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(54) A CONTROL SYSTEM FOR A PRESSURISED GAS PATH

(57) A control system for a pressurised gas path comprising a stem axially movable towards and away from an opening to control the pressurised gas path. A rotary actuator is coupled to the stem so that rotation of the actuator causes axial movement of the stem. At least one element is coupled between the stem and actuator, each

element being biased into a first position in which it can transfer the motion of the actuator to the stem. Each coupling element is arranged to move to a second position, against the action of the biasing force, when the torque applied to the actuator exceeds a threshold value so as to decouple the actuator from the stem.

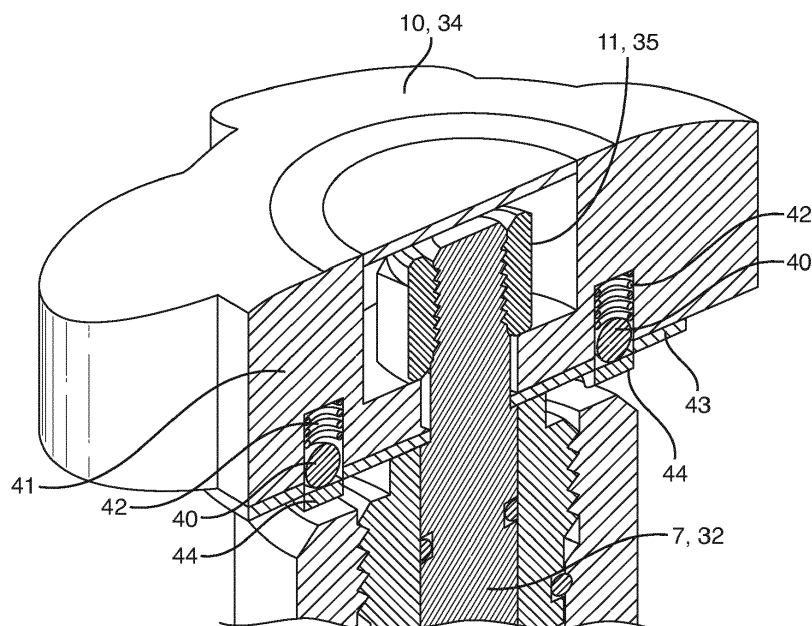


FIG. 3

EP 3 279 533 A1

Description

[0001] The present invention relates to a control system for a pressurised gas path. This may be a shut-off valve which is able to selectively open and close the pressurised gas path. It is equally applicable to a regulator which is able to provide a controlled pressure reduction in the pressure of a high pressure gas stream. Such shut-off valves and regulators are commonly used on free-standing gas bottles to control the gas flow.

[0002] Such control systems will include a stem which is axially moveable towards and away from a seat to selectively control the pressured gas path. The stems are moveable manually, for example using a hand wheel mechanism. There is generally a stop to limit the travel of the stem in both directions. It is therefore possible for a user to turn the hand wheel even when the stem has reached a stop potentially causing damage to the associated components which are overstressed by the user exerting unnecessary force against the end stop.

[0003] According to the present invention there is provided a control system according to claim 1.

[0004] By providing a coupling element which is biased into place but which can be decoupled upon the application of excess torque to the rotary actuator, the present invention is able to protect vulnerable components within the system from damage.

[0005] The control system may be a valve system in which the stem is the valve stem and the opening is a valve seat. Alternatively, the control system may be a regulator in which the stem is the regulator spindle and the opening is the regulator seat.

[0006] The coupling element may be an element which can selectively engage between the stem and the actuator. However, the or each coupling element is preferably a ball bearing. Preferably this is provided in one of the stem and the actuator and is biased into an opening in the other of the stem and actuator. Preferably the biasing force is provided by a helical spring.

[0007] Alternatively, the coupling element may be a projection from one of the stem and actuator which is biased into an opening in the other of the stem and actuator. The coupling element may be individually biased as in the above-mentioned ball bearing or alternatively there may be a single component comprising all of the coupling elements with the biasing being applied to the single element. The single element may be the stem or actuator or may be a plate between the stem and actuator.

[0008] The control system may be used on pressurised mains gas supply lines. However, preferably, the control system is provided on a bottle of pressurised gas.

[0009] Examples of control systems in accordance with the present invention will now be described with reference to the accompanying drawings, in which:

Fig. 1 is a cross-section of a conventional shut-off valve;

Fig. 2 is a cross-section of a conventional regulator; Fig. 3 is a cross-sectional perspective view through a hand wheel and spindle showing a first example of the present invention;

Fig. 4 is a cross-section through one of the coupling elements and the surrounding components in Fig. 3; Fig. 5 is a perspective view of the first example with the hand wheel removed;

Fig. 6 is a cross-section of a second example;

Fig. 7 is a view similar to Fig. 4 of a second example; Fig. 8 is a view similar to Fig. 5 of the second example; and

Fig. 9 is a cross-sectional view of a third example.

[0010] The shut-off valve 1 comprises a valve body 2 which has a screw-threaded attachment 3 for attachment to a high pressure gas cylinder. There is a high pressure gas path 4 and a high pressure outlet 5, flow through which is controlled by a valve element 6 which seats on a valve seat 7. The valve element 6 is moved by a spindle 13. This has a lower spindle 8 which retains the valve element 6 and an upper spindle 9 which engages with a hand wheel 10 and is held in place by a retaining nut 11. The spindle is guided and sealed by a gland nut 12 and the upper and lower spindles are rotatable together as they are engaged via square drive flats.

[0011] In order to open the valve, the hand wheel 10 is rotated which rotates the upper and lower spindles to lift the valve element 6 and hence allows flow from the high pressure gas path 4 to the high pressure outlet 5. The valve seat is commonly made of a soft material such as a polymer. If a user overtightens the hand wheel 10, this can be damaged. There is also an end stop between the upper spindle 9 and gland nut 12 to limit the upper travel of the spindle and this can also be damaged by excessive rotation of the hand wheel 10.

[0012] A regulator 20 is shown in Fig. 2. This comprises a regulator body 21 which is attached to a high pressure inlet 22 for example the high pressure outlet 5 of the previous example. The regulator body 21 has a low pressure outlet 23 to supply gas at a regulated pressure for an external application. Inbetween the high pressure inlet 22 and the low pressure outlet 23 is a regulating element in the form of a sealing element 24 and a shuttle 25 which is biased towards the regulator seat by a spring 27. A piston 28 (or a diaphragm) which is sealed to a regulator chamber 29 by an O-ring 30 is biased downwardly by a regulator spring 31. The biasing force is set by a spindle 32 which is retained by a gland nut 33 and is rotatable via a hand wheel 34 retained in place by a retaining nut 35. Rotation of the hand wheel 34 rotates the spindle 32 which moves downwardly to act via a plate 36 to compress the spring 31 and hence increase the biasing force on the piston 28. At a certain pressure differential, the shuttle 25 allows gas flow through the regulator seat 26. The more the regulator spring 31 is compressed, the higher the differential and the higher the outlet pressure setting will be. The axial movement of the spindle 32 is

limited by impingement of the piston 28 on the bottom of the chamber 29. Similarly, there is an upper stop where a shoulder 37 on the spindle 32 impinges with an upper surface of the chamber 29. Damage to the regulator can occur when over torque of the hand wheel in the opening and closing directions forces the spindle 32 against the end stops.

[0013] A first example of the present invention is shown in Figs. 3 to 5. This example describes the interface between the hand wheel and the spindle. As such, this could be the spindle 7 and hand wheel 10 of the shut-off valve of Fig. 1 or the spindle 32 and hand wheel 34 of the regulator of Fig. 2. The improvement provided is the provision of four coupling elements in the form of ball bearings 40. There may be any number of such ball bearings. These are retained within bores 41 in the hand wheel 10, 34 and project slightly from the hand wheel 34 as each is biased downwardly by a helical spring 42. A bearing plate 43 is attached to the spindle 7, 32. The bearing plate has a number of downwardly bent tongues 44 which effectively create a recess 45 to receive each ball bearing 40.

[0014] During normal use, rotation of the hand wheel 10, 34 with an acceptable level of torque will cause the spindle 7, 32 to be rotated via engagement of the ball bearings 40 in with the bearing plate 43. However, when the spindles 7, 32 reaches an end stop, further rotation of the hand wheel 10, 34 causes a cam force on the ball bearings 40 which caused them to ride out of recesses 45 against the compressive force of the helical spring 41 until the ball bearings 40 will leave their recesses 45 and travel across the upper face of the bearing plate 43 such that rotation of the hand wheel 10, 34 is no longer transmitted to the spindle 7, 32. When the hand wheel is rotated in the opposite direction the hand wheel will have a lower torque, such that the ball bearings 40 will travel back into their recesses 45 allowing the hand wheel 10, 34 to pick up the spindles 7, 32.

[0015] A second example is shown in Figs. 6 to 8. In this case, the ball bearings 40 have been replaced by projections 50 but the bearing plate 43 remains the same. In this case, the biasing force is provided by a single spring 51 which acts to bias the hand wheel 10, 34 downwardly into engagement with the bearing plate 43. This time, overtightening of the hand wheel 10, 34 against an end stop will cause the projections 50 to ride up on to the bearing plate 43 compressing the spring 51 and thereby decoupling the hand wheel 10, 34 from the spindles 7, 32.

[0016] A third example is shown in Fig. 9. This time, there are coupling elements 60 in the spindle 7, 32 itself. These are biased radially outwardly by helical springs 62 into recesses 63 in the hand wheel 10, 34. Again, overtightening of the hand wheel 10, 34 which causes the spindles 7, 32 to hit a stop will result in compression of the springs 62 such that the balls 60 are driven radially inwardly allowing free rotation of the hand wheel 10, 34 on the spindle 7, 32.

Claims

1. A control system for a pressurised gas path, the control system comprising a stem axially movable towards and away from an opening to selectively control the pressurised gas path;
a rotary actuator coupled to the stem such that rotation of the actuator causes axial movement of the stem; and
at least one coupling element between the stem and actuator, the or each coupling element being biased by a biasing force into a first position in which it can transfer motion of the actuator to the stem, the or each coupling element being arranged to move to a second position against the action of the biasing force when the torque applied to the actuator exceeds a threshold value to decouple the actuator from the stem.
2. A control system according to claim 1, wherein the control system is a valve system in which the stem is the valve stem and the opening is a valve seat.
3. A control system according to claim 1, wherein the control system is a regulator in which the stem is the regulator spindle and the opening is the regulator seat.
4. A control system according to any one of the preceding claims, wherein the or each coupling element is a ball bearing.
5. A control system according to claim 4, wherein the or each ball bearing is provided in one of the stem and the actuator and is biased into an opening in the other of the stem and actuator.
6. A control system according to any one of the preceding claims, wherein the biasing force is provided by a helical spring.
7. A control system according to any one of claims 1 to 3, wherein the coupling element is a projection from one of the stem and actuator which is biased into an opening in the other of the stem and actuator.
8. A control system according to claim 7, further comprising a single component comprising all of the coupling elements with the biasing being applied to the single element.
9. A bottle of pressured gas comprising a control system according to any one of the preceding claims.

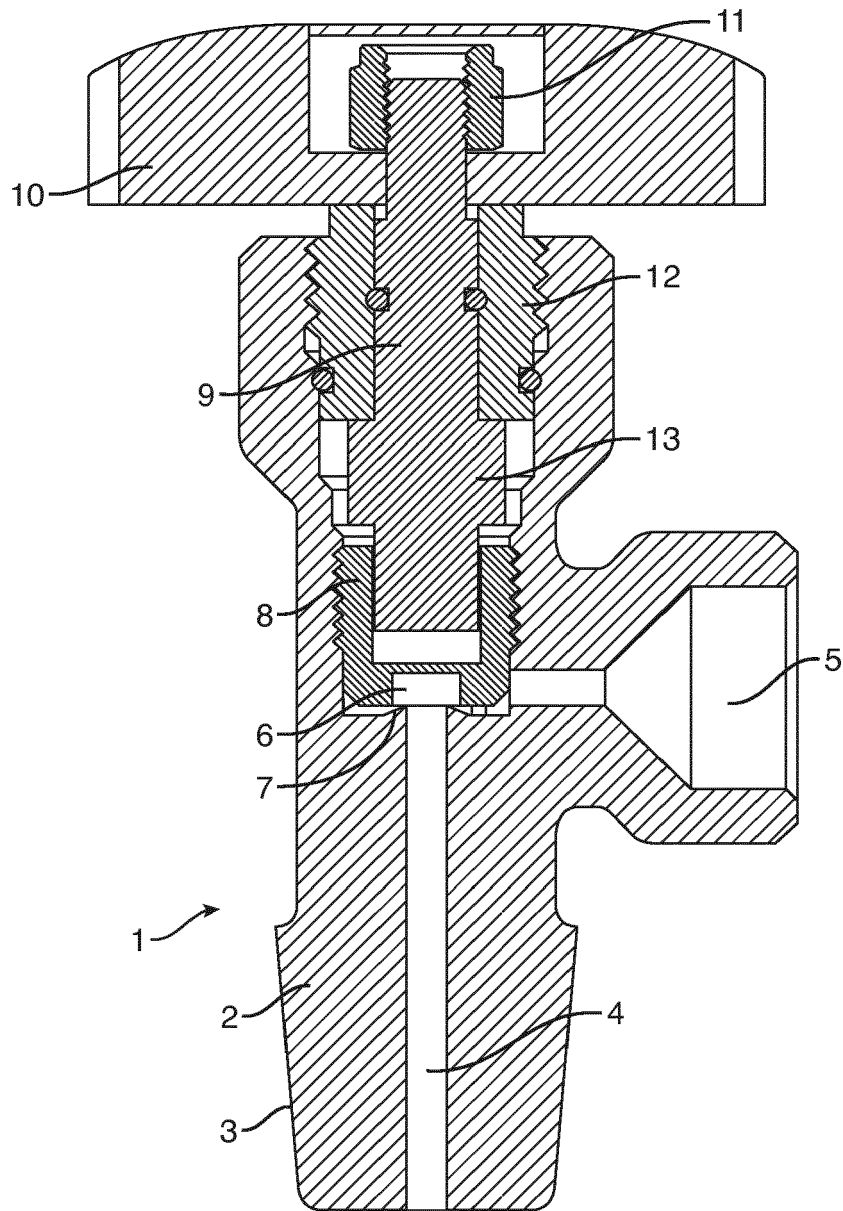


FIG. 1

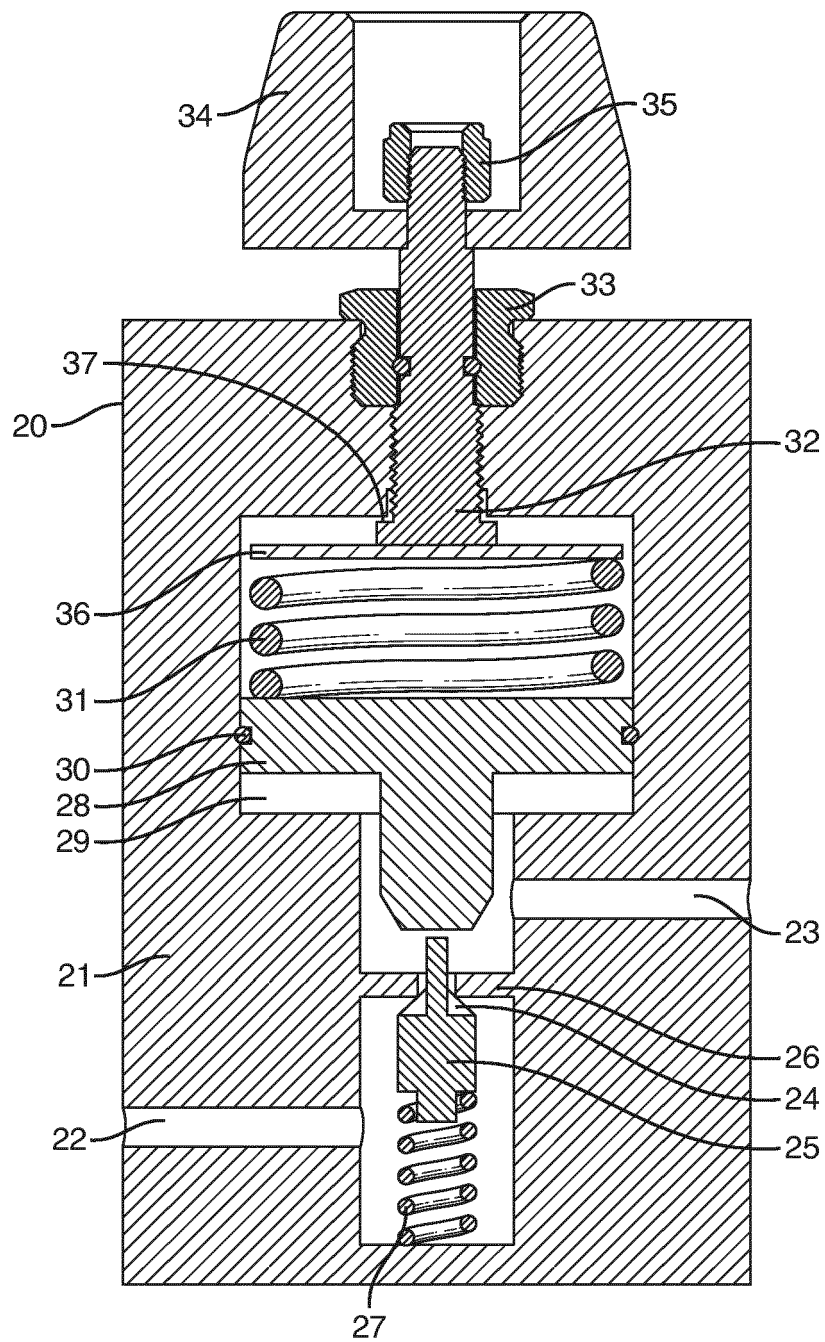


FIG. 2

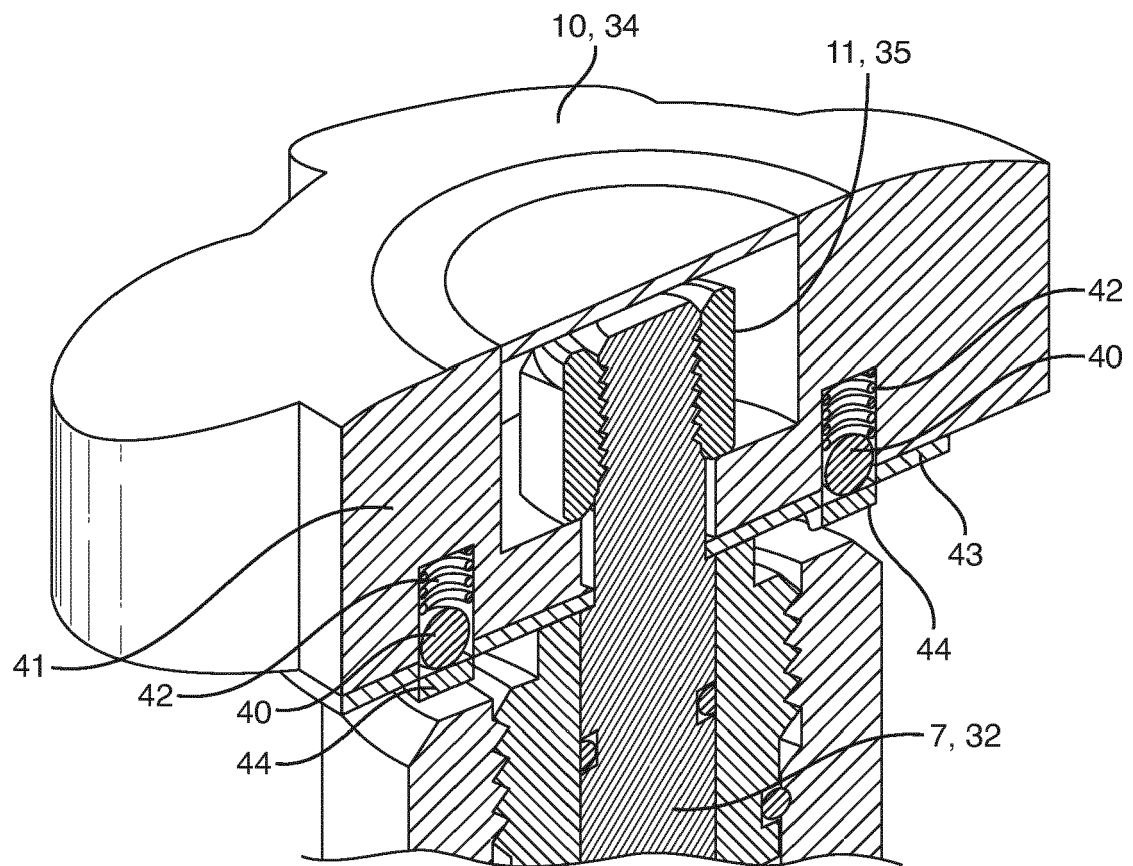


FIG. 3

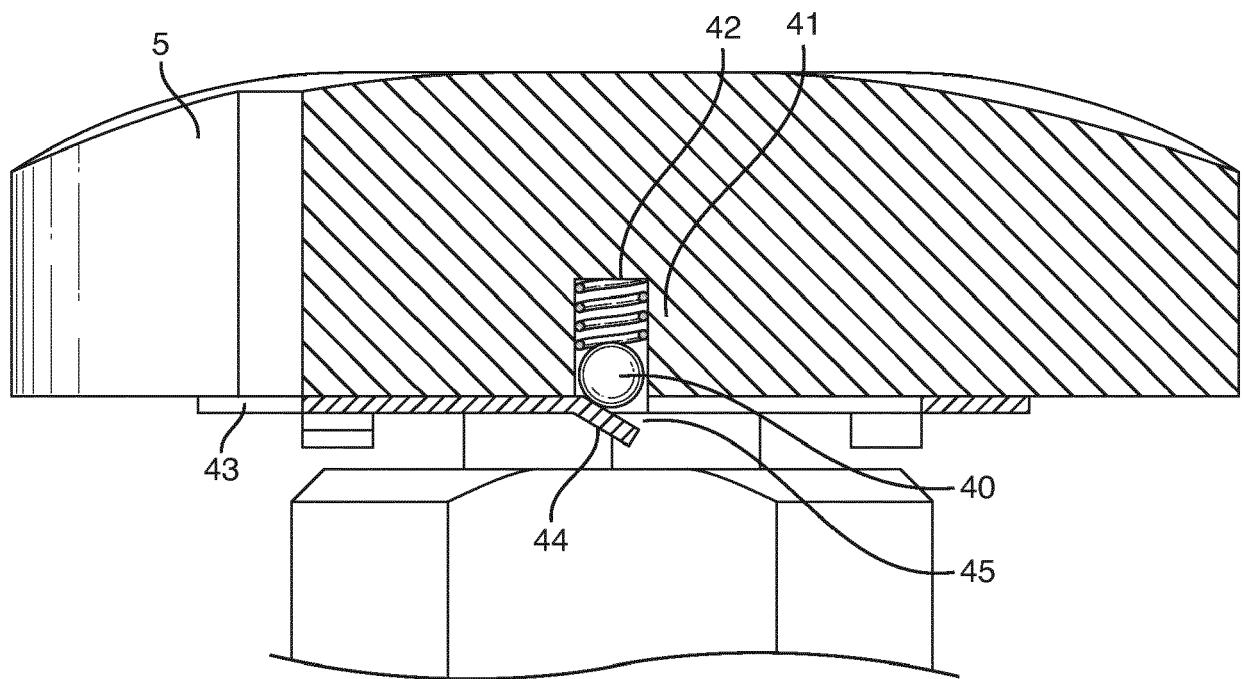


FIG. 4

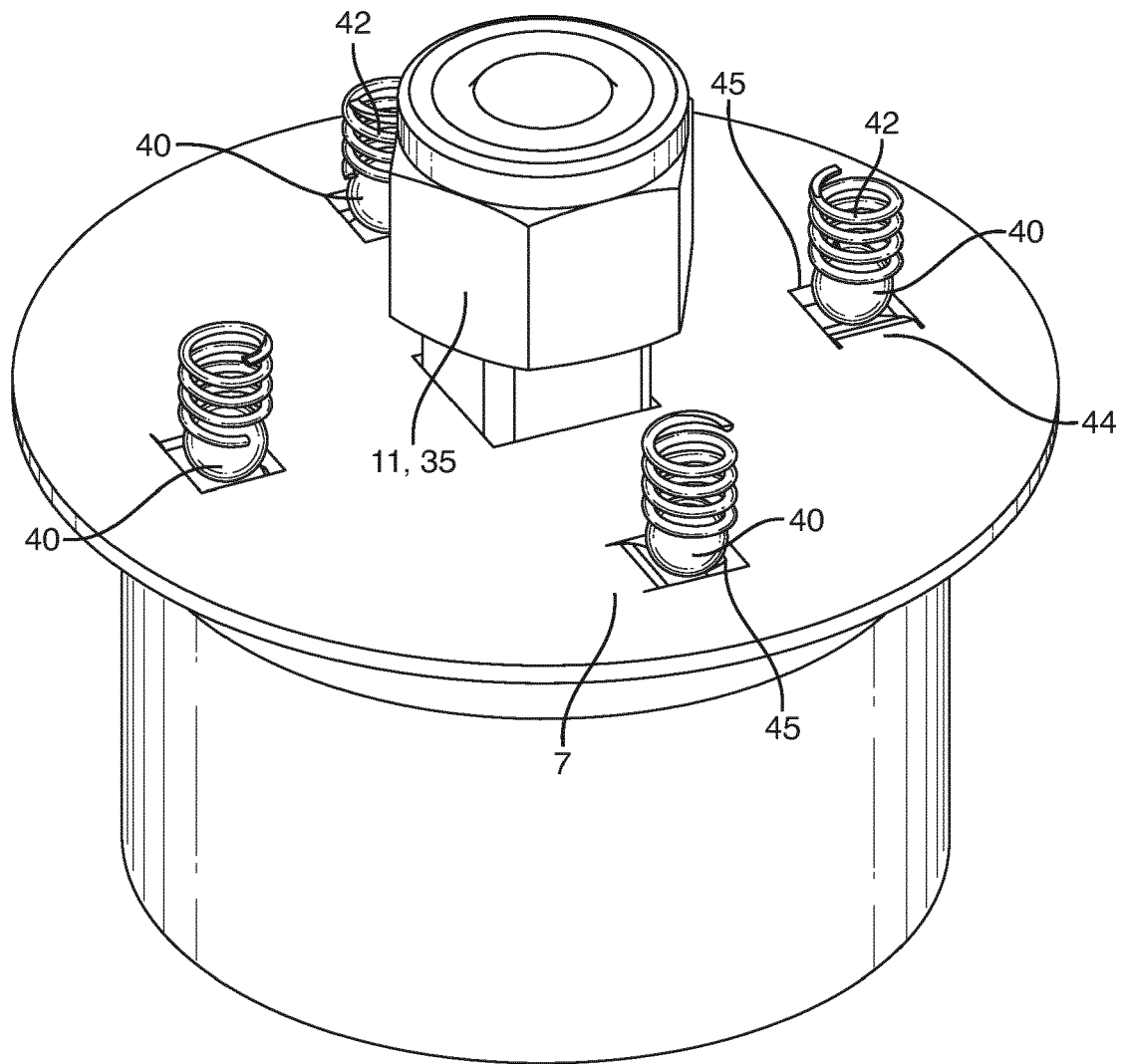


FIG. 5

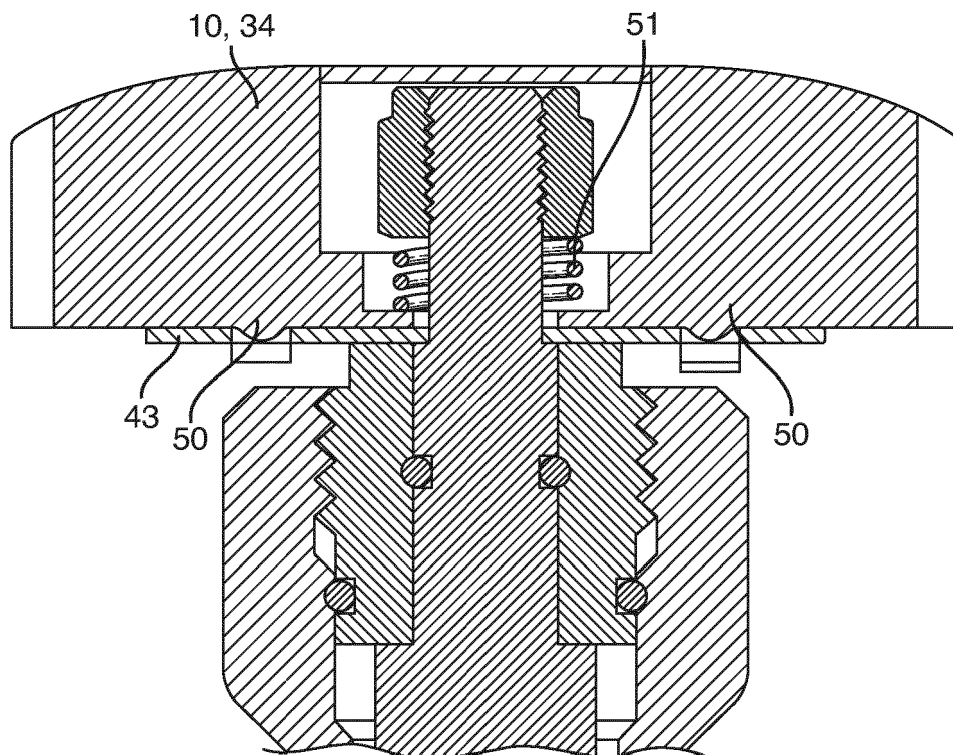


FIG. 6

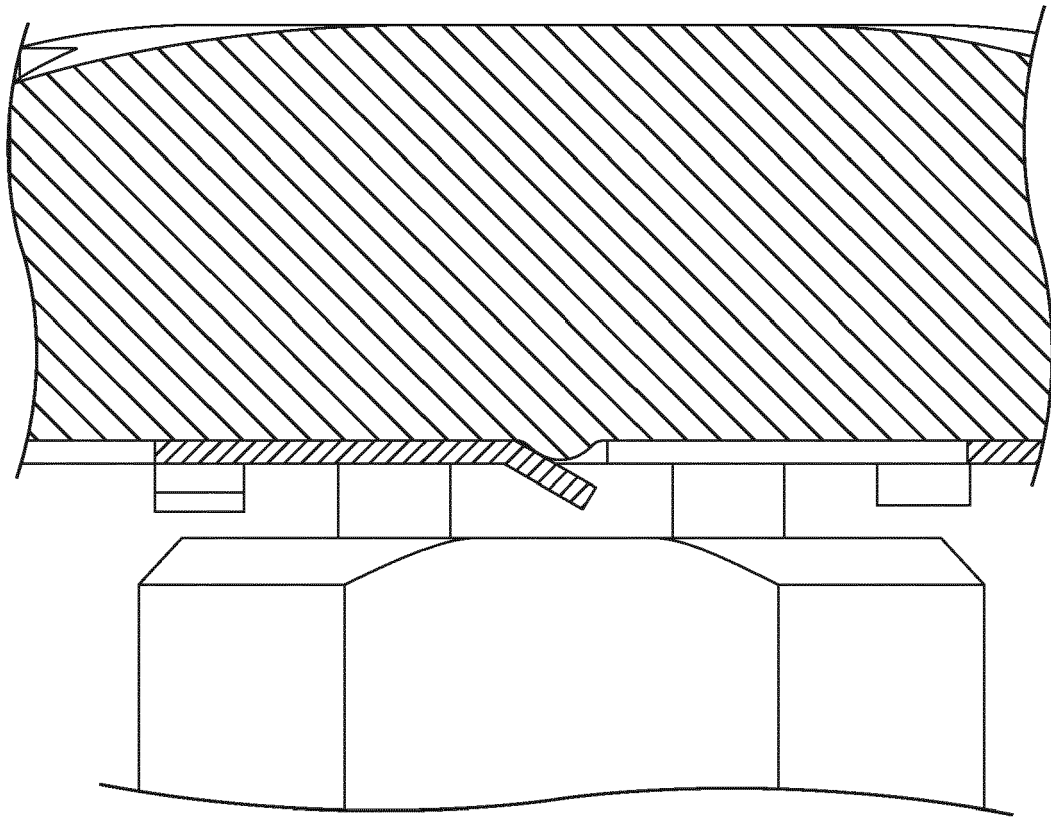


FIG. 7

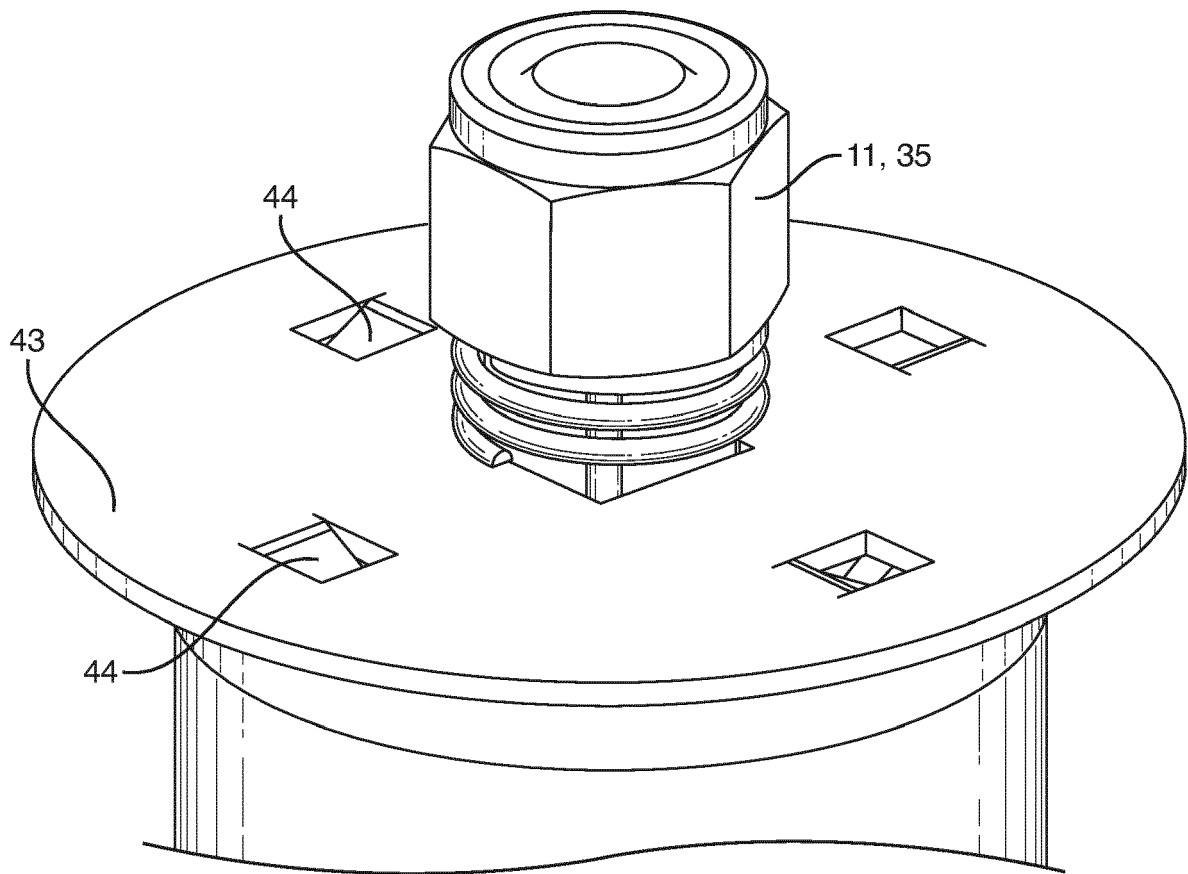


FIG. 8

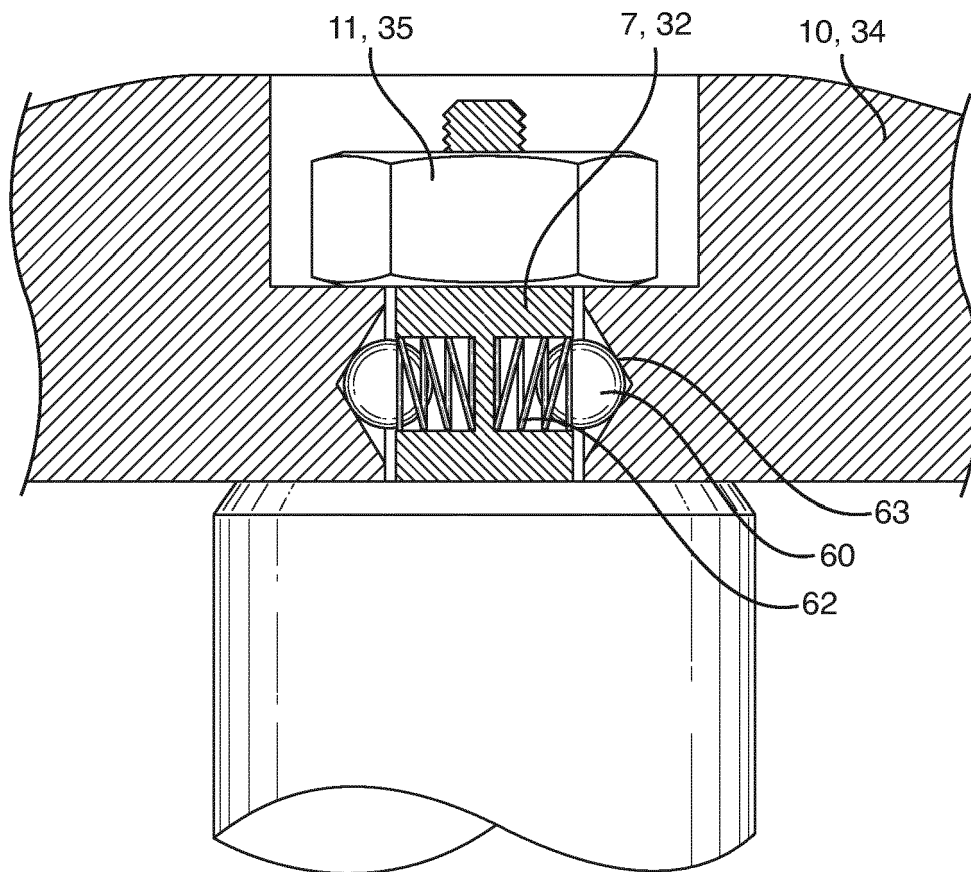


FIG. 9



EUROPEAN SEARCH REPORT

 Application Number
 EP 17 18 4061

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Place of search Munich		Date of completion of the search 11 October 2017	Examiner Sisinni, Giovanni
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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Place of search Munich		Date of completion of the search 11 October 2017	Examiner Sisinni, Giovanni
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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