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(54) **A GIS WITH A DISCONNECTOR-EARTHING SWITCH**

GIS MIT EINEM TRENNER/ERDUNGSSCHALTER

GIS À COMMUTATEUR DE DÉCONNEXION ET RACCORDEMENT À LA TERRE

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EP 3 336 870 B1

Description

TECHNICAL FIELD

[0001] The invention relates to the field of gas-insulated switchgears (GIS). More particularly, the invention relates to a GIS having a disconnector-earthing switch (DES) which causes less dielectric field stress when disconnecting and earthing the electrical conductor in the GIS.

PRIOR ART

[0002] Switchgears are provided in high-voltage electrical power systems to enable downstream equipment to be de-energised and isolated so as to permit, for example, repair, maintenance, or installation of a new component. Gas-insulated switchgears (GIS) are generally preferred to other types of switchgears as they are capable of safely handling large currents and power levels while occupying a substantially smaller volume. Electrical conductors in the GIS are fitted inside tubular compartments filled with insulating gas, typically SF6 gas.

[0003] When work has to be conducted on the GIS, e.g. maintenance, or to facilitate testing of the GIS (e.g. dielectric testing), the power supply has to be switched off, typically with the circuit breakers being disconnected. However, an induced current or a residual charge may sometimes exist in the electrical conductors of the GIS even after the power supply has been switched off, which poses a risk of electrocution for service personnel accessing the interior of the GIS if it is not discharged beforehand. Therefore, once the circuit breakers in a GIS have been operated, disconnector-earthing switches (DES) must then be operated to disconnect and isolate the relevant section of the GIS from the busbar or cable end, and to subsequently earth it by putting it in contact with the GIS enclosure (e.g. the tubular compartments), itself connected to earth.

[0004] The DES typically comprises a disconnector piston arranged to connect to and disconnect from a disconnector contact socket provided in the GIS, and an earthing piston arranged to connect to and disconnect from an earthing contact socket provided in the GIS. Before the earthing piston of the DES can be connected to the earthing contact socket, the disconnector piston must first be disconnected. For safety reasons, it is imperative that disconnector piston and the earthing piston are never both connected to their electrical contact sockets at the same time. As such, a single actuating mechanism is often employed for operating both pistons of the DES, mechanically configured such that one piston is always disconnected from its electrical contact socket prior to the other being connected to its electrical contact socket.

[0005] US2010/0089875 A1 discloses such a DES in a three-phase GIS. In figure 1 of this prior art document, a DES is shown comprising disconnector piston and an earthing piston mechanically connected to an actuating mechanism. The actuating mechanism comprises a rotary control shaft connected to levers to operate the pistons such that when one is extended to connect to the respective electrical contact socket, the other retracts such that the pistons do not connect to their electrical contact sockets simultaneously. However, when one piston is in the process of extending or retracting, the other is in the process of retracting or extending, which could potentially cause arcing due to the proximity of both pistons to their respective electrical contacts midway during the movement. Furthermore, when one piston is in the extended position in contact with the electrical contact socket, the other is in a retracted position where it is not flush with the opening in the DES housing, i.e. the cylinder opening of the cylinder within which the piston is provided. This can cause an undesirable dielectric stress at the opening in the housing.

[0006] In figure 2 of the same document, a DES is disclosed where the disconnector piston and the earthing piston are also mechanically connected, for operation by a different actuating mechanism. The actuating mechanism comprises a profiled actuation member which is rotated to guide cam followers connected to levers so as to extend and retract the pistons. Furthermore, it is arranged such that when either one of the piston is being extended or retracted, the other piston remains in a retracted position flush with the DES housing. While this reduces dielectric stress significantly, the actuating mechanism is not particularly small, taking up quite a bit of space adjacent the two pistons, which again may cause dielectric stress. Moreover, the actuating mechanism does not have a low part-count.

[0007] As such, there is clearly a need for a GIS with a DES having improved dielectric behaviour. There is equally a need for a GIS with a DES which occupies less space, and preferably with a lower part-count.

[0008] EP 2 824 686 describes a high-voltage electric switching arrangement in a metal casing. US 2014/0116859 describes a 3-way switch for a gas-insulated apparatus. US 2012/0118709 describes a high-voltage assembly.

BRIEF DESCRIPTION OF THE INVENTION

[0009] The present invention provides a gas-insulated switchgear (GIS) according to claim 1.

[0010] Preferable features of the invention are detailed in the dependant claims.

BRIEF DESCRIPTION OF THE FIGURES

[0011] The invention will be better understood when reading the following detailed description and non-limiting examples, as well as studying the figures, wherein:

Figure 1 shows a cross-section view of a GIS according to a preferred embodiment of the present invention, with a perspective view of two DES, each

with the disconnector piston and the earthing piston in the retracted position,

Figure 2A show a cross-section view of the DES in figure 1,

Figure 2B show a cross-section view of the DES in figure 1 with the disconnector piston extended and the earthing piston retracted,

Figure 2C show a cross-section view of the DES in figure 1 from the reverse side with both pistons in the retracted position,

Figure 2D show a cross-section view of the DES in figure 1 from the reverse side with the earthing piston extended and the disconnector piston retracted, and

Figure 3 shows a perspective view of the GIS in figure 1, showing each DES with the housing mostly removed and its actuating mechanism linked by a common crankshaft.

[0012] In all of these figures, identical references can designate identical or similar elements. In addition, the various portions shown in the figures are not necessarily shown according to a uniform scale, in order to make the figures more legible.

DETAILLED DESCRIPTION OF PARTICULAR EMBODIMENTS

[0013] Figure 1 shows a partial cross-section view of a section of a three-phase GIS 100 according to a preferred embodiment of the invention. The DES 10 are positioned adjacent to each other and oriented in the same sense (only two of the three DES 10 being visible due to the position of the cross-section). As the DES 10 are identical, only one will be described.

[0014] The DES 10 comprises a housing 11 within which a disconnector piston 30 and an earthing piston 40 are provided, arranged for movement along axes which are at an angle of 90° to one another, but lying in the same plane. The disconnector piston 30 is oriented to move along a horizontal axis to extend from and retract into the housing 11, while the earthing piston 40 is oriented to move along a vertical axis to extend from and retract into the housing 11. To guide movement of the pistons 30, 40 along their axes, the housing 11 is provided with cylinders 13, 14, each cylinder 13, 14 having a cylinder opening 13A, 14A through which the piston 30, 40 can extend out of the housing 11. The cylinder openings 13A, 14A are thus openings in the housing 11 from which the pistons 30, 40 can extend. Electrical contact sockets 32, 42 are provided in the GIS 100 for the pistons 30, 40 of the DES 10 to connect to and disconnect from. The disconnector contact socket 32 on the right of the disconnector piston 30 is linked to a busbar 35 or a cable end, while the earthing contact socket 42 vertically above the earthing piston 40 is linked to the GIS enclosure 45. The DES 10 is connected on the left to an electrical conductor 55 extending through a respective section of the tubular compartment in the GIS 100. It will be appreciated that other orientations of the DES 10 are also possible.

[0015] The DES 10 is shown in the configuration where both the disconnector and earthing pistons 30, 40 are in the retracted position, and flush with the housing 11, in particular with the cylinder openings 13A, 14A at the front end of the cylinders 13, 14. By flush, it is meant that the front end of the piston 30, 40, is aligned, at least substantially, with the opening 13A, 14A of the housing 11 from which it can extend, which in this embodiment is the front end of the cylinder opening 13A, 14A. Ideally, the front end of the piston 30, 40 and the front end of the cylinder opening 13A, 14A are both generally planar and lie in the same plane when the piston 30, 40 is in the retracted position.

[0016] The DES 10 further comprises an actuating mechanism 20 within the housing 11 comprising a crankshaft 28 and piston rods 23, 24 for operating the pistons 30, 40. A main journal 21 of the crankshaft 28 can be seen protruding out of the housing 11. When the crankshaft 28 is rotated, e.g. by an actuating device (not shown), such as a motor or hand-crank, the rotary motion is converted to linear motion of the pistons 30, 40 to move them into and out of contact with their respective electrical contact sockets 32, 42. With the housing 11 and the pistons 30, 40 of the DES 10 being made of metal, the electrical conductor 55 of the GIS 100 can be disconnected and earthed by operating the actuating mechanism 20. So as to provide a better understanding of the actuating mechanism 20, it will be discussed in further detail below with reference to figures providing cross-section views of the DES 10.

[0017] Figure 2A shows a cross-sectional view of a DES 10 revealing part of the components of the actuating mechanism 20. The actuating mechanism 20 is a single actuating mechanism 20 for operating both pistons 30, 40, and comprises a crankshaft 28 extending along and rotatable about a crank axis, the crankshaft 28 comprising two main journals 21, 27 extending along the crank axis, two main webs 22, 26 extending from the main journals 21, 27, and two crankpins 23A, 24A provided between the main webs 22, 26. The crankpins 23A, 24A extend along axes parallel to the crank axis, but the axis of one crankpin 23A, 24A has a phase offset to the other relative to the crank axis. In this case, a 30° phase offset is provided between the axes of the crankpins 23A, 24A relative to the crank axis. The crankpins 23A, 24A together are provided in a split-crankpin arrangement, interconnected by a crankpin web 25 extending therebetween, also forming part of the crankshaft 28. The crankshaft components do not move relative to each other. The actuating mechanism also comprises piston rods 23, 24 rotatably mounted on each crankpin 23A, 24A connecting the crankshaft 28 to the pistons 30, 40.

[0018] In this figure, one main journal 21, one main web 22, the disconnector piston rod 23 (and the position of the disconnector crankpin 23A) are components of the actuating mechanism which can be seen. The crankpin web 25 interconnecting the crankpins 23A, 24A is also visible. As the cross-section view is taken along the plane of this crankpin web 25, only the details of the actuating mechanism 20 for the disconnector piston 30 are visible in this figure while those of the earthing piston 40 are not entirely visible. Figure 2C however provides a view from the reverse side of the same cross-section as in figure 2A, and here the other main journal 27, the other main web 26, the earthing piston rod 24 (and the position of the earthing crankpin 24A) are components of the actuating mechanism 20 for the earthing piston 40 which can be seen, but not entirely those of the disconnector piston 30. The actuating mechanism 20 of the DES 10 can also be seen in Figure 3.

[0019] The crankshaft 28, which may be provided as an assembly of multiple parts or as a single unit, is mounted to the housing 11 of the DES 10 so as to be rotatable about the crank axis. The crank axis extends perpendicularly to a plane parallel to both axes of the piston 30, 40, and therefore, in this case, to the plane in which the axes of both the disconnector piston 30 and the earthing piston 40 lie. In fact, the crank axis intersects the axes of both pistons 30, 40, and therefore, in this case, goes through the intersection of the axes of the two pistons 30, 40. The crank axis is located behind the back end of both pistons 30, 40 when they are in the retracted position.

[0020] The actuating mechanism 20 is arranged such that rotation of the crankshaft 28 can place the pistons 30, 40 in three distinct configurations. In one configuration, both the disconnector piston 30 and the earthing piston 40 are in the retracted position; shown in figures 2A and 2C (view from the reverse side). In another configuration, the disconnector piston 30 is in the extended position while the earthing piston 40 is in the retracted position; this is shown in figure 2B, which provides the view from the same side as figure 2A. In a yet another configuration, the disconnector piston 30 is in the retracted position while the earthing piston 40 is in the extended position; this is shown in figure 2D which provides a view from the same side as figure 2C.

[0021] When in the configuration where both pistons are in the retracted position, each piston is not connected to its electrical contact socket 32, 42 and is flush with the housing 11. In particular, each piston 30, 40 is flush with the cylinder openings 13A, 14A where the piston 30, 40 can extend from. This retracted position is the same position that a piston 30, 40 will be in when in the configurations where the other piston 40, 30 is in the extended position. The GIS 100 is arranged such that the pistons of the DES 10 connect to, completely or as designed, the electrical contact socket 32, 42 when a piston 30, 40 is in the extended position. In order to explain how the actuating mechanism 20 operates and moves the pistons 30, 40, the description will commence with the configuration where both pistons 30, 40 are retracted.

[0022] In figures 1 and 2A, the disconnector piston 30 and the earthing piston 40 are both flush with the DES housing 11. When the crankshaft 28 is rotated anticlockwise about the crank axis (w.r.t. figure 2A), it pushes on the disconnector piston rod 23 which in turn causes translation of the disconnector piston 30 within its cylinder 13, causing it to extend out of the cylinder opening 13A towards its disconnector contact socket 32. Figure 2B shows the disconnector piston 30 in the extended position, where it engages the disconnector contact socket 32 and thereby places the electrical conductor 55 of the GIS in electrical contact with the busbar 35 or a cable end. The DES 10 is most often in this position during normal operations, where it allows the flow of electricity across the relevant section of the GIS 100.

[0023] At the same time, it will be observed that the crankshaft 28 has made a rotation of 120°. While the disconnector piston 30 has been displaced from its retracted position to its extended position, it has done so with the disconnector piston rod 23 remaining on the same side of the crank axis (the disconnector crankpin 23A remaining on the same side of the axis of the disconnector piston 30); see figures 2A and 2B. Meanwhile, the earthing piston rod 24 has cut across the crank axis (the earthing crankpin 24A now being on the other side of the axis of the earthing piston 40); see figures 2C and 2B to visualise. Note that the angle of the main webs 22, 26 relative to the crank axis are not necessarily the same, and correspond to the phase offset of the crankpins 23A, 24A. The earthing crankpin 24A linked to the earthing piston rod 24 has moved around the crank axis to an opposite corresponding side of crank axis with respect to the earthing piston axis. Consequently, the earthing piston 40 which was initially flush with the housing 11 with the disconnector piston 30 in the retracted position, is again flush with the housing 11 with the disconnector piston 30 in the extended position. In between, the earthing piston 40 has dipped behind the cylinder opening 14A.

[0024] Before the DES 10 can be earthed, the disconnector piston 30 must at first be disconnected from the disconnector contact socket 32 for safety reasons. So as to disconnect the disconnector piston 30, the crankshaft 28 is rotated clockwise 120° about the crank axis (w.r.t. figures 2A and 2B). This retracts the disconnector piston 30 until it is in the retracted position flush with the housing 11, and with the earthing piston 40 also being in the retracted position, the earthing crankpin 24A having moved back to the initial position shown in figure 2A. In this configuration, both the disconnector piston 30 and the earthing piston 40 are again in the retracted position flush with the DES housing 11.

[0025] In order to describe the extension of the earthing piston 40, the actuating mechanism 20 will be now be described primarily with reference to Figures 2C and 2D. When the crankshaft 28 is rotated in the anticlockwise direction (further clockwise in the views shown in figures

2A and 2B), it pushes on the earthing piston rod 24 which in turn causes translation of the earthing piston 40 within its cylinder, causing it to extend out of the cylinder opening 14A towards its earthing contact socket 42. Figure 2D shows the earthing piston 40 in the extended position, where it engages the earthing contact socket 42 and thereby places the electrical conductor 55 of the GIS in electrical contact with the GIS enclosure 45 which is earthed. This allows electric charge in the relevant section of the GIS 100 to be discharged.

[0026] It will be observed that the crankshaft 20 has made a rotation of a further 120°. While the earthing piston 40 has been displaced from its retracted position to its extended position, it has done so with the earthing piston rod 24 remaining on the same side of the crank axis (the earthing crankpin 24A remaining on the same side of the axis of the earthing piston 40); see figures 2C and 2D. This time however, the disconnector piston rod 23 has cut across the crank axis (the disconnector crankpin 23A now being on the other side of the axis of the disconnector piston 30); see figures 2D and 2A to visualise. The disconnector crankpin 23A linked to the disconnector piston rod 23 has moved around the crank axis to an opposite corresponding side of crank axis with respect to the disconnector piston axis. Consequently, the disconnector piston 30 which was initially flush with the housing 11 with the earthing piston 40 in the retracted position, is again flush with the housing 11 with the earthing piston 40 in the extended position. In between, the disconnector piston 30 has dipped behind the cylinder opening 13A.

[0027] In order to place the disconnector piston 30 back in contact with the disconnector contact socket 32, the crankshaft 28 needs to be rotated back in the clockwise direction (anticlockwise in the view shown in figure 2A and 2B). It should also be noted that the DES 10 is arranged such that continuous rotation of the crankshaft 28 is mechanically blocked in both directions, preventing the disconnector piston 30 and the earthing piston 40 from being extended out from the housing 11, or being in the extended position, at the same time. In addition, the crankpins 23A, 24A being provided with a phase offset to each other relative to the crank axis in this embodiment permits each piston 30, 40 to be in their extended position with their piston rod 23, 24 parallel to the piston axis (maximum reach), while the crankpin 24A, 23A of the other piston is located such that the other piston 40, 30 is in the retracted position.

[0028] It will be appreciated that several aspects play a role in ensuring the pistons 30, 40, when operated by the actuating mechanism 20, are flush with the housing 11 in the retracted position and engage the electrical contact sockets 32, 42 in the extended position. The length of the pistons 30, 40 and piston rods 23, 24, distance from electrical contact socket 32, 42, the angle between piston axes, the arrangement of the crankpins 23A, 24A, dimensions of the housing 11, etc., may all play a role. It will be within the abilities of the skilled person to arrange the GIS 100 such that the pistons 30, 40 of the DES 10 are flush with the housing 11 when in their retracted position and to position the DES or electrical contact sockets 32, 42 so that the pistons 30, 40 are connected to their electrical contact sockets 32, 42, completely or as designed, when in their extended position.

[0029] Returning to figure 1 showing the three-phase GIS 100, it should be noted that three separate DES 10 are arranged side-by-side in the same orientation, each one intended for disconnecting and earthing one of the three electrical conductors 55 in the GIS 100. Each DES 10 functions as previously described, however the crankshafts 28 of the three DES 10 are connected to each other forming a common crankshaft 28 and the three DES 10 can be operated synchronously. Figure 3 provides a perspective view of the three DES 10 with the housing 11 of each DES 10 mostly stripped away, showing the actuating mechanisms 20 linked by a common crankshaft 28. The common crankshaft 28 will be arranged such that it does not conduct electricity between the three electrical conductors 55, and again may be provided as an assembly of multiple parts, or as a single unit. Depending on the arrangement of the GIS 100 and DES 10, it may also be possible for the pistons 30, 40 of all three DES 10 and their actuating mechanisms 20 to be provided in a common housing. Needless to say, the invention is also applicable to single-phase GIS where just one DES 10 needs to be provided at relevant sections of the GIS. It will also be appreciated that existing GIS can readily be retrofitted so as to provide a GIS 100 according to the present invention.

[0030] The GIS 100 of the present invention thus allows the disconnector piston 30 and earthing piston 40 to be operated while causing less dielectric stress. The provision of the crankshaft 28 neatly enables the pistons 30, 40 to be in the retracted position while the other is in the extended position or the retracted position. The fact that crankshaft 28, unlike a straight rotary shaft, does not run along the crank axis for its entire length means that it frees up space along and around the crank axis. This crucially allows the crankpin 23A, 24A and piston rod 23, 24 to occupy corresponding positions on both sides of the crank axis, enabling the piston 30, 40 to be flush with the housing 11 in the retracted position. By having one piston 30, 40 in the retracted position flush with the housing 11 while the other is in the extended position, the dielectric stress at the openings 13A, 14A of the housing 11 is significantly reduced. The pistons 30, 40 being arranged not to extend from housing 11 while the other 40, 30 is moving between the retracted position and the extended position also contributes to this. On top of that, the crankshaft 28 being located in the DES 10 with the crank axis extending perpendicularly from a plane parallel to the two piston axes, and intersecting the two piston axes, allows for a compact construction. Finally, by providing the crankshaft 28 as a single unit, a reduction in part-count of the DES may also be realised.

[0031] It should be understood that variations to the

preferred embodiment above are possible. For example, while the pistons are angled at 90° to one another, they may alternatively be provided at a different angle to each other, e.g. between 60° and 150°.

[0032] While the actuating mechanism is said to be able to place the pistons in three configurations, this does not necessarily restrict the actuating mechanism from placing the pistons in yet other configurations.

Claims

1. A gas-insulated switchgear, GIS, (100) comprising a disconnector-earthing switch, DES, the DES (10) comprising:

   a housing (11), two pistons comprising a disconnector piston (30) and an earthing piston (40), both pistons arranged in the housing (11) and being each extendable and retractable thereto along a respective axis, the axes of the two pistons (30, 40) being at an angle to each other but parallel to a plane;
   an actuating mechanism (20) arranged to operate the two pistons (30, 40) to place them in three configurations, namely where both the disconnector piston (30) and earthing piston (40) are in their respective retracted positions, where the disconnector piston (30) is in its extended position and the earthing piston (40) is in its retracted position, and where the earthing piston (40) is in its extended position and the disconnector piston (30) is in its retracted position;
   wherein the actuating mechanism (20) comprises a crankshaft (28) and two piston rods (23, 24), the two piston rods (23, 24) comprising a first piston rod (23) linking the disconnector piston (30) to the crankshaft (28) and a second piston rod (24) linking the earthing piston (40) to the crankshaft (28), the crankshaft (28) being arranged to rotate about a crank axis perpendicular to the plane parallel to the axes of the two pistons (30, 40) and which intersects the axes of the two pistons (30, 40), and, whenever the earthing piston (40) or disconnector piston (30) is in its respective retracted position, that piston is flush with the housing (11) in that a front end of that piston (30, 40) is in the same plane as a front end of a cylinder opening (13, 14) provided in the housing (11) from which that piston (30, 40) extends;
   wherein the crankshaft (28) comprises a first crankpin (23A) coupled to the first piston rod (23) and a second crankpin (24A) coupled to the second piston rod (24); and
   wherein the first crankpin (23A) and the second crankpin (24A) are in a split-crankpin arrangement.

2. A GIS according to claim 1, wherein the axes of the two pistons (30, 40) are at an angle of between 60° and 150° to each other.

3. A GIS according to claim 2, wherein the axes of the two pistons (30, 40) are at an angle of 90° to each other.

4. A GIS according to any preceding claim, wherein the first crankpin (23A) and the second crankpin (24A) are provided on axes with a 30° phase offset relative to each other with respect to the crank axis.

5. A GIS according to any preceding claim wherein, when one of the two pistons (30, 40) is moved from its extended position to its retracted position, the piston rod (24, 23) linked to the other of the two pistons (40, 30) cuts across the crank axis.

6. A GIS according to any preceding claim wherein one of the two pistons (30, 40) is in its retracted position when its respective crankpin (23A, 24A) is on one side of the crank axis relative to the piston axis and also when it is at an opposite corresponding side of the crank axis relative to the piston axis.

7. A GIS according to any preceding claim wherein three DES (10) are provided adjacent to each other and arranged in the same orientation, the crankshafts (28) of the three DES (10) being connected to form a common crankshaft (28).

Patentansprüche

1. Gasinsolierte Schaltanlage, GIS, (100), umfassend einen Trennungs-Erdungsschalter, DES, wobei der DES (10) Folgendes umfasst:

   ein Gehäuse (11), zwei Kolben, die einen Trennungskolben (30) und einen Erdungskolben (40) umfassen, wobei beide Kolben in dem Gehäuse (11) angeordnet sind und jeder darin entlang einer jeweiligen Achse ausfahrbar und einziehbar ist, wobei die Achsen der zwei Kolben (30, 40) in einem Winkel zueinander aber parallel zu einer Ebene stehen;
   einen Schaltmechanismus (20), der angeordnet ist, um die zwei Kolben (30, 40) zu betätigen, um sie in drei Konfigurationen zu positionieren, namentlich wenn sich sowohl der Trennungskolben (30) als auch Erdungskolben (40) in seiner jeweiligen zurückgezogenen Position befindet, wenn sich der Trennungskolben (30) in der ausgefahrenen Position und der Erdungskolben (40) in seiner zurückgezogenen Position befindet, und wenn sich der Erdungskolben (40) in seiner ausgefahrenen Position und der Tren-

nungskolben (30) in seiner zurückgezogenen Position befindet;
wobei der Schaltmechanismus (20) eine Kurbelwelle (28) und zwei Kolbenstangen (23, 24) umfasst, die zwei Kolbenstangen (23, 24) eine erste Kolbenstange (23), die den Trennungskolben (30) mit der Kurbelwelle (28) verbindet, und eine zweite Kolbenstange (24), die den Erdungskolben (40) mit der Kurbelwelle (28) verbindet umfassen, wobei die Kurbelwelle (28) so angeordnet ist, dass sie um eine Kurbelachse dreht, die rechtwinkelig ist zu der Ebene ist, die parallel zu den Achsen der zwei Kolben (30, 40) ist und die Achsen der zwei Kolben (30, 40) quert, und immer dann, wenn sich der Erdungskolben (40) oder der Trennungskolben (30) in seiner jeweiligen zurückgezogenen Position befindet, dieser Kolben mit dem Gehäuse (11) fluchtend ist, in dem sich ein vorderes Ende des Kolbens (30, 40) in der gleichen Ebene befindet wie ein vorderes Ende einer Zylinderöffnung (13, 14), die in dem Gehäuse (11) bereitgestellt ist, von dem aus sich der Kolben (30, 40) erstreckt;
wobei die Kurbelwelle (28) einen ersten Kurbelzapfen (23A), der mit der ersten Kolbenstange (23) gekoppelt ist, und einen zweiten Kurbelzapfen (24A), der mit der zweiten Kolbenstange (24) gekoppelt ist, umfasst; und
wobei der erste Kurbelzapfen (23A) und der zweite Kurbelzapfen (24A) in einer geteilten Kurbelzapfenanordnung sind.

2. GIS nach Anspruch 1, wobei die Achsen der zwei Kolben (30, 40) in einem Winkel von zwischen 60° und 150° zueinander stehen.

3. GIS nach Anspruch 2, wobei die Achsen der zwei Kolben (30, 40) in einem Winkel von 90° zueinander stehen.

4. GIS nach einem der vorstehenden Ansprüche, wobei der erste Kurbelzapfen (23A) und der zweite Kurbelzapfen (24A) an Achsen mit 30° Phasenverschiebung zueinander in Bezug auf die Kurbelachse bereitgestellt sind.

5. GIS nach einem der vorstehenden Ansprüche, wobei, wenn einer der zwei Kolben (30, 40) von seiner ausgefahrenen Position in seine zurückgezogene Position bewegt wird, die Kolbenstange (24, 23), die mit dem anderen der zwei Kolben (40, 30) verbunden ist, über die Kurbelachse schneidet.

6. GIS nach einem der vorstehenden Ansprüche, wobei einer der zwei Kolben (30, 40) sich in seiner zurückgezogenen Position befindet, wenn sich sein jeweiliger Kurbelzapfen (23A, 24A) an einer Seite der Kurbelachse in Bezug auf die Kolbenachse befindet, und auch, wenn er sich an einer gegenüberliegenden Seite der Kurbelachse in Bezug auf die Kolbenachse befindet.

7. GIS nach einem der vorstehenden Ansprüche, wobei drei DES (10) angrenzend zueinander bereitgestellt sind und in der gleichen Ausrichtung angeordnet sind, wobei die Kurbelwellen (28) der drei DES (10) verbunden sind, um eine gemeinsame Kurbelwelle (28) zu bilden.

Revendications

1. Appareillage de commutation à isolation gazeuse, GIS, (100) comprenant un commutateur sectionneur et de mise à la masse, DES, le DES (10) comprenant :

un logement (11), deux pistons comprenant un piston sectionneur (30) et un piston de mise à la masse (40), les deux pistons agencés dans le logement (11) et étant chacun extensible et rétractable par rapport à celui-ci le long d'un axe respectif, les axes des deux pistons (30, 40) formant un angle l'un par rapport à l'autre mais étant parallèles à un plan ;
un mécanisme d'actionnement (20) agencé pour faire fonctionner les deux pistons (30, 40) pour les placer dans trois configurations, à savoir là où à la fois le piston sectionneur (30) et le piston de mise à la masse (40) sont dans leurs positions rétractées respectives, où le piston sectionneur (30) est dans sa position étendue et le piston de mise à la masse (40) est dans sa position rétractée, et où le piston de mise à la masse (40) est dans sa position étendue et le piston sectionneur (30) est dans sa position rétractée ;
dans lequel le mécanisme d'actionnement (20) comprend un vilebrequin (28) et deux tiges de piston (23, 24), les deux tiges de piston (23, 24) comprenant une première tige de piston (23) reliant le piston sectionneur (30) au vilebrequin (28) et une seconde tige de piston (24) reliant le piston de mise à la masse (40) au vilebrequin (28), le vilebrequin (28) étant agencé pour tourner autour d'un axe de manivelle perpendiculaire au plan parallèle aux axes des deux pistons (30, 40) et qui recoupe les axes des deux pistons (30, 40), et, lorsque le piston de mise à la masse (40) ou le piston sectionneur (30) est dans sa position rétractée respective, ce piston affleure le logement (11) en ce sens qu'une extrémité avant de ce piston (30, 40) est dans le même plan qu'une extrémité avant d'une ouverture de cylindre (13, 14) prévue dans le logement (11) à partir duquel ce piston (30, 40) s'étend ;

dans lequel le vilebrequin (28) comprend un premier maneton (23A) couplé à la première tige de piston (23) et un second maneton (24A) couplé à la seconde tige de piston (24) ; et
dans lequel le premier maneton (23A) et le second maneton (24A) sont dans un agencement de manetons divisé.

2. GIS selon la revendication 1, dans lequel les axes des deux pistons (30, 40) forment un angle compris entre 60° et 150° l'un par rapport à l'autre.

3. GIS selon la revendication 2, dans lequel les axes des deux pistons (30, 40) forment un angle de 90° l'un par rapport à l'autre.

4. GIS selon l'une quelconque des revendications précédentes, dans lequel le premier maneton (23A) et le second maneton (24A) sont prévus sur des axes avec un déphasage de 30° l'un par rapport à l'autre par rapport à l'axe de manivelle.

5. GIS selon l'une quelconque des revendications précédentes dans lequel, lorsque l'un des deux pistons (30, 40) est déplacé de sa position étendue à sa position rétractée, la tige de piston (24, 23) reliée à l'autre des deux pistons (40, 30) coupe à travers l'axe de manivelle.

6. GIS selon l'une quelconque des revendications précédentes, dans lequel l'un des deux pistons (30, 40) est dans sa position rétractée lorsque son maneton respectif (23A, 24A) se trouve d'un côté de l'axe de manivelle par rapport à l'axe de piston et également lorsqu'il est au niveau d'un côté correspondant opposé de l'axe de manivelle par rapport à l'axe de piston.

7. GIS selon l'une quelconque des revendications précédentes, dans lequel trois DES (10) sont disposés adjacents les uns aux autres et agencés dans la même orientation, les vilebrequins (28) des trois DES (10) étant connectés pour former un vilebrequin commun (28).

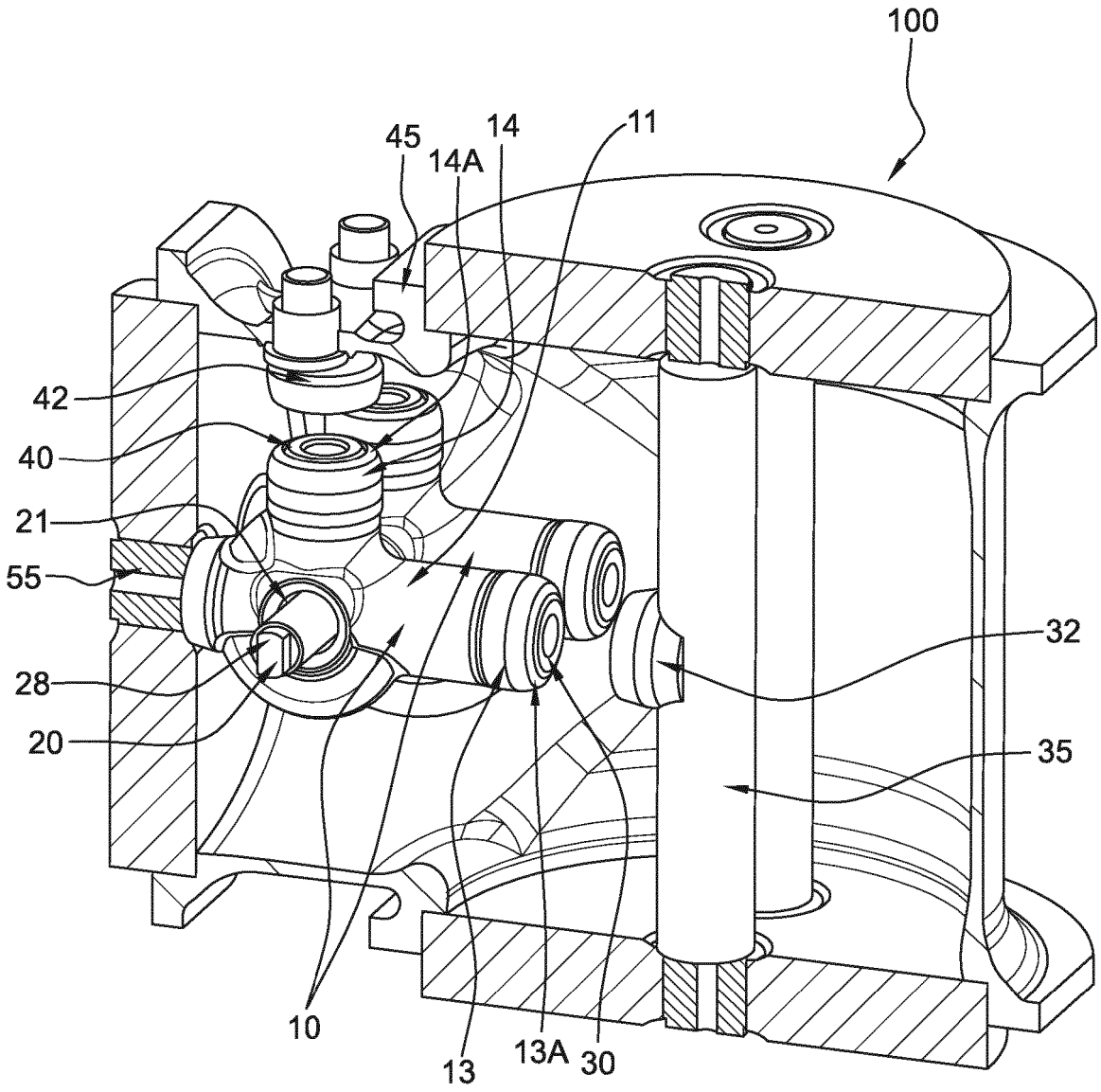


Fig. 1

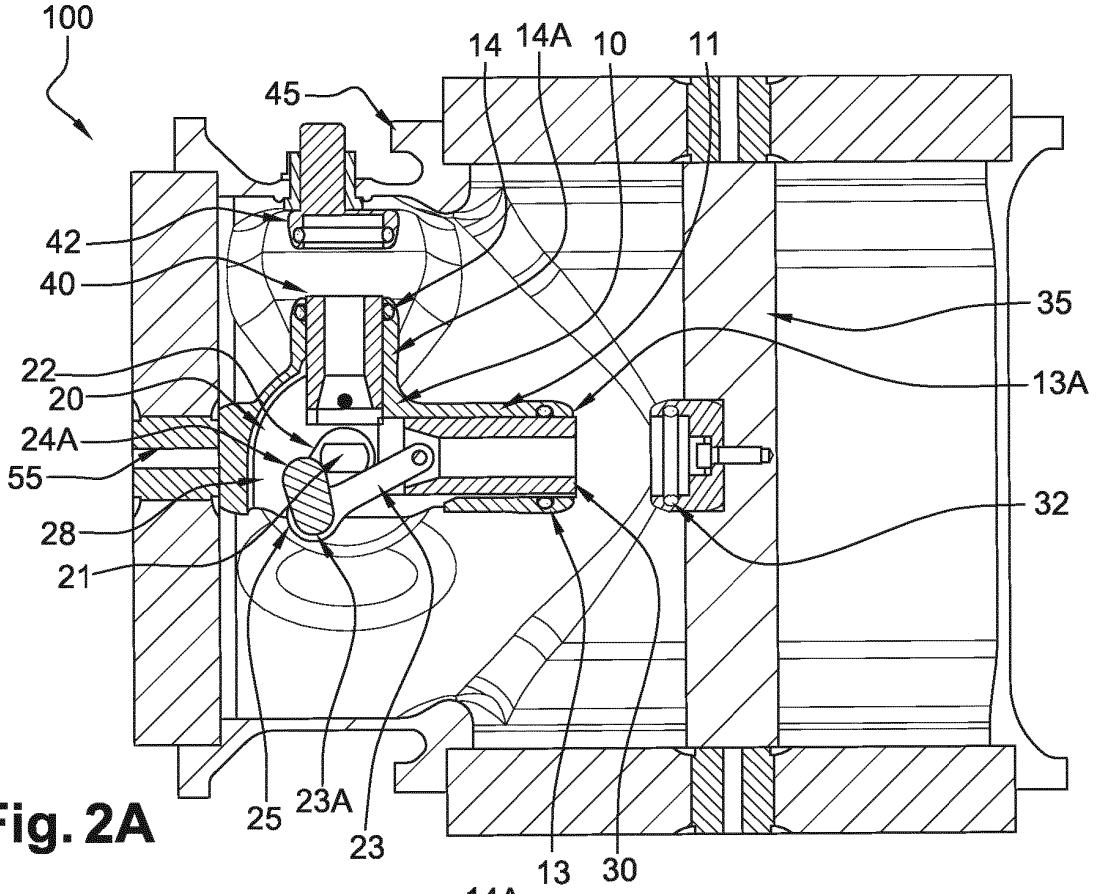

100
14
14A
10
11
45
42
40
35
22
20
13A
24A
55
32
28
21
25
23A
23
13
30

Fig. 2A

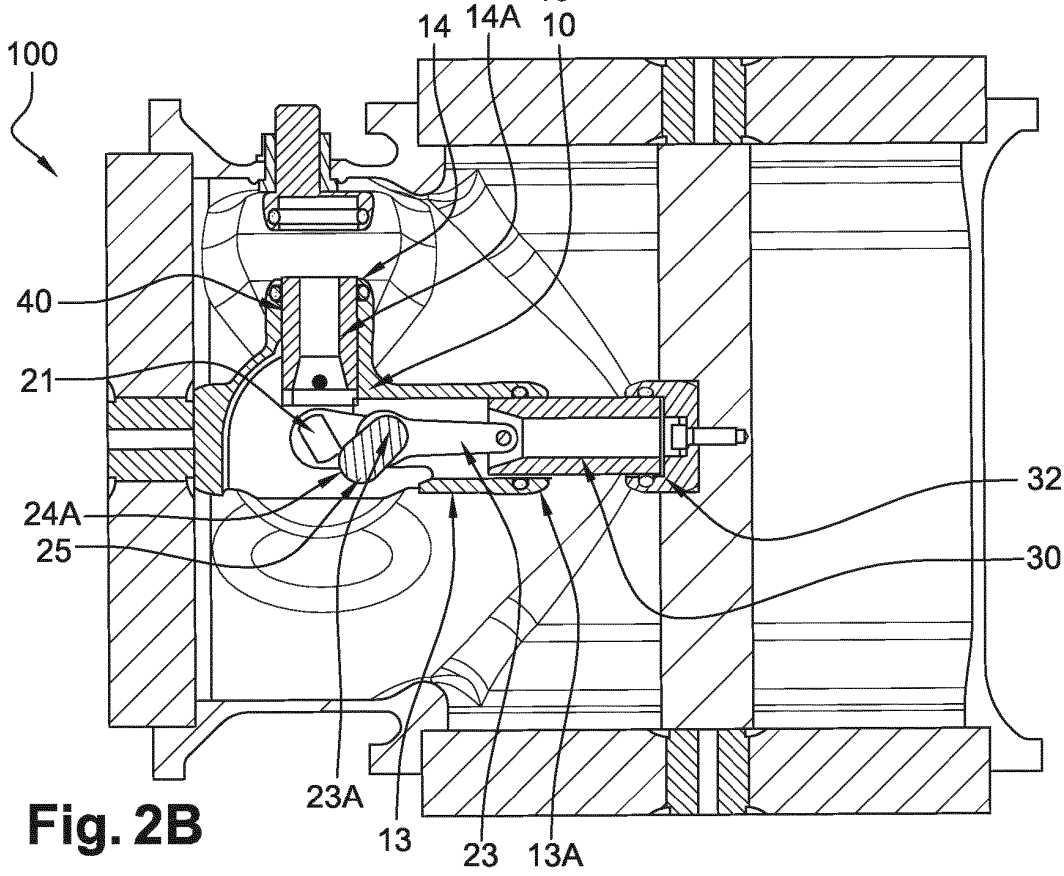

100
14
14A
10
40
21
32
24A
25
30
23A
13
23
13A

Fig. 2B

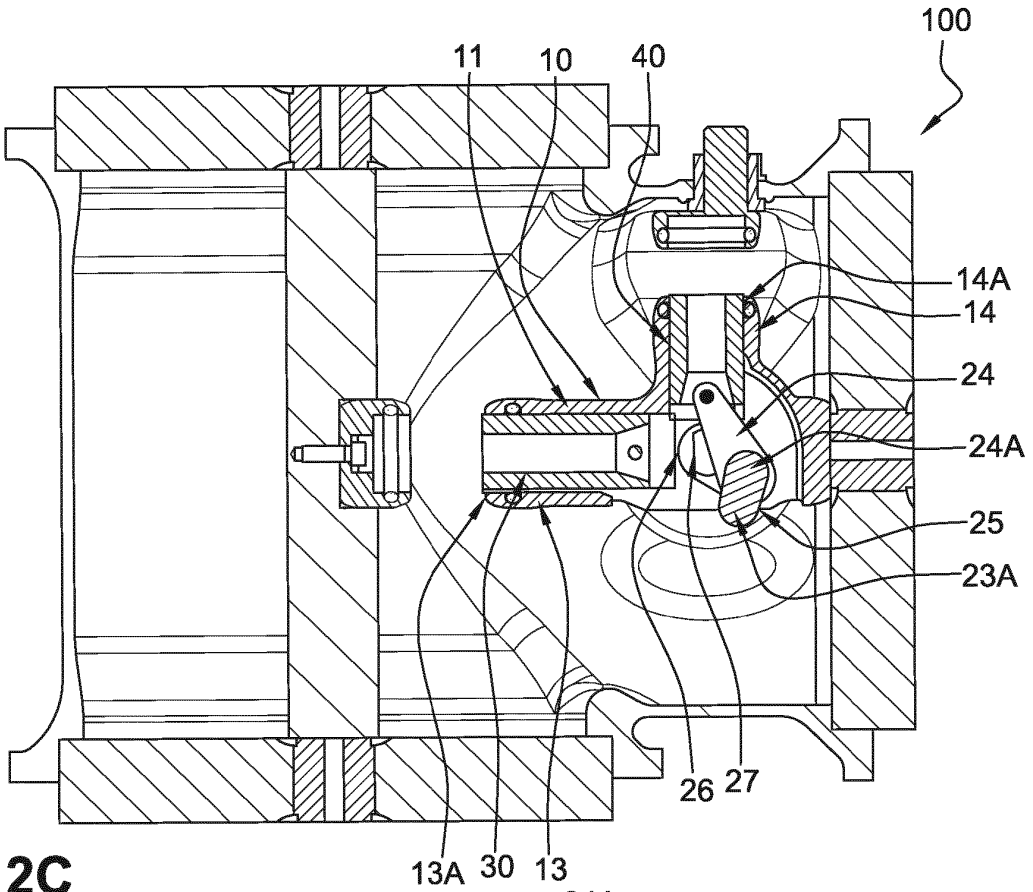

100
11
10
40
14A
14
24
24A
25
23A
26
27
13A
30
13

Fig. 2C

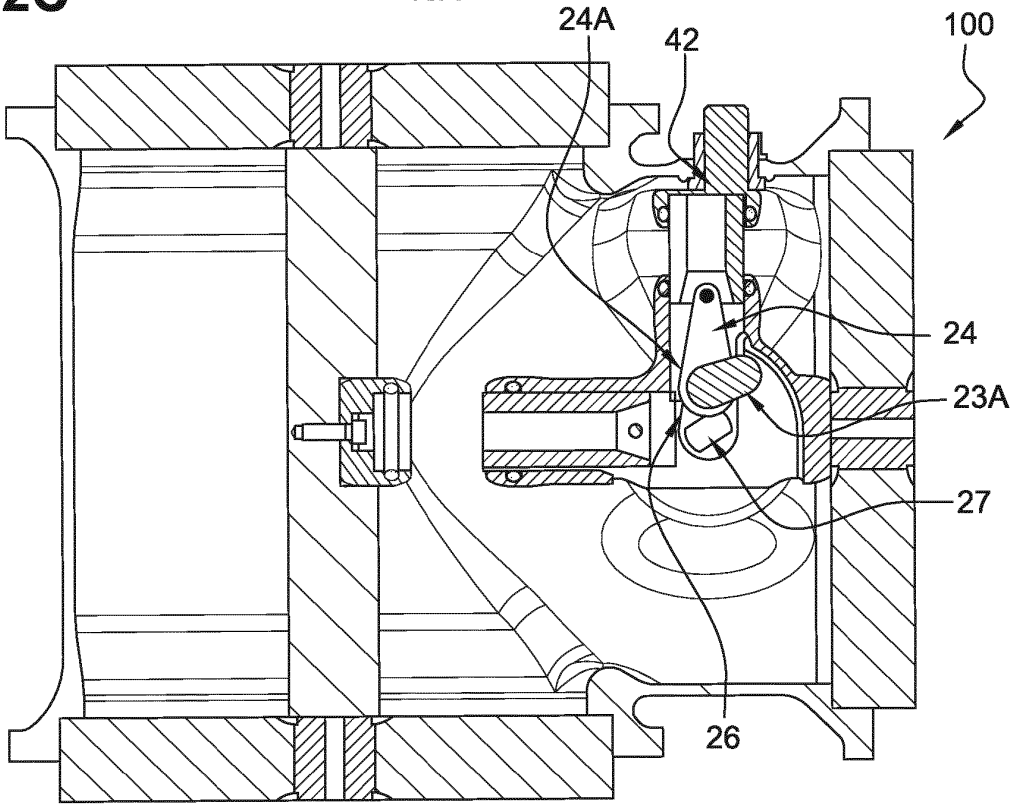

24A
42
100
24
23A
27
26

Fig. 2D

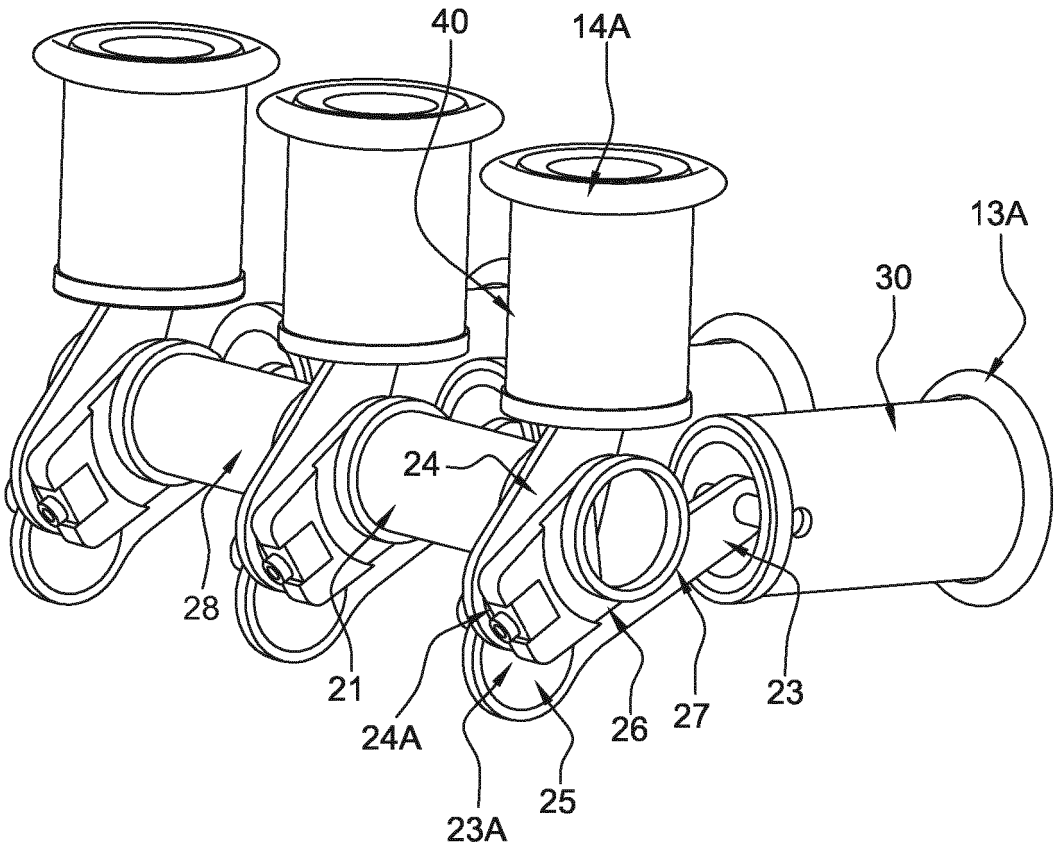


Fig. 3

REFERENCES CITED IN THE DESCRIPTION

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