

(19)



(11)

EP 3 886 128 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:

24.01.2024 Bulletin 2024/04

(51) International Patent Classification (IPC):

H01H 1/00 ^(2006.01) **H01H 11/00** ^(2006.01)
H01H 71/04 ^(2006.01)

(21) Application number: **20165095.9**

(52) Cooperative Patent Classification (CPC):

H01H 1/0015; H01H 11/0062; H01H 2071/044;
H01H 2300/052

(22) Date of filing: **24.03.2020**

(54) **ELECTRICAL SWITCHING DEVICE**

ELEKTRISCHE SCHALTVORRICHTUNG

DISPOSITIF INTERRUPTEUR ÉLECTRIQUE

(84) Designated Contracting States:

**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

(74) Representative: **Maiwald GmbH**

**Elisenhof
Elisenstraße 3
80335 München (DE)**

(43) Date of publication of application:

29.09.2021 Bulletin 2021/39

(56) References cited:

**EP-A1- 2 244 094 EP-A1- 2 405 454
EP-A1- 3 361 491 WO-A1-2018/224155
US-A1- 2019 018 065**

(73) Proprietor: **ABB Schweiz AG**

5400 Baden (CH)

(72) Inventor: **MÜLLER, Peter O.**

69221 Dossenheim (DE)

EP 3 886 128 B1

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

[0001] The present invention relates to a device for switching electrical currents and/or voltages, typically for power switching, such as a relay or a circuit breaker.

[0002] These devices typically comprise a stationary member, a mobile member that is displaceable between a closed position in which a contact pad of the mobile member is in electrically conductive contact with the stationary member, and an open position in which there is no electrically conductive contact, and an actuator for displacing the mobile member. When in such a device the mobile member is moved into or out of the closed position while a voltage is applied to the mobile and stationary members, an arc may form when the distance between the members is small enough but not zero, deteriorating the quality of the contacting surfaces of the mobile and stationary members. This may cause the surfaces to adhere to each other. Initially, weak adhesion may merely delay the switching operation, but if finally adhesion becomes too strong for the actuator to overcome, switching is prevented. Similarly, mechanical wear of the mobile member and its bearings may first merely delay the switching operation and finally prevent it altogether. Mechanical breakage might even cause the switching movement to become faster than normal, if the inertia of moving components is reduced.

[0003] EP 2 290 666 A1 discloses a switching device in which an end position switch or a light barrier is used for controlling whether an end position is properly reached. If it isn't reached, the device is defective and must be replaced, but the defect cannot be predicted before it actually occurs.

[0004] WO 2018/108833 A1 discloses an electrical switching device in which life expectancy of a switching device is predicted based on its chattering behaviour, derived from current flowing through a Reed contact or through the solenoid driving the switching movement. This is a rather indirect way of judging life expectancy, since arc formation is not necessarily accompanied by chattering, but if arcs are formed, chattering will accelerate wear of contact surfaces. Therefore, if it is attempted to minimize downtime of a system by replacing switching devices thereof when these show suspicious chattering, there is a considerable probability that a switching device is replaced prematurely. Although such a replacement can be planned, and downtime for replacement can be kept short, it still causes an interruption of operation of the system in which the switching device is used, and potentially unnecessary cost.

[0005] US 2019/0018065 A1 discloses a switching device in which an acceleration sensor is provided on a mobile member of the acceleration device for measuring acceleration thereof when the mobile member is being switched between closed and open positions, and wear of the switching device is detected based on output of the acceleration sensor.

[0006] The object of the present invention is to improve

sensitivity of the acceleration sensor.

[0007] The object is achieved by an electrical switching device as defined in claim 1. The acceleration sensor is capable of detecting any irregularity of movement of the displaceable member, regardless of its cause. By making the distance between a first position of the sensor associated to the open position and a second position of the sensor associated to the closed position longer than the path of the contact pad between the open and close positions, the acceleration detected by the acceleration sensor is amplified. Specifically, the sensor and the contact pad can be rotatable by a same axis, the radius of the acceleration sensor being longer than that of the contact pad.

[0008] The actuator can be of any type, but typically comprises a solenoid adapted to interact magnetically with the mobile member. In an automatic fuse, most of the energy driving a displacement of the mobile member may be provided by a spring, the magnetic interaction of the solenoid merely serving to unlock the mobile member so as to enable its displacement by the spring.

[0009] The acceleration sensor can be a micromechanical sensor. Such sensors are rugged and suitable for use in any orientation relative to the gravity vector. They are in widespread use e.g. for controlling airbags in motor vehicles and are therefore available at low cost.

[0010] The acceleration sensor can be fixedly integrated into the mobile member, in order to follow its displacement as closely as possible.

[0011] Alternatively, the acceleration sensor might be resiliently coupled to the mobile member. This can be useful in particular if the duration of the displacement of the displaceable member is known and constant; in that case the resonance period of the sensor mount can be tuned to the duration of the displacement so that any variation of that duration has a noticeable effect on the vibration of the sensor caused by the displacement.

[0012] The bandwidth of the acceleration sensor should be high enough to obtain at least one acceleration measurement, i.e. higher than the inverse of the duration of a displacement of the mobile member between the open and closed positions. Preferably, it should be high enough to allow taking a plurality of acceleration measurements in the course of a displacement of the mobile member.

[0013] The switching device may be associated to a processing unit which is adapted, e.g. programmed, to derive a judgment on the integrity of the switching device from current acceleration data obtained in relation to a current displacement of the mobile member between the first and second positions driven by the actuator.

[0014] The switching device and the processing unit can be associated in the form of an assembly for joint installation.

[0015] Alternatively, the processing unit can be remote from the switching device, communicating with the acceleration sensor via a digital network such as a LAN or the Internet.

[0016] The processing unit can be adapted to derive the judgment on the integrity of the switching device from a comparison of said current acceleration data with standard acceleration data.

[0017] Such standard acceleration data can be predetermined data, which may be provided by the manufacturer, for a specific type of switching device.

[0018] Preferably, the processing unit is adapted to derive the standard acceleration data (or to update earlier standard data such as those provided by the manufacturer as mentioned above) based on acceleration data obtained in relation to earlier displacements of said mobile member. In that way, not only individual characteristics of the switching device that is being monitored can be taken into account, but also the influence of the orientation in which it is installed, in particular an influence of gravity on the displacement of the mobile member.

[0019] The current acceleration data that are provided by the acceleration sensor in relation to a current switching movement should cover a time interval before and after an instant in which the mobile member reaches the second position. As is easily understood, data obtained before that instant are indicative of the condition of the mobile member in its first position, such as possible sticking, and of movement from the first position to the second, whereas data obtained after reaching the second position allow to draw conclusions on the condition of the mobile member in the second position.

[0020] The switching device may comprise a network interface for outputting data of the acceleration sensor obtained in relation to a displacement of the mobile member, or data derived from these, e.g. by a local processing unit.

[0021] Further features and advantages of the invention will become apparent from the subsequent description of embodiments thereof, referring to the appended drawings.

Fig. 1 is a schematic diagram of a relay according to the present invention;

Fig. 2 is a schematic diagram of a circuit breaker or an automatic fuse according to the present invention; and

Fig. 3 is an exemplary diagram of a switching movement.

[0022] Fig. 1 is a highly schematic representation of components of a relay. The relay has a mobile member 1, which is displaceable between an closed position in which a contact pad 2 of mobile member 1 is in electrically conductive contact with a stationary member 3, allowing a current to flow between terminals 4, 5, and an open position in which the mobile member 1 is physically separate from the stationary member 3, so that the electrical current between terminals 4, 5 is interrupted.

[0023] The mobile member 1 carries an acceleration

sensor 6. The acceleration sensor 6 is electrically isolated from contact pad 2. The mobile member 1 can e.g. be an elongate metallic body locally covered by an insulator layer to which the acceleration sensor 6 is affixed.

[0024] The acceleration sensor 6 can comprise at least one micromechanical sensor, each e.g. etched from a silicon substrate, comprising an inertial body forming a first capacitor plate, elastically displaceable in the direction of displacement of the mobile member 1, e.g. by at least one resilient web connecting the inertial body to a frame, and a second capacitor plate spaced in the direction of displacement from the frame by an insulating layer and from the inertial body by a gap, so that the capacitance of a capacitor formed by said first and second plates varies depending on the distance between the capacitor plates, and acceleration of the mobile member 1 can be judged based on said capacitance, e.g. from the resonance frequency of a resonator circuit which includes the capacitor.

[0025] If desired, further micromechanical sensors can be provided whose inertial body is displaceable in another direction, typically perpendicular to the displacement direction of the mobile member 1.

[0026] In a miniaturized embodiment, it would be conceivable to form the complete mobile member 1 from a semiconductor substrate, doped in a first region to form the contact pad 2 and doped and etched in a second region to form the sensor or sensors 6.

[0027] Displacement of the mobile member 1 between open and closed positions is driven by a solenoid 8 interacting with a ferromagnetic body 9 attached to mobile member 1. In the embodiment shown, magnetic attraction between the solenoid 8 and the ferromagnetic body 9 holds the mobile member 1 in the closed position. A spring, not shown, may be provided for moving mobile member 1 into an open position, not shown, in which mobile member 1 is in contact with an abutment 10.

[0028] The movement of mobile member 1 can be a translation. In the present embodiment, it is a rotation by an axis 7 perpendicular to the plane of Fig. 1. The sensor 6 is located at a longer radius with respect to axis 7 than the contact pad 2, in order to be subject to a large and precisely detectable acceleration when moving between the open and closed positions.

[0029] In this embodiment, the radius of the sensor 6 with respect to axis 7 is also longer than that of abutment 10, and the sensor 6 is able to vibrate with respect to the mobile member 1, symbolized here by a sensor mount 12 connected to the mobile member 1 by a tapered portion 11. This flexibility enables the sensor 6 to overshoot when the movement of the mobile member 1 is stopped by the abutment 10, so that acceleration data obtained from the sensor 6 after the mobile member 1 making contact with the abutment 10 can be used for drawing conclusions on the state of the device. For example, a resonance frequency of the mobile member 1 may be adapted to an expected duration of the movement of mobile member 1 between open and closed positions, so

that as long as the movement does take the expected time, the overshoot is maximized, whereas when wear causes the movement to become slower or faster, this can be detected due to the reduction in overshoot.

[0030] Acceleration data from sensor 6 are collected by a processing unit 13. The processing unit 13 can be a microcontroller or the like, accommodated in a same housing with the relay, or otherwise forming an assembly together with the relay.

[0031] The processing unit 13 may come with a pre-defined set of data stored in it with which to compare data provided by the acceleration sensor 6 whenever the mobile member 1 is displaced between open and closed positions. Preferably, such a set of data is obtained from measurements carried out on the first displacements carried out by the mobile member 1 when the switching device is still new and can be assumed to be in good order. By comparing data obtained in later displacements with these, wear of the switching device can be detected, as will be explained in more detail later. The result of such a detection, output by processing unit 13, can be a binary judgment indicating that the relay is either in working order or is due for replacement. It can also be a quantitative score representative of the overall quality and/or expected remaining service life of the relay.

[0032] The processing unit 13 includes a network interface 14 for communication with a remote unit 15 by a network 16 such as a LAN, a wireless network and/or the Internet. The remote unit 15 may collect information from a plurality of processing units 13. For instance, it can be run by an operator of an industrial plant to collect data from processing units of the entire plant or of subunits thereof, in order to keep maintenance staff informed of existing or imminent need to replace a relay or other device associated to one of these processing units. In particular if the network 16 is a WAN or the Internet, the remote unit might also be run by a manufacturer of the relay, in order to be able to predict the when and where of future demand for replacement.

[0033] Fig. 2 is a schematic diagram of an automatic fuse or a circuit breaker according to the present invention. The circuit breaker has many components in common with the relay of Fig. 1; these components are depicted identically in Figs. 1 and 2 and have identical reference numerals; their description will not be repeated. The main difference between the two devices is that while in the relay, the solenoid 8 must overcome the force of the spring acting on the mobile member 1 and is thus capable of controlling displacement from open to closed position and vice versa, the solenoid 8 of the circuit breaker is designed to withdraw a latch 17 which locks mobile member 1 in its closed position. When that happens, a spring 18 urges mobile member 1 into the open position, i.e. the acceleration measured by sensor 6 is due to the force of the spring 18. In order to bring the mobile member 1 back into the closed position, manual intervention is necessary.

[0034] Fig. 3 illustrates the movement of mobile mem-

ber 1 when moving from closed to open position in the relay of Fig. 1 or the circuit breaker of Fig. 2. A curve x , representative of the position of the mobile member 1, starts from the closed position, the speed, represented by curve v , starts from zero. A curve a illustrates the acceleration; when the mobile member 1 is being displaced, acceleration sensor 6 provides samples of this curve a .

[0035] In a first phase (i), while the mobile member 1 moves towards the open position, the parabolic shape of curve x and the linear shape of curve v are representative of approximately constant negative acceleration a . The amount of this acceleration is governed by friction and by inertia of the mobile member and components coupled to it. When friction increases, the amount of acceleration decreases, so that a possible impending failure of the device may be predicted by processing unit 13 if this amount drops below a predetermined fraction of a normal acceleration measured for the same device when freshly installed. If, on the other hand, acceleration is higher than said normal acceleration, it must be expected that some mechanical connection within the device is broken, in which case the processing unit should output a signal calling for immediate replacement of the device.

[0036] Duration of said first phase (i) should be inversely proportional to the amount of acceleration; therefore, the processing unit 13 can make use of the number of samples obtained in the first phase (i) to check plausibility of the detected acceleration amount. If the proportionality is violated, the path of the mobile member 1 may be obstructed, or the sensor 6 itself might be defective; in either case replacement of the device should be called for.

[0037] When the mobile member reaches abutment 10, acceleration switches to a high positive value. The amount of the positive acceleration and the duration of the (second) phase (ii) in which it persists depend on elasticity of abutment 10 and of the sensor mount, due e.g. to tapered portion 11. If there is no rebound, sums of accelerations measured in the first and second phases (i), (ii) should sum up to approximately zero. In case of rebound, the sum will be positive, and a third phase (iii) with negative acceleration will follow. If it doesn't, again there is reason to suspect some malfunction that might make replacement necessary.

[0038] In a simple embodiment, requiring only a low temporal resolution of the acceleration sensor 6, it may be sufficient simply to monitor the duration of alternating phases of positive and negative acceleration after a displacement of the mobile member 1. When the normal duration of the displacement (i.e. phase (i)) is tuned to the resonance period of the sensor mount, any increase or decrease of this duration will cause the vibration of the sensor mount to be excited less efficiently than normal, so that the number of subsequent phases (ii), (iii), ... showing accelerations in opposite directions strong enough to be detected will decrease. Here, simply the number of direction changes of the acceleration detected after a displacement of the mobile member 1 may be taken as an indicator of the status of the device, a re-

placement of the device becoming the more urgent, the smaller the number of detected direction changes is.

Reference numerals

[0039]

- 1 mobile member
- 2 contact pad
- 3 stationary member
- 4 terminal
- 5 terminal
- 6 acceleration sensor
- 7 axis
- 8 solenoid
- 9 ferromagnetic body
- 10 abutment
- 11 tapered portion
- 12 sensor mount
- 13 processing unit
- 14 network interface
- 15 remote unit
- 16 network
- 17 latch
- 18 spring

Claims

1. Electrical switching device comprising a stationary member (3), a mobile member (1) which is displaceable between a closed position in which a contact pad (2) of the mobile member (1) is in electrically conductive contact with the stationary member (3), and an open position in which the electrically conductive contact does not exist, an actuator (8, 18) for displacing the mobile member (1) from at least a first one of the closed and open positions to the second one, and an acceleration sensor (6) which is coupled to the mobile member (1) so as to sense an acceleration caused by the actuator (8, 18) displacing the mobile member (1), **characterized in that** the acceleration sensor (6) is coupled to the mobile member (1) so that the distance between a first position of the sensor (6) associated to the open position and a second position of the sensor (6) associated to the closed position is longer than the path of the contact pad (2) between the open and close positions.
2. The electrical switching device of claim 1, wherein the actuator (8, 18) comprises a solenoid (8) adapted to interact magnetically with the mobile member (1).
3. The electrical switching device of claim 1 or 2, wherein the acceleration sensor (6) is a micromechanical sensor.

4. The electrical switching device of any of claims 1 to 3, wherein the acceleration sensor (6) is fixedly integrated into the mobile member (1).
5. The electrical switching device of any of claims 1 to 3, wherein the acceleration sensor (6) is resiliently coupled to the mobile member (1).
6. The electrical switching device of any of the preceding claims, wherein the bandwidth of the acceleration sensor (6) is higher than the inverse of the duration of a displacement of the mobile member between the open and closed positions driven by the actuator, so that the bandwidth is high enough to obtain at least one acceleration measurement in the course of a displacement of the mobile member.
7. The electrical switching device of any of the preceding claims, **characterized in that** it is a relay, a circuit breaker or an automatic fuse.
8. An assembly comprising the electrical switching device of any of the preceding claims and a processing unit (13) for deriving a judgment on the integrity of the switching device from current acceleration data (a) obtained in relation to a current displacement of the mobile member (1) between the first and second positions driven by the actuator (8, 18).
9. The assembly of claim 8, wherein the processing unit (13) is adapted to derive the judgment from a comparison of said current acceleration data (a) with standard acceleration data.
10. The assembly of claim 9, wherein the processing unit (13) is adapted to derive the standard acceleration data from acceleration data obtained in relation to earlier displacements of said mobile member (1).
11. The assembly of claim 8, 9, or 10, wherein the current acceleration data (a) cover a time interval (i, ii, iii, ...) before and after an instant in which the mobile member (1) reaches the second position.
12. The assembly of any of the preceding claims, further comprising a network interface (14) for outputting data of the acceleration sensor (6) obtained in relation to a displacement of the mobile member, or a judgment derived from these.

Patentansprüche

1. Elektrische Schaltvorrichtung, umfassend ein stationäres Element (3), ein bewegliches Element (1), das zwischen einer geschlossenen Stellung, in der ein Kontaktstück (2) des beweglichen Elements (1) in elektrisch leitendem Kontakt mit dem stationären

- Element (3) steht, und einer geöffneten Stellung, in der der elektrisch leitende Kontakt nicht besteht, verschiebbar ist, einen Aktuator (8, 18) zum Verschieben des beweglichen Elements (1) aus mindestens einer ersten der geschlossenen und der geöffneten Stellung in die zweite, und einen Beschleunigungssensor (6), der mit dem beweglichen Element (1) gekoppelt ist, um eine Beschleunigung zu erfassen, die durch den Aktuator (8, 18), der das bewegliche Element (1) verschiebt, verursacht wird, **dadurch gekennzeichnet, dass** der Beschleunigungssensor (6) mit dem beweglichen Element (1) so gekoppelt ist, dass der Abstand zwischen einer ersten Stellung des Sensors (6), die der geöffneten Stellung zugeordnet ist, und einer zweiten Stellung des Sensors (6), die der geschlossenen Stellung zugeordnet ist, länger als der Weg des Kontaktstücks (2) zwischen der geöffneten und der geschlossenen Stellung ist.
2. Elektrische Schaltvorrichtung gemäß Anspruch 1, wobei der Aktuator (8, 18) einen Elektromagneten (8) umfasst, der dazu eingerichtet ist, magnetisch mit dem beweglichen Element (1) zusammenzuwirken.
 3. Elektrische Schaltvorrichtung gemäß Anspruch 1 oder 2, wobei der Beschleunigungssensor (6) ein mikromechanischer Sensor ist.
 4. Elektrische Schaltvorrichtung gemäß einem der Ansprüche 1 bis 3, wobei der Beschleunigungssensor (6) fest in das mobile Element (1) integriert ist.
 5. Elektrische Schaltvorrichtung gemäß einem der Ansprüche 1 bis 3, wobei der Beschleunigungssensor (6) elastisch mit dem beweglichen Element (1) gekoppelt ist.
 6. Elektrische Schaltvorrichtung gemäß einem der vorhergehenden Ansprüche, wobei die Bandbreite des Beschleunigungssensors (6) größer als der Kehrwert der Dauer einer durch den Aktuator bewirkten Verschiebung des mobilen Elements zwischen der geöffneten und der geschlossenen Stellung ist, so dass die Bandbreite groß genug ist, um mindestens eine Beschleunigungsmessung im Verlauf einer Verschiebung des mobilen Elements zu erhalten.
 7. Elektrische Schaltvorrichtung gemäß einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** diese ein Relais, ein Leistungsschalter oder ein Sicherungsautomat ist.
 8. Anordnung umfassend die elektrische Schaltvorrichtung gemäß einem der vorhergehenden Ansprüche und eine Verarbeitungseinheit (13) zum Ableiten einer Beurteilung über die Integrität der Schaltvorrichtung aus aktuellen Beschleunigungsdaten (a), die im Zusammenhang mit einer aktuellen Verschiebung des mobilen Elements (1) zwischen der ersten und der zweiten Stellung, die durch den Aktuator (8, 18) bewirkt wird, erhalten werden.
 9. Anordnung gemäß Anspruch 8, wobei die Verarbeitungseinheit (13) dazu eingerichtet ist, die Beurteilung aus einem Vergleich der aktuellen Beschleunigungsdaten (a) mit Standardbeschleunigungsdaten abzuleiten.
 10. Anordnung gemäß Anspruch 9, wobei die Verarbeitungseinheit (13) dazu eingerichtet ist, die Standardbeschleunigungsdaten aus Beschleunigungsdaten abzuleiten, die im Zusammenhang mit früheren Verschiebungen des mobilen Elements (1) erhalten wurden.
 11. Anordnung gemäß Anspruch 8, 9 oder 10, wobei die aktuellen Beschleunigungsdaten (a) ein Zeitintervall (i, ii, iii, ...) vor und nach einem Zeitpunkt überdecken, in dem das mobile Element (1) die zweite Stellung erreicht.
 12. Anordnung gemäß einem der vorhergehenden Ansprüche, ferner umfassend eine Netzwerkschnittstelle (14) zum Ausgeben von Daten des Beschleunigungssensors (6), die im Zusammenhang mit einer Verschiebung des mobilen Elements erhalten wurden, oder einer daraus abgeleiteten Beurteilung.

Revendications

1. Dispositif interrupteur électrique comprenant un organe fixe (3), un organe mobile (1) qui peut être déplacé entre une position dans laquelle un plot de connexion (2) de l'organe mobile (1) est en contact conducteur avec l'organe fixe (3), et une position ouverte dans laquelle il n'existe pas de contact conducteur, un actionneur (8, 18) pour déplacer l'organe mobile (1) d'au moins une première des positions ouverte et fermée à la seconde, et un capteur d'accélération (6) qui est couplé à l'organe mobile (1) de façon à détecter une accélération causée par l'actionneur (8, 18) déplaçant l'organe mobile (1), **caractérisé en ce que** le capteur d'accélération (6) est couplé à l'organe mobile (1) de sorte que la distance entre une première position du capteur (6) associée à la position ouverte et une seconde position du capteur (6) associée à la position fermée soit plus longue que le trajet du plot de connexion (2) entre les positions ouverte et fermée.
2. Dispositif interrupteur électrique selon la revendication 1, dans lequel l'actionneur (8, 18) comprend une électrovanne (8) conçue pour une interaction magnétique avec l'organe mobile (1).

3. Dispositif interrupteur électrique selon la revendication 1 ou 2, dans lequel le capteur d'accélération (6) est un capteur micromécanique.
4. Dispositif interrupteur électrique selon l'une quelconque des revendications 1 à 3, dans lequel le capteur d'accélération (6) est intégré à demeure dans l'organe mobile (1). 5
5. Dispositif interrupteur électrique selon l'une quelconque des revendications 1 à 3, dans lequel le capteur d'accélération (6) est couplé de façon élastique à l'organe mobile (1). 10
6. Dispositif interrupteur électrique selon l'une quelconque des revendications précédentes, dans lequel la largeur de bande du capteur d'accélération (6) est supérieure à l'inverse de la durée d'un déplacement de l'organe mobile entre les positions ouverte et fermée entraîné par l'actionneur, de sorte que la largeur de bande est suffisamment grande pour obtenir au moins une mesure d'accélération au cours d'un déplacement de l'organe mobile. 15 20
7. Dispositif interrupteur électrique selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**il s'agit d'un relais, d'un disjoncteur ou d'un fusible automatique. 25
8. Ensemble comprenant le dispositif interrupteur électrique selon l'une quelconque des revendications précédentes et une unité centrale (13) destinée à dériver un jugement sur l'intégrité du dispositif interrupteur à partir de données d'accélération courantes (a) obtenues en relation avec un déplacement en cours de l'organe mobile (1) entre les première et seconde positions entraîné par l'actionneur (8, 18). 30 35
9. Ensemble selon la revendication 8, dans lequel l'unité centrale (13) est conçue pour dériver le jugement à partir d'une comparaison desdites données d'accélération courantes (a) avec des données d'accélération standard. 40
10. Ensemble selon la revendication 9, dans lequel l'unité centrale (13) est conçue pour dériver les données d'accélération standard à partir de données d'accélération obtenues en relation avec les déplacements précédents dudit organe mobile (1). 45 50
11. Ensemble selon les revendications 8, 9 ou 10, dans lequel les données d'accélération courantes (a) couvrent un intervalle temporel (i, ii, iii, ...) avant et après un instant auquel l'organe mobile (1) atteint la seconde position. 55
12. Ensemble selon l'une quelconque des revendications précédentes, comprenant en outre une inter-

face de réseau (14) destinée à émettre des données du capteur d'accélération (6) obtenues en relation avec un déplacement de l'organe mobile, ou un jugement dérivé de celles-ci.

Fig. 1

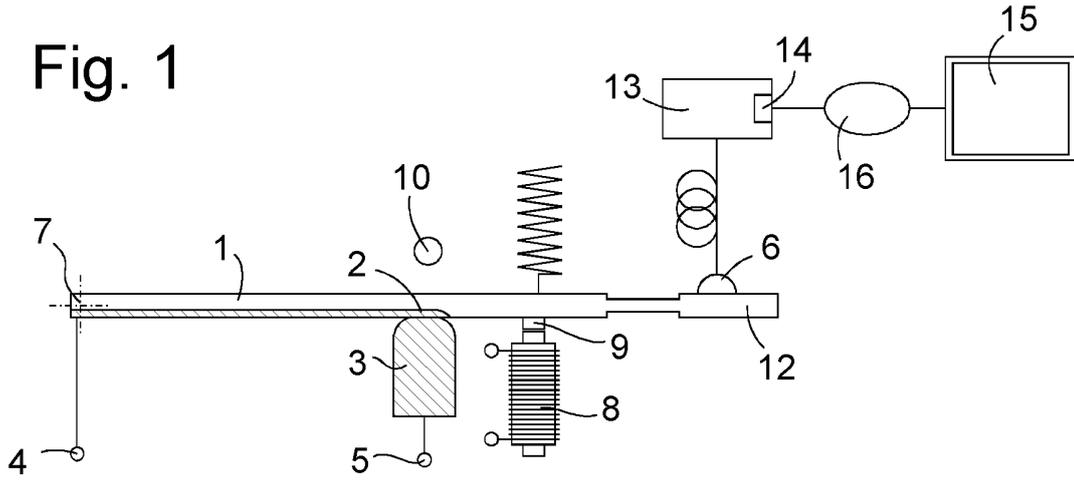


Fig. 2

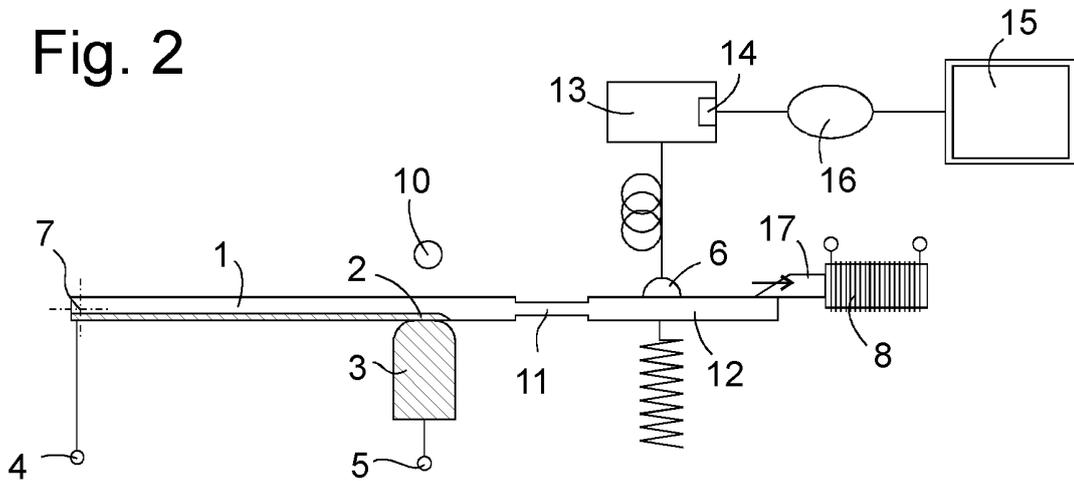
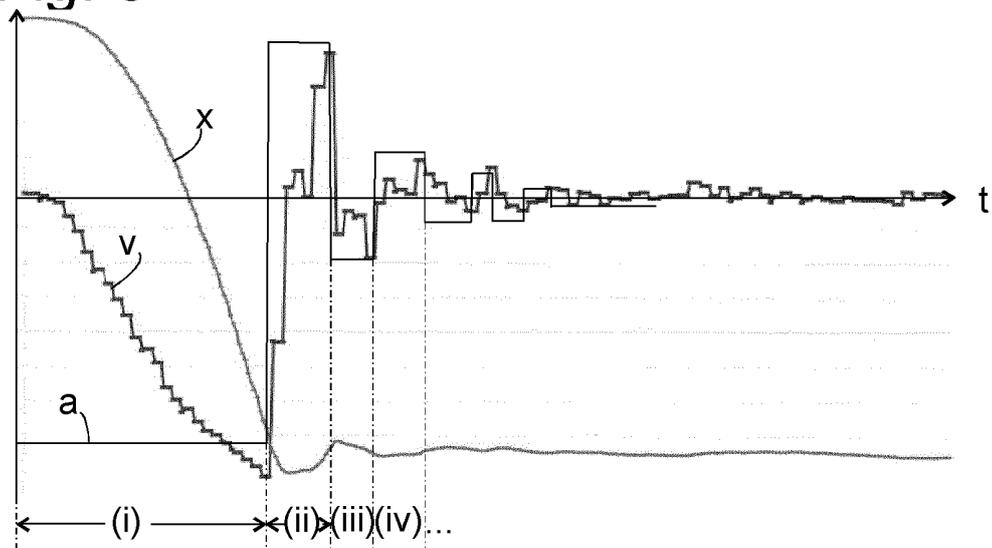


Fig. 3



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 2290666 A1 [0003]
- WO 2018108833 A1 [0004]
- US 20190018065 A1 [0005]