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(54) **Motor drive switch**

(57) A motor drive switch (20) is disclosed which prevents a motor stator winding (11) from being damaged even when contact sticking occurs. In the motor drive switch (20), configuration is made with respect to a start operation of the motor such that the switching of a first contact (21) to a power source P-side terminal (3) is effected earlier than the switching of a second contact (22) to an armature P-side terminal (6), and respect to a stop operation of the motor configuration is made such that the switching of the second contact (22) to an armature N-side terminal (4) is effected earlier than the switching of the first contact (22) to an armature P-side terminal (1).

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Description

[0001] This application claims priority to Japanese patent application serial number 2010-187048, the contents of which are incorporated herein by reference.

[0002] The present invention relates to a motor drive switch that can be used in a motor control circuit.

[0003] Japanese Laid-Open Patent Publication No. 2-184279 discloses a motor drive switch relating to a peripheral technology.

[0004] As shown in FIG 8A, a motor drive switch 100 disclosed in Japanese Laid-Open Patent Publication No. 2-184279 is a double-pole switch consisting of a first contact 101 and a second contact 102, with the first contact 101 and the second contact 102 being interlocked with each other when a motor is driven.

[0005] The first contact 101 of the motor drive switch 100 is connected to one end (12) of a motor stator winding 112, and can be switched between a power source P-side terminal (3) connected to the P side of a power source E and an armature P-side terminal (1) connected to the P side of an armature 104. The second contact 102 is connected to the other end (5) of the motor stator winding 112, and can be switched between an armature P-side terminal (6) and an armature N-side terminal (4) connected to the N side of an armature 104.

[0006] And, as shown in FIG 8A, when the motor drive switch 100 is switched in a start operation of the motor, the first contact 101 is switched to the power source P-side terminal (3), and the second contact 102 is switched to the armature P-side terminal (6). As a result, the stator winding 112 and the armature 114 are connected in series between the P terminal and N terminal of the power source E, whereby the motor is started.

[0007] As shown in FIG 8B, when the motor drive switch 100 is switched in a stop operation of the motor, the first contact 101 is switched to the armature P-side terminal (1), and the second contact 102 is switched to the armature N-side terminal (4), with the result that the stator winding 112 and the armature 114 form a closed loop, and the motor operates like a generator, whereby a brake is applied.

[0008] Between the armature N-side terminal (4) of the second contact 102 and the N terminal of the armature 114, there is provided a resistor 116 for restricting a brake current.

[0009] In the above motor drive switch 100, the first contact 101 and the second contact 102 are switched substantially simultaneously. Thus, in a case where contact sticking occurs at the first contact 101 and the second contact 102 due to aging or the like, it is impossible to determine at which of the positions (1), (3), (4), and (6) such contact sticking occurs.

[0010] For example, as shown in FIG 8C, contact sticking has occurred at the power source P-side terminal (3) of the first contact 101 during the motor is operated, and then motor stop operation is performed on the motor drive switch 100 and the second contact 102 is switched to the armature N-side terminal (4), a large current Im might flow through the stator winding 112, which causes the stator winding 112 to burn out.

[0011] Thus, there is a need in the art to prevent the stator winding of a motor from being damaged even when contact sticking of a motor drive switch occurs.

[0012] One construction for a motor drive switch includes a first contact which is connected to one end of a stator winding of a motor and which can be switched between a power source P-side terminal connected to a P side of a power source and an armature P-side terminal connected to a P side of an armature. The motor drive switch further includes a second contact which is connected to the other end of the stator winding and which can be switched between the armature P-side terminal and an armature N-side terminal connected to an N side of the armature. The motor drive switch used in a motor control circuit is configured such that the first contact is switched to the power source P-side terminal, and that the second contact is switched to the armature P-side terminal by a start operation of the motor, whereby the stator winding and the armature are connected in series between the P side and the N side of the power source thereby to start the motor. The motor drive switch is further configured such that by a stop operation of the motor, the first contact is switched to the armature P-side terminal and the second contact is switched to the armature N-side terminal, with the result that the stator winding and the armature form a closed loop to brake the motor. In the start operation of the motor, the switching of the first contact to the power source P-side terminal is configured to be effected earlier than the switching of the second contact to the armature P-side terminal, and in the stop operation of the motor, the switching of the second contact to the armature N-side terminal is configured to be effected earlier than the switching of the first contact to the armature P-side terminal.

[0013] According to this construction, in the start operation of the motor, the switching of the first contact to the power source P-side terminal is configured to be effected earlier than the switching of the second contact to the armature P-side terminal. Thus, an electric current flows through the stator winding and the armature of the motor at the time when the second contact is switched to the armature P-side terminal. Thus, if contact sticking is to be occurred with the passage of time, it occurs between the second contact and the armature P-side terminal.

[0014] If contact sticking occurs at the armature P-side terminal of the second terminal and then the stop operation is performed on the motor drive switch and the first contact is switched to the armature P-side terminal, no electric current flows through the stator winding of the motor. That is, no abnormal current flows through the stator winding of the motor due to contact sticking.

[0015] Further, in the stop operation of the motor, configuration is made such that the switching of the second contact to the armature N-side terminal is effected earlier

than the switching of the first contact to the armature P-side terminal. Thus, an electric current flows through the stator winding and the armature of the motor at the time when the first contact is switched to the armature P-side terminal. Thus, if contact sticking is to be occurred with the passage of time occurs, it occurs between the first contact and the armature P-side terminal.

[0016] If contact sticking occurs at the armature P-side terminal of the first contact and then start operation is performed on the motor drive switch and the second contact is switched to the armature P-side terminal, the motor does not start and no electric current flows through the stator winding of the motor. That is, no abnormal current flows through the stator winding of the motor due to contact sticking.

[0017] According to another construction, there is provided a trigger that can perform the start operation of the motor by sliding of the trigger from a stop position to a start position and perform the stop operation of the motor by returning of the trigger from the start position to the stop position. The trigger has a first protrusion and a second protrusion that can respectively press the first contact and the second contact during the sliding, and each of the first contact and the second contact is formed in a scale-like arcuate configuration whose center is supported by a fulcrum. Further, each of the first contact and the second contact tilts around the fulcrum when each contact is pressed by the first protrusion and the second protrusion respectively, thereby effecting switching of the contacts. And the first protrusion and the second protrusion are arranged so as to be offset in the sliding direction, whereby there is a difference in switching time between the first contact and the second contact.

[0018] According to another construction, there is provided a trigger that can perform the start operation of the motor by sliding of the trigger from a stop position to a start position and perform the stop operation of the trigger by returning of the trigger from the start position to the stop position. The trigger has a first protrusion and a second protrusion that respectively presses the first contact and the second contact during the sliding, and each of the first contact and the second contact is formed in a scale-like arcuate configuration whose center is supported by a fulcrum. Further, each of the first contact and the second contact tilts around the fulcrum when each contact is pressed by the first protrusion or the second protrusion, thereby effecting switching of the contacts. And bending positions of the first contact and the second contact are offset in the sliding direction, whereby there is a difference in switching time between the first contact and the second contact.

[0019] According to another construction, there is provided a trigger that can perform the start operation of the trigger by sliding of the trigger from a stop position to a start position and perform the stop operation of the trigger by returning of the trigger from the start position to the stop position. Each of the first contact and the second contact is accommodated in a case respectively, and operating pins protruding from the case are pressed or depressed to effect switching of the contacts. The trigger has a first pressing surface and a second pressing surface which are configured to press an operating pin for the first contact and an operating pin for the second contact respectively and which are formed to be offset from each other in the sliding direction.

[0020] According to the above, even if contact sticking occurs in the motor drive switch, no abnormal current flows through the stator winding of the motor. Thus, there is no possibility of the stator winding being damaged, which reduces the burdens of servicing.

[0021] Additional objects, features, and advantages, of the present invention will be readily understood after reading the following detailed description together with the claims and the accompanying drawings, in which:

FIG 1A is a motor control circuit diagram showing a state in which a motor drive switch is switched to a stop side according to an example of the present invention; FIG 1B is a motor control circuit diagram showing the circuit during the switching from the stop side to a start side; and FIG 1C is a motor control circuit diagram showing a state in which the motor drive switch is switched to the start side;

FIG 2A is a motor control circuit diagram showing a state in which the motor drive switch is switched to the start side; FIG 2B is a motor control circuit diagram showing the circuit during the switching from the start side to the stop side; and FIG 2C is a motor control circuit diagram showing a state in which the motor drive switch is switched to the stop side;

FIG 3A and FIG 3B are motor control circuit diagrams showing a state in which contact sticking occurs at a second contact of the motor drive switch;

FIG 4A and FIG 4B are motor control circuit diagrams showing a state in which contact sticking occurs at a first contact of the motor drive switch;

FIG 5A and FIG 5B are schematic longitudinal sectional views showing the operation of the motor drive switch; FIG 5C is a schematic cross-sectional view of the same; and FIG 5D is a bottom view of a trigger of the motor drive switch;

FIG 6A is a side view of a first contact of a motor drive switch according to another example; FIG 6B is a side view of a second contact of the same; FIG 6C and FIG 6D are longitudinal sectional views showing the operational timing of the first contact and the second contact; and FIG 6E is a bottom view of a trigger of the motor drive switch;

FIG 7A is a side view of a trigger of a motor drive switch according to another example; FIG 7B is a bottom view of the trigger; FIG 7C is a side view of the motor drive switch before switching; FIG 7D is a rear view of FIG 7C; and FIG 7E is a side view of the motor drive switch after switching; and

FIG 8A is a motor control circuit diagram showing a state in which a motor drive switch is switched to a

start side in a prior art; FIG 8B is a motor control circuit diagram showing a state in which the motor drive switch is switched to a stop side; and FIG 8C is a motor control circuit diagram showing a state in which contact sticking occurs at a first contact and a second contact.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0022] Each of the additional features and teachings disclosed above and below may be utilized separately or in conjunction with other features and teachings to provide improved motor drive switch. Representative examples of the present teaching, which examples utilize many of these additional features and teachings both separately and in conjunction with one another, will now be described in detail with reference to the attached drawings. This detailed description is merely intended to teach a person of skill in the art further details for practicing preferred aspects of the present teachings and is not intended to limit the scope of the invention. Only the claims define the scope of the claimed invention. Therefore, combinations of features and steps disclosed in the following detailed description may not be necessary to practice the invention in the broadest sense, and are instead taught merely to particularly describe representative examples of the invention. Moreover, various features of the representative examples and the dependent claims may be combined in ways that are not specifically enumerated in order to provide additional useful examples of the present teachings.

[0023] In the following, a motor drive switch of the present invention will be described with reference to FIG 1 to FIG 7.

[0024] First, a summary of a motor drive switch 20 will be described with reference to FIG. 1A to FIG. 1C.

[0025] The motor drive switch 20 is a double-pole double-throw switch used in a control circuit 10 of a series-wound motor (hereinafter referred to as the motor) in which a stator winding and an armature winding are connected in series.

[0026] The motor drive switch 20 is mounted on an electric tool main body (not shown). By performing pull operation of a trigger 30 (refer to FIG 5), the motor of the electric tool main body is started, and by performing returning operation on the trigger 30, a brake is applied to the motor. The motor drive switch 20 is provided with a first contact 21 and a second contact 22 interlocked with the movement of the trigger 30. Further, a fixed end of the first contact 21 is connected to one end side terminal (2) of a stator winding 11 of the motor, and a movable end of the first contact 21 can be switched between a power source P-side terminal (3) connected to the P side of a power source E and an armature P-side terminal (1) connected to the P side of an armature 14. A fixed end of the second contact 22 is connected to the other end side terminal (5) of the stator winding 11 of the motor, and a movable end of the second contact 22 can be switched between an armature P-side terminal (6) and an armature N-side terminal connected to the N side of the armature 14.

[0027] As shown in FIG 1A, etc., the armature P-side terminal (1) to which the first contact 21 is connected and the armature P-side terminal (6) to which the second contact 22 is connected are connected to a brush P of the armature 14 via a conductive wire. The armature N-side terminal (4) is connected to a brush N of the armature 14 via a resistor 16 that can restrict a brake current. Further, the N terminal of the power source E is connected to the brush N of the armature 14 via a fuse 15.

[0028] Due to the above construction, as shown in FIG 1A, when pull operation is performed on the trigger 30 with the motor being stopped, the movable end of the first contact 21 (hereinafter referred to as the first contact 21) is first switched to the power source P-side terminal (3) as shown in FIG 1B. Next, as shown in FIG 1C and FIG 2A, the movable end of the second contact 22 (hereinafter referred to as the second contact 22) is switched to the armature P-side terminal (6). As a result, the stator winding 11 and the armature 14 of the motor are connected in series between the P terminal and the N terminal of the power source E, whereby the motor is started.

[0029] As shown in FIG 2B, by performing returning operation on the trigger 30, the second contact is first switched to the armature N-side terminal (4). Next, as shown in FIG 2C and FIG 1A, the first contact 21 is switched to the armature P-side terminal (1). As a result, the stator winding 11, the armature 14, and the resistor 16 form a closed loop, and a brake current flows through the stator winding 11 to brake the motor. This causes the motor to stop.

[0030] As described above, when pull operation is performed on the trigger 30, the first contact 21 is first switched, and then the second contact 22 is switched as shown in FIG 1, so that an electric current flows through the stator winding 11 at the time when the second contact 22 is connected to the armature P-side terminal (6). No electric current flows through the stator winding 11 at the time when the first contact is connected to the power source P-side terminal (3). Thus, if any contact sticking is to be occurred with the passage of time, it occurs between the second contact 22 and the armature P-side terminal (6). As shown in FIG 3A, when contact sticking occurs between the second contact 22 and the armature P-side terminal (6) during the pull operation of the trigger 30, the electric current for driving the motor flows through the stator winding 11, and no abnormal electric current flows therethrough.

[0031] Further, when returning operation is performed on the trigger 30 in this state, the first contact 21 is switched to the armature P-side terminal (1) as shown in FIG 3B. In the state shown in FIG 3B, no voltage is applied to the stator winding 11, so that no abnormal electric current flows through the stator winding 11. Further, even if returning operation is performed on the trigger 30, the brake is not applied to the motor, and thus it is possible

to detect the occurrence of abnormality.

[0032] When returning operation is performed on the trigger 30 with the motor drive switch 20 being in the normal state, the second contact 22 is first switched, and then the first contact 21 is switched as shown in FIG. 2A to FIG. 2C, so that an electric current flows through the stator winding 11 at the time when the first contact 21 is connected to the armature P-side terminal (1). No electric current flows through the stator winding 11 at the time when the second contact 22 is connected to the armature N-side terminal (4). Thus, if any contact sticking is to be occurred with the passage of time by the returning operation of the trigger 30, it occurs between the first contact 21 and the armature P-side terminal (1). As shown in FIG 4A, in the case where contact sticking occurs between the first contact 21 and the armature P-side terminal (1) during the returning operation of the trigger 30, a brake current flows through the stator winding 11 until the motor stops, and no abnormal electric current flows through the stator winding 11.

[0033] Next, when pull operation is performed on the trigger 30, the second contact 22 is switched to the armature P-side terminal (6) as shown in FIG 4B. In the state shown in FIG 4B, no voltage is applied to the stator winding 11, so that no abnormal electric current flows through the stator winding 11. Further, even if pull operation is performed on the trigger 30, the motor does not rotate, and thus it is possible to detect the occurrence of abnormality.

[0034] As shown in FIG 5A to FIG 5D, the motor drive switch 20 includes the trigger 30, a switch case 35, the first contact 21, and the second contact 22. In the switch case 35, there is accommodated an operating portion 32 of the trigger 30 so as to be slidable in the longitudinal direction (the horizontal direction in FIG 5A). Further, there is accommodated in the switch case 35 a coil spring (not shown) that is biased to push the operating portion 32 of the trigger 30 in a forward direction (in a direction where the operating portion 32 protrudes from the switch case 35).

[0035] Further, as shown in FIG 5C, on the left-hand side of the lower portion of the switch case 35, there are arranged terminals (1), (2), and (3), to which the first contact 21 is to be connected, along the sliding direction of the trigger 30 (See FIG 5A), and on the right-hand side of the lower portion of the switch case 35, there are arranged terminals (4), (5), and (6), to which the second contact 22 is to be connected, along the sliding direction of the trigger 30.

[0036] The terminal (1) of the first contact 21 corresponds to the armature P-side terminal (1), the terminal (2) thereof corresponds to one end side terminal (2) of the stator winding 11, and the terminal (3) thereof corresponds to the power source P-side terminal (3). The terminal (4) of the second contact 22 corresponds to the armature N-side terminal (4), the terminal (5) thereof corresponds to the other end side terminal (5) of the stator winding 11, and the terminal (6) thereof corresponds to the armature P-side terminal (6).

[0037] As shown in FIG 5A, etc., the first contact 21 includes a strip-like metal plate curved into a substantially arcuate configuration so as to be convex on the lower side, with its center forming a fixed end 21 and its front and rear ends forming movable ends 21f and 21h. Further, the fixed end 21c at the center of the first contact 21 is supported from below by the terminal (2) in the form of a scale. Thus, when the first contact 21 is tilted around the fixed end 21c at the center (the terminal (2)) so as to be lower on the front side, the front side movable end 21f is connected to the terminal (1), and the rear side movable end 21h is kept away from the terminal (3) as shown in FIG 5A. That is, the first contact 21 is switched to the armature P-side terminal (1) in this case.

[0038] When the first contact 21 is tilted around the fixed end 21c at the center (the terminal (2)) so as to be lower on the rear side, the rear side movable end 21h is connected to the terminal (3), and the front side movable end 21f is kept away from the terminal (1) as shown in FIG 5B. That is, the first contact 21 is switched to the power source P-side terminal (3) in this case.

[0039] Similarly, the second contact 22 includes a strip-like metal plate curved into a substantially arcuate configuration so as to be convex on the lower side, with its fixed end 22c at the center being supported from below by the terminal (5) in the form of a scale. Further, operation is performed in a manner similar to that in the case of the first contact 21, enabling movable ends 22f and 22h provided at the front and rear ends of the second contact 22 to be respectively connected to the terminal (4) and the terminal (5).

[0040] In the operating portion 32 of the trigger 30 there are embedded a first protrusion 36 pressing the upper surface of the first contact 21 and a second protrusion 37 pressing the upper surface of the second contact 22. The first protrusion 36 and the second protrusion 37 are pin-like members with the same length, with their distal ends being beveled into a hemispherical configuration. Further, the first protrusion 36 and the second protrusion 37 are respectively accommodated in vertical holes formed in the lower surface of the operating portion 32 of the trigger 30, with their distal end portions protruding therefrom. As shown in FIG 5D, the first protrusion 36 and the second protrusion 37 are arranged to be offset each other in a sliding direction by a distance X.

[0041] As shown in FIG 5A, in the state in which the trigger 30 is at the front end position, the first protrusion 36 presses the upper surface of the distal end of the first contact 21, and the second protrusion 37 presses the upper surface of the distal end of the second contact 22, so that the first contact 21 is connected to the terminal (1), and the second contact 22 is connected to the terminal (4). That is, the motor control circuit 10 becomes in the state as shown in FIG 1A and FIG 2C. As stated above, the first protrusion 36 and the second protrusion 37 are arranged to be offset each other in the sliding direction by the distance X. Thus, when pull operation is

performed on the trigger 30, and the first protrusion 36 and the second protrusion 37 slide in the rearward direction on the upper surfaces of the first contact 21 and the second contact 22 respectively, the first protrusion 36 first connects the first contact 21 to the terminal (3), and then the second protrusion 37 connects the second contact 22 to the terminal (6). That is, transferring from the state shown in FIG 1B, the motor control circuit 10 becomes in the state as shown in FIG 2A, whereby the motor is started.

[0042] When returning operation is performed on the trigger 30 and the first protrusion 36 and the second protrusion 37 slide in the forward direction on the upper surfaces of the first contact 21 and the second contact 22 respectively, the second protrusion 37 which is situated on the front side of the first protrusion 36 in the sliding direction first connects the second contact 22 to the terminal (4), and then the first protrusion 36 connects the first contact 21 to the terminal (1). That is, transferring from the state shown in FIG 2B, the motor control circuit 10 becomes in the state as shown in FIG 2C and FIG 1A, whereby a brake electric current flows through the stator winding 11 to brake the motor.

[0043] In the motor drive switch 20 of this example, configuration is made with respect to the motor start operation such that, the first contact 21 is switched to the power source P-side terminal (3) earlier than the switching of the second contact 22 to the armature P-side terminal (6), as shown in FIG 1B. Thus, an electric current flows through the stator winding 11 and the armature 14 at the time when the second contact 22 is switched to the armature P-side terminal (6). Thus, if contact sticking is to be occurred with the passage of time, it occurs between the second contact 22 and the armature P-side terminal (6).

[0044] As shown in FIG 3A, contact sticking occurs at the armature P-side terminal (6) of the second contact 22. If stop operation is performed on the motor drive switch 20, the first contact 21 is switched to the armature P-side terminal (1) as shown in FIG 3B, so that no electric current flows through the stator winding 11 of the motor. That is, no abnormal electric current flows through the stator winding 11 of the motor due to contact sticking.

[0045] As shown in FIG 2B, in the motor stop operation, configuration is made such that the switching of the second contact 22 to the armature N-side terminal (4) is effected earlier than the switching of the first contact 21 to the armature P-side terminal (11). Thus, an electric current flows through the stator winding 11 and the armature 14 of the motor at the time when the first contact 21 is switched to the armature P-side terminal (1). Thus, if contact sticking is to be occurred with the passage of time, it occurs between the first contact 21 and the armature P-side terminal (1).

[0046] As shown in FIG 4A, contact sticking occurs at the armature P-side terminal (1) of the first contact 21. If start operation is performed on the motor drive switch 20, the second contact 22 is switched to the armature P-side terminal (6) as shown in FIG 4B, so that the motor does not start, and the electric current ceases to flow through the stator winding 11 of the motor. That is, no abnormal electric current flows through the stator winding 11 of the motor in this case.

[0047] Thus, the stator winding of the motor may not be damaged, which can reduce the burden of servicing.

[0048] The above construction may not be limited by the above-described example and may various changes may be made without departing from the scope of invention. For example, the above example shows that the mounting positions of the first protrusion 36 and the second protrusion 37 are arranged to be offset from each other in the sliding direction of the trigger 30 (a longitudinal direction) by the distance X, so that there is a time lag in operational timing between the first contact 21 and the second contact 22. However, it is also possible to provide a time lag in operational timing between the first contact 21 and the second contact 22 by mounting the first protrusion 36 and the second protrusion 37 at the same position in the sliding direction (See FIG 6E) and longitudinally offsetting bending positions of the first contact 21 and the second contact 22 from each other.

[0049] That is, it is also possible to adopt a construction in which when sliding the trigger 30 in the backward direction, the first contact 21 is turned ON at a position on the front side of the second contact by the distance X as shown in FIG 6C (i.e., the first contact 21 is switched to the power source P-side terminal (3) earlier than the switching of the second contact 22 to the armature P-side terminal (6)), and in which when returning the trigger 30 in the forward direction, the second contact 22 is turned ON at a position on the rear side of the first contact 21 by the distance X as shown in FIG 6D (i.e., the second contact 22 to the armature N-side terminal (4) is switched earlier than the switching of the first contact 21 to the armature P-side terminal (11)).

[0050] Further, as shown in FIG 7C to FIG 7E, it is also possible to provide a first switch 210 including the first contact 21 and the terminals (1), (2), and (3), and a second switch 220 including the second contact 22 and the terminals (4), (5), and (6), and the trigger 30 that can operate the first switch 210 and the second switch 220.

[0051] More specifically, the first switch 210 is provided with a case 21c including the first contact 22 and the terminals (1), (2), and (3), with an operating pin 21p being attached to the case 21c so as to be capable of being displaced in the vertical direction. Further, the operating pin 21p can be slid down against a spring force, whereby the first contact 21 tilts to the left, with a movable end of the first contact 21 being connected to the terminal (3) as shown in the lower portion of FIG 7E. Further, as shown in FIG 7C, the operating pin 21p is configured to protrude from the case 21c to a predetermined position by the spring force. The first contact 21 tilts to the right with the terminal (2) serving as a fulcrum, and the movable end of the first contact 21 is connected to the terminal (1).

[0052] The second switch 220 is of the same structure as the first switch 210. As shown in the upper portion of FIG 7E, the operating pin 22p can be slid down against the spring force, whereby the movable end of the second contact 22 is connected to the terminal (6). Further, the movable end of the second contact 22 is connected to the terminal (4) in a state where the operating pin 22p protrudes from the case 21c to the predetermined position by the spring force.

[0053] There are formed on the operating portion 32 of the trigger 30 a first pressing surface 32a and a second pressing surface 32b capable of pressing the operating pin 21p of the first switch 210 and the operating pin 22p of the second switch 220 respectively, in the course of sliding.

[0054] The first pressing surface 32a and the second pressing surface 32b are inclined to the same degree, and the first pressing surface 32a is arranged to be offset with respect to the second pressing surface 32b by the distance X in the sliding direction, as shown in FIG 7(B). Thus, by the pull operation of the trigger 30, the first pressing surface 32a first presses the operating pin 21p of the first switch 210, and the first contact 21 is connected to the terminal (3). Then, the second pressing surface 32b presses the operating pin 22p of the second switch 220, and the second contact 22 is connected to the terminal (6).

[0055] By the returning operation of the trigger 30, the second pressing surface 32b is caused to keep away from the operating pin 22p of the second switch 220 firstly, and the second contact 22 is connected to the terminal (4). Then, the first pressing surface 32a is caused to keep away from the operating pin 21p of the first switch 210, and the first contact 21 is connected to the terminal (1).

[0056] As described above, the motor drive switch of the present invention can be used in a motor control circuit. Especially, it can also be used in electric power tools such as miter saws, grinders, and electric screwdrivers etc.

[0057] It is explicitly stated that all features disclosed in the description and/or the claims are intended to be disclosed separately and independently from each other for the purpose of original disclosure as well as for the purpose of restricting the claimed invention independent of the composition of the features in the embodiments and/or the claims. It is explicitly stated that all value ranges or indications of groups of entities disclose every possible intermediate value or intermediate entity for the purpose of original disclosure as well as for the purpose of restricting the claimed invention, in particular as limits of value ranges.

Claims

1. A motor drive switch (20) comprising,
a first contact (21) connected to one end (2) of a stator winding (11) of a motor, the first contact (21) being capable of switching between a power source first-side terminal (3) connected to a first side (P) of a power source (E) and an armature first-side terminal (1) connected to a first side (P) of an armature (14), and
a second contact (22) connected to the other end (5) of the stator winding (11), the second contact (22) being capable of switching between the armature first-side terminal (6) and an armature second-side terminal (4) connected to an second side (N) of the armature (14),
the motor drive switch (20) being used in a motor control circuit (10) configured such that the first contact (21) is switched to the power source first-side terminal (3) and the second contact (22) is switched to the armature first-side terminal (6) by a start operation of the motor, with the result that the stator winding (11) and the armature (14) are connected in series between the first side (P) and the second side (N) of the power source (E) to thereby start the motor,
the motor drive switch (20) further configured such that the first contact (21) is switched to the armature first-side terminal (1), and the second contact (22) is switched to the armature second-side terminal (4) by a stop operation of the motor, with the result that the stator winding (11) and the armature (14) form a closed loop to thereby brake the motor,
the motor drive switch (20) being **characterized**
in that the switching of the first contact (21) to the power source first-side terminal (3) is configured to be effected earlier than the switching of the second contact (22) to the armature first-side terminal (6) in the start operation of the motor, and
in that the switching of the second contact (22) to the armature second-side terminal (4) is configured to be effected earlier than the switching of the first contact (21) to the armature first-side terminal (1) in the stop operation of the motor.

2. The motor drive switch (20) according to claim 1, **characterized**
in that the motor drive switch (20) further comprises a trigger (30) performing the start operation of the motor by sliding of the trigger (30) from a stop position to a start position and performing the stop operation of the motor by returning of the trigger (30) from the start position to the stop position,
in that the trigger (30) has a first protrusion (36) and a second protrusion (37) respectively pressing the first contact (21) and the second contact (22) during the sliding,
in that each of the first contact (21) and the second contact (22) is formed in a scale-like arcuate configuration whose center is supported by a fulcrum, each of the first contact (21) and the second contact (22) tilting around the fulcrum as each location where they are pressed by the first protrusion (36) or the second protrusion (37) varies, thereby effecting switching of

the contacts (21, 22), and
in that the first protrusion (36) and the second protrusion (37) are configured to be arranged to be offset in the sliding direction, whereby a difference in switching time is caused between the first contact (36) and the second contact (37).

3. The motor drive switch (20) according to claim 1, **characterized**
in that the motor drive switch (20) further comprises a trigger (30) performing the start operation of the motor by sliding of the trigger (30) from a stop position to a start position and performing the stop operation of the motor by returning of the trigger (30) from the start position to the stop position,
in that the trigger (30) has a first protrusion (36) and a second protrusion (37) respectively pressing the first contact (21) and the second contact (22) during the sliding,
in that each of the first contact (21) and the second contact (22) is formed in a scale-like arcuate configuration whose center is supported by a fulcrum, each of the first contact (21) and the second contact (22) tilting around the fulcrum as each location where they are pressed by the first protrusion (36) or the second protrusion (37) varies, thereby effecting switching of the contacts (21, 22), and
in that each bending position of the first contact (21) and the second contact (22) is configured to be offset from each other in the sliding direction, whereby a difference in switching time is caused between the first contact (21) and the second contact (22).

4. The motor drive switch (20) according to claim 1, **characterized**
in that the motor drive switch (20) further comprises a trigger (30) performing the start operation of the motor by sliding of the trigger (30) from a stop position to a start position and performing the stop operation of the trigger (30) by returning of the trigger (30) from the start position to the stop position,
in that each of the first contact (21) and the second contact (22) is accommodated in a case (21c, 22c) respectively, and operating pins (21p, 22p) protruding from the cases (21c, 22c) are pressed or depressed to effect switching of the contacts (21, 22), and
in that the trigger (30) has a first pressing surface (32a) and a second pressing surface (32b) configured to press a first operating pin (21p) for the first contact (21) and a second operating pin (22p) for the second contact (22) respectively, the first pressing surface (32a) and the second pressing surface (32b) being offset from each other in the sliding direction.

5. An electric power tool comprising the motor drive switch (20) according to any one of claims 1 to 4.

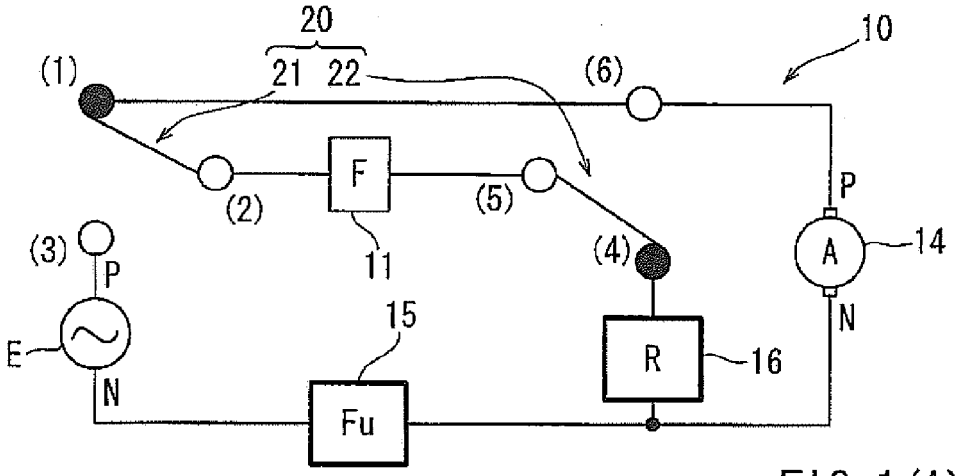


FIG. 1 (A)

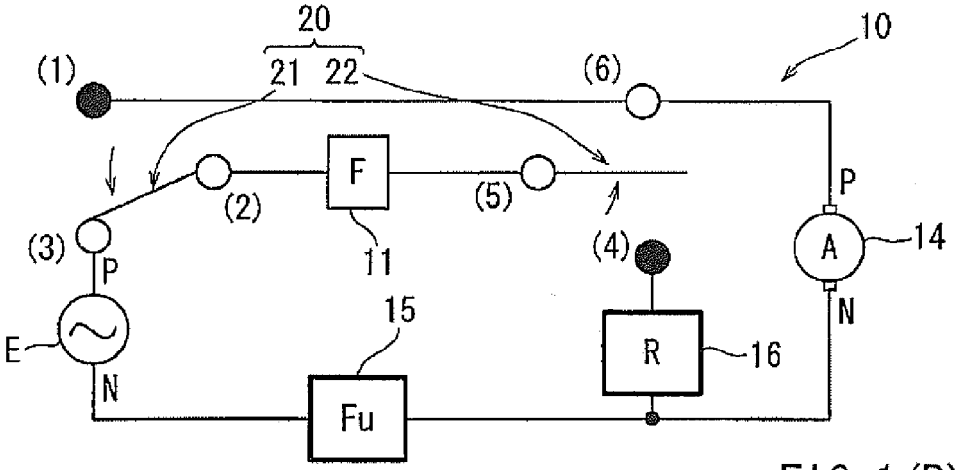


FIG. 1 (B)

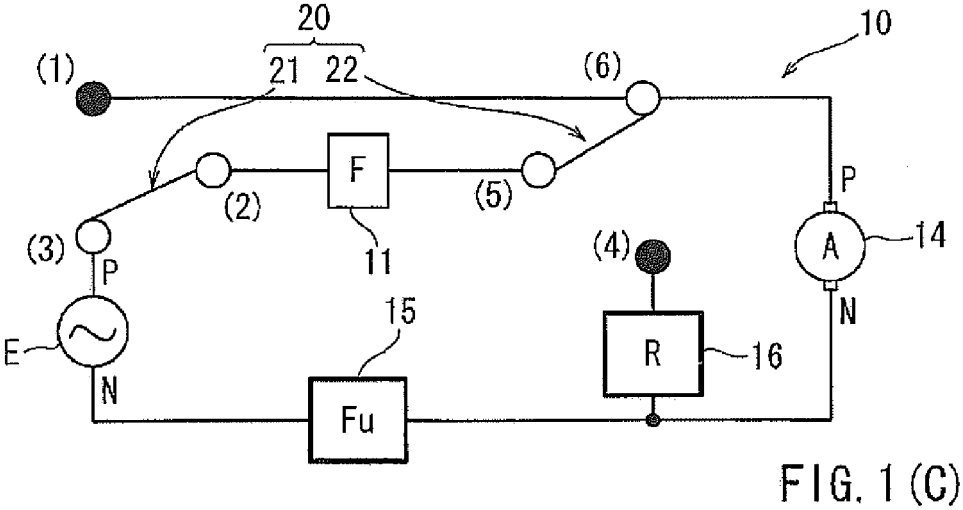


FIG. 1 (C)

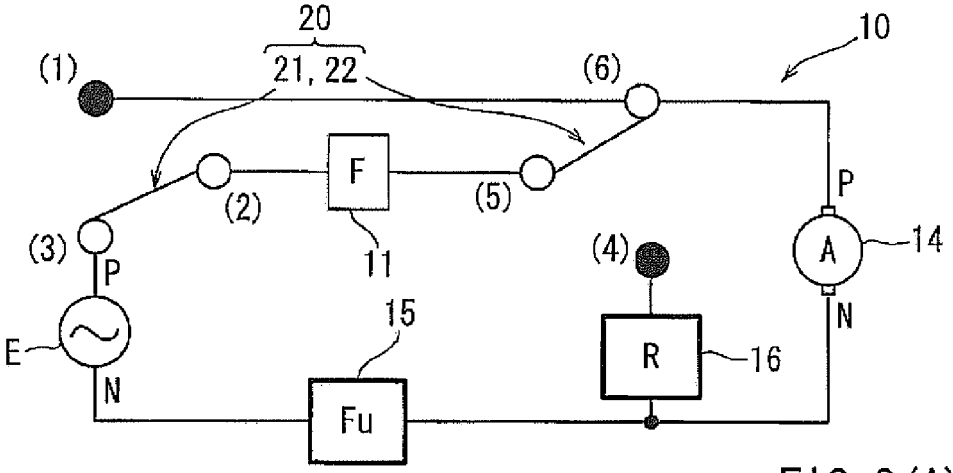


FIG. 2 (A)

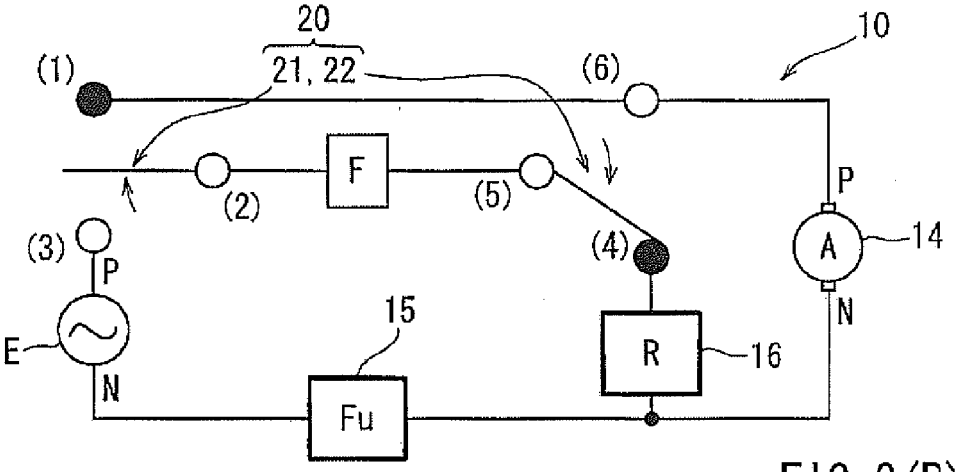


FIG. 2 (B)

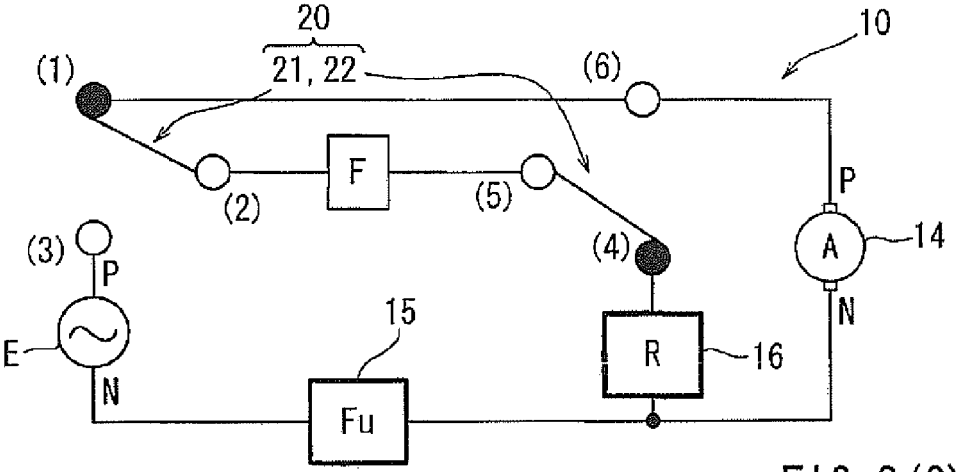
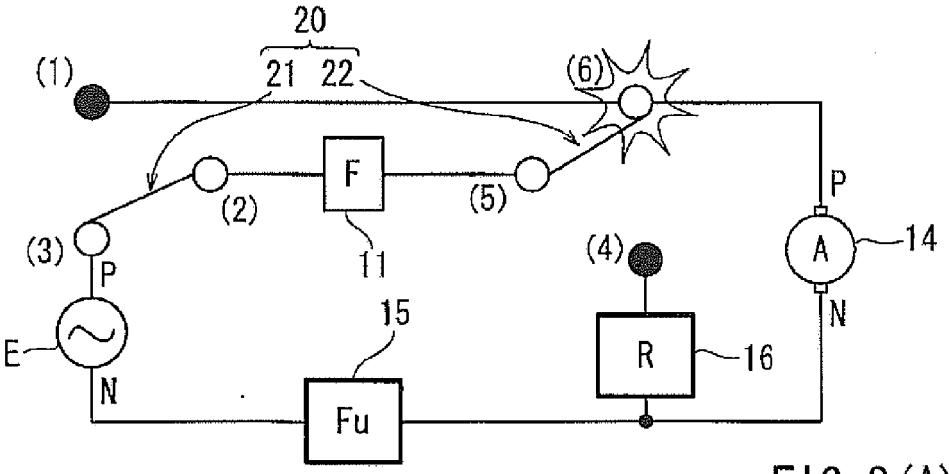


FIG. 2 (C)


20
21 22
(1)
(6)
F
(2)
(5)
P
(3)
P
11
(4)
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14
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E
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R
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Fu

FIG. 3 (A)

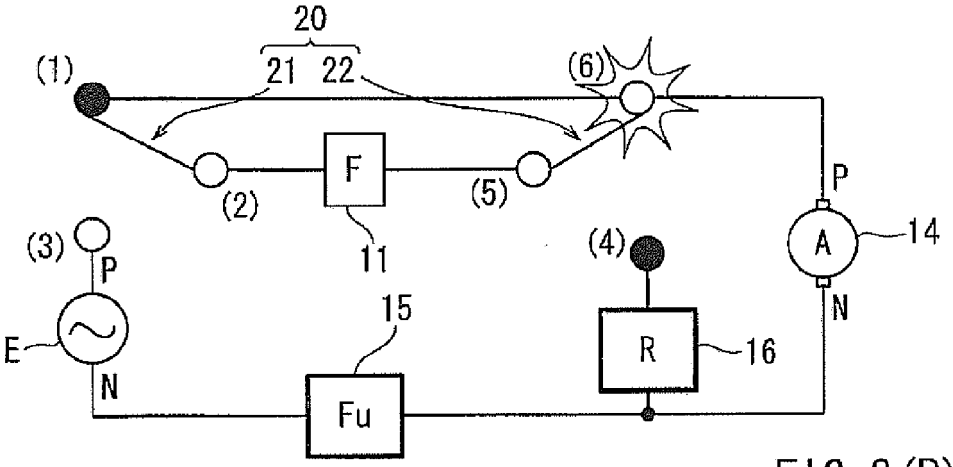
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FIG. 3 (B)

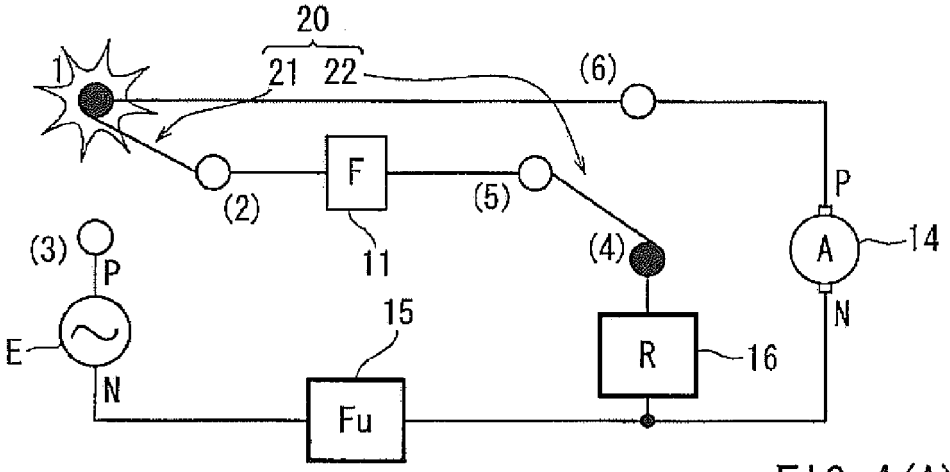
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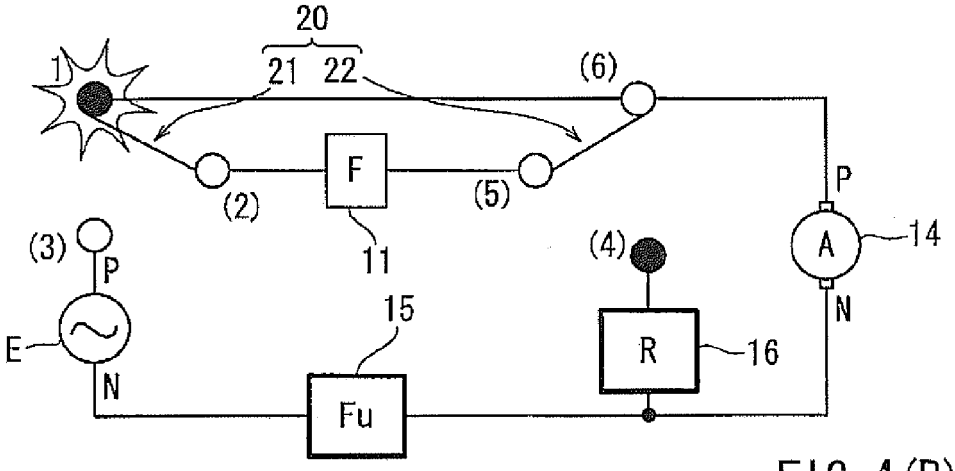
FIG. 4(A)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Fu

FIG. 4(B)

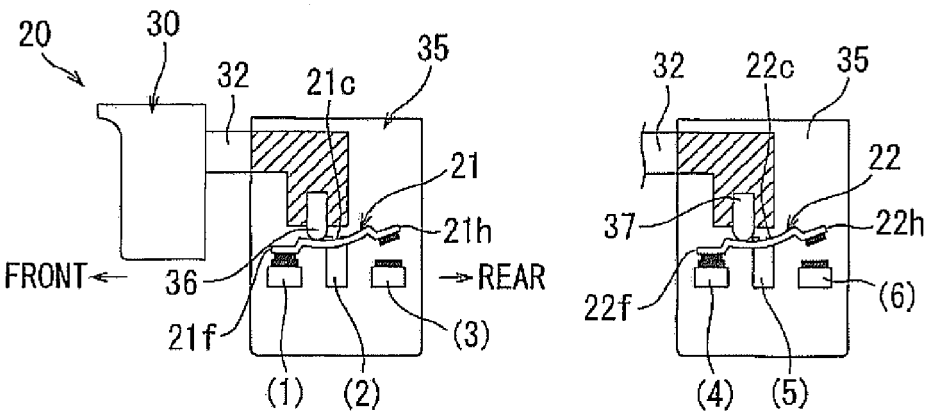

FIG. 5 (A)

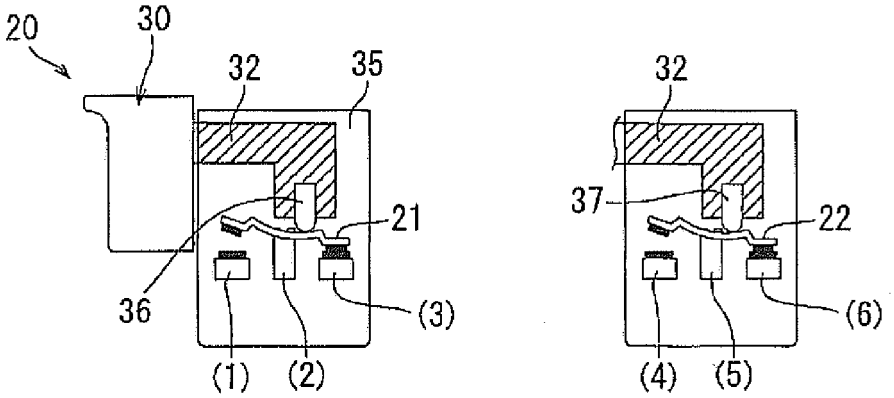

FIG. 5 (B)

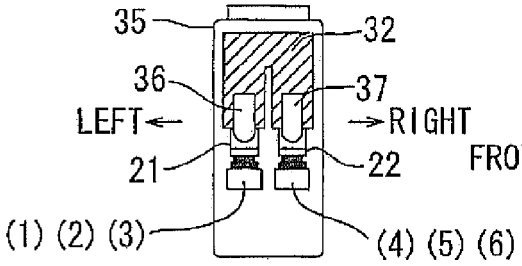

FIG. 5 (C)

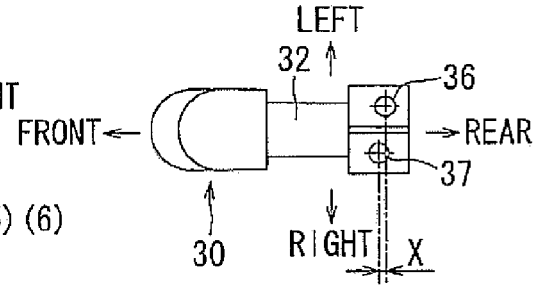

FIG. 5 (D)

FIG. 6 (A)

FIG. 6 (B)

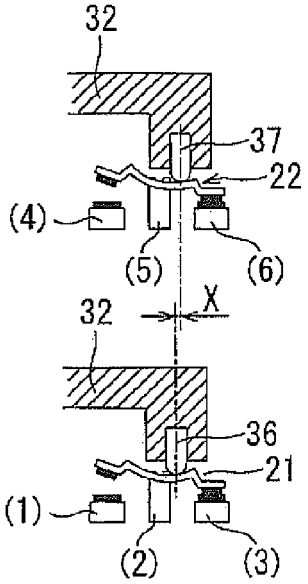

FIG. 6 (C)

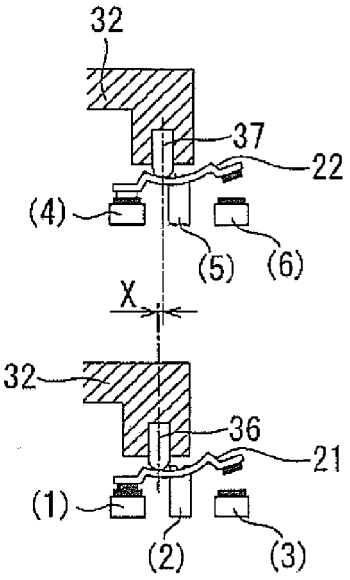

FIG. 6 (D)

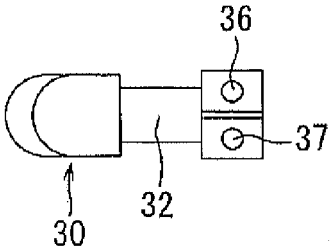

FIG. 6 (E)

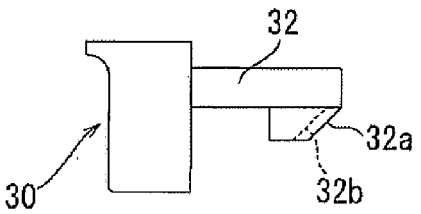

FIG. 7(A)

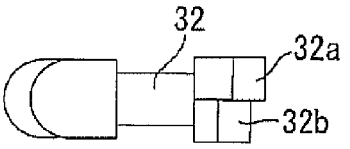

FIG. 7(B)

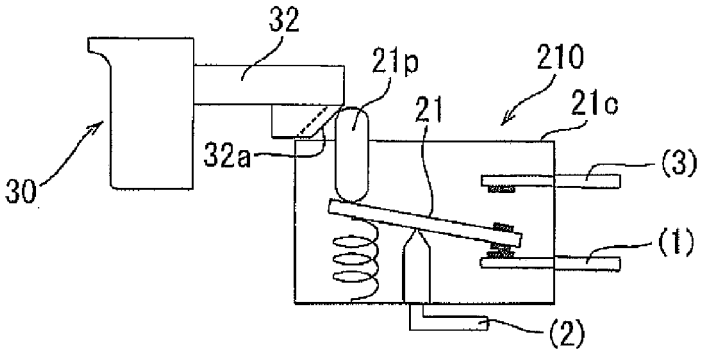

FIG. 7(C)

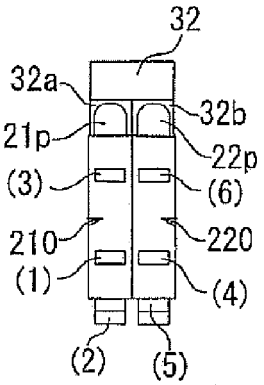

FIG. 7(D)

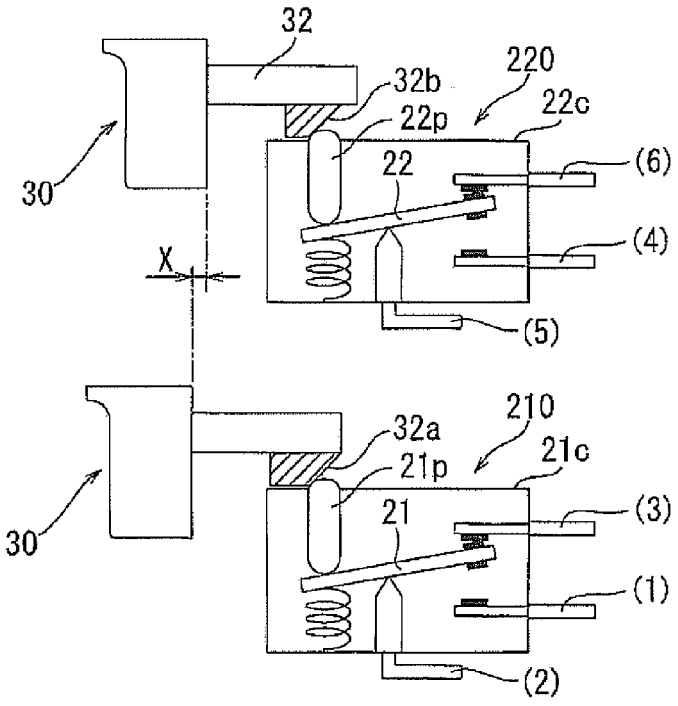

FIG. 7(E)

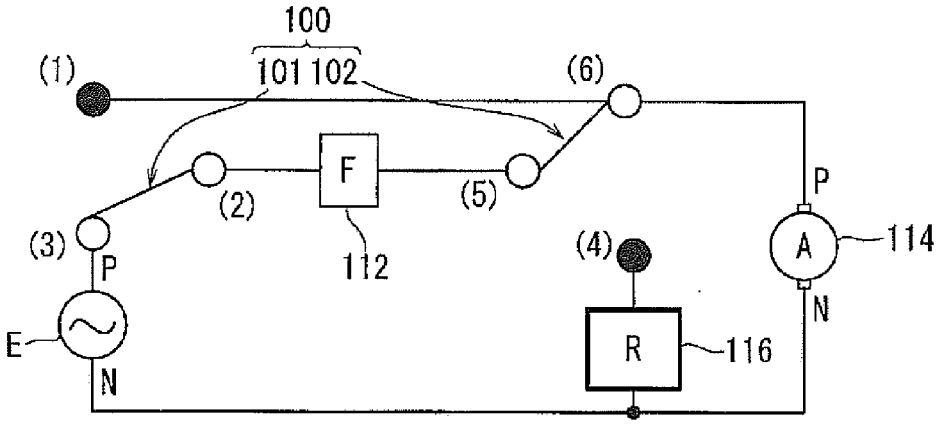

FIG. 8 (A)

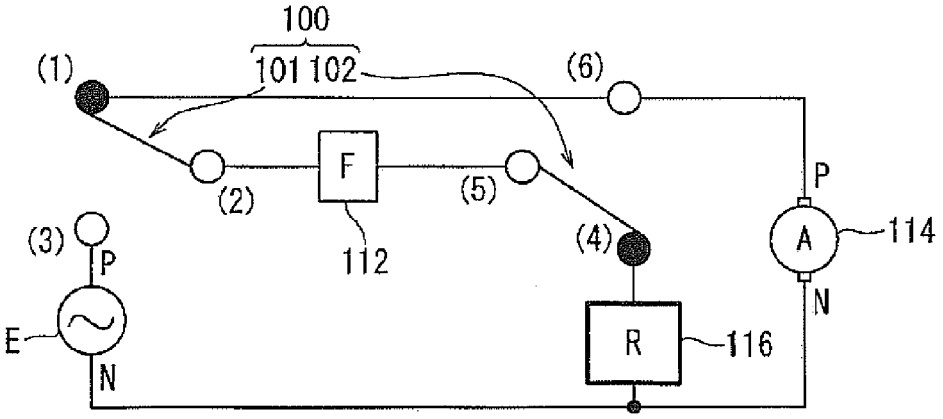

FIG. 8 (B)

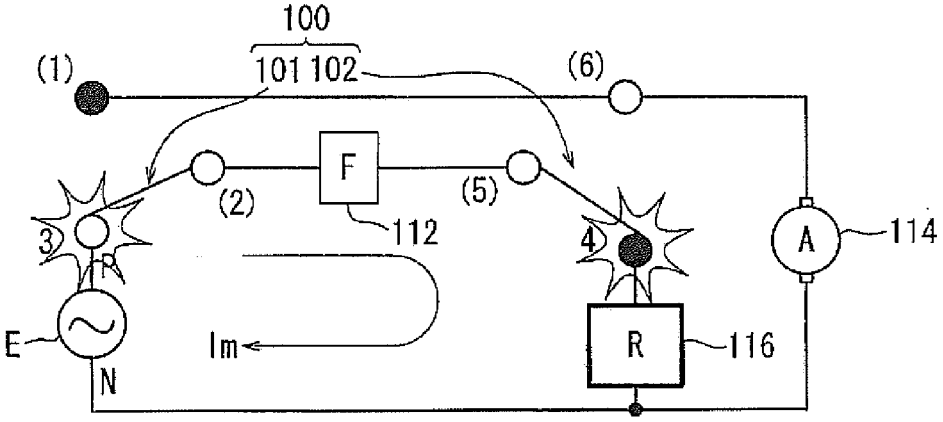

FIG. 8 (C)

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EUROPEAN SEARCH REPORT

Application Number
EP 11 17 7198

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 5 449 992 A (GEIGER AUGUST [DE] ET AL) 12 September 1995 (1995-09-12) * column 4, line 1 - column 14, line 7; figures 1-12 *	1-5	INV. H01H9/06
A	US 5 380 971 A (BITTEL ROBERT W [US] ET AL) 10 January 1995 (1995-01-10) * column 2, line 59 - column 6, line 33; figures 1-8 *	1-5	

TECHNICAL FIELDS SEARCHED (IPC)

H01H
H02P

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	20 December 2011	Nieto, José Miguel

CATEGORY OF CITED DOCUMENTS

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1

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20-12-2011

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US 5380971 A	10-01-1995	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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- JP 2010187048 A **[0001]**
- JP 2184279 A **[0003] [0004]**