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(54) **Universal connection system of a rotary switch with a linear actuator**

(57) A connection system (4) of a rotary switch (8) with a linear actuator (12), comprising - a switch (8) provided with visual signalling means (24) connected so as to rotate, to a first pin (28) integral and offset in relation to a shaft (20) rotating around a rotation axis (X-X), - a linear actuator (12) provided with a mobile end (44) in an actuation direction (Y-Y) not incident with the rotation axis (X-X), - wherein the first pin (28) of the switch (8) is operatively connected to the mobile end (44) of the actuator (12) by mechanical connection means (48) which convert the linear movement along the actuation direction (Y-Y) into rotary movement of the shaft (20) around the rotation axis (X-X). The mechanical connection means (48) comprise a body (52) which supports a bracket (56) which extends from a first connection end (60) to the first pin (28) of the switch (8) and to a second connection end (64) to the mobile end (44) of the actuator (12), the bracket (56) being supported so as to rotate around a second pin (68) defining a hinging axis (Z-Z), parallel to the rotation axis (X-X). The system (4) comprises adjustment means (76) suitable to modify the pitch (80) between the shaft (20) of the switch (8) and the second pin (68) of the bracket (56), said pitch (80) being perpendicular respectively to the rotation axis (X-X) and to the hinging axis (Z-Z).

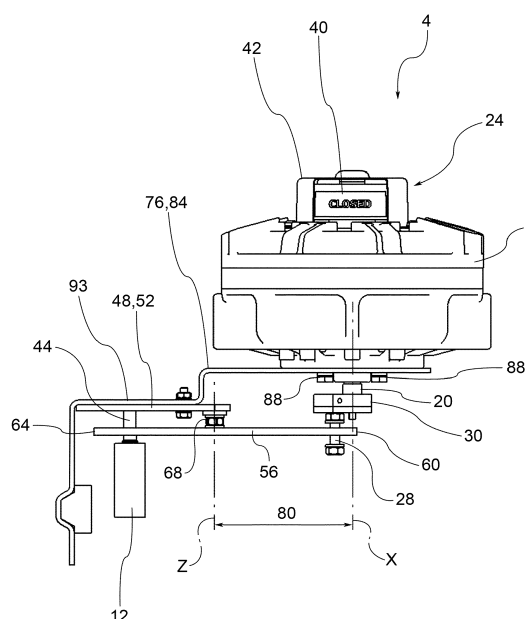


Fig.3

Description

[0001] The present invention relates to a universal connection system of a rotary switch, provided with visual signalling means, with an actuator of the linear type.

[0002] Such a connection system has the function of allowing the transformation of the linear motion of said actuator into rotary motion of the rotary switch, so as to allow the connection of the rotary switches even with linear actuators having strokes very different to each other, variable for example in the range between 2 to 80 mm, and to allow the control of the actuator.

[0003] In particular, a rotary switch is provided with signalling means, such as a status indicator, to provide a visual indication of the operating condition of an actuator device, such as a valve or an actuator, operatively connected to said switch. A rotary switch of this type, fitted with a visual signalling means, is commonly referred to as a 'limit switch box', hereinafter called, for brevity, LSB.

[0004] The LSB switches of the prior art, are usually composed of a body and a cover and contain inside them a rotating member or indicator operatively connected to the shaft of the valve or actuator contained in the body.

[0005] The stem or rotating shaft is used for example in connection with cams operated by further devices, mechanical, magnetic, inductive, capacitive, reed, switches to an analogue meter or similar applications/ devices.

[0006] The rotating members are often equipped with visual indicators of the angular position of the shaft of the valve or actuator, in order to provide, from outside the switch, a visual indication of the operating condition of the valve or actuator.

[0007] These visual indicators are usually housed on the cover so as to be visible from outside the switch, for example the indicator is typically a disk or cap, integral in rotation with the shaft and provided with a relative mask: the mask is fixed and acts as a fixed reference for the angular position of the indicator.

[0008] It is then necessary to operatively connect the linear motion of the valve or actuator to the rotary motion of the stem or rotating shaft of the rotary switch.

[0009] Solutions which permit this connection exist in the prior art: these solutions, however, are complex and expensive. Moreover, a same connection system does not make it possible to adapt to a same rotary switch an actuator having highly variable strokes. As a result the solutions of the prior art provide a plurality of specific mechanical connection systems to be used according to the stroke of the actuator: this redundancy of devices increases costs and does not make it possible to simplify the assembly, setting and performance of the mechanism and phasing of the LSB switch.

[0010] The need is thus felt in the art to provide a universal and versatile connection system which makes it possible to connect the same switch box type switch with actuators and linear valves having strokes also varying greatly, so as to have a rapid phasing of the indicator.

[0011] Such purpose is achieved by a connection sys-

tem made according to claim 1.

[0012] Other embodiments of the switch according to the invention are described in the subsequent claims.

[0013] Further characteristics and advantages of the present invention will be more clearly comprehensible from the description given below of a preferred and non-limiting example of embodiment, wherein:

Figure 1 shows a perspective view of a connection system according to a first embodiment of the present invention;

Figure 2 is a perspective view of the connection system of Figure 1, from a different angle;

Figure 3 shows a side view of the connection system in figure 1 from the arrow III in figure 1;

Figure 4 shows a side plan view of the connection system in figure 1 from the arrow IV in figure 2;

Figure 5 shows a perspective view of a connection system according to a second embodiment of the present invention;

Figure 6 is a perspective view of the connection system of Figure 5, from a different angle;

Figure 7 shows a side view of the connection system in figure 5 from the arrow VII in figure 5;

Figure 8 shows a side plan view of the connection system in figure 5 from the arrow VIII in figure 6.

[0014] With reference to the aforementioned figures, reference numeral 4 globally denotes a connection system of a rotary switch 8 with a linear actuator 12, comprising for example a valve, an actuator, an electromechanical signalling device to an external control unit.

[0015] The rotary switch 8 comprises a switch body 16 which rotatably houses a shaft 20, rotating around a rotation axis X-X.

[0016] The rotary switch 8 is provided with visual signalling means 24 connected so as to rotate, to a first pin 28 integral and offset in relation to the shaft 20 rotating around a rotation axis X-X.

[0017] For example, the first pin 28 is offset in relation to the rotary shaft 20 by means of the interposition of a connecting rod 30. According to one embodiment, said connecting rod 30 has an adjustable length.

[0018] The shaft 20 rotates around the rotation axis X-X according to the operation of the external device, as better described below.

[0019] Preferably, but not necessarily, the switch body 16 is made of metal or metal coated on the outside. The shape, number of walls and the geometric dimensions of the switch body 16 may be of any type and should not in any way be regarded as limiting for the purposes of the present invention.

[0020] The shaft 20 may pass through a bottom 32 of the switch body 16 and may be supported by supports arranged internally and/or externally to the switch body 16, in a known manner.

[0021] The shaft 20 may be associated with cams for the actuation of further devices, such as electrical sig-

nalling devices of switches, inductive sensors, proximity sensors and the like. The type of devices listed above should be considered as a simplification and is not exhaustive.

[0022] The visual signalling means 24 comprise a cover 36, joined so as to close the switch body 16, wherein the cover 36 is provided with an indicator 40 joined in rotation to said shaft 20, so as to permit a visual signalling of the angular position and/or operating condition of the rotating shaft 20, from outside the rotary switch 8.

[0023] Preferably, the cover 36 is made of metal or is externally coated in metal.

[0024] According to one embodiment, the indicator 40 is rotatable around said rotation axis X-X, and may be provided with an indicator cover 42 to allow the visual signalling of the state of operation of the actuator 12. For example, the indicator cover 42 acts as a mask so as to permit a rapid and effective identification of the state of operation of the actuator; for example the cover of the indicator 42 comprises masked areas and the indicator 40 comprises operating signals, such as the wording 'open-closed'.

[0025] The indicator 40 may have any shape; preferably it is axial-symmetric and has a disc shape.

[0026] Indications of the operating status of the external device are shown on the indicator 40, operatively connected to the shaft, said indications being shown by mechanical, chemical, electrochemical procedures or by the affixing of labels.

[0027] The linear actuator 12 is provided with a mobile end 44 in an actuation direction Y-Y not incident with the rotation axis X-X. According to one embodiment, the actuation direction Y-Y is perpendicular to said rotation axis X-X and not incident with the latter.

[0028] The first pin 28 of the rotary switch 8 is operatively connected to the mobile end 44 of the actuator 12 by mechanical connection means 48 which convert the linear movement of the mobile end 44 in the actuation direction Y-Y into rotary movement of the shaft 20.

[0029] In other words, the shaft 20 rotates with the translation of the linear actuator 12 and, by rotating, performs the function of switch by actuating, for example by cams, a plurality of devices connected to the rotary switch 8.

[0030] Moreover, this way, depending on the operation or operating condition of the actuator 12, the switch 8 can operate a plurality of devices; the phasing between the switch 8 and the actuator 12 is guaranteed by the mechanical connection means 48. Furthermore, by rotating, the indicator 40 provides information on the operating state of the actuator 12, thanks to the visual indications provided by the indicator 40 and/or by the indicator cover 42.

[0031] The mechanical connection means 48 comprise a body 52 which supports a bracket 56 which extends from a first connection end 60 to the first pin 28 of the switch 8 and to a second connection end 64 to the mobile end 44 of the actuator 12.

[0032] The bracket 56 is supported so as to rotate around a second pin 68 defining a hinging axis Z-Z, parallel to the rotation axis X-X of the shaft 20.

[0033] According to one embodiment, the first connection end 60 of the bracket 56 to the first pin 28 of the switch 8 comprises a slot 72 which houses said first pin 28 so as to permit the sliding of the first pin 28 along the slot 72, during the rotation of the bracket 56 around the second pin 68. The connection given by the coupling between the second pin 68 and the slot 72 makes it possible to maintain the kinematic connection between the bracket 56 and the shaft 20 of the switch 8 through the first pin 28, during rotation of said bracket.

[0034] According to one embodiment, the second connection end 64 of the bracket 56 at the mobile end 44 of the actuator 12 comprises a slot 72 which houses said mobile end 44 so as to permit the sliding of the mobile end 44 along the slot 72, during the rotation of the bracket 56 around the second pin 68. The connection given by the coupling between the mobile end 44 and the slot 72 makes it possible to maintain the kinematic connection between the bracket 56 and the actuator 12, during the translation of the mobile end 44 of said actuator.

[0035] Advantageously, the connection system 4 comprises adjustment means 76 suitable to modify the pitch 80 between the shaft 20 of the switch 8 and the second pin 68 of the bracket 56, said pitch 80 being perpendicular respectively to the rotation axis X-X and to the hinging axis Z-Z.

[0036] According to one embodiment, the adjustment means 76 comprise a first plate 84 integral with the body 52, and provided with at least one attachment means 88, such as a threaded connection means, attached to the switch body 16 and at least one slot 72 which houses said attachment means 88, so as to vary and block the attachment position of the switch 8 in relation to the second pin 68 of the bracket 56.

[0037] Preferably, said at least one slot 72 of the first plate 84 is directed parallel to the pitch 80.

[0038] According to one embodiment, between the attachment means 88, for example threaded, and the first plate 84, at least one crosspiece 92 is interposed. The crosspiece 92 distributes the load over a wider surface, improves the mechanical attachment and also acts as anti-unscrewing means.

[0039] According to a possible further embodiment, the attachment means 88 may also be non-threaded, comprising, for example, shaped coupling systems, expansion bolts and the like.

[0040] According to a possible embodiment (figures 1-4) the first plate 84 is attached to the body 52 by means of an interposed adjustment plate 93, provided with a plurality of holes 95 so as to permit the relative attachment by means of the interposition of attachment means 88; preferably the adjustment plate 93 comprises a plurality of holes 95 so as to permit a further variation of the pitch 80 between the shaft 20 of the switch 8 and the second pin 68 of the bracket 56.

[0041] According to a further embodiment (figures 5-8) the adjustment means 76 comprise a second plate 96 integral with the body 52, wherein the attachment means 88 are inserted between the second plate 96 and the body 52 suitable for modifying the position of the second plate 96 so as to vary the pitch 80 between the shaft 20 of the switch 8 and the second pin 68 of the bracket 56.

[0042] Preferably, the attachment means 88 are inserted in slots 72 made on the body 52, said slots 72 being positioned parallel to the pitch 80.

[0043] The functioning of the system according to the present invention will now be described.

[0044] In particular, using the connection system of a first embodiment (Figures 1-4), it is possible to adapt the stroke of the actuator to the position of the switch 8 by acting on the adjustment means 76: in particular by loosening the attachment means 88 so as to adjust the pitch 80 between the shaft 20 of the switch 8 and the second pin 68 of the bracket 56, integrally moving the switch itself. After achieving the desired position, the attachment means 88 may be tightened. In the case where the actuator stroke is particularly extensive, it is also possible to act on the adjustment plate 93, by unscrewing the attachment means 88 and positioning the attachment plate 93 so as to increase further, for example, the pitch 80 between the shaft 20 of the switch 8 and the second pin 68 of the bracket 56, moving the switch again.

[0045] Using the connection system of a second embodiment (Figures 5-8), it is possible to adapt the stroke of the actuator 12 to the position of the switch 8 acting again on the adjustment means 76: in particular loosening the attachment means 88 so as to adjust the pitch 80 between the shaft 20 of the switch 8 and the second pin 68 of the bracket 56, moving the body 52 with the relative bracket 56; this way the pitch 80 is changed, given that the switch remains fixed, while varying the position of the second pin 68 of the bracket 56. The phasing of the indicator 40 in the desired position is thus obtained.

[0046] As may be seen from the description, the switch of the present invention makes it possible to overcome the drawbacks of the prior art.

[0047] The system according to the present invention, in its embodiments, may be easily used to connect rotary switches with valves or linear actuators having very different strokes from each other.

[0048] In particular, the same connection system permits a broad range of adjustment making it easily adaptable to valves or actuators having variable strokes even of one or two orders of magnitude.

[0049] This versatility not only makes it possible to simplify the assembly, the setting and performance of the mechanism but also and above all to limit costs considerably. It is in fact possible to make a single type of connection system to be used for the most diverse applications. After use, the connection system may be easily dismantled and connected to a new switch-actuator system requiring rapid and inexpensive adjustments and adaptations.

[0050] This way it is possible to connect different types of linear actuators, having even highly variable strokes, with rotary switches, so as to always have the correct phasing between the linear movement of the actuator and the rotation of the indicator. By acting appropriately on the adjustment means it is always possible to ensure that the phasing of the actuator and the visual signalling means is such as to always have the correct indication of the operating status of the actuator from the outside.

[0051] The present invention thus makes it possible to adapt with extreme ease actuators having different strokes to rotary switches in order to ensure in a rapid and effective manner the perfect phasing between the actuator position and the visual indication of the indicator. In other words, depending on the shifting of the actuator, it is possible to move the indicator from an indication of 'open' to that of 'closed' so as to signal the exact operating condition of the actuator to the outside. In particular, it is possible to calibrate the connection system so as to make a stroke of the actuator correspond to a 90 degree rotation of the indicator.

[0052] A person skilled in the art may make numerous modifications and variations to the connection system described above so as to satisfy contingent and specific requirements while remaining within the sphere of protection of the invention as defined by the following claims.

Claims

1. Connection system (4) of a rotary switch (8) with a linear actuator (12), comprising:

- a switch (8) provided with visual signalling means (24) connected so as to rotate to a first pin (28) integral and offset in relation to a shaft (20) rotating around a rotation axis (X-X),
- a linear actuator (12) provided with a mobile end (44) in an actuation direction (Y-Y) not incident with the rotation axis (X-X),
- wherein the first pin (28) of the switch (8) is operatively connected to the mobile end (44) of the actuator (12) by mechanical connection means (48) which convert the linear movement along the actuation direction (Y-Y) into rotary movement of the shaft (20) around the rotation axis (X-X), so as to place the position of the actuator (12) in phase with the indication of the visual signalling means (24),

characterised in that

- said mechanical connection means (48) comprise a body (52) which supports a bracket (56) which extends from a first connection end (60) to the first pin (28) of the switch (8) and to a second connection end (64) to the mobile end (44) of the actuator (12), the bracket (56) being supported so as to rotate around a second pin (68) defining a hinging axis (Z-Z), parallel to the

- rotation axis (X-X),
 - wherein the system (4) comprises adjustment means (76) suitable to modify the pitch (80) between the shaft (20) of the switch (8) and the second pin (68) of the bracket (56), said pitch (80) being perpendicular respectively to the rotation axis (X-X) and to the hinging axis (Z-Z).
2. Connection system (4) according to claim 1, wherein the actuation direction (Y-Y) is perpendicular to said rotation axis (X-X).
 3. Connection system (4) according to claim 1 or 2, wherein the adjustment means (76) comprise a first plate (84) integral with the body (52), and provided with at least one means of attachment (88) attached to the switch (8) and with at least one slot (72) which houses said means of attachment, so as to vary and block the attachment position of the switch (8) in relation to the second pin (68) of the bracket (52).
 4. Connection system (4) according to claim 3, wherein said means of attachment (88) is a threaded means of attachment.
 5. Connection system (4) according to claim 3 or 4, wherein the attachment means (88) comprise a shaped coupling system, and/or an expansion plug and the like.
 6. Connection system (4) according to any of the claims from 3 to 5, wherein said at least one slot (72) is directed parallel to said pitch (80).
 7. Connection system (4) according to any of the claims from 3 to 6, wherein at least one cross-member (92) is positioned between the means of attachment (88) and the first plate (84).
 8. Connection system (4) according to any of the claims from 3 to 7, wherein the first plate (84) is attached to the body (52) by means of an interposed adjustment plate (93), provided with a plurality of holes (95) so as to permit the relative attachment by means of the interposition of attachment means (88), said holes (95) being staggered so as to permit a variation of the pitch (80) between the shaft (20) of the switch (8) and the second pin (68) of the bracket (56).
 9. Connection system (4) according to claim 1 or 2, wherein the adjustment means (76) comprise a second plate (96) integral with the body (52), wherein attachment means (88) are inserted between the second plate (96) and the body (52) suitable for modifying the position of the second plate (96) so as to vary the pitch (80) between the shaft of the switch (8) and the second pin (68) of the bracket (56).
 10. Connection system (4) according to claim 9, wherein the attachment means (88) are inserted in slots (72) made on the body (52), said slots (72) being positioned parallel to said pitch (80).
 11. Connection system (4) according to claim 9 or 10, wherein said means of attachment (88) is a threaded means of attachment.
 12. Connection system (4) according to claim 9, 10 or 11, wherein the attachment means (88) comprise a shaped coupling system, and/or an expansion plug and the like.
 13. Connection system (4) according to any of the previous claims, wherein the first connection end (60) of the bracket (56) to the first pin (28) of the switch (8) comprises a slot (72) which houses said first pin (28) so as to permit the sliding of the first pin (28) along the slot (72), during the rotation of the bracket (56) around the second pin (68).
 14. Connection system (4) according to any of the previous claims, wherein the second connection end (64) of the bracket (56) to the mobile end (44) of the actuator (12) comprises a slot (72) which houses said mobile end (44) so as to permit the sliding of the mobile end (44) along the slot (72), during the rotation of the bracket (56) around the second pin (68).
 15. Connection system (4) according to any of the previous claims, wherein the first pin (28) is offset in relation to the rotating shaft (20) by means of an interposed connecting rod (30).
 16. Connection system (4) according to any of the previous claims, wherein said connecting rod (30) is adjustable in length.

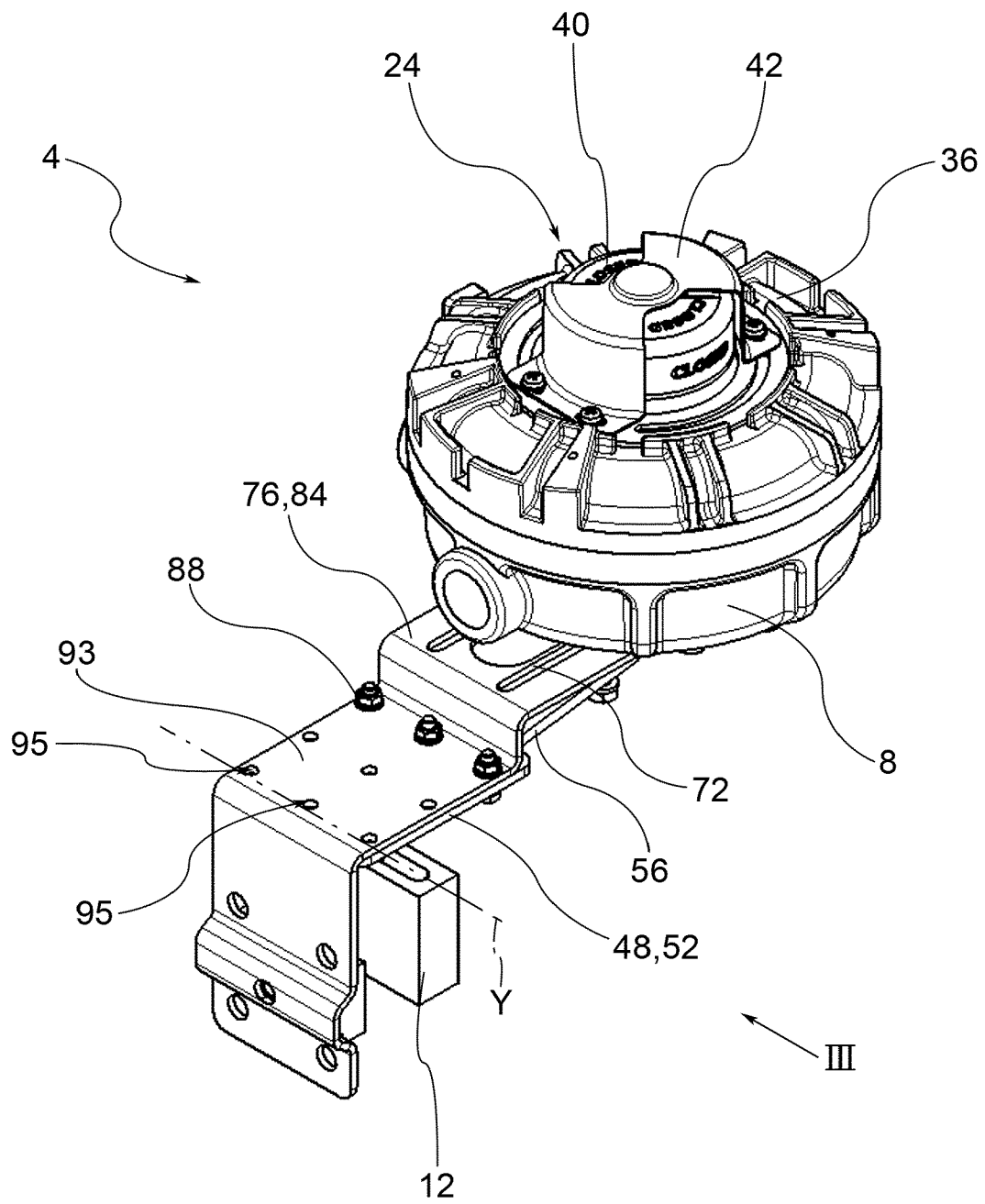


Fig. 1

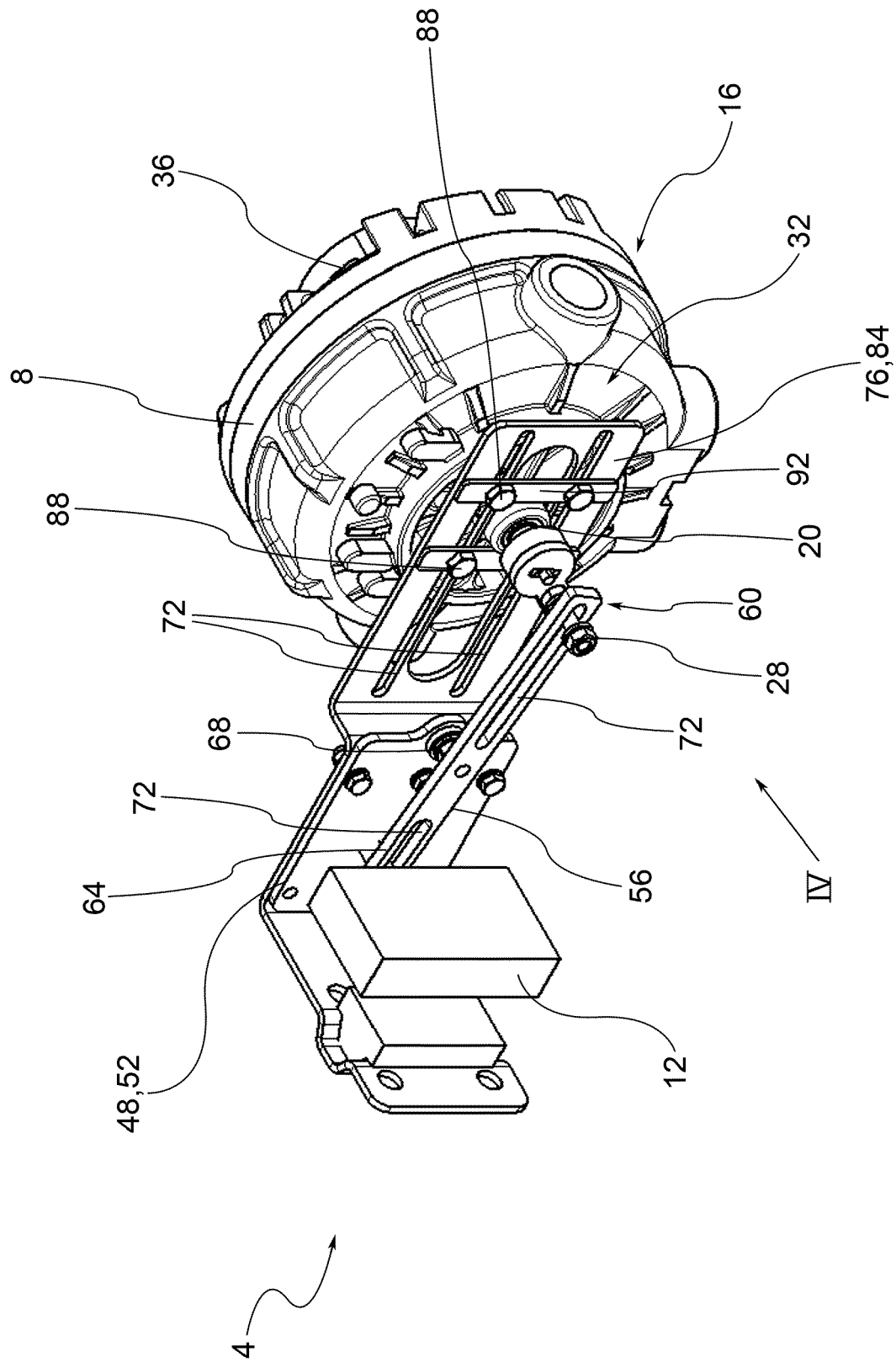


Fig. 2

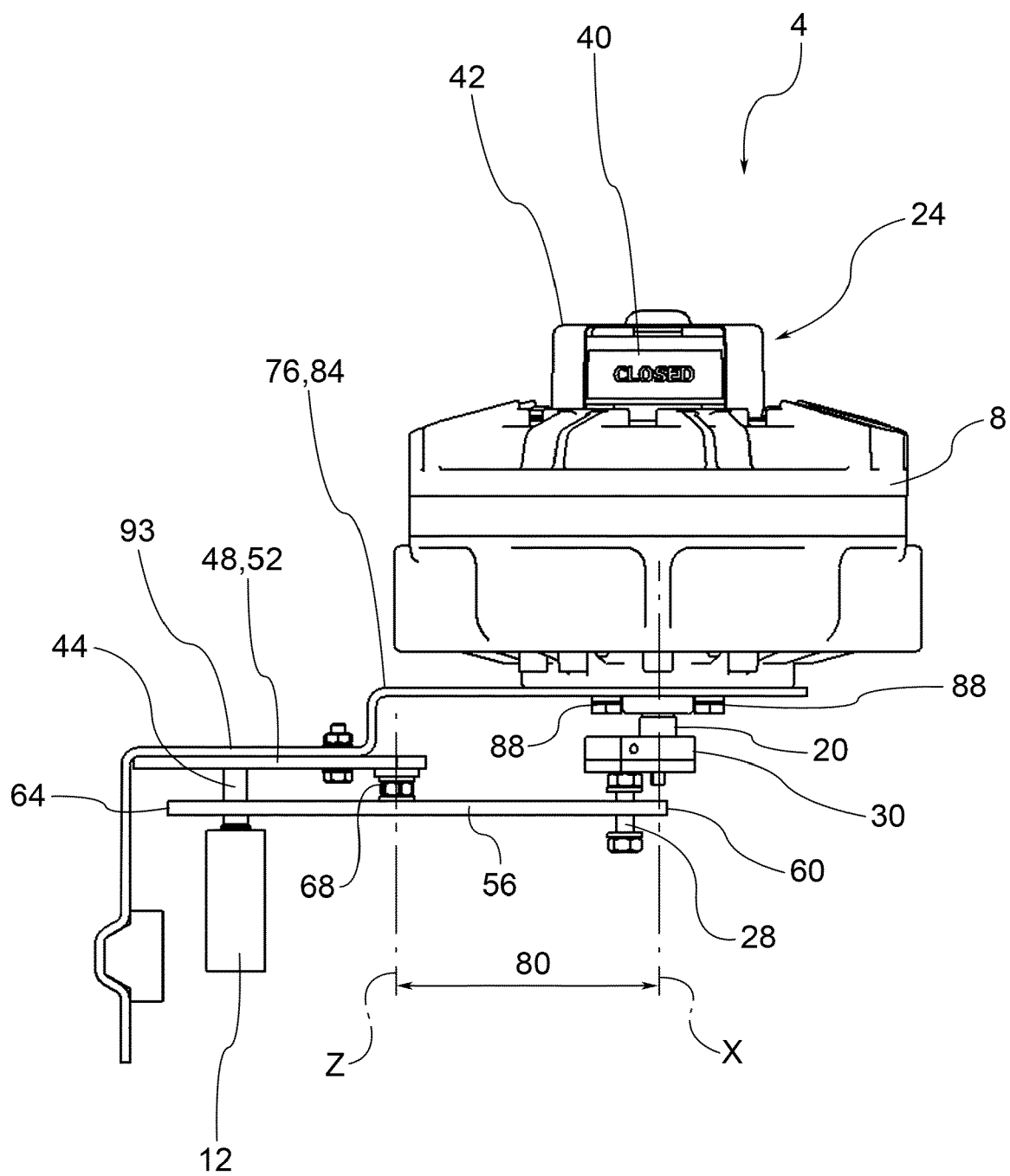


Fig. 3

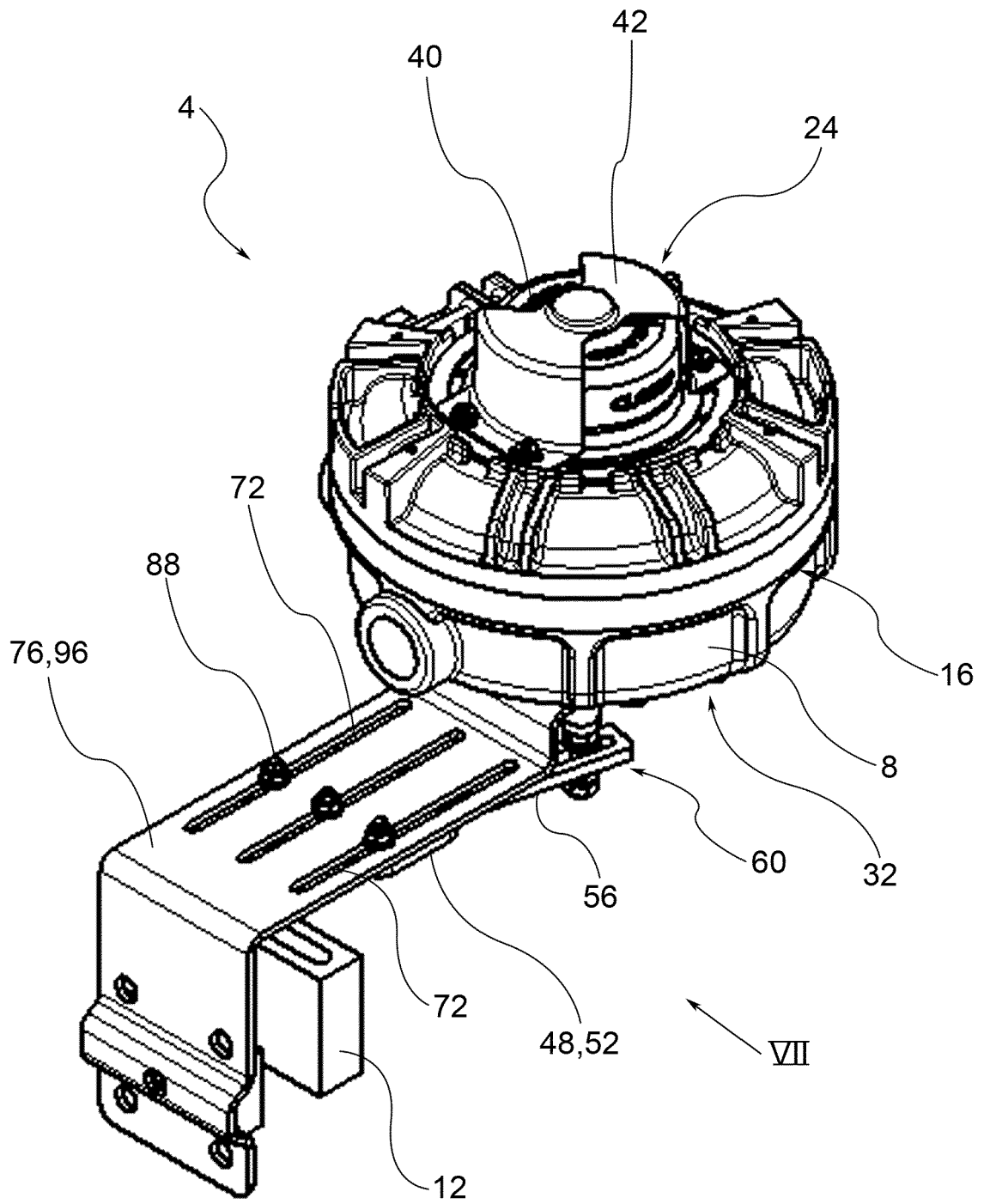


Fig. 5

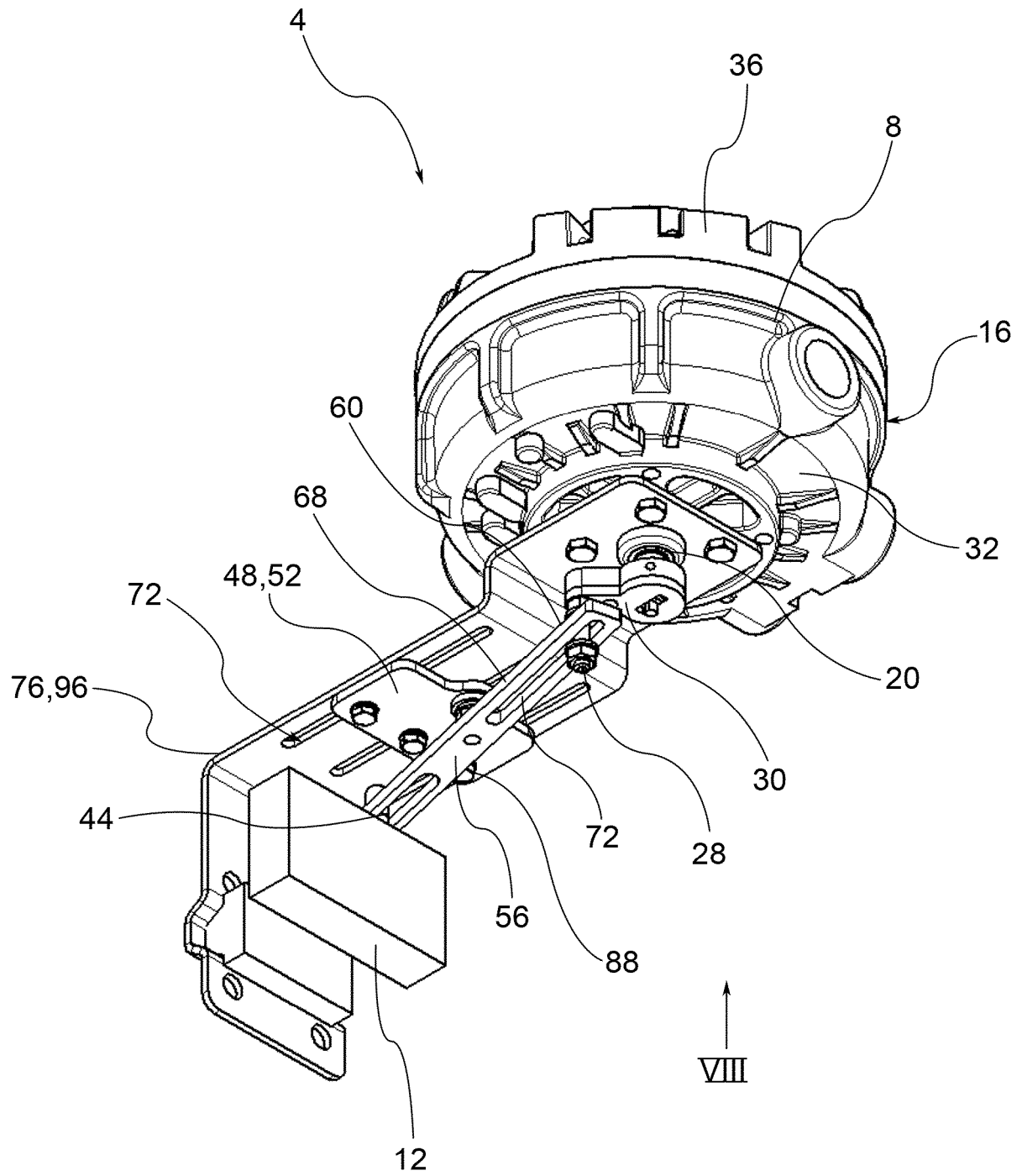


Fig. 6

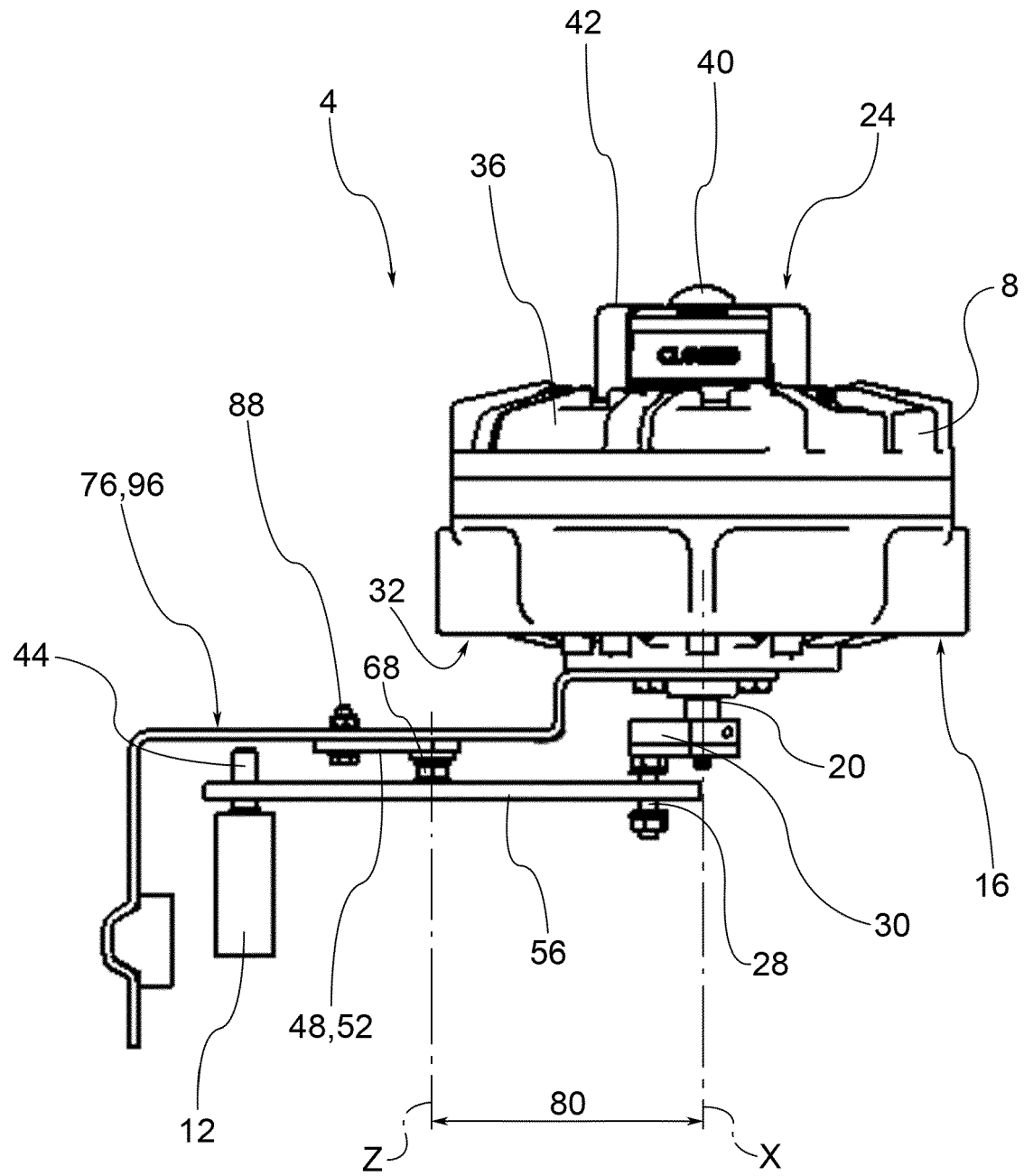


Fig. 7

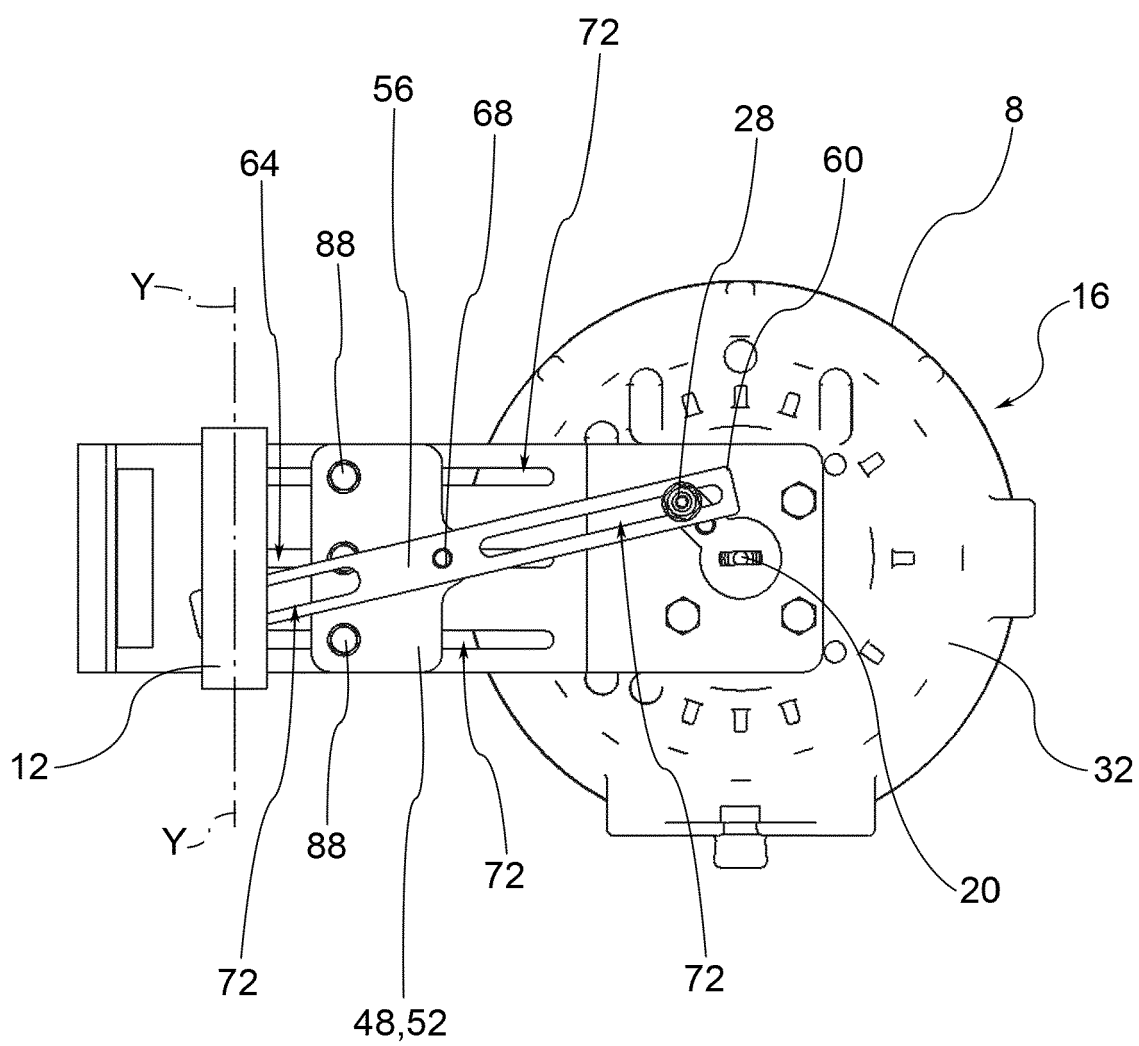


Fig. 8



EUROPEAN SEARCH REPORT

Application Number
EP 14 18 6976

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 6 March 2015	Examiner Nieto, José Miguel
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 14 18 6976

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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