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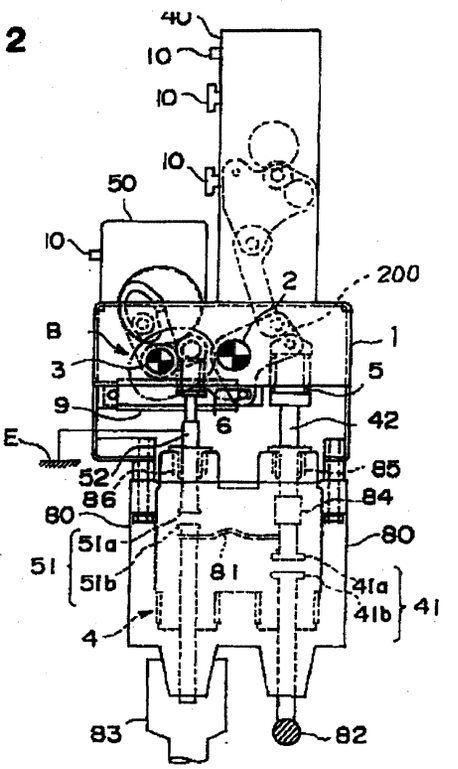
(54) Switchgear

(57) A switchgear having vacuum valves, an interrupter operating mechanism and a ground switch operating mechanism, the latter two being disposed on a metal common base frame. The interrupter operating mechanism comprises a drive shaft that extends on a line of direction of opening and dosing movements of a contact electrode of the vacuum valve, whereby a drive load is directly transmitted to the contact of the vacuum valve along the line of direction. The drive shaft of the interrupter operating mechanism is disposed on the common base frame at a section between movable rods and is connected to the drive shaft through a connecting member. A connecting member and a spring rod of a ground switch side movable rod of the ground switch operating mechanism are connected through a wipe-link mechanism.

FIG. 2



EP 1 126 484 A2

Description

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application is based on Application No. 2000-040040, filed in Japan on February 17, 2000, the contents of which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

[0002] This invention relates to a switchgear having a vacuum valve, an interrupter operating mechanism and a ground switch operating mechanism and, more particularly, to a layout arrangement of the interrupter operating mechanism and the ground switch operating mechanism.

[0003] The layout arrangement of an interrupter operating mechanism and a ground switch operating mechanism of a conventional switchgear will be described in conjunction with Figs. 7 and 8. Fig. 8 is a side view of the apparatus shown in Fig. 7.

[0004] In Figs. 7 and 8, the reference numeral 60 is an interrupter operating mechanism, which comprises a stationary terminal 61a and a movable terminal 61b connected to a vacuum valve 61 as well as an insulating operating rod 62 connected at one end to the movable terminal 61b at the upper portion of the vacuum valve 61 and at the other end to an interrupter drive shaft 21 through a wipe-link mechanism as shown in a circle A in the figure.

[0005] On the other hand, the reference numeral 70 is a disconnector/ground switch operating mechanism, which comprises a disconnector/grounding switch contact 71, ground switch drive shaft 22 connected to the disconnector/ground switch 71, a ground terminal 72 and the like.

[0006] The reference numeral 20 is a tank, which accommodates the interrupter operating mechanism including an interrupter vacuum valves 61, an interrupter drive shaft 21 or the like for opening and closing the vacuum valves 61 as well as the disconnector/ground switch contact 71 of the disconnector/ground switch operating mechanism and a ground switch drive shaft 22 for opening and dosing the contacts 71. Bus bars 82 are also disposed.

[0007] The reference numeral 23 is a mounting frame, 24 is an interrupter link frame, 25 is a ground switch link frame and the arrangement is such that the interrupter link frame 24 mounts the interrupter operating mechanism 60 to the mounting frame 23 and the ground switch link frame 25 mounts the ground switch operating mechanism 70 to the mounting frame 23.

[0008] When the interrupter drive shaft 21 of the interrupter operating mechanism 60 is rotated, the movable contact of the vacuum valve 61 is operated through the wipe-link mechanism (the mechanism encircled by the circle A in Fig. 7) and the insulating operating rod 62.

[0009] Referring now to Fig. 8, the disconnector/ground switch contacts 71 of the disconnector/ground switch operating mechanism 70 are in an A position and is in the connected state. The rotation of the ground switch drive shaft 22 brings the mechanism into a position B to be in the disconnected state, and further rotation of the ground switch drive shaft 22 causes the mechanism into a position C in which the disconnector/ground switch contacts 71 are brought into engagement with and connected to the ground terminal 72 to be placed into the grounded state.

[0010] As described above, according to the conventional arrangement of the interrupter operating mechanism and the ground switch operating mechanism, the drive shaft 21 of the interrupter operating mechanism and the drive shaft 22 of the ground switch operating mechanism are members that are relatively long because it must transmit a drive force through the mounting frame 23 and thick because it must have a sufficient rigidity.

[0011] Also, as shown in Fig. 9, the rotational drive force on the interrupter dnve shaft 21 is converted in its direction of driving force by means of a complicated linkage including links 100 and 102, an elongated rod 104 and pins and shaft connecting therebetween, so that these parts are large and strong members for a sufficient rigidity against bent or the like. The space within which the above links and levers are operated must be sufficiently large so as not to interfere with each other.

[0012] Further, the links, the interrupter link frame 24, the ground switch link frame 25 or the like must have be heavy and large in order to provide a sufficient rigidity because the friction and the load losses at the time of converting the drive direction are large.

[0013] Figs. 10 to 12 inclusive illustrate the wipe-link type mechanism of the portion A shown in Fig. 7. Fig. 10 is a side view of the mechanism in the open position, Fig. 11 is a front view of the mechanism shown in Fig. 10 and Fig. 12 is a front view of the mechanism in the closed position.

[0014] In the figures, the reference numeral 26 is a contacting spring, 27 is a spring rod firmly disposed at an end of the insulating rod 62 to project toward the wipe-link A side and 28 is a U-shaped bracket connected to the lever 21a of the interrupter drive shaft 21 by means of a pin 29.

[0015] The U-shaped bracket 28 has formed therein a hole for allowing an end of the spring rod 27 to extend and slidably move therethrough. This structure is for maintaining the interrupter contact spring 26 compressed to a certain extent after the interrupter contacts of the vacuum valves 61 are brought into contact with each other in order to generate a contact pressure at the vacuum valve 61 for maintaining a contact pressure above a predetermined value even when the operating stroke of the drive link mechanism is decreased.

[0016] In the contact closed position, the spring rod 27 comes out to project from the U-shaped bracket 28 by a distance B shown in Fig. 12 with the above wipe

stroke, so that a relieve distance is provided between the pin 29 and the top of the bolt head attached to the spring rod 27.

[0017] Also, since the U-shaped bracket 28 is made of a metal sheet material bent into a shape, the only guide surface available for guiding the spring rod 27 is the inner peripheral surface having a length corresponding to the thickness C shown in Fig. 12.

[0018] According to the conventional layout arrangement of the operating mechanism for the interrupter and the ground switch, the tank, the interrupter operating mechanism and the ground switch operating mechanism are independently mounted to the mounting frame and they all must have the respective required rigidity, so that each component members or parts is large in size and therefore the installation space for these members was inevitably large.

[0019] Also, the interrupter operating mechanism and the ground switch operating mechanism are respectively mounted to the respective independent link frames, so that an unoccupied space within one of the compartment for one unit cannot be utilized by other unit.

[0020] Also, the contacts, the drive shaft, the mechanism, etc. are arranged in such a manner that their driving direction must be changed, so that the frictional loss and the load loss are high and the links and the shafts must be structured to have a large rigidity.

[0021] Also, the space necessary for driving the components part is large requiring a spacious install area, making the overall switchgear dimension large.

[0022] Further, the conventional wipe-link connection requires to have a relieve space because of its structure, and since the length of the guide for the spring rod movement is only a thickness of the sheet metal is short, the rattling or play of the spring rod 27 is large, whereby the mechanism must be large and rigid.

SUMMARY OF THE INVENTION

[0023] The present invention resides in a switchgear having vacuum valves, an interrupter operating mechanism and a ground switch operating mechanism, characterized in that the interrupter operating mechanism and the ground switch operating mechanism are disposed on a common base frame.

[0024] The common base frame may be made of a single metal sheet bent into a frame form and may be disposed between the vacuum valves.

[0025] The interrupter operating mechanism may comprise a drive shaft that extends on a line of direction of opening and closing movements of a contact electrode of the vacuum valve, whereby a drive load is directly transmitted to the contact electrode of the vacuum valve along the line of direction.

[0026] The drive shaft of the interrupter operating mechanism may be disposed on the common base frame at a section between an interrupter side movable rod of the interrupter operating mechanism and a ground switch side movable rod of the ground switch operating mechanism and wherein the drive shaft of the interrupter operating mechanism may be connected to the interrupter side movable rod through a connecting member.

[0027] A connecting member of the drive shaft of the ground switch operating mechanism and a spring rod of a ground switch side movable rod of the ground switch operating mechanism may be connected through a mechanism including a rotary member rotatably mounted to the connecting member about an axis parallel to the drive shaft and including a bore through which the spring rod slidably extends.

[0028] The connecting members may be canti-levered arms.

[0029] An opening spring of the interrupter operating mechanism may be disposed in a space defined between phases of the ground switch operating mechanism.

[0030] The ground switch operating mechanism having a relatively small height may be disposed in front of the interrupter operating mechanism such that the ground switch operating mechanism can be accessed from the front side of the switchgear.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031] The present invention will become more readily apparent from the following detailed description of the preferred embodiments of the present invention taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a front view of the switchgear of the first embodiment of the present invention;
Fig. 2 is a side view of the switchgear shown in Fig. 1;
Fig. 3 is a side view of the connecting member of the drive shaft of the interrupter operating mechanism;
Fig. 4 is a side view showing the connecting member for the ground switch operating mechanism in the open position;
Fig. 5 is a front view showing the connecting member for the ground switch operating mechanism in the open position;
Fig. 6 is a front view showing the connecting member for the ground switch operating mechanism in closed position:
Fig. 7 is a view illustrating the layout arrangement of the interrupter operating mechanism and the ground switch operating mechanism of a conventional switchgear;
Fig. 8 is a side view of the switchgear shown in Fig. 7;
Fig. 9 is a perspective view of the linkage used in the conventional switchgear;
Fig. 10 is a side view of the connecting member

shown in Fig. 9 for the interrupter operating mechanism in the open position;

Fig. 11 is a front view of the connecting member shown in Fig. 10 in the open position; and

Fig. 12 is a front view of the connecting member shown in Fig. 10 in the closed position.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0032] Fig. 1 is a front view of a switchgear of the present invention and Fig. 2 is a side view of the switchgear shown in Fig. 1. The switch gear of the present invention comprises a vacuum valve mold member 80 in which the interrupter and the ground switch contacts are accommodated. The illustrated switch monitor is a three-phase switchgear comprising the box-shaped mold member 80 having integrally formed within an electrically insulating resin three vacuum valves 4 for phases A, B and C.

[0033] In Fig. 2, within the vacuum valve 4 of which interior is maintained at a high vacuum, an interrupter contact 41 serving as both a disconnector and an interrupter as well as a grounding ground switch contact 51 are provided, and a movable contact 41a and a stationary contact 51b of the ground switch are connected together by a flexible conductor or a shunt 81.

[0034] The stationary contact 41b of the interrupter is connected to a bus conductor 82 outside of the mold member 80 and the stationary contact 51b of the ground switch is connected to a power supply cable 83 at the outside of the mold member 80.

[0035] The movable contact 41a of the interrupter is connected to the external interrupter side movable rod 42 external of the mold member 80 through an insulating rod 84 and bellows 85, and the movable contact 51a of the ground switch is connected to a ground switch side movable rod 52 external of the mold member 80 through bellows 86. The ground switch side movable rod 52 is grounded to the grounding portion E.

[0036] During the ordinary current supplying conditions, the interrupter contact 41 is closed and the ground switch contact 51 is opened, so that an electric current flows from the bus conductor 82 to the power line 83 through the interrupter contact 41, the shunt 81 and the ground switch contact 51.

[0037] Also, when the ground switch contact 51 is dosed in the open state in which the interrupter contact 41 is opened, since the ground switch side movable rod 52 is connected to the ground portion E externally of the mold member 80, the power supply cable 83 can be grounded.

[0038] Then the description will be made in terms of the layout arrangement of the interrupter operating mechanism as well as the ground switch operating mechanism. In Figs. 1 and 2, the reference numeral 40 is an operating unit of the interrupter operating mechanism and the 50 is an operating unit of the ground switch operating mechanism.

[0039] The reference numeral 1 is a common base frame having a U-shaped cross section and for the interrupter and as shown in Fig. 2, the common base frame 1 supports at same frame surface the drive shaft 2 for the interrupter operating mechanism 40 and the drive shaft 3 for the ground switch operating mechanism

[0040] The common base frame 1 is a single metal sheet bent to exhibit a substantially U-shaped cross-section (see Fig. 2) and is attached at the upper portion of the mold member 80 by means of bolts. The position at which the mold member 80 is attached is not outside of the row of the phases A, B and C, but between the vacuum valves 4 such as, as shown in Fig. 1, within a clearance defined between the vacuum valve 4 of phase A and the vacuum valve 4 of the phase B as well as the vacuum valve 4 of phase B and the vacuum valve 4 of the phase C.

[0041] Therefore, as seen from the front view of Fig. 1, the width dimension (W) of the common base frame 1 as viewed in Fig. 1 can be made smaller as compared to the case where the base frame is secured at the outside of the row of the vacuum valves 4 of phases A, B and C.

[0042] By this arrangement, the distance between the secured portions can be made short and a sufficient rigidity can be obtained even with a single metal sheet bent structure. Also, the transverse width of the common base frame 1 shown in Fig. 1 can be made smaller by an amount corresponding to the eliminated securing portions at the outer ends, so that the drive shaft 2 for the interrupter operating mechanism and the drive shaft 3 for the ground switch operating mechanism can similarly be shortened. Thus, the rigidity of these drive shafts 2 and 3 is improved by an amount corresponding to the amount of decrease of the distance between the support points, allowing the further reduction of size of the apparatus.

[0043] In alignment with the line of direction of movement of the interrupter side movable rod 42 for opening and closing the interrupter contact 41 (up and down direction in Fig. 2), a contact pressure spring 5 of the interrupter operating mechanism is disposed, and the operating unit of the interrupter operating mechanism 40 is positioned substantially directly above the direction of opening and closing movements of the interrupter through the drive shaft 2 of the interrupter.

[0044] With this arrangement, the drive direction does not have to be changed or converted so that the load may be transmitted along a straight path, whereby the friction and the load loss can be decreased and the required rigidity against bending of components can be minimized.

[0045] Further, with this arrangement, use of a relatively long lever 100 such as used in the conventional example shown in Fig. 9 is not necessary, so that, as shown in Fig. 3, the contact pressure spring 5 and the operating unit of the interrupter operating mechanism

40 may be connected by a canti-levered arm 200 for example as a relatively short connecting member having a required lever ratio, i.e., as a connecting member for the drive shaft 2 of the interrupter operating mechanism.

[0046] Also, the drive shaft 2 of the interrupter operating mechanism can be positioned above the mold member 80 and between the movable rods 42 arranged in a row and the ground switch side movable rod 52.

[0047] Thus, by utilizing the relatively short connecting member as above described and by positioning the drive shaft 2 between the movable rods 42 and 52, the space necessary for driving can be made small and the switchgear can be small-sized.

[0048] In Fig. 4, the connection between the dnve shaft 3 of the ground switch operating mechanism and the spnng rod 52 disposed at the upper end of the ground switch side movable rod 52 for opening and dosing the grounding switch 51, which is a wipe-link mechanism in this example, will now be explained. In Fig. 4, the drive shaft 3 for the ground switch operating mechanism is connected to the spring rod 52a through the connecting member 3a secured to the drive shaft 3, and the connecting member 3a is connected to the spring rod 52a by the wipe-link mechanism which comprises a rotary member 8 rotatably attached to the connecting member 3a about the axis parallel to the drive shaft 3 and in which one end of the spring rod 52a is slidably inserted into a through hole 8a extending in the direction perpendicular to the axis of the rotary member 8. A contact pressure spring 6 is disposed between the rotary member 8 and the flange portion 52b provided at the lower portion of the spring rod 52a.

[0049] The description will now be made as to the wipe-link connection in conjunction with Figs. 4 to 6. Fig. 4 is a side view of the ground switch contact 51 in the open position, Fig. 5 is a front view of the contact shown in Fig. 4 and Fig. 6 is a front view showing the dosed position.

[0050] In Figs. 4 to 6, the reference numeral 6 is a contact pressure spring of the ground switch operating mechanism, 52a is the spring rod, which is an extension of the upper end portion of the ground switch side movable rod 52 of the ground switch contact 51. 8 is a wipe-link pin as a rotary member and is rotatably attached to the connecting member of the drive shaft 3 of the ground switch operating mechanism, i.e., the canti-levered arm 3 as the connecting member secured to the drive shaft 3.

[0051] Provided at the center of the wipe-link pin 8 is a through hole 8a extending perpendicular to the axis of the pin such that the spring rod 52a having one end slidably inserted into the through hole 8a and the pin 8 maintain the compression state of the contact pressure spring 6 of the ground switch contact 51a therebetween.

[0052] When the drive shaft 3 of the ground switch operating mechanism is rotated clockwise to drive the canti-levered arm 3a downward, the wipe-link pin 8 presses the contact pressure spring 6 to drive the spring rod 52a and the movable rod 52 downward to close the ground switch contact 51.

[0053] After the ground switch contact 51 is closed, the contact pressure spring 6 is further compressed to some extend. Therefore, even when the closing stroke is decreased for some mechanical reasons, a certain level of the contact pressure can be maintained by providing a suitable amount of compression of the contact pressure spring.

[0054] The wipe-link mechanism as above explained is directly mounted by the pin to the canti-levered arm lever 3a serving as the connecting member of the drive shaft 3 for the ground switch operating mechanism, even when the spring rod 52a projects upward from the from the wipe-link pin 8 upon the contact separation of the ground switch, there is no connecting pin or the like that interferes with this movement and only the spring rod 52a projects upward, so that there is no need to provide a relieve space, allowing the switchgear to be made smaller.

[0055] Also, since the hole 8a of the wipe-link pin 8 serves as the guide for the spring rod 52a, providing a longer guide surface that that of the conventional plate thickness, whereby the rattling of the mechanism can be reduced and the stability of the contact pressure can be obtained.

[0056] Referring to Figs. 1 and 2 again, the reference numeral 9 is an interrupter opening spring. This interrupter opening spring 9 is disposed within a clearance defined between the contact pressure springs 6 such as between the contact pressure springs 6 of phase A and phase B as well as between the contact pressure springs 6 of phase B and phase C. This eliminates the need for the installation space only for the interrupter opening spring 9, resulting in a compact switchgear.

[0057] Also, the ground switch operating mechanism 50 having a relatively small height is disposed in front of the interrupter operating mechanism 40 or the operating side (front side of the device). Since the interrupter operating mechanism 40 and the ground switch operating mechanism 50 are arranged as above explained, they can be placed close to each other by utilizing the spaces between the component members, so that the access to the display and the operation of the mechanisms can be established from the operating face side or from the front without using a complex linkage even when the interrupter operating mechanism 40 and the ground switch operating mechanism 50 are arranged in tandem.

[0058] Also, with this arrangement, it is possible to obtain a small-sized switchgear having a simple structure.

[0059] In Figs. 1 and 2, the reference numeral 10 is an operation handle on the operating unit of the interrupter operating mechanism 40 and the ground switch operating mechanism 50 and 11 are display units disposed at the front face of the operating unit.

[0060] It is to be noted that, while the wipe-link connection mechanism is explained as being applied to the ground switch operating mechanism of the first embod-

iment, this wipe-link mechanism may equally be applied to other switchgears and general linkage and not to be limited to the switchgear of the first embodiment.

[0061] As has been described, the switchgear of the present invention has vacuum valves, an interrupter operating mechanism and a ground switch operating mechanism, and is characterized in that the interrupter operating mechanism and the ground switch operating mechanism are disposed on a common base frame. According to the inventions as claimed in any one of claims 1 to 9, the arrangement does not require unnecessary space or high rigidity and number of the component parts is small and is simple in structure and lightweight.

[0062] The common base frame may be made of a single metal sheet bent into a frame form and may be secured between the vacuum valves, so that a single metal sheet may provide a sufficient rigidity and the drive shaft of the operating mechanisms can be made short whereby the rigidity can be increased and the number of the parts may be decreased and the overall apparatus can be small-sized.

[0063] The interrupter operating mechanism may comprise a drive shaft that extends on a line of direction of opening and closing movements of a contact electrode of the vacuum valve, whereby a drive load is directly transmitted to the contact electrode of the vacuum valve along the tine of direction, so that the losses in friction and load can be minimized and the space necessary for the operation can be made small.

[0064] The drive shaft of the interrupter operating mechanism may be disposed on the common base frame at a section between an interrupter side movable rod of the interrupter operating mechanism and a ground switch side movable rod of the ground switch operating mechanism and wherein the drive shaft of the interrupter operating mechanism may be connected to the interrupter side movable rod through a connecting member. Therefore, the overall dimension of the switchgear can be decreased.

[0065] A connecting member of the drive shaft of the ground switch operating mechanism and a spring rod of a ground switch side movable rod of the ground switch operating mechanism may be connected through a mechanism including a rotary member rotatably mounted to the connecting member about an axis parallel to the drive shaft and including a bore through which the spring rod slidably extends, so that a longer guide surface can be obtained and the rattling can be decreased and the contact pressure can be made stable.

[0066] The connecting members may be canti-levered arms, so that there is no need to use an elongated rod or levers, making the device small-sized.

[0067] An opening spring of the interrupter operating mechanism may be disposed in a space defined between phases of the ground switch operating mechanism, so that the overall dimension of the device can be decreased.

[0068] The ground switch operating mechanism having a relatively small height may be disposed in front of the interrupter operating mechanism such that the ground switch operating mechanism can be accessed from the front side of the switchgear, so that the access to the display and the operation of the mechanisms can be established from the operating face side or from the front without using a complex linkage even when the interrupter operating mechanism 40 and the ground switch operating mechanism 50 are arranged in tandem.

Claims

1. switchgear having vacuum valves, an interrupter operating mechanism and a ground switch operating mechanism,
   characterized in that said interrupter operating mechanism and said ground switch operating mechanism are disposed on a common base frame.

2. The switchgear as claimed in daim 1, wherein said common base frame is made of a single metal sheet bent into a frame form.

3. The switchgear as claimed in claim 1 or 2, wherein said common base frame is attached between said vacuum valves.

4. The switchgear as claimed in any one of claims 1 to 3, wherein said interrupter operating mechanism comprises a drive shaft that extends on a line of direction of opening and closing movements of a contact electrode of said vacuum valve, whereby a drive load is directly transmitted to said contact electrode of said vacuum valve along said line of direction.

5. The switchgear as claimed in any one of claims 1 to 4, wherein said drive shaft of said interrupter operating mechanism is disposed on said common base frame at a section between an interrupter side movable rod of said interrupter operating mechanism and a ground switch side movable rod of said ground switch operating mechanism and wherein said drive shaft of said interrupter operating mechanism is connected to said interrupter side movable rod through a connecting member.

6. The switchgear as claimed in any one of claims 1 to 5, wherein a connecting member of said drive shaft of said ground switch operating mechanism and a spring rod of a ground switch side movable rod of said ground switch operating mechanism are connected through a mechanism including a rotary member rotatably mounted to said connecting member about an axis parallel to said drive shaft and including a bore through which said spring rod

slidably extends.

7. The switchgear as claimed in claim 5 or 6, wherein said connecting members are canti-levered arms.

8. The switchgear as claimed in any one of claims 1 to 7, wherein an opening spring 9 of said interrupter operating mechanism is disposed in a space defined between phases of said ground switch operating mechanism.

9. The switchgear as claimed in any one of claims 1 to 8, wherein said ground switch operating mechanism having a relatively small height is disposed in front of said interrupter operating mechanism such that said ground switch operating mechanism can be accessed from the front side of the switchgear.

FIG. 1

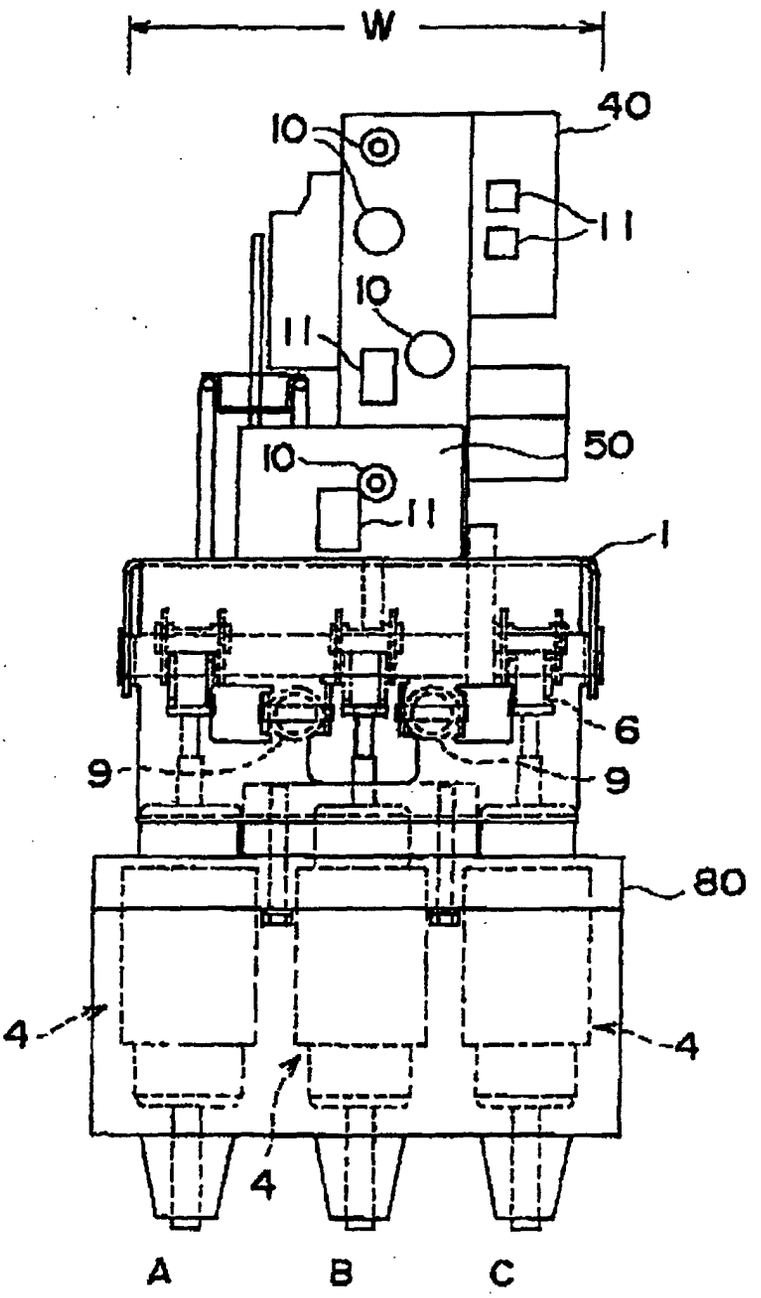


FIG. 2

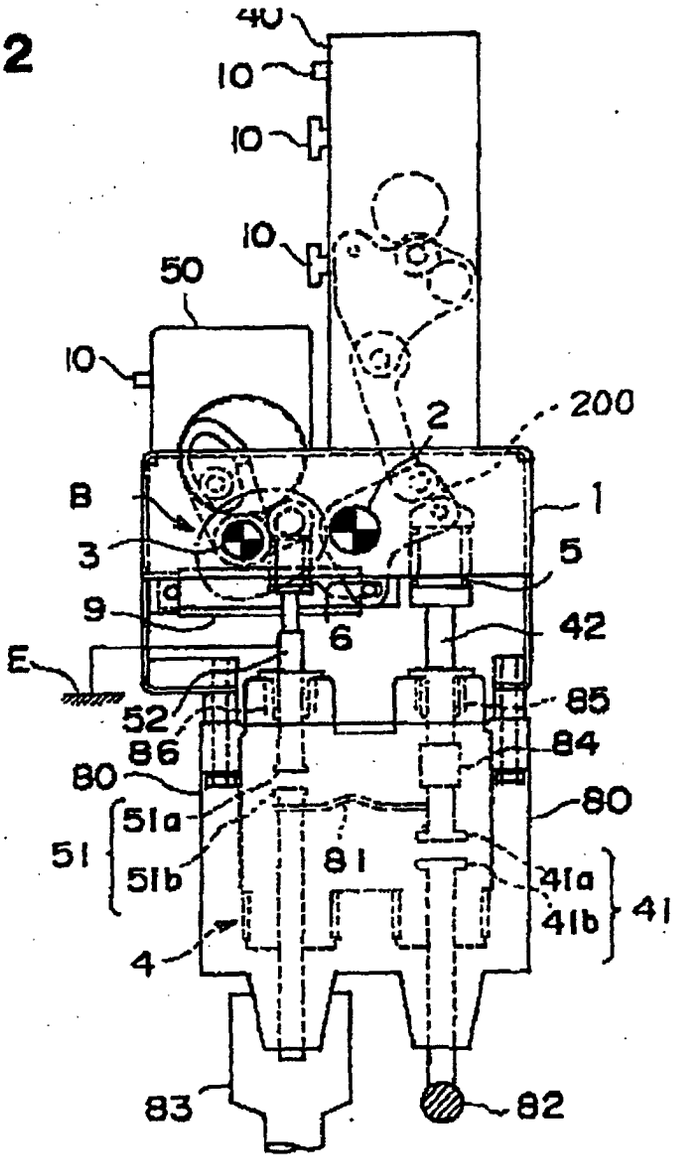

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FIG. 3

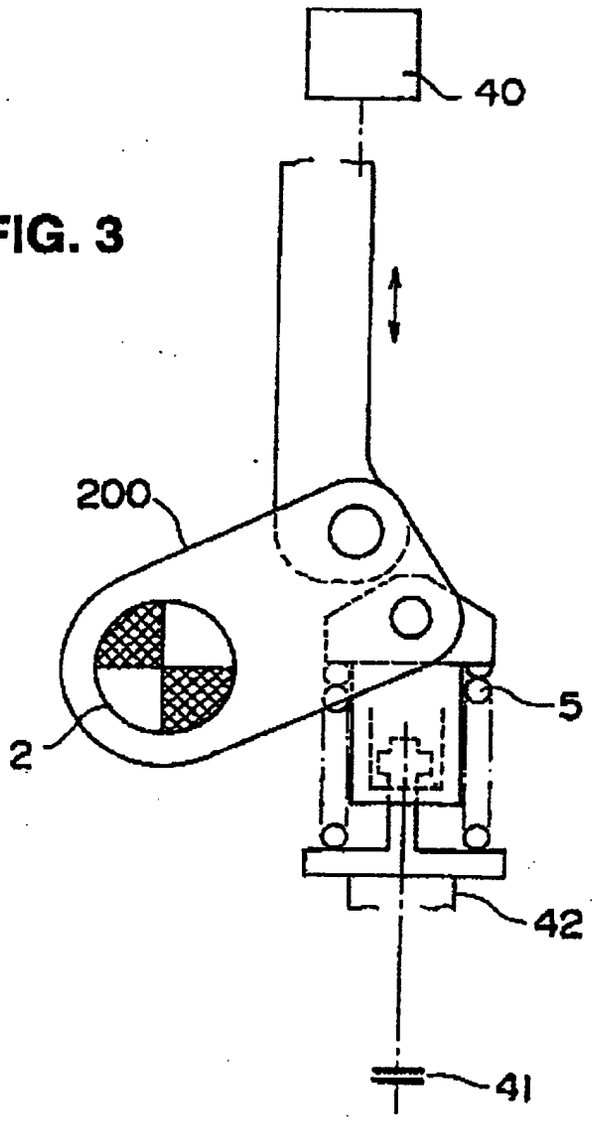


FIG. 4

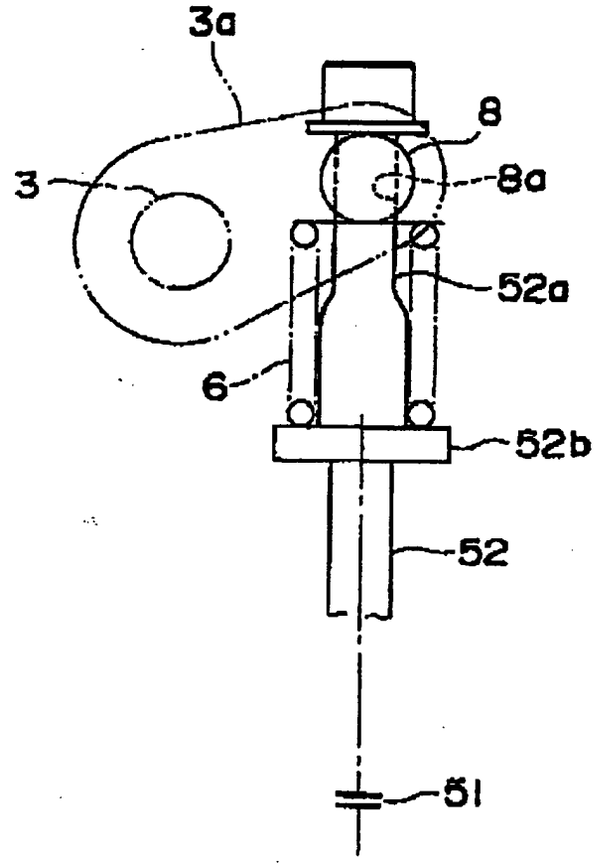


FIG. 5

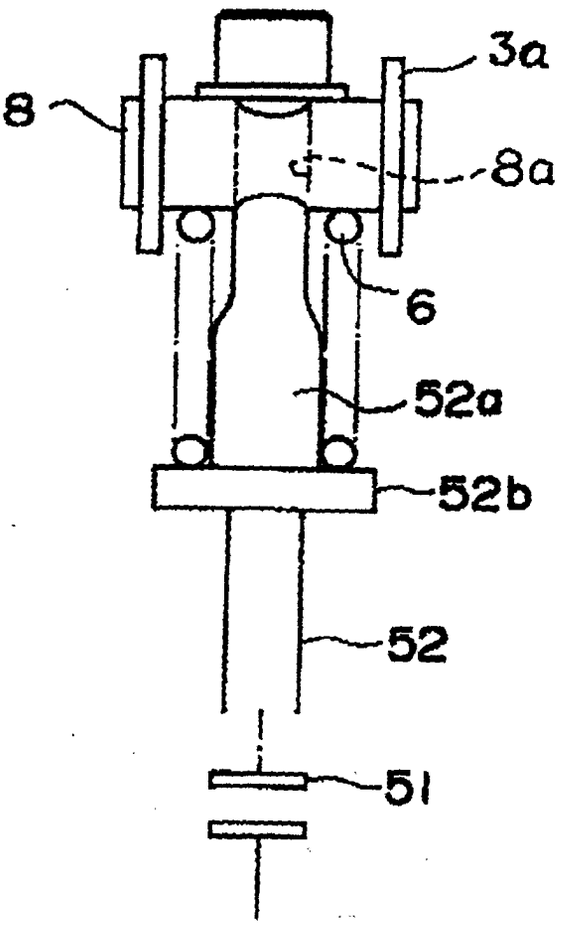


FIG. 6

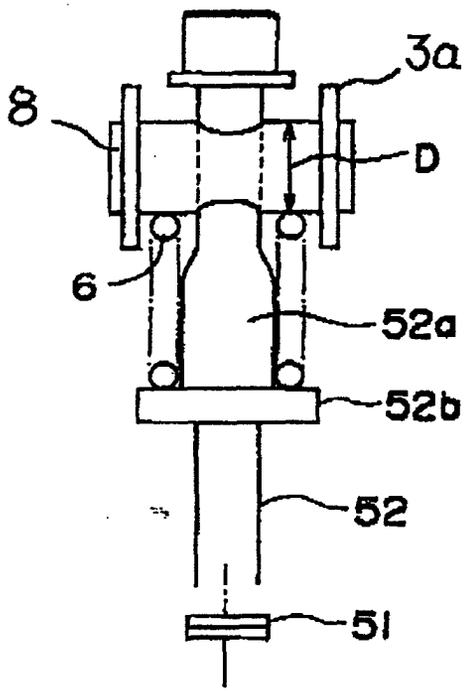


FIG. 7 PRIOR ART

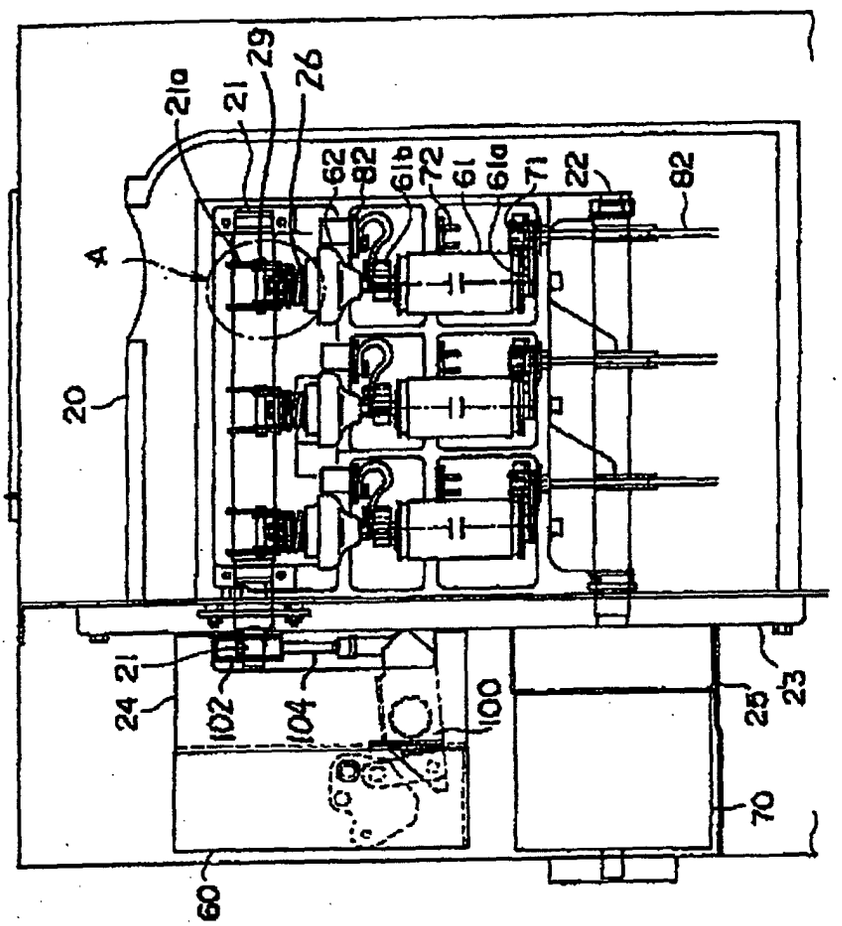
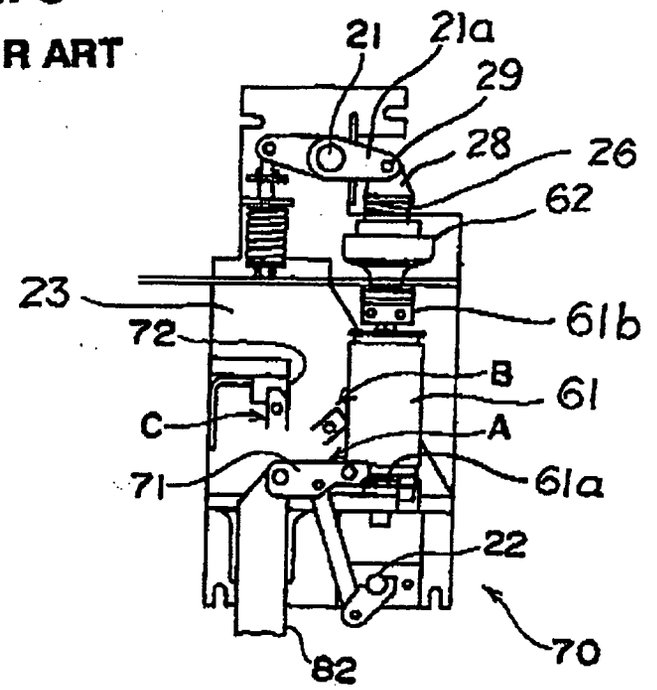


FIG. 8
PRIOR ART



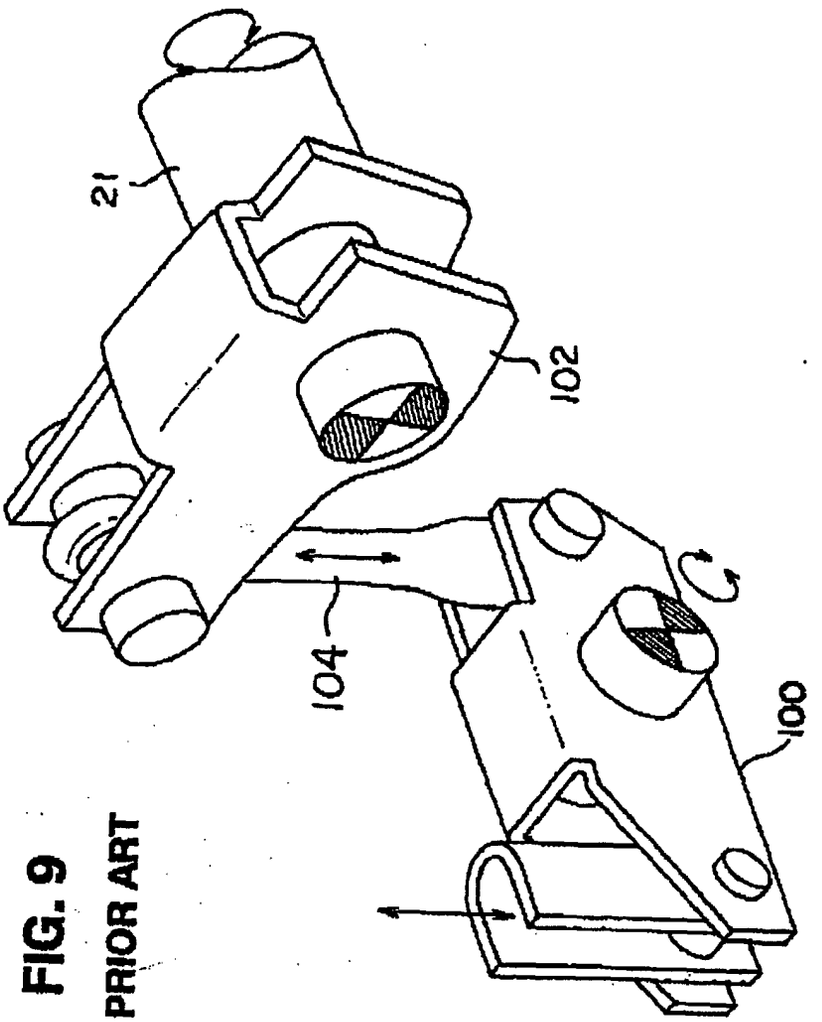


FIG. 9
PRIOR ART

FIG. 10
PRIOR ART

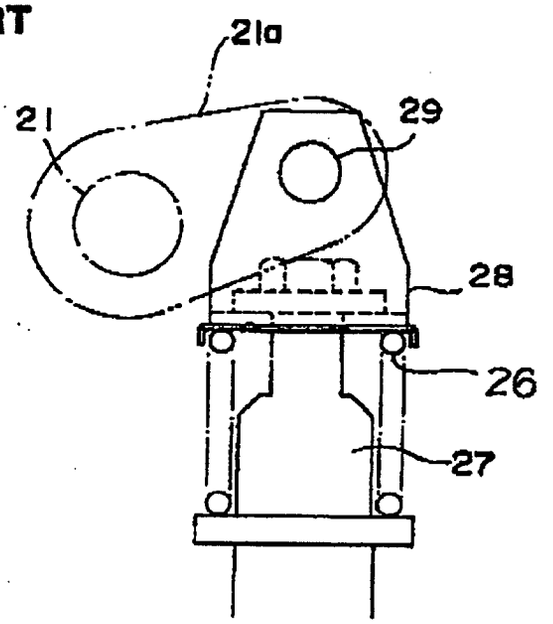


FIG. 11
PRIOR ART

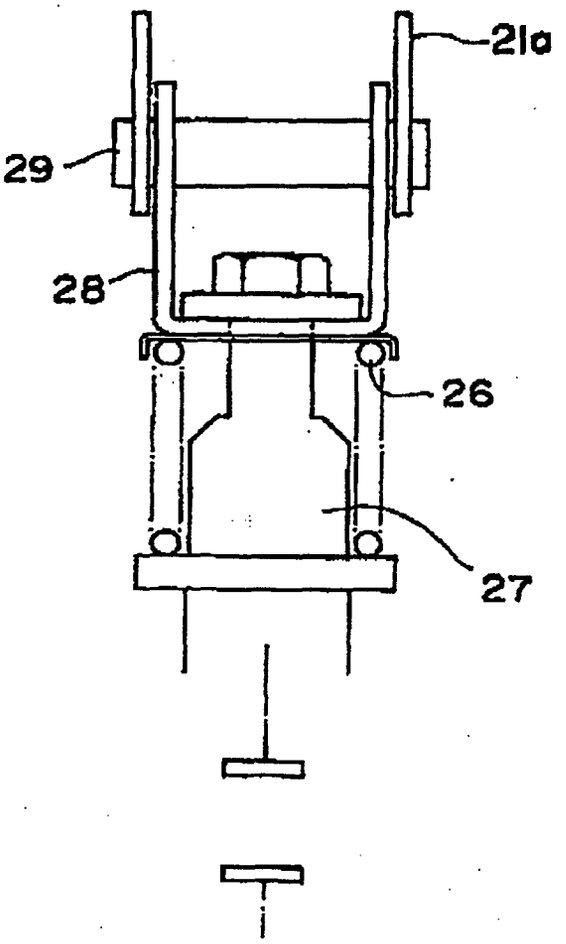


FIG. 12
PRIOR ART