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(54) ELEVATOR SYSTEM

(57) An elevator system (2) comprises: an elevator car (6), which is movably arranged within a hoistway (4); a drive unit (5), which is configured for driving the elevator car (6); at least two brakes (32, 36, 40), which are respectively configured for braking the elevator car (6); and a control unit (30), which is configured for controlling the drive unit (5) and the at least two brakes (32, 36, 40); and an electrical connection device (68), which is switchable between a state of normal operation and a state of brake test operation. The elevator system (2) is configured such that, when the electrical connection device (68) is switched into the state of brake test operation, at least one of the brakes (32, 36, 40) is deactivated and a signal indicating the state of brake test operation is supplied to the control unit (30); and the control unit (30) is configured to operate the elevator system (2) in a brake test mode, if it detects the signal indicating the state of brake test operation.

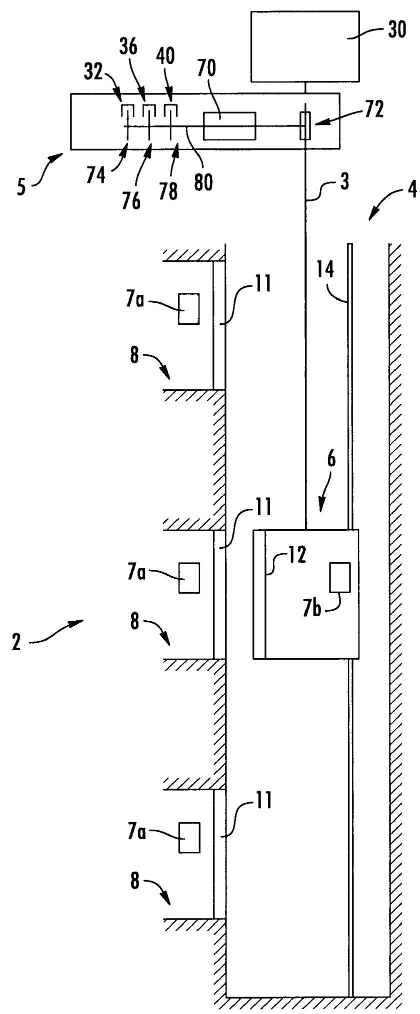

FIG. 1

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Description

[0001] The invention relates to an elevator system, in particular to an elevator system comprising a plurality of brakes. The invention further relates to testing the brakes of an elevator system.

[0002] An elevator system typically comprises at least one elevator car moving along a hoistway extending between a plurality of landings and a driving member which is configured for driving the elevator car. In order to ensure a safe operation, an elevator system usually further comprises a plurality of brakes which are configured for braking the elevator car.

[0003] There are elevator safety procedures which require to regularly check whether the brakes allow to securely stop and hold the elevator car even if one of the brakes fails.

[0004] It therefore would be beneficial to provide an elevator system and a method for checking the brakes of an elevator system allowing to perform the necessary test procedures easily and conveniently.

[0005] According to an exemplary embodiment of the invention, an elevator system comprises: An elevator car, which is movably arranged within a hoistway; a drive unit, which is configured for driving the elevator car; at least two brakes, which are respectively configured for braking the elevator car; and a control unit, which is configured for controlling the drive unit and the at least two brakes; an electrical connection device, which is switchable between a state of normal operation and a state of brake test operation. The elevator system is configured such that, when the electrical connection device is switched into the state of brake test operation, at least one of the brakes is deactivated and a signal indicating the state of brake test operation is supplied to the control unit. The control unit is configured to operate the elevator system in a brake test mode, if it detects the signal indicating the state of brake test operation.

[0006] According to an exemplary embodiment of the invention, a method of testing an elevator system according to an exemplary embodiment of the invention comprises the steps of switching the connection device from the state of normal operation to the state of brake test operation and operating the elevator system in the brake test mode.

[0007] Thus, in the brake test mode, the elevator system may be controlled by the same elevator control unit as in the mode of normal operation, i.e. the mode in which the elevator system is operated for conveying passengers. However, when the elevator control unit detects the signal indicating the state of brake test operation, operation of the elevator system in the mode of normal operation is prevented, so that no passengers may use the elevator system when it is operated in the brake test mode.

[0008] According to another exemplary embodiment of the invention, an elevator system comprises: An elevator car, which is movably arranged within a hoistway; a drive unit, which is configured for driving the elevator car; at least two brakes, which are respectively configured for braking the elevator car; and a control unit, which is configured for controlling the drive unit and the at least two brakes; a power supply line including at least two safety relays, which are serially connected to each other; and an electrical connection device, which is switchable between a state of normal operation and a state of brake test operation. The elevator system is configured such that when the electrical connection device is switched into the state of brake test operation, at least one of the brakes is deactivated so that only the brakes, which are not deactivated, are engaged when one of the safety relays is opened, but all brakes including the at least one deactivated brake are engaged when the other one of the safety relays is opened.

[0009] According to an exemplary embodiment of the invention, a method of testing an elevator system according to an exemplary embodiment of the invention comprises the steps of switching the electrical connection device from the state of normal operation to the state of brake test operation; and engaging the brakes, which are not deactivated, by opening one of the safety relays.

[0010] Exemplary embodiments of the invention allow to perform test procedures for checking the brakes of an elevator system, in particular to check whether the brakes allow to securely stop and/or hold the elevator car even in case one of the brakes fails, easily and conveniently. Exemplary embodiments in particular avoid the need for mechanically blocking at least one of the brakes.

[0011] Exemplary embodiments of the invention will be described in more detail with respect to the enclosed figures:

Figure 1 schematically depicts an elevator system according to an exemplary embodiment of the invention.

Figure 2 depicts a schematic circuit diagram of an electrical circuit according to an exemplary embodiment of the invention in a state of normal operation.

Figure 3 depicts a schematic circuit diagram of an electrical circuit according to an exemplary embodiment of the invention in a state of brake test operation.

Figure 4a schematically illustrates the operation of the brake sensors in the state of normal operation.

Figure 4b schematically illustrates the operation of the brake sensors in the state of brake test operation.

Figures 5 and 6 schematically illustrate the switching between the state of normal operation and the state of brake test operation by means of plug-and-socket-combination.

[0012] Figure 1 schematically depicts an elevator system 2 according to an exemplary embodiment of the invention.

[0013] The elevator system 2 includes an elevator car 6 which is movably arranged within a hoistway 4 extending between a plurality of landings 8. The elevator car 6 in particular may move along a plurality of guiderails 14, extending along the vertical direction of the hoistway 4. Only one of said guiderails 14 is visible in Figure 1. Although only one elevator car 6 is depicted in Figure 1, the skilled person will understand that exemplary embodiments of the invention may comprise elevator systems 2 having a plurality of elevator cars 6 moving in one or more hoistways 4.

[0014] The elevator car 6 is movably suspended by means of a tension member 3. The tension member 3, for example a rope or belt, is connected to a drive unit 5, which is configured for driving the tension member 3 in order to move the elevator car 6 along the height of the hoistway 4 between the plurality of landings 8, which are located on different floors.

[0015] The drive unit 5 in particular comprises a motor 70 and a sheave 72, which is mounted to an axle 80 driven by the motor 70. The tension member 3 runs over the outer periphery of the sheave 72 so that the elevator car 6 may be moved by rotating the sheave 72.

[0016] Each landing 8 is provided with a landing door 11, and the elevator car 6 is provided with a corresponding elevator car door 12 for allowing passengers to transfer between a landing 8 and the interior of the elevator car 6 when the elevator car 6 is positioned at the respective landing 8.

[0017] The exemplary embodiment shown in Figure 1 uses a 1:1 roping for suspending the elevator car 6. The skilled person, however, easily understands that the type of the roping is not essential for the invention and that different kinds of roping, e.g. a 2:1 roping or a 4:1 roping may be used as well. The elevator system 2 may use a counterweight (not shown) or not. The elevator system 2 may have a machine room or may be a machine roomless elevator system. The tension member 3 may be a rope, e.g. a steel core, or a belt. The tension member 3 may be uncoated or may have a coating, e.g. in the form of a polymer jacket. In a particular embodiment, the tension member 3 may be a belt comprising a plurality polymer coated steel cords (not shown).

[0018] The drive unit 5 is controlled by an elevator control unit 30 for moving the elevator car 6 along the hoistway 4 between the different landings 8.

[0019] Input to the control unit 30 may be provided via landing control panels 7a, which are provided on each landing 8 close to the landing doors 11, and/or via an elevator car control panel 7b, which is provided inside the elevator car 6.

[0020] The landing control panels 7a and the elevator car control panel 7b may be connected to the elevator control unit 30 by means of electrical lines, which are not shown in Fig. 1, in particular by an electric bus, or by means of wireless data connections.

[0021] The drive unit 5 is provided with a plurality of brakes 32, 36, 40, in particular three brakes 32, 36, 40. In the embodiment shown in Figure 1 the brakes 32, 36, 40 are configured to selectively engage with brake disks 74, 76, 78, which are mounted to the axle 80 of the motor 70 for braking, i.e. for stopping and/or holding, the elevator car 6. In alternative embodiments, which are not depicted in the figures, the brakes 32, 36, 40 may be configured to engage directly with the tension member 3, the sheave 72 and/or with the axle 80 of the motor 70, respectively. The brakes 32, 36, 40 in particular may be configured as holding brakes, which are engaged every time the elevator car 6 has been stopped at one of the landings 8.

[0022] Details of controlling and testing the brakes 32, 36, 40 are described in the following with respect to Figures 2 to 6.

[0023] Figure 2 depicts a schematic circuit diagram of an electrical circuit 20 which is configured for controlling and testing the brakes 32, 36, 40. Figure 2 in particular illustrates a state of normal operation.

[0024] The electrical circuit 20 comprises an electrical power supply 22 supplying a DC voltage of e.g. 230 V.

[0025] An electrical power supply line 25 electrically connects the (three) brakes 32, 36, 40 of the elevator system 2 with the electrical power supply 22. A first safety relay 24 and a second safety relay 26 are serially arranged within the electrical power supply line 25. As a result, the electrical power supply line 25 is interrupted if at least one of the first and second safety relays 24, 26 is opened.

[0026] The brakes 32, 36, 40 are configured to engage for braking the elevator car 6 when the electrical power supply line 25 is interrupted so that it does not supply any electrical voltage/current from the electrical power supply 22 to the brakes 32, 36, 40. The brakes 32, 36, 40 are further configured to disengage (release) in order to allow the elevator car 6 to move in case both safety relays 24, 26 are closed so that electrical power supply line 25 supplies electrical voltage/current from the electrical power supply 22 to the brakes 32, 36, 40.

[0027] The safety relays 24, 26 are controlled by an overlaying safety chain 82. When the safety chain 82 is interrupted, the safety relays 24, 26 open interrupting the power supply line 25, which engages the brakes 32, 36, 40.

[0028] Free-wheeling diodes 50, 52, 54 and an electrical damping circuit 48 comprising a capacity and inductivities are provided in order to absorb electrical stress peaks which occur within the electrical power supply line 25 when the relays 24, 26 and/or the brakes 32, 36, 40 are engaged and/or disengaged.

[0029] The electrical circuit 20 further comprises five brake sensors (first to fifth brake sensors) 34, 38, 42, 44, 46. A brake sensor 34, 38, 42 is associated with each of the brakes 32, 36, 40, respectively. Each brake sensor 34, 38, 42 is configured for detecting the status ("engaged" or "disengaged") of the respective associated brake 32, 36, 40.

[0030] The brake sensors 34, 38, 42 in particular may be provided as mechanical switches, which are configured to be operated by the movement of a moving part, such as an armature or a brake shoe, of the associated brake 32, 36, 40. As a result, each brake sensor 34, 38, 42 provides an electrical detection signal indicating the current status of the respective associated brake 32, 36, 40.

[0031] The detection signals provided by the brake sensor 34, 38, 42 are delivered to the control unit 30. This allows the control unit 30 to monitor the operation of the brakes 32, 36, 40.

[0032] In the exemplary configuration shown in Figure 2, the fourth and fifth brake sensors 44, 46 are electrically connected with the control unit 30 but are not associated, i.e. mechanically connected, with a corresponding brake.

[0033] The fourth and fifth brake sensors 44, 46 e.g. may be associated with a corresponding brake in case the electrical circuit 20 is employed in a different type of elevator system 2 comprising more than three brakes 32, 36, 40.

[0034] Figure 3 depicts the electrical circuit 20 shown in Figure 2 in a state of brake test operation. In said state of brake test operation, one brake 40, which in the following is called the "third brake" 40, is electrically connected by means of a bypass line 55 with a position 29 of the electrical power supply line 25 which is located between the first and second safety relays 24, 26. As a result, said third brake 40 is not engaged even if the second relay 26 is opened. Instead, only two brakes (the "first" and "second" brakes) 32, 36 of the three brakes 32, 36, 40 are engaged.

[0035] Activating and engaging only two brakes 32, 36 allows to check whether the engagement of only two of the three brakes 32, 36, 40 is sufficient for reliably stopping and/or holding the elevator car 6.

[0036] Even when switched to the state of brake test operation, the electrical circuit 20 shown in Figures 2 and 3 allows to reliably stop the elevator car 6 in case of real emergency situation using all three brakes 32, 36, 40, as all three brakes 32, 36, 40 are engaged when the first safety relay 24 is opened, which interrupts the supply of electrical voltage/current to all three brakes 32, 36, 40. This enhances the safety of the elevator system 2.

[0037] In the state of brake test operation, in addition to bypassing the second relay 25, the output line 47 of at least one of the brake sensors 34, 38, 42, 44, 46 is set to a predefined electrical potential V*, for example to an electrical potential V* of +24 V, representing a "forbidden state", i.e. a state which does not occur during normal operation of the elevator system 2.

[0038] The control unit 30 detects said "forbidden state" as a signal indicating the state of brake test operation, and switches the operation of the elevator system 2 to a brake test mode. Switching the elevator system 2 to the brake test mode prevents normal operation of the elevator system 2 when at least one of the brakes 32, 36, 40 is deactivated. In the brake test mode, the control unit 30 of the elevator system 2 does not allow the transportation of passengers. Rather, only restricted operation, e.g. operation which is controlled by a key or password, for testing the activated brakes 32, 36 is allowed by the control unit 30. In the brake test mode, the control unit 30 in particular opens the second relay 26 via a signal line 84, but it does not open the first relay 24. The first relay is opened by the safety chain 82 only in a real emergency situation in order to engage all brakes 32, 36, 40.

[0039] In the embodiment shown in Figure 3, the output signal of a fifth brake sensor 46, which is not associated with one of the brakes 32, 36, 40 is used for indicating the state of brake test operation. This, however, is only exemplary and the skilled person will understand that the output signal of any of the brake sensors 34, 38, 42, 44, 46 may be used for indicating the state of brake test operation if the control unit 30 is configured accordingly. Even further, any signal, which is input into the control unit 30, may be set to a "forbidden state" in order to indicate the state of brake test operation.

[0040] Figures 4a and 4b schematically illustrate the operation of the brake sensors 34, 38, 42, 44, 46 in the state of normal operation (Figure 4a) and in the state of brake test operation (Figure 4b), respectively.

[0041] In the state of normal operation (Figure 4a) the first three brake sensors 34, 38, 42 open and close in correspondence with engaging and disengaging (releasing) the respectively associated brake 32, 36, 40. The brakes 32, 36, 40 are not shown in Figures 4a and 4b.

[0042] The fourth and fifth brake sensors 44, 46 are not associated with one of the brakes 32, 36, 40. Thus, they are not used in normal operation and therefore remain in a constant, e.g. open, state.

[0043] In the state of brake test operation (Figure 4b) the third brake sensor 42 remains in a constant state as well, as the third brake 40 is deactivated by means of the bypass line 55 and thus remains in a disengaged (released) state, as it has been described before with respect to Figure 3.

[0044] Additionally, the output line 47 of the fifth brake sensors 46 is set ("pinned") to a predefined electrical potential V* representing a "forbidden state" indicating the state of brake test operation.

[0045] Figures 5 and 6 schematically illustrate the switching between the state of normal operation and the state of brake test operation by means of an electrical connection device 68 which is provided by a combination of a plug 64 and two sockets 56, 58.

[0046] Two sockets 56, 58 are provided on a printed circuit board 62, which is depicted only schematically in Figures 5 and 6. One of the two sockets 56, 58 is configured as a normal operation socket 56 and the other one of the two sockets 56, 58 is configured as brake test operation socket 58.

[0047] Switching between the state of normal operation and the state of brake test operation is performed by selectively plugging the plug 64 into one of the two sockets 56, 58.

[0048] The three brakes 32, 36, 40 are shown on the right side of Figures 5 and 6. In order to simplify Figures 5 and 6, from the five brake sensors 32, 38, 42, 44, 46, shown in Figure 3 only the first brake sensor 34, which is associated with the first brake 32, and the fifth brake sensor 46, which is not associated with any of the brakes 32, 36, 40, are shown in Figures 5 and 6.

[0049] In case the plug 64 is plugged into the normal operation socket 56 for switching to the state of normal operation (see Figure 5), all three brakes 32, 34, 36 are connected to an output side 27 of the second safety relay 26. This allows to control all three brakes 32, 34, 36 by switching said second safety relay 26, as it is has been described before with reference to Figure 2.

[0050] The plug 64 also comprises an electrical bridge 60, which connects the output line 47 of the fifth brake sensor 46 with ground potential, when the plug 64 is plugged into the normal operation socket 56.

[0051] The signal of the first brake sensor 34, as well as the signals of the second and third brake sensors 38, 42, which are not shown in Figures 5 and 6, are delivered via the plug 64 to the control unit 30.

[0052] If the plug 64 is plugged into the brake test operation socket 58 for switching to the state of brake test operation (see Figure 6), only the first and second brakes 32, 36 are electrically connected with the output side 27 of the second relay 26. The third brake 40 is electrically connected to the position 29 of the electrical power supply line 25 located between the first and second safety relays 26, 28 (cf. Figure 3). As a result, the third brake 40 is not engaged when the second safety relay 26 opens.

[0053] Simultaneously, the electrical bridge 60 of the plug 64 connects the output line 47 of the fifth brake sensor 46 to the predefined electrical potential V* representing a "forbidden state" which causes the control unit 30 to detect the state of brake test operation, as it has been described before.

[0054] A selection device 66, which may be provided in the form of an electrical connector, is provided between the sockets 56, 58 and the brakes 32, 36, 40. The selection device 66 allows to select the brake 32, 36, 40 which is to be deactivated. This allows to consecutively deactivate any of the brakes 32, 36, 40 in order to check whether every possible combination of two brakes out of the three brakes 32, 36, 40 provides the necessary braking capacity for braking the elevator car 6.

[0055] Although the exemplary embodiment shown in the figures comprises three brakes 32, 36, 40 and five brake sensors 32, 38, 42, 44, 46, the skilled person will understand that the invention may be employed correspondingly in elevator systems 2 comprising different numbers of brakes and brake sensors, respectively.

[0056] A number of optional features are set out in the following. These features may be realized in particular embodiments, alone or in combination with any of the other features.

[0057] According to one embodiment, the elevator system may comprise a power supply line with at least two serially connected safety relays, wherein, in the state of brake test operation, the deactivated brake is not engaged when one of the relays is opened, but all brakes including the deactivated brake are engaged when another one of the safety relays is opened. This allows for a safe operation of the elevator system even in the state of brake test operation, as all brakes may be engaged in a real emergency situation by opening one of the at least one other safety relays.

[0058] According to one embodiment, the elevator system may comprise a plurality of brake sensors wherein at least one brake sensor is associated with each of the brakes, respectively. The brake sensors may be configured for detecting the actual status of the respective associated brake and providing corresponding output signals. The control unit may be configured for receiving the output signals from the brake sensors indicating the status of the respective associated brake. In such a configuration the signal indicating the state of brake test operation may be an output signal of at least one of the brake sensors, which in particular is set to a "forbidden state", i.e. a state which does not occur in normal operation.

[0059] Brake sensors allow to conveniently monitor the proper operation of the brakes. Using an output signal of at least one of the brake sensors provides a convenient way for indicating the state of brake test operation which in particular does not require considerable and expensive modifications of the control unit.

[0060] According to one embodiment, at least one of the brake sensors may be a mechanical switch which is operated by the movement of an armature and/or a brake shoe of an associated brake. A mechanical switch provides an inexpensive and reliable brake sensor. However, different types of brake sensors, such as optical, inductive or capacitive types of brake sensors, may be employed as well.

[0061] According to one embodiment, the connection device may include a normal operation socket corresponding to the state of normal operation, a brake test operation socket corresponding to the state of brake test operation, and a plug which is selectively pluggable into the normal operation socket and into the brake test operation socket for switching between the state of normal operation and the state of brake test operation. Such a configuration allows for an easy, convenient, reliable and secure switching between the state of normal operation and the state of brake test operation.

[0062] According to one embodiment, the elevator system may further comprise a selection device which is configured for selecting at least one brake, which is to be deactivated, from the plurality of brakes. This allows to selectively deactivate each of the brakes for testing all possible combinations of non-deactivated brakes.

[0063] According to one embodiment, the elevator system may comprise more brake sensors than brakes. The elevator system in particular may comprise at least one brake sensor which is not associated with any of the brakes. Such a configuration allows to use on output signal of one of the additional brake sensors, which is not associated with any of the brakes, for indicating the state of brake test operation.

[0064] According to one embodiment, the elevator system may comprise at least three brakes, wherein the electrical connection device is configured to deactivate one of the brakes in the state of brake test operation. The elevator system further may comprise at least five brake sensors.

[0065] According to one embodiment, operating the elevator system in the brake test mode may include braking the elevator car with at least one non-deactivated brake. This allows to check whether the elevator car is reliably stopped and held by the remaining brakes in case one of the plurality of brakes fails.

[0066] According to one embodiment, the method may include opening one of said at least two safety relays for engaging the at least one non-deactivated brake. The method may further include activating all brakes by opening another one of said at least two safety relays.

[0067] According to one embodiment, the method may include consecutively deactivating each of the brakes and operating the elevator system in the brake test mode. The brake test mode in particular may include engaging at least one non-deactivated brake in order to check all possible combinations of non-deactivated brakes.

[0068] While the invention has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition many modifications may be made to adopt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention shall not be limited to the particular embodiment disclosed, but that the invention includes all embodiments falling within the scope of the dependent claims.

References

[0069]

2	elevator system
3	tension member
4	hoistway
5	drive unit
6	elevator car
7a	landing control panel
7b	elevator car control panel
8	landing
11	landing door
12	elevator car door
14	guide rail
20	electrical circuit
22	electrical power supply
24	(first) safety relay
25	power supply line
26	(second) safety relay
27	output side of the second safety relay
29	position between the first and second safety relays
30	control unit
32	first brake
34	first brake sensor
36	second brake
38	second brake sensor
40	third brake
42	third brake sensor
44	fourth brake sensor
46	fifth brake sensor
47	output line of the fifth brake sensor
48	electrical damping circuit
52, 52, 54	free-wheeling diodes
55	bypass line
56	normal operation socket
58	brake test operation socket
60	electrical bridge
62	printed circuit board
64	plug
66	selection device
68	electrical connection device
70	motor
72	sheave
74, 76, 78	brake disks
80	axle of the motor
82	safety chain
84	signal line

Claims

1. An elevator system (2) comprising:

an elevator car (6), which is movably arranged within a hoistway (4);
a drive unit (5), which is configured for driving the elevator car (6);
at least two brakes (32, 36, 40), which are respectively configured for braking the elevator car (6);
a control unit (30), which is configured for controlling the drive unit (5) and the at least two brakes (32, 36, 40); and
an electrical connection device (68), which is switchable between a state of normal operation and a state of brake test operation;
wherein the elevator system (2) is configured such that, when the electrical connection device (68) is switched into the state of brake test operation, at least one of the brakes (32, 36, 40) is deactivated and a signal indicating the state of brake test operation is supplied to the control unit (30); and

wherein the control unit (30) is configured to operate the elevator system (2) in a brake test mode, if it detects the signal indicating the state of brake test operation.

2. The elevator system (2) according to claim 1, further comprising an electrical power supply line (25) including at least two safety relays (24, 26), which are serially connected to each other, wherein, in the state of brake test operation, only the brakes (32, 36), which are not deactivated, are engaged when one of the safety relays (24, 26) is opened, but all brakes (32, 36, 40) including the at least one deactivated brake (40) are engaged when another one of the safety relays (24, 26) is opened.

3. An elevator system (2) comprising:

an elevator car (6), which is movably arranged within a hoistway (4);
a drive unit (5), which is configured for driving the elevator car (6);
at least two brakes (32, 36, 40), which are respectively configured for braking the elevator car (6);
a control unit (30), which is configured for controlling the drive unit (5), which controls the at least two brakes (32, 36, 40);
an electrical power supply line (25) including at least two safety relays (24, 26), which are serially connected to each other; and
an electrical connection device (68), which is switchable between a state of normal operation and a state of brake test operation;
wherein the elevator system (2) is configured such that when electrical connection device (68) is switched into the state of brake test operation, at least one of the brakes (32, 36, 40) is deactivated so that only the brakes (32, 36), which are not deactivated, are engaged when one of the safety relays (24, 26) is opened, but all brakes (32, 36, 40) including the at least one deactivated brake (40) are engaged when the other one of the safety relays (24, 26) is opened.

4. The elevator system (2) according to any of claims 1 to 3, further comprising a plurality of brake sensors (34, 38, 42, 44, 46),
wherein at least one brake sensor (34, 38, 42) is associated with each of the brakes (32, 36, 40), respectively, and configured for detecting the actual status of the associated brake (32, 36, 40),
wherein the control unit (30) is configured for receiving signals from the brake sensors (34, 38, 42, 44, 46) indicating the status of the respective associated brake (32, 36, 40); and
wherein the signal indicating the state of brake test operation is an output signal of at least one of the brake sensors (34, 38, 42, 44, 46).

5. The elevator system (2) according to any of the previous claims, wherein at least one of the brake sensors (34, 38, 42, 44, 46) is a mechanical switch, particularly a mechanical switch which is operated by movement of a moving part of an associated brake (32, 36, 40).

6. The elevator system (2) according to any of the previous claims, wherein the electrical connection device (68) includes a normal operation socket (56) corresponding to the state of normal operation, a brake test operation socket (58) corresponding to the state of brake test operation, and a plug (64) which is selectively pluggable into the normal operation socket (56) and into the brake test operation socket (58) for switching between the state of normal operation and the state of brake test operation.

7. The elevator system (2) according to any of the previous claims comprising a selection device (66) which is configured to allow selecting the at least one brake (40), which is to be deactivated, from the plurality of brakes (32, 36, 40).

8. The elevator system (2) according to any of the previous claims comprising more brake sensors (34, 38, 42, 44, 46) than brakes (32, 36, 40), wherein the brake sensors (34, 38, 42, 44, 46) in particular comprise at least one brake sensor (34, 38, 42, 44, 46) which is not associated with any of the brakes (32, 36, 40).

9. The elevator system (2) according to any of the previous claims comprising at least three brakes (32, 36, 40) and/or comprising at least five brake sensors (34, 38, 42, 44, 46).

10. A method of testing an elevator system (2) comprising:

an elevator car (6), which is movably arranged within a hoistway (4);
a drive unit (5), which is configured for driving the elevator car (6);
at least two brakes (32, 36, 40), which are respectively configured for braking the elevator car (6);
a control unit (30), which is configured for controlling the drive unit (5) and the at least two brakes (32, 36, 40); and
an electrical connection device (68), which is switchable between a state of normal operation and a state of brake test operation;
wherein the method includes:

switching the electrical connection device

(68) from the state of normal operation to the state of brake test operation;
wherein, when the electrical connection device (68) is in the state of brake test operation, at least one of the brakes (32, 36, 40) is deactivated and a signal indicating the state of brake test operation is supplied to the drive unit (5); and
wherein the drive unit (5) is configured to operate the elevator system (2) in a brake test mode if it detects the signal indicating the state of brake test operation.

11. The method according to claim 10, wherein the elevator system (2) comprises an electrical power supply line (25) including at least two safety relays (24, 26), which are serially connected to each other,
wherein, in the state of brake test operation, only the brakes (32, 36), which are not deactivated, are engaged when one of the safety relays (24, 26) is opened, but all brakes (32, 36, 40) including the at least one deactivated brake (40) are engaged when another one of the safety relays (24, 26) is opened; and
wherein the method includes engaging the brakes (32, 36), which are not deactivated, by opening one of the safety relays (24, 26).

12. A method of testing an elevator system (2) comprising:

an elevator car (6), which is movably arranged within a hoistway (4);
a drive unit (5), which is configured for driving the elevator car (6);
at least two brakes (32, 36, 40), which are respectively configured for braking the elevator car (6);
a control unit (30), which is configured for controlling the drive unit (5) and the at least two brakes (32, 36, 40);
an electrical connection device (68), which is switchable between a state of normal operation and a state of brake test operation in which at least one of the brakes (32, 36, 40) is deactivated; and
an electrical power supply line (25) including at least two safety relays (24, 26), which are serially connected to each other, wherein, in the state of brake test operation, only the brakes (32, 36), which are not deactivated, are engaged when one of the safety relays (24, 26) is opened, but all brakes (32, 36, 40) including the at least one deactivated brake (40) are engaged when another one of the safety relays (24, 26) is opened; and
wherein the method includes:

switching the electrical connection device (68) from the state of normal operation to the state of brake test operation; and
engaging the brakes (32, 36), which are not deactivated, by opening one of the safety relays (24, 26).

13. The method according to any of claims 11 or 12, wherein the method includes engaging all brakes (32, 36, 40), by opening another one of the safety relays (24, 26).

14. The method according to any of claims 10 to 13,
wherein the elevator system (2) comprises a plurality of brake sensors (34, 38, 42, 44, 46), wherein at least one brake sensor (34, 38, 42) is associated with each of the brakes (32, 36, 40), respectively, and configured for detecting the actual status of the associated brake (32, 36, 40),
wherein the control unit (30) is configured for receiving signals from the brake sensors (34, 38, 42, 44, 46) indicating the status of the respective associated brake (32, 36, 40) and;
wherein the signal indicating the state of brake test operation, is an output signal of at least one of the brake sensors (34, 38, 42, 44, 46).

15. The method according to any of claims 10 to 14, wherein the method includes consecutively deactivating each of the brakes (32, 36, 40) and operating the elevator system (2) in the brake test mode, which includes engaging at least one brake (32, 36) which is not deactivated.

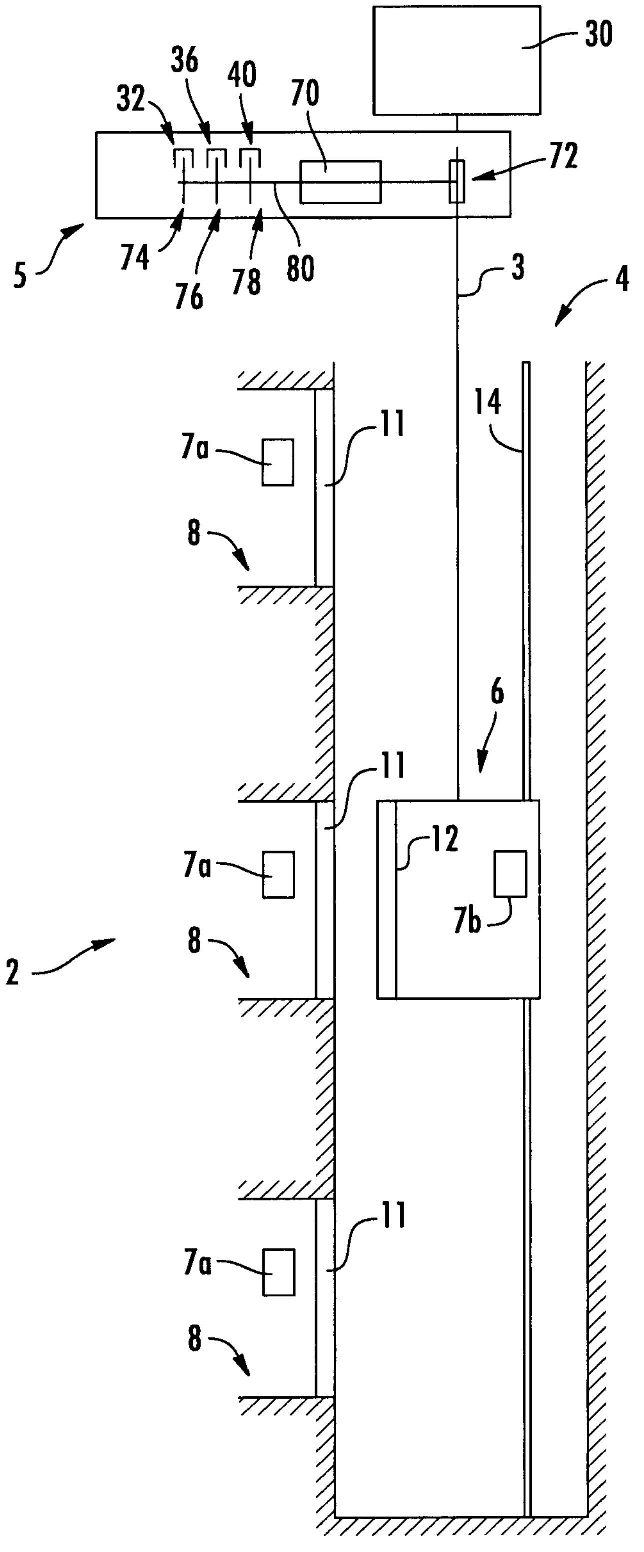

FIG. 1

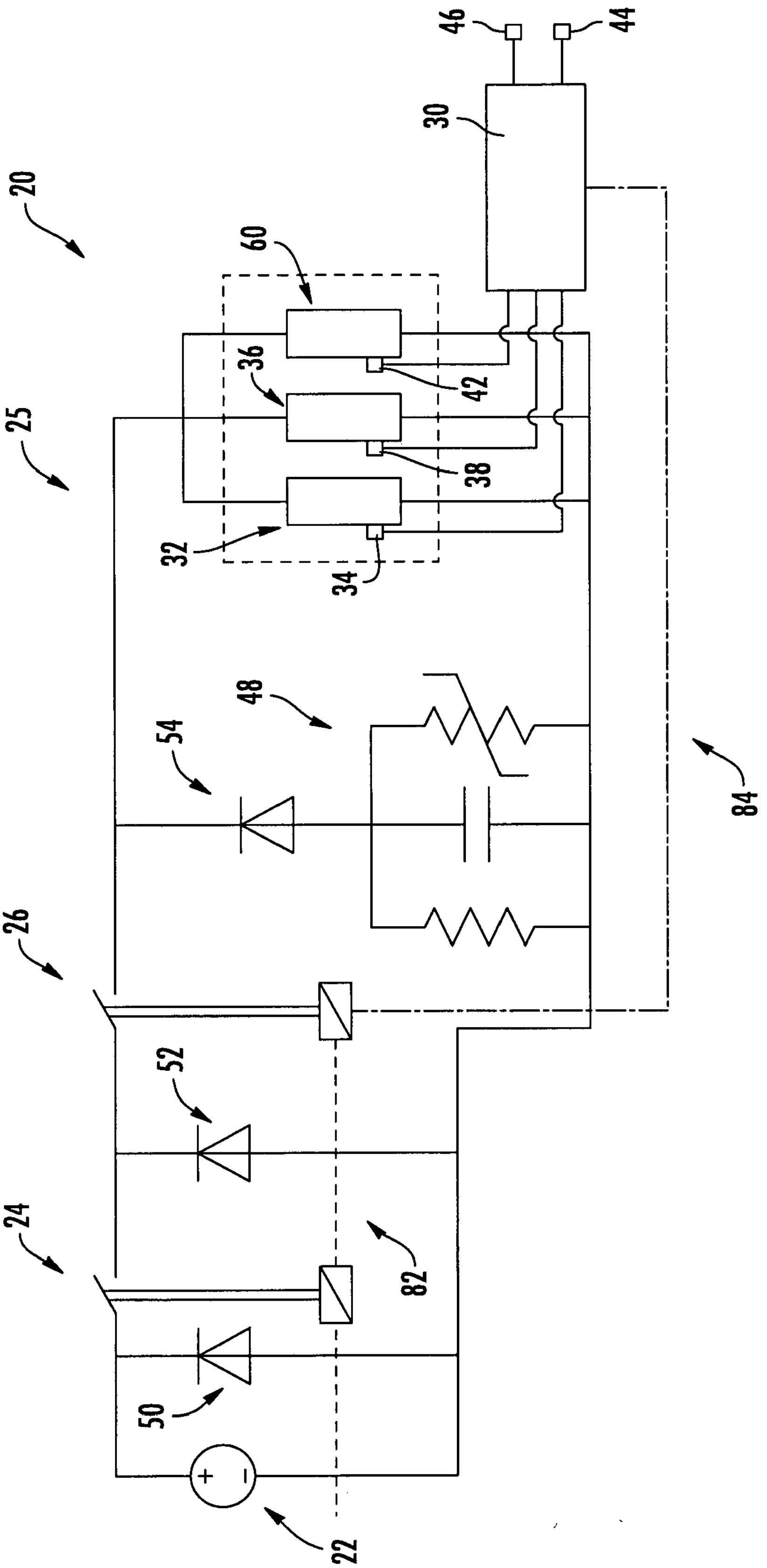

FIG. 2

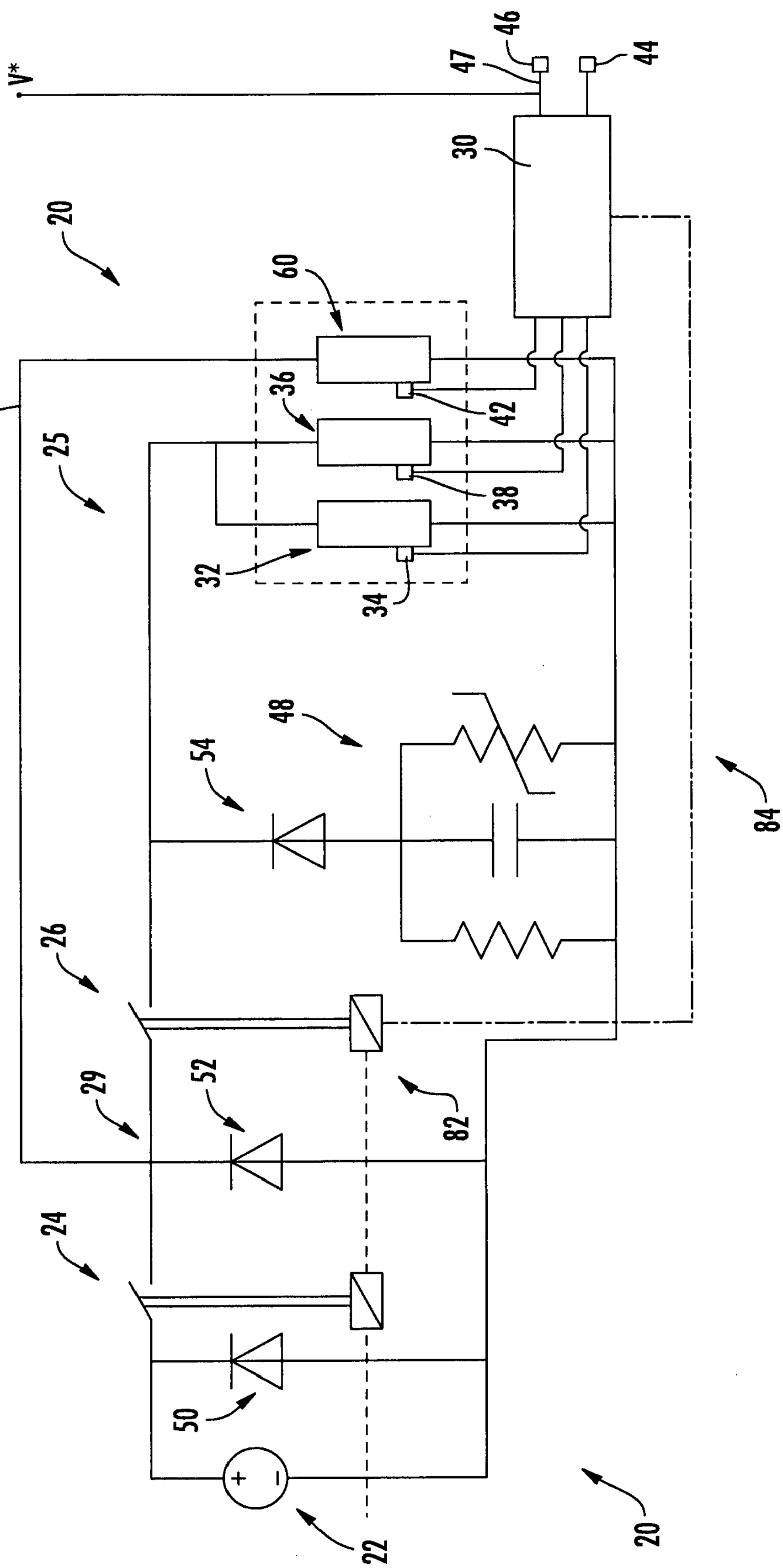

FIG. 3

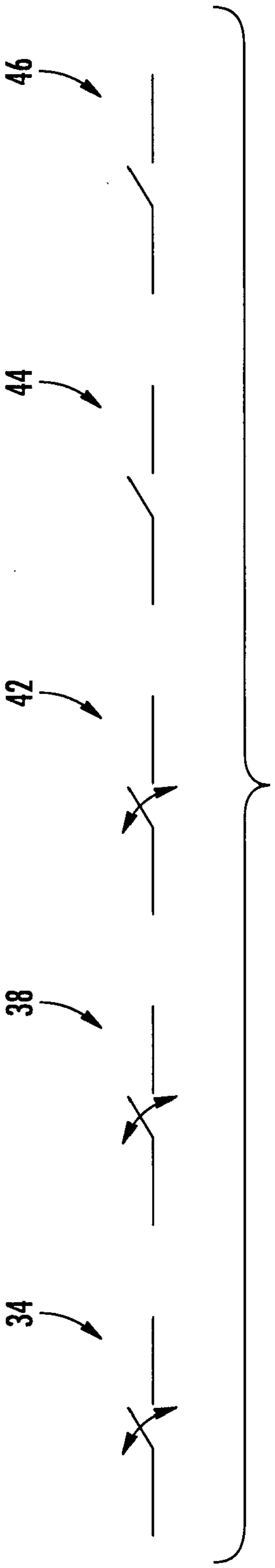

FIG. 4a

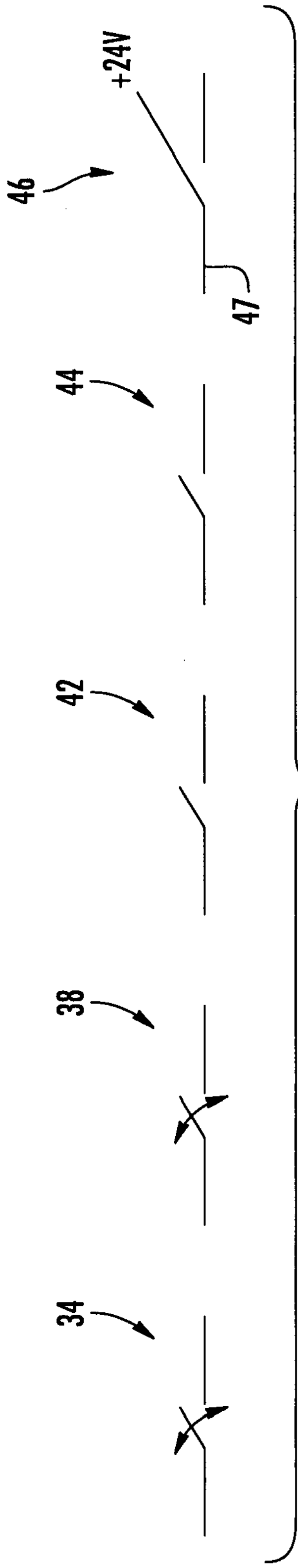

FIG. 4b

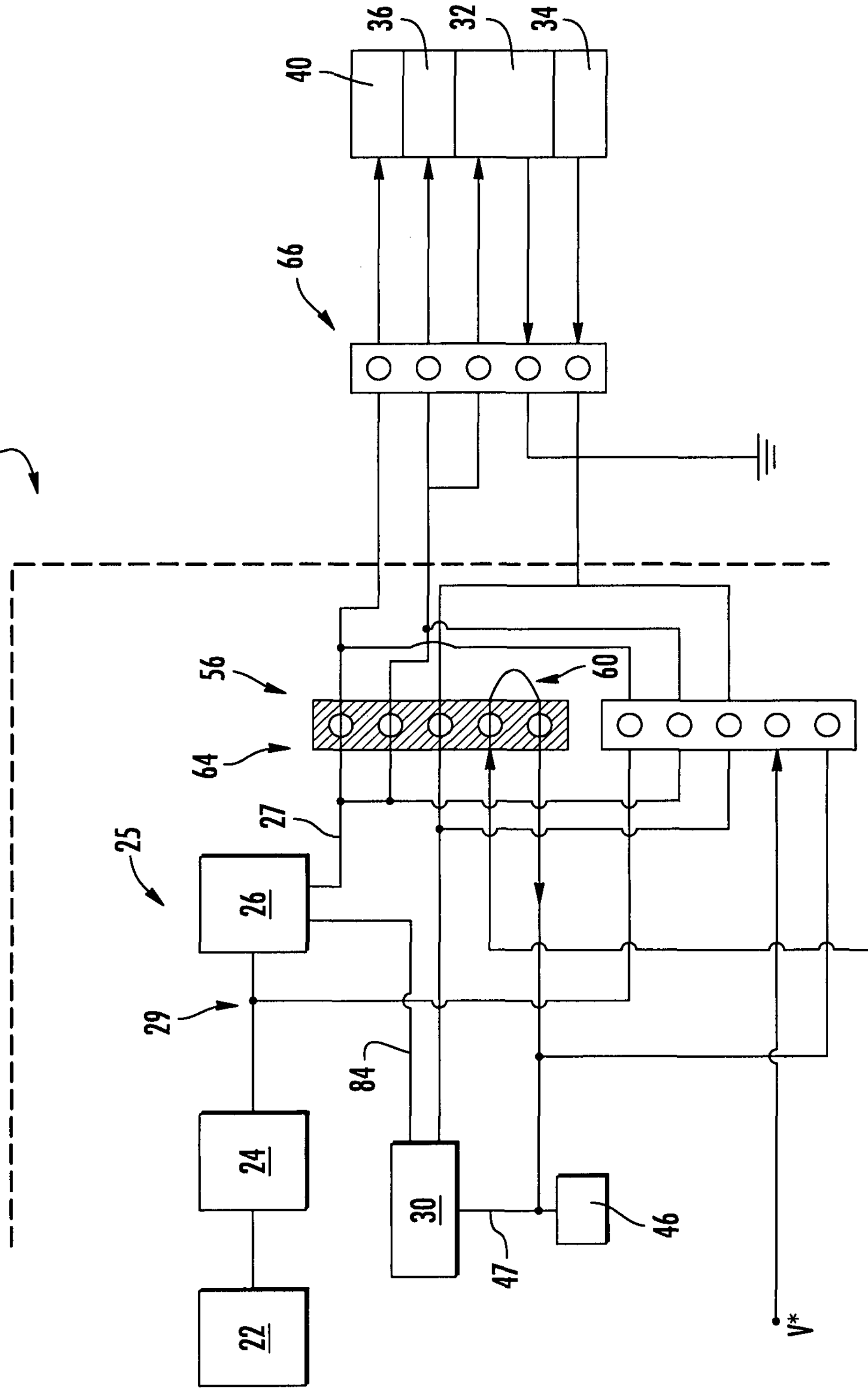

FIG. 5

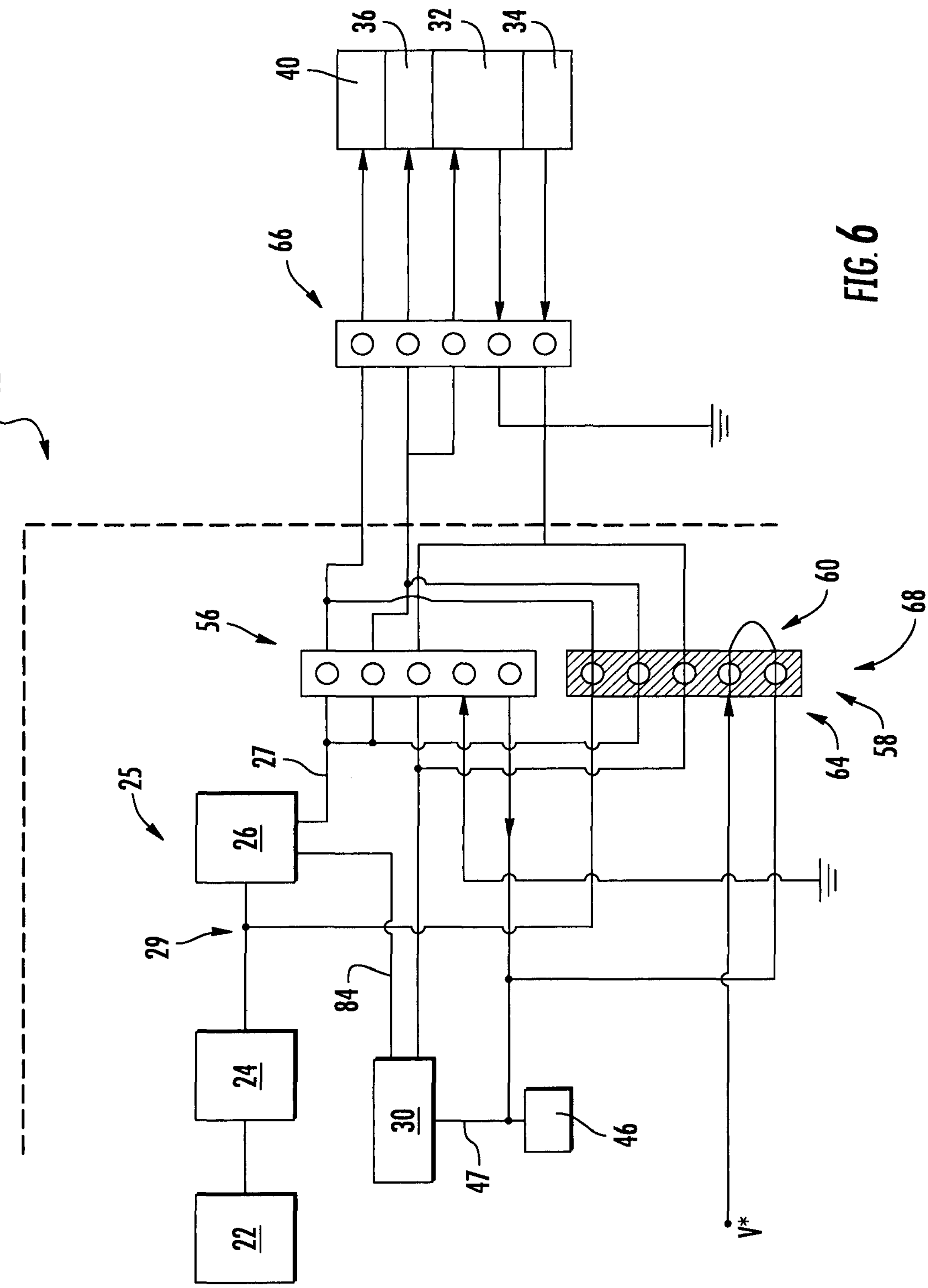

FIG. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 17 15 2812

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The present search report has been drawn up for all claims

3

Place of search	Date of completion of the search	Examiner
The Hague	15 August 2017	Bleys, Philip

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