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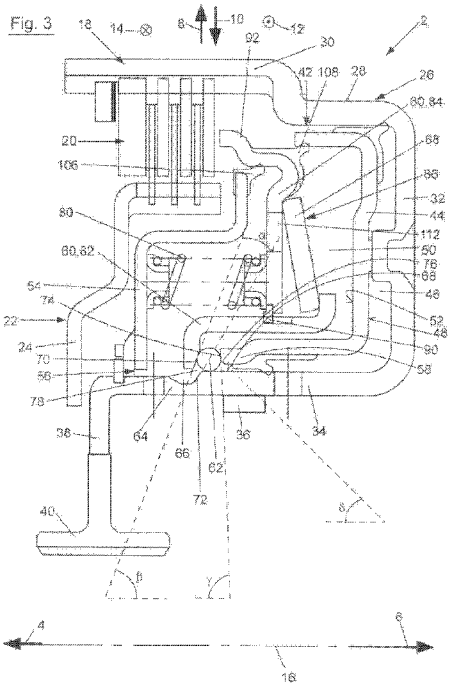

(57) Abstract: The present invention relates to a clutch device (2) comprising at least one clutch (18), in particular a disk clutch, and an actuating device (42), in particular a hydraulic actuating device (42), for actuating the clutch 10 (18), wherein the actuating device (42) can be transferred from an open position, in which the clutch (18) is open, into a closed position, in which the clutch (18) is closed. The actuating device (42) can be locked in a positive locking way in the closed position or in the open position.

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CLUTCH DEVICE

Description

[0001] The present invention relates to a clutch device comprising at least one clutch and an actuating device for actuating the clutch, wherein the actuating device may be transferred from an open position, in which the clutch is open, into a closed position, in which the clutch is closed.

[0002] Clutch devices comprising a clutch, in particular friction clutches, and a hydraulic actuating device for actuating the clutch are known from practice. The actuating device may be transferred via hydraulics from an open position, in which the clutch is open, into a closed position, in which the clutch is closed by means of the actuating device. To hold the normally open clutch in the closed state thereof, the actuating device must be held in the closed position thereof by maintaining the hydraulic pressure. For a normally closed clutch, in contrast, the hydraulic pressure must be maintained to hold the actuating device in the open position thereof.

[0003] The underlying object, among others, of the present invention is to create a clutch device comprising a clutch and an actuating device for actuating the clutch in which the actuating device may be transferred into the closed position or into the open position and held in the respective position at a relatively low energy expenditure.

[0004] This and other problems is/are solved by the features listed in Patent Claim 1. Advantageous embodiments of the invention are the subject matter of the subclaims.

[0005] The clutch device according to the invention has at least one clutch. The clutch is preferably designed as a disk clutch and/or as a wet-running clutch or disk clutch. The clutch may be designed as a normally open clutch or as a

normally closed clutch. An actuating device for actuating the clutch is assigned to the clutch. The actuating device is preferably designed as a hydraulic actuating device for hydraulic actuation of the clutch. The actuating device may be transferred from an open position, in which the actuating device interacts with the clutch in such a way that the clutch is open, into a closed position, in which the actuating device interacts with the clutch in such a way that the clutch is closed, and vice versa. In order to hold the actuating device in the closed position or to hold the clutch in the closed state, or to hold the actuating device in the open position or to hold the clutch in the open state, the force introduced into the actuating device does not need to be maintained or does not need to be completely maintained; instead the actuating device is designed in such a way that it may be locked in a positive locking manner - at least in part - in the closed position or in the open position. In a hydraulic actuating device, this would mean that, for example, the hydraulic pressure for transferring the actuating device into the closed position or into the open position does not need to be maintained or needs to be maintained at a lower level upon reaching the closed position or open position in order to hold the actuating device in the closed position or open position, particularly as the positive locking effects a complete or at least partial holding of the actuating device in the closed position or open position.

[0006] In a preferred embodiment of the clutch device according to the invention, the actuating device is designed in such a way that this is automatically locked by transferring the actuating device into the closed position or open position in order to simplify handling of the clutch device.

[0007] In another preferred embodiment of the clutch device according to the invention, at least one moveable locking element is assigned to the actuating device. The moveable locking element is preferably a rolling body, for example, a

sphere or a roller, or a sliding body, thus, for example, a sliding displaceable block. The locking element listed herein may also be designated as a clamping element. Regardless of the respective embodiment variant of the moveable locking element, the locking element may be moved from a release position into a locking position, in which the actuating element is locked, and vice versa. Even if at least one moveable locking element is always discussed herein, it is, however, preferred if at least two or three moveable locking elements are provided, wherein it is additionally preferred if the at least two or three moveable locking elements are arranged along a circle and/or in the circumferential direction spaced uniformly apart from one another along this circle, particularly as a particularly secure and uniform locking of the actuating device in the closed position or open position may be achieved by this means. It is also advantageous to connect the two or more moveable locking elements with one another in the circumferential direction to guarantee their spacing to one another, for example, by means of a spring element. Alternatively, only one single moveable locking element may be provided, which is designed as a ring, in order to reduce the number of parts, among other things. The diameter of the ring is thereby preferably changeable, if necessary, elastically changeable. For this purpose, it is particularly preferred if the ring has a separation or a gap between two end sections of the elongated ring body forming the ring in order to enable an expansion and/or compression of the ring in the radial direction.

[0008] In another preferred embodiment of the clutch device according to the invention, the locking element may be moved by an actuating force, which is applied or is applicable by the actuating device, from the release position into the locking position. This has the advantage that no additional actuating device, for example, additional hydraulics or a motor drive, has to be provided for the locking element to move the locking element from the release position into the

locking position, by which means the structure of the clutch device is simplified.

[0009] In an advantageous embodiment of the clutch device according to the invention, the locking device is arranged between a first force transmission element and a second force transmission element of the actuating device. The indicated force transmission elements function to transmit the actuating force of the actuating device or a reset force for resetting the clutch. The two force transmission elements, between which the locking element is arranged, thus the first force transmission element and the second force transmission element, are moveable in a movement direction, wherein the movement direction of the two force transmission elements preferably corresponds to the axial directions of the clutch device. Thus, the first and second force transmission elements may, for example, be moved or displaced in the one axial direction of the clutch device and also in the opposite other axial direction of the clutch device.

[0010] In another advantageous embodiment of the clutch device according to the invention, in the release position of the locking element, the first force transmission element and the second force transmission element are supported or are supportable on one another in the movement direction of the force transmission element via the locking element. Consequently, in the release position of the locking element, a force may be transmitted in the movement direction from the one force transmission element via the locking element to the other force transmission element. The force transmission elements are also coupled in the release position of the locking element in such a way that a movement of the one force transmission element in the one movement direction results in a movement of the other force transmission element in the same movement direction, so that it may also be stated that there is a coupling of the movement of the two force transmission elements via the locking element in the release position.

[0011] According to another advantageous embodiment of the clutch device according to the invention, the first force transmission element and the second force transmission element are at least partially or completely decoupled from one another in the locking position of the locking element with respect to the movement direction. In a complete decoupling of the two force transmission elements from one another, it is thus possible to displace the two force transmission elements relative to one another in the movement direction without the result that a movement of the one force transmission element inevitably results in a movement of the other force transmission element in the movement direction. In this first embodiment variant, it is thus possible to lock at least one part of the actuating device and to decouple from the rest of the actuating device, without all elements of the actuating device having to be locked in a predetermined position for locking the same in the closed position or open position. In the previously indicated second embodiment variant, in which the first and second force transmission elements are at least partially decoupled from one another in the locking position of the locking element with respect to the movement direction, only a part of the force applied or transmitted from the one force transmission element is transmitted via the locking element in the locking position to the other force transmission element, so that it may be stated that there is at least a partial decoupling. In this case as well, a force set opposite to or holding counter to the other force transmission element may be lower in order to hold the first-indicated force transmission element in its position and thus also to hold the actuating device in the open or closed position. Thus, in the case of a hydraulic actuating device, only a low hydraulic pressure would be required.

[0012] In a particularly preferred embodiment of the clutch device according to the invention, the actuating device has a hydraulically drivable actuating piston. The actuating piston has in turn a side delimiting a pressure chamber and a side delimiting a pressure compensation chamber. Consequently, by

providing a pressure chamber, at which pressure can be applied using a hydraulic medium, and a pressure compensation chamber filled with a fluid, compensation may be achieved, sometimes called centrifugal oil compensation, for the forces of the hydraulic medium and the fluid, caused by centrifugal force and acting on the actuating piston. The hydraulically drivable actuating piston is designed preferably as a slave piston within the clutch device, so that it may also be stated that there is additionally a slave piston among the components of the clutch device delimiting the pressure chamber. In addition, it is preferred in this embodiment, if the actuating piston is designed as a ring piston, which is guided particularly preferably directly or indirectly along a main hub of the clutch device, if necessary, guided in a sealing way.

[0013] In another advantageous embodiment of the clutch device according to the invention, the actuating piston interacts with the first force transmission element. In other words, a force of the actuating piston may be transmitted via the first force transmission element and the locking element in the release position thereof to the second force transmission element and vice versa. The first force transmission element may hereby be designed, for example, as separate from the actuating piston. In this embodiment, it is, however additionally preferred if the actuating piston is designed as one piece with the first force transmission element to reduce the number of parts and the production expense. Alternatively, the actuating piston may also, however, be fixed on the first force transmission element to be able to implement an, if necessary, advantageous individual manufacturing of the first force transmission element and the actuating piston, before these are fixed on one another.

[0014] To achieve a particularly compact structure of the clutch device, the second force transmission element is arranged, in a particularly advantageous embodiment of the clutch device according to the invention, at least partially

within the pressure compensation chamber. It is additionally preferred hereby if the second force transmission element arranged within the pressure compensation chamber is designed to be at least partially permeable for a fluid within the pressure compensation chamber to create a coherent pressure compensation chamber. It is hereby particularly preferred if one or multiple, if necessary, window like recesses are provided in that section of the second force transmission element, which is arranged in the pressure compensation chamber, to guarantee the previously mentioned permeability for a fluid.

[0015] Basically, the second force transmission element may be designed as one piece. However, to influence the operating behavior of the second force transmission element in a targeted way, in another particularly preferred embodiment of the clutch device according to the invention, the second transmission element is designed at least in two parts made of a first transmission section and a second transmission section wherein the two transmission sections are elastically supported or supportable on one another in the movement direction. In this embodiment, it is additionally preferred if the elastic supportability or support is effected by means of a spring device of the clutch device which has a spring element, in necessary, a plate spring, or multiple spring elements, if necessary, multiple plate springs. In the case of multiple plate springs, it has hereby proven advantageous if these form a plate spring stack.

[0016] In another preferred embodiment of the clutch device according to the invention, the first transmission section of the second force transmission element is pretensioned relative to the second transmission section of the second force transmission element by the spring device in an initial position. It is hereby preferred if the first transmission section is directly or indirectly supported or is supportable on the second transmission section in order to securely hold the first transmission section in the initial position

thereof. Within the context of an indirect support of the first transmission section on the second transmission section, it has proven advantageous if this is carried out by means of a retaining ring, particularly as not only is a secure support hereby guaranteed, but moreover a relatively simple and easy to manufacture structure is also achieved.

[0017] In another preferred embodiment of the clutch device according to the invention, the spring device has an at least two-stage spring characteristic curve comprising a first stage and a second stage with a lower increase of the spring characteristic curve than in the first stage. If the clutch is to be, for example, a normally open clutch, then the second force transmission element might be moved at the beginning of the closing procedure initially relatively quickly in the direction of the closed position, particularly as the first transmission section and the second transmission section of the second force transmission element are supported relatively rigidly on one another in the range of the first stage of the spring characteristic curve. If the closed position is thereby reached, then the second transmission section presses against the clutch or the disk pack thereof. At a further pressure increase, in contrast, the second stage of the spring characteristic curve would be achieved. In this embodiment, it is preferred if the spring characteristic curve runs in a substantially horizontal course in the second stage, wherein an at least low - preferably positive - increase is to be preferably present to prevent an undefined operating state. In addition, the spring device, together with the transmission sections of the second force transmission element, is to be designed preferably in such a way that the first transmission section is moveable relative to the second transmission section in the range of the second stage of the spring characteristic curve.

[0018] According to another preferred embodiment of the clutch device according to the invention, the spring device with the at least two stage spring characteristic curve is

pretensioned by a pretension of the first transmission section in the initial position thereof at least into the first stage, preferably up to the beginning of the second stage or into the second stage, in order to further reinforce the previously indicated advantage.

[0019] In another advantageous embodiment of the clutch device according to the invention, the actuating piston is formed at least in two parts from a first piston section and a second piston section which are displaceable relative to one another in the movement direction. Consequently, in this embodiment, the first and second piston sections jointly form the side delimiting the pressure chamber and the side delimiting the pressure compensation chamber. It is hereby preferred if the first piston section interacts with the first force transmission element, is designed as one piece with the first force transmission element, or is fixed on the first force transmission element. This embodiment has proven advantageous in conjunction with a second force transmission element designed to be formed from at least two parts, in particular, if a spring device is provided between the first transmission section and the second transmission section of the second force transmission element, said spring device having the previously mentioned at least two-stage spring characteristic curve.

[0020] In another advantageous embodiment of the clutch device according to the invention, in which the actuating piston is designed at least in two parts from a first piston section and a second piston section, the second piston section interacts with the second force transmission element, is designed as one piece with the second force transmission element, or is fixed on the second force transmission element. It is hereby preferred, if the second piston section interacts with the second transmission section of the second force transmission element, is designed as one piece with the same or is fixed on the same. Due to this embodiment, a two-stage closing or opening of the clutch is analogously carried out.

If, for example, a pressure is initially increased in the pressure chamber, then both piston sections are moved in the movement direction. A further increase of the pressure within the pressure chamber results in that only the first piston section is still moved counter to the spring force of the spring device - preferably in the range of the second stage of the spring characteristic curve - between the first and second transmission sections of the second force transmission element to either further close or open the clutch, if necessary. The pressure within the pressure chamber may subsequently be reduced to a certain level without appreciably reducing the actuating force of the actuating device, as the actuating device is locked in the closed position or open position.

[0021] In another preferred embodiment of the clutch device according to the invention, the first force transmission element and the second force transmission element are moveable in the movement direction relative to a support element, wherein, in the locking position of the locking element, the second force transmission element, preferably the first transmission section thereof, is supported or is supportable on the support element in the movement direction via the locking element.

[0022] In another advantageous embodiment of the clutch device according to the invention, a first support surface is provided on the second force transmission element, preferably on the first transmission section of the second force transmission element, and a second support surface is provided on the previously mentioned support element. The first and second support surfaces are designed in such a way that the locking element is supported or is supportable on them in the locking position. The first support surface and the second support surface are thereby inclined toward one another in the direction of the release position of the locking element to expand an accommodation space for the locking element arranged between the support surfaces. This results in that a complete decoupling from the first and second force transmission

elements in the locking position of the locking element is impossible; however, it also hereby ensures that the locking element may arrive relatively quickly and without an additional actuating device, analogous to automatically or autonomously, back from the locking position into the release position.

[0023] In another advantageous embodiment of the clutch device according to the invention, the previously mentioned support surfaces, specifically the first support surface on the second force transmission element and the second support surface on the support element, each have a straight line contour. It is hereby preferred if the support surfaces, specifically the first and second support surfaces, are inclined toward one another at an angle between 1° and 20° inclusively, preferably between 5° or 10° inclusively and 18° or 12° inclusively, to enable a rapid return of the locking element from the locking position into the release position, and to guarantee a substantial decoupling from the first and second force transmission element in the locking position of the locking element.

[0024] To reinforce the previously mentioned advantage, the first support surface on the second force transmission element defines an angle with the movement direction which is less than 90°. It is hereby additionally preferred, if the indicated angle is less than 80° or 75°. In this context, it has further proven advantageous if the indicated angle is greater than 50°

[0025] In another preferred embodiment of the clutch device according to the invention, a third support surface is provided on the first force transmission element, on which third support surface the locking element is supportable in the release position, and a fourth support surface is provided, on which the locking element is supported or is supportable in the locking position. The fourth support surface thereby defines an angle with the movement direction

which is less than 90°, preferably less than 45°, particularly preferably greater than 30°. It has also proven hereby advantageous, if the fourth support surface has a straight-line contour.

[0026] Basically, the previously mentioned third support surface may be arranged at an angle of 90° to the movement direction; in another advantageous embodiment of the clutch device according to the invention, however, the third support surface defines an angle with the movement direction which is less than 90° to support the transfer of the locking element from the release position into the locking position.

[0027] In another advantageous embodiment of the clutch device according to the invention, the third support surface defines an angle with the movement direction which is greater than the angle, which is the angle defined by the fourth support surface with the movement direction, so that in this case, a two-stage support of the locking element is analogously carried out. Here, as well as previously and subsequently, the third support surface likewise preferably has a substantially straight-line contour.

[0028] The angles indicated hereby between the respective support surface and the movement directions, are preferably each those angles, which are defined between the respective support surface and the movement direction or the axis of rotation of the clutch device on the side of the respective support surface facing the locking element.

[0029] In another advantageous embodiment of the clutch device according to the invention, the support element is designed as one piece with the main hub for radial support of the clutch device. By this means, the number of parts may be reduced, by which means the manufacturing is simplified.

[0030] Alternatively to the previously described embodiments of the clutch device, the support element in

another preferred embodiment of the clutch device according to the invention is designed as a separate component which is fixed on the main hub for radial support of the clutch device. By this means, a more exact manufacturing of the support element, if necessary, with the previously mentioned second support surface, is possible. In this embodiment, it is preferred if the support element is mounted rotatably fixed and/or detachably on the main hub for radial support of the clutch device. In this embodiment, it is additionally preferred if the separate component is designed as sleeve or tube shaped, and/or plugged or pushed onto the main hub to simplify the manufacturing.

[0031] The invention is subsequently described in greater detail by means of exemplary embodiments with reference to the attached figures.

Figure 1 shows a partial side view of a first embodiment of the clutch device according to the invention in a sectional representation with the actuating device in the open position.

Figure 2 shows the clutch device from Figure 1 with the actuating device in the closed position,

Figure 3 shows a partial side view of a second embodiment of the clutch device according to the invention in a sectional representation with the actuating device in the open position,

Figure 4 shows the clutch device from Figure 3 with the actuating device in the closed position,

Figure 5 shows a partial side view of a third embodiment of the clutch device according to the invention in a sectional representation with the actuating device in the open position,

Figure 6 shows the clutch device from Figure 5 with the actuating device in the closed position,

Figure 7 shows a partial side view of a fourth embodiment of the clutch device according to the invention with the actuating device in the open position,

Figure 8 shows the clutch device from Figure 7 with the actuating device in the closed position,

Figure 9 shows an embodiment of the spring characteristic curve of the spring device from Figures 3 through 8.

[0032] Figures 1 and 2 show a first embodiment of a clutch device 2, wherein the diametrically opposite axial directions 4, 6, the diametrically opposite radial directions 8, 10, and the diametrically opposite circumferential directions 12, 14 of clutch device 2 are indicated by way of corresponding arrows. In addition, the axis of rotation 16 of clutch device 2 is indicated.

[0033] Clutch device 2 has at least one clutch 18 which is designed as a disk clutch with a disk pack 20. In addition, clutch 18 is designed as a wet-running clutch 18 or disk clutch. Clutch 18 has an input or output side 22 in the form of an inner disk carrier 24 and an output or input side 26 in the form of outer disk carrier 28, wherein disk pack 20 is arranged in radial direction 8, 10 between inner disk carrier 24 and outer disk carrier 28. Outer disk carrier 28 has a substantially tubular disk carrier section 30 extending in axial direction 4, 6 and a radial section 32 extending inward substantially in radial direction 10 and connecting to disk carrier section 30 in axial direction 6. Radial section 32 extends inward in radial direction 10 up to a substantially tubular main hub 34, which in turn extends, starting from radial section 32 in axial direction 4 and functions to

support clutch device 2 in radial direction 8, 10, as this is indicated in Figure 1 at least schematically by way of bearing 36. A radial section 38 connects in turn to main hub 34 in axial direction 4, wherein radial section 38 leads inward in radial direction 10 to an input or output hub 40. Consequently, disk carrier 30, radial section 32, and main hub 34 analogously form a housing of clutch device 2, wherein radial section 32, which is designed in this case, for example, as one piece with main hub 34, and radial section 38, which in this case is likewise designed, for example, as one piece with main hub 34, are in rotary driving connection with main hub 34.

[0034] A hydraulic actuating device 42 is assigned to clutch 18, which in the embodiment shown is a normally open clutch, for actuating the same. Thus, actuating device 42 may be transferred from an open position, in which clutch 18 is open and which is shown in Figure 1, into a closed position, in which clutch 18 is closed and which is shown in Figure 2, wherein subsequently the structure of actuating device 42 will be initially explained in greater detail.

[0035] Actuating device 42 has a hydraulically drivable actuating piston 44, which is moveable or displaceable in axial directions 4, 6, for which reason axial directions 4, 6 are also designated as movement directions 4, 6 of actuating device 42. A pressure chamber 46, at which a hydraulic pressure may be applied, is assigned to actuating piston 44 and is delimited on the one side by a side 48 of actuating piston 44, here substantially in axial direction 4. On the other side, pressure chamber 46 is delimited outward in radial direction 8 by a section of disk carrier section 30, in axial direction 6 by radial section 32, and inward in radial direction 10 by main hub 34. In addition, a pressure compensation chamber 50 is assigned to actuating piston 44 and is delimited substantially by the side 52 of actuating piston 44 facing away from side 48. In addition, pressure compensation chamber 50 is delimited in axial direction 4 by a

separator 54 fixed on main hub 34 in axial direction 4. As is clear from Figure 1, pressure compensation chamber 50 has an overflow opening 56 in the region of the connection of separator 54 to main hub 34 in order to achieve, for example, a hydraulic oil column of a specific height within the pressure compensation chamber 50.

[0036] In addition, actuating device 42 has a first force transmission element 58, a second force transmission element 60, and at least one locking element 62 lying therebetween. First force transmission element 58 interacts with actuating piston 44 in such a way that a displacement of actuating piston 44 in axial directions 4, 6, at least, however, in axial direction 4, effects a displacement of first force transmission element 58 in the indicated directions. In the embodiment shown, first force transmission element 58 is designed as one piece with actuating piston 44, wherein first force transmission element 58 connects to actuating piston 44 inwardly in radial direction 10 and extends in axial direction 4. In the embodiment shown, it may also be stated that actuating piston 44 equally forms first force transmission element 58. Alternatively, first force transmission element 58 might also be designed as a separate component which was mounted on actuating piston 44 or which only interacts with actuating piston 44 without being mounted thereon. Second force transmission element 60 is arranged at least partially within pressure compensation chamber 50 and extends in radial direction 10 starting from an inner section, which interacts with locking element 62, substantially outward in radial directly 8, in order to emerge from pressure compensation chamber 50 between separator 54 and actuating piston 44 such that second force transmission element 60 may act on disk pack 20 of clutch 18. Locking element 62 is moveable from a release position, shown in Figure 1, into a locking position, shown in Figure 2, in which locking position, actuating device 42 is lockable or is locked at least partially in a positive locking way in the closed position or the open position, in this case, in the closed position. Actuating device 42 is hereby

automatically lockable by transferring actuating device 42 into the closed position or open position – in this case into the closed position, wherein the exact operation will be explained again later in more detail. In the embodiment shown, locking element 62 may be designed by a sphere, wherein then preferably multiple spherical locking elements 62 are provided spaced apart from one another in circumferential direction 12, 14. Alternatively, locking element 62 may be designed as a ring, the elongated ring body of which extends in circumferential direction 12, 14 around the axis of rotation, wherein the ring body may have a circular cross section. The diameter of the ring is thereby preferably changeable, if necessary, elastically changeable. The ring may thereby be designed as a closed and elastically deformable ring. It may, however, also be advantageous if the ring has a separation or a gap between two end sections, directed in circumferential direction 12 or 14, of the elongated ring body forming the ring, in order to enable an expansion and/or compression of the ring in radial direction 8, 10. Thus, the ring may, for example, be designed as a slit ring.

[0037] Clutch device 2 additionally has a support element 64, toward which first force transmission element 58, second force transmission element 60, and the at least one locking element 62 are relatively moveable in axial directions 4, 6. In the embodiment shown, support element 64 is designed as one piece with main hub 34 which is designed as substantially tubular. In the side of support element 64 pointing outward in radial direction 8, at least one depression 66 is designed which consequently is set back with respect to a support side 68 of support element 64 pointing outward in radial direction 8 or main hub 34. Locking element 62 is accommodatable in depression 66, wherein such a depression 66 may be assigned to each of locking elements 62; it is, however, likewise possible to provide a peripheral depression 66 in circumferential direction 12, 14 in which all locking elements 62 area accommodatable in the locking position of locking element 62 (Figure 2). A peripheral depression 66 in circumferential

direction 12, 14 is also preferred if a single locking element 62 is provided in the form of the ring described above. In addition to support side 68, on which locking element 62 is inwardly supportable in radial direction 10 if locking element 62 is located in the release position thereof (Figure 1), additional support surfaces are assigned to locking element 62. Thus, second force transmission element 60 has a first support surface 70, support element 64 has a second support surface 72, which likewise represents a lateral delimitation of depression 66, and first force transmission element 58 has a third support surface 74 and a fourth support surface 76. The indicated support surfaces 70, 72, 74, 76 may be provided selectively per locking element 62 or may each be designed as peripheral support surfaces 70, 72, 74, or 76 in circumferential direction 12, 14, in particular, if only a single locking element 62 is provided in the form of a ring. It has also proven advantageous, if support surfaces 70, 72, 74, 76 - as is clear in the cross-sectional view of Figures 1 and 2 - have a straight-line contour or a straight course.

[0038] First support surface 70 is designed in such a way that locking element 62 is supported or is supportable in the locking position thereof on first support surface 70 according to Figure 2, wherein first support surface 70 may be further designed in such a way that locking device 62 is, according to Figure 1, already supported or is supportable in the release position thereof on first support surface 70 of second force transmission element 60. Second support surface 72 is, in contrast, arranged or designed on support element 64 in such a way that, according to Figure 2, locking element is supported or is supportable in the locking position thereof on second support surface 72. First support surface 70 and second support surface 72 are, however, not arranged parallel to one another, instead, these are inclined toward one another in the direction of the release position of locking element 62 to expand an accommodation space 78 for locking element 62 in the locking position thereof (Figure 2) arranged between support surfaces 70, 72. This is indicated in the figures by means of

angle α, which clarifies the inclined position of first and second support surfaces 70, 72 relative to one another. It is hereby preferred if angle α is between 1° and 20° inclusively, particularly preferably between 5° or 10° inclusively and 18° or 12° inclusively. Basically, first support surface 70 may thereby define a right angle with the movement direction, in this case axial directions 4, 6. As is clear from Figures 1 and 2, it is, however preferred, if first support surface defines an angle β with axial directions 4, 6 or axis of rotation 16 which is less than 90° to guarantee the guiding of locking elements 62 and the secure arrangement thereof within clutch device 2. In this context, an angle β has proven advantageous which is less than 80°, preferably less than 75°, and particularly preferably not greater than 50°.

[0039] Locking element 62 is supported or is supportable in the release position on third support surface 74 on first force transmission 58 according to Figure 1, while locking element 62 is supported or is supportable in the locking position on fourth support surface 76 on first force transmission element 62 according to Figure 2. Basically, third support surface 74 might define a right angle with the movement direction of actuating device 42, in this case axial directions 4, 6 or axis of rotation 16; it is, however, preferred, deviating from the representation in Figures 1 and 2, if the angle γ defined by third support surface 74 with the movement direction is less than 90°, as this is indicated in the figures. The angle δ, defined by fourth support surface 76 with the movement direction, in this case axial directions 4, 6 or axis of rotation 16, is also less than 90°, wherein it has hereby proven to be advantageous if angle δ is less than 45°, particularly preferably, however, greater than 30°. In addition, it has proven advantageous if angle γ, which is defined between third support surface 74 and the movement direction, is greater than angle δ, which is defined between fourth support surface 76 and the movement direction.

[0040] Subsequently, the operation of clutch device 2 is described during the transfer of actuating device 42 from the open position according to Figure 1 into the closed position according to Figure 2, and vice versa, with reference to Figures 1 and 2.

[0041] In the open position of actuating device 42 according to Figure 1, clutch 18 is open, thus disk pack 20 of clutch 18 is not compressed and inner disk carrier 24 is substantially decoupled from rotary driving connection with outer disk carrier 28. To close clutch 18, the hydraulic pressure is increased within pressure chamber 46 to displace actuating piston 44 in axial direction 4. Locking element 62 is thereby supported in axial direction 6 on third support surface 74 of first force transmission element 58 interacting with actuating piston 44, inward in radial direction 10 on support side 68 of support element 64, and in axial direction 4 on second force transmission element 60, in this case already on first support surface 70 of second force transmission element 60, such that, in the release position of locking element 62 shown in Figure 1, force transmission elements 58, 60 are supported or are supportable on one another in axial directions 4, 6 via locking element 62, and second force transmission element 60, together with actuating piston 44, is displaced in axial direction 4 against disk pack 20 of clutch 18 to compress the disk pack and to close clutch 19, as this is shown in Figure 2, which shows actuating device 42 in the closed position. Due to the described movement of actuating piston 44 and of first force transmission element 58 interacting therewith, locking element 62 is moved by the actuating force applied from actuating device 42 or actuating piston 44 from the release position according to Figure 1 into the locking position according to Figure 2. Locking element 62 is thereby pushed from the release position into the locking position thereof within depression 66 in support element 64. In this locking position according to Figure 2, locking element 62 is thus located in the previously described accommodation space 78 between first support surface 70 of

second force transmission element 60 and second support surface 72 on support element 64. The displacement of second force transmission element 60 is carried out counter to the reset force of at least one spring arrangement 80, via which second force transmission element 60 is elastically supported or is supportable on the previously mentioned separator 54 in axial direction 4.

[0042] In the locking position of locking element 62 shown in Figure 2, locking element 62 is supported or is supportable in axial direction 4 on first support surface 70 of second force transmission element 60 and in diametrically opposite axial direction 6 on both second support surface 72 of support element 64 and also on fourth support surface 76 of first force transmission element 58. Consequently, second force transmission element 60 is supported in axial direction 6 both on support element 64 and also on first force transmission element 58 via locking element 62 such that first and second force transmission elements 58, 60 are at least partially decoupled from one another in axial direction 6, particularly as a part of the reset force of spring arrangement 80, which acts in axial direction 6 on second force transmission element 60, is supported or is supportable on support element 64, and an additional part of the reset force is supported or is supportable on first force transmission element 58.

[0043] If first and second support surfaces 70, 72 were arranged parallel to one another, a complete decoupling of force transmission elements 58, 60 from one another would result. As support surfaces 70, 72 are, however, inclined toward one another in the direction of the release position of locking element 62 to expand accommodation space 78 arranged between support surfaces 70, 72, as this is indicated by way of angle α, the reset force of spring arrangement 80 effects a pushing back of locking element 62 outward in radial direction 8 and in axial direction 6 into the release position outside of depression 66. For this reason, the hydraulic pressure within pressure chamber 46 may indeed be reduced after

reaching the closed position or after closing clutch 18, this pressure is, however, to be maintained up to a certain level to ensure that locking element 62 is held in the locking position thereof via first force transmission element 58 and actuating piston 44 connected thereto.

[0044] During a subsequent opening of clutch 18, actuating device 42 merely has to be transferred back into the open position according to Figure 1. For this purpose, the hydraulic pressure within pressure chamber 46 is reduced in such a way that actuating piston 44 is moved back in axial direction 6 together with first force transmission element 58. Subsequently, first force transmission element 58 releases locking element 62 insofar as the reset force of spring arrangement 80, in connection with support surfaces 70, 72 inclined toward one another, effects a pushing of locking element 62 outward in radial direction 8 and out of depression 66 in axial direction 6. If locking element 62 is pushed out of depression 66 on support element 64, such that the locking element is no longer supported on second support surface 72 of support element 64, then the reset force of spring arrangement 80 effects a further displacement of second force transmission 60 in axial direction 6, wherein locking element 62 is thereby supported again in the way already previously described on first force transmission element 58, second force transmission element 60, and support element 64.

[0045] A second embodiment of clutch device 2 will be subsequently described with reference to Figures 3 and 4, which substantially corresponds to the first embodiment according to Figures 1 and 2, such that only the differences will be introduced; identical reference numerals are used for identical or similar parts and the preceding description correspondingly generally applies.

[0046] In the second embodiment according to Figures 3 and 4, second force transmission element 60 is formed at least in two parts from a first transmission section 82 and a second

transmission section 84. The two transmission sections 82, 84 are thereby moveable within certain limits relative to one another in the movement directions, in this case axial directions 4, 6. First transmission section 82 has first support surface 70, already previously described, on which locking element 62 is supported or is supportable in the locking position thereof (Figure 4), if necessary, also in the release position thereof (Figure 3), such that second force transmission element 60 is supported or is supportable via the first transmission section 82 thereof in the movement direction on support element 64 in the locking position of locking element 62 via locking element 62, as this has already been previously described. Second transmission section 84 is, in contrast, supported or is supportable on separator 54 in axial direction 4 via spring arrangement 40 in the way already previously described.

[0047] The two transmission sections 82, 84 of second force transmission element 60 are elastically supported or supportable on one another in the movement direction, in this case, axial directions 4, 6, wherein a spring device 86 is provided for this purpose. Spring device 86 has at least one spring element 88 or multiple spring elements 88. Spring element 88 is preferably a plate spring, if multiple spring elements 88 are to be provided, then these are preferably multiple plate springs, which interact particularly preferably as a plate spring stack. First transmission section 82 is pretensioned relative to second transmission section 84 by spring device 86, at least in the open position of actuating device 42, shown in Figure 3, in an initial position in axial direction 4, 6. In this embodiment, first transmission section 82 is supported or is supportable on second transmission section 84 in axial direction 6, wherein this is effected in the embodiment shown by means of a retaining ring 90, such that it may also be stated that there is an indirect support of first transmission section 82 on second transmission section 84. It is also mentioned at this point, that in this initial position according to Figure 3, second transmission

section 84 is also supported or is supportable on first transmission section 82 in axial direction 4 by means of retaining ring 90. It is additionally mentioned, that first transmission section 82, deviating from Figures 3 and 4, may also be supported in the initial position directly on second force transmission section 84 and vice versa. Previously mentioned spring device 86 is arranged on the side of second force transmission element 60 facing away from spring arrangement 80 in axial direction 6 in order to function between first and second transmission sections 82, 84 and to achieve a compact structure, in particular, if spring arrangement 80 has one or more helical springs, as this is the case in the embodiment according to Figures 3 and 4.

[0048] As a further difference between the first embodiment according to Figures 1 and 2, it should be stated that in the first embodiment, a radially outward load application section 92 of second force transmission element 60 is available to apply a load on disk pack 20 with a rotary driving connection to outer disk carrier 28, more precisely stated, to disk carrier section 30 of outer disk carrier 28, which is effected in the first embodiment, for example, via a rotary driving contour 94 on load application section 92, said contour being operatively connected to disk carrier section 30. In contrast, with respect to the load application section 92 on second force transmission element 60, stated more precisely, on second transmission section 84 thereof, the embodiment according to Figures 3 and 4 omits such a rotary driving contour 94 and the connection thereof to outer disk carrier 28 or disk carrier section 30. In the embodiment according to Figures 1 and 2, a spring element 96 is also arranged between load application section 92 and disk pack 20, which is omitted in the embodiment according to Figures 3 and 4. Reference should be made to the fact that in the first embodiment according to Figures 1 and 2, additional spring element 96 and/or rotary driving contour 94 may also be omitted analogous to the embodiment according to Figures 3 and 4. In addition, in the embodiment according to Figures 3 and 4, a

corresponding rotary driving contour 94 and/or a corresponding spring element 96 might be provided according to the embodiment of Figures 1 and 2.

[0049] With respect for the operation of clutch 2 through actuation by the actuating device 42, reference is made to the previously described operation, with reference to Figures 1 and 2, wherein the following is supplemental. As already previously mentioned, clutch 18 is closed with actuating device 42 in the closed position according to Figure 4, wherein locking device 62 is located in the locking position thereof within depression 66 of support element 64. Also, in the closed position of actuating device 42, first transmission section 82 may already be displaced relative to second transmission section 84 in axial direction 4 from the initial position of the first transmission section due to compression of spring device 86 according to Figure 3.

[0050] A third embodiment of clutch device 2 will be subsequently described with reference to Figures 5 and 6, which substantially corresponds to the embodiment according to Figures 3 and 4, such that only the differences will be introduced; identical reference numerals are used for identical or similar parts and the preceding description correspondingly generally applies.

[0051] In clutch device 2 according to Figures 5 and 6, previously mentioned actuating piston 44 is formed in at least two parts from a first piston section 98 and a second piston section 100, which are displaceable or moveable relative to one another in the movement direction, in this case axial directions 4, 6. In the embodiment shown, first piston section 98 is designed as radially inward first piston section 98, while second piston section 100 is designed as radially outward second piston section 100, wherein the two piston sections 98, 100 are arranged in a nested configuration in radial direction 8, 10. Consequently, piston sections 98, 100 jointly form the previously mentioned side 48 facing pressure

chamber 46 and jointly form side 52 of actuating piston 44 facing pressure compensation chamber 50. To hereby ensure the sealing of the two-part actuating piston 44, a corresponding seal 102 is arranged between first piston section 98 and second piston section 100, in this case in radial direction 8, 10 between piston sections 98, 100, and peripherally in circumferential direction 12, 14. First piston section 98 interacts in turn with first force transmission element 58, wherein first piston section 98 in the embodiment shown is designed for this purpose as one piece with first force transmission element 58. Alternatively, however, it is also possible that first force transmission element 58 is initially designed separately from first piston section 98 in order to mount first force transmission element 58 on first piston section 98, for example, by means of a detachable connection, or first force transmission element 58 is able to interact with piston section 98 without mounting.

[0052] In contrast, second piston section 100 interacts with the previously mentioned second force transmission element 60, wherein second piston section 100 in the present embodiment is designed for this purpose as one piece with second force transmission element 60, in this case, second transmission section 84 of second force transmission element 60. In this case, it is, however, alternatively also possible that second force transmission element 60 or second transmission section 84 thereof is initially designed separately from second piston section 10 in order to subsequently mount second force transmission element 60 or second transmission section 84 thereof on second piston section 100.

[0053] As a further difference with respect to the embodiment according to Figures 3 and 4, it should be stated that spring device 86, which in this case is formed from a plate spring stack, is arranged together with spring arrangement 80 on the side of second force transmission element 60 facing pressure compensation chamber 50. Spring

arrangement 80 according to the embodiment according to Figures 5 and 6 is not formed from one or multiple helical springs, but instead from at least one plate spring. Furthermore, support element 64 in the embodiment according to Figures 5 and 6 is not designed as one piece with main hub 34 of clutch device 2, but instead as a separate component which is mounted rotatably fixed and/or detachably on main hub 34 for radial support of clutch device 2. For this purpose, support element 64 is designed substantially designed as sleeve or tube shaped, and is plugged or pushed onto main hub 34 in axial direction 4, 6, in this case, in axial direction 6. The rotationally fixed connection to main hub 34 may be hereby carried out, for example, via a press fitting and/or an insertion toothing 104. The connection designated as insertion toothing 104 in Figures 5 and 6 may, however, also be designed as a threaded connection to enable a screwing of support element 64 onto main hub 34.

[0054] The previously described operation applies correspondingly for clutch device 2 according to Figures 5 and 6, wherein the following is supplemental. Due to the increase of the hydraulic pressure in pressure chamber 46, the actuating force is applied directly to second transmission section 84 of second force transmission element, formed in this case as one piece with second piston section 100, in order to press second transmission section 84 with load application section 92 thereof against disk pack 20 of clutch 18. If the indicated load application section 92 compresses disk pack 20, then the pressure within pressure chamber 46 causes the previously mentioned displacement of first transmission section 82 out of the initial position thereof in the movement direction, in this case axial direction 4, relative to second transmission section 84, as this is shown in Figure 6, indeed by compressing spring device 86. By this means, the volume of pressure chamber 46 is expanded.

[0055] Figures 7 and 8 show a further embodiment of clutch device 2, which substantially corresponds to the embodiment

according to Figures 5 and 6, such that only the differences will be introduced; identical reference numerals are used for identical or similar parts and the preceding description correspondingly generally applies.

[0056] In contrast to the embodiment according to Figures 5 and 6, actuating piston 44 is no longer composed in two parts from first piston section 98 and second piston section 100, as this is already the case in the embodiments according to Figures 1 through 4. Consequently, in the embodiment according to Figures 7 and 8 there is no longer any direct operative connection between actuating piston 44 or a section thereof and second transmission section 84 of second force transmission element 60.

[0057] As already described previously, in the embodiment according to Figures 3 through 8, a spring device 86 is provided, via which first and second transmission sections 82, 84 of second force transmission element 60 are elastically supported or are supportable on one another. It is hereby preferred in the indicated embodiments if spring device 86 has an at least two stage spring characteristic curve, which, for example, is depicted in the diagram according to Figure 9, in which the course of the reset force of spring device 86 is recorded via spring path W. Thus, the at least two-stage spring characteristic curve has a first stage a and a second stage b, wherein the spring characteristic curve in second stage b has a lower increase than in first stage a. It is hereby particularly preferred if the spring characteristic curve in second stage b runs substantially horizontally, as this is indicated in Figure 9.

[0058] Referring to the embodiments according to Figures 3 through 8, it is particularly preferred if first transmission section 82, starting from the initial position thereof, is moveable relative to second transmission section 84 of second force transmission element 60 in the range of second stage b. Even if advantageous, first transmission section 82 does not

have to be, however, moveable relative to second transmission section 84 exclusively in the range of section stage b, but instead the first transmission section may basically move relative to second transmission section 84 in part also in the range of first stage a of the spring characteristic curve. In the embodiments shown according to Figures 3 through 8, spring device 86 is pretensioned by pretensioning first transmission section 82 in the initial position thereof at least into first stage a of the spring characteristic curve, as this is depicted in Figure 9 by way of pretension path c. In addition, it is preferred if spring device 86 is pretensioned at least up to the beginning of second stage b of the spring characteristic curve, as this is shown by way of pretension path d in Figure 9. In addition, it may be advantageous if spring device 86 is pretensioned not only up to the beginning of second stage b of the spring characteristic curve, but instead additionally into second stage b of the spring characteristic curve, as this is indicated by means of pretension path e in Figure 9.

[0059] In addition, all previously mentioned embodiments according to Figures 1 through 8 have the commonality that actuating piston 44, if necessary, piston sections 98, 100 thereof, is designed as a clutch device side slave piston and/or as a ring piston. Also, a seal 106 is arranged in each case between separator 54 and second force transmission element 60, if necessary between second transmission section 84 thereof, to seal pressure compensation chamber 50 outward in radial direction 8. In the embodiments according to Figures 1 through 4, a seal 108 is also arranged in each case between second force transmission element 60, if necessary, second transmission section 84 thereof, and actuating piston 44 for sealing pressure compensation chamber 50 outward in radial direction 8. In contrast, in the embodiments according to Figures 5 through 8, a seal 110 is arranged between second force transmission element 60 or second transmission section 84 thereof and outer disk carrier 28, which seal functions for sealing pressure compensation chamber 50 in the embodiment

according to Figures 7 and 8 and for sealing pressure chamber 46 in the embodiment according to Figures 5 and 6. Furthermore, window-like recesses 112 are provided in second force transmission element 60 or in second transmission section 84 thereof in the embodiments according to Figures 1 through 4 and 7 through 8, which enable the passage of a hydraulic medium, for example, hydraulic oil, and thus create a largely coherent pressure compensation chamber 50.

Reference numerals

2	Clutch device
4	Axial direction/Movement direction
6	Axial direction/Movement direction
8	Radial direction
10	Radial direction
12	Circumferential direction
14	Circumferential direction
16	Axis of rotation
18	Clutch
20	Disk pack
22	Input or output side
24	Inner disk carrier
26	Output or input side
28	Outer disk carrier
30	Disk carrier section
32	Radial section
34	Main hub
36	Bearing
38	Radial section
40	Output or input hub
42	Actuating device
44	Actuating piston
46	Pressure chamber
48	Side
50	Pressure compensation chamber
52	Side
54	Separator
56	Overflow opening
58	First force transmission element
60	Second force transmission element
62	Locking element

64	Support element
66	Depression
68	Support side
70	First support surface
72	Second support surface
74	Third support surface
76	Fourth support surface
78	Accommodation space
80	Spring arrangement
82	First transmission section
84	Second transmission section
86	Spring device
88	Spring elements
90	Retaining ring
92	Load application section
94	Rotary driving contour
96	Spring element
98	First piston section
100	Second piston section
102	Seal
104	Insertion toothing
106	Seal
108	Seal
110	Seal
112	Recess
α	Angle
β	Angle
γ	Angle
δ	Angle
a	First stage
b	Second stage
c	Pretension path
d	Pretension path

e		Pretension path
F		Reset force
W		Spring path

Claims

1. A clutch device (2) comprising at least one clutch (18), in particular a disk clutch, and an actuating device (42), in particular a hydraulic actuating device (42), for actuating the clutch (18), wherein the actuating device (42) can be transferred from an open position, in which the clutch (18) is open, into a closed position, in which the clutch (18) is closed, **characterized in that** the actuating device (42) can be locked in a positive locking way in the closed position or in the open position.

2. The clutch device (2) according to Claim 1, **characterized in that** the actuating device (42) can be automatically locked by transferring the actuating device (42) into the closed position or into the open position.

3. The clutch device (2) according to one of Claims 1 or 2, **characterized in that** at least one moveable locking element (62) is assigned to the actuating device (42) and is movable from a release position into a locking position, in which the actuating device (42) is locked, wherein the locking element (62) is preferably moveable from the release position into the locking position by an actuating force applicable or applied by the actuating device (42), and is particularly preferably formed by a sphere or a ring.

4. The clutch device (2) according to Claim 3, **characterized in that** the locking element (62) is arranged between a first force transmission element (58) and a second force transmission element (60) of the actuating device (42) which is moveable in a movement direction (4, 6),

wherein, in the release position of the locking element (62), the force transmission elements (58, 60) are preferably supported or are supportable on one another in the movement direction (4, 6) via the locking element (62) and/or are at least partially or completed decoupled from one another in the locking position of the locking element (62) relative to the movement direction (4; 6).

5. The clutch device (2) according to one of Claims 3 or 4, **characterized in that** the actuating device (42) has a hydraulically drivable actuating piston (44) with a side (48) delimiting a pressure chamber (46) and a side (52) delimiting a pressure compensation chamber (50), wherein the actuating piston (44) preferably interacts with the first force transmission element (58), is particularly preferably designed as one piece with the first force transmission element (58) or is mounted on the first force transmission element (60) and/or the second force transmission element (60) is preferably arranged at least partially within the pressure compensation chamber (50).

6. The clutch device (2) according to one of Claims 4 or 5, **characterized in that** the second force transmission element (60) is formed in at least two parts from a first transmission section (82) and a second transmission section (84), wherein the two transmission sections (82, 84) are elastically supported or supportable on one another in the movement direction (4; 6), preferably by means of a spring device (86) which has a spring element (88), particularly preferably a plate spring, or multiple spring elements (88), particularly preferably multiple plate springs.

7. The clutch device (2) according to Claim 6, **characterized in that** the first transmission section (82) is pretensioned relative to the second transmission section (84) by the spring device (86) in an initial position in which the first transmission section (82) is preferably indirectly, particularly preferably by means of a retaining ring (90), or directly supported or supportable on the second transmission section (84).

8. The clutch device (2) according to one of Claims 6 or 7, **characterized in that** the spring device (86) has at least a two-stage spring characteristic curve with a first stage (a) and a second stage (b) having a lower increase of the spring characteristic curve than in the first stage (a), wherein the spring characteristic curve runs preferably substantially horizontally in the second stage (b) and the first transmission section (82) is moveable relative to the second transmission section (84) particular preferably in the range of the second stage (b).

9. The clutch device (2) according to Claim 8, **characterized in that** the spring device (86) is pretensioned by pretensioning the first transmission section (82) in the initial position thereof at least into the first stage (a), preferably up to the start of the second stage (b), or into the second stage (b) of the spring characteristic curve.

10. The clutch device (2) according to one of Claims 5 through 9, **characterized in that** the actuating piston (44) is formed in at least two parts from a first piston section (98) and a second piston section (100) which are displaceable relative to one another in the movement

direction (4; 6), wherein the first piston section (98) preferably interacts with the first force transmission element (58), is designed as one piece with the first force transmission element (58), or is mounted on the first force transmission element (58) and/or the second piston section (100) preferably interacts with the second force transmission element (60), is designed as one piece with the second force transmission element (60), or is mounted on the second force transmission element (60).

11. The clutch device (2) according to one of Claims 3 through 10, **characterized in that** the first force transmission element (58) and the second force transmission element (60) are moveable relative to a support element (64) in the movement direction (4; 6), and in the locking position of locking element (62), the second force transmission element (60), preferably the first transmission section (82) thereof is supported or supportable on the support element (64) in the movement direction (4; 6) via the locking element (62), wherein a first support surface (70), on which the second force transmission element (60) is supported or is supportable, and a second support surface (72) on the support element (64), on which the locking element (62) is supported or is supportable in the locking position, are inclined toward one another in the direction of the release position of the locking element (62) to expand an accommodation space (78) arranged between the support surfaces (70, 72) for the locking element (62), wherein the support surfaces (70, 72) preferably have a straight line contour and are inclined toward one another particularly preferably at an angle (α) between 1° and 20° inclusively, if necessary between 5° or 10° inclusively or and 18° or 12° inclusively.

12. The clutch device (2) according to Claim 11, **characterized in that** the first support surface (70) defines an angle (β) with the movement direction (4, 6) which is less than 90°, wherein the angle (β) is preferably less than 80° or 75°, particularly preferably greater than 50°.

13. The clutch device (2) according to one of Claims 11 or 12, **characterized in that** a third support surface (74) is provided, on which the locking element (62) is supported or is supportable in the release position, and a fourth support surface (76) is provided, on which the locking element (62) is supported or is supportable in the locking position, on the first force transmission element (58), wherein the fourth support surface (76) defines an angle (δ) with the movement direction (4, 6) which is less than 90°, preferably less than 45°, particularly preferably greater than 30°, and/or the third support surface (74) defines an angle (γ) with the movement direction (4, 6) which is greater than the angle (δ), the angle defined by the fourth support surface (76) with the movement direction (4, 6) and/or is less than 90°.

14. The clutch device (2) according to one of Claims 11 through 13, **characterized in that** the support element (64) is designed as one piece with the main hub (34) for radial support of the clutch device (2), or is designed as a separate component which is mounted, if necessary rotatably fixed and/or detachably, on the main hub (34) for radial support of the clutch device (2), wherein the separate component is preferably designed as sleeve or tube shaped, and/or plugged or pushed onto the main hub (34).

Fig. 1

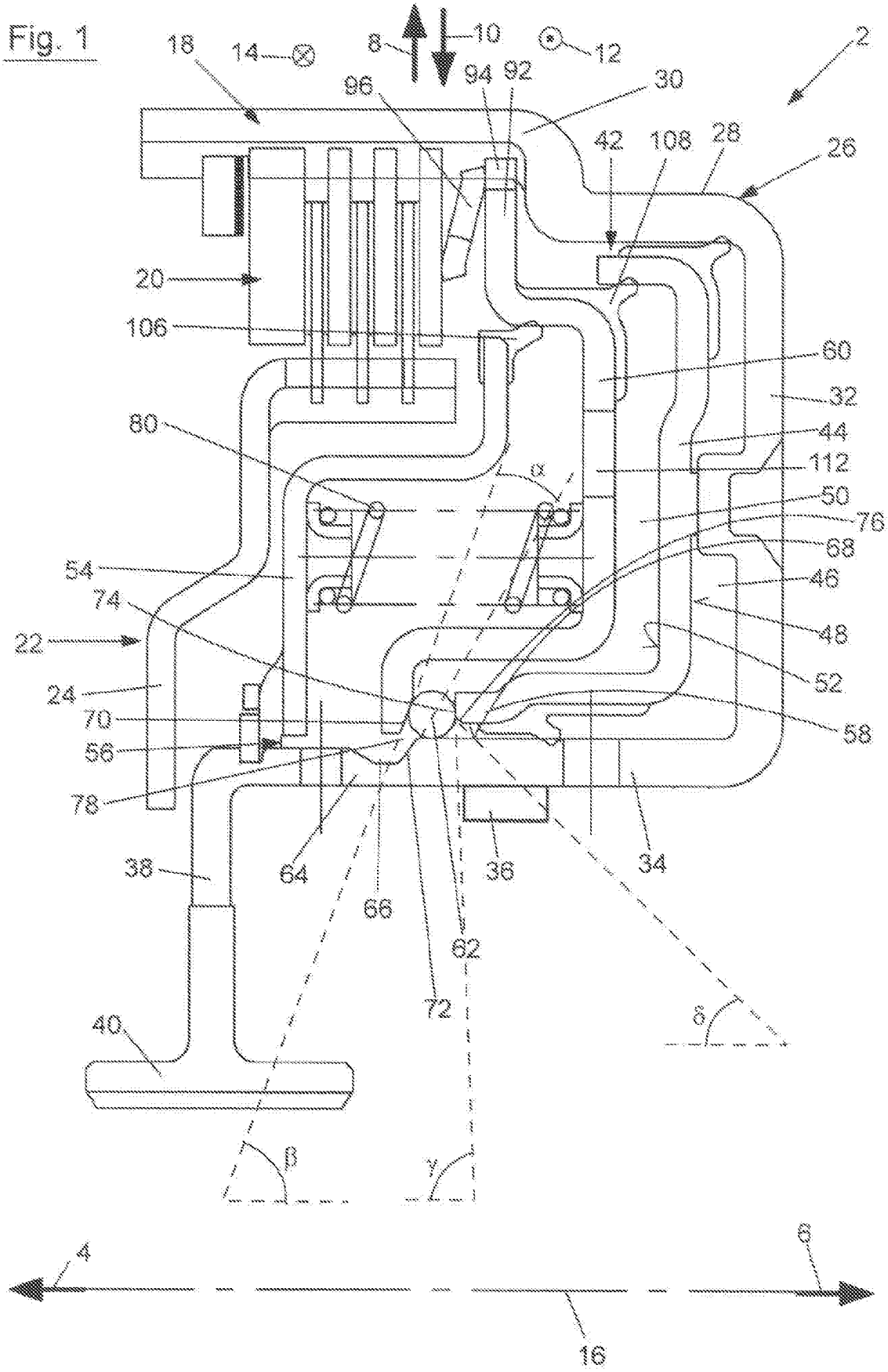
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Fig. 2

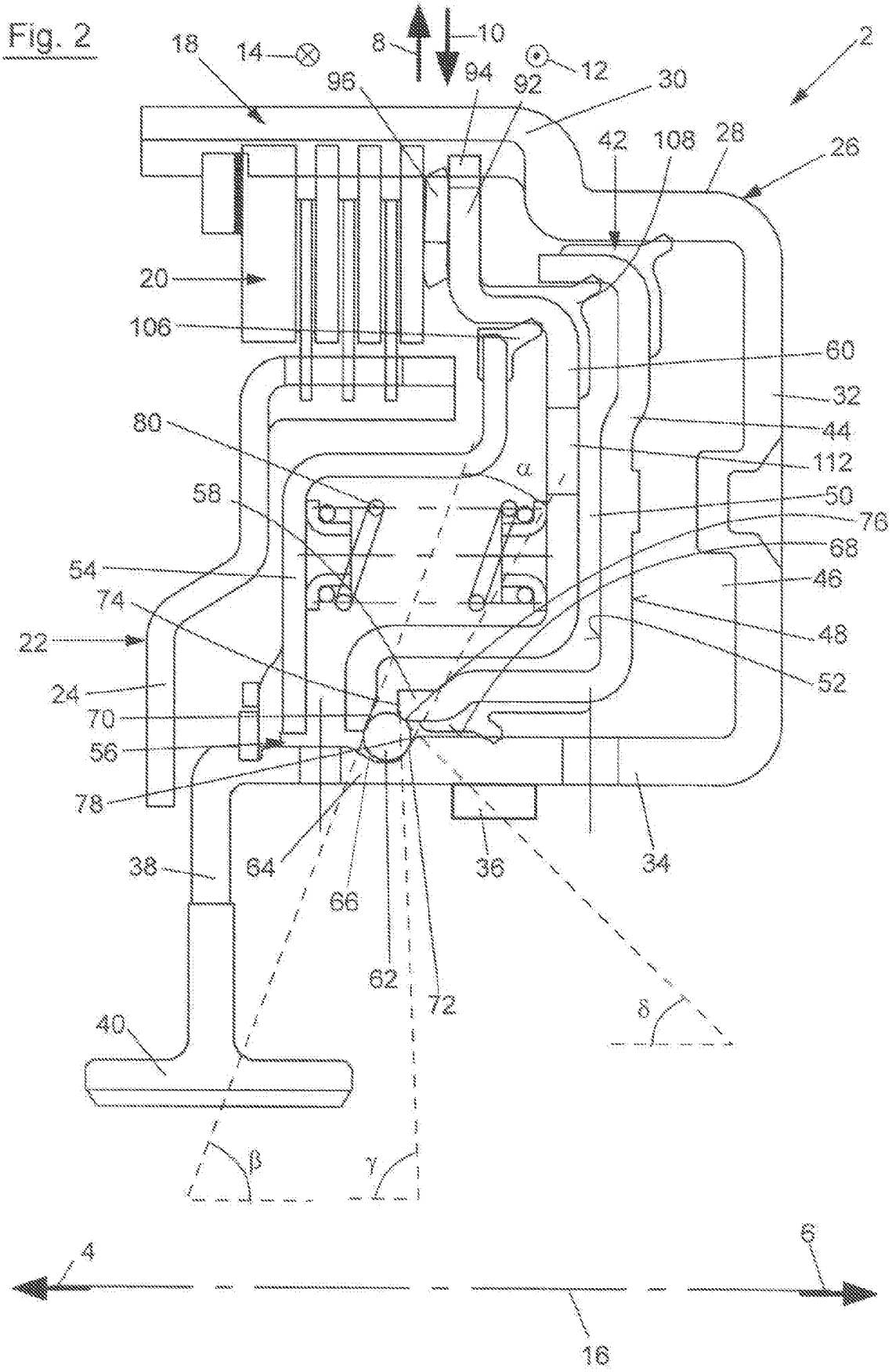
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Fig. 3

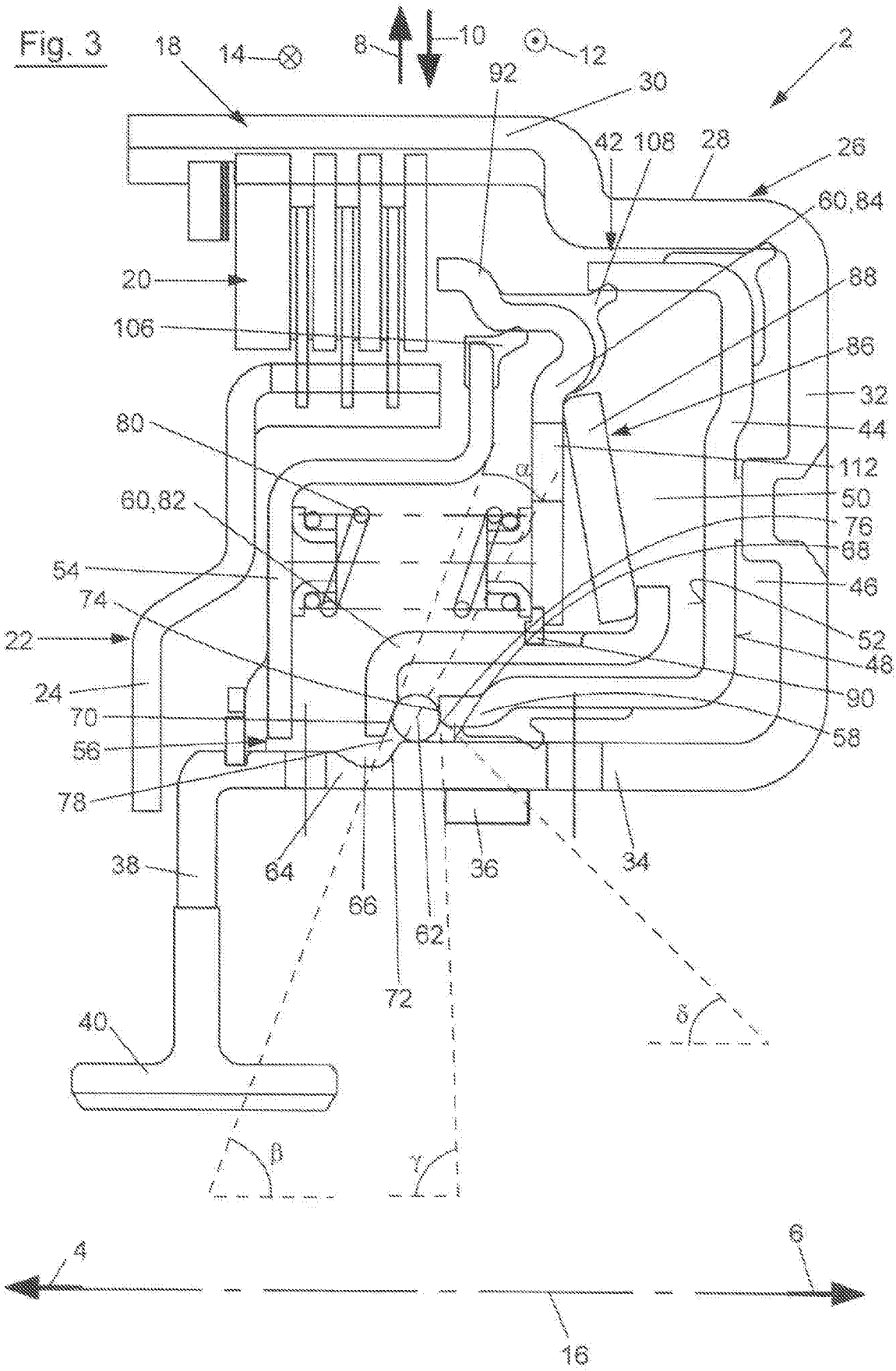
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Fig. 4

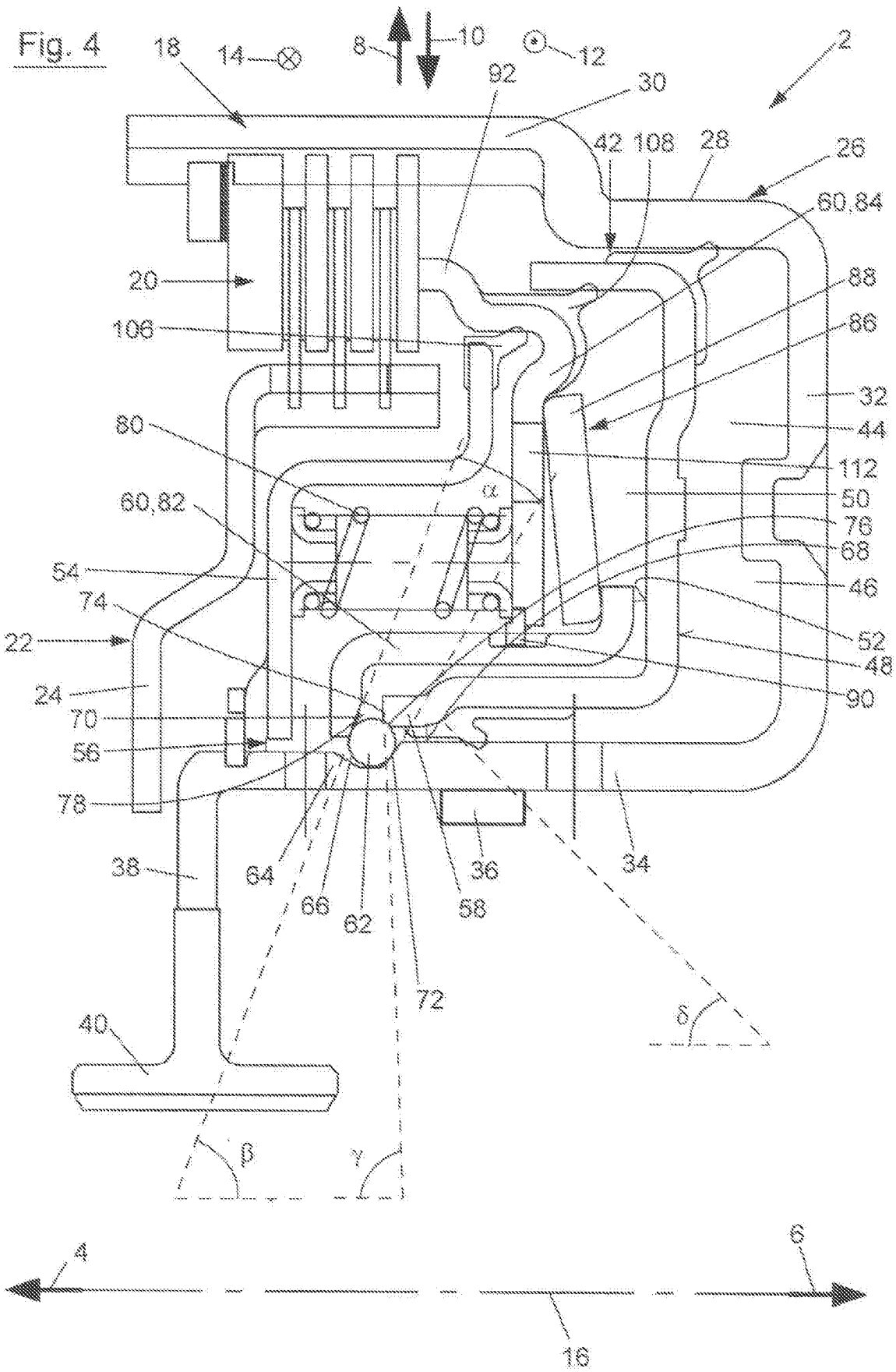
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Fig. 5

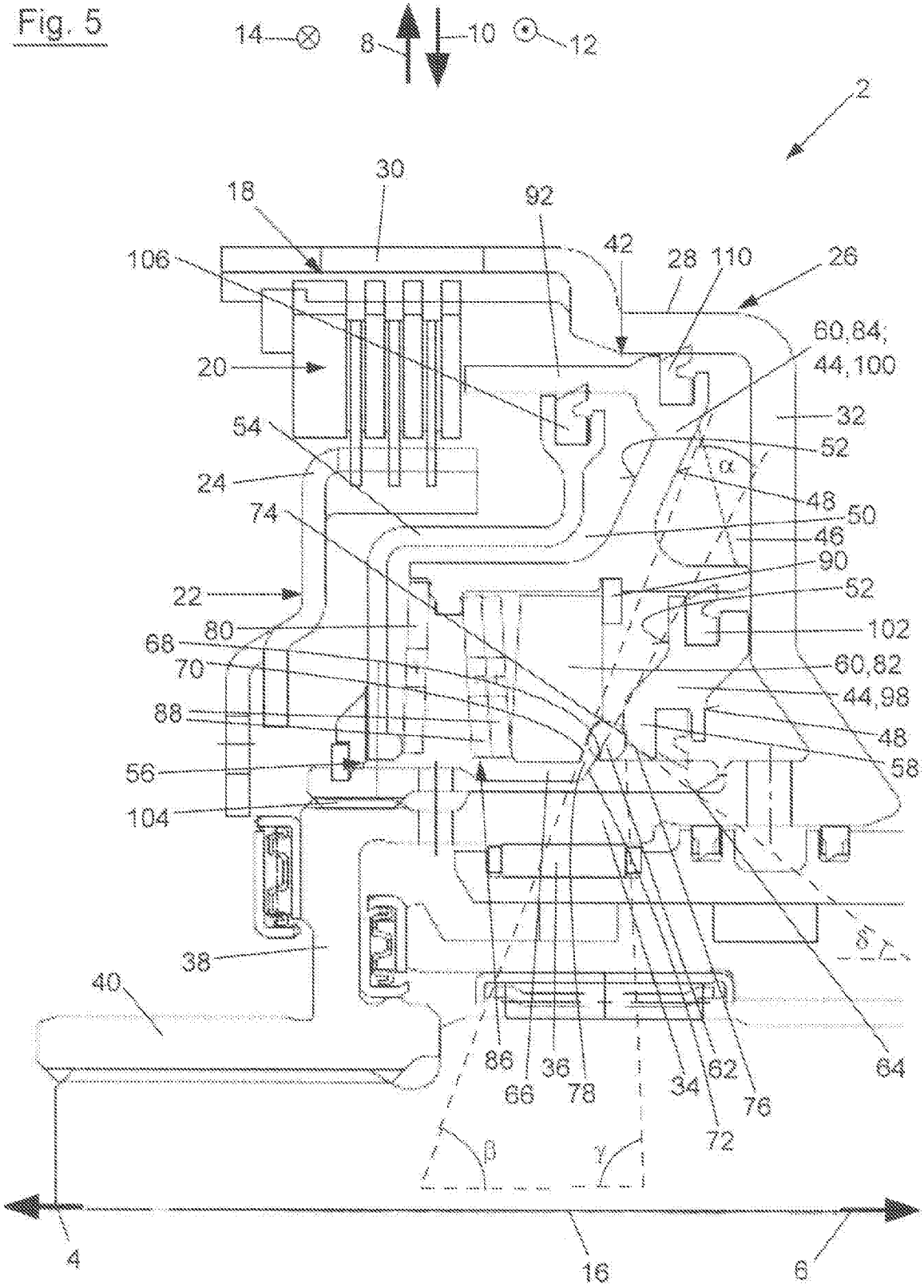
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Fig. 6

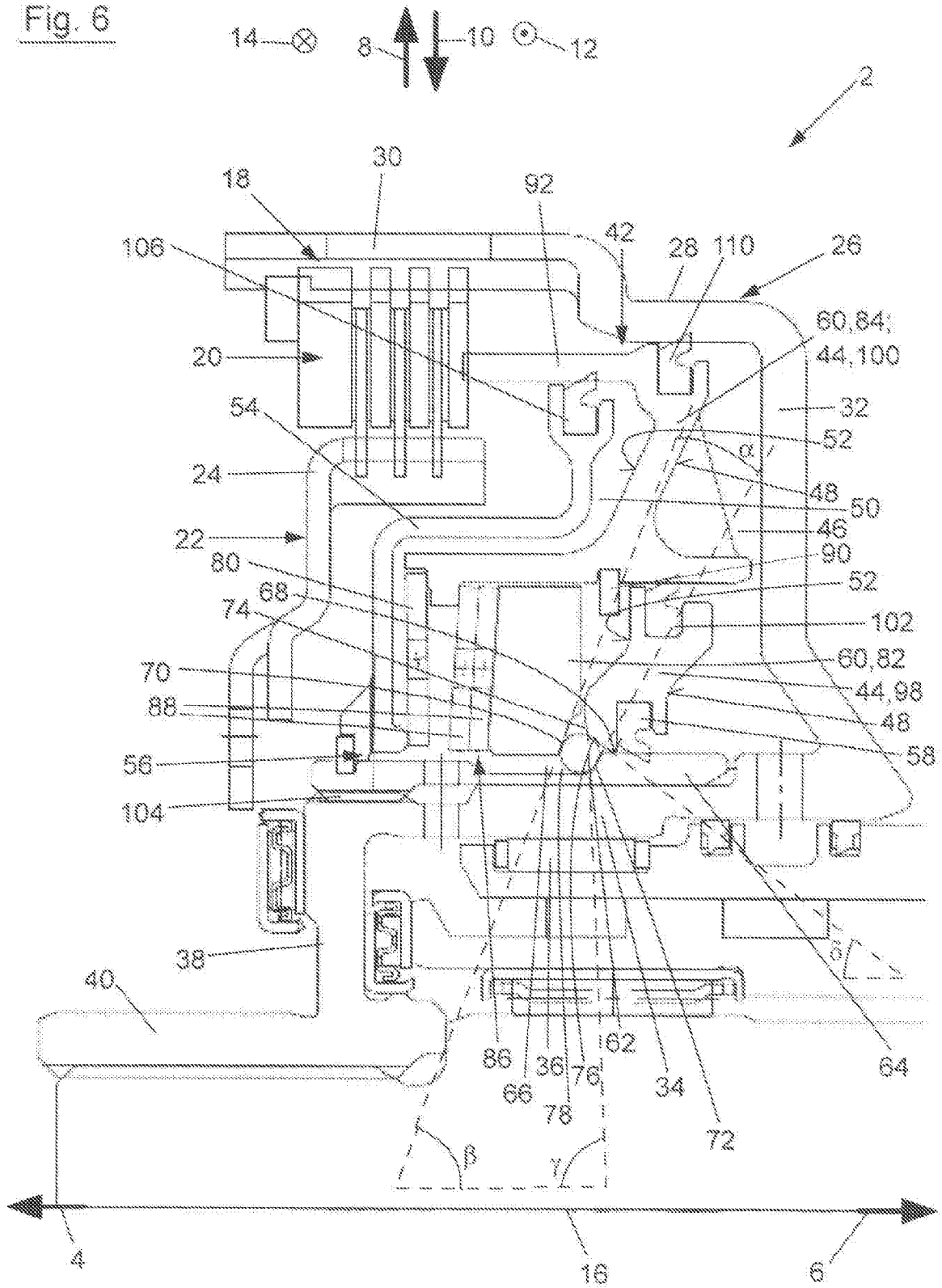
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Fig. 7

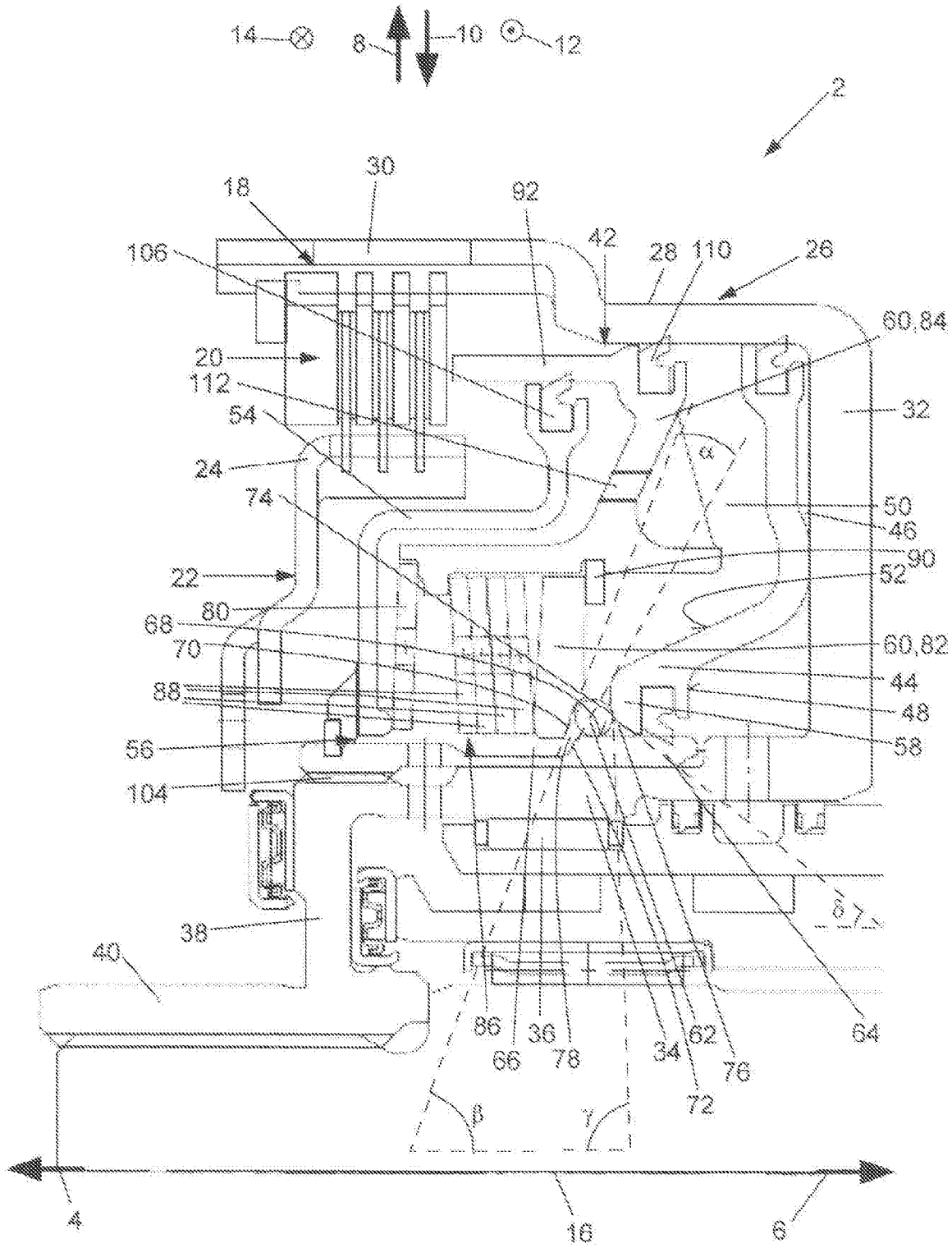
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Fig. 8

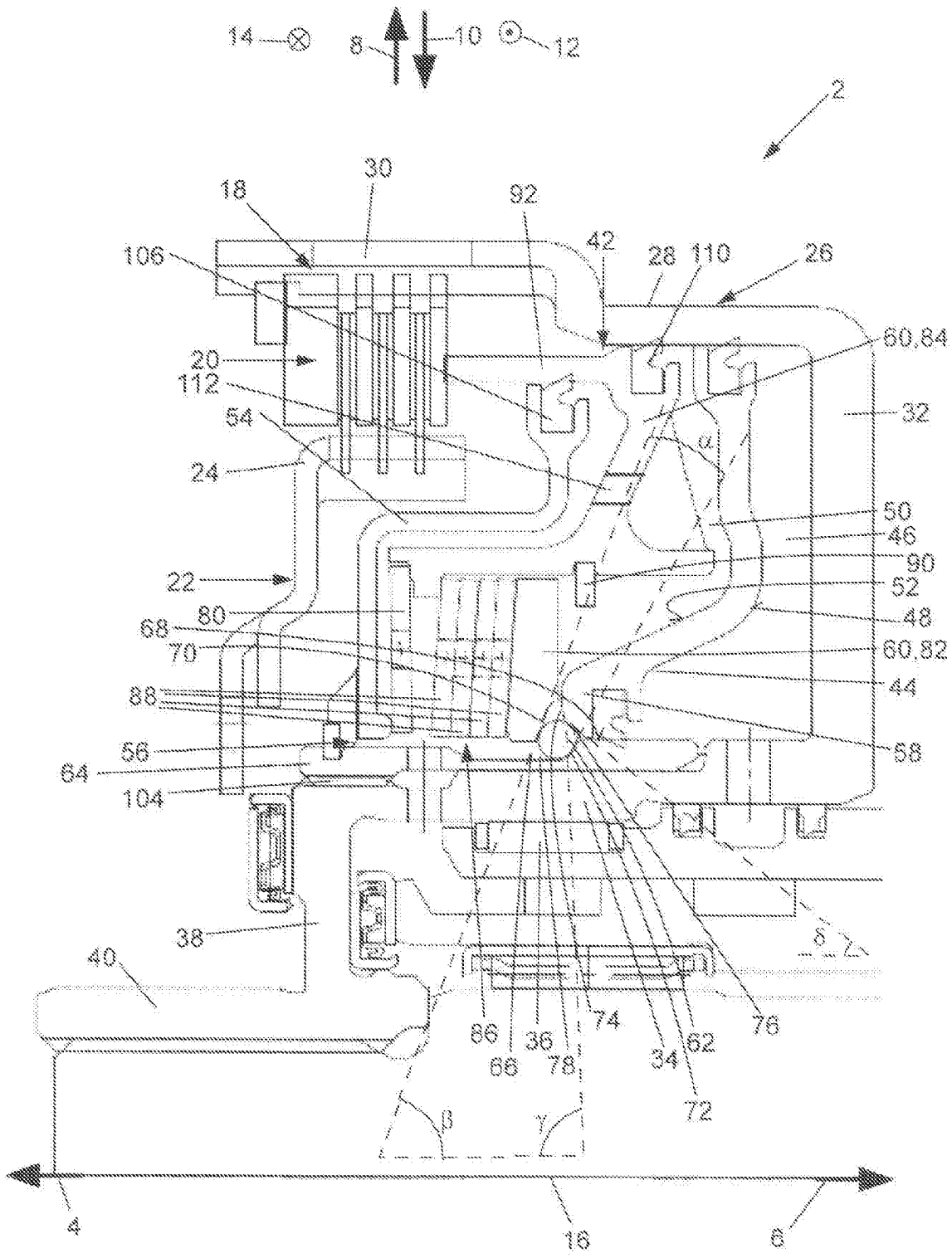
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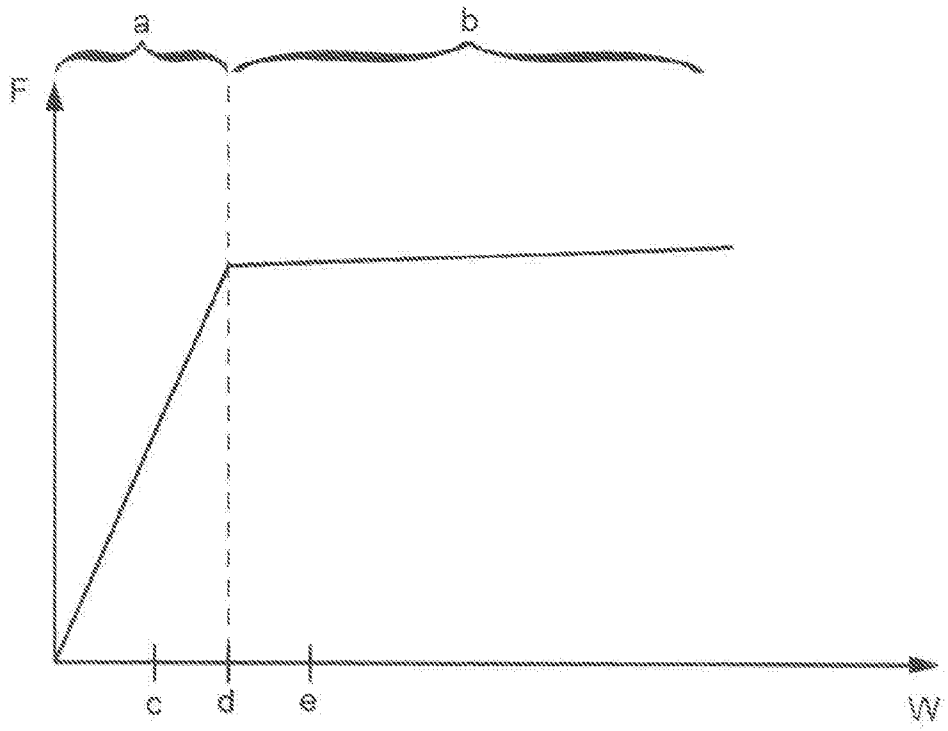
Fig. 9



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/028242

A. CLASSIFICATION OF SUBJECT MATTER

F16D 13/04(2006.01)i, F16D 25/12(2006.01)i, F16D 25/062(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F16D 13/04; F16D 15/00; F16D 13/56; F16D 25/0638; F16D 25/10; F16D 13/42; F16K 21/04; F16D 48/02; F16D 25/12; F16D 25/062

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & keywords: clutch, disk, plate, release, lock, ball, sphere, ring

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008-0314711 A1 (JAYARAM et al.) 25 December 2008 See paragraphs [0042]-[0054] and figures 2-5.	1-3
Y		4,5
A		6-14
Y	US 4550817 A (EULER, JOHN W.) 05 November 1985 See column 2, line 24 - column 3, line 30 and figures 3, 4.	4,5
A	US 2013-0075222 A1 (SCHAEFFLER TECHNOLOGIES AG & CO. KG) 28 March 2013 See paragraphs [0029]-[0062] and figures 2-12.	1-14
A	US 2004-0168878 A1 (YABE et al.) 02 September 2004 See paragraphs [0025]-[0034] and figures 1-7.	1-14
A	JP 2013-249871 A (JATCO LTD. et al.) 12 December 2013 See paragraphs [0010]-[0075] and figures 1-15.	1-14

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 July 2016 (28.07.2016)	**28 July 2016 (28.07.2016)**

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2016/028242

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