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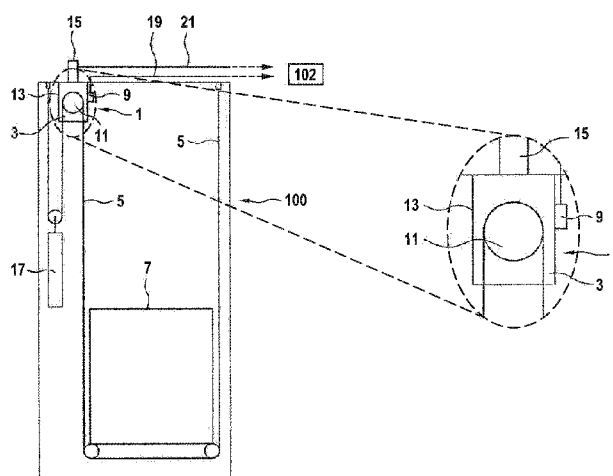
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(54) Title: SENSOR-MONITORED DRIVE ENGINE ARRANGEMENT FOR AN ELEVATOR SYSTEM

Fig. 1



(57) Abstract: A drive engine arrangement (1) for an elevator system (100) is proposed to comprise a drive engine (3) and a sensor (9). The drive engine (3) shall drive suspension traction means (5) for displacing an elevator car (7). The sensor (9) is mechanically coupled to the drive engine (3). Furthermore, the sensor (9) is adapted for determining a mechanical drive condition of the drive engine (3). For example, the sensor (9) may be an acceleration sensor. Alternatively, the sensor (9) may be a magnetic field sensor. Based on signals from the sensor (9), any mechanical malfunctioning of the drive engine (3) may be detected e.g. due to vibrations occurring at a housing (13) of the drive engine (3) or due to a change in orientation of the drive engine (3). Advantageously, the drive engine's (3) mechanical drive conditions may be monitored remotely and/or automatically.

Sensor-monitored drive engine arrangement for an elevator system

The present invention relates to a drive engine arrangement for an elevator system and to an elevator system comprising such drive engine arrangement.

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Elevators are generally applied for transporting persons or items within a building, typically in a vertical direction. Generally, an elevator system comprises an elevator car in which the persons or items may be transported and which may be displaced within the building for example along an elevator hoistway. The elevator car is suspended and
10 displaced using suspension traction means (STM – sometimes also referred to as suspension traction media). Such suspension traction means may comprise one or more ropes or belts. On the one hand, such suspension traction means may hold the elevator car against the force of gravity, on the other hand, the elevator car may be displaced by driving the suspension traction means using a drive engine. Therein, the drive engine
15 typically drives a traction sheave and the rotating traction sheave then drives the suspension traction means and thereby indirectly displaces the elevator car being suspended for example at one end of the suspension traction means. Typically, an opposite end of the suspension traction means is fixed to a counterweight which is then displaced within the elevator hoistway together with the elevator car but in an opposite
20 direction. This defines a conventional 1:1 roping arrangement but it will be appreciated that other roping arrangements are also feasible.

The drive engine typically comprises an electric motor which directly or indirectly via a gear drives the traction sheave. During operating the elevator system, the drive engine, on
25 the one hand, has to withstand significant forces due to the elevator car and, optionally, the counterweight being suspended by the suspension traction means and, on the other hand, has to generate significant forces or torques in order to be able to displace the car and, optionally, the counterweight. Furthermore, during operation, the suspension traction means has to be held, guided and driven by the traction sheave, this traction sheave itself
30 being mechanically coupled and driven by the motor of the drive engine.

Given the essential nature of the drive engine in ensuring performance and availability of the elevator, correct operation of the drive engine of the elevator system should be monitored at all points in time during a lifetime of the elevator system.

Conventionally, in order to guarantee correct operation of the drive engine, maintenance personnel have to periodically check all components of the drive engine arrangement in order to be able to identify any defects and/or any signs of wear at an earliest possible stage.

However, such periodic maintenance requires significant efforts. For example, significant expenditure of human labour has to be provided by maintenance personnel as, typically, a person has to enter the elevator hoistway or any separate machine room in order to inspect and check the drive engine and all its components locally. Of course, such efforts result in significant costs. Furthermore, as there is typically a specific time interval between such periodic maintenance procedures, there is a remaining risk that defects or deteriorations developing at the drive engine in the interim period would not be detected promptly.

Accordingly, there may be a need for a drive engine arrangement and for an elevator system comprising such drive engine arrangement which enable a cost-effective and/or reliable way of monitoring a mechanical drive condition of a drive engine.

Such need may be met by the subject-matter of the independent claims. Advantageous embodiments are described in the dependent claims and in the specification.

According to a first aspect of the invention, a drive engine arrangement for an elevator system is proposed, the drive engine arrangement comprising a drive engine and a sensor. The drive engine is adapted for displacing an elevator car for example within a hoistway. The sensor is mechanically coupled to a non-rotating component of the drive engine and is adapted for determining a mechanical drive condition of the drive engine.

The engine may be arrangement for driving suspension traction means (STM) by means of a traction sheave. Alternatively, the drive engine could be in the form of a linear actuator either driving the suspension traction means or mounted directly to the elevator car to propel the car through the hoistway.

Ideas underlying embodiments of the present invention may be interpreted as being based, inter alia, on the following observations and recognitions.

As described in the introductory portion above, an elevator system typically comprises a drive engine including an electric motor wherein an operation of the drive engine is generally controlled by an elevator control. Therein, the elevator control generally controls an energy supply to the drive engine such that the drive engine correctly drives the suspension traction means in order to thereby displace the elevator car in a required manner.

However, in such conventional elevator system, no technical provisions are made in order to monitor a condition or status of the drive engine. In order to check such condition or status, a maintenance person typically has to access the elevator system and personally check correct operation of its drive engine for example by visual and/or manual inspection.

In order to avoid efforts required for such manual and local inspection, it is proposed herein to provide a specific sensor for the drive engine, such sensor being mechanically coupled to a non-rotating component of the drive engine and being adapted for determining the drive engine's mechanical drive condition. Accordingly, such sensor may provide signals, preferably electric signals, which may be transmitted for example to a controller being provided at a remote location such that the drive engine may be monitored from such remote location. Thus, using the sensor at the drive engine and evaluating its signals, a requirement for periodical manual inspection directly at the location of the drive engine may be avoided and, instead, the drive engine may be manually or automatically monitored remotely.

For example, maintenance personnel may retrieve the signals of the drive engine's sensor and, by analyzing and evaluating such signals, may determine a current mechanical drive condition of the drive engine without having to directly access the drive engine's location. Instead, the sensor's signals may be analysed and evaluated remotely.

Alternatively, signals of the sensor may be permanently or periodically transmitted to a controller, such controller being for example part of an elevator control or of a separate

device. The controller may permanently monitor the drive engine's condition or status based on such signals and, if necessary, may initiate suitable steps for example in case any abnormal condition of the drive engine is determined. Particularly, the drive engine's mechanical drive condition may be monitored automatically and/or remotely.

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It may be noted that the formulation "the sensor is mechanically coupled to the drive engine" may be interpreted in that the sensor is physically connected to the drive engine in such way that any motion or at least specific motions of the drive engine are mechanically transmitted to the sensor such that such drive engine's motion may be sensed and/or measured by the sensor.

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Furthermore, the formulation "mechanical drive condition of the drive engine" may be interpreted as relating to a condition or status of the drive engine resulting from mechanical properties of the drive engine occurring during driving the suspension traction means. For example, such mechanical drive condition may relate to any positioning or orientation of the drive engine, particularly to temporary changes of such positioning and/or orientation such as for example motions of the drive engine and/or vibrations of the drive engine. Particularly, the "mechanical drive condition" shall relate to current properties or characteristics of the drive engine which result from the drive engine's mechanical properties and/or characteristics, i.e. from a way how the drive engine behaves mechanically. Thus, the "mechanical drive condition" may distinguish from any other physical drive condition such as for example a temperature, electrical characteristics or any other non-mechanical characteristics of the drive engine.

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According to an embodiment, the sensor is an acceleration sensor. Such acceleration sensor may be adapted to sense and/or measure accelerations in one or plural directions. As the acceleration sensor is mechanically coupled to the drive engine, it may measure accelerations acting onto the drive engine. For example, the acceleration sensor may be implemented with a small semiconductor device, also referred to microelectronic device. Such acceleration sensors may be provided at low costs and with high reliability and sensitivity.

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According to an embodiment, the sensor is adapted to provide a 3D acceleration signal representing accelerations of the drive engine in all spatial directions. In other words, the

sensor is an acceleration sensor being adapted for sensing accelerations not only in one direction but in at least three directions, these three directions being transverse, preferably orthogonal, to each other. For example, such sensor may comprise three or more separate sensor components, such as e.g. small semiconductor devices, which are arranged at different orientations with respect to each other in order to sense accelerations in different directions. Accordingly, from a 3D acceleration signal provided by such sensor, accelerations acting onto the drive engine in various spatial directions may be sensed and/or measured.

Specifically, according to an embodiment, the sensor is adapted and arranged for measuring an acceleration of the drive engine, an orientation of the drive engine and/or a vibration of the drive engine.

In other words, due to its own physical characteristics and due to the manner how and where it is mechanically coupled to the drive engine, the sensor is specifically adapted and arranged such that at least one of various mechanical drive conditions of the drive engine may be measured using the sensor, such mechanical drive conditions comprising one or more accelerations acting onto the drive engine, a current orientation of the drive engine and/or current vibrations occurring at the drive engine.

Specifically, the sensor may be adapted and arranged such that accelerations of the drive engine may be detected. Such accelerations may occur during operation of the drive engine for example due the fact that a motor of the drive engine rotates and generates motions of the drive engine. Accordingly, based on measured accelerations of the drive engine, it may be determined whether the drive engine is active, i.e. is currently operated, or whether it is passive, i.e. is not currently operated and, thus, is not rotating. Accordingly, in such embodiment, the determined mechanical drive condition of the drive engine is its activity status. Such activity status may be determined for example based on calculating a standard deviation (STD) of signals provided by the sensor.

Alternatively or additionally, the sensor may be adapted and arranged for measuring an orientation of the drive engine such as for example a drive tilt angle (2D). Generally, the orientation of the drive engine should be stable and, in an ideal case, should not change during the lifetime of the elevator system. However, the drive engine is typically coupled

to static structures of the building via damping buffers in order to avoid for example transmissions of vibrations from the drive engine to the building structures. Over time, such damping buffers may deform. Such deformation may result in changes of the orientation of the drive engine. Already small changes in such orientation may negatively
5 affect the drive engine's characteristics as for example a traction sheave fixedly connected to the drive engine is slightly tilted together with the drive engine and may therefore not correctly guide any suspension traction means driven by such traction sheave. Increased wear of components of the elevator system such as the traction sheave and/or the suspension traction means may occur. Accordingly, it may help to permanently
10 or frequently monitor the orientation of the drive engine based on signals from a sensor mechanically coupled to the drive engine and being able to detect the drive engine's orientation in order to thereby avoid such negative effects.

Furthermore, alternatively or additionally, the sensor may be adapted for measuring
15 vibrations of the drive engine. Such vibrations may occur for example due to any imbalances for example in the drive engine's bearings or other components, such imbalances resulting in low-frequency or high-frequency vibrations of the drive engine upon its rotating motion. While, upon operation, minor vibrations always occur at the drive engine, a significant increase in such vibrations may indicate for example extensive
20 wear or even defects at the drive engine. Accordingly, monitoring vibrations of the drive engine may help avoiding critical situations in which the drive engine does not function correctly for example due to wear or defects. For example, any malfunction of the drive engine may be detected by analyzing signals from an acceleration sensor coupled to the drive engine and determining whether a vibration energy in the drive engine increases
25 over time. Such increase may be detected for example by applying a Fast Fourier Transformation (FFT) to the sensor signals or by evaluating time-domain features like the standard deviation (STD).

In an alternative embodiment, the sensor is a magnetic field sensor. Such magnetic field
30 sensor is generally adapted for sensing and/or measuring a magnetic field occurring at the location of the sensor. For example, the magnetic field sensor may be a Hall sensor.

Specifically, according to an embodiment, the sensor is adapted and arranged for measuring a magnetic field generated by an electric motor of the drive engine. Generally,

such electric motor comprises magnets in order to generate a torque resulting in a rotation of a rotor of the motor. Using a magnetic field sensor, it may thus be determined whether the drive engine is currently active or passive by measuring the magnetic field generated by the engine's electric motor. Therein, a measured magnetic field varying over time may
5 indicate an active drive engine whereas a measured magnetic field being static may indicate that the drive engine is currently passive, i.e. its electric motor is not rotating. Preferably, the magnetic sensor is adapted to provide a 3D acceleration signal representing accelerations of the drive engine in all spatial directions.

10 According to an embodiment, the drive engine comprises a housing and the sensor is attached to the housing. In other words, components of the drive engine such as its electric motor are provided at or within the housing. Preferably, all components of the drive engine are comprised within the housing such that the housing encloses all these components thereby forming one single unit. In such implementation, motions of
15 components of the drive engine are generally at least partly transferred to the housing. Accordingly, by attaching a sensor to the housing, motions of the housing may be sensed and information about mechanical drive conditions of the drive engine, particularly of conditions of components within the housing, may be derived from the sensor signals.

20 Preferably, according to an embodiment, the sensor is attached to an outside surface of the housing. In other words, the sensor may be provided externally to the drive engine's housing and in mechanical contact with its outside surface. Such arranging of the sensor externally to the drive engine's housing may be beneficial in that the sensor may be accessed from outside the drive engine. Accordingly, the sensor may be installed,
25 repaired and/or replaced for example without having to open the drive engine's housing. Thus, there is no risk of for example damaging any components of the drive engine within its housing and/or harming any maintenance personnel for example by an electric shock or by mechanical contact with rotating parts of the drive engine.

30 Particularly, the sensor may be retrofitted at an existing drive engine without necessarily precisely knowing any technical details of the drive engine. Thus, by coupling a specific sensor to the drive engine, even drive engines of elevator systems of another manufacturer may be monitored in order to detect any abnormal mechanical drive conditions.

Specifically, according to an embodiment, a circuitry of the sensor is separated from a circuitry of the drive engine. In other words, any electric connections to the sensor may be separate from electric connections to the drive engine. Accordingly, while the sensor and the drive engine are coupled mechanically after the sensor is mounted to the drive engine, the sensor and the drive engine are originally two separate units, each having its own electric circuitry and being electrically independent of the other unit. Accordingly, the sensor may be mounted, repaired, replaced and/or retrofitted to the drive engine independent of the drive engine's operation. Particularly, the drive engine's operation does not necessarily have to be interrupted during a repairing, replacing or retrofitting action.

According to a second aspect of the present invention, an elevator system is proposed to comprise a drive engine arrangement according to an embodiment of the above described first aspect of the invention. Furthermore, the elevator system comprises a controller. This controller is adapted for determining a mechanical drive condition of the drive engine based on signals from the sensor of the drive engine arrangement.

In other words, by providing the above described drive engine arrangement together with a specific controller to an elevator system, a mechanical drive condition of the drive engine may be permanently or periodically and preferably automatically determined by the controller based on signals from the sensor comprised in the drive engine arrangement. Accordingly, in case the controller determines any critical mechanical drive condition indicating for example excessive wear or even defects of the drive engine, suitable countermeasures may be initiated. Such countermeasures could be for example sending an information or a request to maintenance personnel, outputting an alarm or even setting the elevator system into an idle mode.

According to an embodiment, the controller is arranged at or accessible from a remote position with respect to the drive engine. In other words, while the sensor is directly mechanically coupled to the drive engine, the controller may be provided at a different position for example remote to the location of the drive engine or may at least be accessed from such remote position. The remote position may be e.g. portion of the building which is separate from the hoistway and/or machine room of the elevator

system. For example, the remote position may be in a control room. Alternatively, the remote position may be located at a place external to the building comprising the elevator system. Accordingly, signals from the sensor may be analyzed by the controller and may be provided to such remote position. Thereby, remote monitoring of the drive engine arrangement may be enabled. Accordingly, no direct access of for example maintenance personnel to the drive engine may be necessary in order to monitor the drive engine's mechanical drive condition.

According to an embodiment, the controller is adapted for determining the mechanical drive condition of the drive engine based on a comparison of current signals from the sensor with a reference signal value, multiple reference signal values and/or a reference signal range. In other words, the controller may derive information about the mechanical drive condition of the drive engine by comparing current signals from the sensor with one or more reference signal values or with a reference signal range. Therein, it may be for example determined whether the current signals exceed any predetermined reference signal value, such exceeding indicating for example that monitored mechanical drive conditions have changed over time to such a degree such that suitable measures should be initiated. Alternatively, it may be checked whether current signals of the sensors are still within an acceptable reference signal range representing a normal operation of the drive engine or whether such current signals lie outside of such acceptable range such that countermeasures should be initiated.

Preferably, according to an embodiment, the controller is adapted for determining the reference signal value, the multiple reference signal values and/or the reference signal range during a learning procedure by operating the drive engine in a predetermined operation state and acquiring signals from the sensor during such operation.

In other words, a learning procedure may be performed in a predetermined operation state of the drive engine in which for example the drive engine's mechanical drive conditions are known. For example, the learning procedure may be performed directly after installing the elevator system and precisely checking its correct function. In such initial operating state, the mechanical drive conditions of the drive engine are assumed to be in an acceptable range. In such predetermined operation state, the learning procedure may be performed by acquiring signals from the sensor, such signals indicating for example

the current orientation of the drive engine, current vibrations of the drive engine and/or accelerations currently acting onto the drive engine. From such acquired sensor signals, one or more reference signal values and/or the reference signal range may be derived and stored for comparison purposes during later operation of the elevator system.

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During such later operation, the controller may then compare current signals from the sensor with the initially acquired reference signal values or ranges and may for example determine whether the drive engine still operates within acceptable mechanical drive conditions. Specifically, the controller may for example determine whether an orientation
10 of the drive engine is still within acceptable limits or has excessively changed for example due to any deformations of damping buffers supporting the drive engine. Alternatively, by comparing with initially acquired reference signal values or a reference signal range, it may be determined whether vibrations of the drive engine are still within acceptable limits or whether they exceed such limits due to for example wear or defects at
15 bearings of the engine's motor or other components.

According to a third aspect of the present invention, a method of operating an elevator system according to an embodiment of the above-mentioned second aspect is provided, the method comprising the step of determining a mechanical drive condition of the drive
20 engine of the elevator system based on signals received from the sensor of the drive engine arrangement.

Preferably, such method may be performed automatically, i.e. without any necessary interaction with human maintenance personnel. Furthermore, preferably, such method
25 may enable remotely controlling the mechanical drive conditions of the drive engine.

Optionally, the method may be implemented in software, i.e. with a computer program product including computer-readable instructions which, when performed by a programmable machine such as a processor of a programmable elevator controller,
30 instruct or control performing the above defined method. Such software may be stored on a computer-readable medium such as a CD, a DVD, flash memory, etc. such that the software may be uploaded into a programmable machine in order to thereby enable the machine for performing or controlling the above-mentioned method.

It shall be noted that possible features and advantages of embodiments of the invention are described herein partly with respect to a drive engine arrangement, partly with respect to an elevator system comprising such drive engine arrangement and partly with respect to a method for operating such elevator system. One skilled in the art will recognize that the features may be suitably transferred from one embodiment to another and features may be modified, adapted, combined and/or replaced, etc. in order to come to further embodiments of the invention.

In the following, advantageous embodiments of the invention will be described with reference to the enclosed drawing. However, neither the drawing nor the description shall be interpreted as limiting the invention.

Fig. 1 shows an elevator system comprising a drive engine arrangement according to an embodiment of the present invention.

The figure is only schematic and not to scale.

Fig. 1 shows an elevator system 100 comprising a drive engine arrangement 1 according to an embodiment of the present invention. The drive engine arrangement 1 comprises a drive engine 3 in which an electric motor (not explicitly shown) drives a traction sheave 11 into rotating motion. The traction sheave 11 drives a suspension traction means 5 such as one or more belts or ropes. The suspension traction means 5 suspends an elevator car 7 as well as a counterweight 17. An operation of the drive engine 3 is controlled by an elevator control 15.

The drive engine arrangement 1 furthermore comprises a sensor 9. The sensor 9 is directly and mechanically coupled to the drive engine 3. Preferably, the sensor 9 is attached to an outside surface of a housing 13 enclosing the drive engine's 3 components such as its electric motor. Accordingly, the sensor 9 is mechanically coupled to the drive engine's 3 components via the housing 13 such that motions of such drive engine's components are transferred to the sensor 9.

Preferably, the sensor 9 is an acceleration sensor. Such acceleration sensor may sense accelerations of the drive engine 3 or, more specifically, of the housing 13 comprising the

drive engine's 3 components, in various spatial directions, preferably in all spatial directions. Thereby, the sensor 9 may sense or measure accelerations of the drive engine 3, an orientation of the drive engine 3 and/or vibrations of the drive engine 3.

5 For example, any change in orientation of the drive engine 3 may be determined with high precision of for example less than a few degrees as such change in orientation of the drive engine 3 results in a change of accelerations which act onto the sensor 9 for example due to gravity.

10 Alternatively or additionally, for example vibrations of the housing 13 may be determined using the sensor 9 thereby obtaining a precise indication about mechanical drive conditions of the drive engine 3 such as for example about any wear or defects of the electric motor of the drive engine 3 or its bearings.

15 According to an alternative, the sensor 9 may be a magnetic field sensor. Using such magnetic field sensor, magnetic fields or, more specifically, changes in a magnetic field may be sensed or measured thereby obtaining a precise indication about a current operating status of the drive engine's 3 electric motor.

20 The sensor 9 may be provided as a separate device to the drive engine 3. Particularly, an electric circuitry of the sensor 9 may be separate and electrically isolated from a circuitry of the drive engine 3 and/or of its elevator control 15.

For example, the sensor 9 may provide its signals via a transmission line 19 towards a
25 controller 102 provided at a remote position. Optionally, the elevator control 15 may transmit signals indicating for example its operation mode via a separate transmission line 21. Alternatively, the signals of the sensor 9 and/or of the elevator control 15 may be transmitted in a wireless manner to the remote controller 102.

30 In the controller 102, one or more reference signal values and/or a reference signal range may be stored. The reference signal value(s) or range may be determined during a preceding learning procedure in which signals from the sensor 9 are acquired during the drive engine 3 being in a predetermined operation state. For example, such learning

procedure may be performed directly after installing and checking the elevator system 100.

5 Then, during subsequent normal operation of the elevator system 100, the controller 102 may permanently, or in adequate time intervals, monitor the mechanical drive condition of the drive engine 3 for example by comparing current signals from the sensor 9 with the reference signal value(s) or range.

10 Based on such comparison, it may for example be remotely determined whether the drive engine 3 is currently active or not active, e.g. by calculating a standard deviation. Alternatively, a tilt angle of the drive engine 3 may be monitored. Further alternatively, any malfunction of the drive engine 3 may be detected for example by determining an increase in vibration energy based on for example a Fast Fourier Transformation or time-domain features like the standard deviation.

15 In contrast to conventional elevator systems in which no drive-engine-born measurement instrument was provided, the elevator system 100 with the drive engine arrangement 1 proposed herein enables, inter alia, a fine-tuning of a drive installation via sensor measurements. Furthermore, monitoring of the drive engine during operation may be
20 enabled without any human observer being necessary. The elevator system 100 proposed herein is ready for remote monitoring. Furthermore, the elevator system 100 and its drive engine arrangement 1 may be configurable in that feature computation from acceleration signals may be changed “on-the-fly”, i.e. via software. As proposed herein, also existing elevator installations or third party drive engines may be monitored by attaching a sensor
25 to the drive engine.

Finally, it should be noted that terms such as “comprising” do not exclude other elements or steps and terms such as “a” or “an” do not exclude a plurality. Also elements described in association with different embodiments may be combined. It should also be
30 noted that reference signs in the claims should not be construed as limiting the scope of the claims.

List of reference signs

	1	drive engine arrangement
5	3	drive engine
	5	suspension traction means
	7	elevator car
	9	sensor
	11	traction sheave
10	13	housing
	15	elevator control
	17	counterweight
	19	transmission line
	21	transmission line
15	100	elevator system
	102	controller

Claims:

1. Drive engine arrangement (1) for an elevator system (100), comprising:
a drive engine (3) for displacing an elevator car (7);
5 a sensor (9);
wherein the sensor (9) is mechanically coupled to a non-rotating component of the drive engine (3); and
wherein the sensor (9) is adapted for determining a mechanical drive condition of the drive engine (3).
10
2. Drive engine arrangement of claim 1, wherein the sensor (9) is an acceleration sensor.
3. Drive engine arrangement of claim 2, wherein the sensor (9) is adapted to
15 provide a 3D acceleration signal representing accelerations of the drive engine (3) in all spatial directions.
4. Drive engine arrangement of one of claims 2 and 3, wherein the sensor (9) is adapted and arranged for measuring at least one of an acceleration of the drive engine (3),
20 an orientation of the drive engine (3) and a vibration of the drive engine (3).
5. Drive engine arrangement of claim 1, wherein the sensor (9) is a magnetic field sensor.
- 25 6. Drive engine arrangement of claim 5, wherein the sensor (9) is adapted and arranged for measuring a magnetic field generated by an electric motor of the drive engine (3).
7. Drive engine arrangement of one of the preceding claims, wherein the drive
30 engine (3) comprises a housing (13) and wherein the sensor (9) is attached to the housing (13).

8. Drive engine arrangement of claim 7, wherein the sensor (9) is attached to an outside surface of the housing (13).

5 9. Drive engine arrangement of one of the preceding claims, wherein a circuitry of the sensor (9) is separated from a circuitry of the drive engine (3).

10. Elevator system (100) comprising:
a drive engine arrangement (1) according to one of claims 1 to 9;
a controller (102);
10 wherein the controller (102) is adapted for determining a mechanical drive condition of the drive engine (3) based on signals received from the sensor (9) of the drive engine arrangement (1).

11. Elevator system of claim 10, wherein the controller (102) is one of arranged at
15 remote position with respect to the drive engine (3) and accessible from a remote position with respect to the drive engine (3).

12. Elevator system of one of claim 10 and 11, wherein the controller (102) is
adapted for determining the mechanical drive condition of the drive engine (3) based on a
20 comparison of current signals from the sensor (9) with at least one of a reference signal value, multiple reference signal values and a reference signal range.

13. Elevator system of one of claims 10 to 12, wherein the controller (102) is
adapted for determining at least one of the reference signal value, the multiple reference
25 signal values and the reference signal range during a learning procedure by operating the drive engine (3) in a predetermined operation state and acquiring signals from the sensor (9) during such operation.

14. Method of operating an elevator system (100) according to one of claims 10 to
30 13, the method comprising:
determining a mechanical drive condition of the drive engine (3) based on signals received from the sensor (9) of the drive engine arrangement (1).

15. Method of operating an elevator system (100) according to claim 14, further comprising the step of retrofitting the sensor (9) to an existing drive engine arrangement (1).

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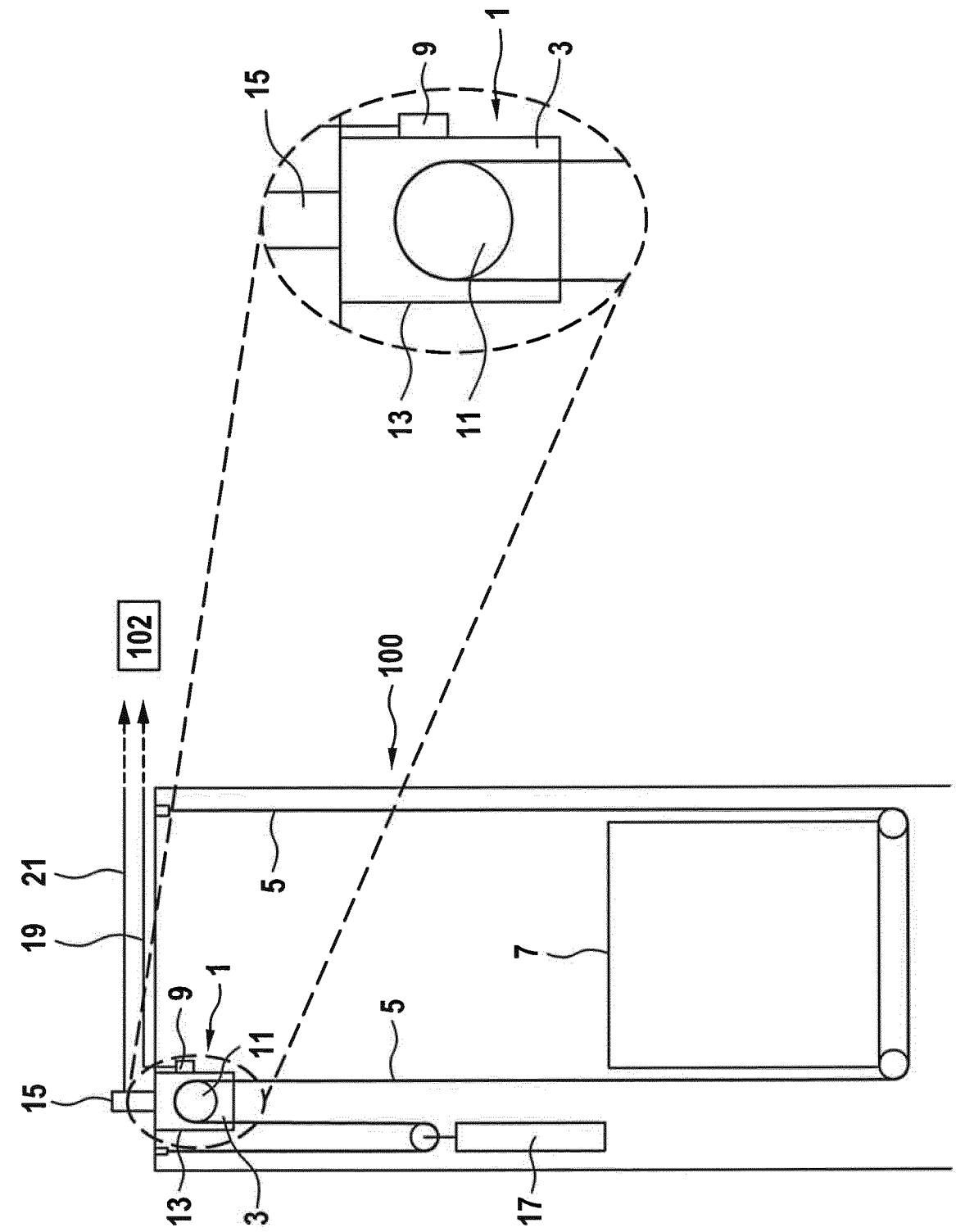


Fig. 1

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/075796

A. CLASSIFICATION OF SUBJECT MATTER
INV. B66B5/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B66B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	JP 2005 247468 A (MITSUBISHI ELECTRIC CORP) 15 September 2005 (2005-09-15) abstract figures 1-5 -----	1-4,7-15 5,6
X A	WO 2012/074508 A1 (OTIS ELEVATOR CO [US]; BLANC ARTHUR [US]; BLASKO VLADIMIR [US]) 7 June 2012 (2012-06-07) abstract paragraphs [0004], [0010] - [0017] figures 1, 2 -----	1-4,7-15 5,6
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Information on patent family members

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