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BETRIEBSEINRICHTUNG

DISPOSITIF D'ACTIONNEMENT

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Description

Field

[0001] The present invention relates to an operating device of a switch.

Background

[0002] In a conventional switch, a window that enables visual confirmation of a switch main body is provided, to prepare for a case when mismatch occurs between an open/close state of the switch main body and a display state of a switch display that is provided in an operating device.

[0003] According to Patent Literature 1, in an electric-spring operating device, there is provided a torque limiter that generates slide when a load torque becomes equal to or larger than a predetermined value between a motor that accumulates energy of a spring and gears, thereby preventing breakage of a power transmission mechanism itself by an excessive load torque.

[0004] Patent Literature 1: Japanese Utility Model Laid-open Publication No. S55-138716

Summary

Technical Problem

[0005] In a power transmission mechanism of a conventional switch, when a load equal to or larger than that assumed in designing occurs, for example, when a frictional resistance of a sliding unit in the mechanism increases or when a parts fastening bolt becomes loose, there is a possibility that a part in the power transmission mechanism is broken, that a switch at a main circuit side does not operate although an open/close operation is completed at an operating device side, and that an open/close state of the operating device and an open/close state of a switch main body do not match each other. At an electric power substation, for example, a portion to be monitored is grounded by turning on a separate switch after a circuit is separated from a system in an operation of maintenance and monitoring. In this case, if the state of the switch cannot be correctly confirmed, it is possible that a high voltage portion is erroneously turned on.

[0006] Furthermore, in an operating device having a torque limiter incorporated therein described in Patent Literature 1, the device has an object of preventing generation of an excessive load by controlling not to transmit an excessive torque equal to or larger than an assumed value. However, when the torque limiter operates immediately before completing an open/close operation, the mechanism continues operating based on inertia of a rotation shaft at a power transmission mechanism side immediately after a torque limiter operation. As a result, there is a possibility that other parts are broken due to a collision between parts in the mechanism.

[0007] Documents US-A-4912380 and US-A-4713505 disclose operating devices according to the preambles of independent claims 1 and 4, respectively.

[0008] The present invention has been achieved in view of the above problems, and an object of the present invention is to provide an operating device that can prevent generation of an unexpected load between a switch main body and the operating device, prevent breakage of a power transmission mechanism, and match an open/close state of the operating device with an open/close state of the switch main body.

Solution to Problem

[0009] The solution to the above-mentioned problems is provided by an operating device according to claims 1 and 4.

Advantageous Effects of Invention

[0010] According to the present invention, by converting the energy of an inertia motion of a motor into heat energy via first and second resistors immediately after completing a turn-on operation or an open operation, a torque generated by the inertia motion of the motor after disconnecting a motor current can be reduced, and a load that is applied to a motor transmission mechanism is reduced. Therefore, generation of a torque equal to or larger than that assumed in designing can be prevented even after completing a turn-on operation or an open operation.

[0011] Therefore, according to the present invention, it is possible to prevent generation of an unexpected load between a switch main body and an operating device, to prevent breakage of a power transmission mechanism, and to match an open/close state of the operating device with an open/close state of the switch main body.

Brief Description of Drawings

[0012]

FIG. 1 is a configuration diagram of a switching device that includes an operating device according to a first embodiment of the present invention.

FIG. 2 is a circuit diagram of an operating circuit.

FIG. 3 is a circuit diagram of a motor control circuit.

FIG. 4 is a circuit configuration diagram of an initial state (a switched-off state) of an operating circuit (FIG. 4(a)) and a motor control circuit (FIG. 4(b)).

FIG. 5 is a circuit configuration diagram when a closed-path signal is on (a CX coil voltage is applied) of an operating circuit (FIG. 5(a)) and a motor control circuit (FIG. 5(b)).

FIG. 6 is a circuit configuration diagram when a closed-path signal is completed (a CX coil voltage is cancelled) of an operating circuit (FIG. 6(a)) and a motor control circuit (FIG. 6(b)).

FIG. 7 is a circuit configuration diagram when a closed-path signal is completed (AX/BX coil voltages are cancelled) of an operating circuit (FIG. 7(a)) and a motor control circuit (FIG. 7(b)).

FIG. 8 is a configuration diagram of a switching device that includes an operating device according to a second embodiment of the present invention.

FIG. 9 is an example of time changes of a generated torque in the operating device according to the second embodiment, a winding current of a motor armature, and a motor current.

Reference Signs List

[0013]

1	SWITCH
2	OPERATING DEVICE
3	POWER TRANSMISSION MECHANISM
4	TANK
5	SWITCHING UNIT
6	MONITORING WINDOW
7	MOTOR
8	MOTOR CONTROL CIRCUIT
9	OPERATING CIRCUIT
10	TORQUE LIMITER
11	SPEED REDUCTION MECHANISM
12	OPEN/CLOSE STATE DISPLAY MECHANISM
13	OUPUT SHAFT
15	SPRING

Description of Embodiments

[0014] Exemplary embodiments of an operating device according to the present invention will be explained below in detail with reference to the accompanying drawings.

First embodiment.

[0015] FIG. 1 is a configuration diagram of a switching device that includes an operating device 2 according to a first embodiment of the present invention. The switching device shown in FIG. 1 includes a switch 1, the operating device 2 that operates the switch 1, and a power transmission mechanism 3 provided between the switch 1 and the operating device 2 and that transmits a torque generated by the operating device 2 to the switch 1 as an operation force. The switch 1 is a disconnecting switch or a ground switch of a gas-insulating switch device, for example.

[0016] The switch 1 includes a switching unit 5 that includes a conductor that performs an open/close operation in a tank 4 that is sealed with a gas. A monitoring window 6 provided in the tank 4 is for visually confirming an open/close state.

[0017] In the operating device 2, a motor 7 as a generation source of an operation force is provided. The motor 7 is controlled by a motor control circuit 8, and the motor control circuit 8 is controlled by an operating circuit 9.

[0018] A power transmission shaft as a rotation shaft of the motor 7 is connected to a speed reduction mechanism 11. Rotation of the motor 7 is decelerated via the speed reduction mechanism 11, and thereafter is transmitted as rotation of an output shaft 13 of the speed reduction mechanism 11. The output shaft 13 is connected to the power transmission mechanism 3, and operates the switching unit 5 as a main body of the switch 1 via a shaft that is hermetically accommodated in the tank 4. The power transmission mechanism 3 is configured to include a shaft, for example. In the present embodiment, a torque limiter 10 is provided that stops transmission of a torque when a torque equal to or larger than a predetermined value is generated between the motor 7 and the speed reduction mechanism 11.

[0019] In the operating device 2, an open/close state display mechanism 12 is provided that can display an open/close state by moving a display plate with a bar that is coordinated with the output shaft 13, for example.

[0020] A circuit configuration of the operating circuit 9 is explained next. FIG. 2 is a circuit diagram of the operating circuit 9. First, a limit switch H opens when the switching unit 5 is at a turn-on position and closes when the switching unit 5 is at an open position, and this is mechanically controlled by a position of gears or the like. On the other hand, a limit switch L closes when the switching unit 5 is at a turn-on position and opens when the switching unit 5 is at an open position. As shown in FIG. 2, the limit switch H is a closed switch and the limit switch L is an opened switch, and therefore FIG. 2 is a circuit diagram when the switching unit 5 is in a disconnected state (an open-path state).

[0021] A relay CX22 represents a coil portion of a relay used for a turn-on operation (a close operation). The relay CX22 includes contacts CX23 and CX25. The limit switch H is connected between the relay CX22 and the contact CX23. An input signal voltage as a turn-on operation signal (a closed-path command signal) can be applied between the limit switch H and the contact CX23. When the turn-on operation signal is input in a closed state of the limit switch H like in an example shown in FIG. 2, a coil incorporated in the relay CX22 is excited, and the contact CX23 is closed by a force generated by this coil. The contacts CX23 and CX25 can be open/close controlled by exciting the coil of the relay CX22 or by cancelling excitation of the coil. An operating voltage is always applied to both ends of the contact CX23, the limit switch H, and the relay CX22 that are connected in series.

[0022] A relay TX20 indicates a coil portion of a relay used for a turn-off operation (an open operation). The relay TX20 includes contacts TX21 and TX24. The limit switch L is connected between the relay TX20 and the contact TX21. An input signal voltage as a turn-off operation signal (an open-path command signal) can be applied between the limit switch L and the contact TX21.

The contacts TX21 and TX24 can be open/close controlled by exciting a coil of the relay TX20 or by cancelling excitation of the coil. An operating voltage is always applied to both ends of the contact TX21, the limit switch L, and the relay TX20 that are connected in series.

[0023] A timer relay T has a contact Ta and a contact Tb. The contact Ta is opened when a coil incorporated in the relay T is excited, and closes when excitation is cancelled. In the example shown in FIG. 2, because both the contact TX24 and the contact CX25 that are connected in series to the timer relay T are closed, the timer relay T is in an excited state and the contact Ta is opened, at an operating voltage that is always applied. The contact Tb is a timer contact and is always in a closed state, but is opened after a lapse of a predetermined time when the contact Ta is closed.

[0024] The operating circuit 9 further includes relays AX and BX. The relay AX or BX is connected in series to the contact Tb and the contact Ta, and an operating voltage is applied to their both ends.

[0025] A circuit configuration of the motor control circuit 8 is explained next. FIG. 3 is a circuit diagram of the motor control circuit 8.

[0026] In FIG. 3, portions excluding a resistor circuit 50 and a resistor circuit 51 are explained first. The resistor circuit 50 is constituted by a braking resistor R1 (a first resistor), a contact BX32, and a contact BX33, and the resistor circuit 51 is constituted by a braking resistor R2 (a second resistor), a contact AX30, and a contact AX31. Centered around a motor armature M, a bridge circuit is configured by having arranged contacts CX26, CX27, TX28, and TX29 at four sides, respectively. This bridge circuit is connected in series to a motor field element MF, and an operating voltage is applied to their both ends.

[0027] The contacts CX26 and CX27 are those of the relay CX22, respectively. The contacts TX28 and TX29 are those of the relay TX20, respectively. In FIG. 3, when only the contacts CX26 and CX27 are closed, a motor current flows to the motor armature M and the motor field element MF at an operating voltage. On the other hand, when only the contacts TX28 and TX29 are closed, a current flows in a direction opposite to that when only the contacts CX26 and CX27 are closed. An open operation or a close operation of the switching unit 5 is performed by inverting a rotation direction of the motor by forward/reverse controlling a direction of a current that flows to the motor armature M.

[0028] In FIG. 3, the resistor circuit 51 is connected in parallel to the bridge circuit, and the resistor circuit 50 is connected in parallel to the motor armature M in the bridge circuit. In the resistor circuit 51, the contact AX30, the resistor R2, and the contact AX31 are connected in series in this order. In the resistor circuit 50, the contact BX32, the resistor R1, and the contact BX33 are connected in series in this order. The contacts AX30 and AX31 are those of the relay AX in FIG. 2, respectively, and both contacts close when a coil incorporated in the relay AX is excited. The contacts BX32 and BX33 are those of the relay BX in FIG. 2, respectively, and both contacts close when a coil incorporated in the relay BX is excited.

[0029] Although the motor 7 and the motor control circuit 8 are shown separately in FIG. 1, the motor control circuit 8 is actually configured to include the motor armature M and the motor field element MF as shown in FIG. 3.

[0030] An operation in the present embodiment is explained next with reference to FIGS. 4 to 7. A closed-path operation is explained as an example. FIG. 4 is a circuit configuration diagram of an initial state (a switched-off state) of an operating circuit (FIG. 4(a)) and a motor control circuit (FIG. 4(b)). FIG. 5 is a circuit configuration diagram when a closed-path signal is on (a CX coil voltage is applied) of an operating circuit (FIG. 5(a)) and a motor control circuit (FIG. 5(b)). FIG. 6 is a circuit configuration diagram when a closed-path signal is completed (a CX coil voltage is cancelled) of an operating circuit (FIG. 6(a)) and a motor control circuit (FIG. 6(b)). FIG. 7 is a circuit configuration diagram when a closed-path signal is completed (AX/BX coil voltages are cancelled) of an operating circuit (FIG. 7(a)) and a motor control circuit (FIG. 7(b)).

[0031] First, the switch 1 is in an open state, and in this case, the operating circuit 9 and the motor control circuit 8 are in an initial state (a switched-off state) of FIGS. 4(a) and 4(b), respectively. Next, when an input signal voltage as a turn-on operation signal is applied (FIG. 4(a)), a coil incorporated in the relay CX22 is excited, and the contact CX23 is closed by a force generated by this coil (FIG. 5(a)). In this case, in the motor control circuit 8, a motor current flows by closing the contacts CX26 and CX27 that are connected in series to the motor armature M (FIG. 5(b)). That is, based on a closed-path signal input, the motor armature M and the motor field element MF are connected in series via the contacts CX26 and CX27, and an operating voltage is applied to both ends of the series circuit (first series circuit) and a motor current flow. As a result, the motor 7 starts rotating, and a closed-path operation of the switching unit 5 is started by a torque of the motor. Arrows in FIG. 5(b) indicate directions in which a current flows.

[0032] Next, when the switching unit 5 reaches a turn-on position, the limit switch H opens, and excitation of the relay CX22 is cancelled and the contacts CX23, CX25, CX26, and CX27 are opened, thereby disconnecting a motor current that flows to the motor armature M and the motor field element MF (FIG. 6). At the same time, excitation of the timer relay T is cancelled, and therefore the contact Ta is closed (FIG. 6(a)), the relay BX is excited, and the contacts BX32 and BX33 that are connected to the motor control circuit 8 are closed. As a result, a closed loop circuit that has the motor armature M and the resistor R1 connected in series is configured in the motor control circuit 8. This closed loop circuit is independent by being separated from other circuit portions. Although a motor current is not supplied to the motor armature M, a current is induced in this closed loop circuit by inertia rotation of the self (arrows in FIG. 6(b)), and this current is further converted to heat energy by the resistor R1. That is, although the motor armature M continues rotation by inertia, a torque generated by the motor 7 is reduced because energy of an inertia motion is converted to heat energy by the resistor R1.

[0033] Further, in this case, a current that flows through a field winding of the motor field element MF is also reduced by the resistor R2 (FIG. 6(b)). That is, when the contact Ta is closed (FIG. 6(a)), the relay AX is also excited, and the contacts AX30 and Ax31 that are connected to the motor control circuit 8 are closed. Accordingly, the resistor R2 and the motor field element MF are connected in series to the motor control circuit 8, and an operating voltage is applied to their both ends. At the same time, a series circuit (a second series circuit) that is separated from the closed loop circuit described above is configured.

[0034] When a certain time set in advance by a timer passes after a coil of the timer relay T is excited, the contact Tb is opened (FIG. 7(a)). Accordingly, excitation of the relays AX and BX is cancelled, and the contacts AX30 and AX31 and the contacts BX32 and BX33 that are connected to the motor control circuit 8 are opened, thereby disconnecting the resistors R1 and R2. A timer setting time is set such that a circuit is disconnected when an excessive torque stops generating after a torque by the motor 7 is reduced.

[0035] An open-path operation can be also similarly explained. In this case, in FIG. 2, the operation is started in an initial state that the limit switch L is closed and the limit switch H is opened. An input signal voltage as a turn-off operation signal is applied, the relay TX20 is excited, and the contact TX21 is closed. A subsequent operation can be explained in a similar manner to that of the closed-path operation. However, a direction of a current that flows to the motor armature M becomes opposite to that of the closed-path operation.

[0036] As explained above, in the present embodiment, the operating device 2 includes the torque limiter 10 that causes the power transmission shaft of the motor 7 to slide when a torque exceeds a constant torque value. Further, because breakage of the power transmission mechanism 3 due to collision of parts occurs at the end of the open/close operation, the operating circuit 9 is controlled in a circuit configuration such that after completing an open/close operation, a braking current flows to the resistors R1 and R2 by switching the motor control circuit 8.

[0037] According to the present embodiment, in addition to providing the torque limiter 10, energy of an inertia motion of the motor 7 is converted to heat energy via the braking circuit that includes the resistors R1 and R2 that are configured in the motor control circuit 8, after completing a turn-on operation or an open operation. With this arrangement, a torque generated by the inertia motion of the motor 7 after disconnecting a motor current can be reduced, a torque generated in the output shaft 13 that is transmitted from the motor 7 becomes small, and a load that is added to the power transmission mechanism 3 and the main body of the switch 1 can be suppressed.

[0038] Therefore, according to the present embodiment, it becomes possible to prevent occurrence of an unexpected load between the main body of the switch 1 and the operating device 2, prevent breakage of the power transmission mechanism 3, and match an open/close state of the operating device 2 with an open/close state of the main body of the switch 1.

[0039] In the present embodiment, the open/close state display mechanism 12 is arranged nearer to a main body side of the switch 1 than to the torque limiter 10. That is, the torque limiter 10 is provided between the motor 7 and the speed reduction mechanism 11, and is mounted on the power transmission shaft of the motor 7. On the other hand, the open/close state display mechanism 12 is provided at the main body side of the switch 1, and displays an open/close state of the switch 1 that is coordinated with the output shaft 13. Accordingly, even when the torque limiter 10 operates due to generation of a torque equal to or larger than that assumed in designing, the open/close state display mechanism 12 can display a state of the main body of the switch 1 because the open/close state display mechanism 12 is coordinated with the output shaft 13. When the open/close state display mechanism 12 is provided between the motor 7 and the torque limiter 10, for example, the open/close state display mechanism 12 displays an open/close state of the switch 1 that is coordinated with the power transmission shaft of the motor 7. When the torque limiter 10 operates and when rotation of the motor 7 is not transmitted to the output shaft 13, a state of the main body of the switch 1 cannot be correctly displayed.

[0040] There is also a merit that installation of the monitoring window 6 can be omitted by improving the reliability of the open/close state display mechanism 12.

Second embodiment.

[0041] FIG. 8 is a configuration diagram of a switching device that includes an operating device 52 according to a second embodiment of the present invention. As shown in FIG. 8, the operating device 52 is an electric-spring operating device that includes a spring 15 of which energy is accumulated by rotation of the motor 7. Other constituent elements of the present embodiment are identical to those of the first embodiment, and thus, in FIG. 8, constituent elements identical to those shown in FIG. 1 are denoted by like reference signs, and explanations thereof will be omitted.

[0042] The operating device 52 accumulates energy of the spring 15 via the speed reduction mechanism 11 by rotation of the motor 7. When the energy-accumulated spring 15 reaches a predetermined point, energy accumulation is completed, and the spring 15 releases energy and rotates the output shaft 13.

[0043] The operating circuit 9 according to the present embodiment is identical to that shown in FIG. 2. The motor control circuit 8 is also identical to that shown in FIG. 3. An operation in the present embodiment is explained for a closed-path operation as an example. First, the operating circuit 9 and the motor control circuit 8 rotate the motor 7 as shown in FIGS. 3 and 4, but a closed-path operation of the switching unit 5 is not performed during accumulation of energy of the spring 15.

[0044] Next, the limit switch H is opened simultaneously with the completion of energy accumulation of the spring 15, and the operating circuit 9 and the motor control circuit 8 operate as shown in FIGS. 5 and 6. Therefore, a motor current is disconnected at the time of completing the energy accumulation of the spring 15. At the same time, energy of the spring 15 is released, and a closed-path operation of the switching unit 5 is performed by a torque of the spring 15 and by a torque due to inertia rotation of the motor 7. After energy accumulation is completed, because a braking circuit that includes the resistors R1 and R2 is configured as shown in FIG. 6, a current generated by an inertia motion of the motor 7 is suppressed, in a similar manner to that of the first embodiment. Therefore, generation of a torque in the output shaft 13 of the operating device 2 becomes small, and a force that is applied to each part of the power transmission mechanism 3 and the main body of the switch 1 is suppressed, in a similar manner to that of the first embodiment.

[0045] FIG. 9 is an example of time changes of a generated torque in the operating device 52 according to the present embodiment, a winding current of a motor armature, and a motor current. In FIG. 9, the generated torque is a result of measurement by holding the output shaft 13 of the operating device 52. The motor current indicates a rise near a left end of a time axis, and this is an inrush current accompanied with the start of the motor 7. When a turn-on operation signal is completed and when the limit switch H is disconnected at a time T1, the motor current momentarily reduces based on an effect of the resistor R1. Thereafter, because a current flows through a closed loop circuit, the motor current rises and becomes at substantially a constant value at a time T2 afterward, and thereafter reduces before a timer setting time T3 and becomes almost zero. The generated torque increases at the time T1. This is because a torque of inertia rotation of the motor 7 is superimposed with a torque of the energy-accumulated spring 15. The generated torque becomes at a peak value at the time T2, and thereafter, rapidly reduces by a portion of heat energy that is consumed by the closed loop circuit. Thereafter, the generated torque becomes substantially at a constant value, based on a torque of the spring 15. The winding current of the motor armature also changes corresponding to a change of the generated torque.

[0046] As shown in FIG. 9, a torque is designed to be generated simultaneously with the completion of energy accumulation of the spring 15 by the motor 7. Although a torque by the inertia rotation of the motor 7 is temporarily superimposed on a torque by the spring 15, the generated torque is suppressed by electrically braking the motor 7.

[0047] According to the present embodiment, because a motor current is disconnected after completing accumulation of energy of the spring 15 by the motor 7, a subsequent torque by the motor 7 is based on inertia rotation, and a load that is applied to the power transmission mechanism 3 by the motor 7 is reduced. Because a circuit is configured such that a braking current is generated in the motor control circuit 8 simultaneously with the completion of energy accumulation of the spring 15, a torque by the inertia rotation of the motor 7 can be reduced. By superimposing a torque by the inertia rotation of the motor 7 on a torque by the spring 15, generation of a torque equal to or larger than that assumed in designing can be prevented. Other effects of the present embodiment are identical to those of the first embodiment.

[0048] As explained above, in the operating devices 2 and 52 according to the present invention, there are effects that designing of the strength of a mechanism is optimized by suppressing an output and that an open/close state of the operating devices 2 and 52 can be matched with an open/close state of the main body of the switch 1.

Industrial Applicability

[0049] The present invention is useful as an operating device of a switch of a gas-insulating switch device.

Claims

1. An operating device (2) that comprises a motor, a motor control circuit (8) that controls the motor (7), an operating circuit (9) that controls the motor control circuit (8), and a torque limiter (10) that does not output a torque equal to or larger than a predetermined value by the motor (7), and that performs an open/close operation by transmitting a torque by the motor (7) to a switch (1) via a power transmission mechanism (3), the operating device being configured such that
during a turn-on operation or a turn-off operation of the switch (1), the operating circuit (9) controls the motor control circuit (8) in a first circuit configuration including a first series circuit in which a motor armature (M) of the motor (7) and a motor field element (MF) are connected in series and in which a motor current flows, **characterised in that**
during a certain time after completing said turn-on operation or said turn-off operation, the operating circuit (9) controls the motor control circuit (8) in a second circuit configuration including a closed loop circuit in which the motor armature (M) and a first

resistor (R1) are connected in series and a second series circuit in which the motor field element (MF) and a second resistor (R2) are connected in series, the closed loop circuit and the second series circuit being electrically separated from each other, in said second circuit configuration.

2. The operating device (2) according to claim 1, wherein the motor control circuit (8) includes:

a bridge circuit that includes a pair of first contacts (26, 27) that are opened and closed while being coordinated with each other, a pair of second contacts (28, 29) that are opened and closed while being coordinated with each other, and the motor armature, where one of the first contacts (27) and one of the second contacts (28) are connected in series, the other one of the first contacts (26) and the other one of the second contacts (29) are connected in series, one end of the motor armature is connected between the one of the first contacts (27) and the one of the second contacts (28), and the other end of the motor armature (M) is connected between the other one of the first contacts (26) and the other one of the second contacts (29);
a first resistor circuit that is connected in parallel to the motor armature (M) in the bridge circuit and has the first resistor (R1) and a third contact (32, 33) connected in series;
a second resistor circuit that is connected in parallel to the bridge circuit and has the second resistor (R2) and a fourth contact (30, 31) connected in series; and
the motor field element (MF) that is connected in series to the bridge circuit, and
during a turn-on operation or a turn-off operation of the switch, the operating circuit (9) is configured such as to control the motor control circuit (8) in said first circuit configuration such that the third (32, 33) and fourth (30, 31) contacts are opened and the first (26, 27) or second (28, 29) contacts are closed, and
during a certain time after completing a turn-on operation or a turn-off operation, the operating circuit (9) is configured such as to control the motor control circuit (8) in said second circuit configuration such that the first (26, 27) and second (28, 29) contacts are opened and the third (32, 33) and fourth (30, 31) contacts are closed.

3. The operating device (2) according to claim 1 or 2, further comprising:

a speed reduction mechanism (11) that outputs a rotation force via an output shaft (13) after decelerating rotation of the motor (7); and
a display mechanism (12) that displays an open/close state of the switch (1) while being coordinated with the output shaft (13).

4. An operating device (2) that comprises a motor (7), a motor control circuit (8) that controls the motor (7), an operating circuit (9) that controls the motor control circuit (8), a torque limiter (10) that does not output a torque equal to or larger than a predetermined value by the motor (7), and a spring (15) of which energy is accumulated by the motor (7), and that performs an open/close operation by transmitting torques of the motor (7) and the spring (15) to a switch (1) via a power transmission mechanism (3) after completing energy accumulation of the spring (15) by the motor (7), **characterised in that** said operating device is configured such that
during accumulation of energy of the spring (15), the operating circuit (9) controls the motor control circuit (8) in a first circuit configuration including a first series circuit in which a motor armature (M) of the motor and a motor field element (MF) are connected in series and in which a motor current flows, and
during a certain time after completing accumulation of energy of the spring (15), the operating circuit (9) controls the motor control circuit (8) in a second circuit configuration including a closed loop circuit in which the motor armature (M) and a first resistor (R1) are connected in series and a second series circuit in which the motor field element (MF) and a second resistor (R2) are connected in series, the closed loop circuit and the second series being electrically separated from each other, in said second circuit configuration.

5. The operating device (2) according to claim 4, further comprising:

a speed reduction mechanism (11) that outputs a rotation force via an output shaft (13) after decelerating rotation of the motor (7); and
a display mechanism (12) that displays an open/close state of the switch (1) while being coordinated with the output shaft (13).

Patentansprüche

1. Betriebseinrichtung (2), die einen Motor, eine Motorsteuerschaltung (8), die den Motor (7) steuert, eine Betriebsschaltung (9), welche die Motorsteuerschaltung (8) steuert, und einen Drehmomentbegrenzer (10) aufweist, der kein Drehmoment durch den Motor (7) ausgibt, das gleich oder größer als ein vorbestimmter Wert ist, und der einen Öffnungs-/Schließbetrieb durchführt, indem ein Drehmoment durch den Motor (7) über einen Kraftübertragungsmechanismus (3) an einen Schalter (1) übertragen wird, wobei die Betriebseinrichtung derart konfiguriert ist, dass während eines Einschaltbetriebs oder eines Ausschaltbetriebs des Schalters (1) die Betriebsschaltung (9) die Motorsteuerschaltung (8) in einer ersten Schaltungskonfiguration steuert, die eine erste Reihenschaltung aufweist, in der ein Motoranker (M) des Motors (7) und ein Motorfeldelement (MF) in Reihe geschaltet sind und in der ein Motorstrom fließt, **dadurch gekennzeichnet, dass** während einer bestimmten Zeit nach Abschluss des Einschaltbetriebs oder des Ausschaltbetriebs die Betriebsschaltung (9) die Motorsteuerschaltung (8) in einer zweiten Schaltungskonfiguration steuert, die einen geschlossenen Regelkreis, in dem der Motoranker (M) und ein erster Widerstand (R1) in Reihe geschaltet sind, und eine zweite Reihenschaltung aufweist, in der das Motorfeldelement (MF) und ein zweiter Widerstand (R2) in Reihe geschaltet sind, wobei der geschlossene Regelkreis und die zweite Reihenschaltung in der zweiten Schaltungskonfiguration elektrisch voneinander getrennt sind.

2. Betriebseinrichtung (2) nach Anspruch 1, wobei die Motorsteuerschaltung (8) aufweist:

eine Brückenschaltung, die ein Paar erste Kontakte (26, 27) aufweist, die geöffnet und geschlossen werden und dabei miteinander koordiniert sind, ein Paar zweite Kontakte (28, 29) aufweist, die geöffnet und geschlossen werden und dabei miteinander koordiniert sind, und den Motoranker, wobei einer der ersten Kontakte (27) und einer der zweiten Kontakte (28) in Reihe geschaltet sind, der andere der ersten Kontakte (26) und der andere der zweiten Kontakte (29) in Reihe geschaltet sind, ein Ende des Motorankers zwischen dem einen der ersten Kontakte (27) und dem einen der zweiten Kontakte (28) aufgeschaltet ist, und das andere Ende des Motorankers (M) zwischen dem anderen der ersten Kontakte (26) und dem anderen der zweiten Kontakte (29) aufgeschaltet ist;
eine erste Widerstandsschaltung, die mit dem Motoranker (M) in der Brückenschaltung parallelgeschaltet ist und den ersten Widerstand (R1) und einen dritten Kontakt (32, 33) hat, die in Reihe geschaltet sind;
eine zweite Widerstandsschaltung, die mit der Brückenschaltung parallelgeschaltet ist und den zweiten Widerstand (R2) und einen vierten Kontakt (30, 31) hat, die in Reihe geschaltet sind; und
das Motorfeldelement (MF), das mit der Brückenschaltung in Reihe geschaltet ist, und
während eines Einschaltbetriebs oder eines Ausschaltbetriebs des Schalters die Betriebsschaltung (9) dazu konfiguriert ist, die Motorsteuerschaltung (8) in der ersten Schaltungskonfiguration derart zu steuern, dass die dritten (32, 33) und vierten (30, 31) Kontakte geöffnet und die ersten (26, 27) oder zweiten (28, 29) Kontakte geschlossen werden, und
während einer bestimmten Zeit nach Abschluss eines Einschaltbetriebs oder eines Ausschaltbetriebs die Betriebsschaltung (9) dazu konfiguriert ist, die Motorsteuerschaltung (8) in der zweiten Schaltungskonfiguration derart zu steuern, dass die ersten (26, 27) und zweiten (28, 29) Kontakte geöffnet und die dritten (32, 33) und vierten (30, 31) Kontakte geschlossen werden.

3. Betriebseinrichtung (2) nach Anspruch 1 oder 2, darüber hinaus aufweisend:

einen Drehzahlreduktionsmechanismus (11), der eine Drehkraft über eine Abtriebswelle (13) nach Abbremsen einer Drehung des Motors (7) ausgibt; und
einen Anzeigemechanismus (12), der einen Öffnungs-/Schließzustand des Schalters (1) anzeigt und dabei mit der Abtriebswelle (13) koordiniert ist.

4. Betriebseinrichtung (2), die einen Motor (7), eine Motorsteuerschaltung (8), die den Motor (7) steuert, eine Betriebsschaltung (9), welche die Motorsteuerschaltung (8) steuert, einen Drehmomentbegrenzer (10), der kein Drehmoment durch den Motor (7) ausgibt, das gleich oder größer als ein vorbestimmter Wert ist, und eine Feder (15) aufweist, deren Energie durch den Motor (7) gespeichert wird, und der einen Öffnungs-/Schließbetrieb durchführt, indem Drehmomente des Motors (7) und der Feder (15) über einen Kraftübertragungsmechanismus (3) nach Abschluss einer Energiespeicherung der Feder (15) durch den Motor (7) an einen Schalter (1) übertragen werden, **dadurch gekennzeichnet, dass** die Betriebseinrichtung derart konfiguriert ist, dass
während einer Speicherung von Energie der Feder (15) die Betriebsschaltung (9) die Motorsteuerschaltung (8) in einer ersten Schaltungskonfiguration steuert, die eine erste Reihenschaltung aufweist, in der ein Motoranker (M) des Motors und ein Motorfeldelement (MF) in Reihe geschaltet sind und in der ein Motorstrom fließt, und während einer bestimmten Zeit nach Abschluss einer Speicherung von Energie der Feder (15) die Betriebsschaltung (9) die Motorsteuerschaltung (8) in einer zweiten Schaltungskonfiguration steuert, die einen geschlossenen Regelkreis, in dem der Motoranker (M) und ein erster Widerstand (R1) in Reihe geschaltet sind, und eine zweite Reihenschaltung aufweist, in der das Motorfeldelement (MF) und ein zweiter Widerstand (R2) in Reihe geschaltet sind, wobei der geschlossene Regelkreis und die zweite Reihenschaltung in der

zweiten Schaltungskonfiguration elektrisch voneinander getrennt sind.

5. Betriebseinrichtung (2) nach Anspruch 4, darüber hinaus aufweisend:

einen Drehzahlreduktionsmechanismus (11), der eine Drehkraft über eine Abtriebswelle (13) nach Abbremsen einer Drehung des Motors (7) ausgibt; und
einen Anzeigemechanismus (12), der einen Öffnungs-/Schließzustand des Schalters (1) anzeigt und dabei mit der Abtriebswelle (13) koordiniert ist.

Revendications

1. Dispositif d'actionnement (2) comprenant un moteur, un circuit de commande de moteur (8) qui commande le moteur (7), un circuit d'actionnement (9) qui commande le circuit de commande de moteur (8), et un limiteur de couple (10) qui ne sort pas, par le moteur (7), un couple égal ou supérieur à une valeur prédéterminée, et effectuant un actionnement d'ouverture/fermeture en transmettant un couple par le moteur (7) à un commutateur (1) via un mécanisme de transmission de puissance (3), le dispositif d'actionnement étant configuré de telle sorte que pendant un actionnement de mise en marche ou un actionnement de mise à l'arrêt du commutateur (1), le circuit d'actionnement (9) commande le circuit de commande de moteur (8) dans une première configuration de circuit incluant un premier circuit en série dans lequel un induit de moteur (M) du moteur (7) et un élément de champ de moteur (MF) sont connectés en série et dans lequel un courant de moteur circule, **caractérisé en ce que** pendant un certain temps après achèvement dudit actionnement de mise en marche ou dudit actionnement de mise à l'arrêt, le circuit d'actionnement (9) commande le circuit de commande de moteur (8) dans une deuxième configuration de circuit incluant un circuit en boucle fermée dans lequel l'induit de moteur (M) et une première résistance (R1) sont connectés en série et un deuxième circuit en série dans lequel l'élément de champ de moteur (MF) et une deuxième résistance (R2) sont connectés en série, le circuit en boucle fermée et le deuxième circuit en série étant séparés électriquement l'un de l'autre, dans ladite deuxième configuration de circuit.

2. Le dispositif d'actionnement (2) selon la revendication 1, sachant que le circuit de commande de moteur (8) inclut :

un circuit en pont qui inclut une paire de premiers contacts (26, 27) qui s'ouvrent et se ferment tout en étant coordonnés l'un avec l'autre, une paire de deuxièmes contacts (28, 29) qui s'ouvrent et se ferment tout en étant coordonnés l'un avec l'autre, et l'induit de moteur, sachant que l'un des premiers contacts (27) et l'un des deuxièmes contacts (28) sont connectés en série, l'autre des premiers contacts (26) et l'autre des deuxièmes contacts (29) sont connectés en série, une extrémité de l'induit de moteur est connectée entre l'un des premiers contacts (27) et l'un des deuxièmes contacts (28), et l'autre extrémité de l'induit de moteur (M) est connectée entre l'autre des premiers contacts (26) et l'autre des deuxièmes contacts (29) ;
un premier circuit de résistance qui est connecté en parallèle à l'induit de moteur (M) dans le circuit en pont et dont la première résistance (R1) et un troisième contact (32, 33) sont connectés en série ;
un deuxième circuit de résistance qui est connecté en parallèle au circuit en pont et dont la deuxième résistance (R2) et un quatrième contact (30, 31) sont connectés en série ; et
l'élément de champ de moteur (MF) qui est connecté en série au circuit de pont, et
pendant un actionnement de mise en marche ou un actionnement de mise à l'arrêt du commutateur, le circuit d'actionnement (9) est configuré de manière à commander le circuit de commande de moteur (8) dans ladite première configuration de circuit de telle sorte que les troisièmes (32, 33) et quatrièmes (30, 31) contacts s'ouvrent et les premiers (26, 27) ou deuxièmes (28, 29) contacts se ferment, et
pendant un certain temps après achèvement d'un actionnement de mise en marche ou d'un actionnement de mise à l'arrêt, le circuit d'actionnement (9) est configuré de façon à commander le circuit de commande de moteur (8) dans ladite deuxième configuration de circuit de telle sorte que les premiers (26, 27) et deuxièmes (28, 29) contacts s'ouvrent et les troisièmes (32, 33) et quatrièmes (30, 31) contacts se ferment.

3. Le dispositif d'actionnement (2) selon la revendication 1 ou 2, comprenant en outre :

un mécanisme de réduction de vitesse (11) qui sort une force de rotation via un arbre de sortie (13) après décélération de la rotation du moteur (7) ; et
un mécanisme d'affichage (12) qui affiche un état d'ouverture/fermeture du commutateur (1) tout en étant coordonné avec l'arbre de sortie (13).

4. Dispositif d'actionnement (2) comprenant un moteur

(7), un circuit de commande de moteur (8) qui commande le moteur (7), un circuit d'actionnement (9) qui commande le circuit de commande de moteur (8), un limiteur de couple (10) qui ne sort pas, par le moteur (7), un couple égal ou supérieur à une valeur prédéterminée, et un ressort (15) de lequel l'énergie est accumulée par le moteur (7), et qui effectue un actionnement d'ouverture/fermeture en transmettant des couples du moteur (7) et du ressort (15) à un commutateur (1) via un mécanisme de transmission de puissance (3) après achèvement d'une accumulation d'énergie du ressort (15) par le moteur (7), **caractérisé en ce que** ledit dispositif d'actionnement est configuré de telle sorte que pendant l'accumulation d'énergie du ressort (15), le circuit d'actionnement (9) commande le circuit de commande de moteur (8) dans une première configuration de circuit incluant un premier circuit en série dans lequel un induit de moteur (M) du moteur et un élément de champ de moteur (MF) sont connectés en série et dans lequel un courant de moteur circule, et
pendant un certain temps après achèvement de l'accumulation d'énergie du ressort (15), le circuit d'actionnement (9) commande le circuit de commande de moteur (8) dans une deuxième configuration de circuit incluant un circuit en boucle fermée dans lequel l'induit de moteur (M) et une première résistance (R1) sont connectés en série et un deuxième circuit en série dans lequel l'élément de champ de moteur (MF) et une deuxième résistance (R2) sont connectés en série, le circuit en boucle fermée et le deuxième circuit en série étant séparés électriquement l'un de l'autre, dans ladite deuxième configuration de circuit.

5. Le dispositif d'actionnement (2) selon la revendication 4, comprenant en outre :

un mécanisme de réduction de vitesse (11) qui sort une force de rotation via un arbre de sortie (13) après décélération de la rotation du moteur (7) ; et
un mécanisme d'affichage (12) qui affiche un état d'ouverture/fermeture du commutateur (1) tout en étant coordonné avec l'arbre de sortie (13).

FIG.1

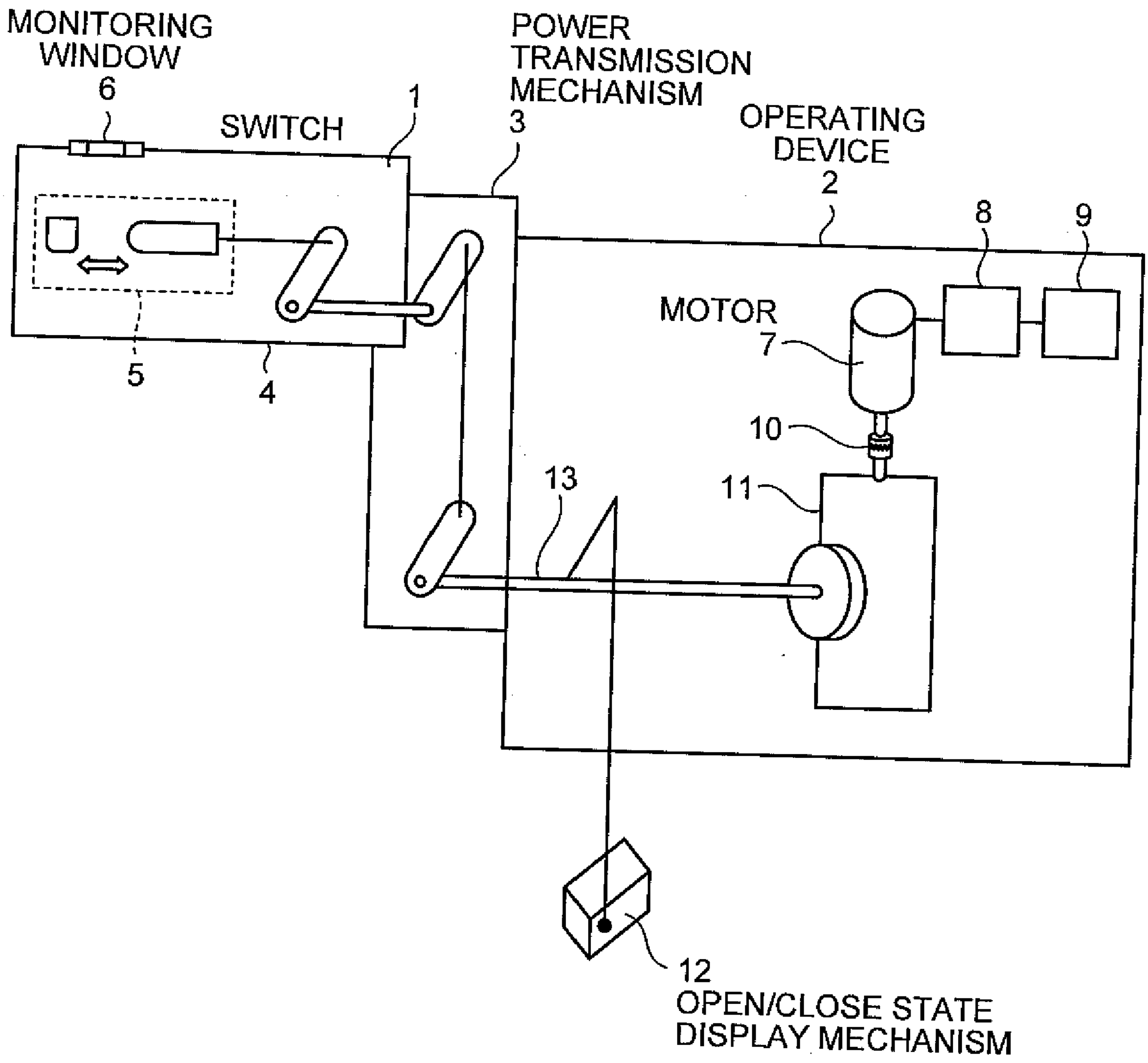

MONITORING WINDOW
6
SWITCH
1
POWER TRANSMISSION MECHANISM
3
OPERATING DEVICE
2
8
9
MOTOR
7
10
11
13
5
4
12
OPEN/CLOSE STATE DISPLAY MECHANISM

FIG.2

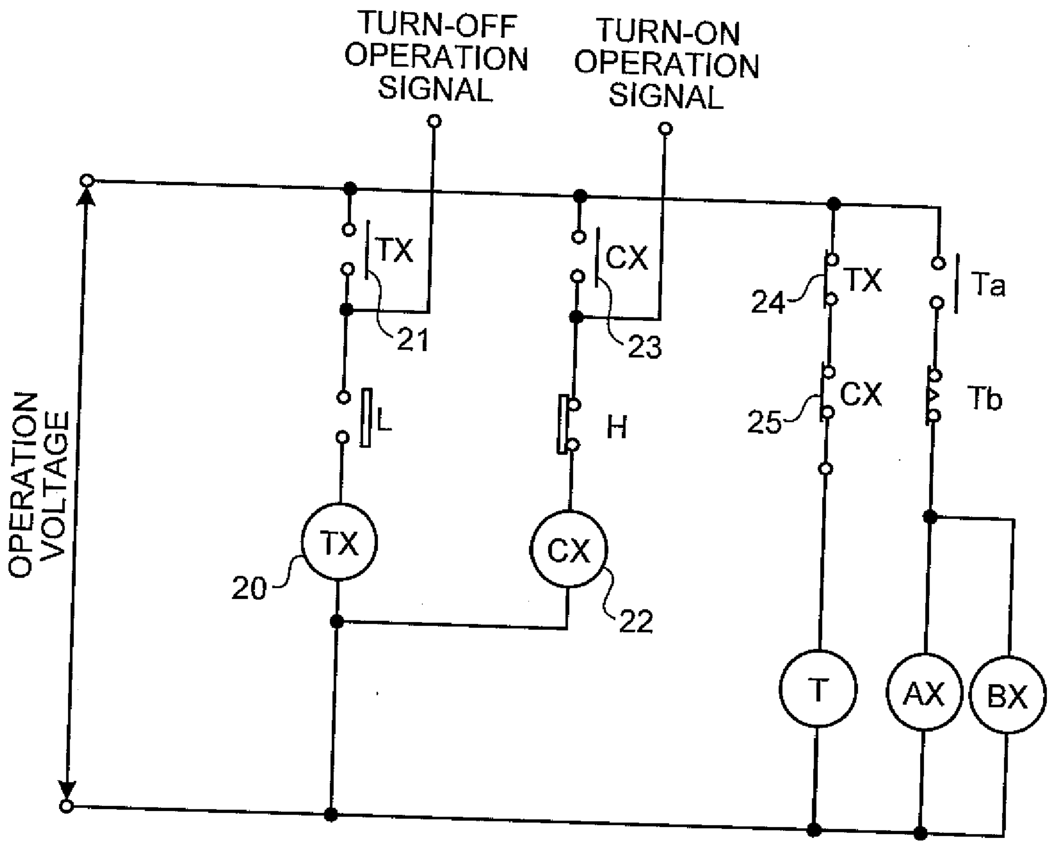

TURN-OFF
OPERATION
SIGNAL
TURN-ON
OPERATION
SIGNAL
OPERATION
VOLTAGE
TX
21
CX
23
24
TX
Ta
L
H
25
CX
Tb
TX
20
CX
22
T
AX
BX

FIG.3

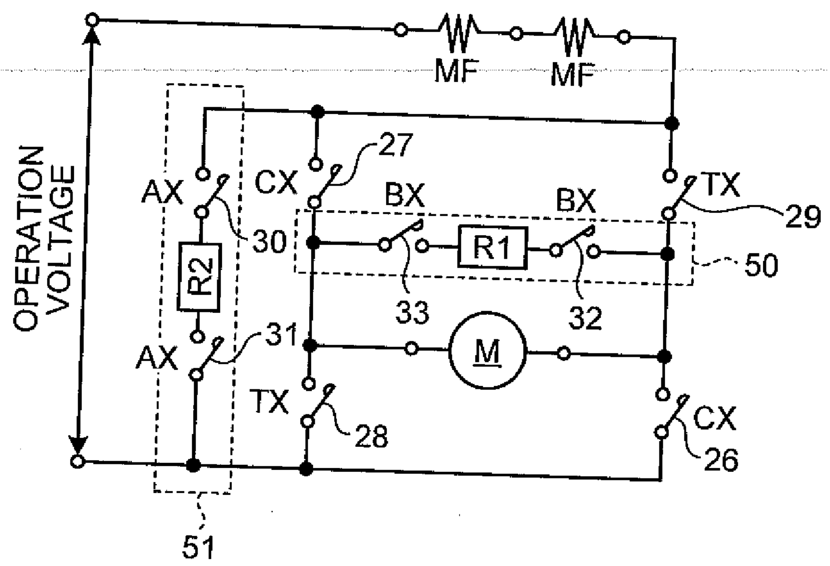
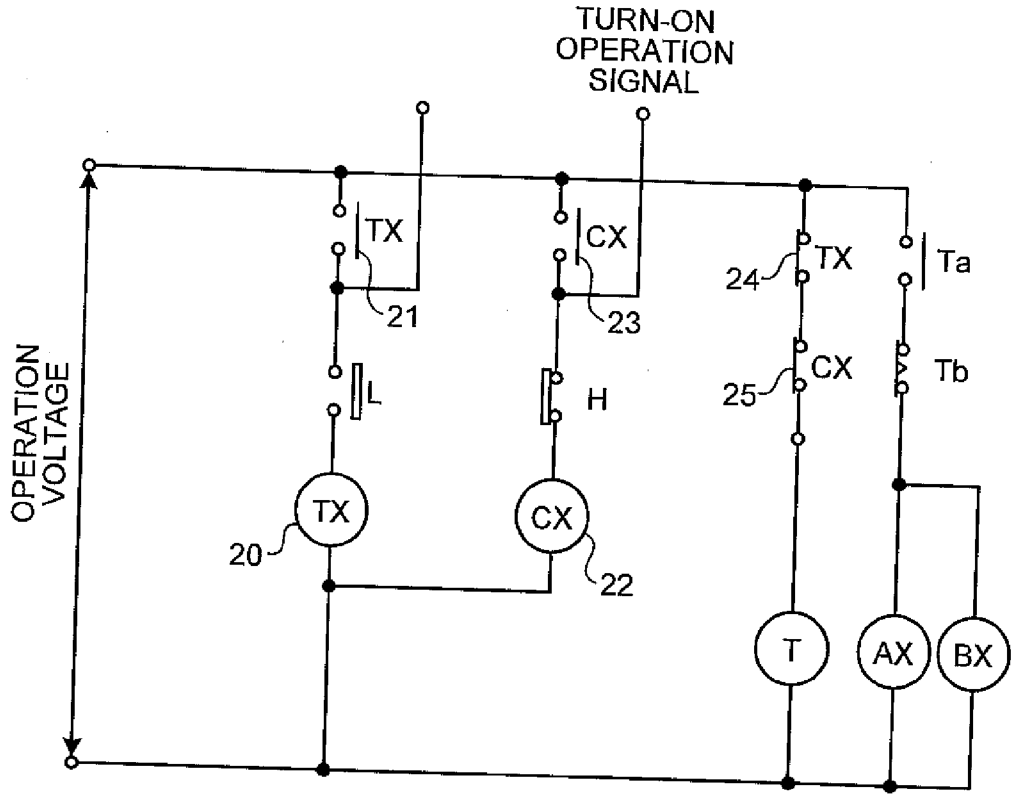

MF
MF
OPERATION
VOLTAGE
AX
30
R2
AX
31
CX
27
BX
BX
TX
29
R1
50
33
32
M
TX
28
CX
26
51

FIG.4

INITIAL STATE
(SWITCHED-OFF STATE)

(a)



(b)

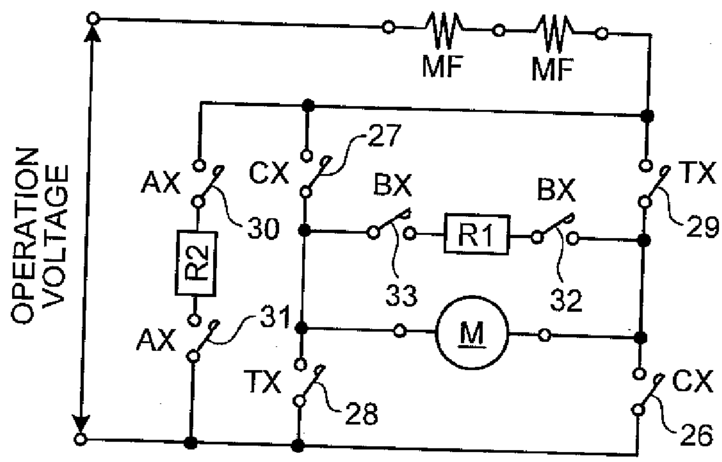
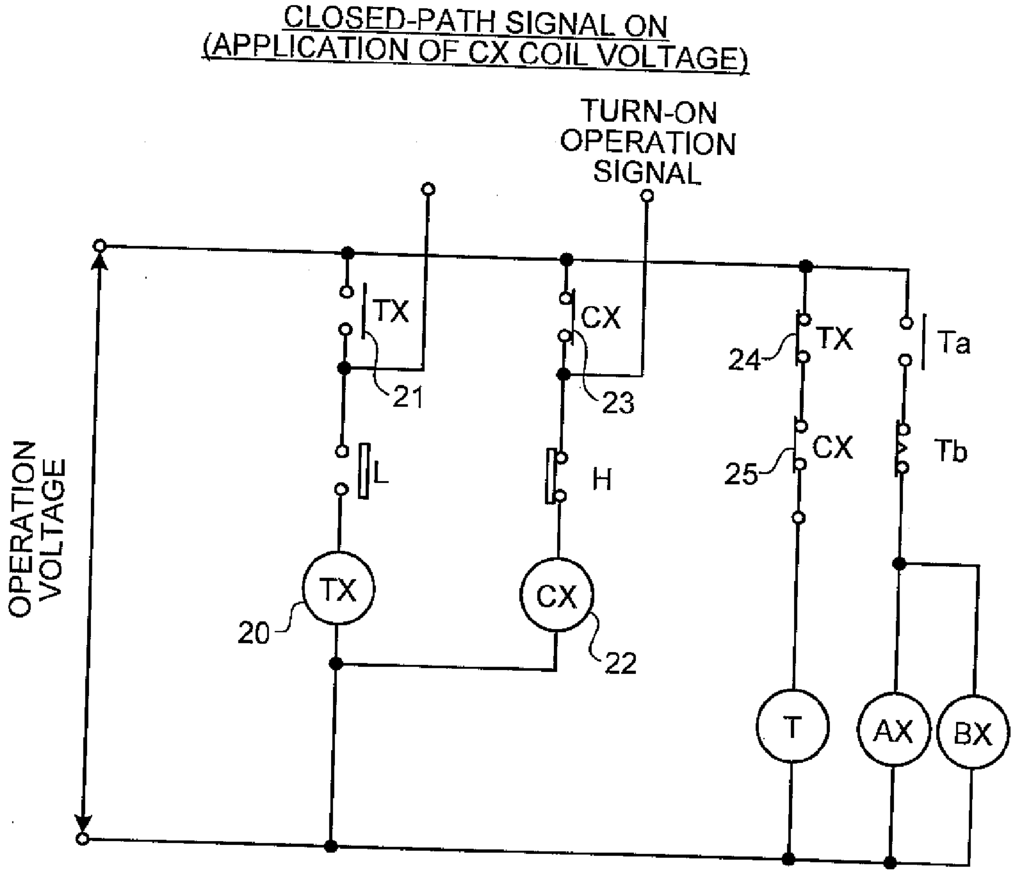


FIG.5

(a)


CLOSED-PATH SIGNAL ON
(APPLICATION OF CX COIL VOLTAGE)
TURN-ON
OPERATION
SIGNAL
OPERATION
VOLTAGE
TX
21
CX
23
24
TX
Ta
25
CX
Tb
L
H
TX
20
CX
22
T
AX
BX

(b)

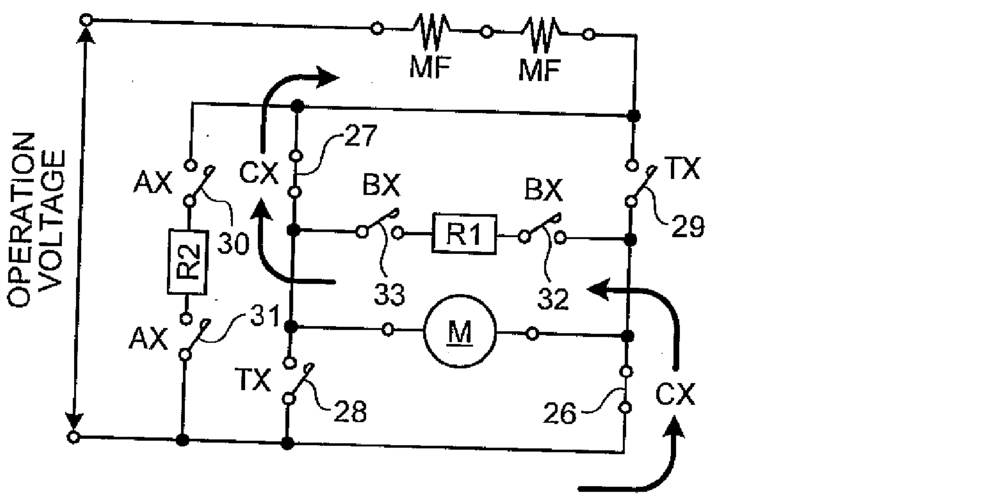
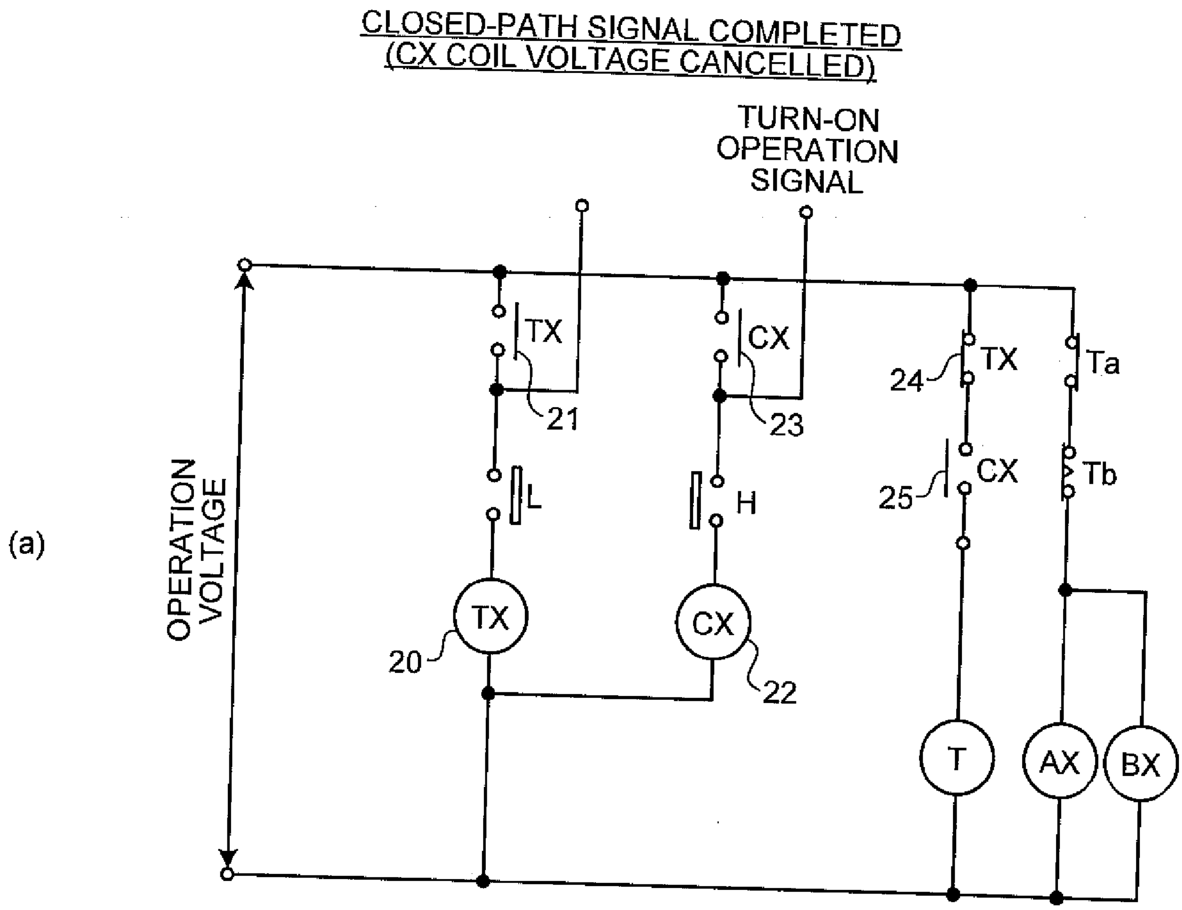

OPERATION
VOLTAGE
MF
MF
27
AX
CX
BX
BX
TX
29
30
R2
R1
33
32
31
AX
M
TX
28
26
CX

FIG.6


CLOSED-PATH SIGNAL COMPLETED
(CX COIL VOLTAGE CANCELLED)
TURN-ON
OPERATION
SIGNAL
(a)
OPERATION
VOLTAGE
TX
21
CX
23
L
H
TX
20
CX
22
24
TX
25
CX
Ta
Tb
T
AX
BX

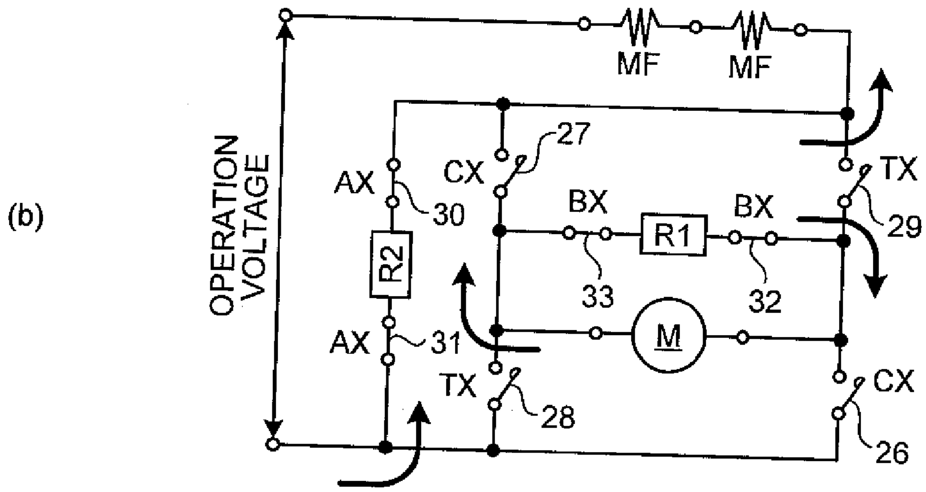
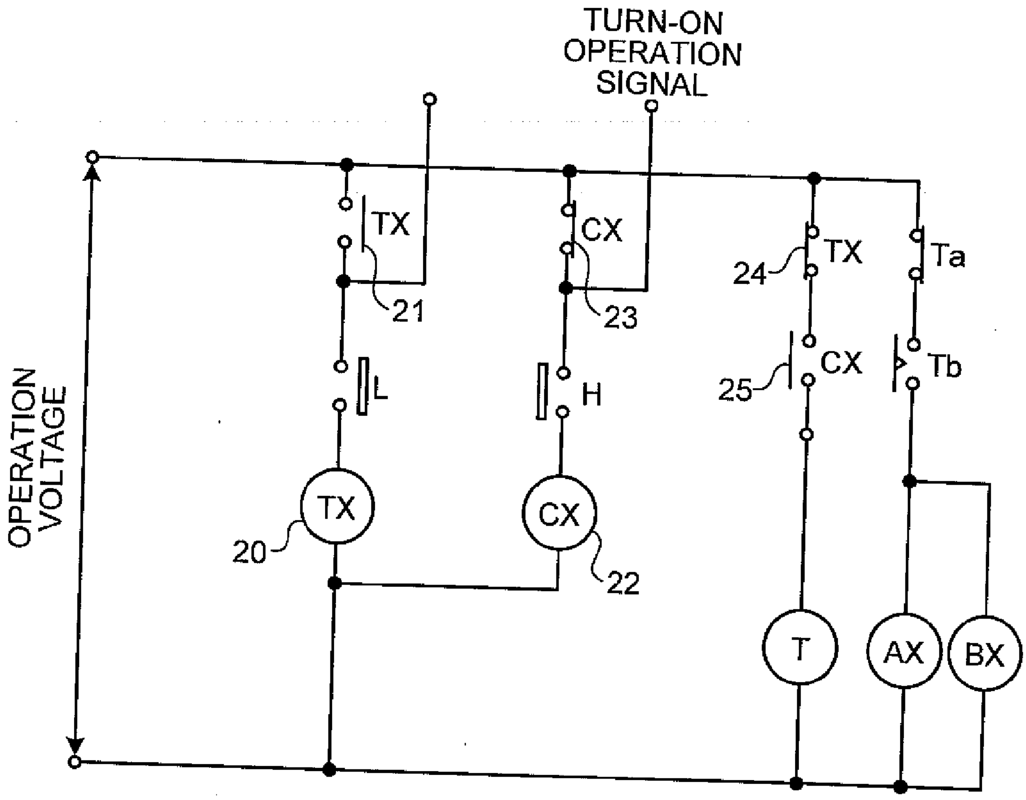

(b)
OPERATION
VOLTAGE
MF
MF
AX
30
R2
AX
31
CX
27
BX
33
R1
BX
32
M
TX
28
TX
29
CX
26

FIG.7

CLOSED-PATH SIGNAL COMPLETED
(AX/BX COIL VOLTAGES CANCELLED)

(a)



(b)

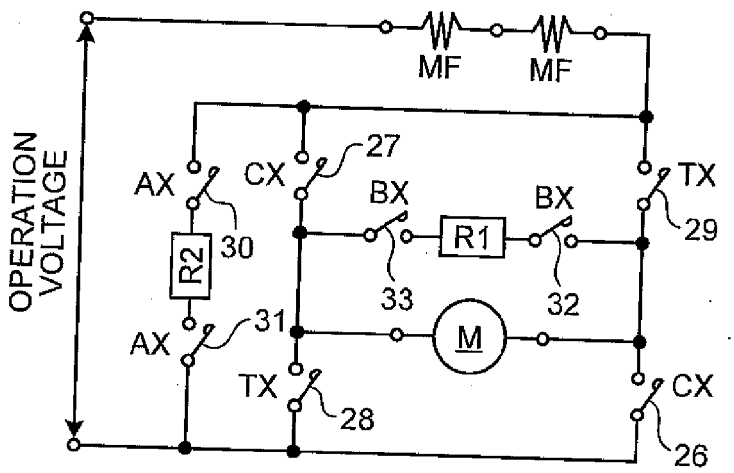


FIG.8

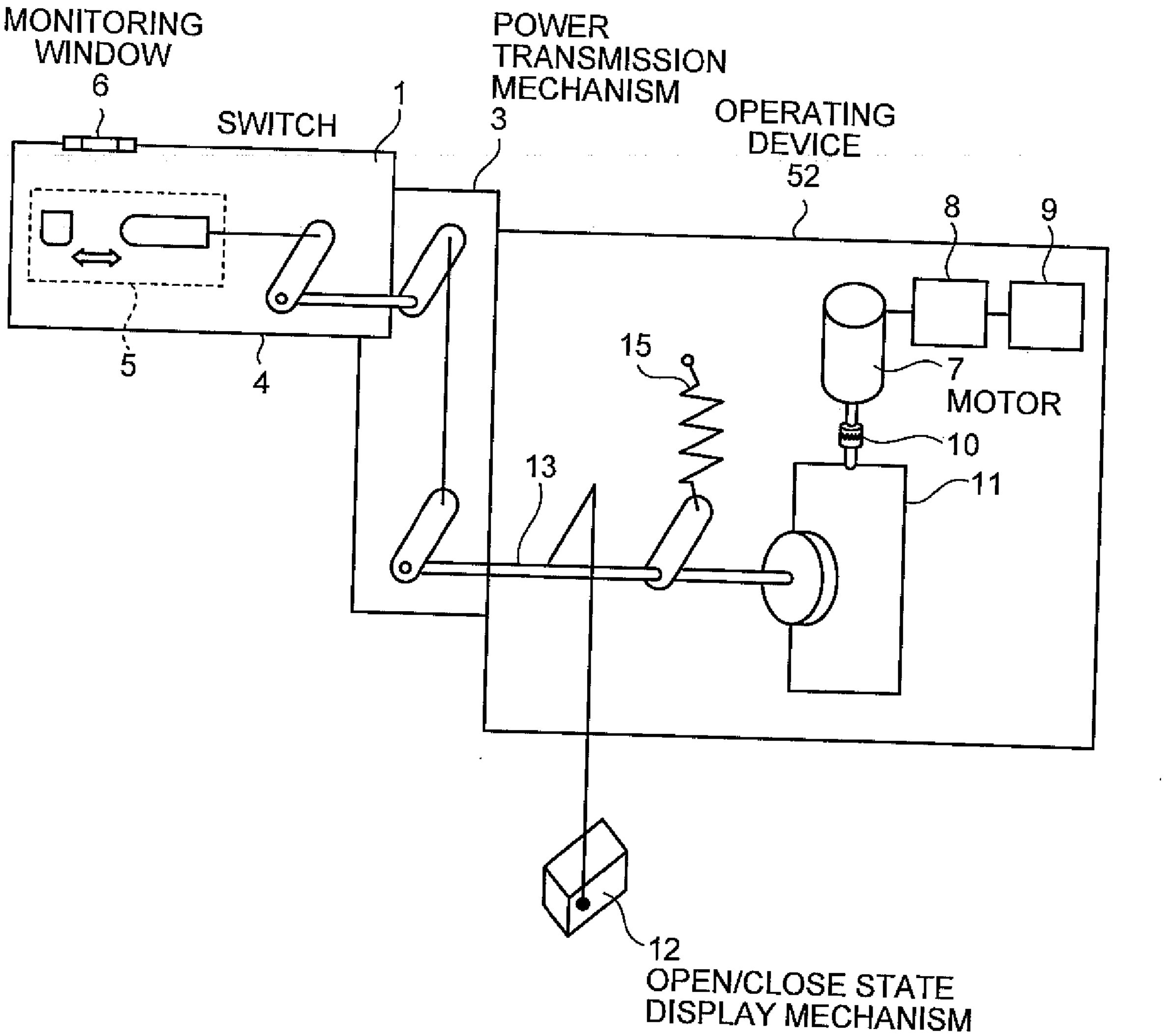
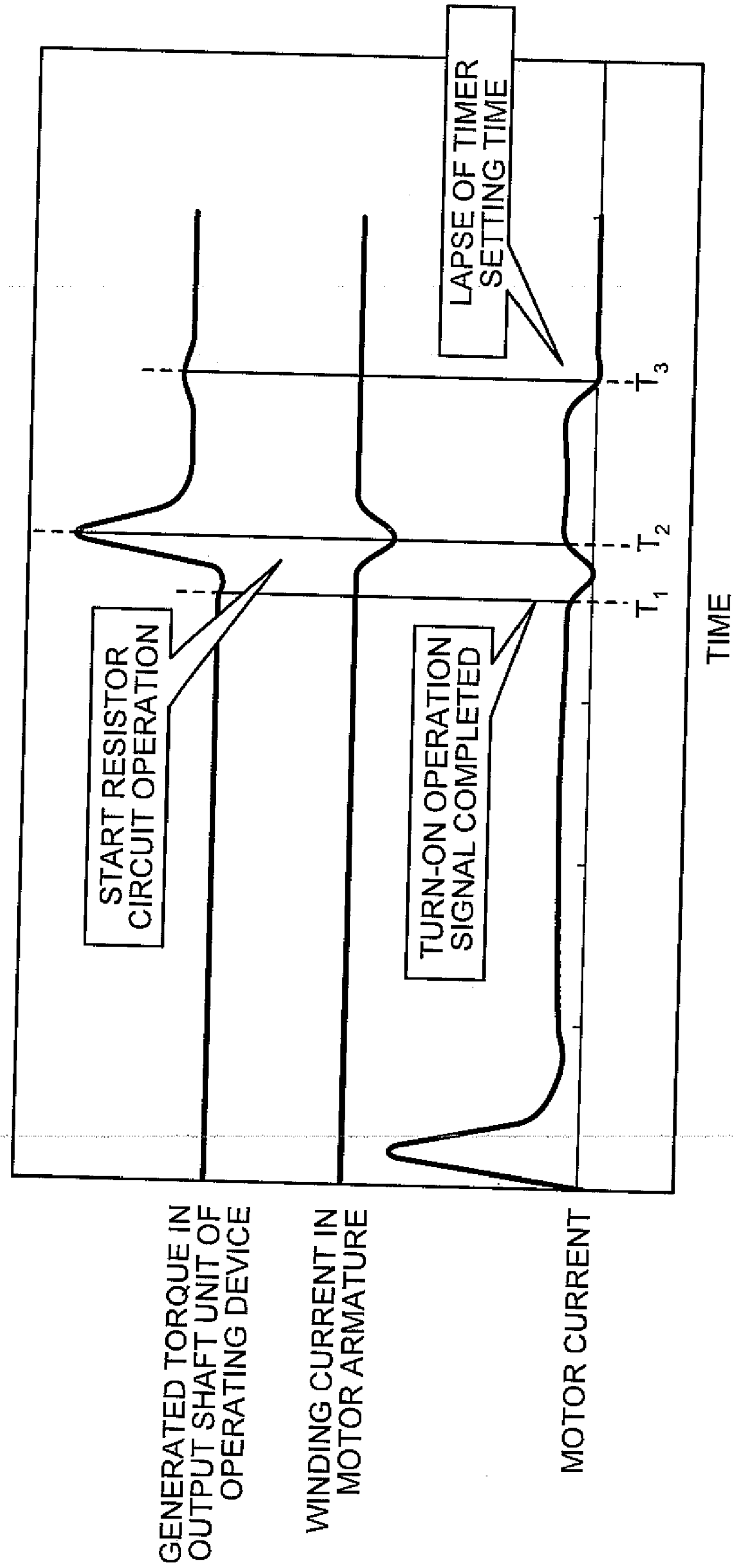

MONITORING WINDOW
6
SWITCH
1
POWER TRANSMISSION MECHANISM
3
OPERATING DEVICE
52
8
9
5
4
15
7
MOTOR
10
13
11
12
OPEN/CLOSE STATE DISPLAY MECHANISM

FIG.9


START RESISTOR CIRCUIT OPERATION
TURN-ON OPERATION SIGNAL COMPLETED
LAPSE OF TIMER SETTING TIME
T_1
T_2
T_3
TIME
GENERATED TORQUE IN OUTPUT SHAFT UNIT OF OPERATING DEVICE
WINDING CURRENT IN MOTOR ARMATURE
MOTOR CURRENT

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP S55138716 B **[0004]**
- US 4912380 A **[0007]**
- US 4713505 A **[0007]**