(19) DANMARK

(10) **DK/EP 2957802 T3**

Patent- og Varemærkestyrelsen

(12) Oversættelse af europæisk patentskrift

(51) Int.Cl.: ***F 16 K 31/524 (2006.01)*** ***A 01 C 23/00 (2006.01)*** ***F 16 K 11/14 (2006.01)***
F 16 K 11/16 (2006.01) ***F 16 K 11/18 (2006.01)***

(45) Oversættelsen bekendtgjort den: **2017-12-11**

(80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2017-09-13**

(86) Europæisk ansøgning nr.: **15401048.2**

(86) Europæisk indleveringsdag: **2015-06-01**

(87) Den europæiske ansøgnings publiceringsdag: **2015-12-23**

(30) Prioritet: **2014-06-17 DE 102014108472**

(84) Designerede stater: **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**

(73) Patenthaver: **Amazonen-Werke H. Dreyer GmbH & Co. KG, Am Amazonenwerk 9-13, 49205 Hasbergen, Tyskland**

(72) Opfinder: **Austermann, Stefan, Schwienhorst 9a, 48291 Telgte, Tyskland**
Langkamp, Laurenz, Elbinger Str. 19, 49545 Tecklenburg, Tyskland
Müller, Norbert, Konstantinstrasse 80, 53179 Bonn, Tyskland
Frank Große Prues, Bieste 51, 49434 Neuenkirchen-Vörden, Tyskland

(74) Fuldmægtig i Danmark: **Patrade A/S, Fredens Torv 3A, 8000 Århus C, Danmark**

(54) Benævnelse: **FLERVEJSVENTIL MED TO-TRINS AKTUATOR**

(56) Fremdragne publikationer:
DE-A1-102006 006 985
DE-A1-102007 007 870
DE-B- 1 045 749
NL-C- 59 688

Multiway valve with two-stage actuation

The present invention relates to a multiway valve, which can be used in particular for agricultural field spraying and which comprises a supply connection for a pressure line, N consumer connections, N valve elements, which can each produce a fluid-permeable connection between the supply connection and at least one of the N consumer connections, and an actuator for selecting at least one of the N valve elements and for moving the selected valve element into an open position or a closed position. Such multiway valves for agricultural field sprayers are also known by the name of pressure cock.

A multiway valve according to the preamble of Claim 1 is known by way of NL59688C.

A multiway valve, in particular for agricultural field sprayers, is known for example from DE 10 2006 006 985 A1. This laid-open specification for a German patent application discloses a multiway valve with a housing, to which an inlet line designed as pressure line and a plurality of outlet lines are connected. A number of valve bodies corresponding to the number of outlet lines are circularly arranged around a rotatably mounted central actuation element. For selecting a certain valve or a certain outlet line, the central actuation element is moved to the corresponding valve to be actuated via the switching shaft. The arrangement is configured so that upon the rotary movement the central actuation element pushes the valve body towards the outside so that a connection between the pressure line and the outlet line corresponding to the valve is opened. If a valve is to be selected in the case of which more than one valve is located between the current position of the actuation element and the valve to be selected, the actuation element has to be moved past these valve elements, upon which these valve elements are briefly actuated. During the selection of a certain valve, more than one valve is therefore generally actuated briefly, i.e. the corresponding outlet lines are briefly under pressure. This also means that liquid enters outlet lines where this was actually not intended. Furthermore, this also means an undesirable loss of energy during the switching operation since the brief pressure loss caused by the discharge into the undesirable outlet lines has to be compensated.

A similar arrangement for a multiway valve, in particular for an agricultural field sprayer, is also disclosed in the laid-open specification of the patent application DE 10 2007 007 870 A1. This prior art shows a multiway valve with a housing into which lead a suction line and more than one feed line, the number thereof corresponding to the number of channels, which are assigned the valve bodies which open and close the junction of the feed lines. The multiway valve shown there also comprises a central actuation element by means of which the valve bodies can be put into a closing or opening position. In order to create a simply constructed and compact multiway valve, the feed lines are arranged to lead radially into the housing. The multiway valve comprises a central actuation element to be actuated by a hand lever, by means of which the valve bodies assigned to the connection lines can be actuated. The valve bodies are radially moveable to the outside perpendicularly to the axis of rotation of the central actuation element and are held in a closed position, i.e. pressed radially to the inside, via a spring. The central actuation element consists of a switching shaft on which an actuation cam is attached. By rotating the switching shaft, the cam is positioned relative to a valve element. The cam then pushes the valve element out of its closed position into an open position against the spring pressure. During the positioning of the cam against a certain valve element, all valve elements which lie between the current position of the cam and the valve element to be selected are briefly actuated. Because of this, liquid undesirably flows out of a non-selected feed line into the suction line, i.e. undesirable liquid and also pressure losses are created which have to be compensated.

It is therefore an object of the present invention to provide a multiway valve which can be brought into any desired position without individual valve elements having to be actuated during the selection operation.

This object is solved by a multiway valve according to Claim 1. This object is solved, in particular, by a multiway valve comprising the following: a supply connection; N consumer connections; N valve elements, which can each produce a fluid-permeable connection between the supply connection and at least one of the N consumer connections; and an actuator for selecting at least one of the N valve elements and for actuating the selected valve element into an open position or a closed position. The

multiway valve according to the invention is characterised in that the actuator and the N valve elements are designed and arranged in such a manner that the selection and the actuation of one of the N valve elements takes place independently in two stages, and therefore, during the selection of the at least one valve element, none of the N valve elements is actuated.

Because of this it is possible with the actuator to perform the selection operation and the actuation operation separately, i.e. independently of one another, for example through different movement directions of the actuator for the selection operation and the actuation operation so that during the selection of a certain valve element no valve element is actuated. The arrangement and the actuation direction of the valve elements then have to be adapted to the movement directions of the actuator. According to the invention, the actuator has a projection extending radially outwards with respect to a central axis; and each of the N valve elements has a recess in which the projection of the actuator can engage. Because of the recess in each valve element, on the one hand, the projection of the actuator can pass the valve elements not selected without obstruction during the selection of the valve element and, on the other hand, the recess serves as engagement for the projection so that the actuator can actuate the valve element into an open or closed position. Here, the projection of the actuator is designed so that it extends over a radial region which permits optionally the actuation of an individual valve element or the simultaneous actuation of two adjacent valve elements. This means that when the projection of the actuator is formed with an adequate width, the projection of the actuator can engage in both recesses in an intermediate position between two adjacent valve elements and thus make possible a simultaneous actuation of the adjacent valve elements. In an embodiment, the N valve elements are arranged in a circular manner around a central axis in corresponding cavities of a multiway valve housing in such a manner that the N valve elements are movable, independently of one another parallel to the central axis within the corresponding cavity between an open position and a closed position. With this arrangement, the actuator performs a rotary movement during the valve selection. During the subsequent actuation of the selected valve, the actuator performs a movement parallel to the axis of rotation (central axis). Since the movement direction for actuating the valve is perpendicular to the movement direction of the actuator

during the valve selection it is possible with this arrangement to perform a selection of valve elements independently of their actuation.

In an embodiment this can be realised in that the actuator is mounted rotatably around the central axis and displaceably parallel to the central axis. I.e. by rotating the actuator around the central axis, a valve can be selected and by shifting the actuator parallel to the central axis, a selected valve can be actuated. The rotary movement and the vertical movement of the actuator can be performed independently.

In a further embodiment, the multiway valve furthermore comprises a switching shaft which is arranged coaxially with respect to the central axis and is mounted rotatably relative to the multiway valve housing, wherein the actuator is connected to the switching shaft so as to be secure against rotation relative to the switching shaft but moveable parallel to the central axis, such that the actuator can be rotated around the central axis by the switching shaft in order to select at least one of the N valve elements; and a displacement device for displacing the actuator parallel to the central axis relative to the switching shaft, and therefore the actuator can be displaced by the displacement device relative to the switching shaft along the central axis between a first position corresponding to a closed valve and a second position corresponding to an open valve in order to open or to close the at least one selected valve element. With this embodiment, the selection of a valve element and the actuation of the selected valve element can be realised independently of one another, in that the actuator can be rotated via a switching shaft for selecting and in that the actuator can be shifted parallel to the central axis with a displacement device. The two elements "switching shaft" and "displacement device" allow the movement of the actuator in the axial direction and in the rotation direction to be actuable independently of one another.

In order to achieve a precise guidance of the actuator along the central axis and around the central axis, the actuator can be embodied at least partly as a hollow cylinder, wherein the hollow cylinder receives the switching shaft. This means that the actuator is arranged coaxially around the switching shaft.

In a further embodiment, the actuator and the N valve elements are designed and arranged in such a manner that the switching shaft can be rotated only when the actuator is in the first position. In other words, a selection of a valve can take place only when all valve elements are in a defined state. Because of this the operational safety of the valve is ensured since no undefined switching states can occur as a result of which the switching mechanism can possibly jam.

For example, the multiway valve can be designed in such a manner that all of the N valve elements are in the closed position when the supply connection is under pressure. This means that the valve elements are normally (i.e. when the actuator is in the first position) closed and have to be actively opened with the actuator when a connection between the supply connection and a consumer connection is to be established. Since the valves are normally closed, no undefined valve state during the selection of a valve element can materialise either, so that the functional efficiency of the multiway valve is ensured.

In another embodiment, the multiway valve furthermore comprises at least one prestressing element which holds at least one of the N valve elements in a closed position for as long as it is not actuated by the actuator. By way of the prestressing element it is ensured that the valve element is in a defined, preferentially a closed position even when there is no pressure at the supply connection. This measure also serves to improve the operational safety of the multiway valve. Preferentially, each of the N valve elements is equipped with a prestressing element.

In an embodiment, the multiway valve furthermore has a device for selecting a valve element and for actuating the selected valve element. This selecting and actuating device can for example be a manually actuable lever which is coupled via a pin to a driver at the end of the switching shaft such that the lever is rotatable perpendicularly to the central axis with the pin as axis of rotation and is secure against rotation relative to the switching shaft parallel to the central axis, wherein the lever is furthermore fastened via a cylinder pin to one end of the actuator, such that the actuator can be displaced relative to the switching shaft with the lever parallel to the central axis. Because of this, the lever is connected to the switching shaft and the actuator in a

manner rotationally fixed relative to one another so that with the lever the projection of the actuator can be rotated/positioned relative to a certain valve element. Because of the pin, the lever, furthermore, is rotatably mounted on the driver perpendicularly to the rotary selection movement so that during the rotating of the lever around the pin axis (perpendicularly to the central axis), the actuator can be lifted via the cylinder pin on the lever, wherein the lever can support itself on the pin in the driver. Because of this, both the selection mechanism and also the actuation mechanism for each of the N valves can be actuated independently of one another because of the manually actuable lever. In an embodiment of the multiway valve, an outer side of a cylindrical portion of the actuator has two rows lying one above the other each with N notches or optionally 2xN notches, and therefore the actuator can latch in place at a selected valve position or optionally additionally at an intermediate position between two adjacent valve elements in an open position or a closed position. Because of this, during the rotating of the lever/switching handle in a neutral or closed position for selecting the valve element, the lever can engage in the individual valve positions or optionally also in intermediate positions so that the switching positions or actuation positions can be easily found. Accordingly, a haptic or acoustic feedback is created during the adjusting of the valve positions.

In a further embodiment, the multiway valve has at least one sealing ring between the switching shaft and the actuator and also a groove ring between the actuator and the housing for sealing the pressurised interior of the valve so that no liquid can reach the outside at the gaps between actuator and switching shaft and between the actuator and the housing. The groove ring, furthermore, has the advantage that the sealing effect keeps improving with increasing pressure. Furthermore, the groove ring can offset eccentricities and irregularities as well as defects in the surface of the housing.

In another embodiment of the multiway valve, the device for selecting a valve element comprises a first motor with a first gear mechanism and the device for actuating the selected valve element comprises a second motor with a second gear mechanism. By way of this, a fully automatic operation of the multiway valve can be realised.

In the following, exemplary embodiments, further developments, advantages and possible applications of the invention are explained in more detail by way of the attached figures. In the figures

Fig. 1 shows a perspective 3D view of the multiway valve according to the invention;

Fig. 2 shows a view from above of the multiway valve of Fig. 1;

Fig. 3 shows a section through the multiway valve along the line I-I in Fig. 2 with the valve element in a neutral or closed position;

Fig. 4 shows a section through the multiway valve along the line I-I of Fig. 2 with the valve element in an open position;

Fig. 5 shows a section through the multiway valve along the line II-II of Fig. 2;

Fig. 6 shows an alternative embodiment of the multiway valve according to the invention with a lever position for a valve in a closed position;

Fig. 7 shows the multiway valve of Fig. 6 with a lever position for an open valve position;

Fig. 8 shows an embodiment of the multiway valve according to the invention in a view from above with the upper housing part removed;

Fig. 9 shows a perspective 3D view of an embodiment of the multiway valve according to the invention with motor control; and

Fig. 10 shows a sectional view of the motor-operated multiway valve of Fig. 9.

The aim of the present invention was to provide a multiway valve which overcomes the disadvantages of known multiway valves. In particular, with the present invention, the disadvantage is overcome that in selecting a certain valve in a multiway valve, those valves which are skipped during the selection are briefly actuated. Because of the brief valve actuations, the relevant output lines are briefly under pressure, which results in unintentional contamination, pressure loss and energy loss during the switching operation. According to the invention, this problem is solved in that the actuator is designed so that it becomes possible to perform the selection operation and the actuation operation separately, i.e. independently of one another, for example by way of different movement directions of the actuator for the selection operation and the actuation operation so that during the selection of a certain valve element no valve element is actuated. The arrangement and the actuation direction of the valve elements then have to be adapted to the movement directions of the actuator.

In the following examples, the valve elements and the actuator are arranged and designed so that the valve selection is effected by a rotary movement of the actuator. For the subsequent actuation of the selected valve, the actuator performs a movement parallel to the axis of rotation. Since the movement direction for actuating the valve is perpendicular to the movement direction of the actuator during the valve selection, it is possible, with this arrangement, to make a selection of valve elements independently of their actuation.

Although the exemplary embodiments describe a valve selection by a rotary movement of the actuator here and the actuation movement takes place parallel to the axis of rotation, this invention is not limited to these cases. For example, the valve selection can take place by a rotary movement and the actuation of the valve element takes place by a movement that is directed radially to the outside or inside relative to the axis of rotation. The valve selection can also take place by a linear movement of the actuator. The subsequent actuation of the valve element is then effected by a movement of the actuator that is directed perpendicularly thereto.

Fig. 1 shows a perspective 3D view of an embodiment of a multiway valve 10, which is suitable for an agricultural field sprayer, for manual actuation. Such a multiway

valve is also known by the name of pressure cock. Fig. 1 shows a two-part housing 50 with an upper housing part 50a and a lower housing part 50b, which are screwed to one another by way of screws (without reference sign). In the lower housing part 50b a supply connection 30 and a plurality of consumer connections 20 are located. The consumer connections 20 are assigned valve elements 40 which are arranged around a central axis (not marked in Fig. 1) of the multiway valve 10. Each consumer connection 20 is closed by a separate valve element 40. In Fig. 1, radial covers for radial guides of the valve elements 40 are visible on the top of the housing upper part 50a. Fig. 1, furthermore, shows a manually actuable lever 60 with which valves can be selected and opened.

Fig. 2 shows a view of the multiway valve from Fig. 1 from above. The manually actuable lever 60 is rotatably arranged relative to the housing coaxially to the central housing axis A on the top of the housing. Six valve elements 40-1, 40-2, 40-3, 40-4, 40-5 and 40-6 are circularly arranged around the central axis A in the valve housing 50. In Fig. 2, reference signs which are identical with reference signs in Fig. 1, mark the same features. This applies also to all following figures. In order to avoid repetitions, the technical feature belonging to the reference sign is generally described when first occurring and further repetitions in the following figures are omitted.

Individual valves can be selected with the lever 60 by rotating around the axis A. The dash-dotted lines in Fig. 2 indicate locations for possible positions of the lever 60. Fig. 2 shows a position of the lever 60 in the position ZS1. This position corresponds to an intermediate position between the valve elements 40-1 and 40-2. In this intermediate position, the valve elements 40-1 and 40-2 can be simultaneously actuated as explained in more detail in connection with Fig. 8. Analogously, it is also possible to select intermediate positions between two valves in the intermediate positions ZS2, ZS3, ZS4 and ZS5. The positions S1, S2, S3, S4, S5 and S6 mean that the lever 60 has selected the valve element 40-1 (S1), 40-2 (S2), 40-3 (S3), 40-4 (S4), 40-5 (S5) or 40-6 (S6). The positions ZS1, ZS2, ZS3, ZS4, ZS5, ZS6 and ZS7 are locations for intermediate positions. The position NS is a neutral position, in which no valve is selected. By rotating the lever 60, each of the six valve elements 40-1 to 40-6 can be directly selected. By pressing the lever 60 downwards, i.e. perpendicularly to the drawing

plane away from the observer, the lever 60 rotates around a cylinder pin 160 perpendicularly to the sheet plane, as a result of which an actuator in the valve housing (not visible in Fig. 2) is lifted and thus brings the selected valve element into an open position. In the open valve position, the lever 60 can no longer be rotated around the central axis A. In the position of the lever 60, in which the lever 60 can be rotated around the central axis A, all valve elements 40-1 to 40-6 are closed. This means that during the positioning of the actuator (not shown in Fig. 2) by the lever 60 into one of the positions S1 to S6, NS and ZS1 to ZS7, none of the six consumer connections 20 or none of the associated valve elements 40-1 to 40-6 is travelled over while open.

Fig. 3 shows a section through the multiway valve along the line I-I, i.e. along the line between the lever positions S1 and ZS4, however with the lever 60 in position S1. The sectional representation shown in Fig. 3 shows the selected valve element in the closed position. Fig. 3 shows a cross section through the housing 50 with a housing upper part 50a and a housing lower part 50b, which are connected to one another via screws (without reference sign). The reference sign 20 again designates the consumer connections. In the housing 50, cavities are formed in which valve bodies 42 are located. The cavities are designed so that the valve body 42 can move vertically, i.e. parallel to the central axis A. On the lower side, each valve body 42 comprises a seal 44 and centring dowel 43. In the representation shown in Fig. 3 the valve body 42 comprises four dowels. The valves are centred on the lower side in the lower part of the housing by way of the four dowels. One of the dowels in each case serves as an alignment aid for the valve during the assembly. In the lower part of the housing 50b, two strips are injection moulded in the outflow openings (not visible in Fig. 3), in which the dowel is guided. The seal 44 seals the outflow funnel to the consumer connection 20 and can in the process offset eccentricities and irregularities as well as defects in the surface of the housing. When the supply connection (not shown in Fig. 3, reference sign 30 in Fig. 1) is under pressure, the valve body 42 is pushed downwards so that the seal 44, for example a seal injection moulded onto the valve body 42, is pressed against the housing lower part 50b so that the consumer connection 20 is sealed. On the top side of the valve body 42 is located a radial valve guide 47, which is received in a radial recess 41 in the housing upper part 50a, in order to guide, together with the centring dowel 43, the valve body 42 in an axial direction parallel to

the central axis A both in the housing upper part 50a as well as in the housing lower part 50b. The cavity for receiving the valve body 42 is configured so that in a closed valve position above the valve body, cavities 50c and 50d remain vacant in order to make possible a vertical movement of the valve body 42 (parallel to the central axis A). In order to hold the valve body 42 securely in a closed position even with a low pressure at the supply connection, a compression spring, which presses the valve body 42 downwards into the closed position, is located in the region of the radial valve guides 47. The valve body 42 contains a recess 46 in which a projection 100a of an actuator 100 can engage. In a closed position of the valve body 42, the projection 100a of the actuator 100 can be freely moved past the valve body 42 without actuating the valve, i.e. the closed valve remains closed.

The actuator 100 is connected to a driver 140 in a rotationally fixed manner, which driver 140 is connected to a manually actuable lever 60 so that a rotation of the lever 60 around the central axis A brings about a rotation of the projection 100a of the actuator 100 around the central axis A. By rotating the lever 60 around the central axis A, the projection 100a can be positioned against a valve (40-1 to 40-6 in Fig. 2) to be selected.

In the upper region of the actuator 100 are located two slots 190 in which the driver 140 engages. The slots make possible a rotationally fixed engagement of the driver 140 in the actuator 100 and allow, on the other hand, the actuator 100 to remain displaceable relative to the driver 140 parallel to the central axis A. The driver 140 is supported on a switching shaft 120 and is preferentially connected to the switching shaft 120 in a fixed manner or can be an integral part of the switching shaft 120 in order to hold the driver 140 in place on the housing 50. The switching handle 60 is fastened to the driver 140 with a pin 160. The pin 160 simultaneously serves as axis of rotation for the switching handle/lever. The lever 60 is therefore mounted so as to be rotatable around the pin axis of the pin 160 relative to the driver 140. However, with respect to the central axis A, the lever 60 is rotationally fixed relative to the driver 140 of the switching shaft 120 so that upon a rotation of the lever 60 around the central axis A the switching shaft 120 is co-rotated. Since the actuator 100 is likewise mounted in

a rotationally fixed manner with respect to the driver 140, the actuator 100 co-rotates when the lever 60 is rotated around the central axis A.

The switching shaft 120 is rotatably supported on a hollow base shaft 110. To prevent the rotation, the base shaft has a collar 130 with at least one recess. A lug (not visible in Fig. 3), which can be injection moulded in the housing lower part 50b, engages in the recess. The base shaft 110 is fastened to the housing lower part 50b with a nut (without reference sign). The base shaft 110 is therefore fixed relative to the housing 50, i.e. not rotatable.

The switching shaft 120 is coaxially and freely rotatably connected to the base shaft. Between switching shaft 120 and base shaft 110, a sliding disc can be located for wear reduction, or the switching shaft 120 is provided with wear protection. The switching shaft 120 and the base shaft 110 form a unit wherein they are rotatable relative to one another, which is held together by a screw 170. The screw is inserted from the outside through the hollow-bored base shaft 110.

The actuator 100 comprises a region 100b in the form of a hollow cylinder and the projection 100a projecting out of the same. The hollow-cylindrical region 100b is mounted coaxially on the base shaft in the lower region, and coaxially on the switching shaft in the upper region. In the neutral (closed) position of the valve body 42, the actuator 100 with the projection 100a can be rotated around the central axis A without obstacles and up to 360°, since the lateral recesses 46 in the valve body 42 allow the projection 100a to pass without obstruction.

At least one seal 195, for example an O-ring, seals the actuator 100 relative to the switching shaft 120. Furthermore, the actuator 100 is sealed relative to the base shaft 110 by at least one seal 196, for example an O-ring. The seal between actuator 100 and housing upper part 50a is effected in the embodiment according to Fig. 3 by a groove ring 170. Because of the groove ring 170, the sealing effect keeps improving with increasing pressure. By way of its self-effecting readjustment under pressure, the groove ring can offset wear. Furthermore, the groove ring can offset eccentricities and irregularities as well as defects in the surface of the housing. The groove ring 170

is positioned in the housing upper part 50a and is fixed by a flange 180. The flange 180 is screwed to the housing upper part 50a for example using three self-tapping screws.

In the upper region of the actuator 100, a cylinder pin 150 is inserted in order to connect the actuator 100 to the lever 60 so that when the lever 60 is pressed down, i.e. when the lever 60 is rotated around the axis of the pin 160, the actuator 100 is lifted by the cylinder pin 150. A vertical slot is worked into the driver 140, in which slot the cylinder pin 150 can move freely in order to ensure that the actuator 100 can be freely moved relative to the switching shaft in a vertical direction (i.e. parallel to the central axis A). In the region of the central axis A of the lever 60, two surfaces, through which the cylinder pin 150 runs, can be provided (reference sign 200 in Fig. 4), so that the lever 60, via the cylinder pin 150, is connected to the upper part of the actuator 100 and the actuator 100 can be lifted by the lever 60. When the lever 60 is rotated around the pin 160, the surfaces 200 by means of the cylinder pin 150 lift the actuator 100 and the valve is opened.

This situation is shown in Fig. 4. In order to ensure that the actuator 100, in the open position as shown in Fig. 4, cannot be rotated further, a lug 101a is located on the top side of the projection 100a of the actuator 100, which lug in the open position engages in a recess 50e of the housing upper part 50a, so that the actuator 100 cannot be rotated around the central axis A. Because of this, damage to the valve is prevented when attempts are made to change the position of the actuator 100 in the open valve state.

Fig. 5 shows a section along the line II-II in Fig. 2, i.e. along the line between the lever positions NS (neutral position) and ZS3, i.e., intermediate position 3 for selecting the valve elements 40-3 and 40-4. Fig. 5 shows a ball pressure screw 210, which is arranged in the flange 180, so that the ball of the ball pressure screw 210 presses radially to the inside against the actuator 100. The ball pressure screw 210 can be adjusted (moved) in the flange 180 in order to adjust the ball contact pressure. On an outer surface of the cylindrical region 100b of the actuator 100 are located two rows of countersinks 220 and 230. Each valve is represented by a countersink. Optionally, countersinks can also be provided for intermediate positions. When the lever 60 is

rotated in the neutral (closed) position, the ball pressure screw 210 engages in the upper rim of the countersinks 220 according to a certain valve selection position. A haptic or acoustic feedback of the valve position is provided in this way.

When the lever 60 (see Fig. 4 and 5) is pressed down, the actuator 100 is pulled up and the ball pressure screw 210 engages in a countersink in the lower rim of the countersinks 230 and fixes the actuator 100 in the open position. By way of the contour of the countersink, the holding force of the ball pressure screw 210 can be adapted. The position of the actuator and the holding force can be additionally raised in that an engagement lug is provided in the switching cam for the intended position.

Fig. 6 and 7 show an alternative embodiment for a manually actuable multiway valve according to the present invention. Fig. 6 shows the multiway valve in a closed position and Fig. 7 shows the multiway valve in an open position. Since the switching forces for opening the actuator are very great, the required force cannot be generated, under certain conditions, by the short lever 60 and by the simple lifting surface (reference sign 200 in Figure 4) on the switching handle/lever 60. In the embodiment according to Fig. 6 and 7, a multiway valve with an optimised lever 60 for optimising the axial movement of the actuator is provided. In order to achieve a force amplification of the lever, the pin 1600 (fulcrum of the lever 60) is arranged above the cylinder pin 1500 for lifting the actuator (in Figure 6 and 7 without reference signs) and force amplification curves 1410 and 1450 are worked into the lifting surfaces 1400 (reference sign 200 in Fig. 4). The force amplification curves 1410 and 1450 serve as support curves 1410 and 1450, on which the cylinder pin 1500 moves when the lever 60 is pressed down. The pitch of the curve 1410 is very flat at the beginning of the stroke, for example the first 4 mm of stroke, so that great forces can be transmitted. Since with an approximately 4 mm stroke the valve is completely circulated by flow and almost the same pressure prevails on the valve body at the top and the bottom, the valve is in a pressure-equalised state. For this reason, the remaining stroke, for example a 6 mm stroke, can be accomplished without additional force expenditure with a greater pitch 1450 (see Fig. 7). In order to eliminate as completely as possible the friction between curve surface 1410 and 1450 and driver 1400, two ball bearings on a shaft can be used instead of the cylinder pin 1500 (reference sign 150 in Fig. 3

and 4). The bearings roll with low friction on the surface of the curve 1410 and 1450. Engagement lugs can also be attached in the curve 1410 for defined positions.

Fig. 8 shows a top view of the multiway valve similar to Fig. 2, however with removed lever and housing upper part. The actuator 100 is in the intermediate position ZS1, i.e. the projection 100a of the actuator 100 can simultaneously actuate the valve elements 40-1 and 40-2, i.e. bring the same into an open position. In Fig. 8 it can be seen that the projection 100a of the actuator 100 projects out of the cylindrical part 100b of the actuator 100. The cylindrical part 100b of the actuator 100 is mounted above and around the switching shaft 120. The projection 100a of the actuator 100 comprises an indentation 100c for example of 4 mm. Since the switching forces become twice as great when two valves are simultaneously actuated, the second valve must only be lifted when the first valve is in the pressure-equalised state. Because of the indentation 100c, the second valve 40-2 lags the first valve 40-1 during opening and the entire switching operation can be carried out with constant force.

Fig. 9 and 10 show an embodiment for a multiway valve with an electric drive. Although in this description, only a manual or an electrical actuation of the multiway valve is described, the present invention is not restricted to such actuations, but an actuation can also take place pneumatically or hydraulically.

Fig. 9 shows a perspective 3D view of an electrically operated multiway valve and Fig. 10 shows a section along the central axis of the multiway valve. As is evident in Fig. 9, the lever in the preceding figures is replaced by a motor and gear attachment. The reference sign 500 designates a motor for rotating the actuator (not visible in Fig. 9) in order to select a valve element and reference sign 600 designates a motor for lifting the actuator in order to open a valve element. The rotary movement of the motors 500 and 600 is transmitted to the switching shaft and the actuator via gear wheels 510 and 610.

Fig. 10 shows, in the upper region of the actuator 100, an internal thread 622, in which an external thread 621 of a driveshaft 620 can engage. When a motor (not shown in Fig. 10) rotates the driveshaft 620 via the gear wheel 610, the actuator 100 is lifted.

By way of the gear wheel 510, a motor (not shown in Fig. 10) can rotate the actuator for selecting a valve element.

For example, the actuator 100 can be provided in the upper region with a left-hand thread 622. The driveshaft 620 is then provided with the corresponding mating thread 621. Between actuator 100 and driveshaft 620 a freewheel can be provided. When the driveshaft 620 rotates clockwise, the actuator 100 can be radially positioned for example by way of a potentiometer. When the driveshaft 620 rotates anticlockwise, the rotary movement is interrupted by the freewheel. The thread of the drive now acts as a spindle drive which lifts or lowers the actuator 100. When the direction of rotation changes, the freewheel is reactivated and the actuator 100 can be positioned again.

Since the base shaft of the multiway valve is embodied as a hollow shaft, the drive can also be space-savingly attached on the back of the multiway valve.

List of reference signs

10:	Multiway valve
20:	Consumer connections
30:	Supply connection
40, 40-1, etc.:	Valve elements
41:	Radial recess in the upper part of the valve housing
42:	Valve body
43:	Centring dowels on the lower side of the valve body for centring the valve body in the lower side of the valve housing
44:	Seal, for example injection moulded onto the valve body
45:	Spring for closing the valve element at low pressure
46:	Lateral recess in the valve body
47:	Radial valve guide on the upper side of the valve body
50:	Valve housing
50a:	Upper part of the valve housing

50b:	Lower part of the valve housing
50c:	Cavity in the upper part of the valve housing for receiving the radial valve guide on the valve body in an open position
50d:	Cavity in the valve housing for receiving the valve body in an open position
50e:	Recess in the top side of the valve housing for receiving a lug 111 of the actuator in an open position, in order to block a rotary movement of the actuator
60:	Lever/switching handle
100:	Actuator
100a:	Projection of the actuator for opening a valve element
100b:	Hollow cylinder-shaped upper part of the actuator
100c:	Indentation in the projection 100a of the actuator 100 for the offset actuation of two adjacent valve elements in an intermediate position of the actuator between two adjacent valve elements
101:	Lug on the projection of the actuator
110:	Base shaft
120:	Switching shaft
130:	Collar on the base shaft secured against rotation relative to the lower side of the valve housing and simultaneously lower stop for the actuator
140:	Driver
150:	Cylinder pin for lifting the actuator
160:	Pin as axis of rotation of the lever 60 for opening a valve element
170:	Groove ring for sealing the actuator with respect to the housing
180:	Fastening flange for fixing the groove ring
190:	Slots at the end of the actuator pointing towards the lever for engaging the driver
195:	Sealing ring between actuator and switching shaft
196:	Sealing ring between actuator and base shaft
200:	Surfaces on the lever for receiving the cylinder pin 150 for lifting the actuator 100
210:	Ball pressure screw

220:	Countersink in the cylindrical upper part 100b of the actuator 100 for engaging at a valve position
230:	Countersink in the cylindrical upper part 100b of the actuator 100 for fixing the actuator in the open position
500:	Electric motor for rotating the actuator
510:	Gear wheel for transmitting the rotary movement of the motor 500 to the actuator 100
600:	Electric motor for lifting and lowering the actuator
610:	Gear wheel for force transmission of the rotary movement of the motor 600 to the actuator 100
620:	Driveshaft
621:	External thread on the driveshaft
622:	Internal thread on the top side of the actuator corresponding to the external thread 621
700:	Holding structure for the gear wheel 610
1400:	Surfaces on the lever with worked-in lifting curves for receiving the cylinder pin 150 or the ball bearing with shaft 1500 for lifting the actuator 100
1410, 1450:	Lifting curves for improved force transmission during the opening of the valve counter to the pressure from the supply connection
1500:	Ball bearing and shaft for rolling on the lifting curve for lifting/opening the actuator
1600:	Pin and axis of rotation for the lever 60

PATENTKRAV

1. Flervejsventil (10) især til landbrugsmarksprøjtning som omfatter følgende:
en forsyningstilslutning (30);
N forbrugertilslutninger (20);
N ventilelementer (42), som hver er i stand til at etablere en væskegennemtrængelig forbindelse mellem forsyningstilslutningen (30) og mindst en af N forbrugertilslutningerne (20); og
en reguleringsanordning (100) til udvælgelse af mindst et af N ventilelementerne (42) og til styring af det udvalgte ventilelement i en åben position eller en lukket position;
hvor reguleringsanordningen (100) og N ventilelementerne (42) er udformet og anbragt således at udvælgelsen og styringen af et af N ventilelementerne (42) kan gøres uafhængigt i 2 trin, således at ingen af N ventilelementerne (42) styres ved udvælgelsen af mindst et ventilelement (42), hvor reguleringsanordningen (100) omfatter et fremspring (100a), der strækker sig radialt udad i forhold til en centerakse (A); og
hvor hver af N ventilelementerne (42) omfatter en fordybning (46), som reguleringsanordningens (100) fremspring (46) kan gribe ind i, **kendetegnet ved, at** reguleringsanordningens (100) fremspring (100a) strækker sig over et radialt område, som valgfrit tillader styringen af et enkelt ventilelement (42) eller der samtidig tillader styringen af to tilstødende ventilelementer (42).

2. Flervejsventil (10) ifølge krav 1, hvor N ventilelementerne (42) er anbragt cirkelformet rundt om centeraksen (A) i tilsvarende hulrum af et flervejsventilhus (50), således at N ventilelementerne (42) er bevægelige uafhængigt af hinanden parallelt med centeraksen (A) inden for det tilsvarende hulrum mellem en åben position eller en lukket position.

3. Flervejsventil (10) ifølge krav 2, hvor reguleringsanordningen (100) er monteret drejeligt omkring centeraksen (A) og forskydelig parallelt i forhold til centeraksen (A).

4. Flervejsventil (10) ifølge et af kravene 1 - 3, der endvidere omfatter følgende:
En skifteaksel (120) anbragt koaksialt med centeraksen (A) og drejeligt monteret i forhold til flervejsventilhuset (50), hvor reguleringsanordningen (100) er drejesikret i

forhold til skifteakselen (120) men forbundet bevægelig med skifteakselen (120) parallelt med centeraksen (A), således at reguleringsanordningen (100) gennem skifteakselen (120) kan drejes omkring centeraksen (A), for at udvælge mindst et af N ventilelementerne (42); og

en forskydningsanordning til at forskyde reguleringsanordningen (100) parallelt med centeraksen (A) i forhold til skifteakselen (120), således at reguleringsanordningen (100) kan forskydes i forhold til skifteakselen (120) gennem forskydningsanordningen langs centeraksen (A) gennem en første position svarende til en lukket ventil og en anden position svarende til en åben ventil, for at åbne eller lukke mindst det ene udvalgte ventilelement (42).

5. Flervejsventil (10) ifølge krav 4, hvor reguleringsanordningen (100) er anbragt koaksialt omkring skifteakselen (120).

6. Flervejsventil (10) ifølge et af kravene 4 - 5, hvor reguleringsanordningen (100) og N ventilelementerne (42) er udformet og anbragt, således at skifteakselen (120) kun kan drejes, når reguleringsanordningen (100) befinder sig i første position.

7. Flervejsventil (10) ifølge et af kravene 1 - 6, hvor flervejsventilen (10) er udformet således, at alle N ventilelementerne (42) befinder sig i den lukkede position, når forsyningstilslutningen (30) er under tryk.

8. Flervejsventil (10) ifølge et af kravene 1 - 7, der endvidere omfatter mindst et forspændningselement (45), der mindst holder et af N ventilelementerne (42) i en lukket position, så længe det ikke styres gennem reguleringsanordningen (100).

9. Flervejsventil (10) ifølge et af kravene 1 - 8, der endvidere omfatter en anordning til at udvælge et ventilelement (42) og til styring af det udvalgte ventilelement (42).

10. Flervejsventil (10) ifølge krav 9, hvor anordningen til udvælgelse og styring er en manuel styrbar stang (60), der er fastgjort ved hjælp af en stift (160) til en medbringer (160) ved enden af skifteakselen (120), således at stangen (60) er drejelig vinkelret til centeraksen (A) og er drejesikret parallel til centeraksen (A) i forhold til skifteakselen (120),

hvor stangen (60) endvidere er fastgjort ved hjælp af en cylinderstift (150) på enden af reguleringsanordningen (100), således at reguleringsanordningen (100) kan forskydes med stangen (60) i forhold til skifteakselen (120).

11. Flervejsventil (10) ifølge krav 10, der endvidere omfatter to over hinanden liggende rækker af N fordybninger eller valgfrit 2 x N fordybninger ved en yderside af en cylinderformet del af reguleringsanordningen (100), således at reguleringsanordningen (100) kan fastlåses i en udvalgt ventilposition eller eventuelt yderligere i en mellemposition i en åben position eller en lukket position.

12. Flervejsventil (10) ifølge et af kravene 4 - 11, der endvidere omfatter en tætningsring (195) mellem skifteakselen (120) og reguleringsanordningen (100), samt en rillering (170) mellem reguleringsanordningen (100) og huset (50) til tætning af huset (50).

13. Flervejsventil (10) ifølge krav 9, hvor anordningen til udvælgelse er en første motor (500) med en første gearingsmekanisme (510,520) og anordningen til styring er en anden motor (600) med en anden gearingsmekanisme (610, 620, 621).

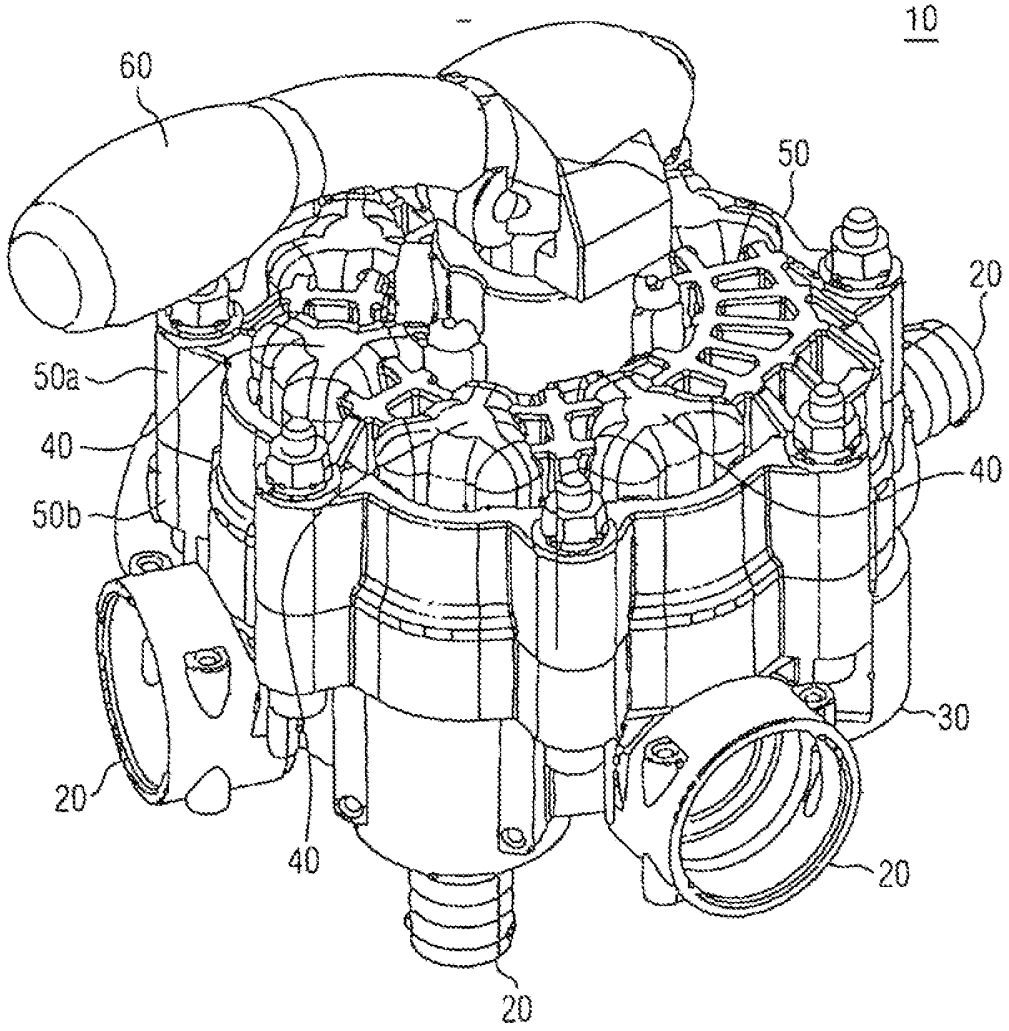

FIG 1

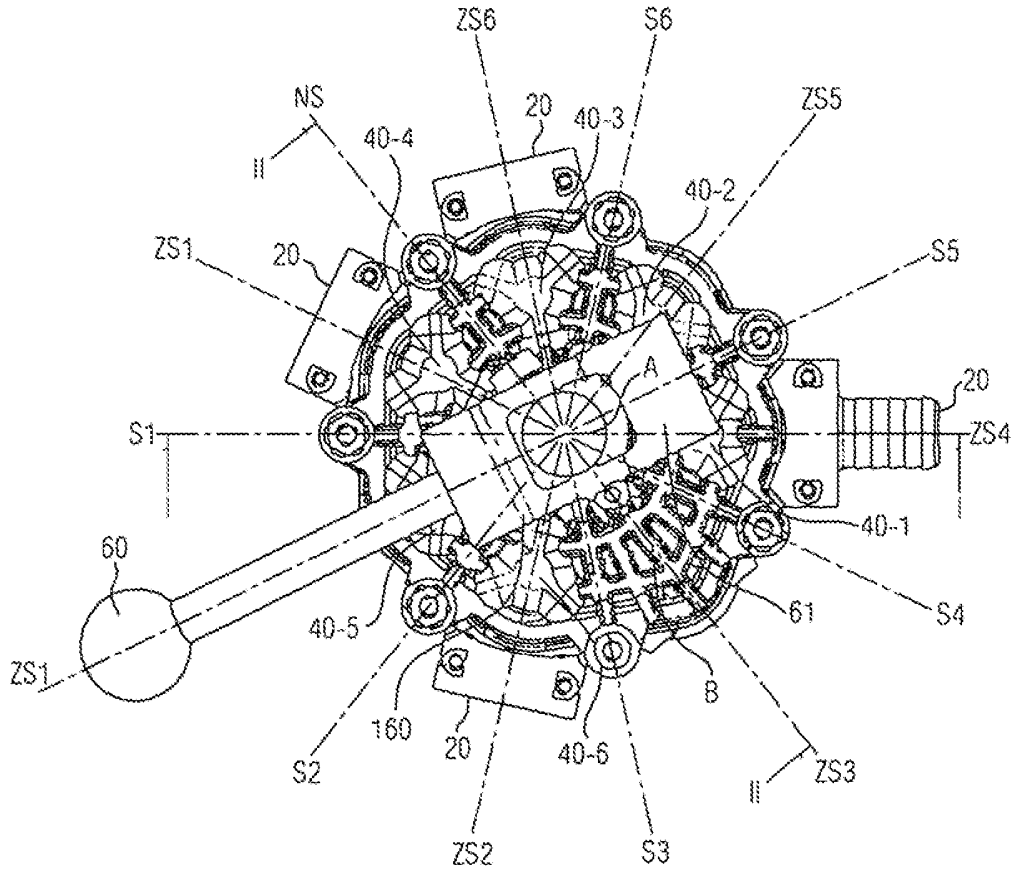
ZS6
S6
NS
20
40-3
ZS5
II
40-4
40-2
ZS1
20
S5
A
20
S1
ZS4
40-1
60
61
S4
40-5
ZS1
B
160
20
40-6
S2
II
ZS3
ZS2
S3

FIG 2

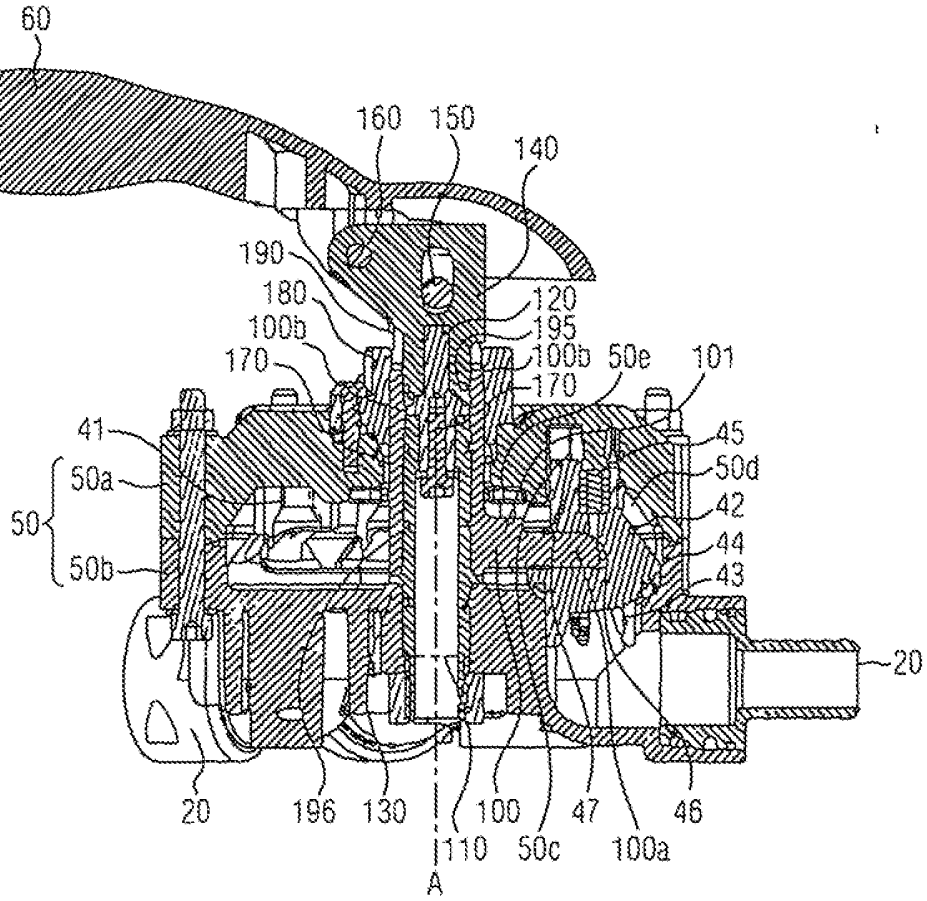
60
160
150
140
190
180
120
195
100b
170
100b
50e
101
170
41
45
50a
50d
50
42
50b
44
43
20
20
196
130
100
47
46
110
50c
100a
A

FIG 3

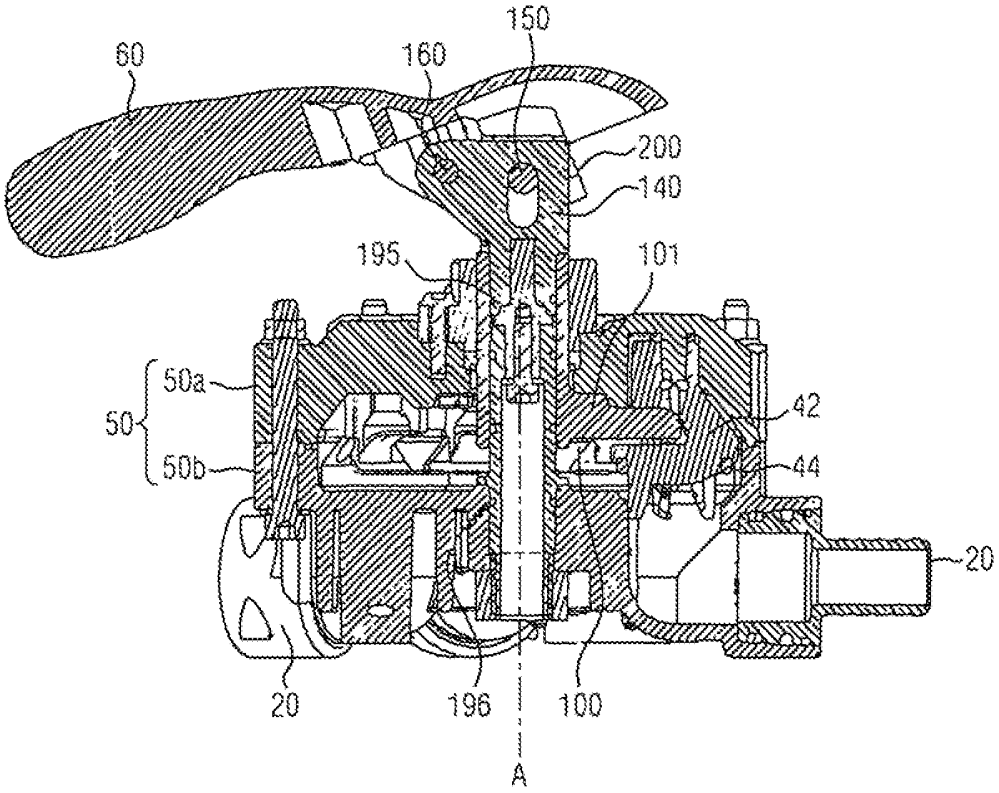

FIG 4

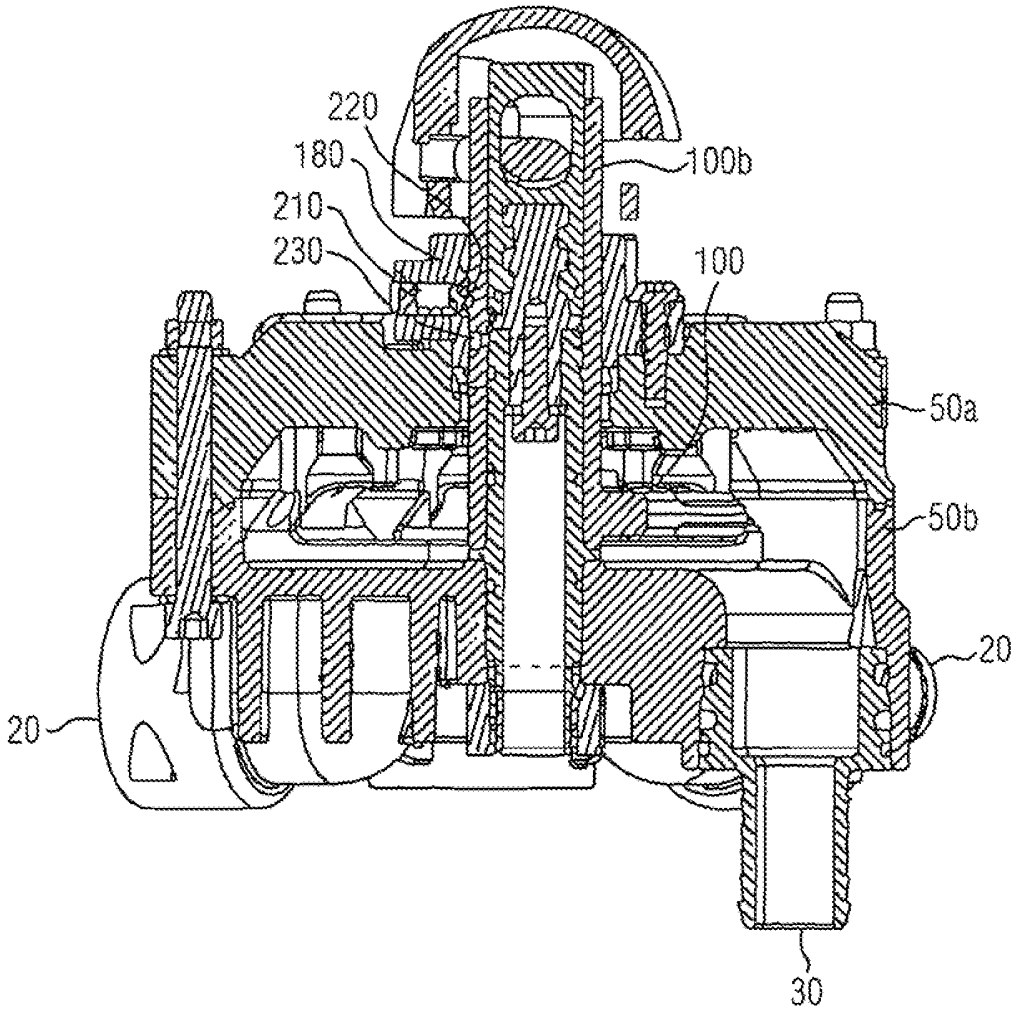

FIG 5

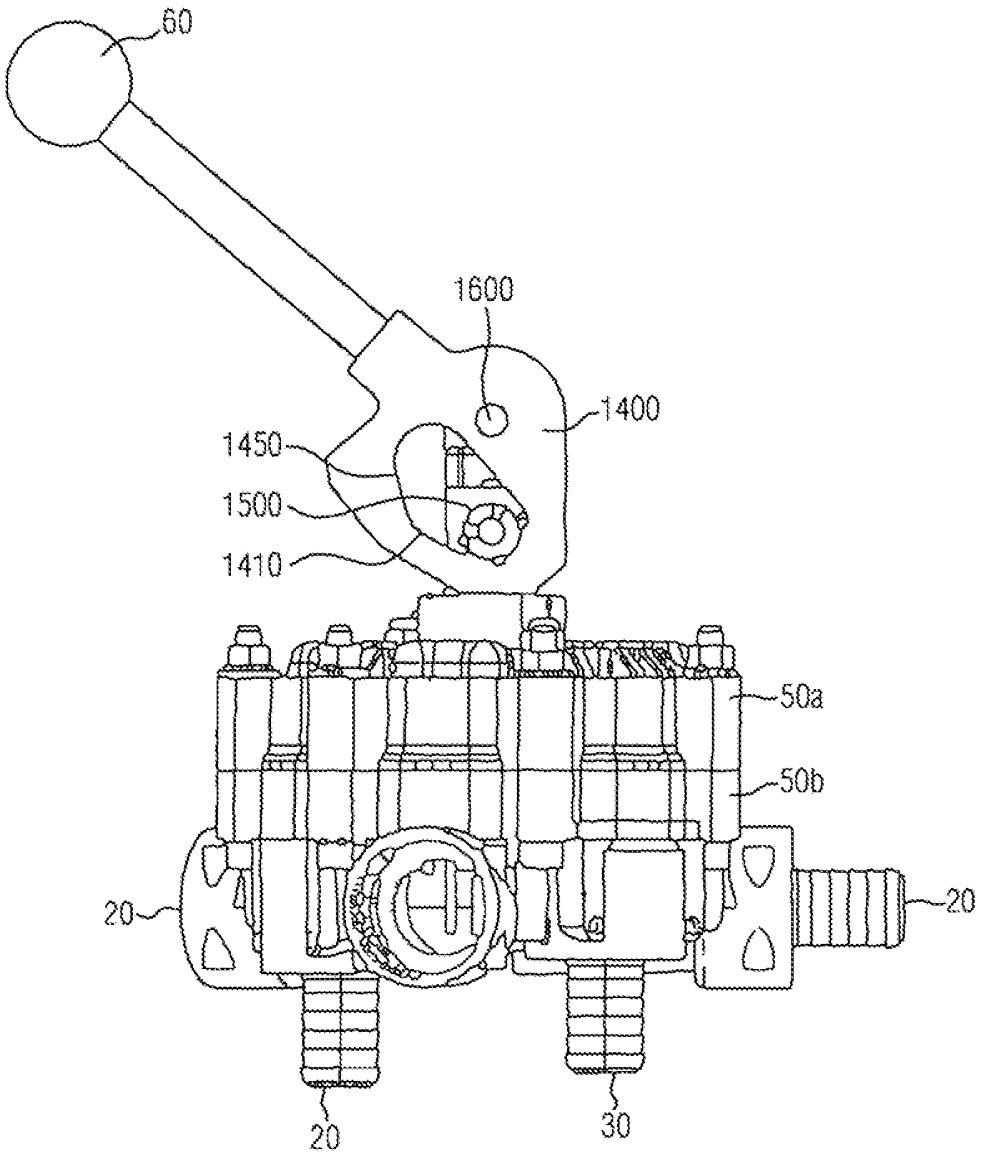

FIG. 6

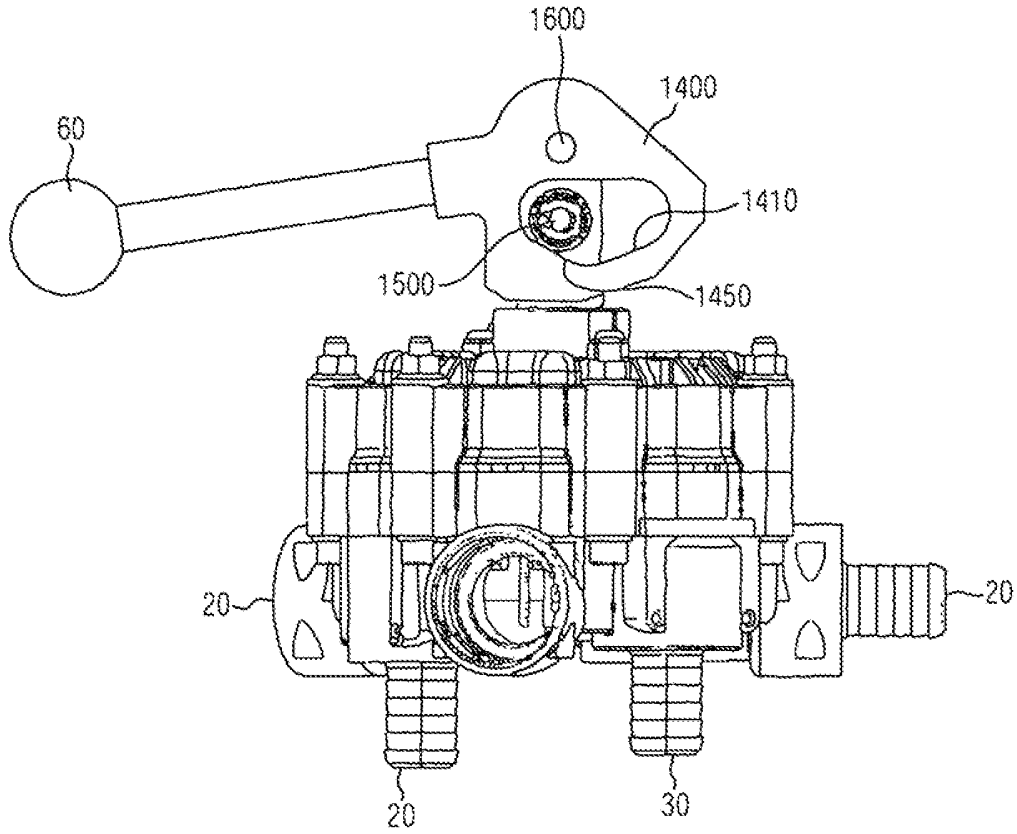

FIG. 7

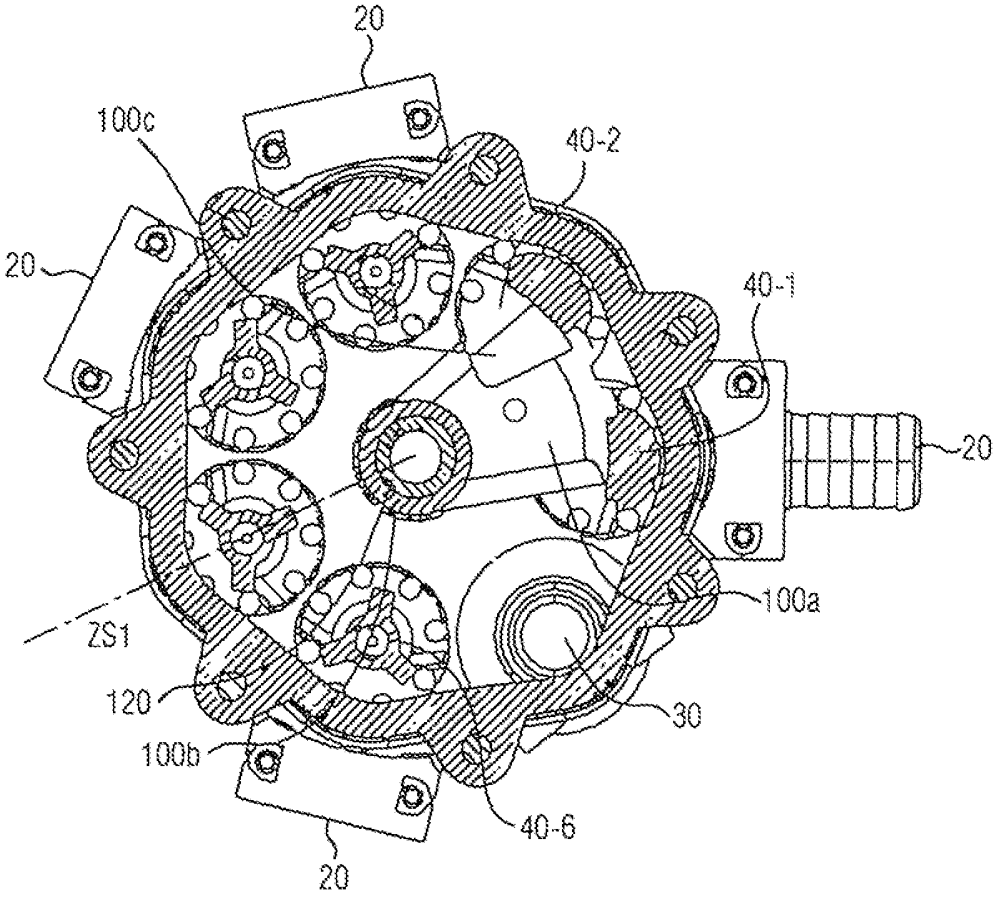

FIG. 8

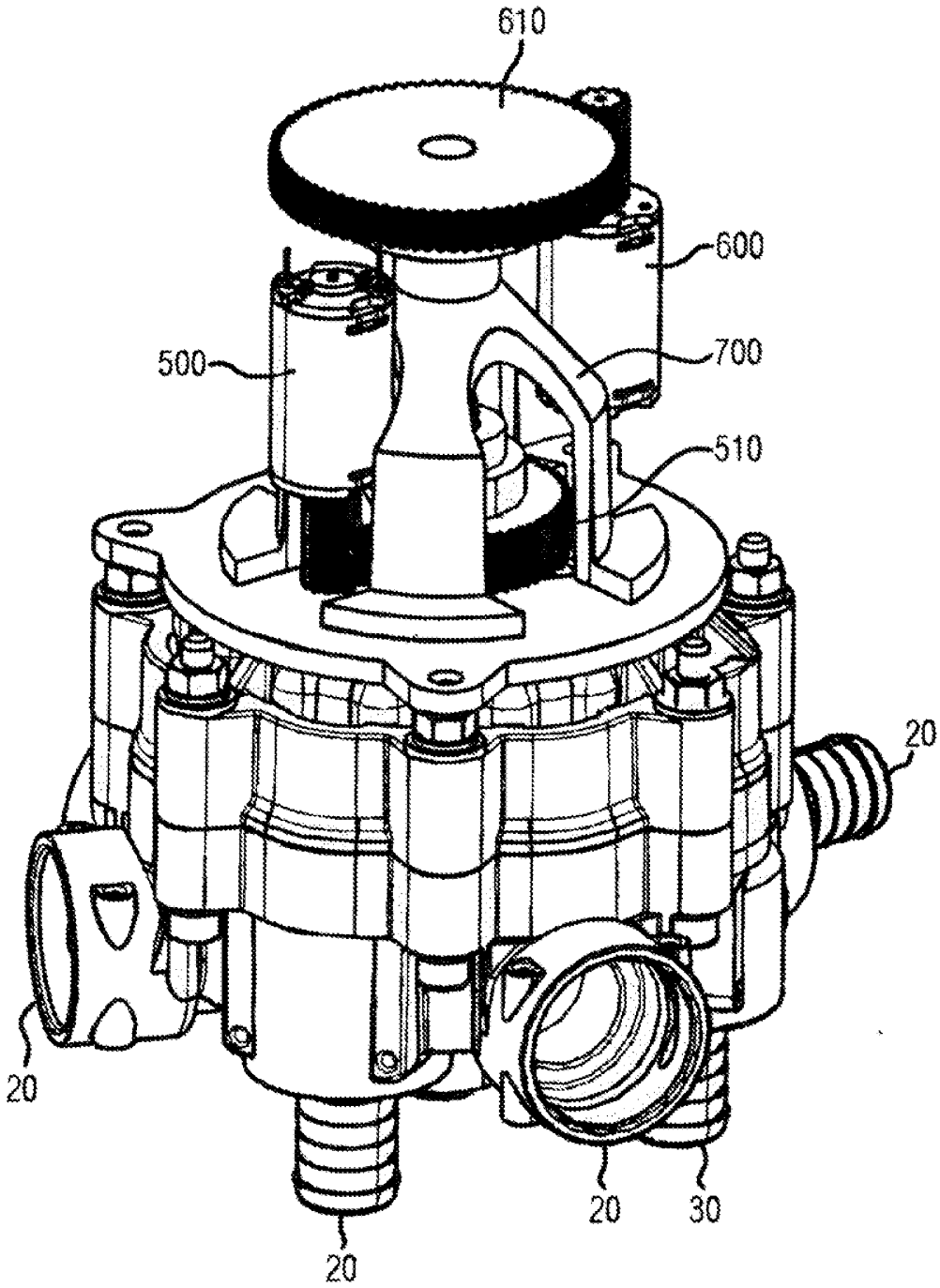

FIG. 9

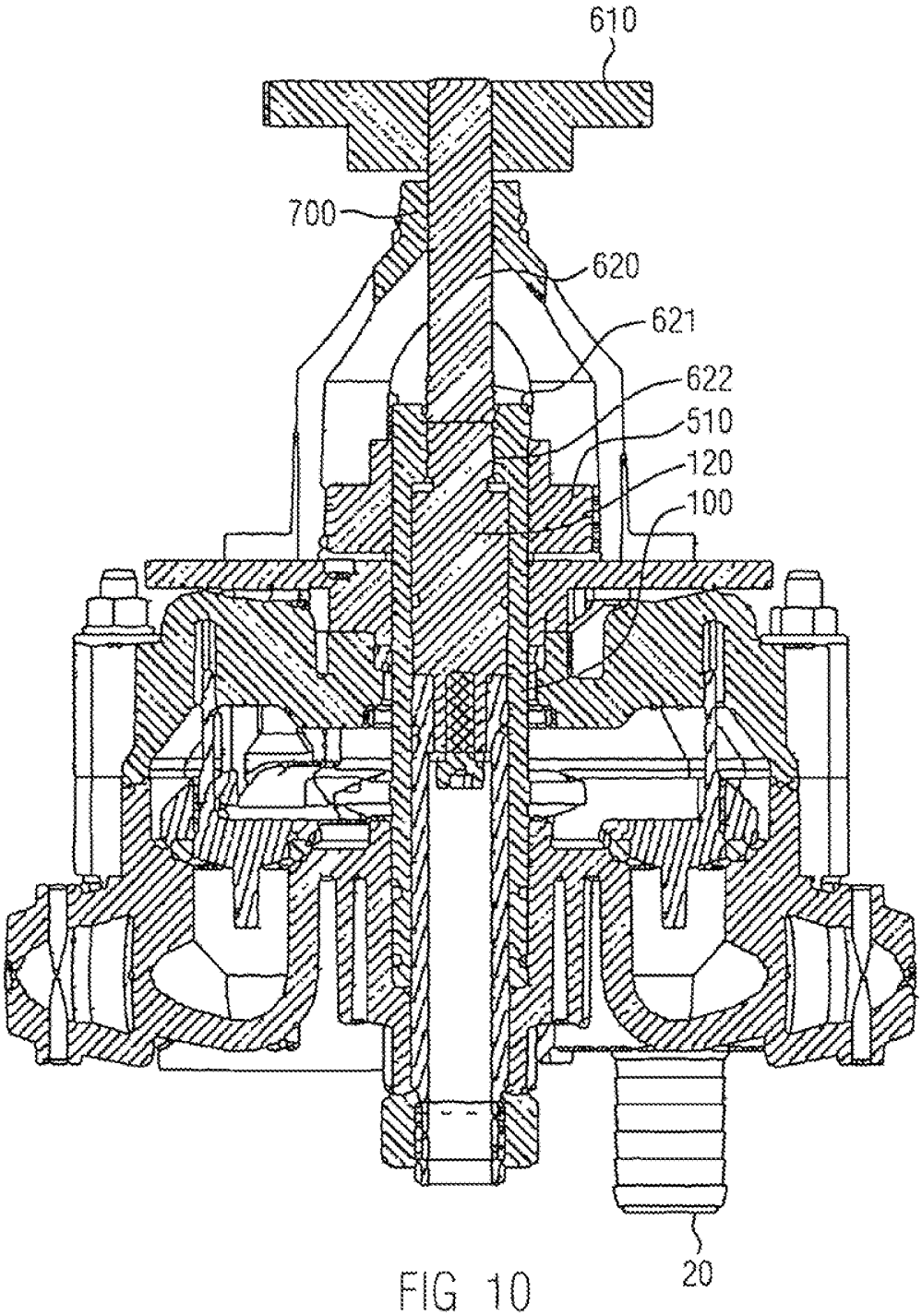

FIG 10