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(71) Applicant: **Inventio AG**
6052 Hergiswil NW (CH)

(72) Inventors:
- **Henneau, Philippe**
  8005, Zürich (CH)
- **Grumbrecht, Roland**
  6043, Adligenswil (CH)

(54) Apparatus and method for detecting whether an elevator car has become jammed along its travel path

(57) An elevator installation having a car (20), a counterweight (6), traction means (8) interconnecting and supporting the car (20) and counterweight (8), a drive unit (12) to drive the traction means (8) and a controller (18) to control and regulate the movement of the drive unit (12) and thereby the movement of the car (20) further includes a load measurement sensor (32) mounted to the car (20) to output a signal (F) representative of the load of the elevator car (20). A processing unit (34) having an input to receive the load measurement sensor signal (F) transmits a first signal (J) from its output indicating that the elevator car (20) has jammed if the load measurement sensor signal (F) deviates outside a predetermined range (F1-F2).

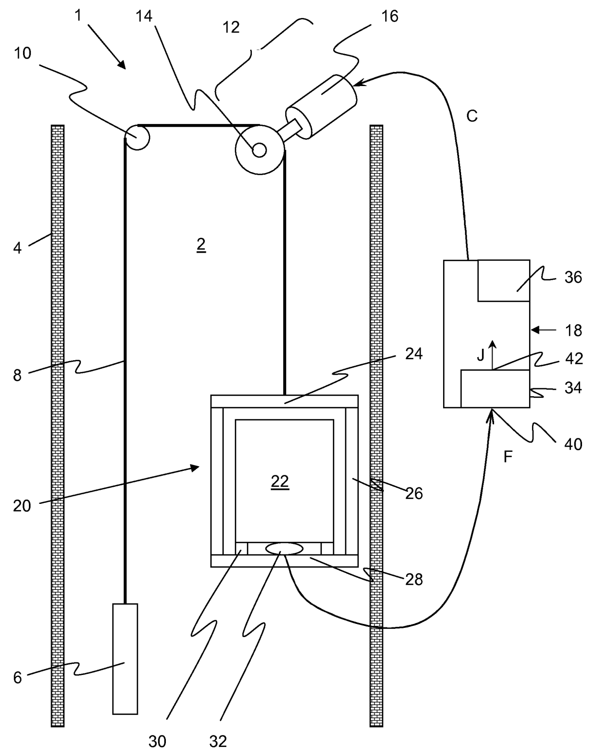

FIG. 1

EP 2 292 546 A1

Description

[0001] In an elevator installation, an elevator car and a counterweight are conventionally supported on and interconnected by traction means. The traction means is driven through engagement with a motor-driven traction sheave to move the car and counterweight in opposing directions along the elevator hoistway. The drive unit, consisting of the motor and traction sheave, is normally located in the upper end of the elevator hoistway or alternatively in a machine room directly above the hoistway.

[0002] Traditionally, steel cables have been used as traction means. More recently, synthetic cables and belt-like traction means comprising steel or aramid cords of relatively small diameter coated in a synthetic material have been developed. An important aspect of these synthetic traction means is the significant increase in the coefficient of friction they exhibit through engagement with the traction sheave as compared to the traditional steel cables. Such is the increase in friction that if the counterweight becomes stuck along the hoistway, so that the section of the traction means between the traction sheave and the counterweight becomes slack, the drive may still be capable of moving the elevator car upwards. In a second converse situation, if the car becomes jammed while being lowered down the hoistway, resulting in slackening of the section of the traction means between the car and the traction sheave, the drive may still be capable of moving the counterweight upwards. Either situation presents a severe risk of injury to any passengers in the car because when the elevator controller eventually directs the drive unit to stop, the elevator car will drop back down the hoistway in the first situation whereas the counterweight will fall back and subsequently jerk the car upwards in the second situation.

[0003] US2008/085232 describes an apparatus and method for solving the problems associated with the first situation described above. The drive unit has a motor unit and a deflecting unit. If the counterweight which is supported by the deflecting unit rests on a pit buffer for example, the deflecting unit is unloaded and is raised by means of a spring element of the monitoring device. A sensor of the monitoring device detects the movement of the deflecting unit and switches off the motor of the motor unit via a safety circuit.

[0004] The problems associated with second situation outlined above have conventionally been solved by monitoring the tension in the traction means on the car-side of the traction sheave with a slack rope contact such as described in US2007/0170009. Because of its complexity, the slack rope contact solution is expensive, time-consuming to install and must be individually tailored to the existing car or car frame during modernization of an existing installation.

[0005] The invention provides an elevator installation having a car, a counterweight, traction means interconnecting and supporting the car and counterweight, a drive unit to drive the traction means and a controller to control and regulate the movement of the drive unit and thereby the movement of the car. The elevator installation further comprises a load measurement sensor mounted to the car to output a signal representative of the load of the elevator car. A processing unit having an input to receive the load measurement sensor signal transmits a first signal from its output if the load measurement sensor signal deviates outside a predetermined range.

[0006] In all elevator installations, the load of the elevator car is continually monitored by the associated elevator controller for numerous reasons. The reason which is most recognisable to passengers is that of an overload condition when too many passengers have boarded the stationary car at an elevator landing in which case the controller prevents the doors from closing and the drive from moving the car and normally activates a buzzer to notify the passengers. The load signal also enables the controller to pretorque the motor before a trip so that when the brakes are lifted the trip commences safely and smoothly. Accordingly, the invention provides an additional purpose for an existing load measurement signal so that the additional cost of providing and installing a slack rope contact to determine whether the elevator car has jammed along its downward travel path is avoided.

[0007] Preferably, the controller is connected to the output of the processing unit. Accordingly, the controller can automatically instruct the drive unit to commence an emergency stop on condition that the first signal has been received from the processing unit and the car is moving downwards. Accordingly, the car can be stopped immediately and thereby minimise the risk of injury to passengers or damage to the car.

[0008] Furthermore, a communications module is preferably connected to the output of the processing unit. The communications module can immediately inform a remote monitoring centre, such as those conventionally used to respond to alarms raised by passengers within the elevator car, that the car has jammed. Accordingly, a technician can be dispatched automatically by the remote monitoring centre to deal with the situation.

[0009] The invention also provides a detection device for detecting whether an elevator car has become jammed along its travel path, the detection device having an input connectable to a load measurement sensor mounted on an elevator car, a processing unit to analyse signals from the load measurement sensor and an output connectable to an elevator controller. The processing unit outputs a first signal when the load measurement sensor signal deviates outside a predetermined range. Accordingly, the detection device can be installed as an upgrade to existing installations quickly, easily and with minimum interruption.

[0010] A method according to the invention for detecting whether an elevator car has become jammed along its downward travel path includes the steps of monitoring the load of the car as it moves downwards and indicating that the car has jammed if the monitored load of the car deviates outside a predetermined range. Preferably, an emergency stop is conducted upon indication that the car has jammed. Furthermore, a remote monitoring centre can be notified upon indication that the car has jammed.

[0011] The invention is herein described by way of specific examples with reference to the accompanying drawings of which:

FIG. 1 is a schematic of an elevator installation according to the present invention;
FIG. 2A is a velocity profile of the elevator car of FIG. 1 as it travels from an elevator landing to another landing further down the hoistway;
FIG. 2B is a profile of the load measurement signal as the car makes the journey illustrated in FIG. 2B;
FIG. 2C is a profile of the load measurement signal as the car of FIG. 3 follows the same downward velocity profile as illustrated in FIG. 2A; and
FIG. 3 is a schematic of an alternative elevator installation according to the present invention.

[0012] An elevator installation 1 according to the invention is shown in FIG. 1. The installation 1 is generally defined by a hoistway 2 bound by walls 4 within a building wherein a counterweight 6 and car 20 are movable in opposing directions along guide rails (not shown). Suitable traction means 8 supports and interconnects the counterweight 6 and the car 20. In the present example, the traction means 8 is fastened to the counterweight 6 at one end, passed over a deflecting pulley 10 positioned in the upper region of the hoistway 2, passed through a traction sheave 14 also located in the upper region of the hoistway, and fastened to the elevator car 20. Naturally, the skilled person will easily appreciate other roping arrangements are equally possible. The traction sheave 14 is driven by motor 16 which together from the drive unit 12 of the elevator. Motion of the drive unit 12 is controlled and regulated by command signals C from an elevator controller 18.

[0013] The car 20 comprises a frame consisting of an upper cross beam 24, two side struts 26 and a lower yoke 28 to which a passenger cabin 22 is mounted by means of resilient blocks 30. Guides (not shown) are mounted to opposing sides of the frame to ensure the smooth movement of the car 20 along its associated rails.

[0014] A load measurement sensor 32 located between the lower yoke 28 of the car frame and the passenger cabin 22 senses the extent of compression of the resilient blocks 30 by the cabin 22 and thereby the load of the cabin 22. The signal F from the load measurement sensor 32 is feed into an input 40 of a processing unit 34 which in the present embodiment is incorporated within the elevator control 18. The load measurement sensor 32 effectively provides an indication of the vertical position of the cabin 22 within the frame. Accordingly, the skilled person will readily appreciate that the sensor 32 can alternatively be located between the upper cross beam 24 of the frame and the cabin 22 to provide an indication of the vertical position of the cabin 22 within the frame and thereby the load of the cabin 22.

[0015] As mentioned previously, the signal F from the load measurement sensor 32 is conventionally used by the elevator controller 18 for numerous reasons which include identifying an overload condition when too many passengers have boarded the stationary cabin 22 at an elevator landing and pre-torquing the motor 16 before a trip so that every journey commences safely and smoothly.

[0016] The invention provides an additional purpose for the load measurement signal F which will be described with reference to FIGS. 2A and 2B. Consider the situation where a journey is requested from one landing of the installation to a lower destination landing. At the beginning of the journey, the controller 18 outputs a command signal C to the drive unit 12 instructing the drive unit 12 to accelerate the car 20 downward as shown in the first phase of the velocity profile of FIG. 2A. During the second phase, the car 20 travels downward with a constant, rated velocity. In the final phase of the journey, the command signal C instructs the drive unit 12 to decelerate the car 20 so as to arrive at the lower destination landing. The signal F from the load measurement sensor 32 for this journey is depicted by the solid line in FIG. 2B where the static load of the cabin 22 is represented by the term mg.

[0017] If the car 20 jams during the downward journey, which can happen particularly after modernization of an installation due to misalignment of the existing guide rails, the frame suddenly stops as depicted at times t1, t2 or t3 in FIGS. 2A and 2B. However, momentum associated with the resilient mounted cabin 22 will cause a sudden spike in signal F from the load measurement sensor 32 as depicted in hashed lines in FIG. 2B. In this situation, the processing unit 34 monitoring the output from the load measurement sensor 32 determines that the signal F has exceeded an upper threshold F1 and automatically transmits a first signal J via its output 42 to the controller 18 which in turn commands the drive unit 12 to perform an emergency stop.

[0018] Consider another situation, where the car frame moves smoothly along the guide rails during the downward journey but the cabin 22 is impeded by an obstruction in the shaft 2. In this case, the weight of the cabin 22 will be supported by the obstruction rather than resilient blocks 30 and lower yoke 28 and accordingly the signal F from the load measurement sensor 32 drops dramatically as illustrated by hashed lines in FIG. 2C. The processing unit 34 monitoring the output from the load measurement sensor 32 determines that the signal F has dropped below a lower threshold F2 and automatically directs the controller 18 to command the drive unit 12 to perform an emergency stop.

[0019] The processing unit 34 can also inform a remote monitoring centre, such as those conventionally used to respond to alarms raised within the elevator cabin 22, that the car 20 has jammed via a communications module

36 incorporated within the controller 18. Accordingly, a technician can be dispatched automatically by the remote monitoring centre to deal with the situation.

[0020] FIG. 3 illustrates a further embodiment of the present invention and is similar to that shown in FIG. 1 except the cabin 22 is mounted directly to the lower yoke 28 of the frame and the load measurement sensor 32 measures the strain in the upper cross beam 24. The load of the cabin 22 is effectively suspended from either end of the upper cross beam via the yoke 28 and side struts 26. Accordingly, the strain in the cross beam 24 is representative of the load of the cabin 22.

[0021] In this instance, if the car 20 jams during the downward journey shown in FIG. 2A, the frame suddenly stops as depicted at times t1, t2 or t3 in FIG. 2C. The strain in the upper cross beam 24 is suddenly relieved and accordingly the signal F from the load measurement sensor 32 drops dramatically as illustrated by hashed lines in FIG. 2C. The processing unit 34 monitoring the output from the load measurement sensor 32 determines that the signal F has dropped below a lower threshold F2 and automatically directs the controller 18 to command the drive unit 12 to perform an emergency stop. As in the previous embodiment, the processing unit 34 can also inform a remote monitoring centre that the car 20 has jammed via a communications module 36 incorporated within the controller 18.

[0022] Although the processing unit 34 of the previously described embodiments is incorporated within the elevator controller 18, it will be appreciated that the processing unit 34 can be provided as a separate self-containing detection device which can be newly installed during modernisation for example between an existing load measurement sensor 32 and an existing controller 42.

Claims

1. An elevator installation (1) having a car (20), a counterweight (6), traction means (8) interconnecting and supporting the car (20) and counterweight (6), a drive unit (12) to drive the traction means (8) and a controller (18) to control and regulate the movement of the drive unit (12) and thereby the movement of the car (20), the elevator installation (1) further comprising:

a load measurement sensor (32) mounted to the car (20) to output a signal (F) representative of the load of the elevator car (20);
a processing unit (34) having an input (42) to receive the load measurement sensor signal (F), the processing unit (34) transmitting a first signal (J) from an output (42) if the load measurement sensor signal (F) deviates outside a predetermined range (F1 - F2).

2. An elevator installation (1) according to claim 1, wherein the controller (18) is connected to the output (42) of the processing unit (34).

3. An elevator installation (1) according to claim 2, wherein the controller (18) instructs the drive unit (14) to commence an emergency stop on condition that the first signal (J) has been received from the processing unit (34) and the car (20) is moving downwards.

4. An elevator installation (1) according to any preceding claim, wherein the processing unit (34) is incorporated within the controller (18).

5. An elevator installation (1) according to any preceding claim further comprising a communications module (36) connected to the output (42) of the processing unit (34).

6. An elevator installation (1) according to claim 5, wherein the communications module (36) is incorporated within the controller (18).

7. A detection device for detecting whether an elevator car (20) has become jammed along its travel path, the detection device comprising:

an input (40) connectable to a load measurement sensor (32) mounted on an elevator car (20);
a processing unit (34) to analyse signals (F) from the load measurement sensor (32); and
an output (42) connectable to an elevator controller (18);
wherein the processing unit (34) outputs a first signal (J) when the load measurement sensor signal (F) deviates outside a predetermined range (F1 - F2).

8. A method for detecting whether an elevator car (20) has become jammed along its downward travel path, comprising the steps of:

monitoring the load of the car (20) as it moves downwards; and
indicating that the car (20) has jammed if the monitored load of the car (20) deviates outside a predetermined range (F1 - F2).

9. A method according to claim 8 further comprising the step of conducting an emergency stop upon indication that the car (20) has jammed.

10. A method according to any preceding claim further comprising the step of notifying a remote monitor centre upon indication that the car has jammed.

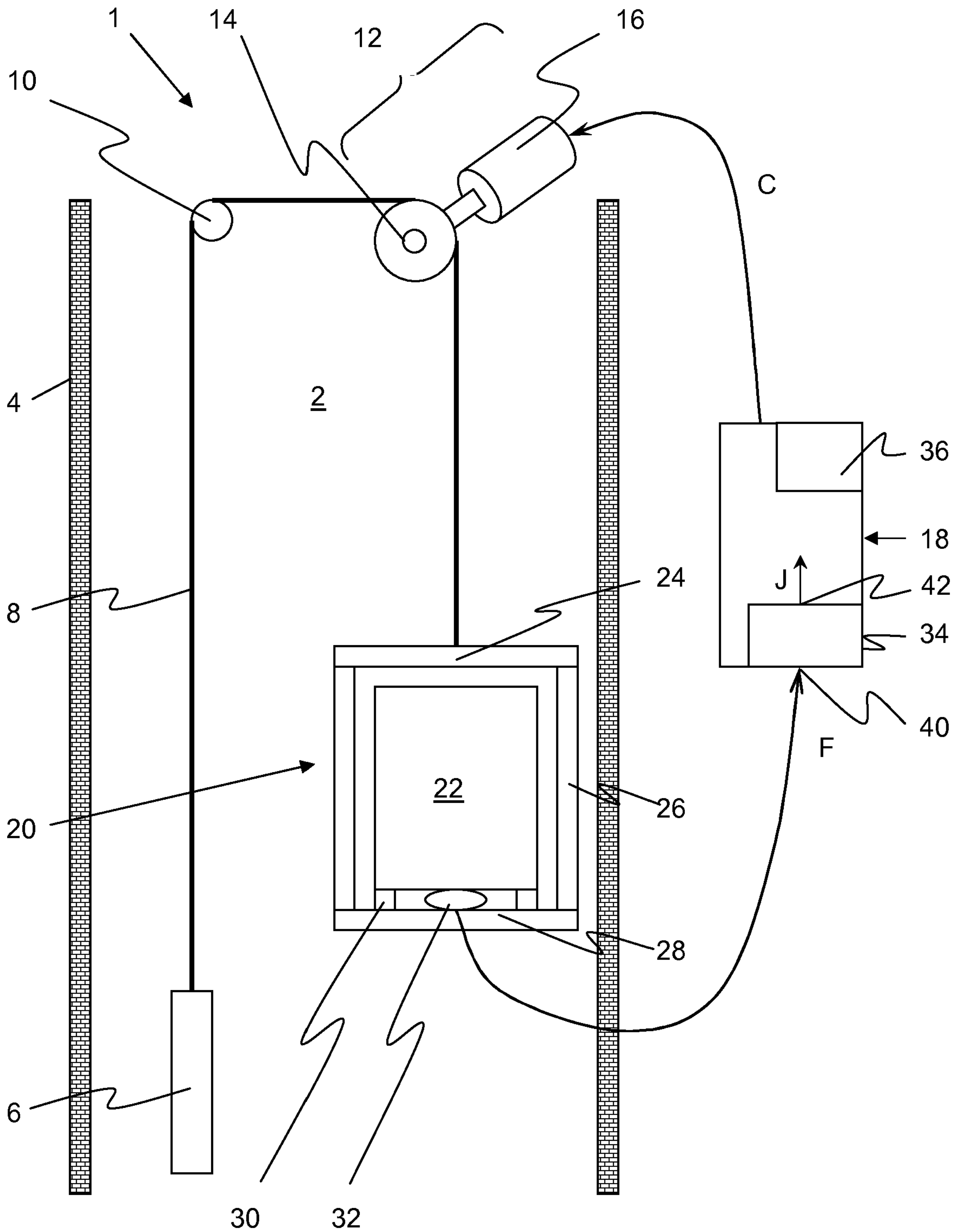

FIG. 1

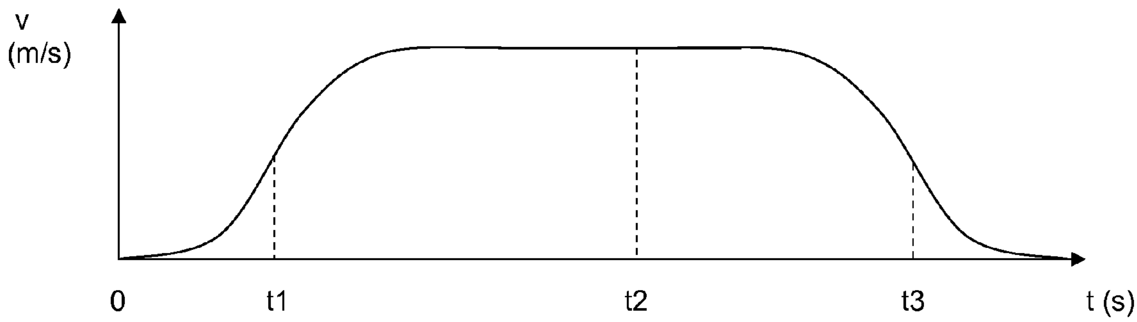

FIG. 2A

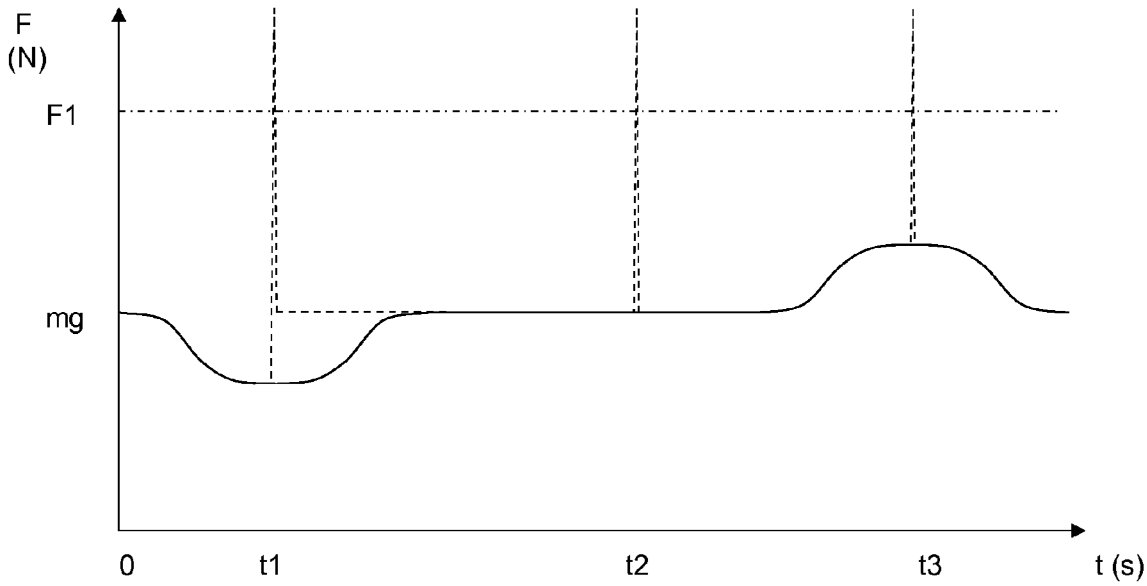

FIG. 2B

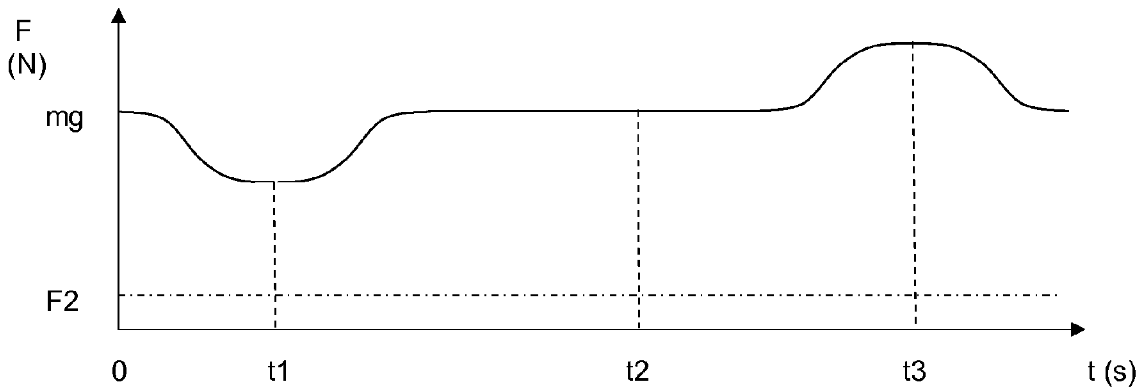

FIG. 2C

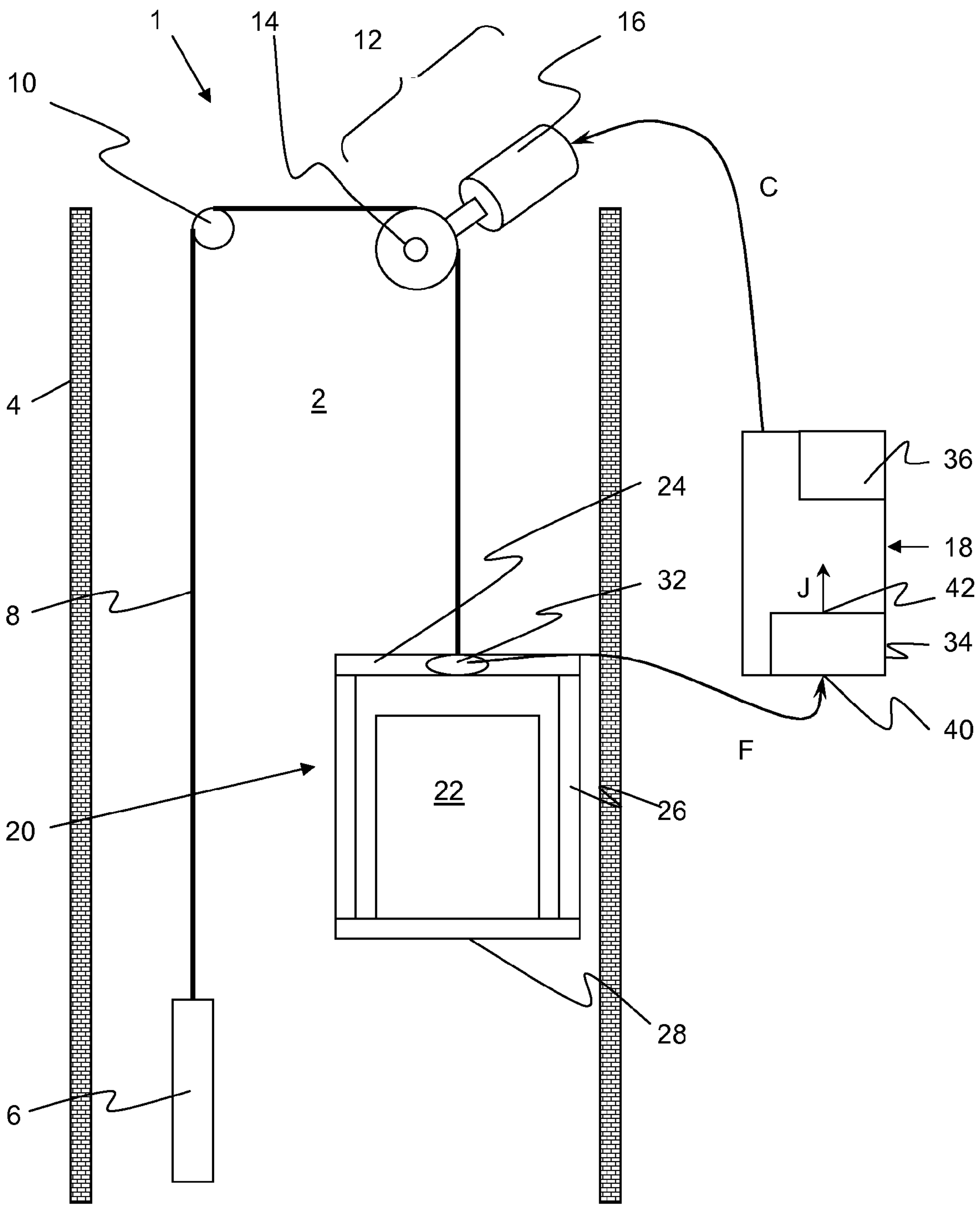

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 09 16 9536

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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	5 February 2010	Oosterom, Marcel

CATEGORY OF CITED DOCUMENTS

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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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