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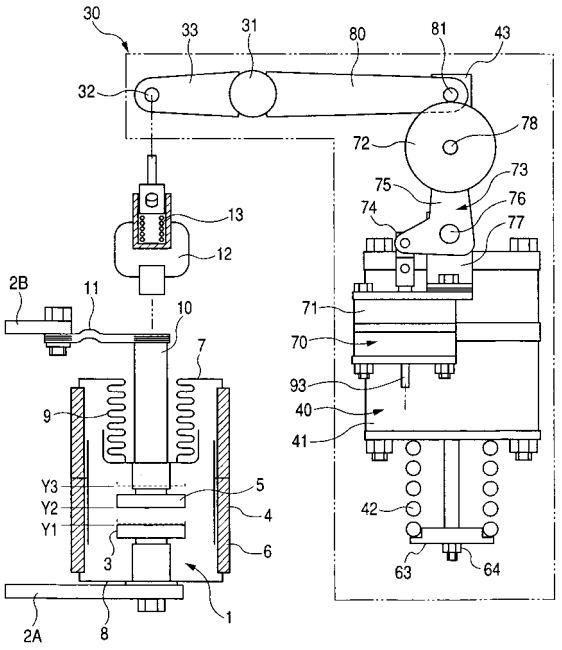
(54) **Device for controlling the opening/closing operation of an electric switchgear**

(57) In the switchgear opening/closing device, a movable contact 5 can be switched to the first position Y1, the second position Y2 and the third position Y3 with respect to a fixed contact. The device comprises an operation lever 80 interlocked with the movable contact 5, a shaft 31 to which the base of the operation laver 80 is fixed, a first operation mechanism 40, coupled with the shaft 31, to switch-operate the movable contact 5 to the first position, the second position and the third position, and a second operation mechanism 70 to selectively switch between prevention of movement and movement of the movable contact 5 from the second position to the third position by the first operation mechanism 40.

FIG. 1



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Description

TECHNICAL FIELD:

[0001] The present invention relates to a switchgear opening/closing device which moves a movable contact to three positions, a closed position, an open position and a disconnection position.

BACKGROUND ART:

[0002] A power receiving equipment is provided with a closed type switch board (referred to as a "switchgear") accommodating a vacuum circuit breaker to break a load current or circuit fault current, a disconnector and an earth switch to ensure an operator's safety upon maintenance and checkup of the load, a detection unit to detect a system voltage and current, a protection relay, and the like.

[0003] In this switchgear, various insulation methods are used. In addition to the conventional air insulation switchgear and a cubicle-type GIS using SF6 gas, recently, solid insulation, compressed air insulation, full vacuum insulation and the like are used from the viewpoint of environmental considerations. Further, downsizing of the respective components, the circuit breaker, the disconnector and the earth switch is accelerated by the various insulation methods, while a vacuum valve where functions of circuit breaker, disconnector and ground are integrated in a single container are proposed.

[0004] Further, in this type of vacuum valve, the three functions of circuit breaker, disconnector and earth switch are switch-operated in three positions or four positions by an opening/closing device (for example, see Patent Document 1).

[Patent Document 1] Japanese Published Unexamined Patent Application No. Hei 10-308145

[0005] In this type of opening/closing device, generally, a movable electric conductor and an operation driving source are coupled with a link mechanism including plural cranks, a crank arm, a link and the like. Accordingly, this link mechanism has a pivotal coupling members using a large number of pins and the like.

[0006] The pivotal coupling member is coated with lubricant such as grease. The lubricant is solidified after elapse of a long period. As a result, the resistance at the pivotal coupling member is increased, and a high operation force is required. The increase in the operation force is one of impediments to downsizing of the opening/closing device. '

[0007] Further, as the above-described conventional opening/closing device uses the pivotal coupling member including a large number of links, pins and the like, a loss of operation force is caused by distortion and looseness of these parts, therefore the operation efficiency is not excellent.

SUMMARY OF THE INVENTION:

[0008] The present invention has been made in view of the above situation, and has an object to provide a switchgear opening/closing device in which the number of pivotal coupling members in the link mechanism can be reduced and the efficiency of opening/closing operation can be improved.

[0009] To attain the above object, the present invention provides a switchgear opening/closing device capable of switching a movable contact to a first position, a second position and a third position with respect to a fixed contact, comprising: an operation lever interlocked with the movable contact; a shaft to which a base of the operation lever is fixed; a first operation mechanism, coupled with the shaft, that switch-operates the movable contact to the first position, the second position and the third position; and a second operation mechanism that selectively switches between prevention of movement and movement of the movable contact from the second position to the third position by the first operation mechanism.

BRIEF DESCRIPTION OF THE DRAWINGS:

[0010]

Fig. 1 is a side view including a partial cross sectional view, showing the embodiment of the switchgear opening/closing device of the present invention.

Fig. 2 is a top view of the embodiment of the switchgear opening/closing device of the present invention shown in Fig. 1.

Fig. 3 is a cross-sectional view for explaining the internal structure of the electromagnet in the first operation mechanism of the embodiment of the switchgear opening/closing device of the present invention.

Fig. 4 is a cross-sectional view for explaining the internal structure of the electromagnet in the second operation mechanism of the embodiment of the switchgear opening/closing device of the present invention.

Fig. 5 is a sectional side elevation including a partial cross sectional view, showing the embodiment of the switchgear opening/closing device of the present invention.

Fig. 6 is a sectional side elevation representing the open state in the embodiment of the switchgear opening/closing device of the present invention.

Fig. 7 is a sectional side elevation for explaining the power-on operation in the embodiment of the switchgear opening/closing device of the present invention.

Fig. 8 is a sectional side elevation representing the closed state in the embodiment of the switchgear opening/closing device of the present invention.

Fig. 9 is an operation explanatory view for explaining maintenance of the closed state in the electromagnet shown in Fig. 3.

Fig. 10 is an operation explanatory view for explain-

ing the tripping operation of the magnetic latch in the electromagnet shown in Fig. 3.

Fig. 11 is a sectional side elevation for explaining the disconnection operation in the embodiment of the switchgear opening/closing device of the present invention.

Fig. 12 is a sectional side elevation representing the disconnection state in the embodiment of the switchgear opening/closing device of the present invention.

Fig. 13 is a side view showing the other embodiment of the switchgear opening/closing device of the present invention.

Fig. 14 is a sectional side elevation for explaining the operation of the third operation mechanism of the embodiment of the switchgear opening/closing device of the present invention.

PREFERRED EMBODIMENTS FOR CARRYING OUT THE INVENTION:

[0011] One aspect of the present invention provides a switchgear opening/closing device capable of switching a movable contact to a first position, a second position and a third position with respect to a fixed contact, comprising: a first operation lever interlocked with the movable contact; a shaft to which a base of the operation lever is fixed; a second operation lever coupled with the shaft; a first operation mechanism, coupled with the second operation lever, that switch-operates the movable contact to the first position, the second position and the third position; and a second operation mechanism that selectively switches between prevention of movement and movement of the movable contact from the second position to the third position by the first operation mechanism.

[0012] Further, the third invention is a switchgear opening/closing device capable of switching a movable contact to a closed position, an open position and a disconnection position with respect to a fixed contact, comprising: a first operation lever interlocked with the movable contact; a shaft to which a base of the operation lever is fixed; a second operation lever coupled with the shaft; a first operation mechanism, coupled with the second operation lever, that switch-operates the movable contact to the closed position, the open position and the disconnection position; and a second operation mechanism that selectively switches between prevention of movement and movement of the movable contact from the open position to the third position by the first operation mechanism.

[0013] Another aspect of the present invention is a switchgear opening/closing device capable of switching a movable contact to a closed position, an open position and a disconnection position with respect to a fixed contact, comprising: a first operation lever interlocked with the movable contact; a shaft to which a base of the operation lever is fixed; a second operation lever coupled with the shaft; a first operation mechanism, coupled with the second operation lever, having an electromagnet to drive the movable contact to a closed position direction and a spring energy-stored in accordance with movement of the movable contact in the closed position direction by the electromagnet; and a second operation mechanism that selectively switches between prevention of movement and movement of the movable contact from the open position to the disconnection position by an energy-storing force of the spring in the first operation mechanism.

[0014] Further, still another aspect of the present invention provides the electromagnet of the first operation mechanism wherein its plunger is positioned outside its fixed iron core when the movable contact is in the disconnection position, in the above-mentioned inventions.

[0015] A still another aspect of the present invention provides the second operation mechanism has a binding release member in contact with an end side of the second operation lever and an electromagnet that move-operates the binding release member, in the above-mentioned inventions.

[0016] Further, a still another aspect of the present invention provides a binding release member is a disk rotatably provided on the lever operated with the electromagnet, in the above-mentioned inventions.

[0017] Further, another aspect of the present invention provides a binding release member, which is a cam provided on the lever operated with the electromagnet, in the above-mentioned inventions.

[0018] Further, another aspect of the present invention provides a device comprising: an earth switch; a third operation mechanism that operates its movable contact; and an interlock mechanism that disables power-on of the movable contact of the earth switch when the contact is in the opening position Y2, and disables actuation of the second operation mechanismwhen the earth switch is powered-on, in accordance with the second operation mechanism in any one of the first to eighth invention.

[0019] According to the present invention, since the movable contact and its operation mechanism are coupled via at least one lever, the number of levers and pivotal coupling members can be reduced, and the transmission efficiency of driving force by the operation mechanism can be improved. Further, as the mechanical interlock between circuit breaker and disconnector can be easily realized, the operation reliability can be improved.

[0020] Hereinbelow, a embodiments of a switchgear opening/closing device of the present invention will be described using the drawings. In the following, reference numerals denote members set forth below:

1---vacuum valve, 5---movable contact, 13---contact pressure spring,30---position operation mechanism, 31---first shaft, 40---first operation mechanism, 41---electromagnet in first operation mechanism, 42---trip spring, 70---second operation mechanism, 71---electromagnet in second operation mechanism, 72---roller, 81---stopper pin, 100---earth switch,

102---earth switch operation mechanism, 108---interlock mechanism, Y1---closed position, Y2---open position, Y3---disconnection position

[0021] Fig. 1 is a side view showing the embodiment of the switchgear opening/closing device of the present invention. Fig. 2 is a top view of Fig. 1. Fig. 1 shows a case where the switchgear is in an open state.

[0022] A vacuum valve 1 is connected to a power source or a load (not shown) via a fixed side feeder 2A and a movable side feeder 2B. A movable contact 5 to a fixed contact 3 in the vacuum valve is stopped in three positions, a closed position Y1 for energization, an open position Y2 to break an electric current, and a disconnection position Y3 to ensure an operator's safety against a surge voltage such as thunder.

[0023] A vacuum container 4 comprises a ceramic cylinder 6, upper and lower end plates 7 and 8, and a bellows 9. The operation of the movable contact 5 is enabled while a vacuum-tight state is maintained with the bellows 9. A movable conductor 10 and the movable side feeder 2B are coupled via a flexible conductor 11, such that energization performance upon operation is ensured.

[0024] Upon coupling between a vacuum valve 1 and a 3-position operation mechanism 30, an insulation rod 12 is inserted so as to electrically separate a main circuit from a mechanism part. In this embodiment, a contact pressure spring 13 to apply a contact load to the contact is included in the insulation rod 12. The insulation rod 12, coupled with a contact lever 33 fixed to a first shaft 31 via a pin 32, operates the movable contact 5 by rotation operation of the first shaft 31.

[0025] Note that as shown in Fig. 2, in this embodiment, a 3-phase switchgear is described, however, the present invention is applicable to a single-phase opening/closing device.

[0026] Thestructure of the above-described3-position operation mechanism 30 will be described in more detail using Figs. 1 and 2.

[0027] The 3-position operation mechanism 30 comprises a first shaft 31, a first operation mechanism 40 for switch operation between the closed position Y1 and the open position Y2, and a second operation mechanism 70 for switch operation between the open position Y2 and the disconnection position Y3. The first operation mechanism 40 has an electromagnet 41 and a trip spring 42. In a coupling portion between the electromagnet 41 and an operation lever 44, a coupling member 43 to allow circular motion of the operation lever 44 and linear motion of the electromagnet 41 by rotation of the first shaft 31 is provided.

[0028] On the other hand, the second operation mechanism 70 comprises a roller operation mechanism 73 and an electromagnet 71 as its driving source. A lever 75 is supported rotatably about a shaft 76, and a roller 72 is provided at one end of the lever 75 rotatably with a pin 78. The roller 72 is in contact with a stopper pin 81 provided on the end side of a disconnection lever 80. The rear anchor of the disconnection lever 80 is fixed to the first shaft 31.

[0029] The other end of the above-described lever 75 is coupled with the electromagnet 71. The electromagnet 71 and the lever 75 are coupled via a coupling member 74 for linear motion of the electromagnet 71 and circular motion of the lever 75. A bearing 77 of a shaft 76 is fixed to an upper part of the electromagnet 71.

[0030] Next, the structures of the above-described electromagnet 41 and the electromagnet 71 will be described using Figs. 3 and 4.

[0031] First, the structure of the electromagnet 41 will be described using Fig. 3. A movable iron core, comprising a plunger 50 and a movable flat plate 51, has a T-shaped cross section. A stainless rod 52 is inserted through the plunger 50 and the movable flat plate 51, and fixed to the plunger 50 and the movable flat plate 51 with a nut 53.

[0032] A fixed iron core comprises an upper iron core 54, a side leg steel pipe 55, a central leg 56, and a permanent magnet bed 57. A coil 65 is provided inside the fixed iron core. The plunger 50 is inserted through the center of the coil 65. A ring-shaped permanent magnet 58 is attached to the permanent magnet bed 57 so as to be opposite to the movable flat plate 51. A steel pipe 59 to reduce leak magnetic flux to the outside the electromagnet is provided around the permanent magnet 58. The upper iron core 54, the side leg steel pipe 55, the permanent magnet bed 57, the steel pipe 59 and a lower steel plate 60 are held with a bolt 61 and a nut 62 and assembled to the electromagnet 41.

[0033] Further, the trip spring 42 is held between a member 63 and the lower steel plate 60 provided at an end (lower end in Fig. 3) of the stainless rod 52. The member 63 is fixed to the stainless rod 52 with a nut 64.

[0034] Next, the structure of the above-described electromagnet 71 will be described using Fig. 4. A fixed iron core comprises three steel plates 85, 86 and 87, and two steel pipes 88 and 89. Two coils 90 and 91 are provided inside the core. When the respective coils are excited, a plunger 92 moves in upward and downward directions. The plunger 92 is fixed to an operation shaft 93. As shown in Fig. 1, the upper end of the operation shaft 93 is coupled with the other end of the lever 75. Further, a return spring 94 is provided between the steel plate 85 and the plunger 92.

[0035] As shown in Fig. 5, an earth switch 100 is provided in the fixed side feeder 2A of the respective vacuum valves 1 shown in Figs. 1 and 2. A movable contact 101 with respect to a fixed contact of the earth switch 100 is movably-operated by an earth switch operation mechanism 102.

[0036] The earth switch operation mechanism 102 comprises a second shaft 103 provided in parallel with the first shaft 31, a contact lever 104 provided on the second shaft 103, a ground lever 105 provided on the second shaft 103, a coupling rod 106 to couple the contact lever 104 with the movable contact 101, and an elec-

tromagnet 107 coupled with the ground lever 105.

[0037] The electromagnet 107 in the earth switch operation mechanism 102 is coupled with the operation shaft 93 of the electromagnet 71 in the above-described second operation mechanism 70 via an interlock mechanism 108. When the movable contact 5 in the vacuum valve is in the disconnection position Y3 as the position 3 to ensure an inspection operator's safety against a surge voltage such as thunder, the interlock mechanism 108 enables power-on of the movable contact 101 to the fixed contact of the earth switch 100 with the electromagnet 107. Further, when the movable contact 5 in the vacuum valve is in the open position Y2 as the position 2 to break an electric current, the interlock mechanism 108 disables power-on of the movable contact 101 to the fixed contact of the earth switch 100 with the electromagnet 107. Further, when the movable contact 101 is powered-on in the fixed contact of the earth switch 100, the interlock mechanism 108 disables actuation of the electromagnet 71 in the second operation mechanism 70.

[0038] That is, the interlock mechanism 108 comprises a pin 110 provided at a lower end of the operation shaft 109 of the electromagnet 107, an interlock shaft 111 provided in parallel with the second shaft 103 below the electromagnet 107, a lever 112 provided on the shaft 111 and coupled with a lower end of the operation shaft 93 of the electromagnet 71 in the second operation mechanism, and two levers 113 and 114 provided on the shaft 111 and engaged with the pin 110.

[0039] Next, the operation of the embodiment of the above-described switchgear opening/closing device of the present invention will be described using Figs. 6 to 11.

[0040] Fig. 6 shows a state where the movable contact 5 in the vacuum valve 1 is set in the open position Y2 to break an electric current. In Fig. 6, the first operation mechanism 40 always applies a clockwise rotation force to the disconnection lever 80 provided on the first shaft 31 with its trip spring 42 via the coupling member 43.

[0041] In this arrangement, the stopper pin 81 provided on the disconnection lever 80 is in contact with the roller 72, which suppresses further clockwise rotation by the trip spring 42. That is, movement from the open position Y2 to break an electric current to the disconnection position Y3 to ensure the operator's safety against a surge voltage such as thunder can be prevented.

[0042] Note that an interference point P by the contact between the stopper pin 81 and the roller 72 is set to be on the opposite side to the electromagnet 71 with respect to a straight line connecting the rotation shaft 78 of the roller 72 with the shaft 76 of the lever 75. Accordingly, the lever 75 receives a counterclockwise rotation force to its shaft 76. However, as movement of the plunger 92 of the electromagnet 71 coupled with the lever 75 is suppressed with the steel plate 87, the position of the interference point P, i.e., the open position Y2 is regulated. Further, the open position Y2 can be adjusted with the number of thin plates 95 provided on a bearing fixing member of the shaft 76.

[0043] Next, the operation (power-on operation) from the open position Y2 to the closed position Y1 by the first operation mechanism 40 will be described using Fig. 7.

[0044] As shown in Fig. 7, when the coil 65 of the electromagnet 41 is energized, an attraction force F1 acts on its plunger 50, then the plunger 50, the movable flat plate 51 and the stainless rod 52 move upward in Fig. 7. The driving force is transmitted to the first shaft 31 via the coupling member 43, to rotate the first shaft 31 in the counterclockwise direction. By this arrangement, the contact lever 33 rotates in the counterclockwise direction, to move the movable contact 5 in the direction of the closed position Y1. In the closed state, the trip spring 42 and the contact pressure spring 13 are both in energy-stored state, in preparation for opening operation.

[0045] Note that the contact state between the stopper pin 81 and the roller 72 is cleared by the power-on operation as shown in Fig. 8. However, the position of the roller 72 does not change since the plunger 92 receives a downward force by the return spring 94 of the electromagnet 71.

[0046] As shown in Fig. 8, in the state held in the closed position Y1, a holding force to resist the energy-storing force of the trip spring 42 and the contact pressure spring 13 is required of the first operation mechanism 40. To obtain the holding force, in the present embodiment, the attraction force of the permanent magnet 58 in the first operation mechanism 40, i.e. a so-called magnetic latch is applied. As shown in Fig. 9, attraction forces Fp and Fp1 act on the plunger 50 and the movable flat plate 51 by a magnetic flux Φ made by the permanent magnet 58 in the electromagnet 41. The total sum Fp + Fp1 is set to a level equal to or higher than the above-described spring energy-storing force so as to maintain the state in the closed position Y1.

[0047] Generally, an electric interlock is provided to prevent the operation of the second operation mechanism 70 to disable the disconnection operation when the switchgear is in the closed state. Recently, as there are increasing safety improvement needs, generally a mechanical interlock is also provided on the premise of failure of the electric interlock. In the 3-position operation mechanism 30 used in the present invention, as shown in Fig. 8, the interference by the contact between the stopper pin 81 and the roller 72 is cleared in the closed state, such that even if the second operation mechanism 70 operates, the first shaft 31 and the movable contact 5 are not influenced. That is, one of the mechanical interlocks between the circuit breaker and the disconnector, "when the movable contact is in the closed position, the disconnection operation is disabled" is automatically realized.

[0048] Next, the operation (opening operation) from the closed position Y1 to the open position Y2 by the first operation mechanism 40 will be described.

[0049] In the opening operation, the energy-storing force of the trip spring 42 and the contact pressure spring 13 is utilized. A tripping operation of the magnetic latch

will be described using Fig. 10. The coil 65 in the electromagnet 41 is excited in an opposite direction to that upon power-on operation, to cancel the magnetic flux Φ of the permanent magnet 58, and reduce the attraction force to act between the plunger 50 and the central leg 56. The attraction force FP1 to act on the movable flat plate 51, not depending on the excitation of the coil 45, is almost constant. When the total sum of the attraction forces FP + FP1 becomes lower than the energy-storing force of the spring 42, the plunger 50 starts operation downward in the figure, to restore the open state shown in Fig. 6.

[0050] Next, the operation (disconnection operation) from the open position Y2 to the disconnection position Y3 by the second operation mechanism 70 will be described using Fig. 11.

[0051] In the open state shown in Fig. 11, when the coil 90 of the electromagnet 71 is excited, an attraction force F2 in an upward direction in the figure acts on the plunger 92. By this driving force, the lever 75 and the roller 72 connected with the lever rotate in the clockwise direction about the shaft 76. By this arrangement, the roller 72 moves to a position indicated with an alternate long and two short dashes line. Fig. 12 shows a state after the movement, i.e., the disconnection state.

[0052] As described above, the clockwise rotation force always acts on the first shaft 31 by the trip spring 42 of the first operation mechanism 40. Accordingly, the stopper pin 81 and the roller 72 are always in contact point with each other during the disconnection operation. The contact, i.e., the interference point P is shifted downward in the figure by the movement of the roller 72.

[0053] As a result, the first shaft 31 rotates in the clockwise direction, and the movable contact 5 moves to the disconnection position Y3 via the contact lever 33. The disconnection position Y3 is regulated with a position where the plunger 92 and the steel plate 85 of the electromagnet 71 collide with each other. That is, when a bidirectionally movable electromagnet is employed in the second operation mechanism 70, the interval between the open position Y2 and the disconnection position Y3 is automatically regulated with the operation range of the electromagnet, thereby an adjusting mechanism is not required. Further, the contact between the stopper pin 81 and the roller 72 is employed for smooth disconnection operation with reduced friction upon movement.

[0054] In the disconnection state shown in Fig. 12, the plunger 50 of the electromagnet 41 in the first operation mechanism 40 exists lower than the permanent magnet bed 57, i.e., outside the fixed iron core. Accordingly, even if the coil 65 is excited in the disconnection state, there is almost no magnetic flux passing through the plunger 50 and no attraction force occurs. That is, the mechanical interlock between the circuit breaker and the disconnector, "when the movable contact is in the disconnection position, the power-on operation is disabled" is realized.

[0055] Next, the operation from the disconnection position Y3 to the open position Y2 by the second operation mechanism 70 will be described using Fig. 12.

[0056] As shown in Fig. 12, in the disconnection state, when the coil 91 of the electromagnet 71 in the second operation mechanism 70 is excited, a downward attraction force F3 acts on the plunger 92. By the attraction force F3, the lever 75 and the roller 72 rotate-move in the counterclockwise direction about the shaft 76. By this arrangement, the roller 72 pushes the stopper pin 81 in contact with the roller upward, thereby the movable contact 5 moves to the open position Y2.

[0057] Next, the association between the disconnection position Y3 by the second operation mechanism 70 and the earth switch operation mechanism 102 will be described using Fig. 5. When the movable contact 5 in the vacuum valve is in the open position Y2 as the position 2 to break an electric current, the lever 113 in the interlock mechanism 108 is engaged with the pin 110 provided at the lower end of the operation shaft 109 of the electromagnet 107, the power-on of the movable contact 101 to the fixed contact of the earth switch 100 is disabled with the electromagnet 107.

[0058] Further, when the movable contact 101 is powered-on in the fixed contact of the earth switch 100, i.e., in the ground state, as the lever 114 in the interlock mechanism 108 interferes with the pin 110 provided at the lower end of the operation shaft 109 of the electromagnet 107, the actuation of the electromagnet 71 in the second operation mechanism 70 is disabled. On the other hand, as shown in Fig. 14, when the movable contact 5 of the vacuum valve 1 exists in the input position Y1 or the open position Y2, as the pin 110 and the lever 113 interfere with each other, the actuation of the earth switch operation mechanism 102 is disabled. That is, the power-on operation of the earth switch 100 in the closed state and the open state, and further, the disconnection operation in the ground state, are not allowed by the interlock mechanism 108.

[0059] Note that in the above-described embodiment, a freely-rotatable roller 72 is used in the roller operation mechanism 73 of the second operation mechanism 70, however, the roller 72 may be replaced with a partially-circular shaped cam.

[0060] Further, the electromagnet 41 of the first operation mechanism 40 and the electromagnet 71 of the second operation mechanism 70 are arranged below the disconnection lever 80, however, these electromagnets 41 and 71 may be arranged above the disconnection lever 80 as shown in Fig. 13. In this case, the operation rod is coupled with an intermediate part of the disconnection lever 80.

[0061] Further, the electromagnet 71 of the second operation mechanism 70 may be arranged in a direction orthogonal to the actuation direction of the electromagnet 41 in the first operation mechanism 40. Further, the electromagnetic operation system is applied to the first operation mechanism 40, however, other operation system such as electric spring system may be employed.

[0062] According to the above-described embodiment

of the present invention, even though the second operation mechanism 70 for disconnection operation is provided in the first operation mechanism 40, the operation characteristic of the first operation mechanism 40 does not change from that in the case of 2-position operation mechanism. The problem in the conventional devices such as degradation of transmission efficiency of operation force can be solved.

[0063] Further, as the stopper pin 81 and the roller 72 do not interfere with each other in the closed state, even if the electric interlock is broken and the second operation mechanism 70 is operated, only the position of the roller 72 changes but the first shaft 31 and the movable contact 5 are not influenced. That is, one of the mechanical interlocks between the circuit breaker and the disconnector, "when the movable contact is in the closed position, the disconnection operation is disabled" is automatically realized.

[0064] Further, as the plunger 50 of the electromagnet 41 in the first operation mechanism 40 exists outside the fixed iron core in the disconnection state, even if the electromagnet 41 is excited, no attraction force acts and the power-on operation is not performed. That is, the other one of the mechanical interlocks "when the movable contact is in the disconnection position, the power-on operation is disabled" is also realized. That is, according to the 3-position operation mechanism 30 of the present invention, the efficiency of the first operation mechanism, of which a large current input and disconnection duty are required, is improved, and further, the link member for mechanical interlock between the circuit breaker and the disconnector is not required. Accordingly, downsizing, and further, the reliability, can be improved.

Claims

1. A switchgear opening/closing device capable of switching a movable contact to a first position, a second position and a third position with respect to a fixed contact, comprising:

an operation lever interlocked with the movable contact;
a shaft to which a base of the operation lever is fixed;
a first operation mechanism, coupled with the shaft, for switching the movable contact to the first position, the second position and the third position; and
a second operation mechanism for selectively switching between prevention of movement of the movable contact from the second position to the third position and movement of the movable contact from the second position to the third position by the first operation mechanism.

2. A switchgear opening/closing device according to claim 1, wherein
the shaft to which the base of the operation lever is fixed is connected to a second operation lever; and
the first operation mechanism is coupled with the second lever.

3. A switchgear opening/closing device according to claim 2, wherein
the three positions are a closed position, open position and disconnection position, respectively;
the first operation mechanism, coupled with the second operation lever, switches the movable contact to the closed position, the open position and the disconnection position; and
the second operation mechanism that selectively switches between prevention of movement and movement of the movable contact from the open position to the third position by the first operation mechanism.

4. A switchgear opening/closing device according to claim 2, wherein
the first operation mechanism, coupled with the second operation lever, has an electromagnet to drive the movable contact to a closedposition direction anda spring energy-stored in accordance with movement of the movable contact in the closed position direction by the electromagnet.

5. The switchgear opening/closing device according to claim 4, wherein in the electromagnet of the first operation mechanism, its plunger is positioned outside its fixed iron core when the movable contact is in the disconnection position.

6. The switchgear opening/closing device according to claim 5, wherein the second operation mechanism has:

a binding release member in contact with an end side of the second operation lever; and
an electromagnet that move-operates the binding release member.

7. The switchgear opening/closing device according to claim 6, wherein the binding release member is a disk rotatably provided on the lever operated with the electromagnet.

8. The switchgear opening/closing device according to claim 6, wherein the binding release member is a cam provided on the lever operated with the electromagnet.

9. The switchgear opening/closing device according to any one of claims 1 to 8, comprising: an earth switch; a third operation mechanism that operates its movable contact; and an interlock mechanism that disa-

bles power-on of the movable contact of the earth switch when the point is in the opening position Y2, and disables actuation of the second operation mechanism when the earth switch is power-on, in accordance with the second operation mechanism.

FIG. 1

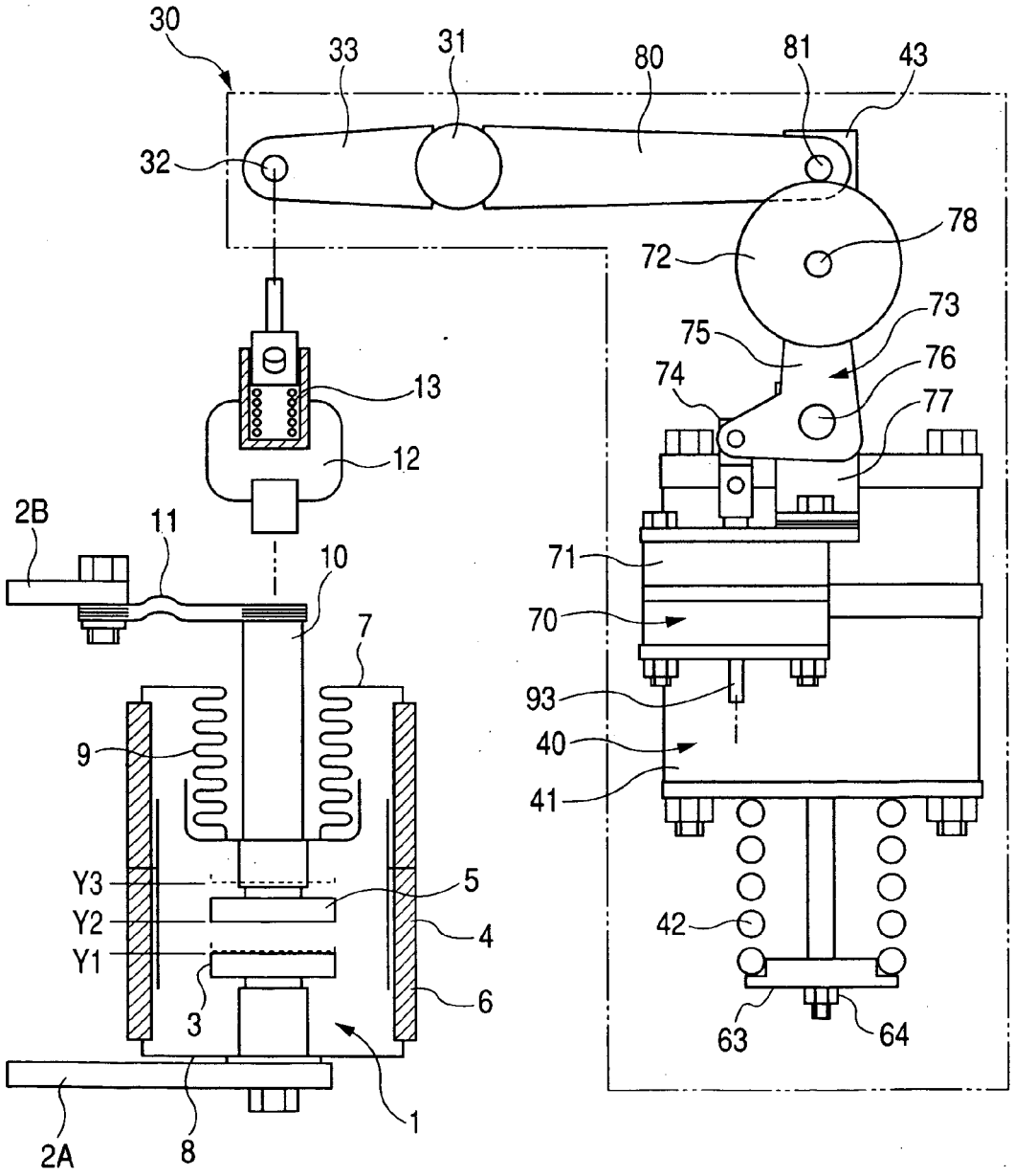
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FIG. 2

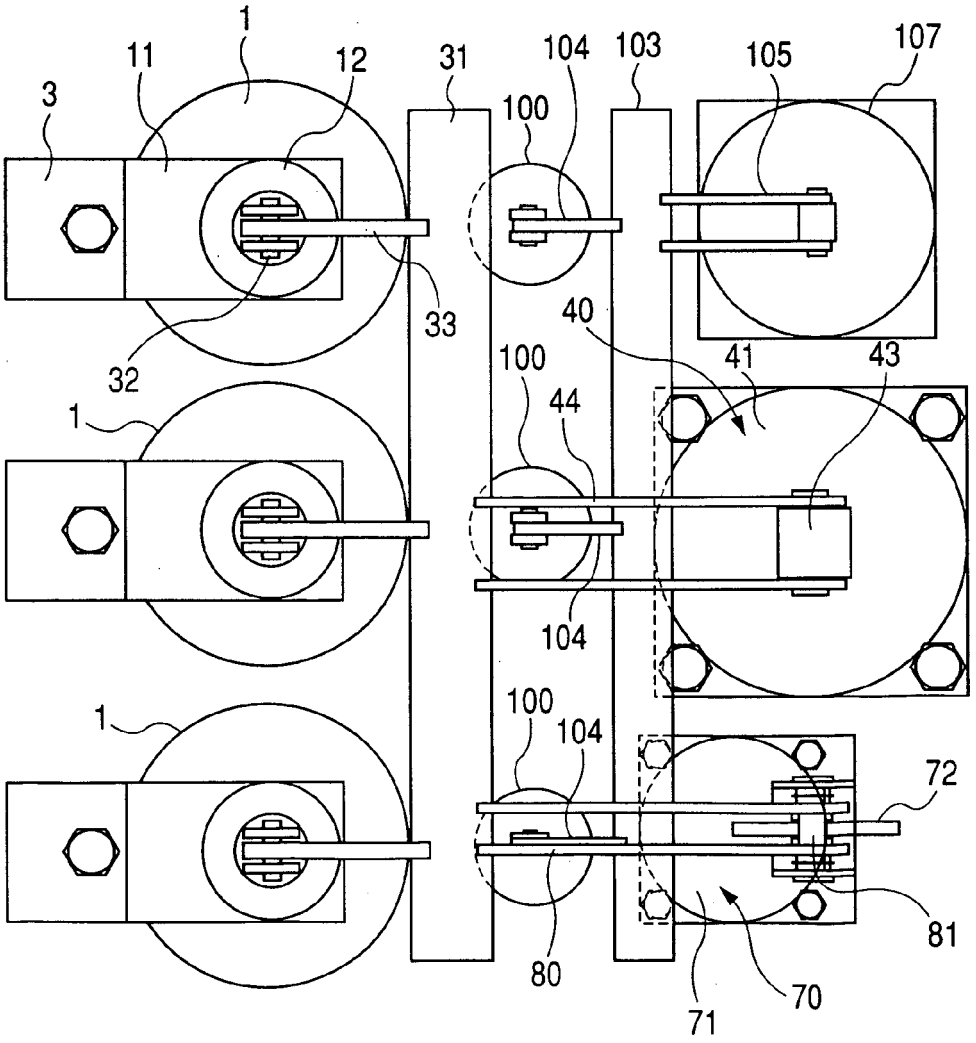
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FIG. 3

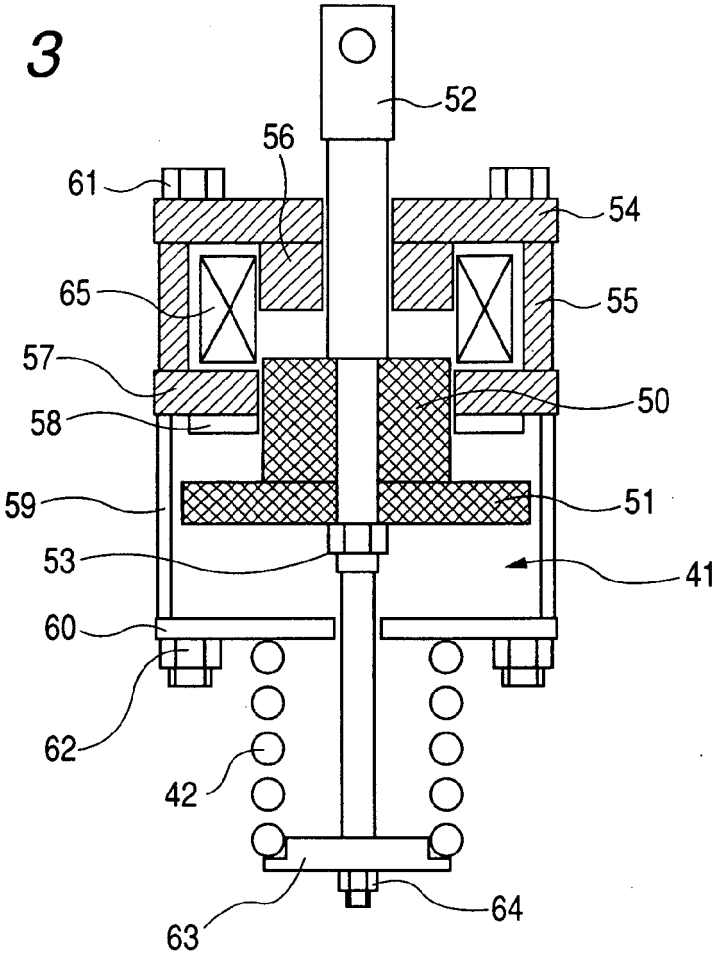
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FIG. 4

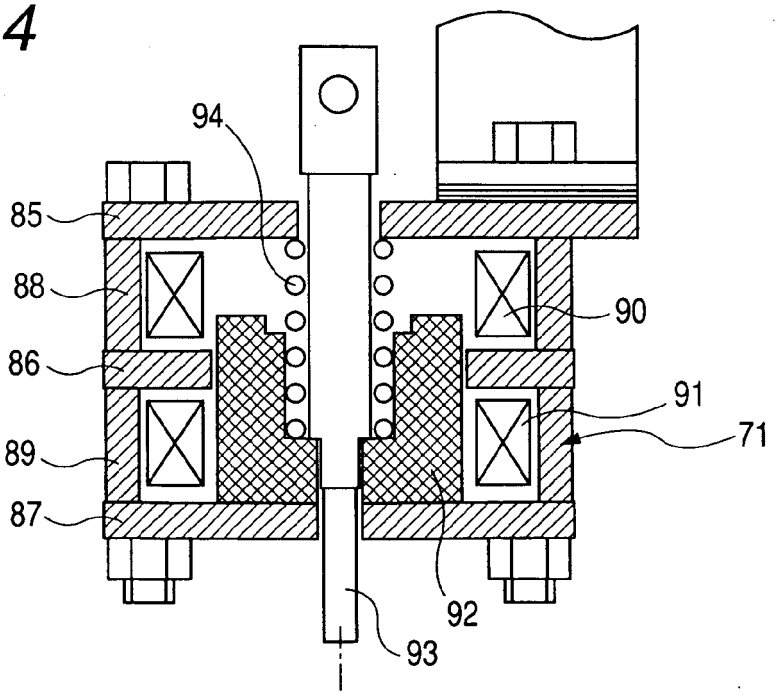
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FIG. 5

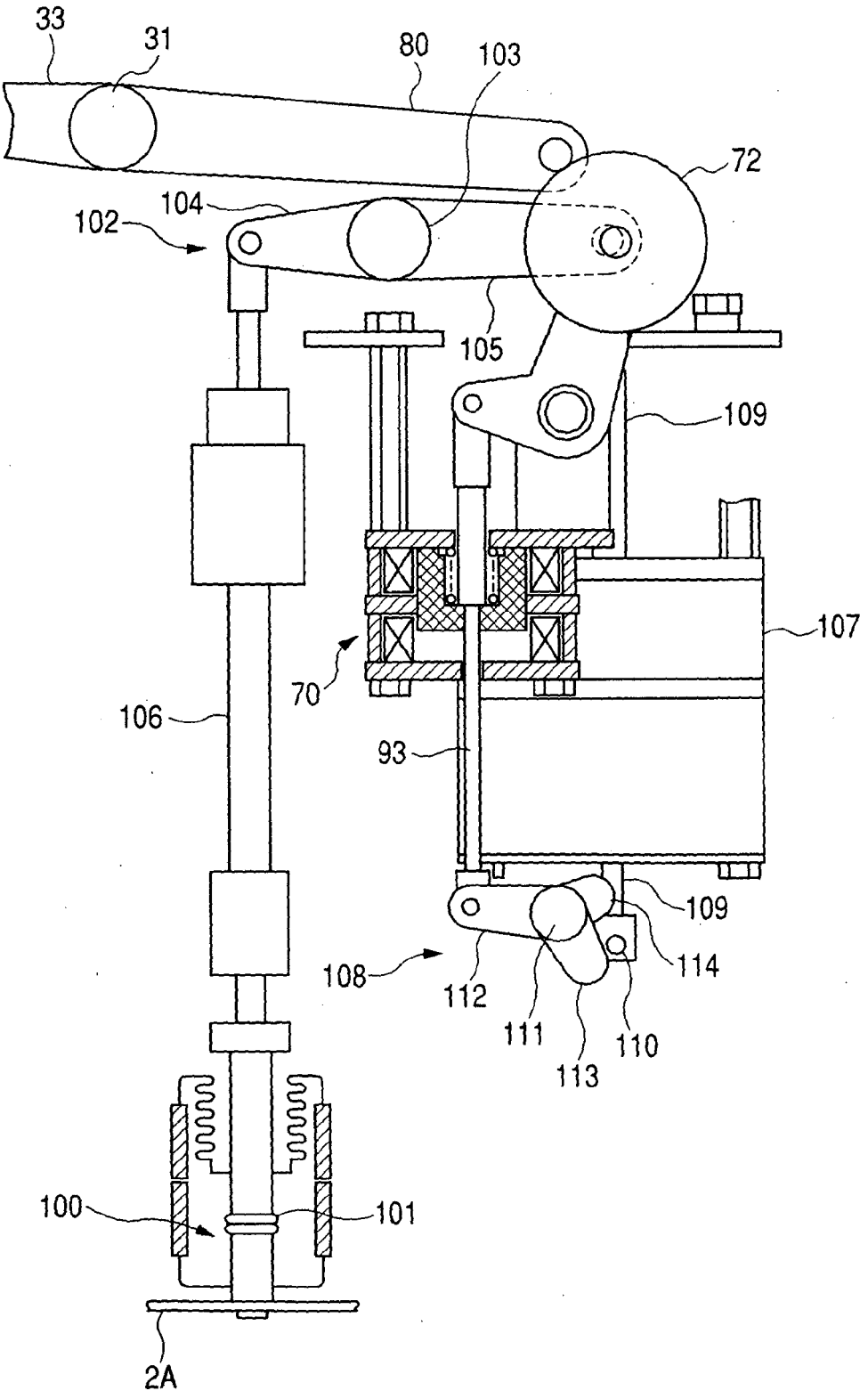
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FIG. 6

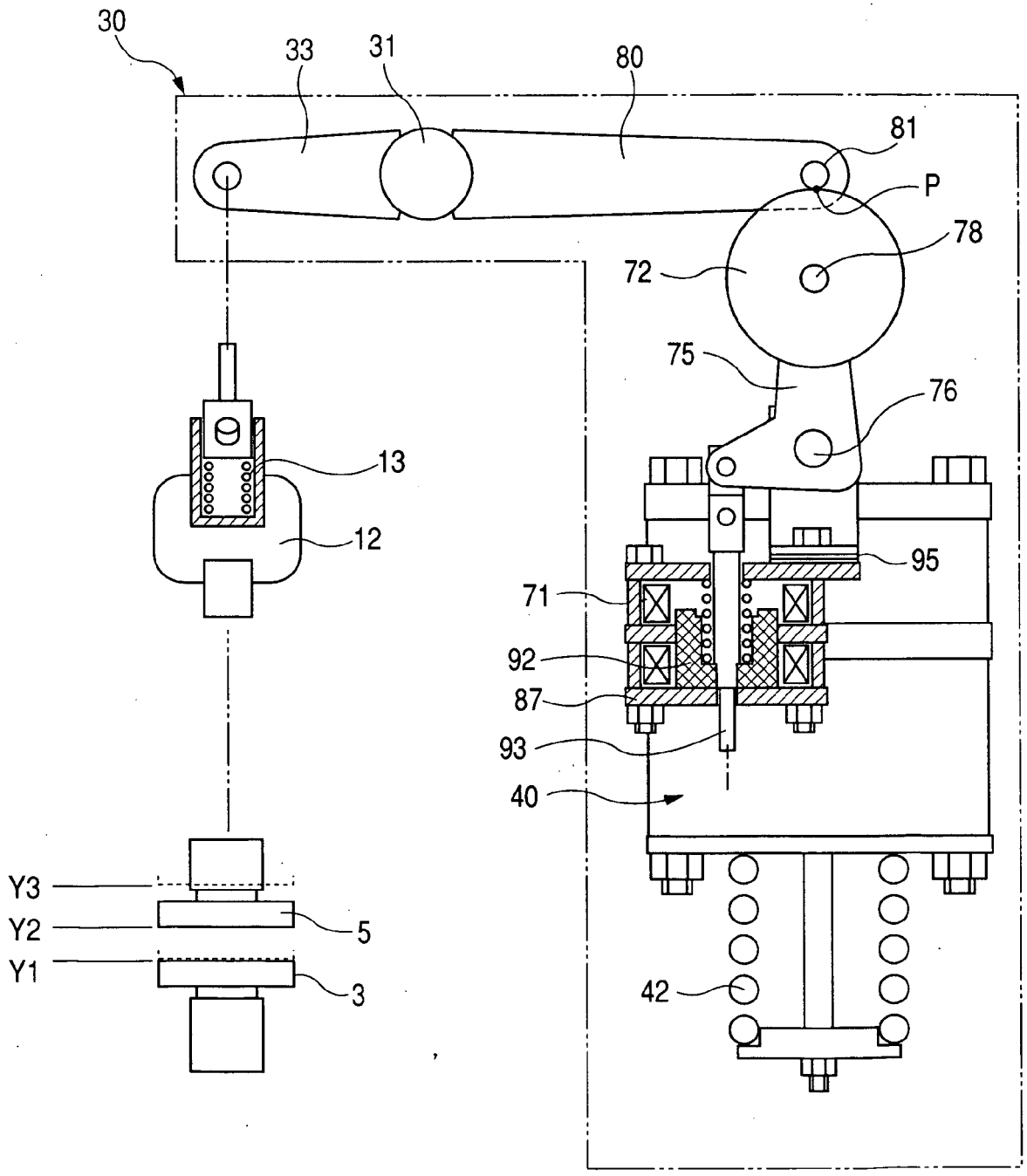

FIG. 7

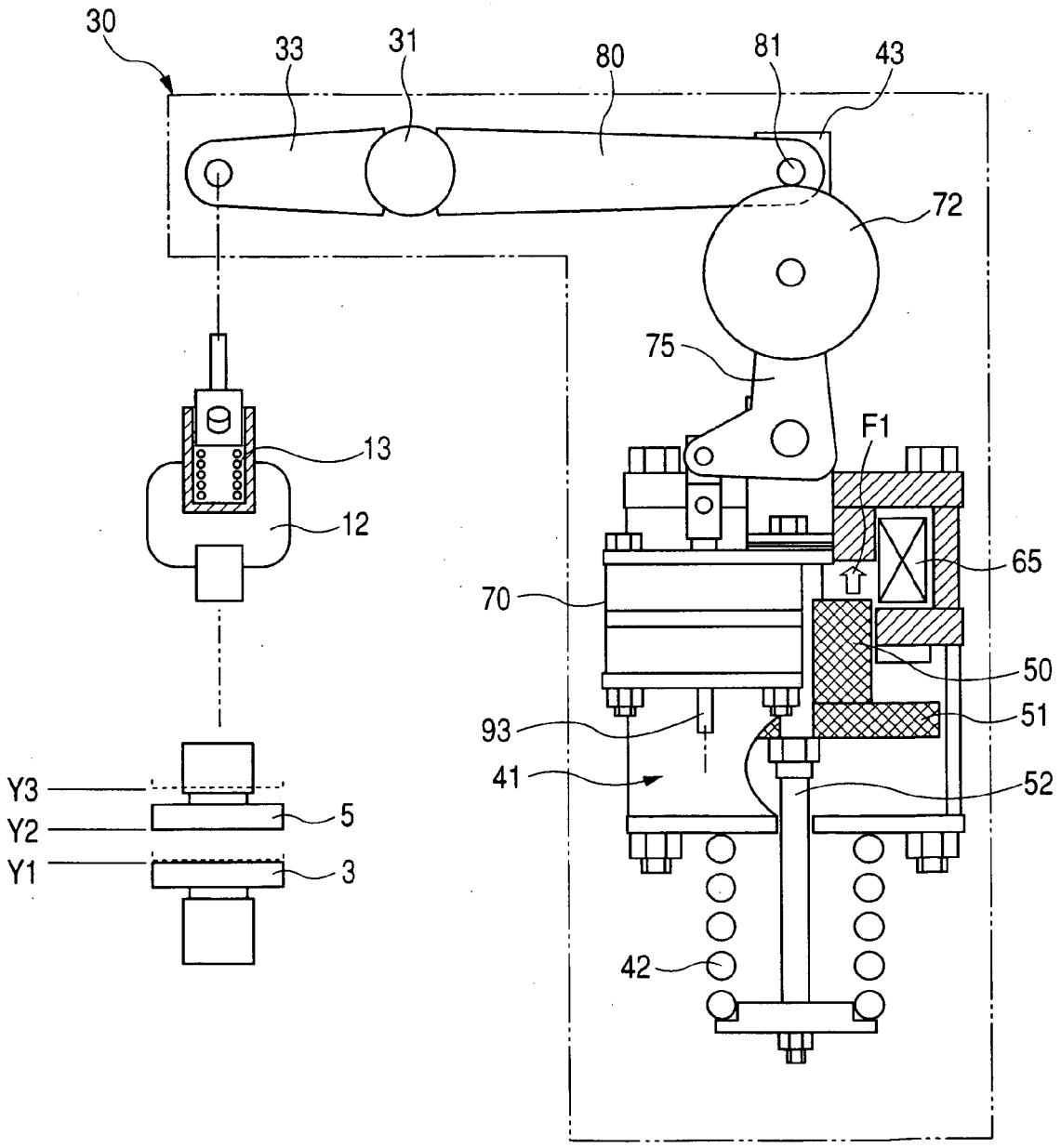

FIG. 8

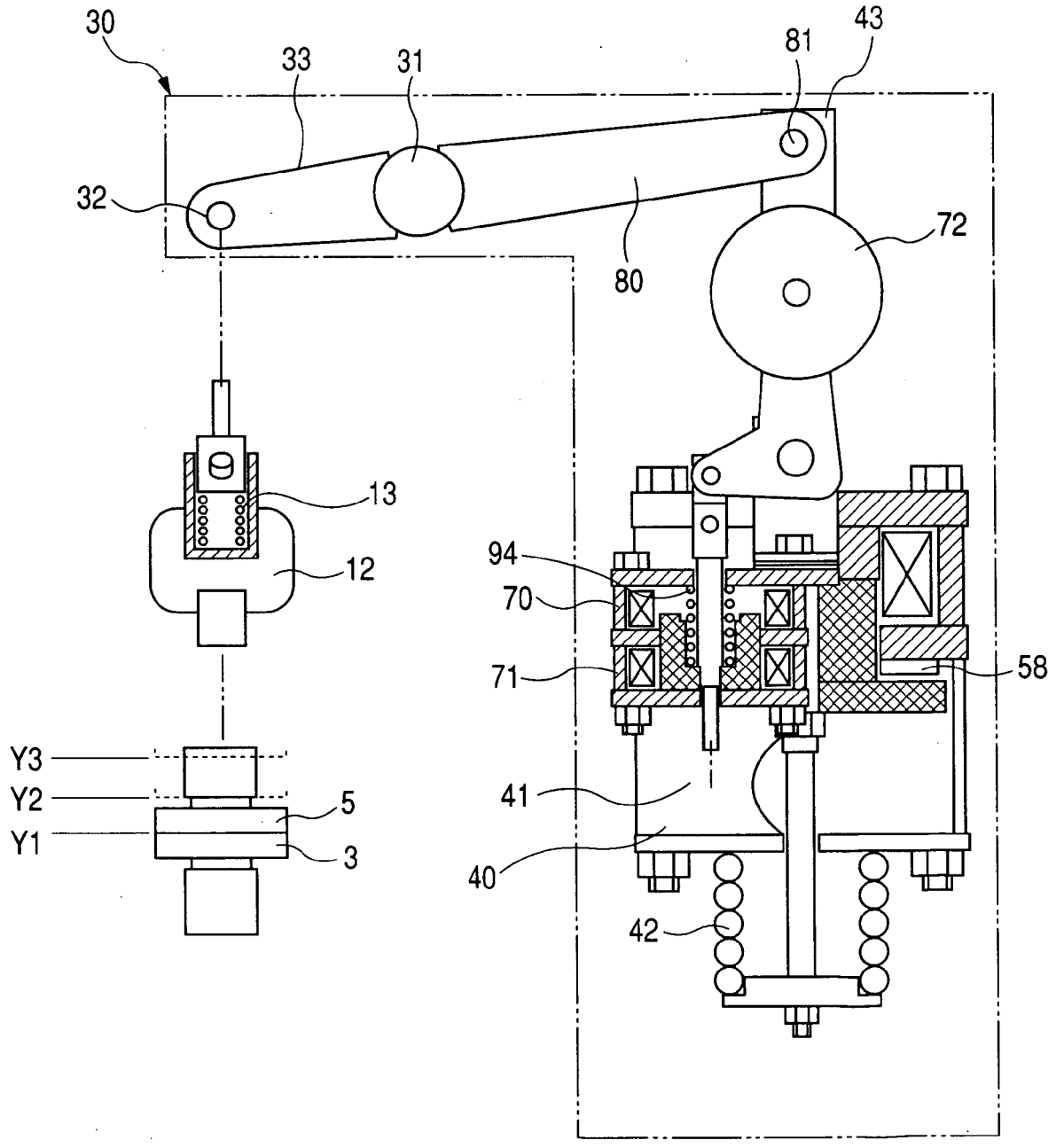

FIG. 9

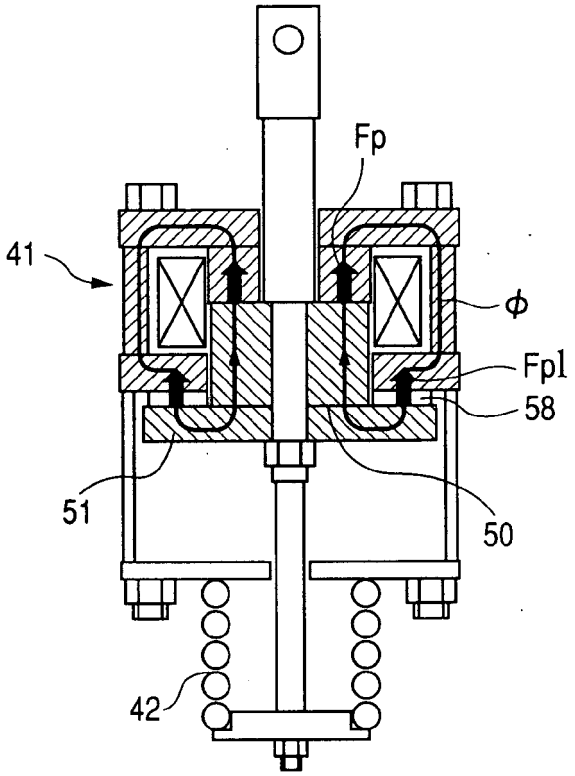

FIG. 10

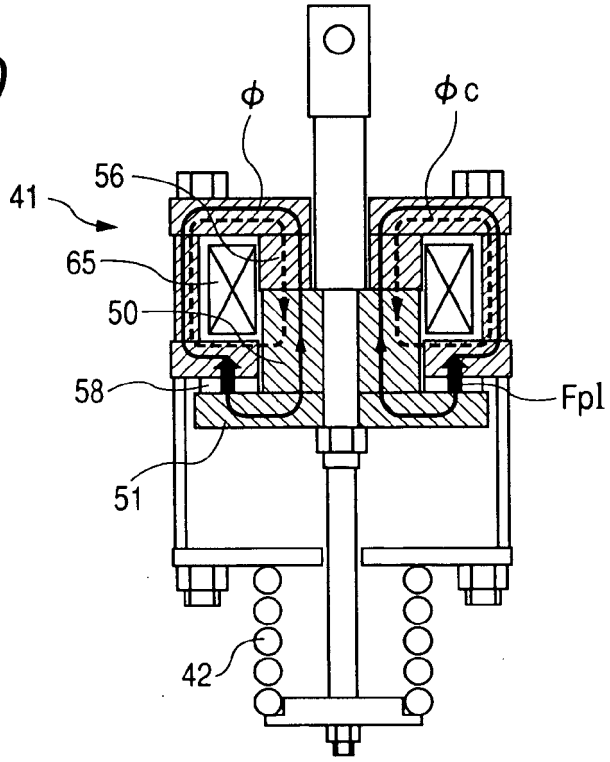

FIG. 11

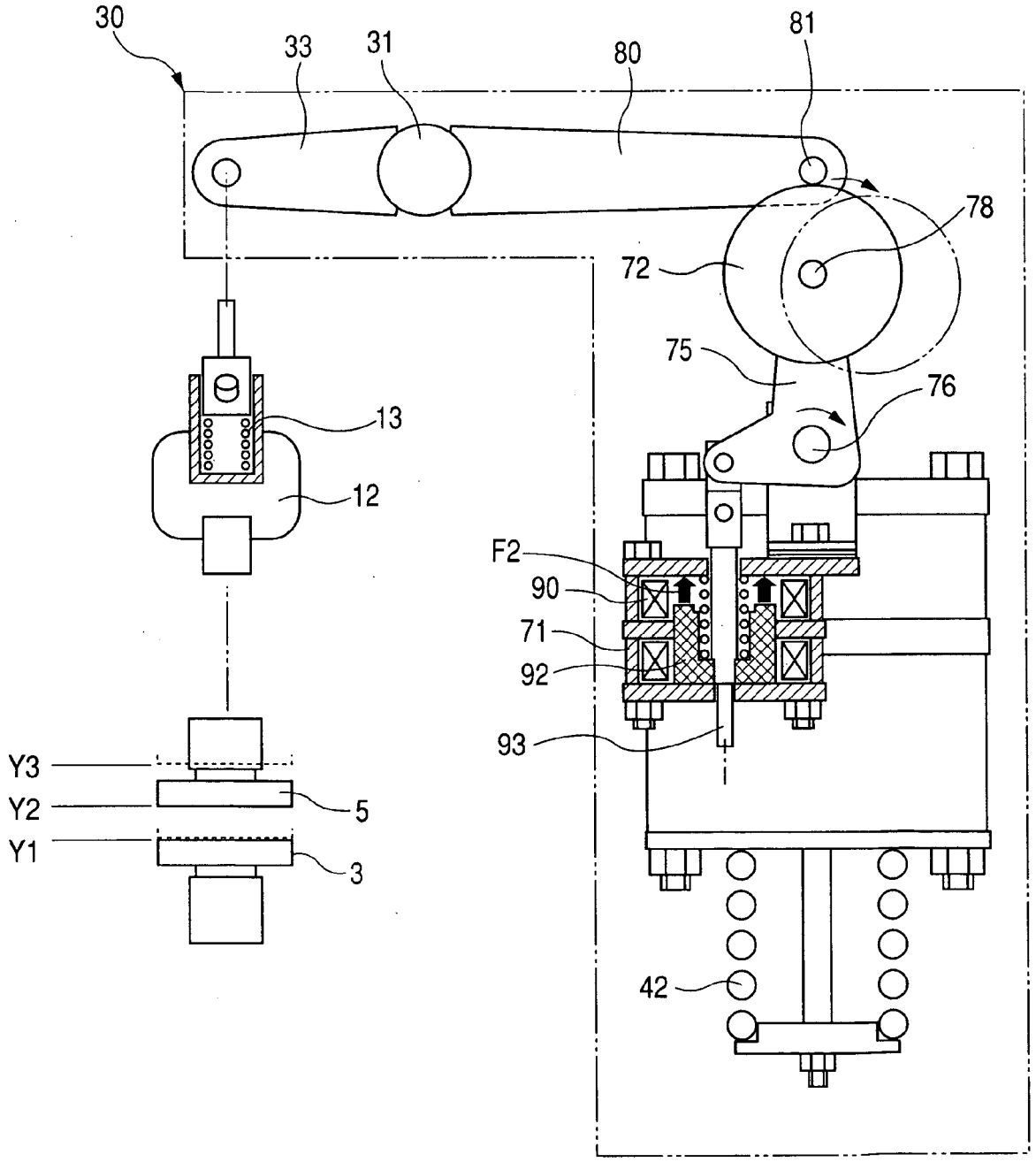

FIG. 12

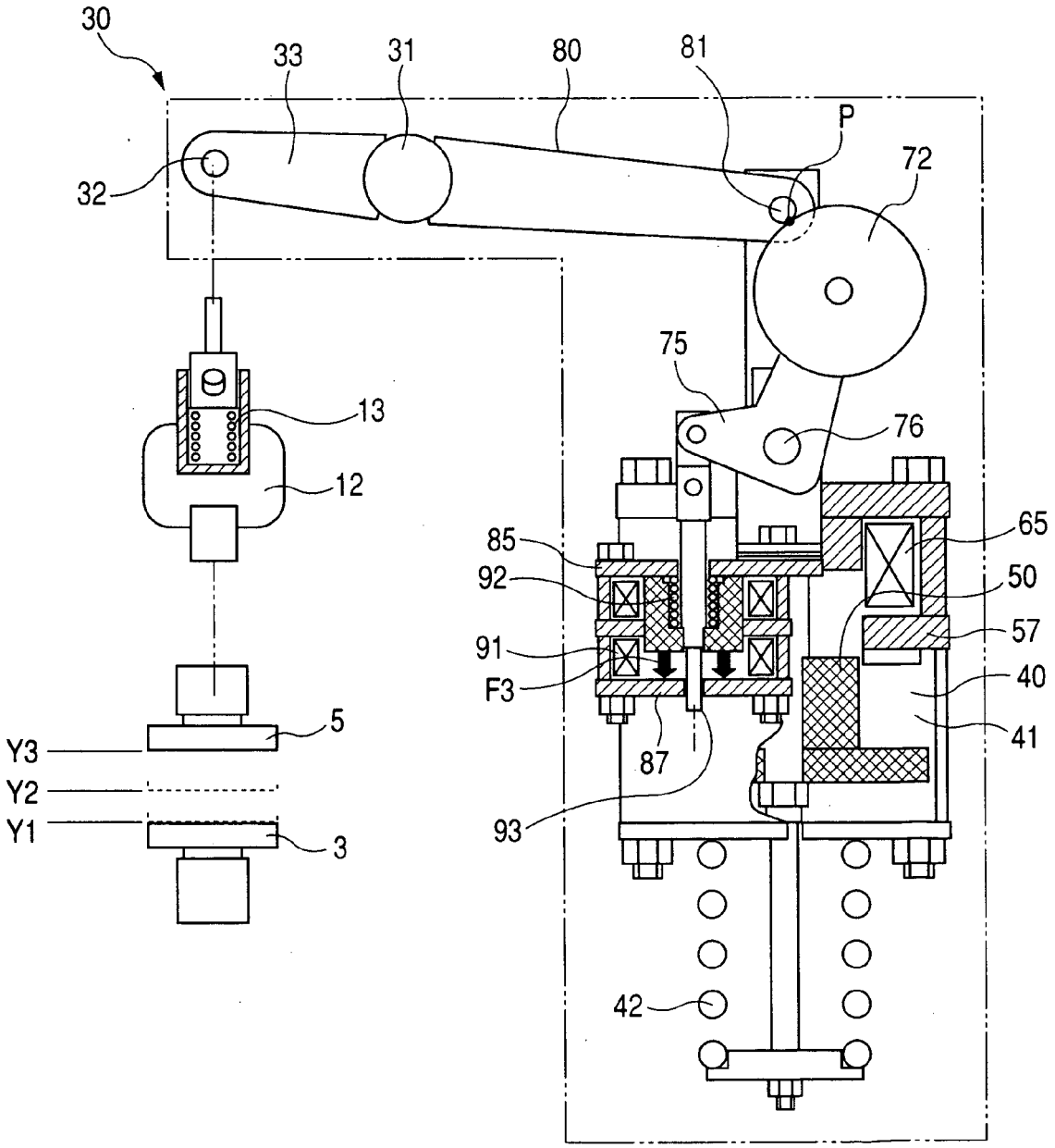
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FIG. 13

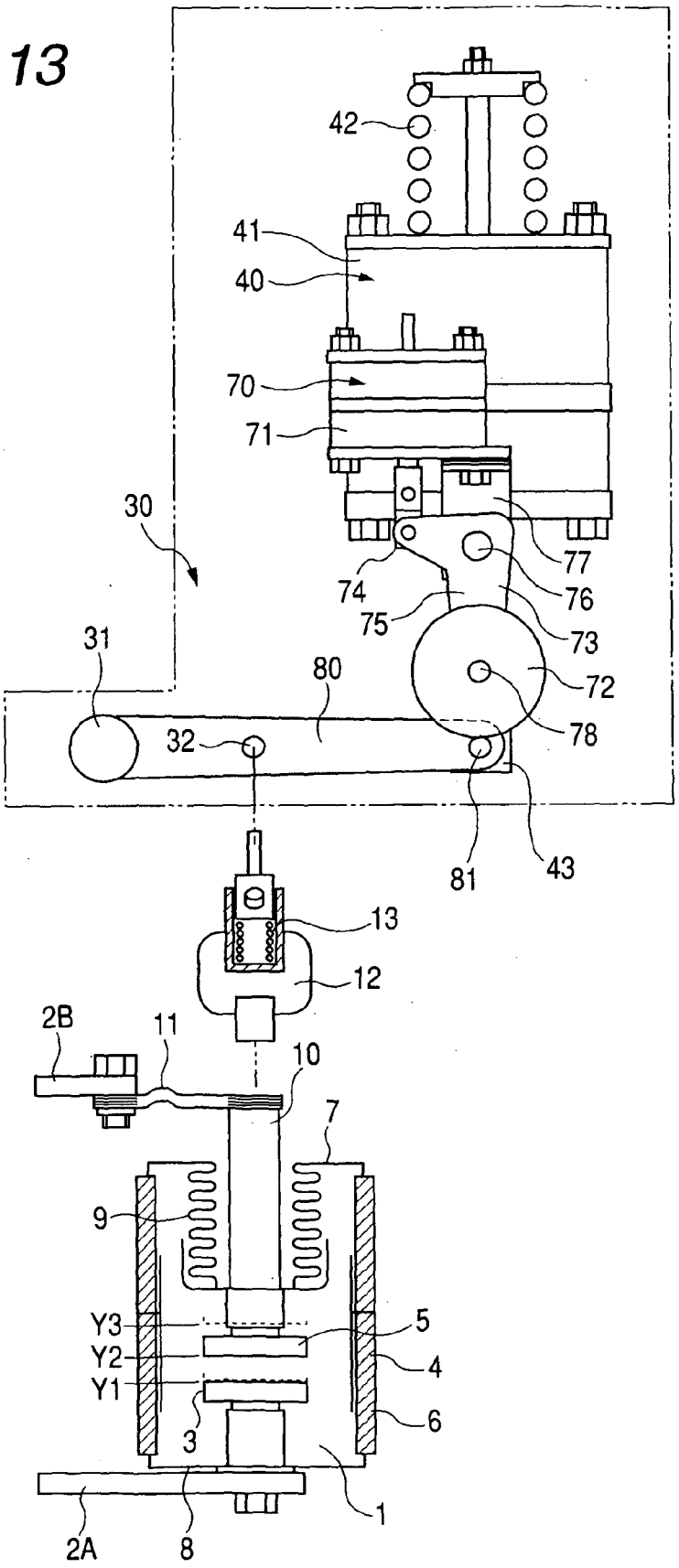
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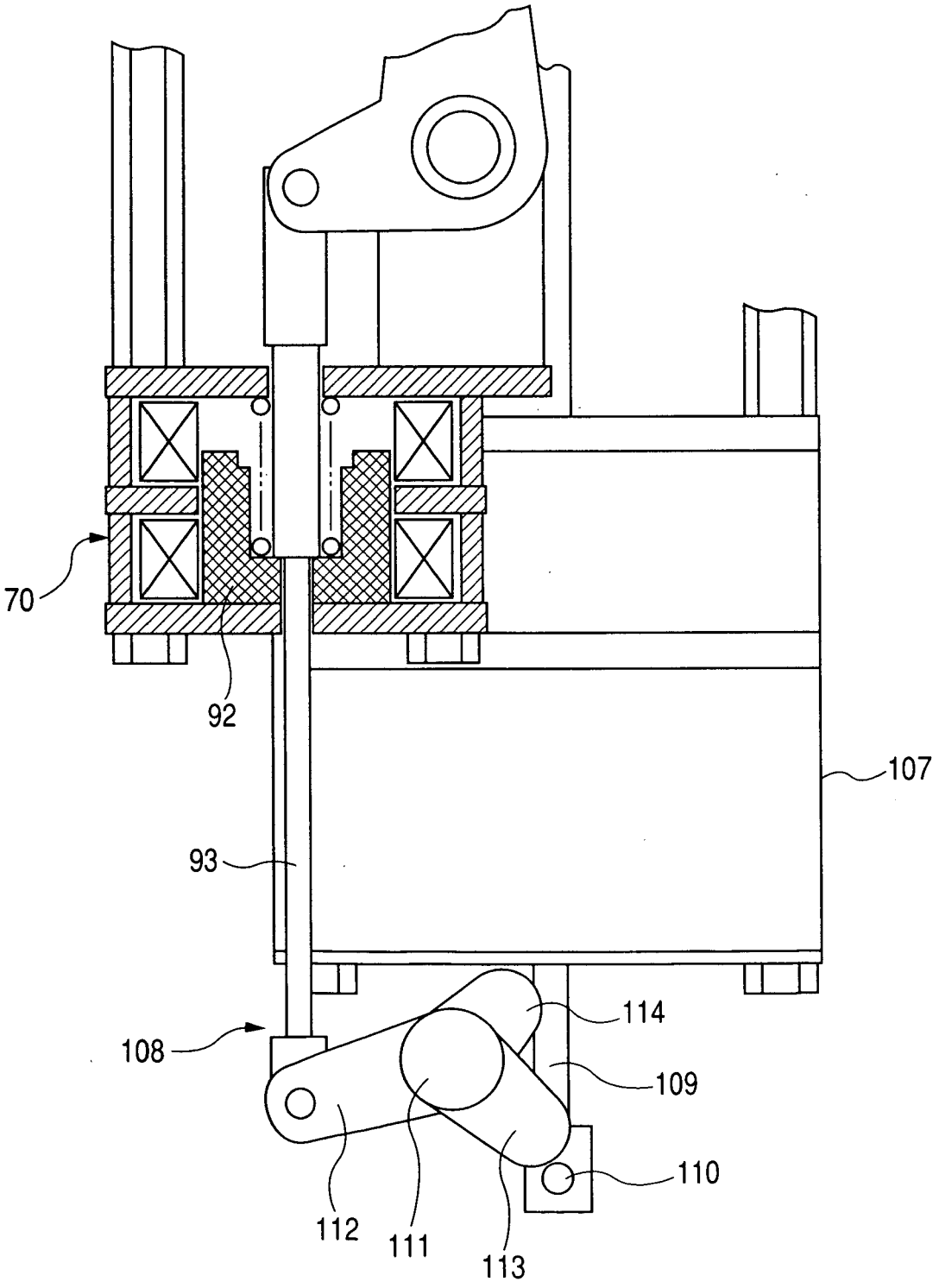
FIG. 14



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Patent documents cited in the description

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