as to be accessible from the outside for a movement of the rod-lock piston from the active position to the inactive position.

8. Cylinder according to any one of the preceding claims, wherein a closing cap (74) is sealingly housed in the rod-lock piston seat (9) and forms in cooperation with the second end (8b) of the rod-lock piston (8) a rod-lock piston actuation chamber (76) wherein is pumped the pressurized control fluid that causes the translation of the rod-lock piston from the active axial locking position of the rod to the inactive position.

9. Cylinder according to claim 8, wherein in the head of the piston wherein the rod-lock piston (8) is housed, a pneumatic supply hole (30;300) is obtained in fluidic communication with the rod-lock piston actuation chamber (76) by means of a primary supply duct (31;310), the rod-lock piston actuation chamber (76) being in turn in fluidic communication with the cylinder chamber (4) by means of a secondary supply duct (32).

10. Cylinder according to claim 9, wherein the pneumatic supply hole (30) extends along a pneumatic hole axis (Y) with direction orthogonal to the axis of translation

(X), and wherein the primary supply duct (31) is inclined with respect to said pneumatic hole axis (Y).

11. Cylinder according to claim 9 or 10, wherein the secondary supply duct (32) is in fluidic communication with a shock absorber device (36) at the piston end-of-stroke.

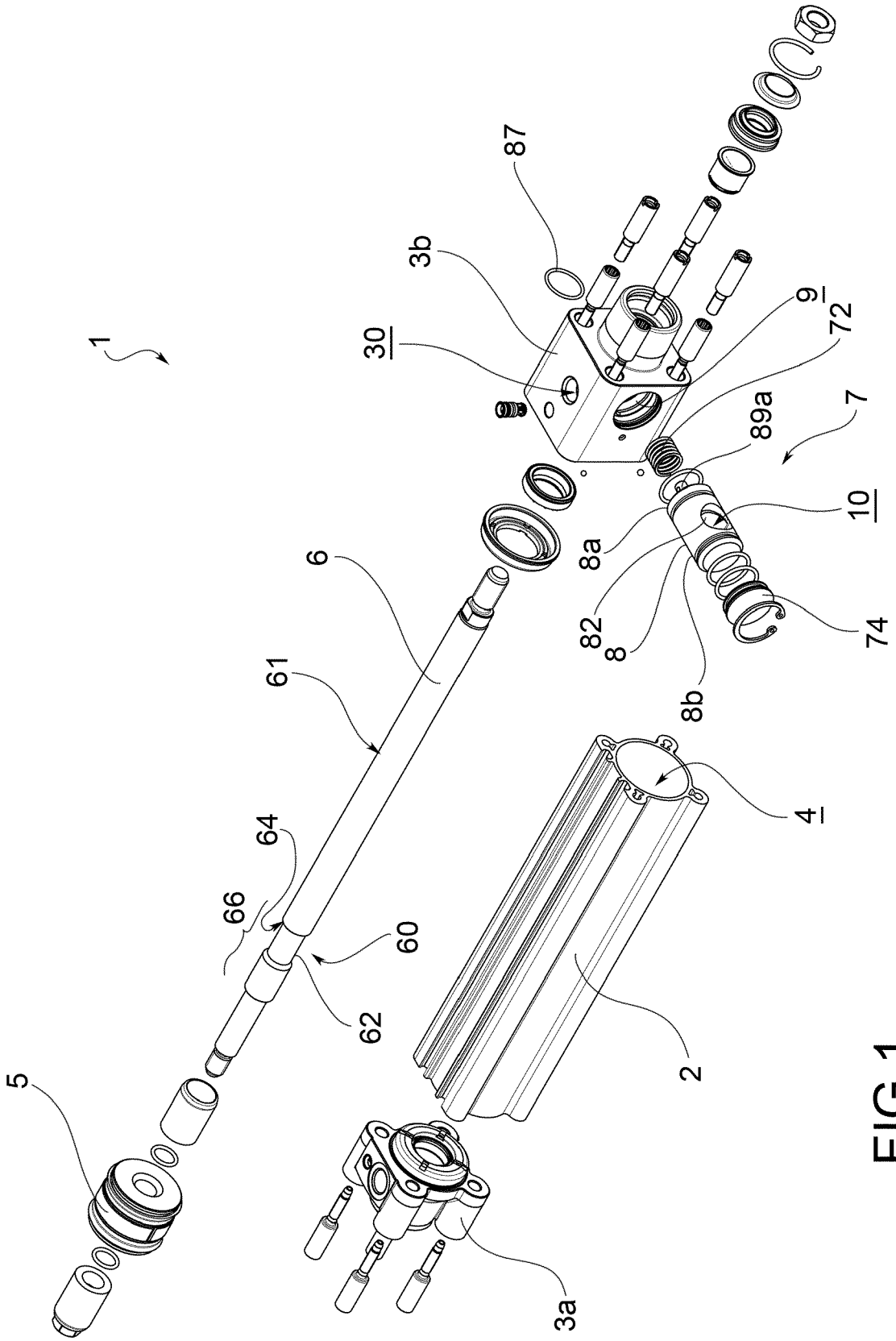

FIG.1

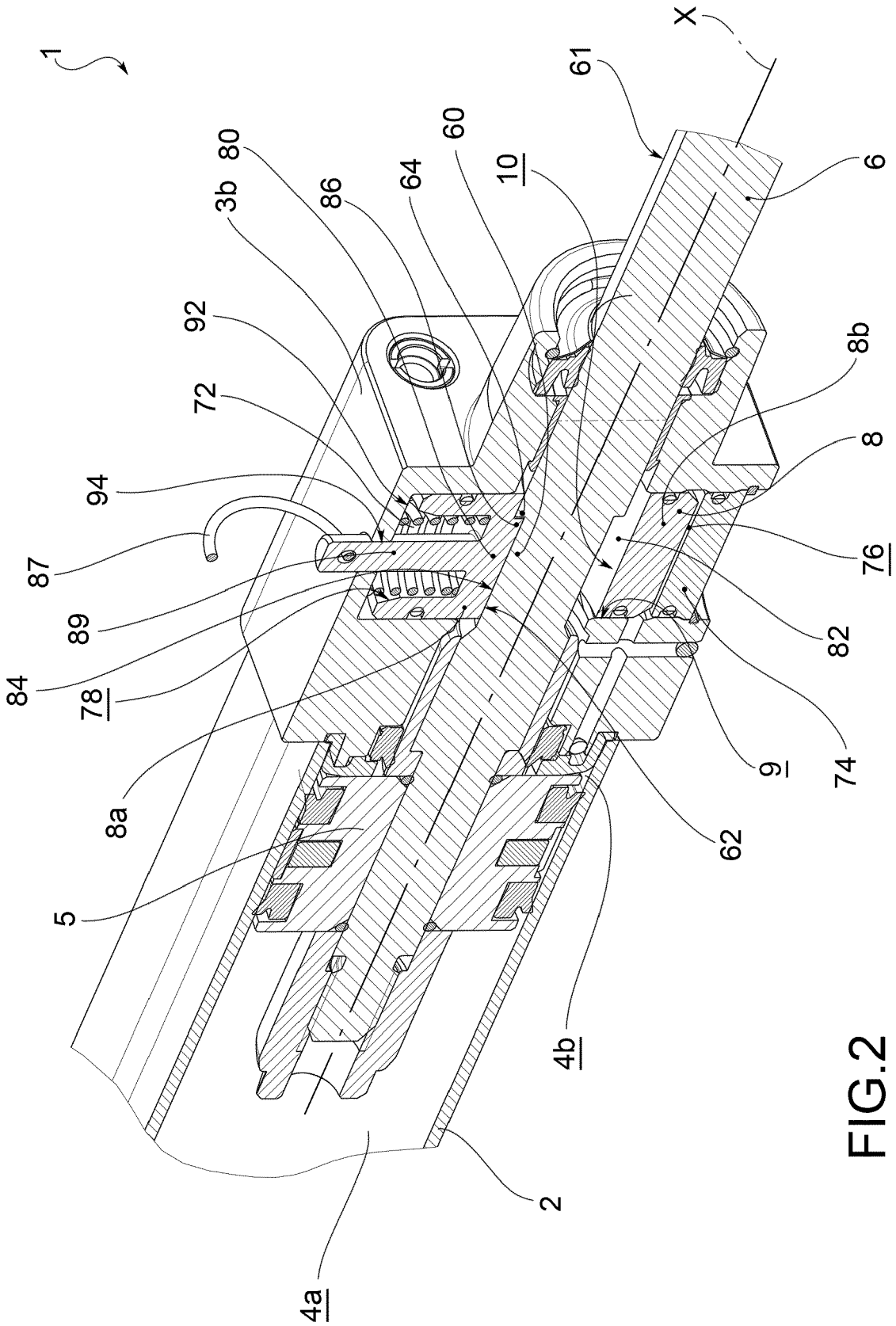
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FIG.2

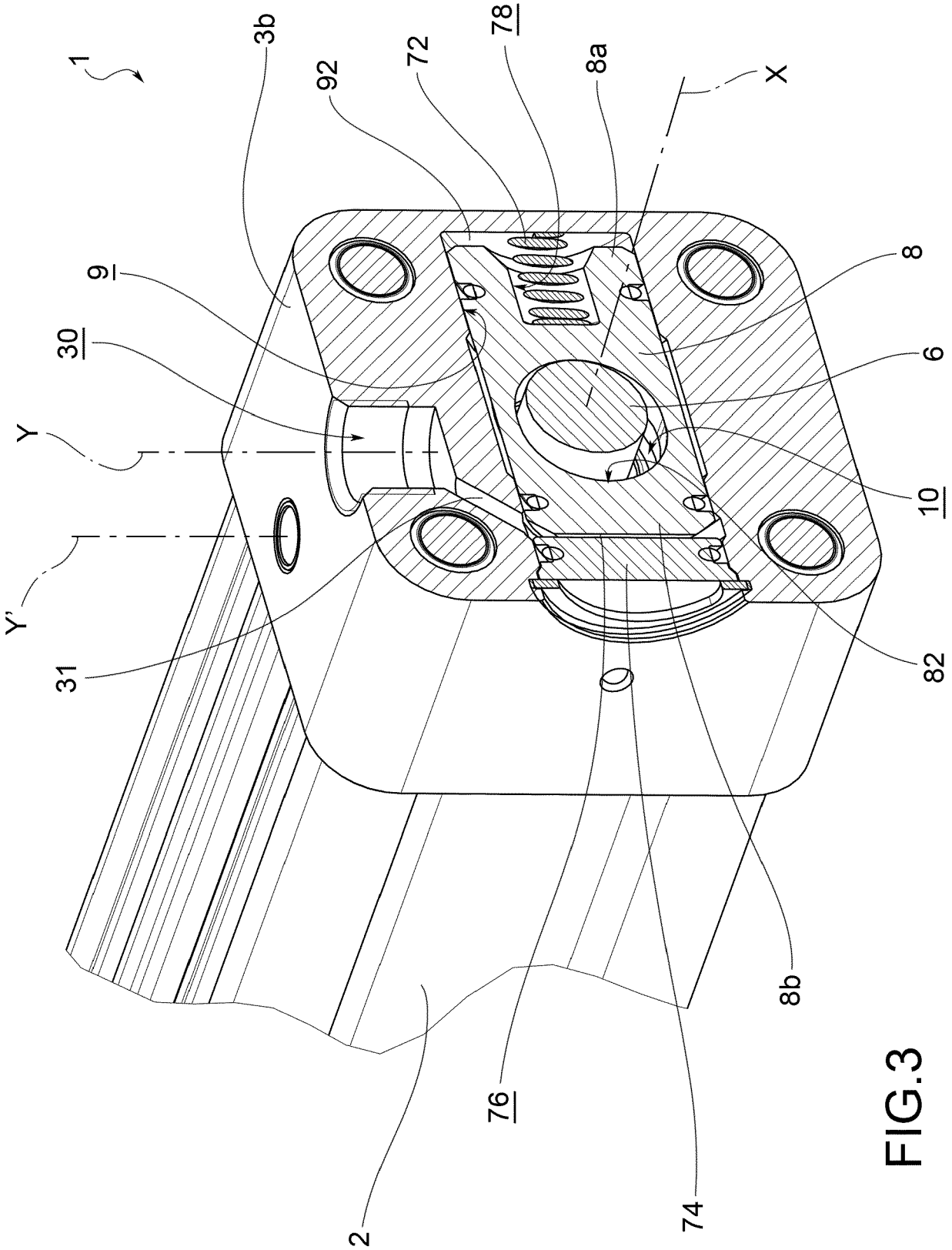


FIG.3

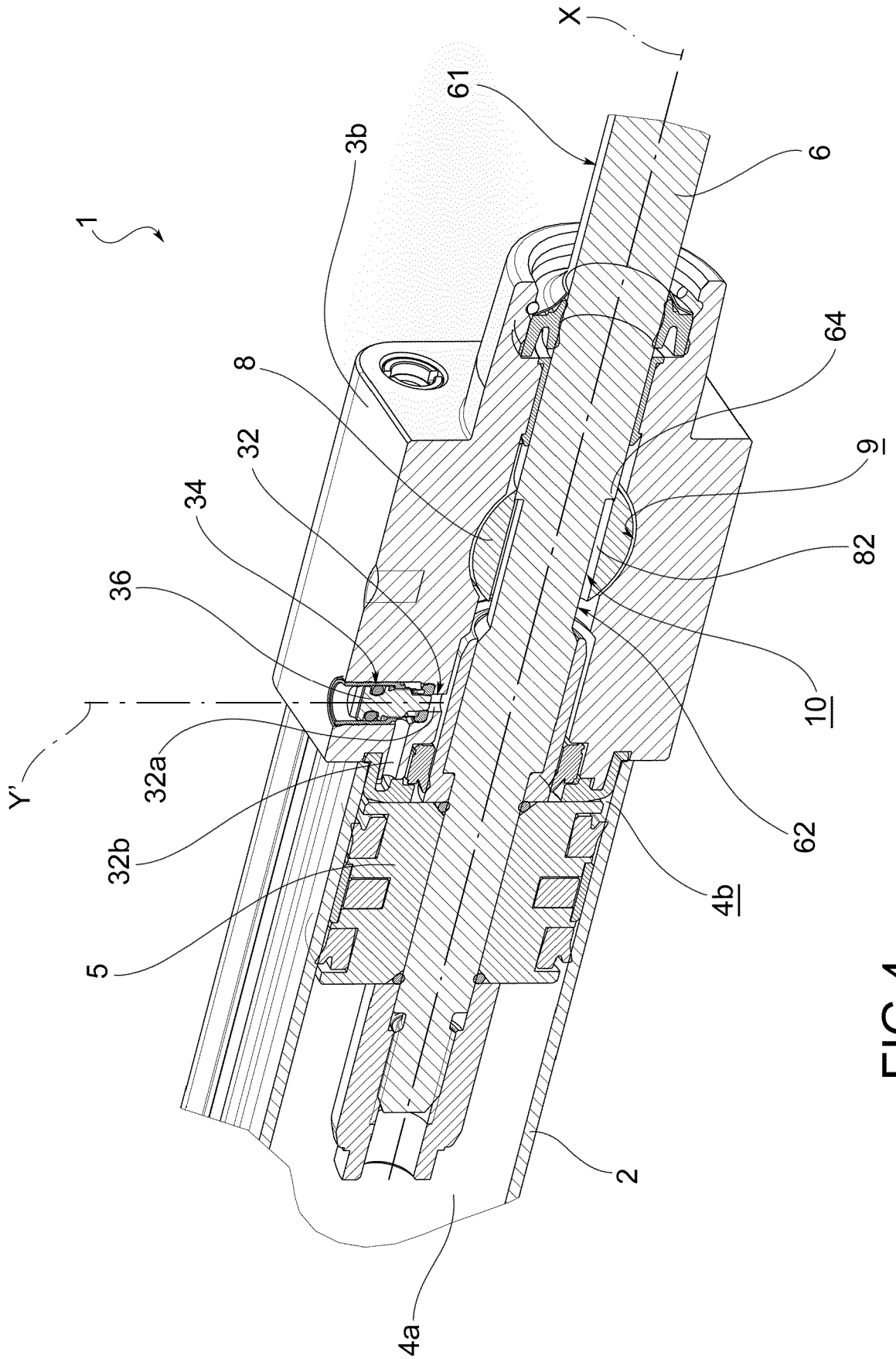


FIG.4

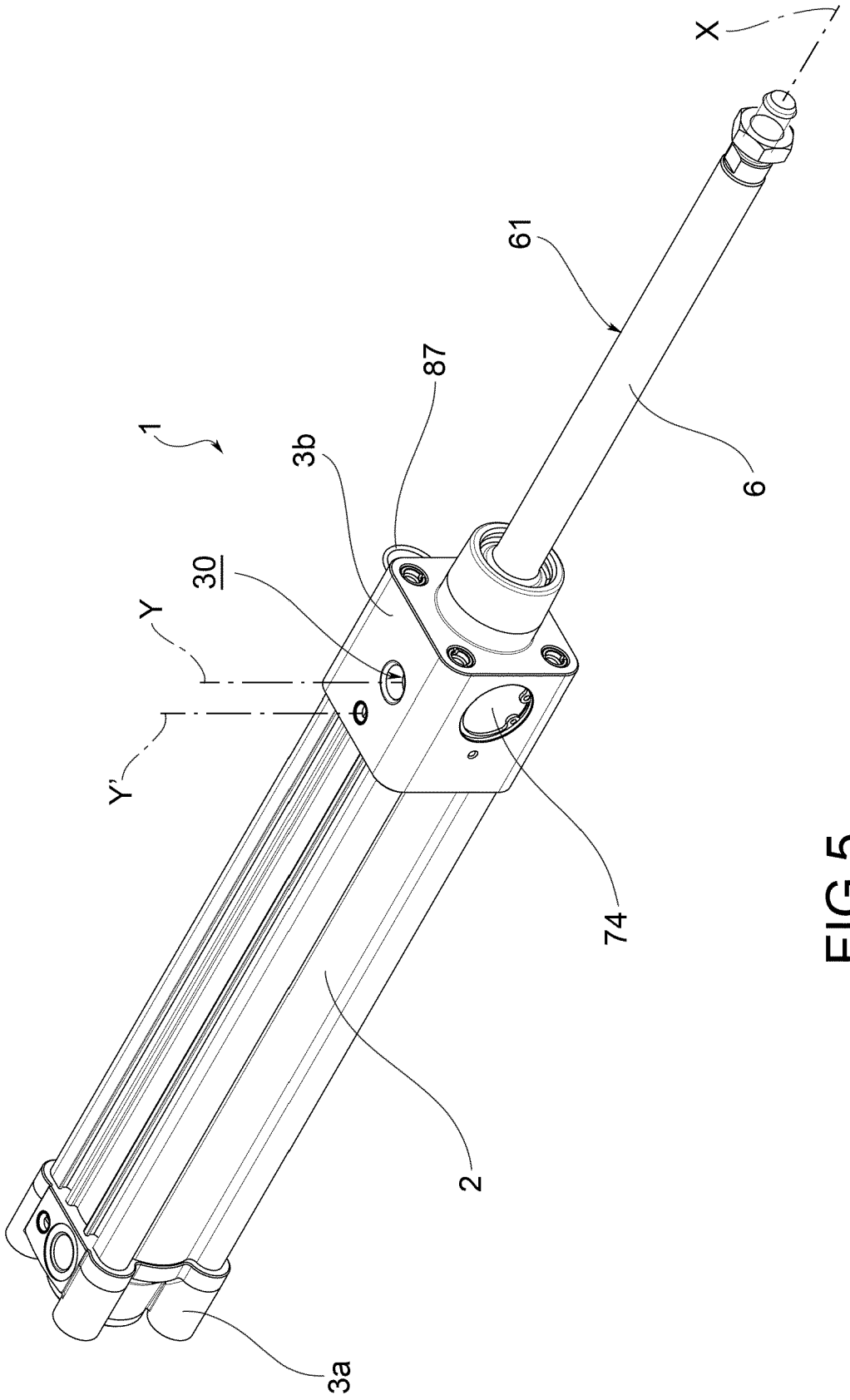
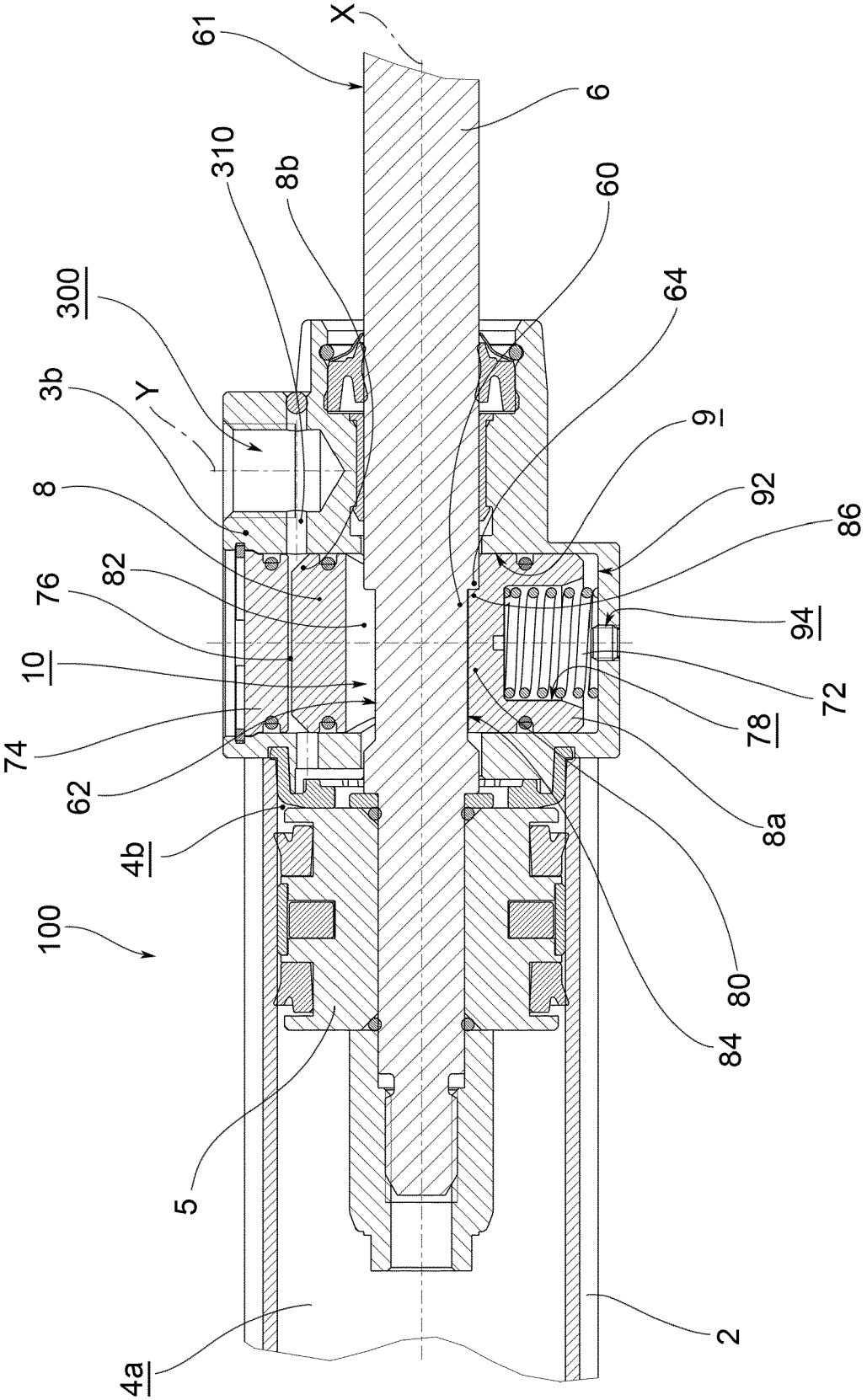


FIG.5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5
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4a

FIG.6

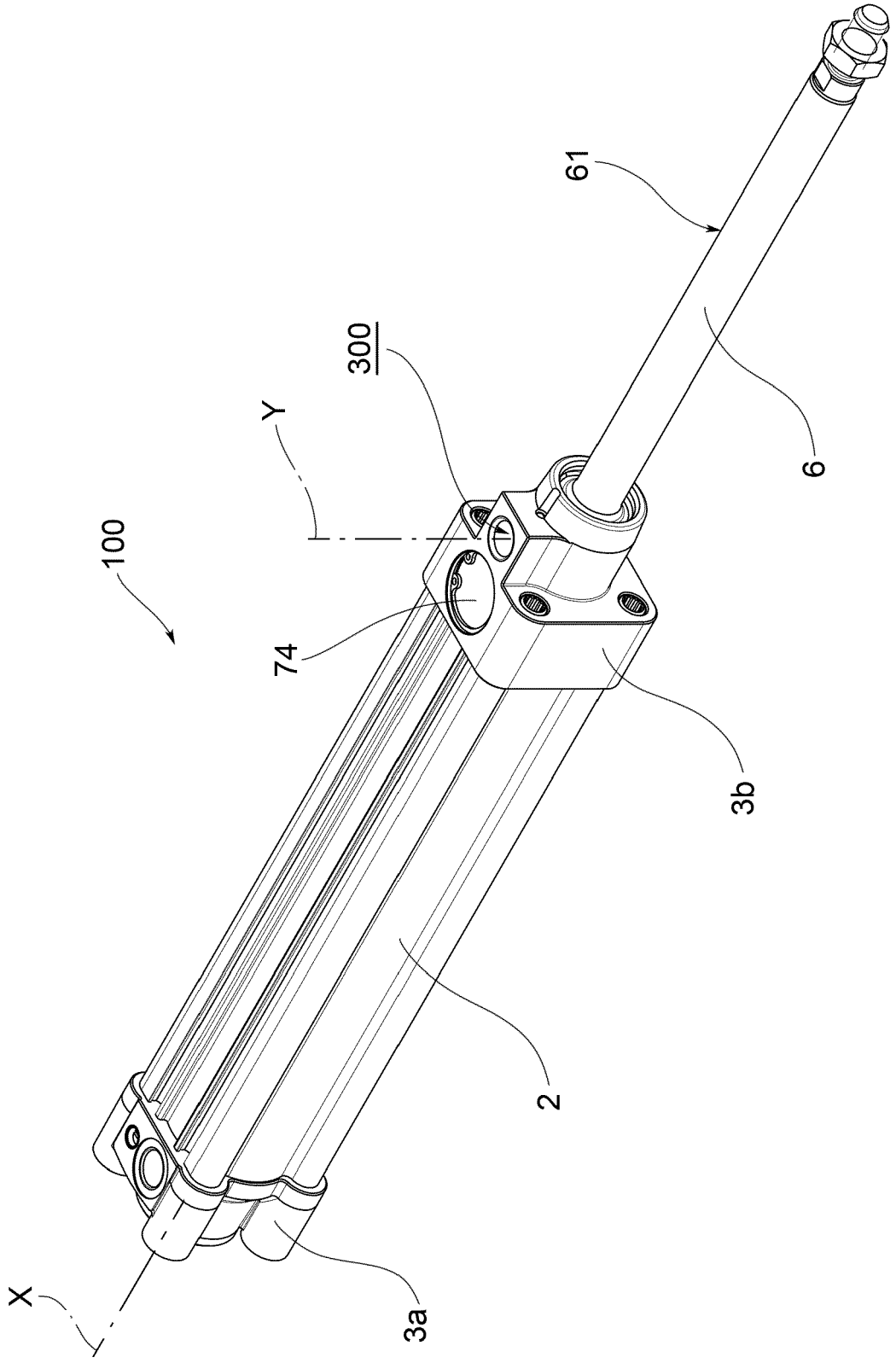

FIG.7

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EUROPEAN SEARCH REPORT

Application Number
EP 20 16 7221

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	US 2 932 370 A (LUDWIG KRAUS ET AL) 12 April 1960 (1960-04-12) * column 4, line 20 - column 5, line 18; figures 4, 6 *	1-6,8-11 7	INV. F15B15/26
X	DE 37 35 103 A1 (BOSCH GMBH ROBERT [DE]) 27 April 1989 (1989-04-27) * column 1, line 49 - column 3, line 38; figures 1-7 *	1-6,8-10	
X	DE 10 2011 015086 B3 (FESTO AG & CO KG [DE]) 16 August 2012 (2012-08-16) * paragraph [0036] - paragraph [0098]; figures 1-13 *	1-7	
X	EP 1 669 612 A2 (BOSCH REXROTH TEKNIK AB [SE]) 14 June 2006 (2006-06-14) * paragraph [0023] - paragraph [0028] *	1-8	
Y	DE 17 51 159 A1 (RUDOLF GEIGER PRAEZ S DREH UND) 22 April 1971 (1971-04-22) * page 8, paragraph 1; figure 1 *	7	TECHNICAL FIELDS SEARCHED (IPC) F15B
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	17 September 2020	Díaz Antuña, Elena

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
L : document cited for other reasons

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 16 7221

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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