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(54) **Electrical switch assembly**

(57) An electrical switch assembly comprising a base plate (12); depressible switch buttons (14) mounted on the base plate and including electrical switch contacts; a cover plate (20) spaced from the base plate and extending in a plane substantially parallel to the plane of the base plate; an aperture (22) in the cover plate having a centre aligned with an axis (A), the axis being substantially perpendicular to the plane of the base plate; a knob (24) located on the opposite side of the cover plate to the base plate, the knob having a shaft (26) extending through the aperture, the aperture having a predetermined size and shape to restrict the translational movement of the knob shaft in the aperture to predetermined directions away from the centre of the aperture; actuating means (28) secured to the knob shaft on the opposition side of the cover plate to the knob, the actuating means having chamfered surfaces (30) at predetermined positions; actuating rods (32) extending in a direction substantially parallel to the axis between the switch buttons and the actuating means, at least one of the rods being selectively engageable with an associated one of the chamfered surfaces on translational movement of the knob away from the centre of the aperture to depress the associated switch button by way of said at least one rod; a cardan shaft (34) extending between the knob shaft and the base plate, the cardan shaft being extendable in length; a first cardan joint (36) connected between the cardan shaft and the knob shaft; a second cardan joint (38) connected between the cardan shaft and the base plate; wherein translational movement of the knob away from the centre of the aperture causes the cardan shaft to extend in length.

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Description

Technical Field

[0001] The present invention relates to an electrical switch assembly in which the switch knob has the capability of movement in different directions and in which the switch assembly has multiple switch actions or functions.

Background of the Invention

[0002] Electrical switch assemblies are known which have a switch knob in the form of a joystick. Such known assemblies have limitations in terms of the number of separate switch actions or functions which are possible. Also, translation movement of the knob or joystick causes the knob or joystick to pivot relative to an associated cover plate, which may be unacceptable.

Summary of the Invention

[0003] It is an object of the present invention to overcome the above mentioned disadvantages.

[0004] An electrical switch assembly in accordance with the present invention comprises a base plate; depressible switch buttons mounted on the base plate and including electrical switch contacts; a cover plate spaced from the base plate and extending in a plane substantially parallel to the plane of the base plate; an aperture in the cover plate having a centre aligned with an axis, the axis being substantially perpendicular to the plane of the base plate; a knob located on the opposite side of the cover plate to the base plate, the knob having a shaft extending through the aperture, the aperture having a predetermined size and shape to restrict the translational movement of the knob shaft in the aperture to predetermined directions away from the centre of the aperture; actuating means secured to the knob shaft on the opposition side of the cover plate to the knob, the actuating means having chamfered surfaces at predetermined positions; actuating rods extending in a direction substantially parallel to the axis between the switch buttons and the actuating means, at least one of the rods being selectively engageable with an associated one of the chamfered surfaces on translational movement of the knob away from the centre of the aperture to depress the associated switch button by way of said at least one rod; a cardan shaft extending between the knob shaft and the base plate, the cardan shaft being extendable in length; a first cardan joint connected between the cardan shaft and the knob shaft; a second cardan joint connected between the cardan shaft and the base plate; wherein translational movement of the knob away from the centre of the aperture causes the cardan shaft to extend in length.

[0005] In the present invention, the cardan shaft and joints allow the knob to move in a translational direction away from the aperture centre and axis whilst maintaining the knob in the same orientation relative to the cover plate. In preferred embodiments, the cardan shaft and joints also allow rotation of the knob to cause rotation of the encoder; and allow depression of the knob to cause depression of the encoder and the actuator. Any one of these movements of the knob, either individually or simultaneously, causing actuation of one or more switch contacts on the base plate.

Brief Description of the Drawings

[0006] The present invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a schematic illustration of the potential movements of the knob of the electrical switch assembly in accordance with the present invention;
Figure 2 is a schematic illustration of the adjustable length of the cardan shaft of the electrical switch assembly in accordance with the present invention;
Figure 3 is a perspective view, partially in cross-section, of certain elements of the electrical switch assembly in accordance with the present invention;
Figure 4 is a perspective view of the aperture in the cover plate;
Figure 5 is a partial perspective view of the actuating means and actuator rod;
Figure 6 is a perspective view of the rest or normal position of the knob and cardan shaft;
Figure 7 is a perspective view of the position of the knob and extended cardan shaft when the knob is moved in a translational direction away from the rest position;
Figures 8 and 9 are perspective views of the knob, cardan shaft, encoder and actuator when the knob is push (depressed); and
Figure 10 is a perspective view of the encoder when the knob is rotated.

Description of the Preferred Embodiment

[0007] Referring to the drawings, an electrical switch assembly 10 in accordance with the present invention comprises a base plate 12 with depressible switch buttons 14 mounted thereon, each button including electrical switch contacts (not shown) for actuation or de-actuation of an associated electrical load (not shown). The base plate 12 is preferably a printed circuit board.

[0008] In a preferred arrangement, a depressible actuator 16, which functions as or acts on an electrical switch, is also mounted on the base plate 12. The electrical switch of the actuator 16 is electrically connected to a number of electrical loads (not shown) by way of a control module (not shown) for actuation or de-actuation of the electrical loads. An encoder 18 is associated with, and engageable with, the actuator 16 on the opposite side of the actuator to the base plate 12. The encoder 18 is also connected to the control module (not shown). The

encoder 18 is rotatable about an axis A relative to the actuator 16, the axis being substantially perpendicular to plane of the base plate 12. The rotational position of the encoder 18 relative to the base plate 12 generates a signal which is sent to the control module which determines which electrical load is actuated or de-actuated by subsequent depression of the actuator 16. The encoder 18 is preferably cup-shaped and has an outer wall 44 which is castellated. The outer wall 44 passes through an optical reader 46 (Figure 10), which is mounted on the base plate 12, on rotation of the encoder 18 to generate the signal. Alternatively, the encoder may be substantially flat with the outer edge being castellated. The encoder may take other suitable forms, and/or may generate the signal by other means, such as by a magnetic arrangement rather than an optical arrangement.

[0009] In accordance with the present invention, a cover plate 20 is spaced from the base plate 12 and extends in a plane substantially parallel to the plane of the base plate. An aperture 22 in the cover plate 20 has a centre aligned with the axis A. A knob 24 is located on the opposite side of the cover plate 20 to the base plate 12, the knob having a shaft 26 extending through the aperture 22. The aperture 22 has a predetermined size and shape to allow rotation of the knob shaft 26 at any position within the aperture but to restrict the translational movement of the knob shaft in the aperture to predetermined directions away from the centre of the aperture. The aperture 22 is preferably in the form of a cross, as shown in Figure 4. In this example, the aperture 22 comprises four slots 22A-D extending away from the centre of the aperture, with opposed slots 22A-B, 22C-D being aligned and the aligned pairs of slots crossing at substantially ninety degrees to one another. Alternatively, the aligned pairs of slots may cross at an angle other than ninety degrees. Further still, the aperture may comprise only two slots, or three slots defining a substantially Y-shape, or any other suitable number of slots and configuration. The shape of the aperture 22 determines the possible or allowable paths for the translation movement of the knob 24 relative to the cover 20. Resilient means (not shown) may be provided to bias the knob 24 and knob shaft 26 to the centre of the aperture 22, for example one or more springs acting on the knob shaft 26.

[0010] In accordance with the present invention, actuating means 28 are secured to the knob shaft 26 on the opposition side of the cover plate 20 to the knob 24. The resilient means biasing the knob 24 to the centre of the aperture 22 may be one or more springs (not shown) acting on the outer circumferential edge 29 of the actuating means 28. The actuating means 28 has chamfered surfaces 30 at predetermined positions adjacent its circumferential edge. The chamfered surfaces 30 extend at an angle to the plane of the cover plate 20 or base plate 12 from adjacent the outer circumferential edge 29 towards the rotation axis A. Actuating rods 32 (Figure 5) extend between the switch buttons 14 and the actuating means 28. Each actuating rod 32 is selectively engageable with one of the chamfered surfaces 30. Each actuating rod 32 is slidably positioned within a substantially rigid tube 33. Each tube 33 is fixed relative to the base plate 12 and located above a switch button 14. Each tube 33 has a longitudinal axis which is substantially parallel to the rotation axis A, thereby restricting movement of the associated rod 32 to translational movement in a direction substantially parallel to the rotation axis A. Translational movement of the knob 24 away from the centre of the aperture 22, that is away from the rotation axis A, causes the actuating means 28 to move in the same direction. Movement of the actuating means 28 causes a chamfered surface 30 to engage its associated actuating rod 32, causing sliding movement of the rod in its associated tube 33, thereby causing depression of (and actuation of) the switch button 14 associated with that rod. Translation movement of the knob 24 thereby actuates the switch buttons 14 (by way of the chamfered surfaces 30 and the actuating rods 32), and the direction of movement of the knob 24 away from the centre of the aperture 22 relative to the cover 20 determines which switch button 14 is actuated, or which switch buttons 14 are actuated. The resilient effect of the switch buttons 14 also tends to move the knob 24 back to the centre of the aperture 22 by way of the rods 32 and chamfered surfaces 30.

[0011] In accordance with the present invention, a cardan shaft 34 extends between the knob shaft 26 and the encoder 18. A first cardan joint 36 connects one end of the cardan shaft 34 to the knob shaft 26. A second cardan joint 38 connects the other end of the cardan shaft 34 to the encoder 18. The cardan shaft 34 is extendable in length (as shown in Figure 2). The cardan shaft 34 preferably comprises two axially extending parts 40, 42 which are linked together, and which are preferably substantially identical. The two parts 40, 42 are keyed together at adjacent ends (the opposed ends to the joints 36, 38) by means which allow lengthwise extension of the cardan shaft 34 and which ensure simultaneous rotation of the two parts. The keying means is preferably a tongue-and-groove arrangement. Resilient means (not shown) may be associated with the keying means (for example, a spring positioned between the keyed adjacent ends of the parts 40, 42, and tending to extend or compress the length of the cardan shaft 34) to take up any play between the two parts. Alternatively, the resilient means may be the same as the resilient means provided to bias the knob 24 and knob shaft 26 to the centre of the aperture 22. The longitudinal axis Z of the cardan shaft 34 normally extends along the rotation axis A (Figure 6). If the knob 24 is moved in a translational direction relative to the cover plate 20, the longitudinal axis Z of the cardan shaft 34 is orientated at an angle to the rotation axis A (Figure 7), however rotation of the knob 24, and hence rotation of the cardan shaft 34 and the encoder 18 is still possible. Further, if the knob 24 is pushed (depressed) towards the cover plate 20, the encoder 18 is pushed towards the depressible actuator 16 to actuate or de-actuate an electrical load dependent on the rota-

tional position of the encode 18 relative to the base plate 12, as described above. Where a spring is associated with the keying means, pushing of the knob 24 to depress the depressible actuator 16 is possible in any position of the knob 24 within the aperture 22, as well as when the knob 24 is positioned at the centre of the aperture.

[0012] The present invention provides an electrical switch assembly in which several switch functions are possible using a single switch knob. The knob is capable of translation movement, rotational movement, and depression (returnable push movement) relative to a cover plate 20. Additionally, translational movement of the knob does not cause the knob to tilt relative to the cover plate.

[0013] The present invention may be used in conjunction with the motion control assembly described and claimed in EP patent application no. (Applicant's reference DP-317147) filed the same day as the present application.

Claims

1. An electrical switch assembly comprising a base plate (12); depressible switch buttons (14) mounted on the base plate and including electrical switch contacts; a cover plate (20) spaced from the base plate and extending in a plane substantially parallel to the plane of the base plate; an aperture (22) in the cover plate having a centre aligned with an axis (A), the axis being substantially perpendicular to the plane of the base plate; a knob (24) located on the opposite side of the cover plate to the base plate, the knob having a shaft (26) extending through the aperture, the aperture having a predetermined size and shape to restrict the translational movement of the knob shaft in the aperture to predetermined directions away from the centre of the aperture; actuating means (28) secured to the knob shaft on the opposition side of the cover plate to the knob, the actuating means having chamfered surfaces (30) at predetermined positions; actuating rods (32) extending in a direction substantially parallel to the axis between the switch buttons and the actuating means, at least one of the rods being selectively engageable with an associated one of the chamfered surfaces on translational movement of the knob away from the centre of the aperture to depress the associated switch button by way of said at least one rod; a cardan shaft (34) extending between the knob shaft and the base plate, the cardan shaft being extendable in length; a first cardan joint (36) connected between the cardan shaft and the knob shaft; a second cardan joint (38) connected between the cardan shaft and the base plate; wherein translational movement of the knob away from the centre of the aperture causes the cardan shaft to extend in length.

2. An electrical switch assembly as claimed in Claim 1, further comprising a depressible actuator (16) mounted on the base plate (12) for actuating a number of electrical loads; an encoder (18) rotatably mounted on the base plate and engageable with the actuator on the opposite side of the actuator to the base plate, the encoder being rotatable about the axis (A) relative to the actuator to determine the electrical load to be actuated by the actuator; wherein the second cardan joint (38) is connected to the encoder on the base plate; and wherein the aperture (22) has a predetermined size and shape to allow rotation of the knob shaft (26) at any position in the aperture.

3. An electrical switch assembly as claimed in Claim 2, wherein the encoder (18) has a castellated outer edge (44) which passes through a reader (46) mounted on the base plate (12) on rotation of the encoder.

4. An electrical switch assembly as claimed in Claim 3, wherein the encoder (18) is substantially cup-shaped.

5. An electrical switch assembly as claimed in Claim 3 or Claim 4, wherein the reader is an optical reader or a magnetic reader.

6. An electrical switch assembly as claimed in any one of Claims 1 to 5, wherein the cardan shaft (34) comprises two axially extending parts (40, 42) which are linked together, and wherein the first cardan joint (36) is attached to one end of one part (40) and the second cardan joint (38) is attached to one end of the other part (42).

7. An electrical switch assembly as claimed in Claim 6, wherein the two parts (40, 42) are substantially identical.

8. An electrical switch assembly as claimed in Claim 6 or Claim 7, wherein the two parts (40, 42) are keyed together at adjacent ends, which are the opposed ends to the cardan joints (36, 38), by means which allow the lengthwise extension of the cardan shaft (34) and which ensure simultaneous rotation of the two parts.

9. An electrical switch assembly as claimed in Claim 8, wherein the keying means is a tongue-and-groove arrangement.

10. An electrical switch assembly as claimed in Claim 8 or Claim 9, wherein the keying means includes a resilient connection between the two parts (40, 42) of the cardan shaft (34).

11. An electrical switch assembly as claimed in any one

of Claims 1 to 10, wherein the aperture (22) is substantially X- shaped, with the arms (22A-D) extending substantially parallel to one another.

12. An electrical switch assembly as claimed in any one of Claims 1 to 10, wherein the aperture (22) is substantially Y-shaped.

13. An electrical switch assembly as claimed in any one of Claims 1 to 12, wherein the actuating rods (32) are slidable in an axial direction in tubes (33) which are fixed relative to the base plate (12), and which extend substantially parallel to the axis (A).

14. An electrical switch assembly as claimed in any one of Claims 1 to 13, further comprising resilient means acting on the knob (24) to bias the knob to the centre of the aperture (22).

Fig.1.

Functionality

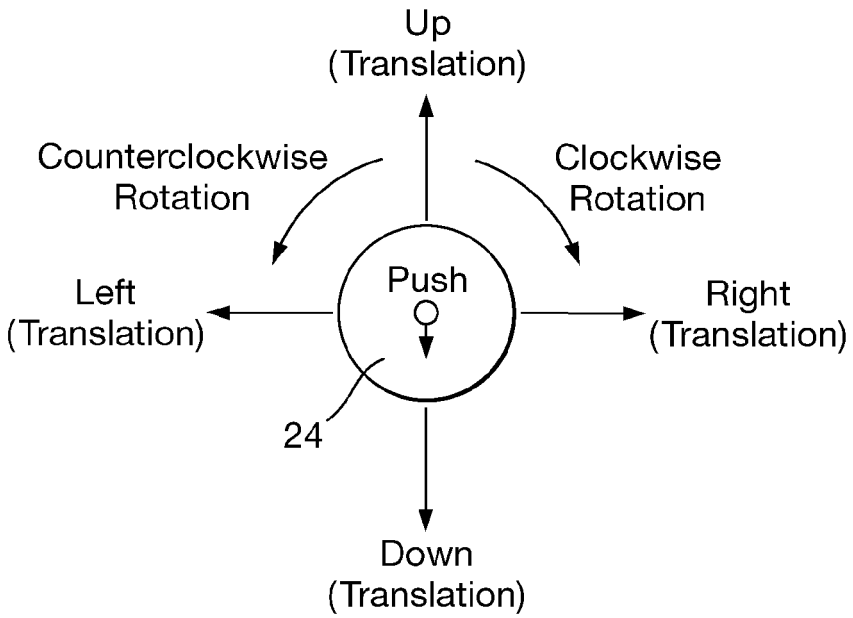

Fig.2.

Link Length

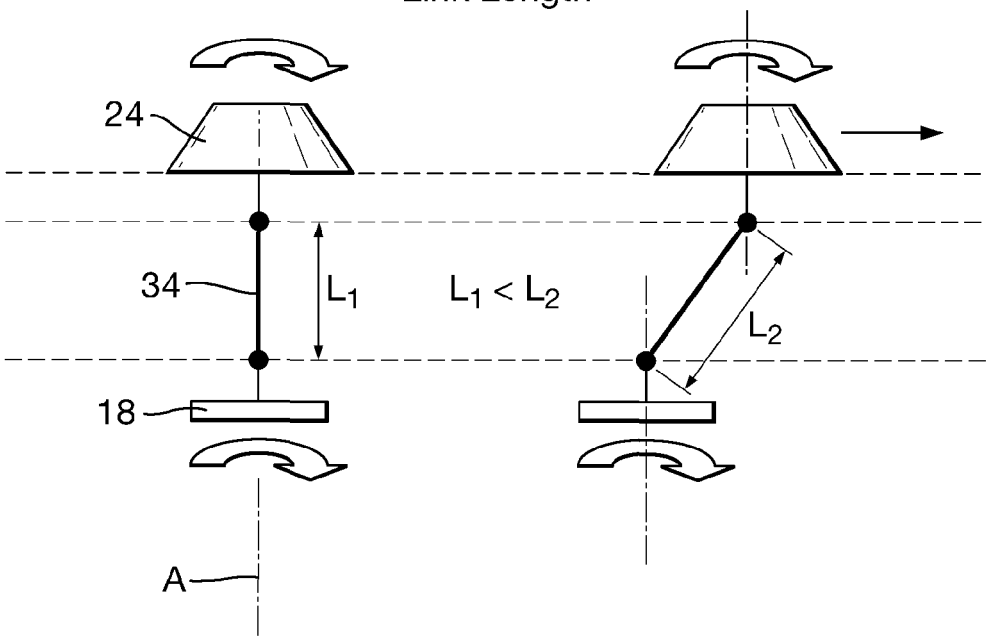

Fig.3.

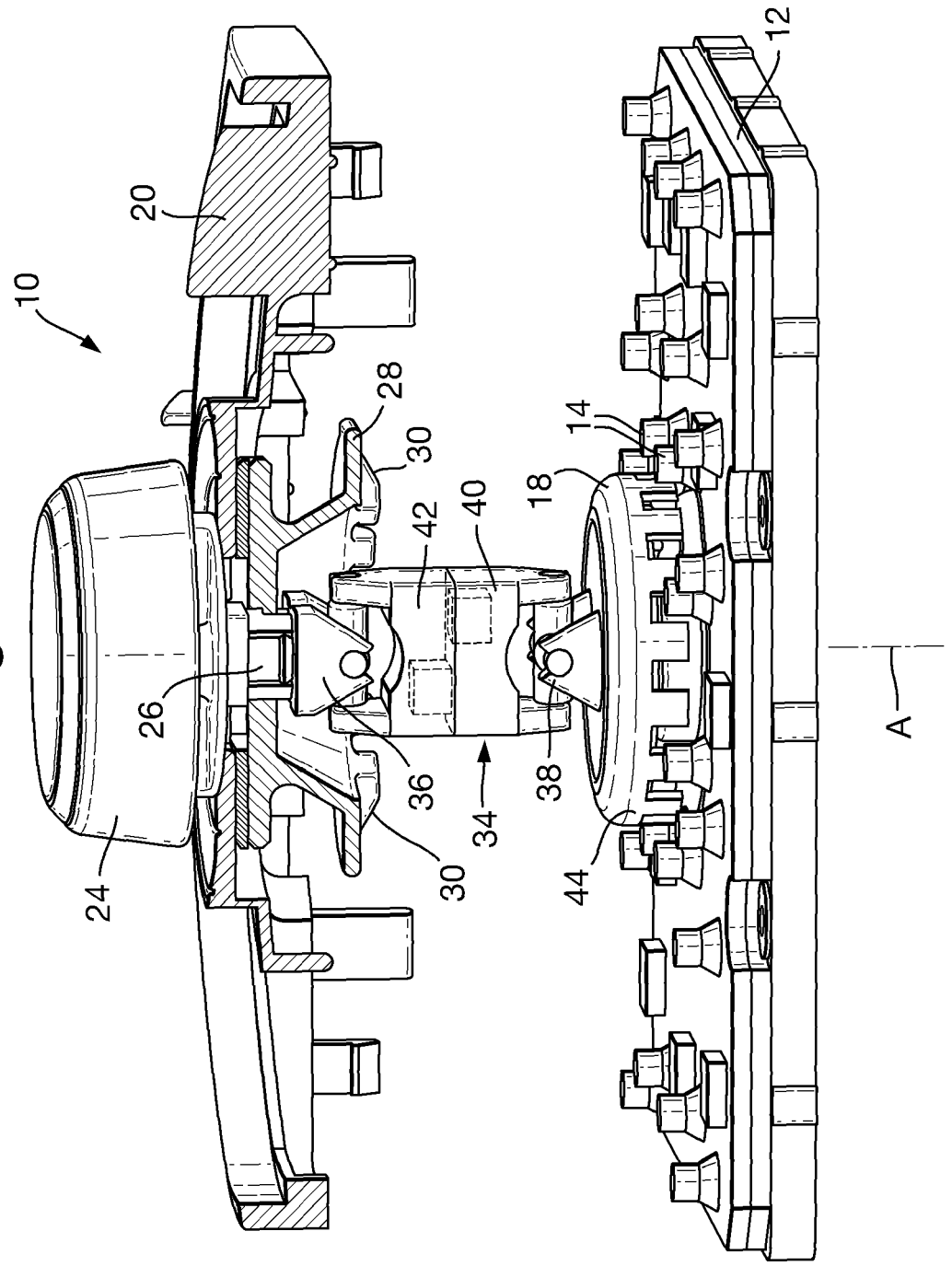

Fig.4.

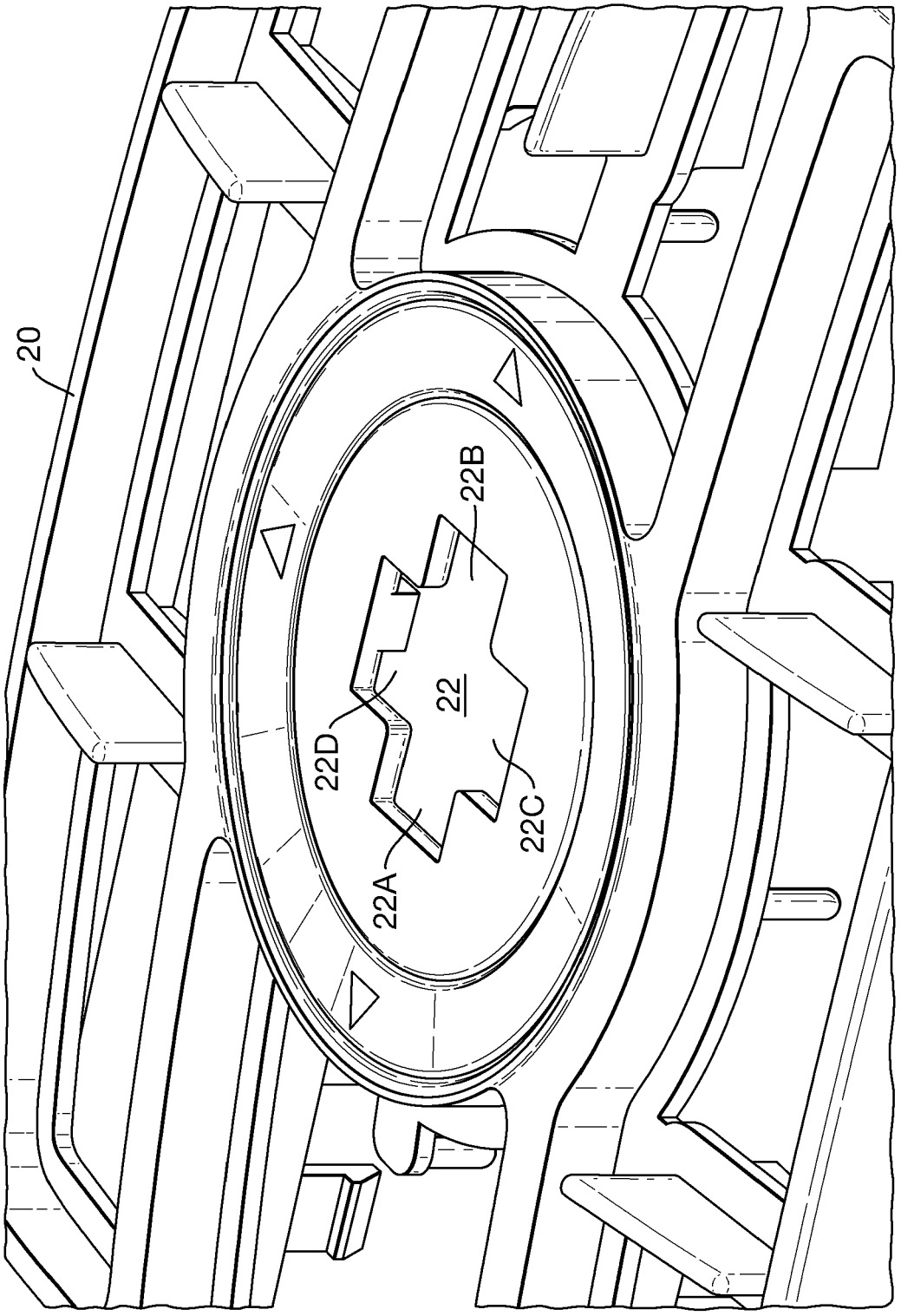

Fig.5.

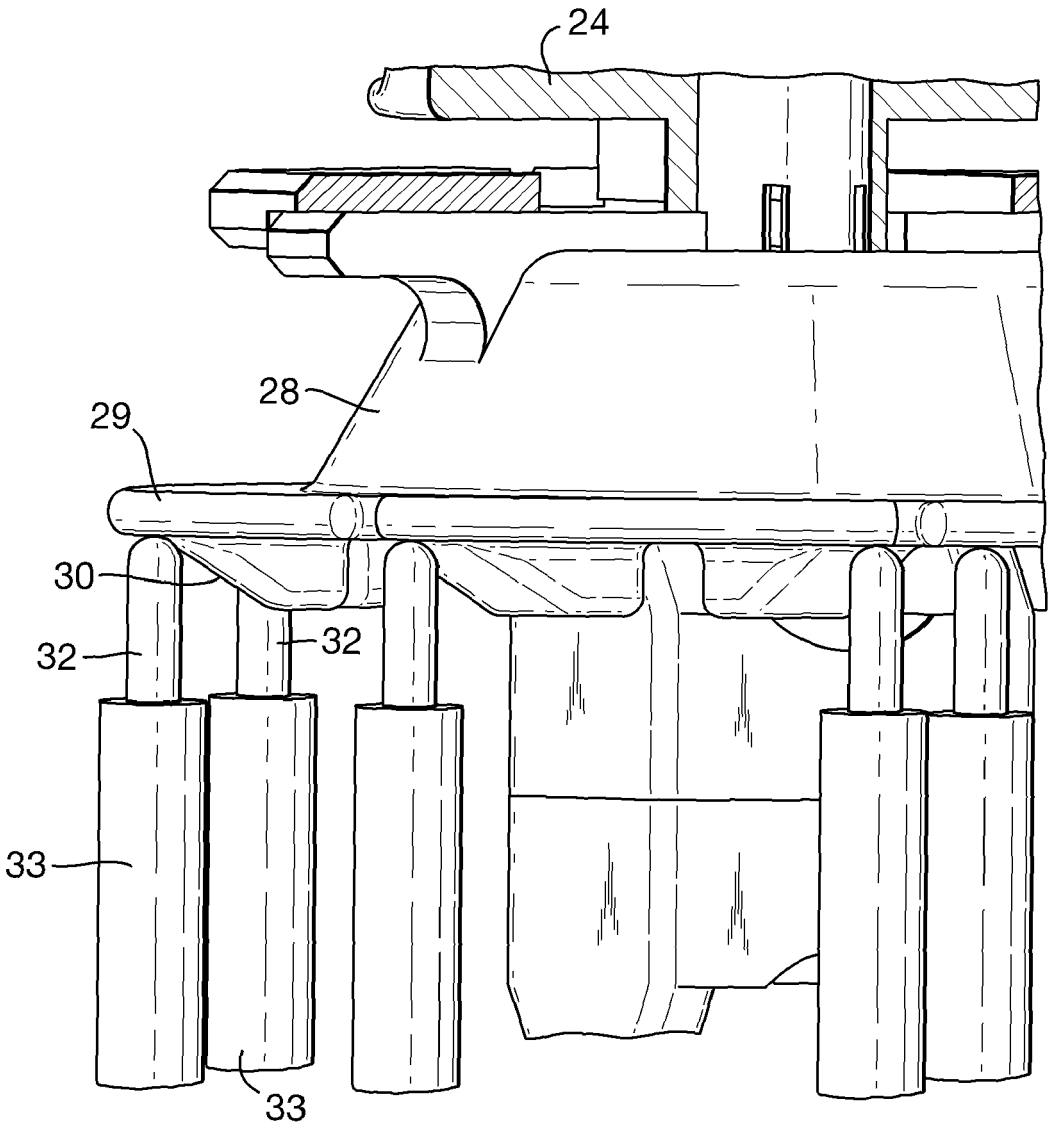

Fig.6.

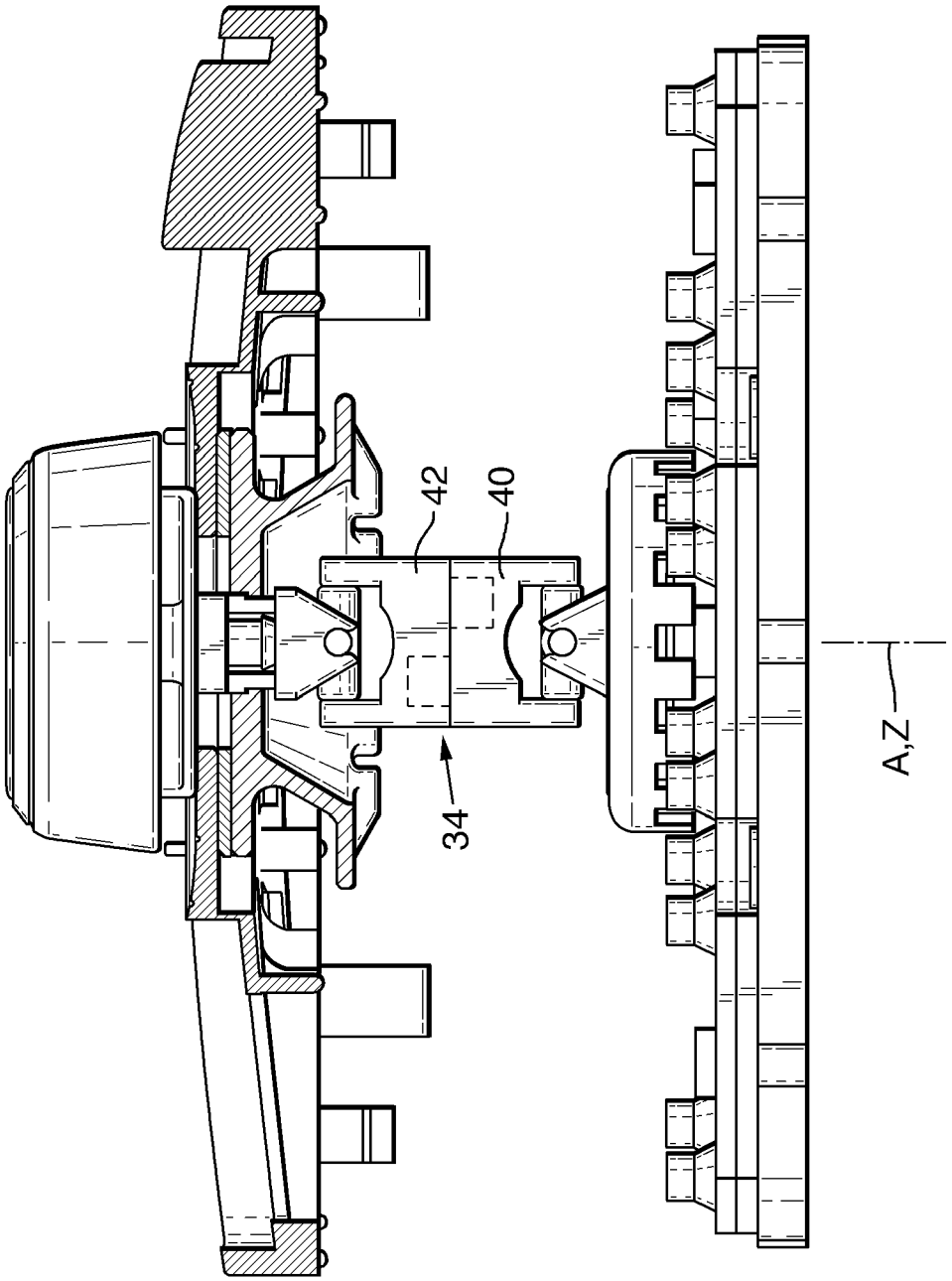

Fig.7.

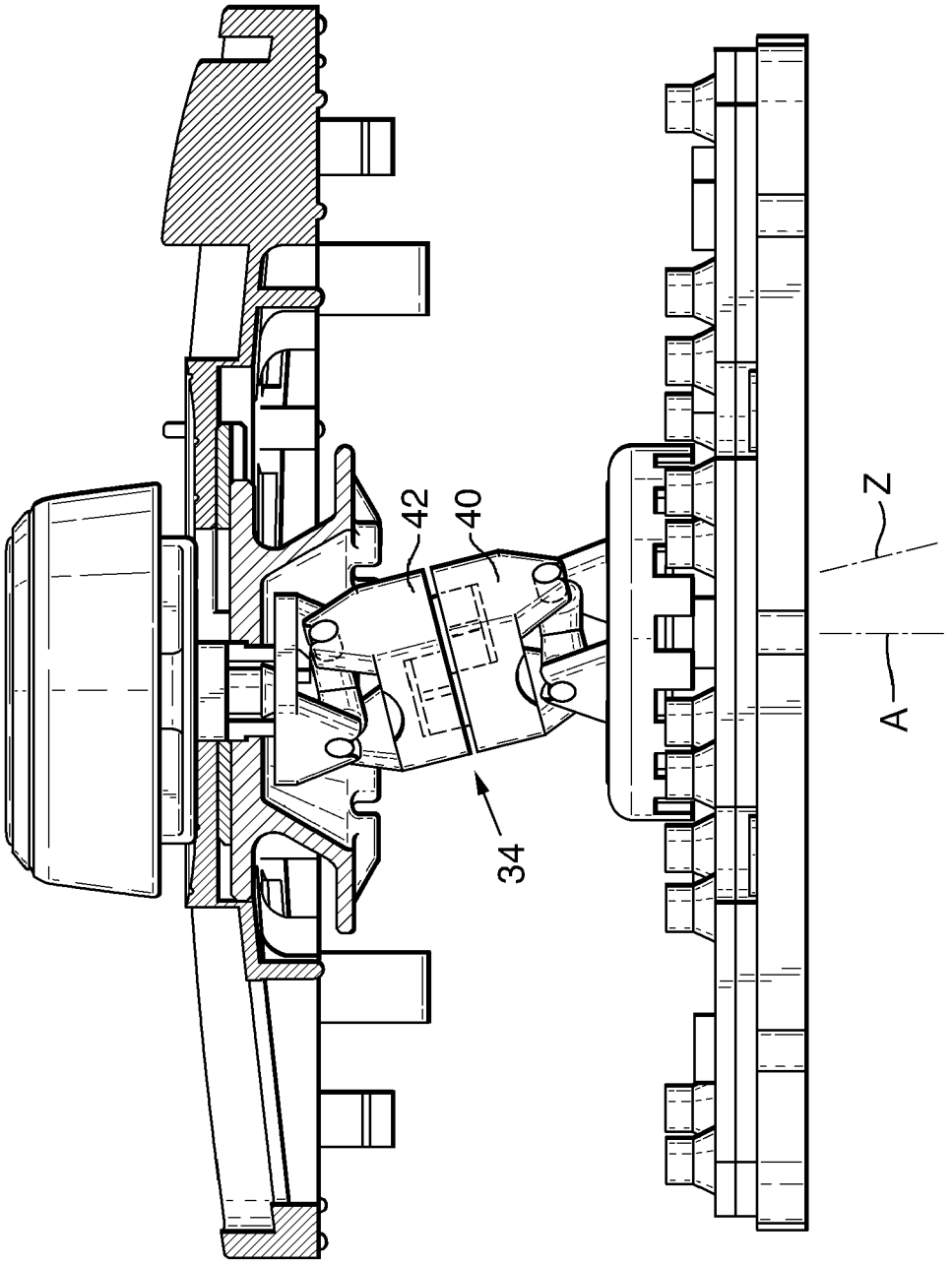

Fig.8.

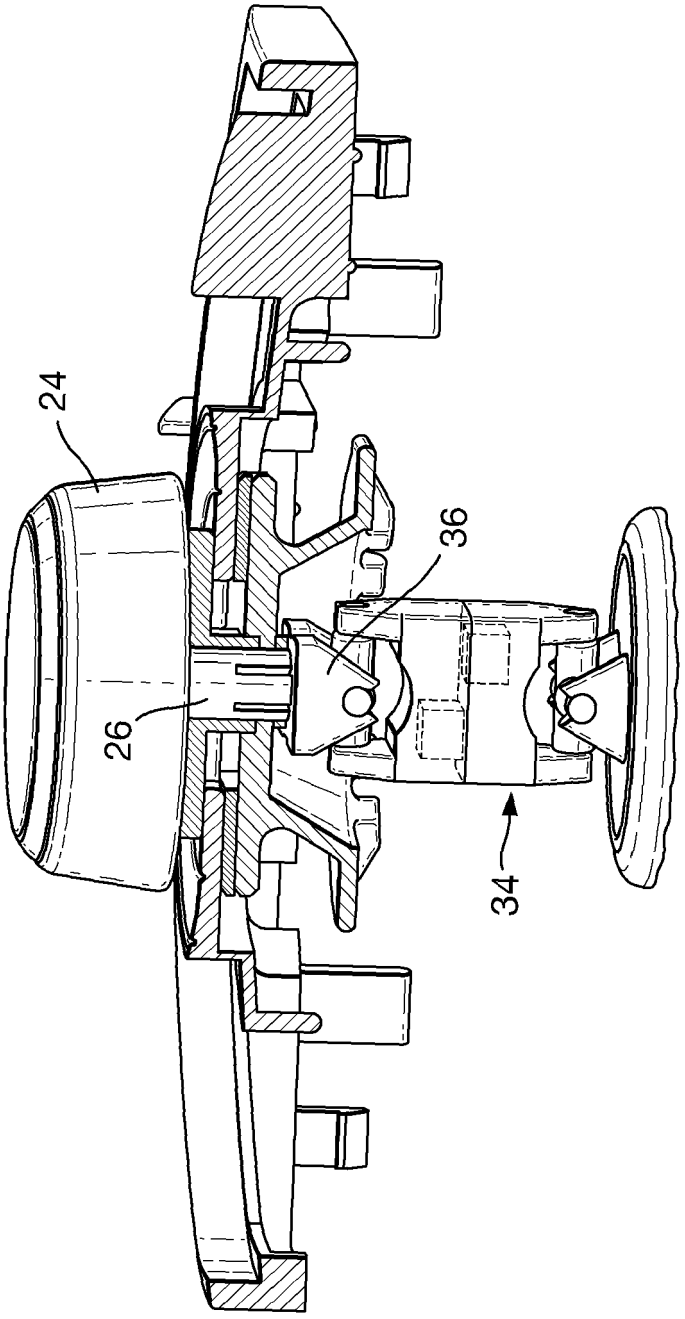

Fig.9.

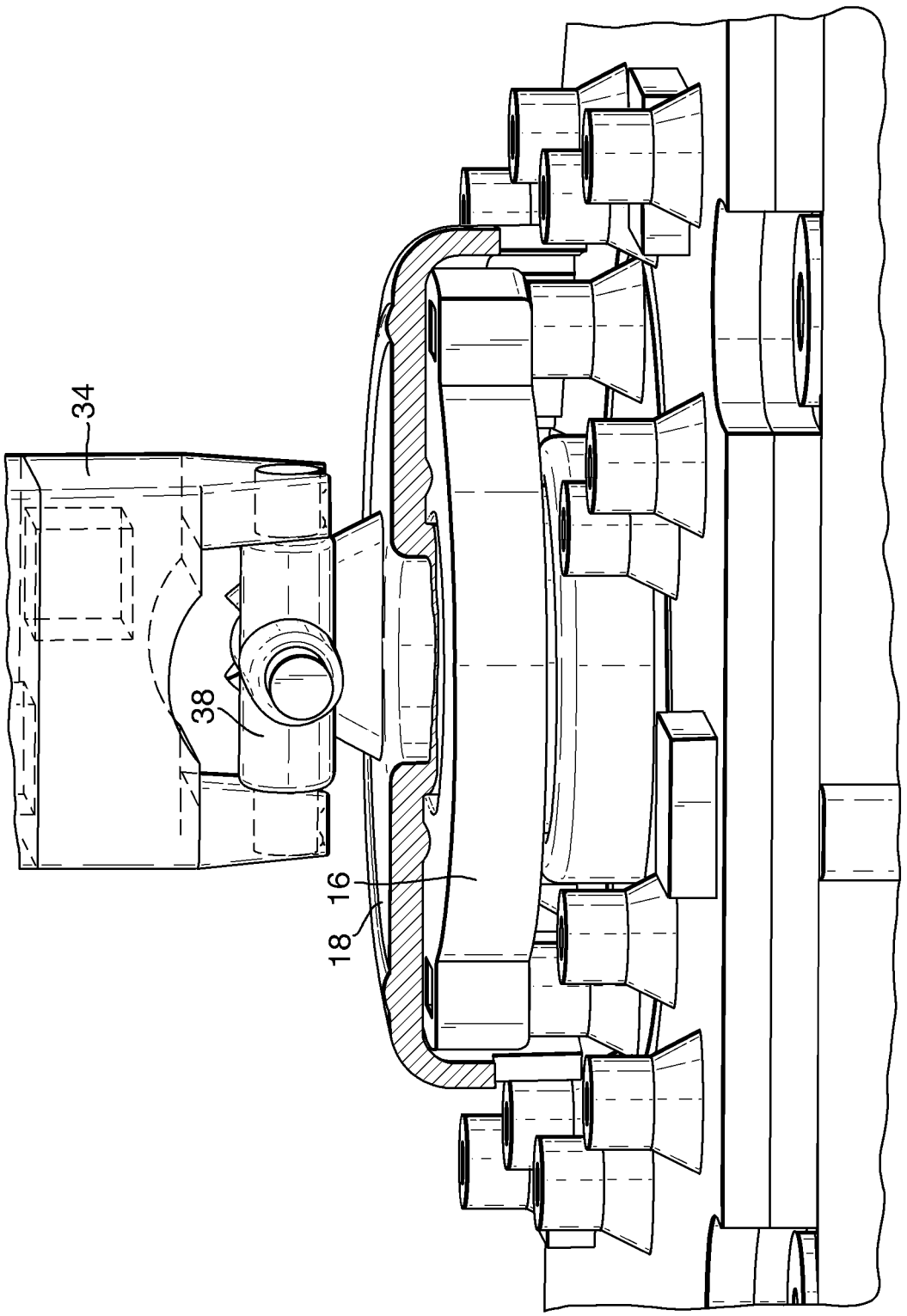

Fig.10.