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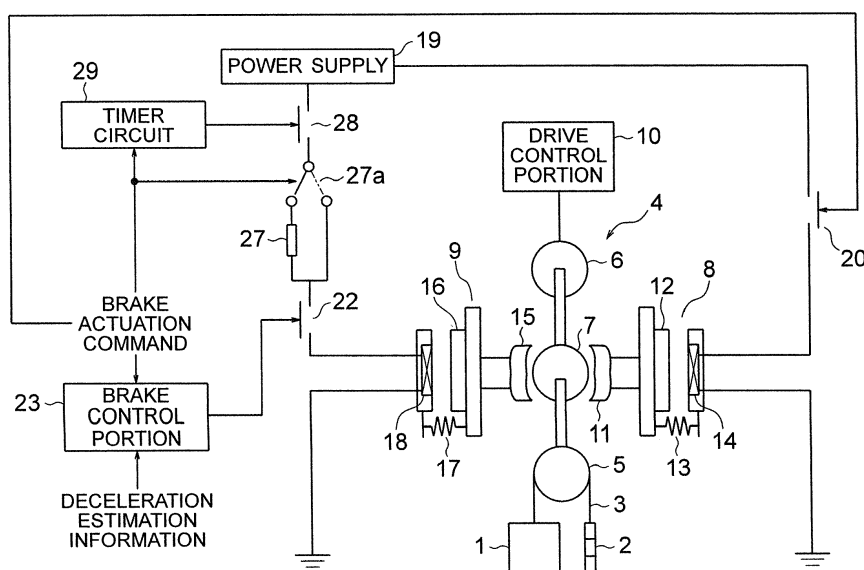
This application was filed on 08-04-2014 as a divisional application to the application mentioned under INID code 62.

(54) **Elevator apparatus**

(57) In an elevator apparatus, a brake device stops a car from running. The brake device in particular has a first brake portion body and a second brake portion body, wherein a control portion controls a braking force generated by the second brake portion body at a time of emer-

gency braking to adjust a deceleration of the car. The first brake portion body performs braking operation immediately regardless of the control state of the second brake portion body at the time of emergency braking.

FIG. 7



Description

Technical Field

[0001] The present invention relates to an elevator apparatus allowing the deceleration of a car at a time of emergency braking to be adjusted.

Background Art

[0002] In a conventional brake device for an elevator, the braking force of an electromagnetic brake is controlled at the time of emergency braking such that the deceleration of a car becomes equal to a predetermined value, based on a deceleration command value and a speed signal (for example, see Patent Document 1).

[0003] Patent Document 1: JP 07-157211 A

Disclosure of the Invention

Problem to be solved by the Invention

[0004] In the conventional brake device as described above and a braking control device, however, the basic operation of emergency braking and the control of a braking force are both performed by a single braking force control unit. Therefore, in a case where the deceleration of the car is excessively low owing to a malfunction in the braking force control unit or the like, the breaking distance becomes excessively large.

[0005] The present invention has been made to solve the above-mentioned problem, and it is therefore an object of the present invention to obtain an elevator apparatus allowing the car to be stopped more reliably even in the event of a malfunction in a brake control portion while suppressing the deceleration at the time of emergency braking.

Means for solving the Problems

[0006] An elevator apparatus according to the present invention includes: a car; and a brake device for stopping the car from running, in which the brake device has a brake control portion for controlling a braking force generated at a time of emergency braking to adjust a deceleration of the car; and a timer circuit for invalidating control of the braking force performed by the brake control portion after a lapse of a predetermined time from a moment when an emergency braking command is generated.

Brief Description of the Drawings

[0007]

Fig. 1 is a schematic diagram showing an elevator apparatus according to Embodiment 1 of the present invention.

Fig. 2 is a schematic diagram showing an elevator apparatus according to Embodiment 2 of the present invention.

Fig. 3 is a schematic diagram showing an elevator apparatus according to Embodiment 3 of the present invention.

Fig. 4 is a schematic diagram showing an elevator apparatus according to Embodiment 4 of the present invention.

Fig. 5 is a schematic diagram showing an elevator apparatus according to Embodiment 5 of the present invention.

Fig. 6 is a schematic diagram showing an elevator apparatus according to Embodiment 6 of the present invention.

Fig. 7 is a schematic diagram showing an elevator apparatus according to Embodiment 7 of the present invention.

Fig. 8 is a schematic diagram showing an elevator apparatus according to Embodiment 8 of the present invention.

Fig. 9 is a schematic diagram showing an elevator apparatus according to Embodiment 9 of the present invention.

Fig. 10 is a schematic diagram showing an elevator apparatus according to Embodiment 10 of the present invention.

Best Modes for carrying out the Invention

[0008] Preferred embodiments of the present invention will be described hereinafter with reference to the drawings.

Embodiment 1

[0009] Fig. 1 is a schematic diagram showing an elevator apparatus according to Embodiment 1 which is part of the disclosure, but not part of the present invention. Referring to Fig. 1, a car 1 and a counterweight 2 are suspended within a hoistway by a main rope 3. The car 1 and the counterweight 2 are raised/lowered within the hoistway due to a driving force of a hoisting machine 4.

[0010] The hoisting machine 4 has a drive sheave 5 around which the main rope 3 is looped, a motor 6 for rotating the drive sheave 5, a brake drum 7 as a brake rotational body that is rotated integrally with the drive sheave 5 as the car 1 runs, and a brake portion body 9 for braking rotation of the drive sheave 5. The driving of the motor 6 is controlled by a drive control portion 10 as an operation control portion.

[0011] The brake portion body 9 has a brake shoe 15 that is brought into contact with and away from the brake drum 7, an armature 16 mounted on the first brake shoe 15, a braking spring 17 for pressing the brake shoe 15 against the brake drum 7, and a brake coil 18 disposed facing the armature 16 to generate an electromagnetic force for opening the brake shoe 15 away from the brake

drum 7 against the braking spring 17.

[0012] A brake switch 22 and a timer switch 28 are connected in series between the brake coil 18 and a power supply 19. By opening at least one of the switches 22 and 28, the supply of a power to the brake coil 18 is shut off, so the brake shoe 15 is pressed against the brake drum 7 by the braking spring 17. The timer switch 28 is normally closed. Accordingly, during normal operation, when the brake switch 22 is closed, the brake coil 18 is thereby supplied with a power, so the brake shoe 15 is opened away from the brake drum 7.

[0013] The turning ON/OFF of the brake switch 22 is controlled by a brake control portion 23. The brake control portion 23 is constituted by a microcomputer having a calculation processing portion (a CPU), a storage portion (a ROM, a RAM, and the like), and signal input/output portions.

[0014] When a brake actuation command (including a normal braking command and an emergency braking command) is generated, the brake control portion 23 opens the brake switch 22, and shuts off the supply of a current to the brake coil 18 to cause the brake portion body 9 to perform braking operation. When the brake actuation command is canceled, namely, when a brake opening command is generated, the brake control portion 23 closes the brake switch 22 to cancel a braking force of the brake portion body 9. The brake actuation command and the -brake opening command are generated by an elevator control portion including the drive control portion 10, and then input to the brake control portion 23.

[0015] When a brake actuation command, namely, an emergency braking command is generated while the car 1 is running, the brake control portion 23 estimates a deceleration (the absolute value of a negative acceleration) of the car 1 based on deceleration estimation information for estimating the deceleration of the car 1, and controls an electromagnetic force generated by the brake coil 18 (an open/closed state of the brake switch 22) such that the deceleration of the car 1 does not become excessively high or low. Thus, the brake control portion 23 controls a pressing force with which the brake shoe 15 is pressed against the brake drum 7.

[0016] Available as the deceleration estimation information is information from a hoisting machine rotation detector for detecting rotation of the motor 6, a car position detector provided on a speed governor, a return pulley rotation detector for detecting rotation of a return pulley around which the main rope 3 is looped, a weighing device for detecting a load within the car 1, a speedometer mounted on the car 1, an accelerometer mounted on the car 1, an axial torque meter for detecting an axial torque of the drive sheave 5, or the like. Employable as the rotation detectors and the car position detector are encoders or resolvers.

[0017] Employed as the second brake switch 22 is a switch allowing the amount of the current supplied to the brake coil 18 to be adjusted, for example, an open/close switch capable of chopping or a slide switch for continu-

ously changing a resistance value. The following description of Embodiment 1 of the present invention will be given as to a case where the open/close switch is employed. However, in a case where the slide switch is employed, the switch is slid to change the resistance value instead of being turned ON/OFF.

[0018] The timer switch 28 is opened in response to an opening command from a timer circuit 29. When a brake actuation command is generated, the timer circuit 29 starts measuring (counting down) a time, and outputs the opening command to the timer switch 28 after the lapse of a predetermined time from a moment when the brake actuation command is generated. Accordingly, the control of the braking force of the brake portion body 9 performed by the brake control portion 23 is invalidated after the lapse of a predetermined time from a moment when an emergency braking command is generated.

[0019] When the brake actuation command is canceled, the measurement of the time by the timer circuit 29 is reset, so the timer switch 28 is closed. A brake device in Embodiment 1 of the present invention has the brake portion body 9, the brake switch 22, the brake control portion 23, the timer switch 28, and the timer circuit 29.

[0020] In the elevator apparatus structured as described above, the control of braking force performed by the brake control portion 23 is invalidated after the lapse of the predetermined time from the moment when the emergency braking command is generated. It is therefore possible to stop the car 1 more reliably even in the event of a malfunction in the brake control portion 23 while suppressing the deceleration of the car 1 at the time of emergency braking.

Embodiment 2

[0021] Next, Fig. 2 is a schematic diagram showing an elevator apparatus according to Embodiment 2 which is part of the disclosure, but not part of the present invention. Referring to Fig. 2, a current limiter 27 and a changeover switch 27a are connected between the brake coil 18 and the power supply 19. The current limiter 27 limits the current flowing through the brake coil 18. Employed as the current limiter 27 is, for example, a resistor. The changeover switch 27a makes a changeover between an operation of limiting a current from the power supply 19 by means of the current limiter 27 to supply the brake coil 18 with the limited current and an operation of supplying the brake coil 18 with the current from the power supply 19 without the intermediation of the current limiter 27.

[0022] More specifically, the changeover switch 27a has normally been changed over to a circuit side from which the current limiter 27 is excluded. In this state, when a brake actuation command is generated, the changeover switch 27a is changed over to a circuit side including the current limiter 27. When the brake actuation command is canceled, the changeover switch 27a is returned to the circuit side from which the current limiter 27

is excluded. Embodiment 2 of the present invention is identical to Embodiment 1 of the present invention in other configurational details and other operational details.

[0023] In the elevator apparatus structured as described above, the current limiter 27 is employed to set an upper limit of the amount of the current supplied to the brake coil 18 which can be controlled by the brake control portion 23, so only part of a power-supply voltage is applied to the brake coil 18. Accordingly, it is possible to suitably limit the amount of the control of the brake portion body 9 performed by the brake control portion 23.

Embodiment 3

[0024] Next, Fig. 3 is a schematic diagram showing an elevator apparatus according to Embodiment 3 which is part of the disclosure, but not part of the present invention. Referring to Fig. 3, a forcible braking switch 26 is provided between the brake coil 18 and the power supply 19. The forcible braking switch 26 is connected in series to the brake switch 22 and is normally closed. By opening the forcible braking switch 26, the brake portion body 9 is forced to perform braking operation regardless of a command from the brake control portion 23. That is, the forcible braking switch 26 invalidates the control of braking force performed by the brake control portion 23 in response to an external signal, thereby forcing the brake portion body 9 to generate a total braking force. Embodiment 3 of the present invention is identical to Embodiment 2 of the present invention in other configurational details and other operational details.

[0025] In the elevator apparatus structured as described above, the forcible braking switch 26 is provided between the brake coil 18 and the power supply 19. It is therefore possible to invalidate the control performed by the brake control portion 23 according to need and cause the brake portion body 9 to perform braking operation immediately.

Embodiment 4

[0026] Next, Fig. 4 is a schematic diagram showing an elevator apparatus according to Embodiment 4 which is part of the disclosure, but not part of the present invention. Referring to Fig. 4, the brake switch 22 is directly opened/closed depending on whether or not there is a brake actuation command (brake opening command), without being controlled by the brake control portion 23. An adjustment switch 22a, the current limiter 27, and the timer switch 28 are connected in parallel with the brake switch 22 between the power supply 19 and the brake coil 18.

[0027] In this example, a normal open/close switch is employed as the brake switch 22. Employed as the adjustment switch 22a is a switch allowing the amount of the current supplied to the brake coil 18 to be adjusted, for example, an open/close switch capable of chopping or a slide switch for continuously changing a resistance

value. During normal operation, the adjustment switch 22a is open, and the timer switch 28 is closed. The following description of Embodiment 4 of the present invention will be given as to a case where the open/close switch is employed. However, in a case where the slide switch is employed, the switch is slid to change the resistance value instead of being turned ON/OFF.

[0028] The turning ON/OFF of the adjustment switch 22a is controlled by the brake control portion 23. More specifically, the brake control portion 23 monitors the deceleration of the car 1 during the running thereof regardless of whether or not there is a brake actuation command, and controls an electromagnetic force generated by the second brake coil 18, namely, an open/close state of the adjustment switch 22a such that the deceleration of the car 1 does not become excessively high or low. The timer switch 28 is opened after the lapse of a predetermined time from a moment when a brake actuation command is generated. The brake control portion 23 detects and monitors the deceleration of the car 1 independently of the drive control portion 10. Embodiment 4 of the present invention is identical to Embodiment 1 of the present invention in other configurational details and other operational details.

[0029] In the elevator apparatus structured as described above, the adjustment switch 22a for adjusting a braking force is disposed in parallel with the brake switch 22 in a circuit, and the brake switch 22 is opened immediately in response to a brake actuation command. It is therefore possible to cause the brake portion body 9 to perform braking operation immediately without an operational delay when the brake actuation command is generated.

[0030] The brake control portion 23 detects and monitors the deceleration of the car 1 independently of the drive control portion 10. It is therefore possible to improve the reliability.

Embodiment 5

[0031] Next, Fig. 5 is a schematic diagram showing an elevator apparatus according to Embodiment 5 which is part of the disclosure, but not of the present invention. Referring to Fig. 5, a brake actuation command is also input to the brake control portion 23. When the brake actuation command is input to the brake control portion 23, the brake control portion 23 monitors the deceleration of the car 1 during the running thereof, and controls an electromagnetic force generated by the brake coil 18, namely, an open/closed state of the adjustment switch 22a such that the deceleration of the car 1 does not become excessively high or low. Embodiment 5 of the present invention is identical to Embodiment 4 of the present invention in other configurational details.

[0032] As described above, it is also appropriate to allow the brake control portion 23 to control the deceleration of the car 1 only when the brake actuation command is generated.

Embodiment 6

[0033] Next, Fig. 6 is a schematic diagram showing an elevator apparatus according to Embodiment 6 which is part of the disclosure, but not of the present invention. Referring to Fig. 6, the forcible braking switch 26 is provided between the brake coil 18 and the power supply 19. The forcible braking switch 26 is normally closed. By opening the forcible braking switch 26, the brake portion body 9 is forced to perform braking operation regardless of a command from the brake control portion 23 and an open/closed state of the brake switch 22. Embodiment 6 of the present invention is identical to Embodiment 4 of the present invention in other configurational details and other operational details.

[0034] In the elevator apparatus structured as described above, the forcible braking switch 26 is provided between the brake coil 18 and the power supply 19. It is therefore possible to invalidate the control performed by the brake control portion 23 according to need.

[0035] It is also appropriate to input a brake actuation command to the brake control portion 23 and allow the brake control portion 23 to control the deceleration of the car 1 only when the brake actuation command is generated.

Embodiment 7

[0036] Next, Fig. 7 is a schematic diagram showing an elevator apparatus according to Embodiment 7 of the present invention. Referring to Fig. 7, the hoisting machine 4 has the drive sheave 5, the motor 6, the brake drum 7, a first brake portion body 8 for braking rotation of the drive sheave 5, and a second brake portion body 9 for braking rotation of the drive sheave 5.

[0037] The first brake portion body 8 has a first brake shoe 11 that is moved into contact with and away from the brake drum 7, a first armature 12 mounted on the first brake shoe 11, a first braking spring 13 for pressing the first brake shoe 11 against the brake drum 7, and a first brake coil 14 disposed facing the first armature 12 to generate an electromagnetic force for opening the first brake shoe 11 away from the brake drum 7 against the first braking spring 13.

[0038] The second brake portion body 9, which corresponds to the brake portion body 9 in Embodiment 2 of the present invention, has a second brake shoe 15, a second armature 16, a second braking spring 17, and a second brake coil 18.

[0039] A first brake switch 20 is provided between the first brake coil 14 and the power supply 19. The first brake switch 20 is directly opened/closed depending on whether or not there is a brake actuation command. When the brake actuation command is generated, the first brake switch 20 is opened to shut off the supply of a power to the first brake coil 14, so the first brake shoe 11 is pressed against the brake drum 7 by the first braking spring 13. When a brake opening command is generated, the first

brake switch 20 is closed, so the braking force of the first brake portion body 8 is canceled.

[0040] The second brake switch 22 corresponds to the brake switch 22 in Embodiment 2 of the present invention. That is, the turning ON/OFF of the second brake switch 22 is controlled by the brake control portion 23. The first brake portion body 8 has a sufficient braking force to stop the car 1 even when the braking force exerted by the second brake portion body 9 remains canceled.

[0041] A brake device in Embodiment 7 of the present invention has the first brake portion body 8, the second brake portion body 9, the first brake switch 20, the second brake switch 22, the brake control portion 23, the current limiter 27, the changeover switch 27a, the timer switch 28, and the timer circuit 29. Embodiment 7 of the present invention is identical to Embodiment 2 of the present invention in other configurational details and other operational details.

[0042] In the elevator apparatus structured as described above, when a brake actuation command is generated, the first brake portion body 8 performs braking operation immediately regardless of the control state of the second brake portion body 9. It is therefore possible to prevent a delay in starting braking operation more reliably.

[0043] In Embodiment 7 of the present invention, the second brake portion body 9 first performs braking operation when a brake actuation command is generated, and reduces a braking force when the deceleration of the car 1 becomes excessively high. However, it is also appropriate to keep the second brake switch 22 closed even when a brake actuation command is generated, and open the second brake switch 22 to perform braking operation when the deceleration of the car 1 is equal to or lower than a predetermined value.

Embodiment 8

[0044] Next, Fig. 8 is a schematic diagram showing an elevator apparatus according to Embodiment 8 of the present invention. Referring to Fig. 8, the forcible braking switch 26 is provided between the second brake coil 18 and the power supply 19. The forcible braking switch 26 is normally closed. By opening the forcible braking switch 26, the second brake portion body 9 is forced to perform braking operation regardless of a command from the brake control portion 23. Embodiment 8 of the present invention is identical to Embodiment 7 of the present invention in other configurational details and other operational details.

[0045] In the elevator apparatus structured as described above, the forcible braking switch 26 is provided between the brake coil 18 and the power supply 19. It is therefore possible to invalidate the control performed by the brake control portion 23 according to need.

Embodiment 9

[0046] Next, Fig. 9 is a schematic diagram showing an elevator apparatus according to Embodiment 9 of the present invention. Referring to Fig. 9, the hoisting machine 4 has the drive sheave 5, the motor 6, the brake drum 7, the first brake portion body 8 for braking rotation of the drive sheave 5, and the second brake portion body 9 for braking rotation of the drive sheave 5.

[0047] The first brake portion body 8 has the first brake shoe 11, the first armature 12, the first braking spring 13, and the first brake coil 14 as in the cases of Embodiments 7 and 8 of the present invention. The second brake portion body 9, which corresponds to the brake portion body 9 in Embodiment 4 of the present invention, has the second brake shoe 15, the second armature 16, the second braking spring 17, and the second brake coil 18.

[0048] The first brake switch 20 is provided between the first brake coil 14 and the power supply 19. The first brake switch 20 is directly opened/closed depending on whether or not there is a brake actuation command.

[0049] The second brake switch 22 corresponds to the brake switch 22 in Embodiment 4 of the present invention. That is, the second brake switch 22 is directly opened/closed depending on whether or not there is a brake actuation command, without being controlled by the brake control portion 23. The adjustment switch 22a, the current limiter 27, and the timer switch 28 are connected in parallel with the second brake switch 22 between the power supply 19 and the second brake coil 18.

[0050] The turning ON/OFF of the adjustment switch 22a is controlled by the brake control portion 23. More specifically, the brake control portion 23 monitors the deceleration of the car 1 during the running thereof regardless of whether or not there is a brake actuation command, and controls an electromagnetic force generated by the second brake coil 18, namely, an open/closed state of the adjustment switch 22a such that the deceleration of the car 1 does not become excessively high or low. The timer switch 28 is opened after the lapse of a predetermined time from a moment when the brake actuation command is generated.

[0051] A brake device in Embodiment 9 of the present invention has the first brake portion body 8, the second brake portion body 9, the first brake switch 20, the second brake switch 22, the adjustment switch 22a, the brake control portion 23, the current limiter 27, the timer switch 28, and the timer circuit 29. Embodiment 9 of the present invention is identical to Embodiments 4 and 7 of the present invention in other configurational details and other operational details.

[0052] In the elevator apparatus structured as described above, when a brake actuation command is generated, the first brake portion body 8 performs braking operation immediately regardless of the control state of the second brake portion body 9. It is therefore possible to prevent a delay in starting braking operation more reliably.

[0053] The adjustment switch 22a for adjusting a braking force is disposed in parallel with the second brake switch 22 in a circuit, and the second brake switch 22 is directly opened/closed depending on whether or not there is a brake actuation command. It is therefore possible to cause the second brake portion body 9 to perform braking operation immediately without an operational delay when the brake actuation command is generated.

[0054] It is also appropriate to input a brake actuation command to the brake control portion 23, and allow the brake control portion 23 to control the deceleration of the car 1 only when the brake actuation command is generated.

Embodiment 10

[0055] Next, Fig. 10 is a schematic diagram showing an elevator apparatus according to Embodiment 10 of the present invention. Referring to Fig. 10, the forcible braking switch 26 is provided between the second brake coil 18 and the power supply 19. The forcible braking switch 26 is normally closed. By opening the forcible braking switch 26, the second brake portion body 9 is forced to perform braking operation regardless of a command from the brake control portion 23. Embodiment 10 of the present invention is identical to Embodiment 9 of the present invention in other configurational details and other operational details.

[0056] In the elevator apparatus structured as described above, the forcible braking switch 26 is provided between the second brake coil 18 and the power supply 19. It is therefore possible to invalidate the control performed by the brake control portion 23 according to need.

[0057] In Embodiment 10 of the present invention, it is also appropriate to input a brake actuation command to the brake control portion 23, and allow the brake control portion 23 to control the deceleration of the car 1 only when the brake actuation command is generated.

[0058] Further, although the brake control portion 23 is constituted by the computer in the foregoing examples, an electric circuit for processing analog signals may be employed to constitute the brake control portion 23.

[0059] Still further, although the brake device is provided on the hoisting machine 4 in the foregoing examples, it is also appropriate to provide the brake device at another position. That is, the brake device may be a car brake mounted on the car 1, a rope brake for gripping the main rope 3 to brake the car 1, or the like.

[0060] Yet further, the brake rotational body is not limited to the brake drum 7. For example, the brake rotational body may be a brake disc.

[0061] Further, three or more brake portion bodies may be provided for a single brake rotational body.

[0062] Still further, the brake device is disposed outside the brake rotational body in the foregoing examples. However, the brake device may be disposed inside the brake rotational body.

Yet further, the brake rotational body may be integrated

with the drive sheave 5.

[0063] The following points are also part of the disclosure:

1. An elevator apparatus, comprising:

a car; and
a brake device for stopping the car from running, wherein
the brake device has a brake control portion for controlling a braking force generated at a time of emergency braking to adjust a deceleration of the car; and
a timer circuit for invalidating control of the braking force performed by the brake control portion after a lapse of a predetermined time from a moment when an emergency braking command is generated.

2. The elevator apparatus according to 1, wherein:

the brake device has:

a brake shoe that is moved into contact with and away from a brake rotational body that is rotated as the car runs;
a braking spring for pressing the brake shoe against the brake rotational body; and
a brake coil for generating an electromagnetic force for opening the brake shoe away from the brake rotational body against the braking spring;
the brake control portion controls the electromagnetic force generated by the brake coil at the time of emergency braking; and
the timer circuit shuts off supply of a power to the brake coil after the lapse of the predetermined time from the moment when the emergency braking command is generated.

3. The elevator apparatus according to 2, wherein the brake device further has a current limiter for limiting a current flowing through the brake coil.

4. The elevator apparatus according to 1, further comprising an operation control portion for controlling operation of the car, wherein
the brake control portion detects a deceleration of the car independently of the operation control portion.

5. The elevator apparatus according to 1, wherein the brake device has a forcible braking switch for invalidating the control of the braking force performed by the brake control portion in response to an external signal to forcibly cause generation of a total braking force.

Claims

1. An elevator apparatus, comprising:

a car (1); and
a brake device for stopping the car (1) from running,
wherein the brake device has:

a first brake portion body (8);
a second brake portion body (9);
a brake control portion (23) for controlling a braking force generated by the second brake portion body (9) at a time of emergency braking to adjust a deceleration of the car (1);
a timer circuit (29) for invalidating control of the braking force performed by the brake control portion (23) after a lapse of a predetermined time from a moment when an emergency braking command is generated; wherein
the first brake portion body (8) performs braking operation immediately regardless of the control state of the second brake portion body (9) at the time of emergency braking.

2. The elevator apparatus according to Claim 1, wherein the first brake portion body (8) has a sufficient braking force to stop the car (1) even when the braking force exerted by the second brake portion body (9) remains canceled.

3. The elevator apparatus according to Claims 1 or 2, wherein:

the second brake portion body has:

a second brake shoe (15) that is moved into contact with and away from a brake rotational body (7) that is rotated as the car (1) runs;
a second braking spring (17) for pressing the brake shoe against the brake rotational body (7); and
a second brake coil (18) for generating an electromagnetic force for opening the second brake shoe (15) away from the brake rotational body (7) against the second braking spring (17);
the brake control portion (23) controls the electromagnetic force generated by the second brake coil (18) at the time of emergency braking; and
the timer circuit (29) shuts off supply of a power to the second brake coil (18) after the lapse of the predetermined time from the

moment when the emergency braking command is generated.

4. The elevator apparatus according to any one of Claims 1 to 3, wherein the first brake portion body (8) has
a first brake shoe (11) that is brought into contact with and away from the brake rotational body (7),
a first braking spring (13) for pressing the first brake shoe (11) against the brake rotational body (7), and
a first brake coil (14) for generating an electromagnetic force for opening the first brake shoe (11) away from the brake rotational body (7) against the first braking spring (13).
5. The elevator apparatus according to Claim 3, wherein the brake device further has a current limiter (27) for limiting a current flowing through the second brake coil (18).
6. The elevator apparatus according to any one of the preceding Claims, further comprising an operation control portion (10) for controlling operation of the car (1), wherein
the brake control portion (23) detects a deceleration of the car (1) independently of the operation control portion (10).
7. The elevator apparatus according to any one of the preceding Claims, wherein the brake device has a forcible braking switch (26) for invalidating the control of the braking force performed by the brake control portion (23) in response to an external signal to forcibly cause generation of a total braking force.

FIG. 1

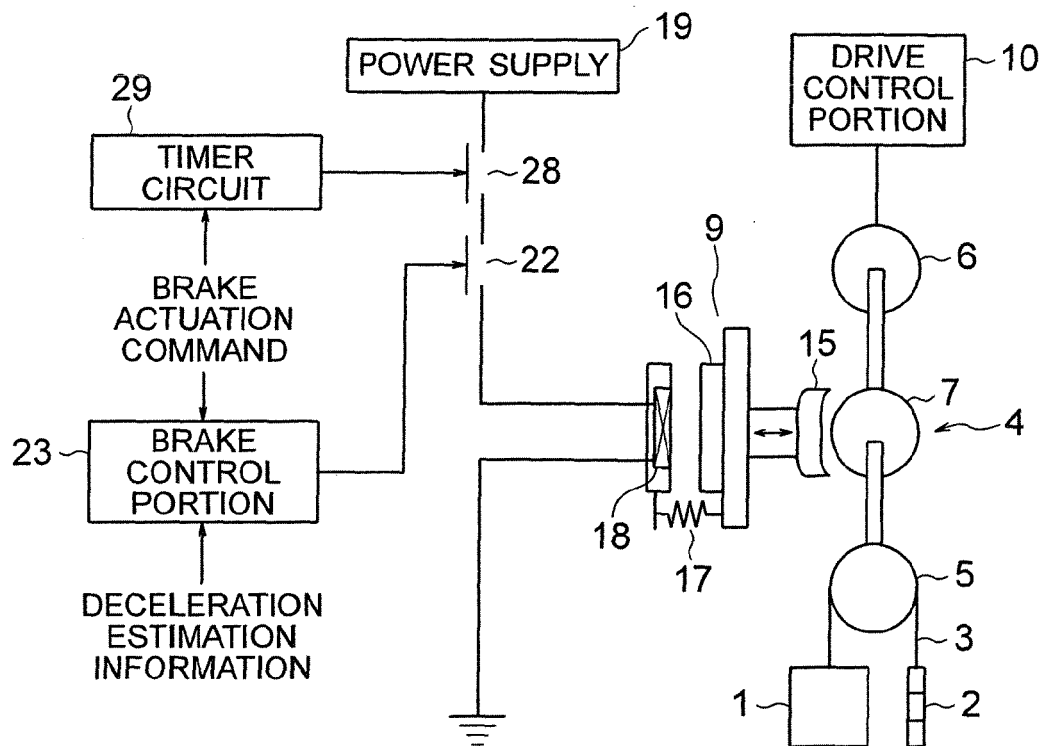


FIG. 2

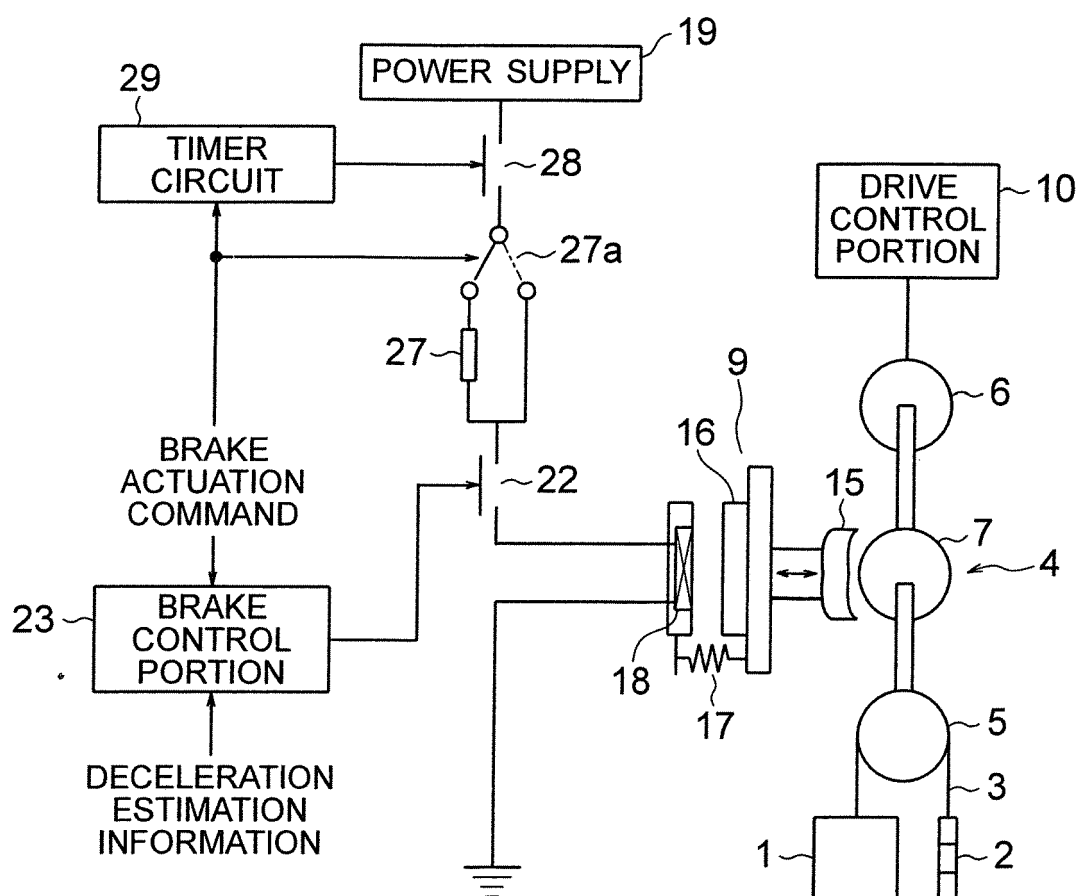


FIG. 3

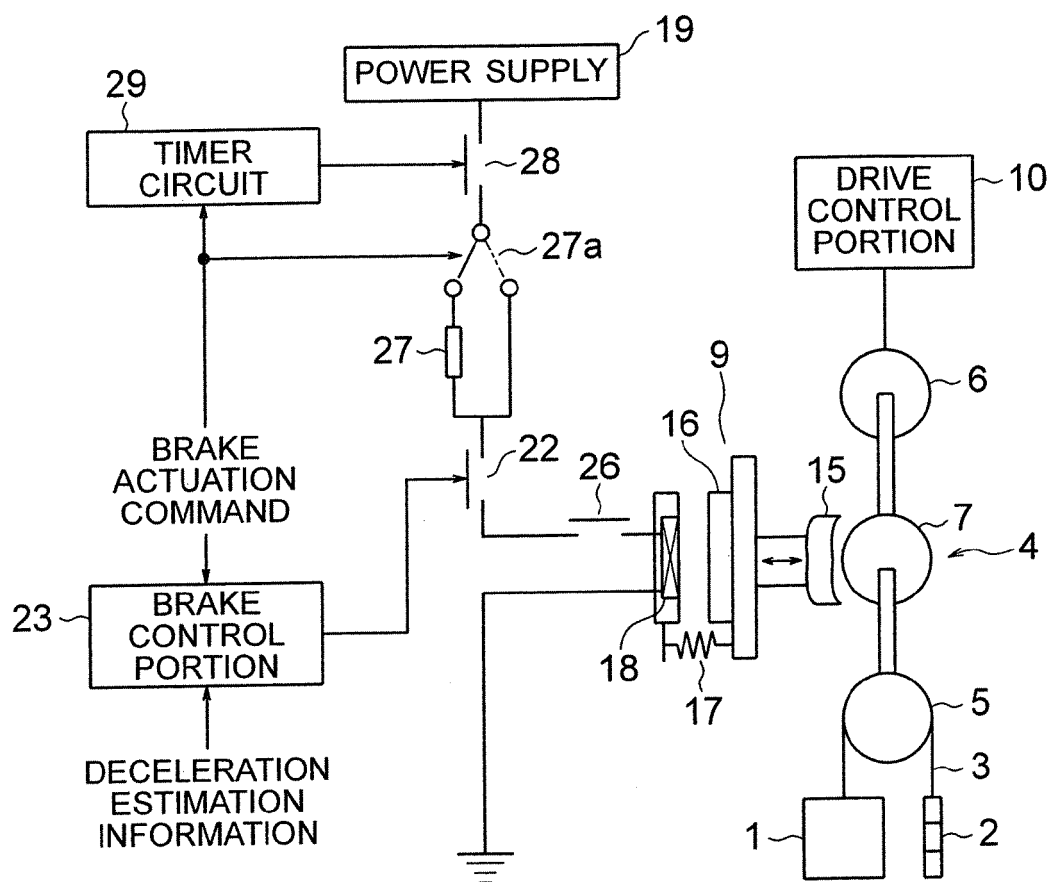


FIG. 4

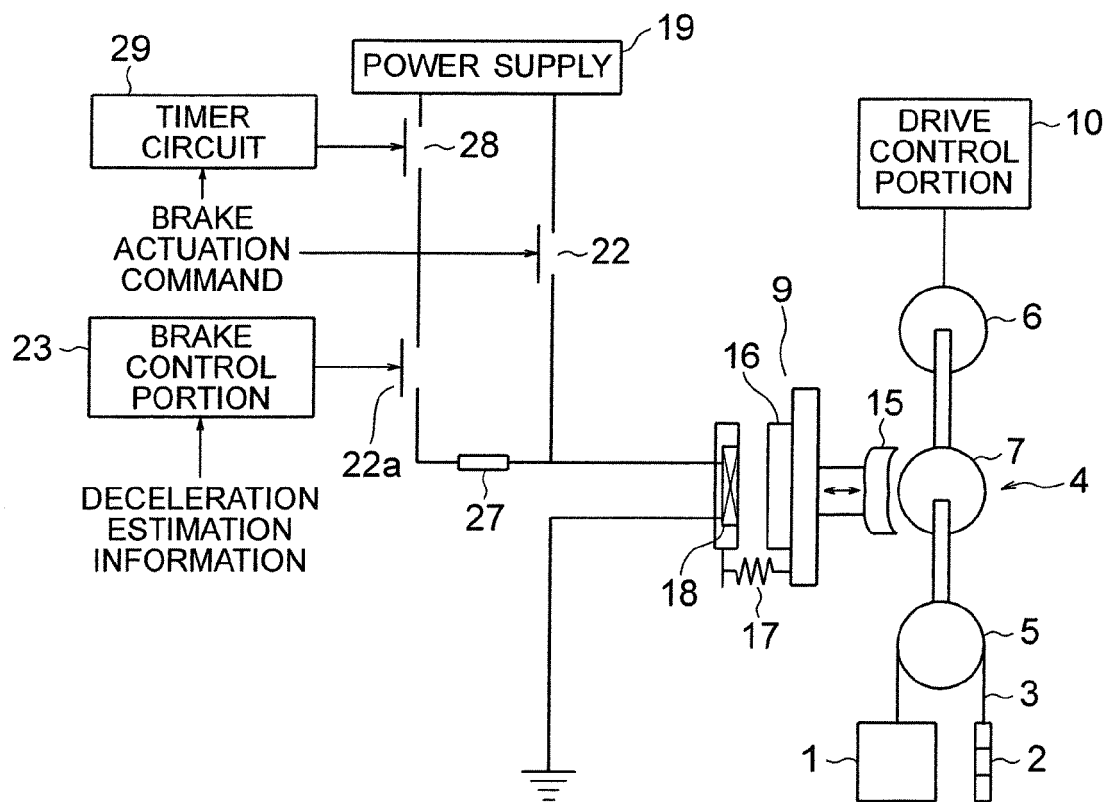


FIG. 5

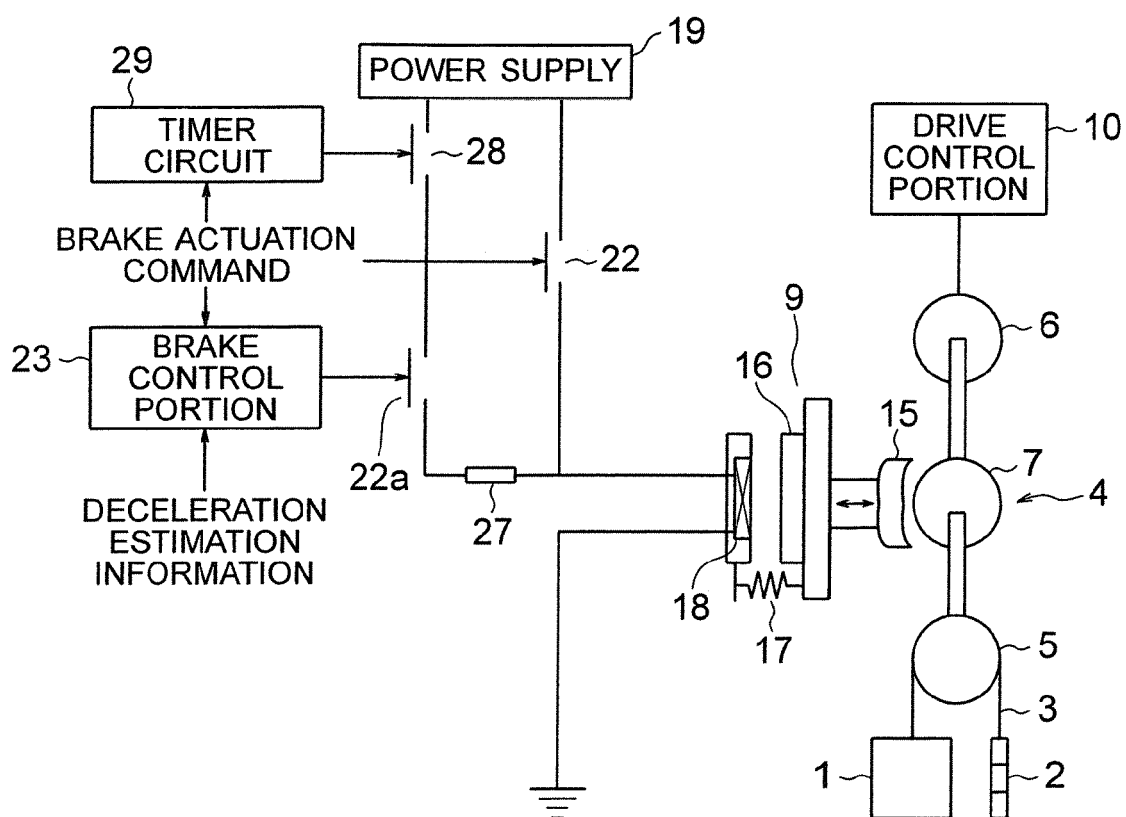


FIG. 6

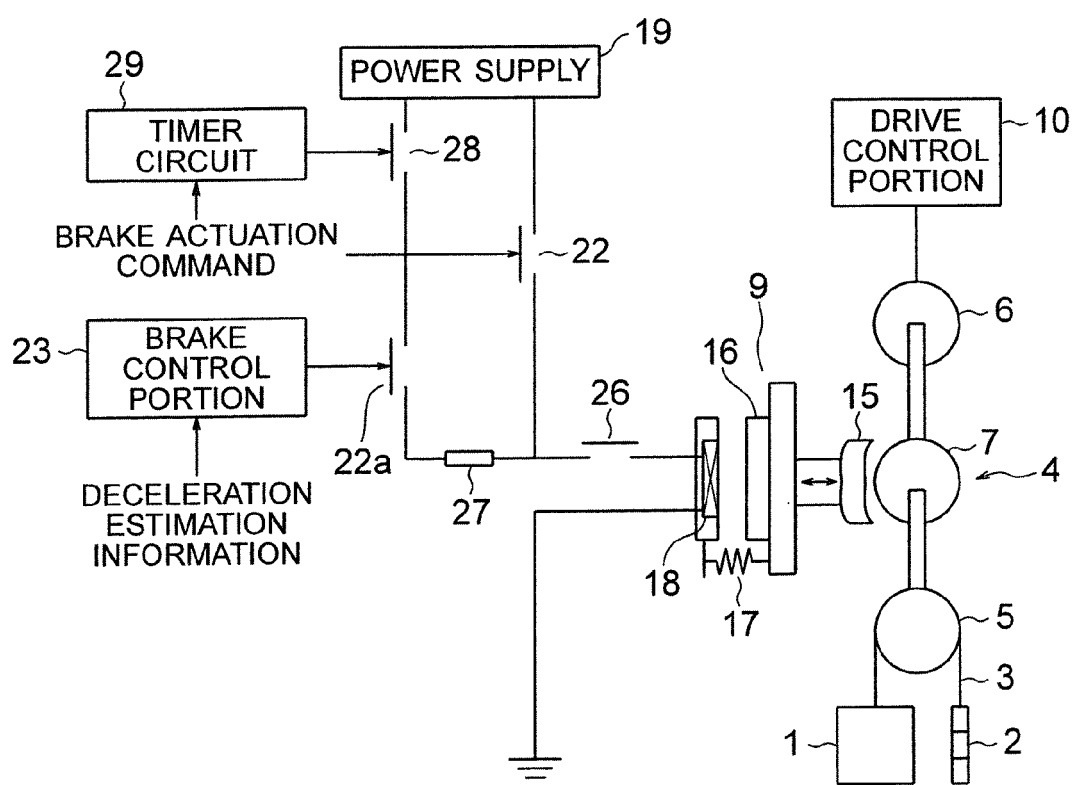
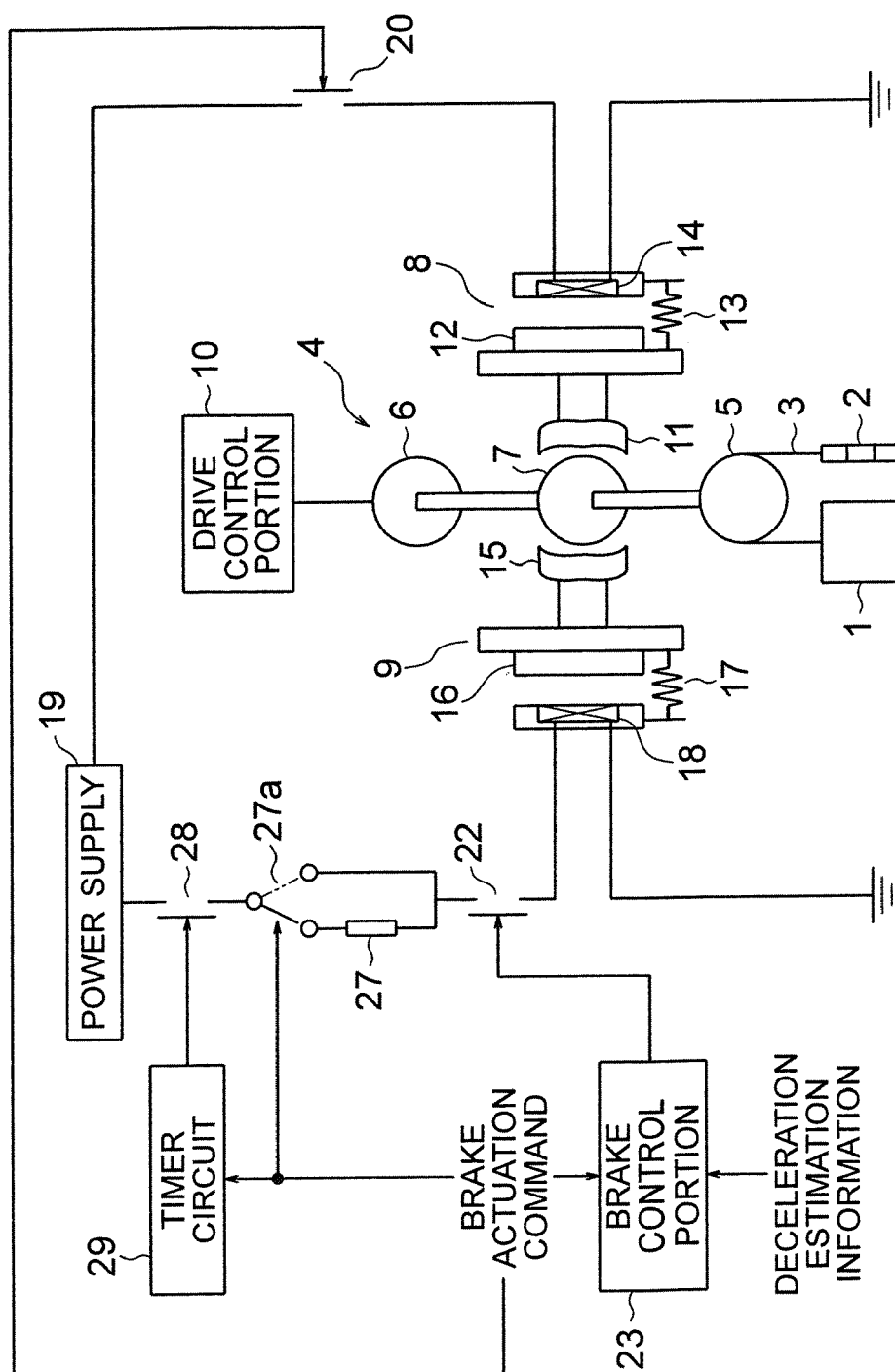


FIG. 7



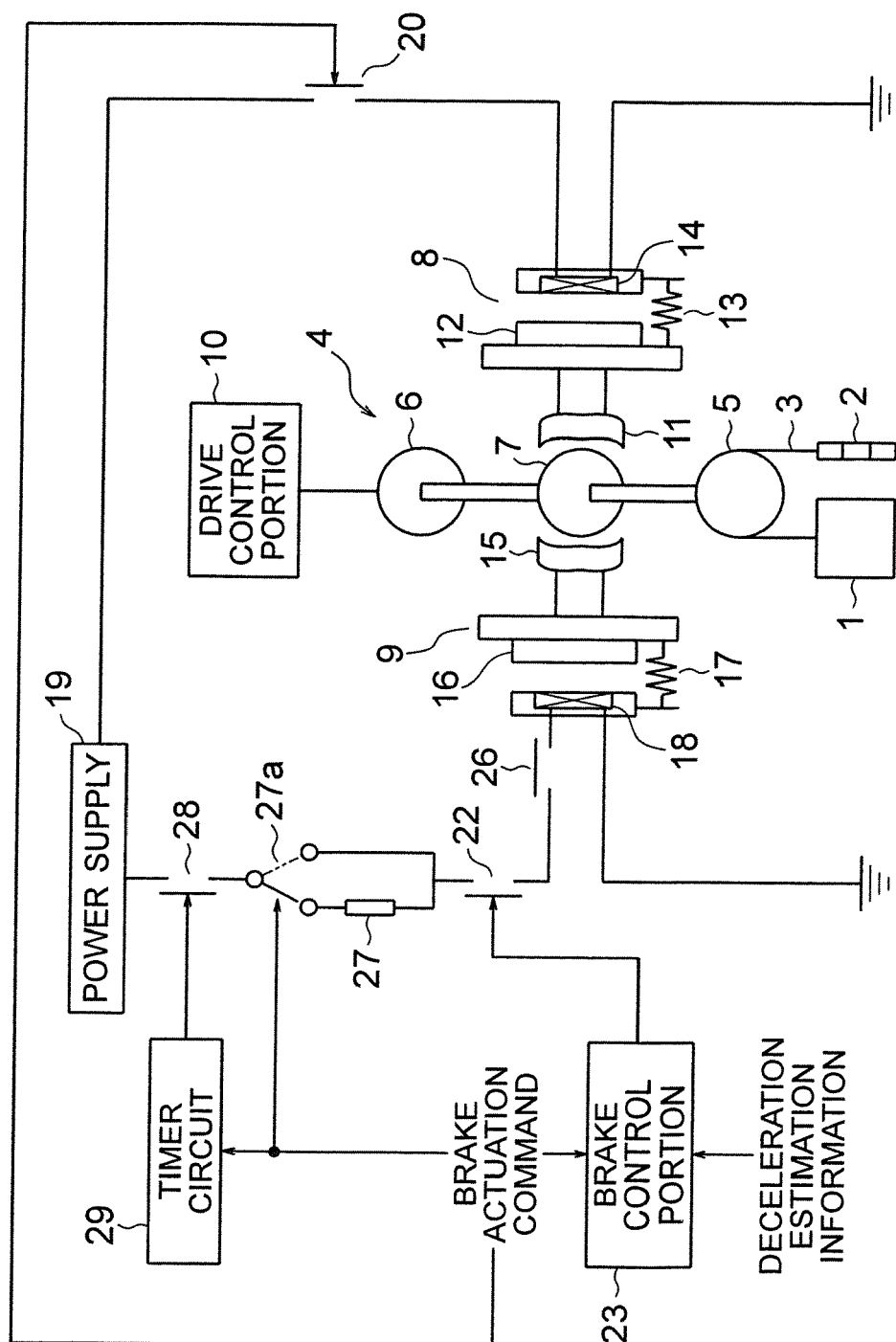
$$\frac{F}{G} \infty$$


FIG. 9

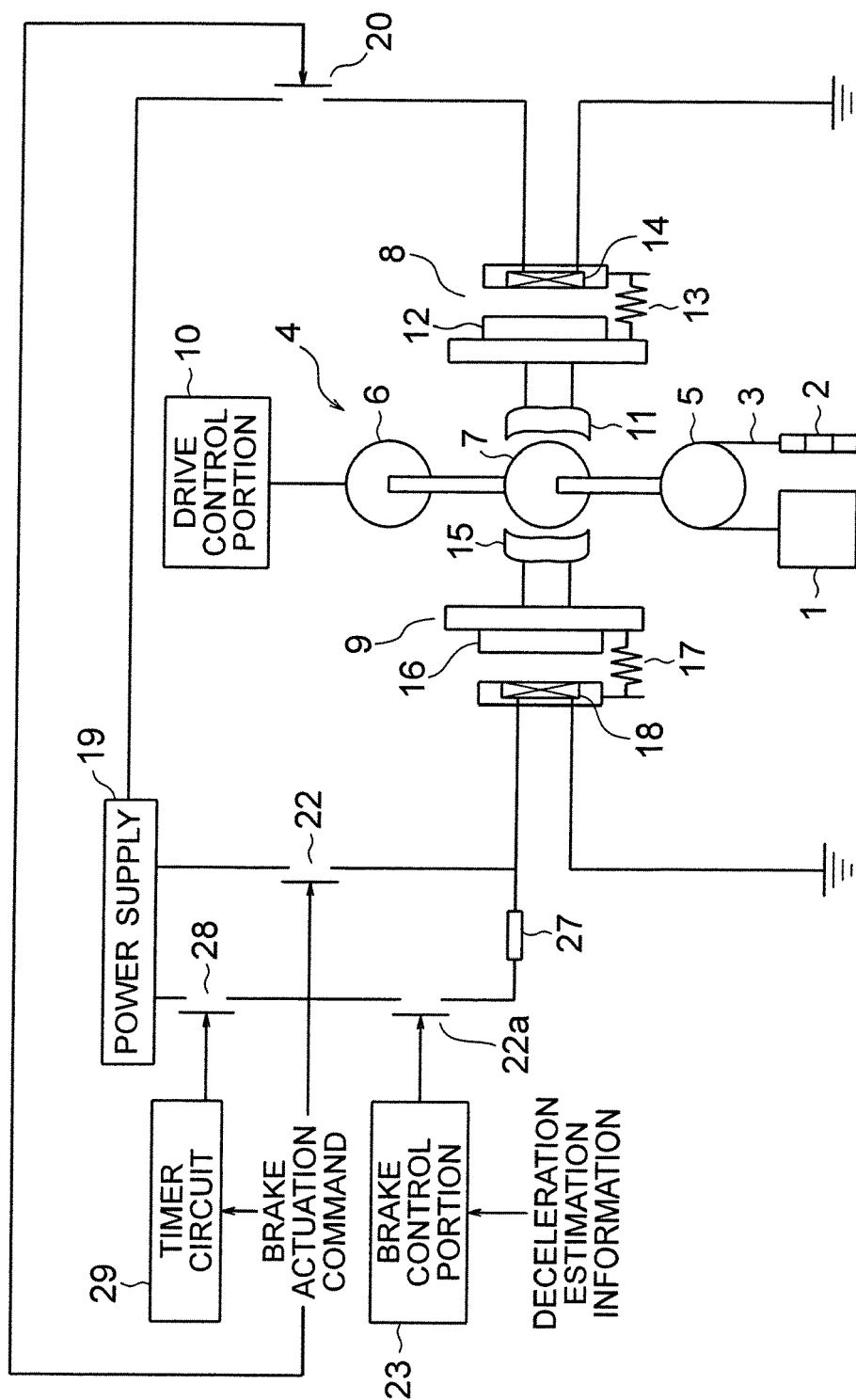
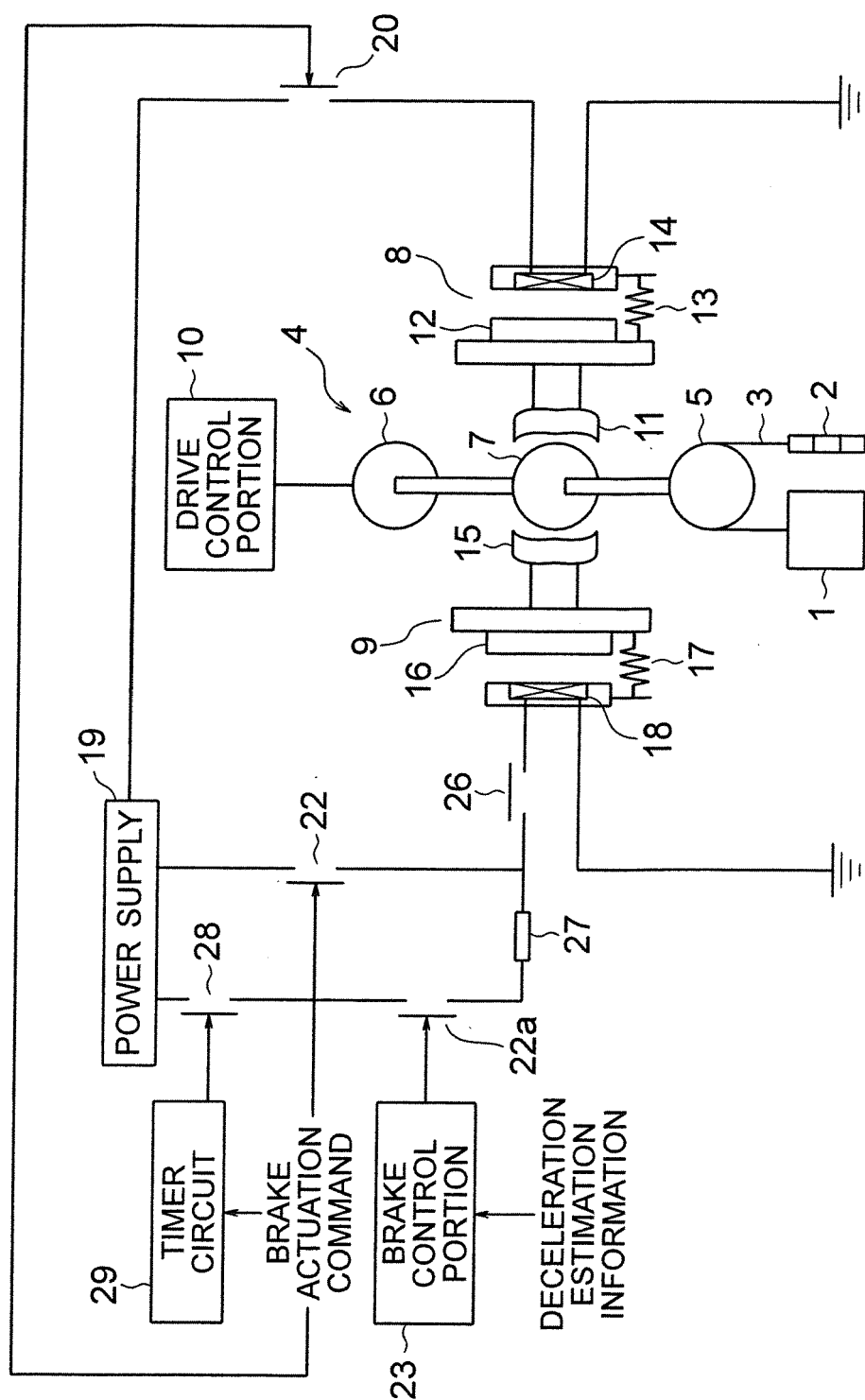


FIG. 10





EUROPEAN SEARCH REPORT

Application Number
EP 14 16 3836

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2004/173413 A1 (ANGST PHILIPP [CH] ET AL) 9 September 2004 (2004-09-09) * paragraphs [0037] - [0042]; figures 1a, 1b, 6 *	1-7	INV. B66B1/32 B66B5/02
A	JP 2001 278572 A (MITSUBISHI ELECTRIC CORP) 10 October 2001 (2001-10-10) * abstract; figures 1, 2, 5, 6 * * paragraphs [0005], [0006], [0013], [0014], [0018] - [0020] *	1-7	
			TECHNICAL FIELDS SEARCHED (IPC)
			B66B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 30 June 2014	Examiner Iuliano, Emanuela
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

1
EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 14 16 3836

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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30-06-2014

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2004173413 A1	09-09-2004	AT 348779 T	15-01-2007
		BR 0210750 A	20-07-2004
		CA 2448538 A1	16-01-2003
		CN 1524057 A	25-08-2004
		DK 1401757 T3	10-04-2007
		EP 1401757 A1	31-03-2004
		ES 2278027 T3	01-08-2007
		HK 1065014 A1	01-06-2007
		JP 2005515134 A	26-05-2005
		JP 2009215082 A	24-09-2009
		PT 1401757 E	28-02-2007
		US 2004173413 A1	09-09-2004
		WO 03004397 A1	16-01-2003

JP 2001278572 A	10-10-2001	JP 4439074 B2	24-03-2010
		JP 2001278572 A	10-10-2001

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 7157211 A [0003]