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(54) **MAN CONVEYOR CONTROLLER, AND MAN CONVEYOR**

(57) When switching of a passenger conveyor from low-speed operation to high-speed operation is effected, a drive motor (2) connected to conversion device (1) connected to utility power (R, S, T) is disconnected from the conversion device (1). Subsequently, when a residual voltage of the motor (2) has dropped, the motor (2) is connected directly to the utility power (R, S, T). Even when switching from high-speed operation to low-speed

operation is effected, the motor (2) connected directly to the utility power (R, S, T) is disconnected from the utility power (R, S, T). Subsequently, while the residual voltage of the motor (2) has dropped, the motor (2) is connected directly to the conversion device (1). As a result, switching between low-speed operation and high-speed operation can be effected without involvement of switching shock or noise and by means of a low-cost configuration.

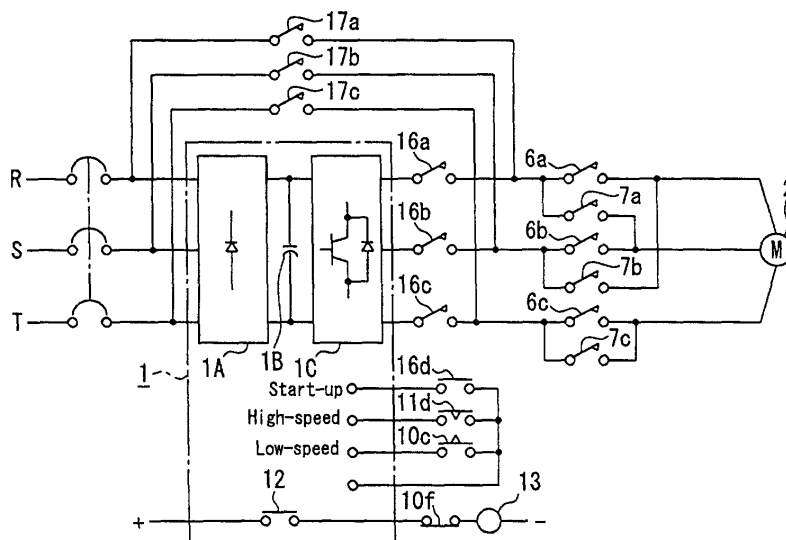


Fig. 1

Description

TECHNICAL FIELD

[0001] The present invention relates to a controller for use with passenger conveyors, such as variable-speed escalators or moving sidewalks, as well as to a passenger conveyor.

BACKGROUND ART

[0002] There has already been available a passenger conveyor whose drive motor is driven by way of a converter connected to utility power while its speed is converted.

[0003] In this case, a three-phase AC current of given frequency supplied for utility power is converted to a voltage-variable, frequency-variable three-phase AC current by means of a conversion device, and the thus-converted three-phase AC current is supplied to the motor. More specifically, a three-phase AC current which is lower in frequency than utility power is output, thereby driving the motor at low speed. The frequency is gradually increased by means of the conversion device. When the frequency of the three-phase AC current becomes close to the frequency of utility power, the motor is connected to utility power and driven at high speed.

[0004] As described in, e.g., Japanese Patent Publication 5752/1993, some of the related-art passenger conveyor controllers are provided with a synchronism detector. A three-phase AC current output from the conversion device is brought into synchronism with a three-phase AC current of utility power, and the connection between the electric motor and the conversion device switches to the connection between the electric motor and utility power.

[0005] In such a related-art passenger conveyor controller equipped with the synchronism detector, when a passenger conveyor is switched from low-speed operation to high-speed operation, synchronism between the frequency of a three-phase AC current output from the conversion device and the frequency of a three-phase AC current output from utility power is detected, thereby switching power. Thus, switching between low-speed operation and high-speed operation is effected smoothly, thereby lowering switching shock or noise due to switching.

[0006] However, the synchronous detector has a complicated structure and is expensive.

[0007] Switching of the passenger conveyor between low-speed operation and high-speed operation is performed while no passengers are using the conveyor. In short, when no passengers are using the conveyor, the conveyor is operated at low speed. Before passengers ride the passenger conveyor, the conveyor is switched to high-speed operation so as to convey the passengers at high speed. Hence, in such a case, even when a synchronism detector is not employed, passengers are not

directly subjected to switching shock or noise. However, drive components constituting the passenger conveyor may suffer switching shock or noise.

[0008] The present invention has been conceived to solve the foregoing drawbacks and is aimed at providing a passenger conveyor controller and a passenger conveyor which are less costly and highly reliable and which can reduce switching shock or noise without use of a synchronism detector.

DISCLOSURE OF THE INVENTION

[0009] As described above, according to the present invention, when switching from low-speed operation to high-speed operation is effected, a drive motor connected to a conversion device connected to utility power is disconnected from the conversion device. Subsequently, the motor is connected directly to the utility power while a residual voltage of the motor is lowered. Further, even when switching from high-speed operation to low-speed operation is effected, the drive motor connected directly to the utility power is disconnected from the utility power. Subsequently, the motor is connected to the foregoing conversion device while the residual voltage of the motor remains in a low state. As a result, there can be achieved switching action between low-speed operation and high-speed operation without involvement of switching shock or noise, by means of a low cost configuration.

[0010] The present invention relates to the foregoing improved passenger conveyor controller, wherein a drive motor is disconnected from a conversion device when switching from low-speed operation to high-speed operation is effected. After a given period of time, the drive motor is connected to utility power. Further, at the time of switching being effected from high-speed operation to low-speed operation, a drive motor is disconnected from utility power. After a given period of time, the drive motor is connected to the conversion device. As a result, switching between low-speed operation and high-speed operation can be achieved without involvement of switching shock or noise and by means of a low-cost configuration.

[0011] The present invention relates to the foregoing improved passenger conveyor controller equipped with a residual voltage sensor for sensing a residual voltage of the drive motor. When switching from low-speed operation to high-speed operation is effected, the drive motor is disconnected from the conversion device. After detection that the residual voltage has dropped to or below a certain value, the drive motor is connected to utility power. Further, when switching from high-speed operation to low-speed operation is effected, the drive motor is disconnected from utility power. After detection that the residual voltage has dropped to or below a certain value, the drive motor is connected to the conversion device. As a result, switching between low-speed operation and high-speed operation can be achieved without

involvement of switching shock or noise and by means of a low-cost configuration.

[0012] The present invention relates to the foregoing improved passenger conveyor equipped with a load device for reducing a residual voltage of the drive motor. After the motor has been disconnected from the conversion device or utility power, the motor is connected to the load device. As a result, the residual voltage of the drive motor can be reduced actively, thereby shortening a switching time and lessening switching shock.

[0013] The present invention relates to the foregoing improved passenger conveyor, when operation is switched from low-speed operation to high-speed operation, one of a plurality of drive motors connected to a conversion device connected to utility power is disconnected from the conversion device. Subsequently, while a residual voltage of the motor has dropped, all of the motors are connected directly to the utility power. Further, even at the time of switching of operation from high-speed operation to low-speed operation, all of the drive motors connected directly to utility power are disconnected from the utility power. Subsequently, while the residual voltages of the motors have dropped, some of the motors are connected to the conversion device. As a result, the residual voltages of the motors can be diminished quickly, thereby lessening switching shock.

[0014] The present invention relates to the foregoing improved passenger conveyor controller, wherein some of drive motors are disconnected from the conversion device at the time of switching of operation from low-speed operation to high-speed operation. After a given period of time, all the motors are connected to utility power. Further, all the motors are disconnected from the utility power when operation is switched from high-speed operation to low-speed operation. After a given period of time, some of the motors are connected to the conversion device. As a result, the residual voltages of the motors can be diminished quickly, thereby lessening switching shock.

[0015] The present invention relates to the foregoing improved passenger conveyor controller equipped with a residual voltage sensor for sensing residual voltages of drive motors. When switching is effected from low-speed operation to high-speed operation, some of the drive motors are disconnected from the conversion device. After detection that the residual voltages have dropped to or below a certain value, all the drive motors are connected to utility power. Further, when switching from high-speed operation to low-speed operation is effected, all the drive motors are disconnected from utility power. After detection that the residual voltages have dropped to or below a certain value, some of the drive motors are connected to the conversion device. As a result, residual voltages of the motors can be diminished quickly, thereby lessening switching shock.

[0016] The present invention relates to the foregoing improved passenger conveyor controller equipped with a load device for reducing residual voltages of a plurality

of drive motors. After some or all of the motors have been disconnected from the conversion device or utility power, the motor is connected to the load device. As a result, the residual voltages of the motors can be diminished actively, and hence shortening of a switching time and reduction of switching shock can be effected.

[0017] The present invention relates to the foregoing improved passenger conveyor controller equipped with a passenger sensor for sensing presence/absence of users of the conveyor. When users are detected, the passenger conveyor is switched from low-speed operation to high-speed operation. If no users are detected, the passenger conveyor is switched from high-speed operation to low-speed operation. As a result, changing of speed of the passenger conveyor can be effected in accordance with presence/absence of users with a high level of reliability and by means of a low cost configuration.

[0018] The present invention relates to a passenger conveyor equipped with the foregoing passenger conveyor controller. As a result, switching of operation between high-speed operation and low-speed operation can be effected without involvement of switching shock or noise.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

Fig. 1 is a schematic diagram of a motor circuit of the passenger conveyor controller according to the first embodiment of the present invention.

Fig. 2 is a schematic diagram of a control circuit of the passenger conveyor controller according to the first embodiment of the present invention.

Fig. 3 is a schematic diagram of a control circuit followed Fig. 2.

Fig. 4 is a illustration showing voltage waveforms appearing at the time of power supply switching according to the a control circuit of the passenger conveyor controller of the first embodiment of the present invention.

Fig. 5 is a illustration showing voltage waveforms according to the a control circuit of related art corresponding to Fig. 4

Fig. 6 is a control circuit diagram showing the passenger conveyor controller according to the second embodiment of the present invention.

Fig. 7 is a power circuit diagram of the passenger conveyor controller according to the third embodiment of the present invention.

Fig. 8 is a control circuit diagram of the passenger conveyor controller according to the third embodiment of the present invention.

Fig. 9 is a chart showing a waveform of a voltage arising at the time of switching of power of the passenger conveyor controller according to the third embodiment of the present invention.

Fig. 10 is a power circuit diagram of a passenger conveyor controller according to the fourth embodiment of the present invention.

Fig. 11 is a control circuit diagram according to the passenger conveyor controller to the fourth embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0020] The present invention will be described in more detail by reference to the accompanying drawings.

[0021] By reference to Figs. 1 through 5, a passenger conveyor controller according to a first embodiment of the present invention will now be described. Fig. 1 is a schematic diagram of a motor circuit of the passenger conveyor controller according to the first embodiment. Figs. 2 and 3 are schematic diagrams of a control circuit. Figs. 4 and 5 are illustrations showing voltage waveforms appearing at the time of power supply switching.

[0022] As shown in Figs. 1 through 3, R, S, and T denote three-phase utility power; and + and - denote DC control power sources. Reference numeral 1 designates a variable-voltage, variable-frequency device (hereinafter referred to as a "VVVF device") for converting three-phase AC currents, for the three-phase utility power R, S, and T, to a three-phase voltage-variable, frequency-variable AC current. The VVVF device 1 has a converter 1A for converting a three-phase AC current into a DC current; a smoothing capacitor 1B connected to an output terminal of the converter 1A; and an inverter 1C which is connected to the smoothing capacitor 1B and converts the DC current to a three-phase AC current. Reference numeral 2 designates an induction motor (a drive motor) for driving a passenger conveyor connected to the AC-side of the inverter 1C.

[0023] Reference numeral 3 designates safety switches; 4 designates a stop switch; 5 designates a start-up switch; 6 designates an electromagnetic contactor for ascending purpose (hereinafter called as an "ascending contactor"); 6a through 6d designate normally-open contact points of the contactor 6; 6e designates a normally-closed contact point of the same; 7 designates an electromagnetic contactor for descending purpose (hereinafter called a "descending contactor"); 7a through 7d designate normally-open contact points of the contactor 7; 7e designates a normally-closed contact point of the same; 8 designates an operation relay; 8a and 8b designate normally-open contact points of the relay 8; and 9 designates a manual speed changeover switch.

[0024] Reference numeral 10 designates a low-speed relay; 10a and 10b designate normally-open contact points of the relay 10; 10c designates a normally-open timed contact point of the same; 10d through 10f designate normally-closed contact points of the same; 11 designates a high-speed relay; 11a through 11c designate normally-open contact points of the relay 11; 11d designates

a normally-open timed contact points of the same; 11e designates a normally-closed contact point of the same; 12 designates a contact point which is closed when the frequencies of the AC power supply R, S, and T have become equal to an output frequency of the VVVF device 1; 13 designates a power supply frequency detection relay; 13a designates a normally-open contact point of the relay 13; 13b designates a normally-closed contact point of the same; 13c designates a normally-closed timed contact point of the same; 14 designates a VVVF device activation relay; 14a designates a normally-open contact point of the relay 14; 14b designates a normally-closed contact point of the same; 15 designates a switching time setting relay; 15a designates a normally-open timed contact point of the relay 15; and 15b designates a normally-closed contact point of the same.

[0025] Reference numeral 16 designates an electromagnetic contactor for the VVVF device (hereinafter referred to as a "VVVF device contactor"); 16a through 16d designate normally-open contact points of the contactor 16; 16e designates a normally-closed contact point of the same; 17 designates an electromagnetic contactor for a power supply (hereinafter referred to as a "power supply contactor"); 17a through 17c designate normally-open contact points of the same; and 17d designates a normally-closed contact point of the same.

[0026] The operation of the passenger conveyor controller according to the first embodiment will now be described.

[0027] The general outline of switching from low-speed operation to high-speed operation will first be described.

[0028] The VVVF device 1 converts an AC current of the utility power R, S, T into an AC current having a frequency lower than that of the utility power R, S, T, thereby driving the motor 2 by way of the contact points 16a through 16c, the contact points 6a through 6c, and the contact points 7a through 7c. In short, a low-speed circuit is closed (or turned on), thus constituting a closed circuit. Then, the frequency of the AC current is gradually increased. When the frequency of the AC current has reached the frequency of the utility power R, S, T, the contact points 16a through 16c are opened, thus temporarily disconnecting the motor 2 from the VVVF device 1. Thus, the low-speed circuit is opened (turned off), thereby constituting an open circuit. After lapse of a given period of time, the contact points 17a through 17c are closed only after a residual voltage remaining in the motor 2 has diminished. The motor 2 is connected directly to the AC power supply R, S, T, thereby switching to high-speed operation. In short, the high-speed circuit is closed, thereby constituting a closed circuit.

[0029] The detailed operation of the passenger conveyor will now be described.

[0030] First, an ascending operation for the passenger conveyor from low speed to high speed is performed in the following manner.

[0031] When the start-up switch 5 is turned to an ascending side, the ascending contactor 6 is energized by way of a path of +, 3, 4, 5, 7e, 6, and -. The contact points 6a through 6d are closed, and the contact point 6e is opened. The operation relay 8 is energized as a result of closing of the contact point 6d, thereby closing the contact points 8a and 8b. If the speed changeover switch 9 remains in a low-speed position at this time, the low-speed relay 10 is energized by way of a path of +, 8a, 9, 10, and -. As a result of closing of the contact point 10a, the low-speed relay 10 is self-held. Further, the contact point 10b is also closed, so that the contact points 10d through 10f are opened. The timed contact point 10c is closed after lapse of a given period of time.

[0032] The VVVF device activation relay 14 is energized by way of a path of +, 8b, 10b, 15b, 14, -, thereby closing the contact point 14a and opening the contact point 14b. As a result of closing of the contact point 14a, the VVVF device contactor 16 is energized by way of a path of +, 8b, 14a, 13c, 17d, 16, -, thereby closing the contact points 16a through 16d and opening the contact point 16e. Since the contact point 10c and the contact point 16d are closed, a low-speed start-up instruction is output, and the VVVF device 1 is activated. The output frequency rises to a low frequency as compared with that of the utility power R, S, T. Then, an electromagnetic brake (not shown) is released, and the motor 2 starts low-speed ascending operation.

[0033] When the speed changeover switch 9 is turned to a high-speed position, the high-speed relay 11 is energized along a path of +, 8a, 9, 11, -, thereby closing the contact points 11a through 11d and opening the contact point 11e. As a result of opening of the contact point 11e, the low-speed relay 10 is de-energized, thereby opening the contact points 10a through 10c and closing the contact points 10d through 10f. As a result, the high-speed relay 11 is self-held. As a result of closing of the contact point 11b, the VVVF device activation relay 14 is held in an energized state.

[0034] The timed contact point 10c is opened, and the timed contact point 11d is closed, thereby outputting a high-speed operation instruction. The output frequency of the VVVF device 1 is increased toward a frequency equal to that of the utility power R, S, T, thereby accelerating the motor 2. When the output frequency of the VVVF device 1 has become equal to the frequency of the utility power R, S, T, the contact point 12 is closed. Further, the power frequency detection relay 13 is energized, and the contact point 13a is closed. In addition, the contact point 13b and the timed contact point 13c are opened. Since, the contact point 10b has already been opened, the VVVF device activation relay 14 is de-energized as a result of opening of the contact point 13b. Thus, the contact point 14a is opened, and the contact point 14b is closed.

[0035] As a result of opening of the contact point 14a, the VVVF device connection contactor 16 is de-energized, thereby opening the contact points 16a through

16d and closing the contact point 16e. Further, as a result of closing of the contact point 14b, the switching time setting relay 15 is energized along a path of +, 8b, 13a, 11c, 10e, 14b, 15, -. After lapse of a predetermined period of time, the timed contact point 15a is closed. The power supply contactor 17 is energized along a path of +, 8b, 15a, 16e, 17, -, thereby closing the contact points 17a through 17c and opening the contact point 17d.

[0036] The VVVF device 1 accelerates the motor 2 up to a level equal to the frequency of utility power R, S, T. The motor 2 is temporarily disconnected from the VVVF device 1, thus performing idle running. Subsequently, the motor 2 is connected to the utility power R, S, T, thus performing a high-speed operation.

[0037] The same also applies to a descending operation for the passenger conveyor, and hence detailed explanation thereof is omitted.

[0038] Figs. 4 and 5 show waveforms of voltages developing when switching between the VVVF device contactor 16 and the power supply contactor 17 is effected. It is assumed that a phase difference between the waveform of a voltage V1 of the utility power R, S, T and the waveform of a voltage V2 applied to the motor 2 is maximum at this time.

[0039] As shown in Fig. 4, when the operation to be performed by the inverter 1C during an operation time T1 is finished, the motor 2 is disconnected from the VVVF device 1, thus performing idle running. The applied voltage V2 attenuates within a changeover time T2 defined by the switching time setting relay 15.

[0040] After completion of the switching time T2, the motor 2 is connected to the utility power R, S, T, thereby entering a normal operation time T3. When the switching time T2 is ensured, a switching operation involving low switching shock can be achieved, as indicated by A, without involving occurrence of synchronism between an output from the VVVF device 1 and an output from the utility power R, S, T. The reason for this is that, as a result of idle running of the motor 2, a residual voltage V3 lowers, thereby lessening switching shock. Desirably, the switching time assumes a value of about 0.7 second, thereby diminishing attenuation of speed of the passenger conveyor.

[0041] As illustrated in Fig. 5, when the motor 2 has a short switching time T4; that is, an idle-running time, a residual voltage V4 does not become small. As indicated by B, switching shock becomes great.

[0042] Next, a descending operation for the passenger conveyor from a high-speed operation to a low-speed operation is performed in the following manner.

[0043] It is assumed that a high-speed ascending operation is being performed while the power supply contactor 17 is energized and the motor 2 is connected to the utility power R, S, T. At this time, when the speed changeover switch 9 is turned to a low-speed position, the low-speed relay 10 is energized, and the contact point 10d is opened, thus de-energizing the high-speed relay 11. The contact point 10e is opened, thus de-en-

energizing the switching time setting relay 15. As a result, the timed contact point 15a is opened. Accordingly, the power supply contactor 17 is de-energized, and the motor 2 is disconnected from the utility power R, S, T.

[0044] As a result of the switching time setting relay 15 being de-energized, the contact point 15b is closed. At this time, since the contact point 10b remains closed, the VVVF device activation relay 14 is energized, and the contact point 14a is closed. In contrast, the contact point 10f is opened by means of energization of the low-speed relay 10. After lapse of a predetermined period of time, the timed contact 13c is closed. Accordingly, the VVVF device contactor 16 is energized by way of a path of +, 8b, 14a, 13c, 17d, 16, -. The motor 2 is then connected to the VVVF device 1. More specifically, the motor 2 is temporarily disconnected from the utility power R, S, T, thus performing idle running. Subsequently, the motor 2 is connected to the VVVF device 1.

[0045] As in the case of switching from low-speed operation to high-speed operation mentioned previously, the motor 2 is connected to the VVVF device 1 after the residual voltage of the motor 2 has dropped. Hence, switching shock can be lessened.

[0046] Subsequently, the timed contact 11d is opened after lapse of a given period of time following de-energizing of the high-speed relay 11. After lapse of a given period of time following de-energizing of the low-speed relay 10, the timed contact 10c is closed. As a result, the output frequency of the VVVF device 1 shifts from the frequency of the utility power R, S, T to a lower set frequency, and the motor 2 is decelerated.

[0047] In this way, after the residual voltage V3 of the motor 2 has dropped from a voltage level obtained when the motor 2 is disconnected from the VVVF device 1 or the utility power R, S, T; namely, after a given period of time has elapsed from when the motor 2 is disconnected from the VVVF device 1 or the utility power R, S, T, the motor 2 is connected to the utility power R, S, T or the VVVF device 1. Hence, switching operation can be performed without involvement of switching shock or noise and by means of a low-cost configuration.

[0048] Fig. 6 describes a passenger conveyor controller according to a second embodiment of the present invention. Fig. 6 is a control circuit diagram showing the passenger conveyor controller according to the second embodiment. Figs. 1, 2, 4, and 5 are employed also in connection with the second embodiment.

[0049] As shown in Fig. 6, reference numeral 11f designates a normally-open contact point of the high-speed relay 11; 13d designates a normally-open contact point of the power supply frequency detection relay 13; 13e designates a normally-closed contact point of the same; 16f designates a normally-open contact point of the VVVF device contactor 16; 16g and 16h designate normally-closed contact points of the same; 17e designates a normally-open contact point of the power supply contactor 17; 17f through 17h designate normally-closed contact points of the same; 21 designates a residual

voltage detector for detecting a residual voltage of the motor 2; 21a designates a normally-open contact point of the residual voltage detector 21; 22 designates a residual voltage detection relay; and 22a through 22d designate normally-open contact points of the residual voltage detection relay 22.

[0050] The operation of the passenger conveyor according to the present embodiment performed when switching from high-speed operation to low-speed operation is effected will now be described. Provided that the motor 2 is connected to the utility power R, S, T and performing a high-speed ascending operation and that the speed changeover switch 9 remains in a low-speed position, the low-speed relay 10 is energized, and the high-speed relay 11 is de-energized, as has been described in connection with the first embodiment. Since the contact point 11f is opened, the power contactor 17 is de-energized. Further, the contact point 14a remains opened, and hence the VVVF device contactor 16 is also de-energized, and the motor 2 performs an idle running operation. Further, the contact points 16h and 17h remain closed, and the residual voltage detector 21 starts detecting a residual voltage.

[0051] As a result of idle running of the motor 2, the residual voltage drops. When the residual voltage has dropped to or below a predetermined level, the contact point 21a is closed. Then, the residual voltage detection relay 22 is energized, and the contact points 22a through 22d are closed. As a result of closing of the contact point 22a, the VVVF device activation relay 14 is energized, thereby closing the contact point 14a. The VVVF device contactor 16 is then energized, thereby switching the motor 2 to the VVVF device 1. Simultaneously, as a result of closing of the contact point 16f, the residual voltage detection relay 22 is held.

[0052] The motor 2 is temporarily disconnected from the utility power R, S, T and performs idle running. Subsequently, the motor 2 is connected to the VVVF device 1. After lapse of a given period of time following de-energizing of the high-speed relay 11, the timed contact point 11d is opened. If the timed contact point 10c is closed after lapse of a given period of time following energizing of the low-speed relay 10, the output frequency of the VVVF device 1 shifts from the frequency of utility power R, S, T to a lower set frequency, thereby decelerating the motor 2.

[0053] In this way, switching is performed after a drop in residual voltage has been checked, and hence switching operation can be realized with a higher degree of reliability and through use of a low-cost configuration.

[0054] By reference to Figs. 7 through 9, a passenger conveyor controller according to a third embodiment of the present invention will be described. Fig. 7 is a power circuit diagram of the passenger conveyor controller according to the third embodiment; Fig. 8 is a control circuit diagram; and Fig. 9 is a chart showing a waveform of a voltage arising at the time of switching of power. Here, Fig. 2 is also employed for the third embodiment.

[0055] As shown in the drawings, reference numeral 14c designates a normally-open contact point of the VVVF device activation relay 14; 15c designates a normally-open contact point of the switching time setting relay 15; 16i designates a normally-closed contact point of the VVVF device contactor 16; 17i designates a normally-closed contact point of the power supply contactor 17; 23 designates an electromagnetic contactor for use in connecting a load (hereinafter referred to as a "load connection contactor"); 23a through 23c designate normally-open contact points of the contactor 23; 23d and 23e designate normally-closed contact points of the same; 24 designates a disconnect time setting relay; 24a designates a normally-closed timed contact point of the relay 24; and 25 designates a load device, such as a resistor or a reactor, which is removably connected to the motor 2 by way of the contact points 23a through 23c. In other respects, the passenger conveyor according to the present embodiment is identical with those shown in Figs. 1 and 3.

[0056] The operation of the passenger conveyor according to the third embodiment will now be described. The passenger conveyor of the present embodiment differs from the previously-described passenger conveyors only in switching operation. Only the difference will now be described.

[0057] The contact point 10b is closed during low-speed operation. When the speed changeover switch 9 shown in Fig. 2 is turned to the high-speed position in this state, the high-speed relay 11 is energized, as mentioned previously. The contact point 11b is closed, and hence the VVVF device activation relay 14 is held in an energized state. Now, since the high-speed relay 11 is energized, the output frequency of the VVVF device 1 increases so as to become equal to that of the utility power R, S, T, thus accelerating the motor 2.

[0058] When the output frequency has become equal to that of the utility power R, S, T, the power supply frequency detection relay 13 is energized, and the contact point 13a is closed. Further, the timed contact point 13c is opened. As a result of opening of the timed contact point 13c, the VVVF device contactor 16 is de-energized, so that the motor 2 is disconnected from the VVVF device 1 and performs idle running. Further, as a result of closing of the contact point 13a, the switching time setting relay 15 is energized, thereby closing the contact point 15c (the contact point 14c remains open at this time). Accordingly, the load connection contactor 23 is energized by way of a path of +, 8b, 15c, 16i, 17i, 24a, 23, -, and the contact points 23a through 23c are closed.

[0059] Since the load device 25 is connected to the motor 2, the residual voltage of the motor 2 drops. Further, as a result of closing of the contact point 15c, the disconnection time setting relay 24 is energized. After lapse of a predetermined period of time, the timed contact point 24a is opened. Hence, the load connection contactor 23 is de-energized, thereby opening the con-

tact points 23a through 23c. Then, the load device 25 is disconnected from the motor 2. As a result of energizing of the switching time setting relay 15, the timed contact point 15a is closed after lapse of a predetermined period of time. Hence, the power contactor 17 is energized, thereby closing the contact points 17a through 17c.

[0060] In short, the motor 2 is accelerated by the VVVF device 1 up to the frequency of the utility power R, S, T and is temporarily disconnected from the VVVF device 1, thus performing idle running. Further, the motor 2 is connected to the load device 25 and later connected to the utility power R, S, T, thereby performing idle running.

[0061] Fig. 9 shows a waveform of the voltage appearing when switching between the VVVF device contactor 16 and the power supply contactor 17 is effected. As a result of connection of the load device 25, after lapse of a given period of time T5 the residual voltage of the motor 2 drops in the manner as designated by C. As a result, the resultant switching shock becomes smaller.

[0062] In the third embodiment, the load device 25 is disconnected after expiration of time limit of the disconnection time setting relay 24. However, it is evident that the load device 25 may be disconnected by use of the previously-described residual voltage detector 21 when a residual voltage has dropped to and below a predetermined value.

[0063] In this way, the energy of the motor 2 is actively consumed by use of the load device 25. Hence, shortening of a switching time and lessening of switching shock can be effected.

[0064] By reference to Figs. 10 and 11, a passenger conveyor controller according to a fourth embodiment of the present invention will now be described. Fig. 10 is a power circuit diagram of a passenger conveyor controller according to the fourth embodiment. Fig. 11 is a control circuit diagram. Figs. 2 and 9 can be employed also in connection with the fourth embodiment.

[0065] As illustrated, reference numeral 2A designates an induction motor (drive motor) for driving a passenger conveyor and connected to the motor 2 by way of the contact points 23a through 23c; 11g designates a normally-open contact point of the high-speed relay 11; 13f designates a normally-open contact point of the power supply frequency detection relay 13; and 23d designates a normally-open contact point of the load connection contactor 23. In other respects, the passenger conveyor is identical with those shown in Figs. 1 and 8.

[0066] The operation of the passenger conveyor according to the fourth embodiment will now be described. In the present embodiment, a passenger conveyor having a plurality of motors 2 and 2A is controlled. The present embodiment is analogous to the third embodiment, and hence the primary point of the present embodiment will be described.

[0067] When the passenger conveyor is operated at

low speed, only one of the plurality of motors 2 and 2A drives the passenger conveyor by means of energizing of the VVVF device contactor 16. Switching to high-speed operation arises, and the output frequency of the VVVF device 1 becomes equal to the frequency of the utility power R, S, T. At this time, the timed contact 13c is opened, and the VVVF device contactor 16 is de-energized. The motor 2 is then disconnected from the VVVF device 1.

[0068] When the contact point 16f is closed as a result of de-energization of the VVVF device contactor 16, the load connection contactor 23 is energized, because the contact points 11g and 13f are closed. Then, the contact points 23a through 23c are closed, thereby connecting the motor 2 to the induction motor 2A. When the contact point 23d is closed, the contact point 16e remains closed. Hence, the power supply contactor 17 is energized, and the motors 2 and 2A are connected to the utility power R, S, T. Since the load connection contactor 23 remains energized, the motors 2 and 2A drive the passenger conveyor at high speed.

[0069] The waveform of a voltage developing at the time of switching action is as illustrated in Fig. 9. By means of the motor 2 being connected to the induction motor 2A, the residual voltage of the motor 2 diminishes quickly, thereby lessening switching shock.

[0070] In each of the foregoing embodiments, the speed of the passenger conveyor is switched by means of the manual speed changeover switch 9. However, speed may be changed automatically. More specifically, the passenger conveyor may be provided with a passenger sensor (not shown) for sensing the presence or absence of a user. If no use is detected, the VVVF device 1 produces an AC current having a frequency lower than that of the utility power R, S, T, thereby operating the motor 2 at low speed. If a user is detected in this state, the frequency of the AC current is gradually increased. When the frequency of the AC current has become close to that of the utility power R, S, T, the motor 2 is connected to the utility power R, S, T, thereby operating the motor 2 at high speed.

[0071] In contrast, if no user is detected during high-speed operation, the VVVF device 1 produces an AC current having the same frequency as that of the utility power R, S, T. After having been disconnected from the utility power R, S, T, the motor 2 is connected to the VVVF device 1, thereby operating the motor 2 at low speed. The switching means described in connection with the foregoing embodiments can be applied to switching between the high-speed and low-speed operations.

[0072] The respective embodiments have described circuits constituted of relays and contact points. Needless to say, the circuit can be embodied in a computer program.

[0073] Also, it goes without saying that the present invention is not limited to the above-described embodiments and that the embodiments are susceptible to

modifications other than those implied in the respective embodiments, as required. Further, the numbers, positions, and geometries of the constituent members are not limited to those described in connection with the embodiments. There may be employed a preferred number of constituent elements disposed at preferred positions, or preferred shapes of may be employed. Throughout the drawings, the same constituent elements are assigned the same reference numerals.

INDUSTRIAL APPLICABILITY

[0074] As described above, according to the passenger conveyor controller of the present invention, when switching from low-speed operation to high-speed operation is effected, a drive motor connected to a conversion device connected to utility power is disconnected from the conversion device. Subsequently, the motor is connected directly to the utility power while a residual voltage of the motor is lowered. Further, even when switching from high-speed operation to low-speed operation is effected, the drive motor connected directly to the utility power is disconnected from the utility power. Subsequently, the motor is connected to the foregoing conversion device while the residual voltage of the motor remains in a low state. As a result, the present invention is applicable to a passenger conveyor controller which can achieve switching action between low-speed operation and high-speed operation without involvement of switching shock or noise, by means of a low cost configuration.

[0075] The present invention relates to the passenger conveyor controller, wherein a drive motor is disconnected from a conversion device when switching from low-speed operation to high-speed operation is effected. After a given period of time, the drive motor is connected to utility power. Further, at the time of switching being effected from high-speed operation to low-speed operation, a drive motor is disconnected from utility power. After a given period of time, the drive motor is connected to the conversion device. As a result, the present invention is applicable to a passenger conveyor controller which can achieve switching between low-speed operation and high-speed operation without involvement of switching shock or noise and by means of a low-cost configuration.

[0076] The present invention relates to the passenger conveyor controller equipped with a residual voltage sensor for sensing a residual voltage of the drive motor. When switching from low-speed operation to high-speed operation is effected, the drive motor is disconnected from the conversion device. After detection that the residual voltage has dropped to or below a certain value, the drive motor is connected to utility power. Further, when switching from high-speed operation to low-speed operation is effected, the drive motor is disconnected from utility power. After detection that the residual voltage has dropped to or below a certain value, the

drive motor is connected to the conversion device. As a result, the present invention is applicable to a passenger conveyor controller which can achieve switching between low-speed operation and high-speed operation without involvement of switching shock or noise and by means of a low-cost configuration.

[0077] The present invention relates to the passenger conveyor controller equipped with a load device for reducing a residual voltage of the drive motor. After the motor has been disconnected from the conversion device or utility power, the motor is connected to the load device. As a result, the present invention is applicable to a passenger conveyor controller which can actively reduce the residual voltage of the drive motor, thereby shortening a switching time and lessening switching shock.

[0078] The present invention relates to the passenger conveyor controller, when operation is switched from low-speed operation to high-speed operation, some of the plurality of drive motors connected to a conversion device connected to utility power is disconnected from the conversion device. Subsequently, while a residual voltage of the motor has dropped, all of the motors are connected directly to the utility power. Further, even at the time of switching of operation from high-speed operation to low-speed operation, all of the drive motors connected directly to utility power are disconnected from the utility power. Subsequently, while the residual voltages of the motors have dropped, some of the motors are connected to the conversion device. As a result, the present invention is applicable to a passenger conveyor controller which can diminish the residual voltages of the motors quickly, thereby lessening switching shock.

[0079] The present invention relates to the passenger conveyor controller, wherein some of the plurality of drive motors are disconnected from the conversion device at the time of switching of operation from low-speed operation to high-speed operation. After a given period of time, all the motors are connected to utility power. Further, all the motors are disconnected from the utility power when operation is switched from high-speed operation to low-speed operation. After a given period of time, some of the plurality of motors are connected to the conversion device. As a result, the present invention is applicable to a passenger conveyor controller which can diminish the residual voltages of the motors quickly, thereby lessening switching shock.

[0080] The present invention relates to the passenger conveyor controller equipped with a residual voltage sensor for sensing residual voltages of drive motors. When switching is effected from low-speed operation to high-speed operation, some of the plurality of drive motors are disconnected from the conversion device. After detection that the residual voltages have dropped to or below a certain value, all the drive motors are connected to utility power. Further, when switching from high-speed operation to low-speed operation is effected, all the drive motors are disconnected from utility power. After

detection that the residual voltages have dropped to or below a certain value, some of the drive motors are connected to the conversion device. As a result, the present invention is applicable to a passenger conveyor controller which can diminish residual voltages of the motors quickly, thereby lessening switching shock.

[0081] The present invention relates to the passenger conveyor controller equipped with a load device for reducing residual voltages of a plurality of drive motors. After some or all of the motors have been disconnected from the conversion device or utility power, the motor is connected to the load device. As a result, the present invention is applicable to a passenger conveyor controller which can diminish the residual voltages of the motors actively, and hence shortening of a switching time and reduction of switching shock can be effected.

[0082] The present invention relates to the passenger conveyor controller equipped with a passenger sensor for sensing presence/absence of users of the conveyor. When users are detected, the passenger conveyor is switched from low-speed operation to high-speed operation. If no users are detected, the passenger conveyor is switched from high-speed operation to low-speed operation. As a result, the present invention is applicable to a passenger conveyor controller which can effect changing of speed of the passenger conveyor in accordance with presence/absence of users with a high level of reliability and by means of a low cost configuration.

[0083] The present invention relates to a passenger conveyor equipped with the foregoing passenger conveyor controller. As a result, the present invention is applicable to a passenger conveyor which can effect switching of operation between high-speed operation and low-speed operation without involvement of switching shock or noise.

Claims

1. A passenger conveyor controller comprising:

a high-speed operation circuit which connects, in a reconnectable manner, a utility power for supplying a three-phase AC current of given frequency with a drive motor for driving a passenger conveyor;

a low-speed operation circuit which connects a conversion device, connected to the utility power, with the drive motor in a reconnectable manner, the conversion device converting the three-phase AC current of given frequency into a variable-voltage and variable-frequency three-phase AC current; and

a changeover switch which changes the speed of the passenger conveyor by means of switching between the high-speed operation circuit and the low-speed operation circuit;

wherein the changeover switch converts a low-frequency AC current produced by the conversion device into an AC current such that the AC current has substantially the same frequency as that of an AC current produced by the utility power; then opens a closed circuit constituted of the drive motor and the conversion device or the utility power, thereby constituting an open circuit; and closes an open circuit constituted of the drive motor and the utility power or the conversion device after a residual voltage of the drive motor has dropped, thereby constituting a closed circuit.

2. The passenger conveyor controller according to claim 1, wherein the changeover switch opens a closed circuit constituted of the drive motor and the conversion device or the utility power, thereby constituting an open circuit, and closes an open circuit constituted of the drive motor and the utility power or the conversion device after lapse of a certain period of time, thereby constituting a closed circuit.

3. The passenger conveyor controller according to claim 1 or 2, further comprising a residual voltage detector for detecting a residual voltage of the drive motor;

wherein the changeover switch opens a closed circuit constituted of the drive motor and the conversion device or the utility power, thereby constituting an open circuit, and closes an open circuit constituted of the drive motor and the utility power or the conversion device after the residual voltage detected by the residual voltage detector has dropped to and below a predetermined value, thereby constituting a closed circuit.

4. The passenger conveyor controller according to any one of claims 1 to 3, further comprising a load device which reduces a residual voltage of the drive motor and is removably connected to the drive motor;

wherein the load device is connected to the drive motor after having opened a closed circuit constituted of the drive motor and the conversion device or the utility power, thereby constituting an open circuit.

5. A passenger conveyor controller comprising:

a plurality of high-speed operation circuits which connect, in a reconnectable manner, a utility power for supplying a three-phase AC current of given frequency with a plurality of drive motors for driving a passenger conveyor; a plurality of low-speed operation circuits which connect a conversion device, connected to the utility power, with the plurality of drive motors in a reconnectable manner, the conversion device

converting the three-phase AC current of given frequency into a variable-voltage and variable-frequency three-phase AC current; and a changeover switch which changes the speed of the passenger conveyor by means of switching between the plurality of high-speed operation circuits and the low-speed operation circuits;

wherein the changeover switch converts a low-frequency AC current produced by the conversion device into an AC current such that the AC current has substantially the same frequency as that of an AC current produced by the utility power; then opens a closed circuit constituted of some or all of the drive motors and the conversion device or the utility power, thereby constituting an open circuit; and closes an open circuit constituted of all or some of the drive motors and the utility power or the conversion device after a residual voltage of some or all of the drive motors have dropped, thereby constituting a closed circuit.

6. The passenger conveyor controller according to claim 5, wherein the changeover switch opens a closed circuit constituted of some or all of the drive motors and the conversion device or the utility power, thereby constituting an open circuit, and closes an open circuit constituted of all or some of the drive motors and the utility power or the conversion device after lapse of a certain period of time, thereby constituting a closed circuit.

7. The passenger conveyor controller according to claim 5 or 6, further comprising a residual voltage detector for detecting residual voltages of the plurality of drive motors;

wherein the changeover switch opens a closed circuit constituted of some or all of the drive motors and the conversion device or the utility power, thereby constituting an open circuit, and closes an open circuit constituted of all or some of the drive motors and the utility power or the conversion device after the residual voltages detected by the residual voltage detector has dropped to and below a predetermined value, thereby constituting a closed circuit.

8. The passenger conveyor controller according to any one of claims 5 to 7, further comprising a load device which reduces residual voltages of the plurality of drive motors and is removably connected to the drive motors;

wherein the load device is connected to the drive motors after having opened a closed circuit constituted of some or all of the drive motors and the conversion device or the utility power, thereby constituting an open circuit.

9. The passenger conveyor controller according to any one of claims 1 to 8, further comprising a passenger sensor for detecting presence or absence of users of the passenger conveyor;

wherein the changeover switch changes the speed of the passenger conveyor in accordance with the result of detection of the passenger sensor.

10. A passenger conveyor equipped with the passenger conveyor controller as defined in any one of claims 1 to 9.

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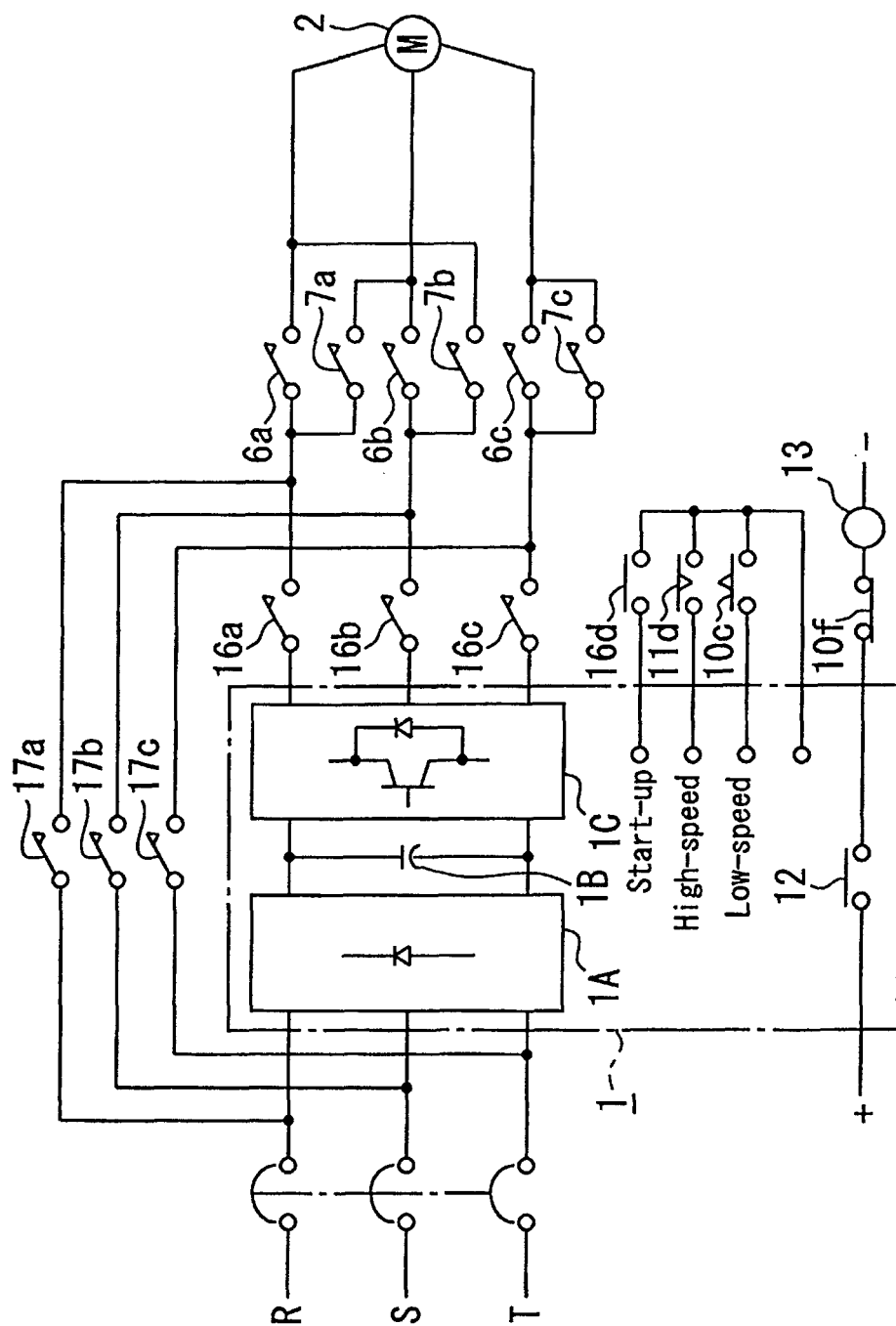
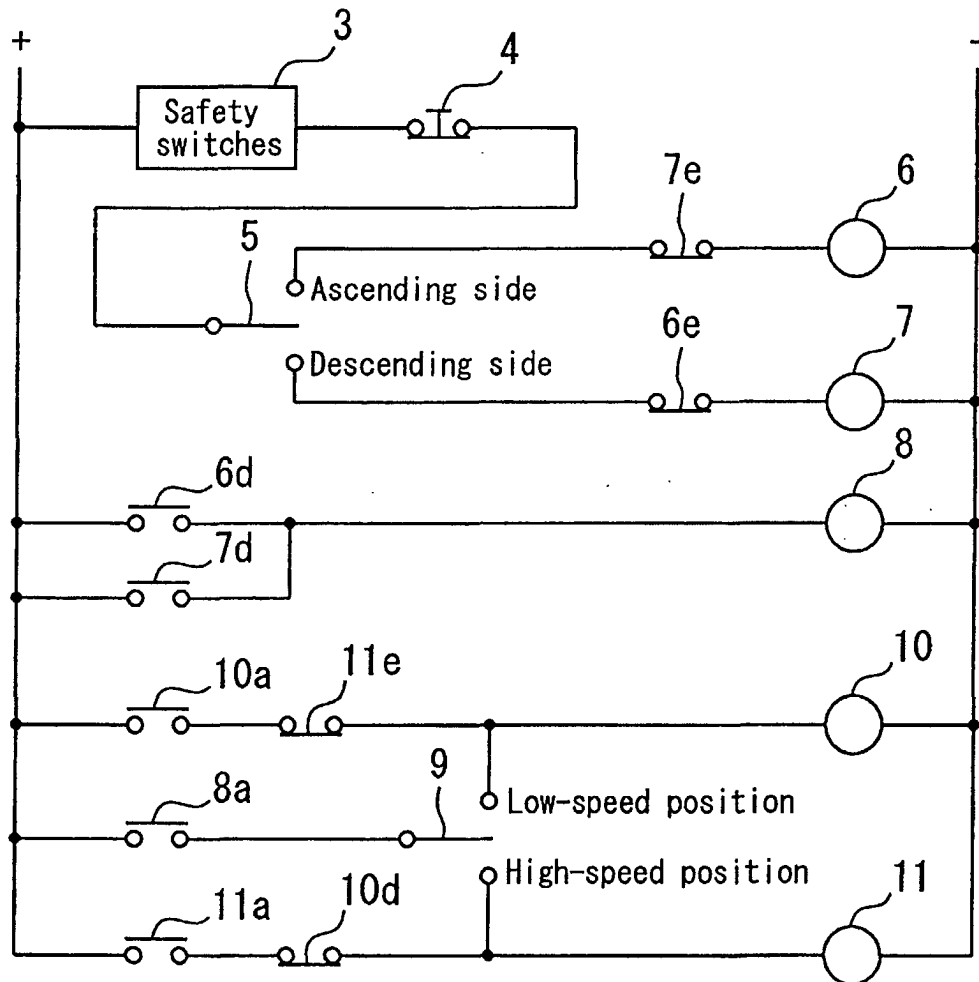
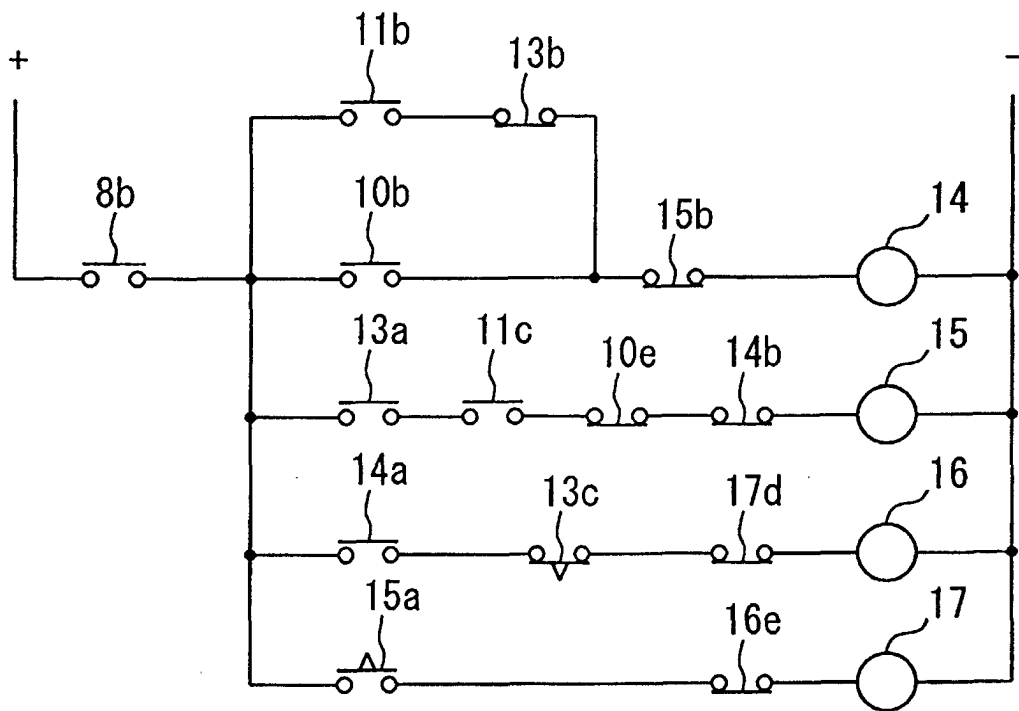


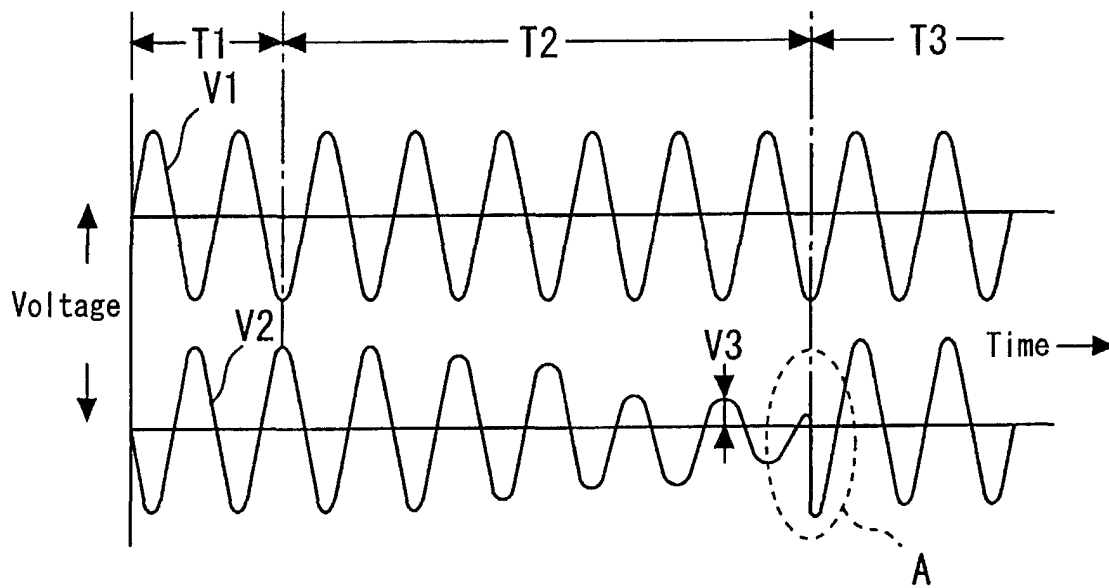
Fig. 1



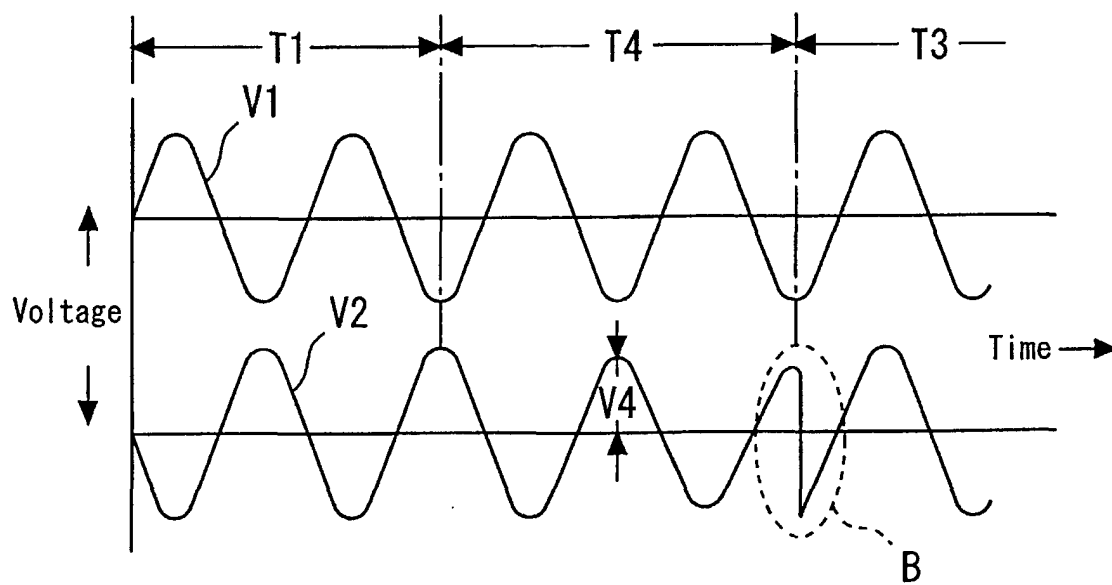
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F i g . 4



F i g . 5

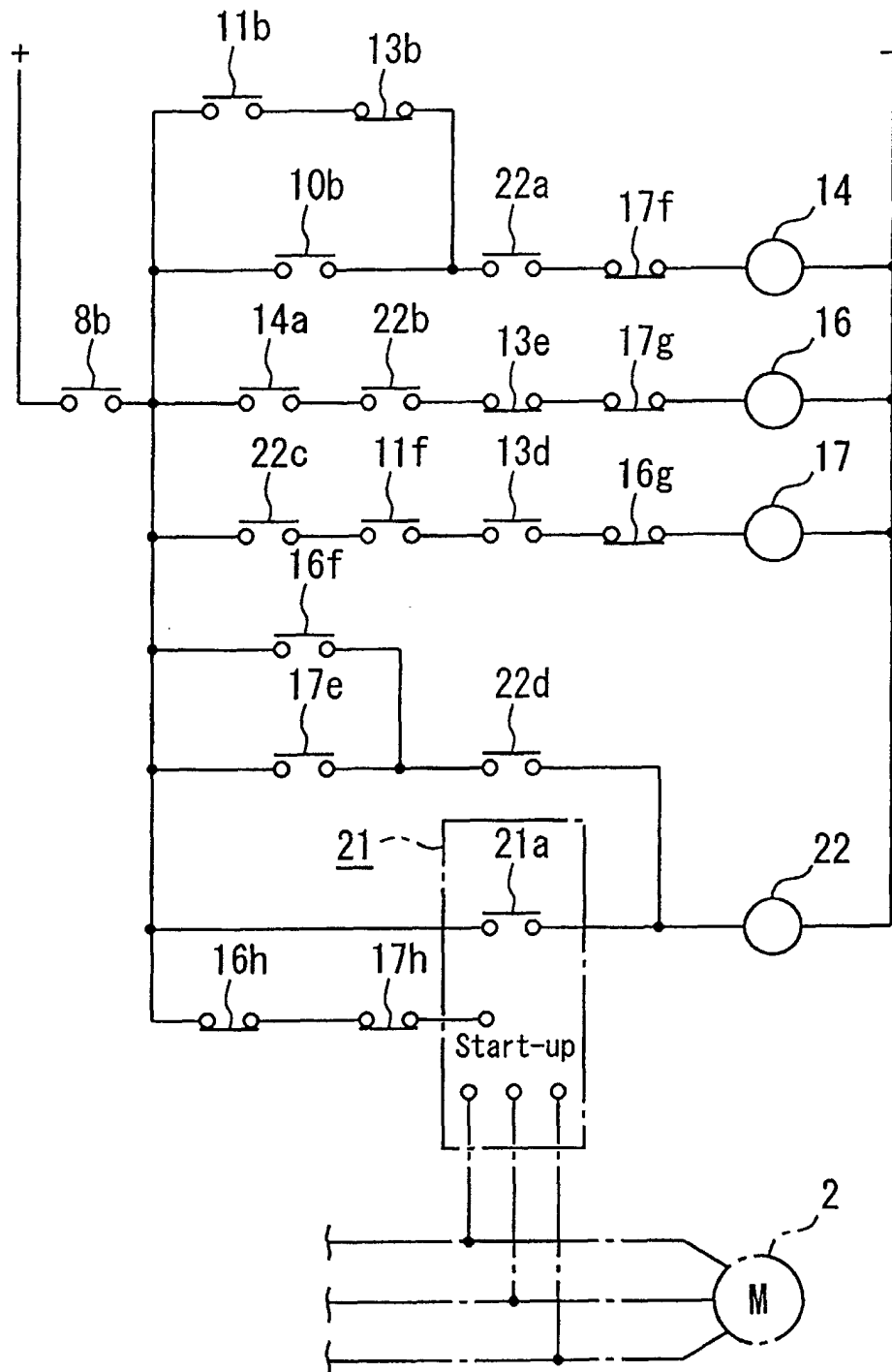
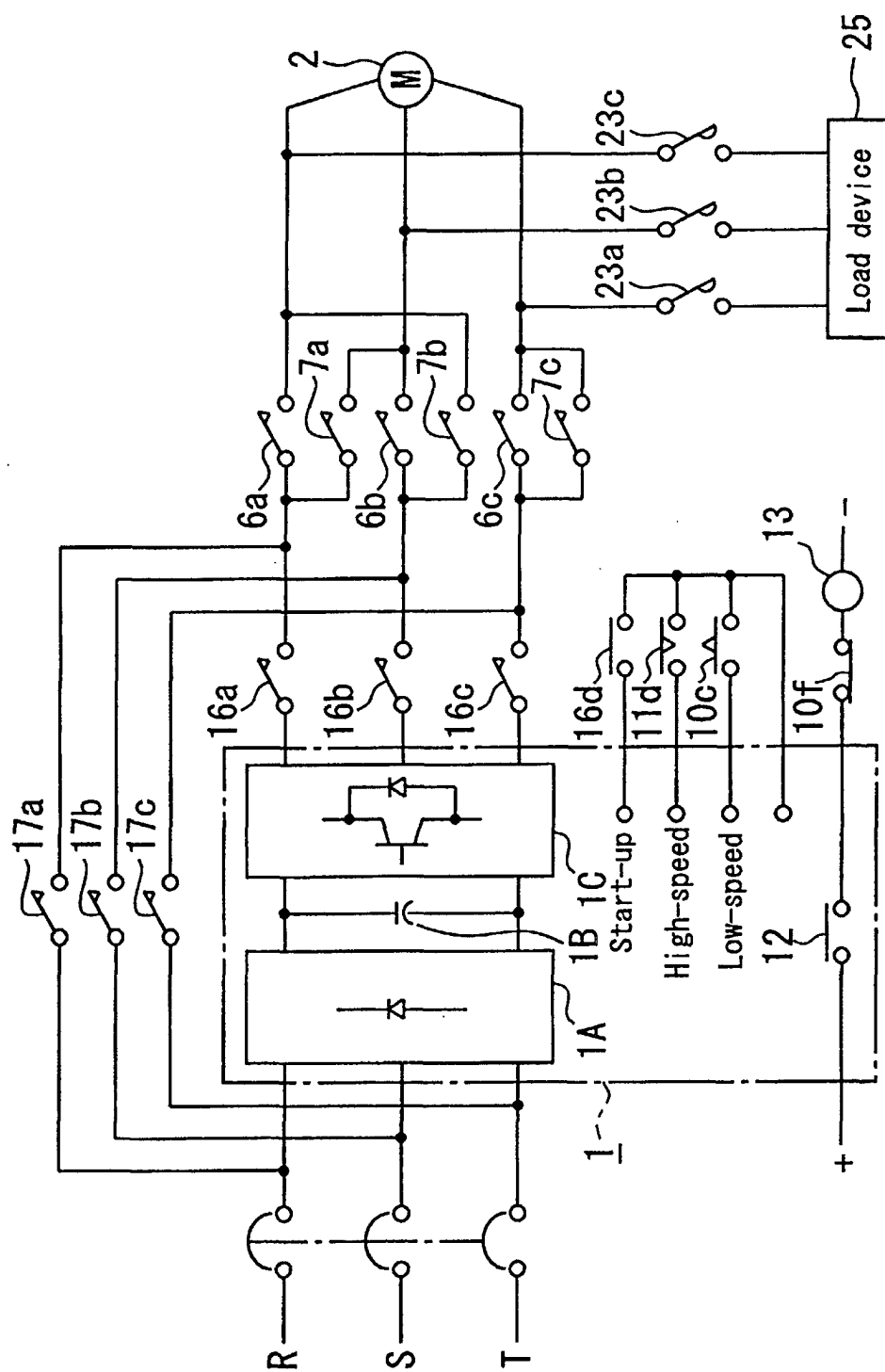
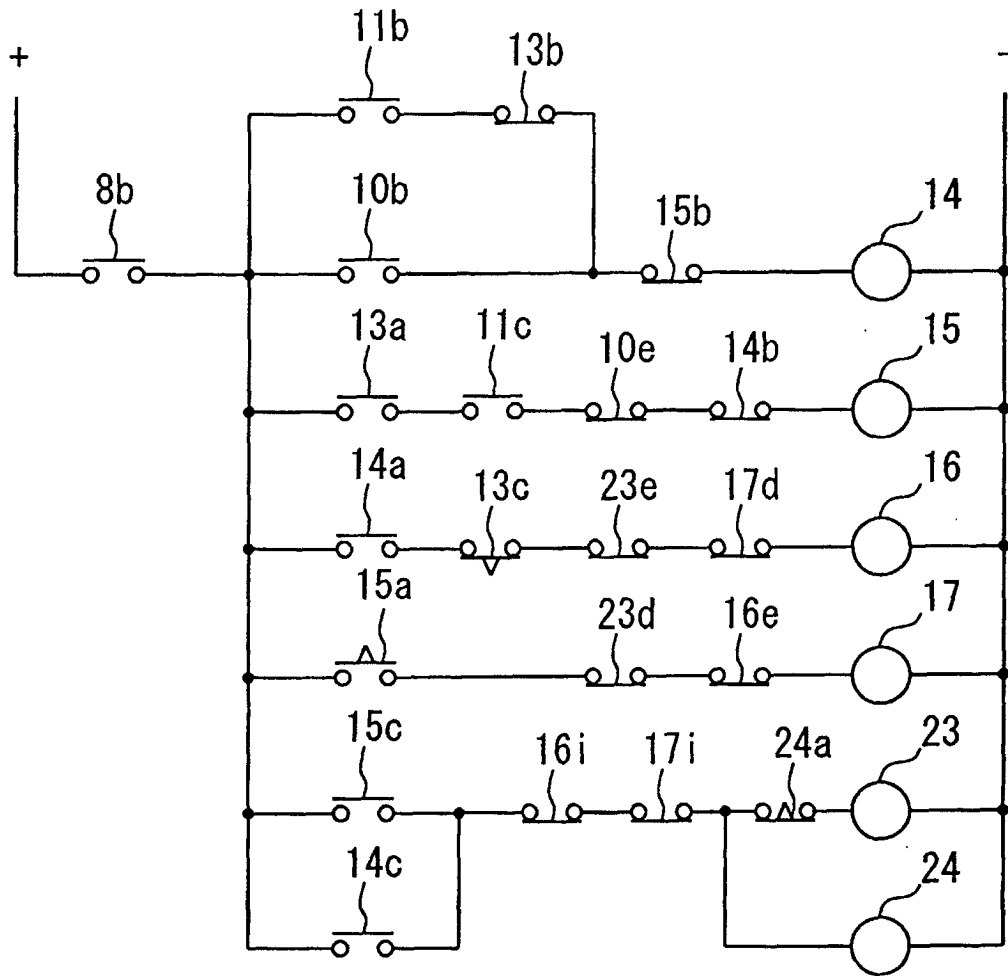


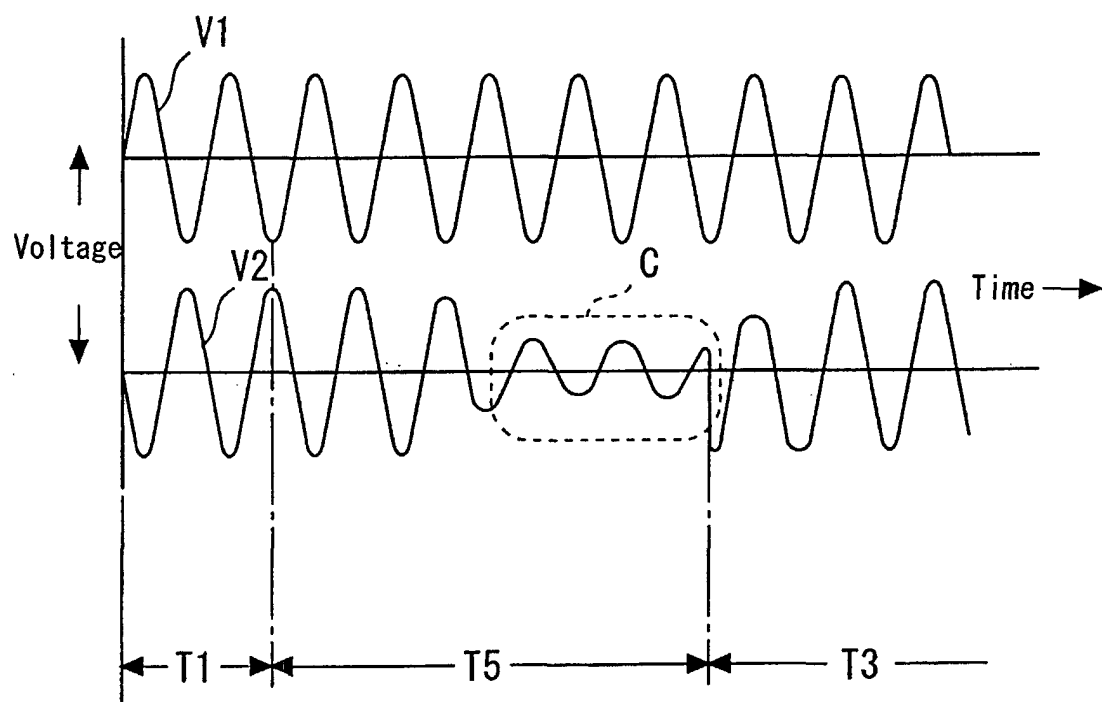
Fig. 6



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F i g . 8



F i g . 9

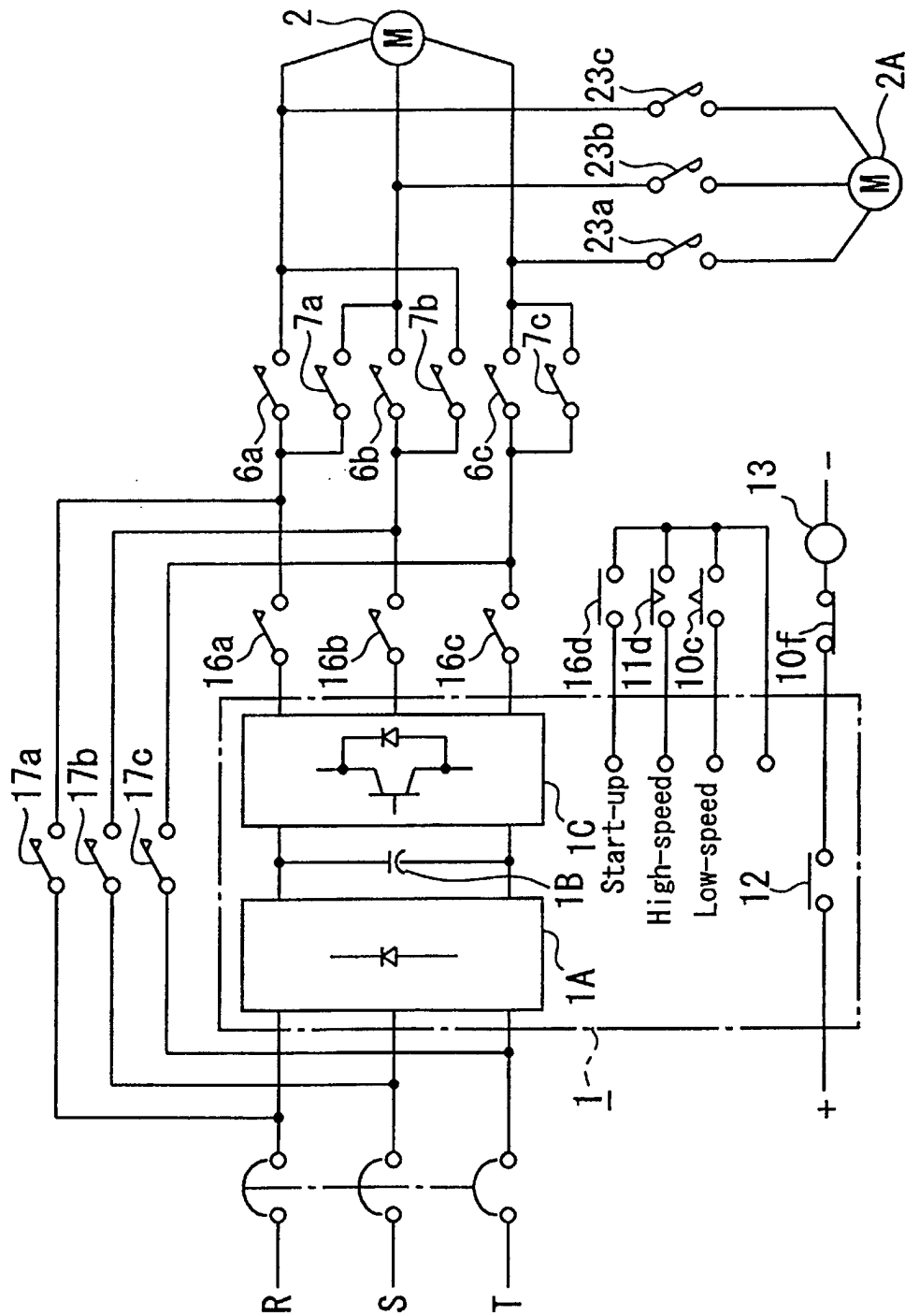
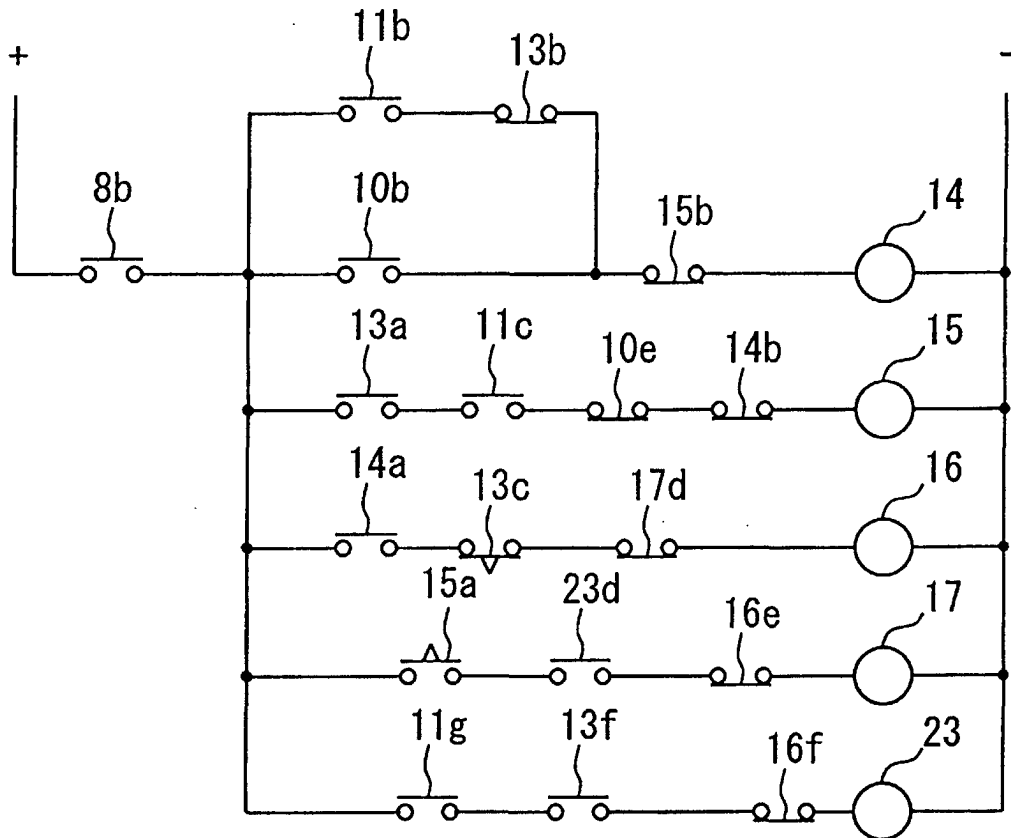


Fig. 10



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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP01/05459

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl. ⁷ B66B 25/00		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) Int.Cl. ⁷ B66B 21/00-B66B 31/02		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2001 Kokai Jitsuyo Shinan Koho 1971-2001 Toroku Jitsuyo Shinan Koho 1994-2001		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 9-86849 A (Hitachi, Ltd.), 31 March, 1997 (31.03.97), (Family: none)	1-2, 10 3-8
X Y	JP 2000-229776 A (Hitachi, Ltd.), 22 August, 2000 (22.08.00), (Family: none)	1-2, 9-10 3-8
Y	JP 3-82394 A (Mitsubishi Electric Corporation), 08 April, 1991 (08.04.91), (Family: none)	3-4, 7-8
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 160305/1983 (Laid-open No. 69278/1985), (Mitsubishi Electric Corporation), 16 May, 1985 (16.05.85), (Family: none)	5-8
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed		"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family
Date of the actual completion of the international search 16 October, 2001 (16.10.01)		Date of mailing of the international search report 30 October, 2001 (30.10.01)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP01/05459

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 61-291390 A (Mitsubishi Electric Corporation), 22 December, 1986 (22.12.86), & CN 86103291 A & US 4748394 A & KR 8902456 B	1,10

Form PCT/ISA/210 (continuation of second sheet) (July 1992)