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(73) Patenthaver: **Torqeedo GmbH, Friedrichshafener Straße 4a, 82205 Gilching, Tyskland**

(72) Opfinder: **HARTMEYER, Marc, Lehrer-Wirth-Str. 29, 81829 München, Tyskland**
KRIEGER, Philipp, Seewiesstr. 40a, 82340 Feldafing, Tyskland
BIEBACH, Jens, Bergwiesenstr. 7, 82327 Tutzing, Tyskland

(74) Fuldmægtig i Danmark: **Plougmann Vingtoft A/S, Strandvejen 70, 2900 Hellerup, Danmark**

(54) Benævnelse: **ELEKTRISK LAGRING MED VANDSENSOR**

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US-B1- 6 669 516

ELECTRICAL STORAGE WITH WATER SENSOR

The invention relates to a boat having an electrical storage which has at least one storage element and a positive and a negative terminal, wherein the terminals are in conductive connection with the storage element. The invention also relates to a method for the safety shut-down of such an electrical storage on a boat, and to a boat with such a storage.

If electrical contacts between which a DC voltage is applied are brought into contact with water, this results in electrolysis. Here, galvanic contact corrosion occurs and oxyhydrogen is formed. Oxyhydrogen is highly explosive and poses a corresponding potential danger. With voltages that are higher than extra-low voltage, i.e. higher than 60 V, individuals are additionally exposed to the risk of electrical accidents.

Electrical outboard motors for boats have therefore been equipped hitherto with a housing according to protection class IP67. These housings protect the electrical outboard motor against the infiltration of water in the case of temporary submersion. The test standard for this prescribes a water tightness of 30 minutes at a depth of 1 m.

Protection class IP67 guarantees the water tightness at a submersed depth of one metre only for half an hour. In the event of a boat accident, however, the outboard motor may sink to even greater depths and/or might not be salvaged from the water within half an hour. In addition, in the case of an accident the insulation of the housing may be damaged, so that there is subsequently again the risk of oxyhydrogen formation and electrical shock.

US 6 669 516 B1 shows a boat with electric storage, US 2011/135984 A1 shows a safety device for electrical and hybrid electrical energy storage systems, and WO 2010/127911 A1 shows a short-circuit fuse for an electric vehicle battery.

The object of the present invention is therefore to provide a method and a device with which these risks are avoided.

This object is achieved by a boat having an electrical storage which has at least one storage element and a positive and a negative terminal, wherein the terminals are in conductive connection with the storage element, said electrical storage being characterised in that a water sensor is provided which detects whether one of the terminals is in contact with water, and wherein the water sensor is in operative connection with a shut-down device which serves to interrupt the conductive connection between at least one of the terminals and the storage element

The use of protection class IP67 does provide important basic protection. Due to the time limitation and the limitation resulting from the maximum depth, however, risks remain that are reduced or eliminated by the installation according to the invention.

An important field of application of the invention is constituted by electrical storages on boats, in particular on boats with electric drive.

The invention proposes, in the case of an accident, when one of the terminals of the electrical storage comes into contact with water, to disconnect the terminal or terminals from the power supply so as to at least minimise consequent damage and in particular so as to avoid the above-described contact corrosion. A water sensor is therefore provided which detects the contact of one of the terminals with water. If one of the terminals is in water or underwater or if a certain moisture threshold has been exceeded, the terminal in question or both terminals is/are disconnected from the power supply. The water sensor is for this purpose operatively connected to a shut-down device, which in this case isolates the electrically conductive connection between at least one of the terminals and the electrical storage.

The electrical storage is in particular a battery or an accumulator. The invention provides a particular safety increase in the case of electrical storages, in particular batteries or accumulators, which provide a voltage of more than 60 V, more than 100 V, or more than 200 V. The safety circuit according to the invention is thus used for example advantageously on boats that have a voltage supply of 300 V or 400 V.

The water sensor registers when water is present at the point to be monitored. For example, an optical measuring principle can be used in the water sensor, in which the presence of water is determined by means of a light source and a light receiver. Depending on the embodiment of the water sensor, water at the measurement point will interrupt the luminous flux between light source and light receiver or will only enable said luminous flux via scattering. A change of the luminous flux thus indicates the presence of water at the measurement point.

Alternatively, the water sensor is based on an electrical measuring principle. The water sensor in this case has a first and a second measuring contact and a measuring circuit for determining an electrical measuring variable present between the first and the second measuring contact. When the gap between the two measuring contacts is filled with water, which gap for example is initially filled with air, the resistance and the conductivity between the measuring contacts thus change. This change is interpreted by the water sensor as the presence of water.

In a further embodiment, one of the terminals of the electrical storage serves as one of the measuring contacts. Either the positive terminal or the negative terminal of the electrical storage

is used as the first measuring contact. The water is detected by measuring an electrical variable, for example the electrical resistance, between one of the terminals and the second measuring contact. This approach has the advantage that the water is detected in the immediate vicinity of one terminal of the electrical storage.

In a further embodiment of the invention, the measuring circuit is connected with the positive and/or the negative terminal via a series resistor, such that the current from the measuring circuit or into the measuring circuit is limited and even in the case of a hard short circuit between a terminal of the measuring circuit and the terminal of the battery which is not part of the measuring circuit, the current does not exceed a critical value. The measuring circuit is normally designed to determine the impedance between one measuring contact and a second measuring contact, which may also be a battery terminal. In the case where a battery contact itself is the reference contact, it must be ensured that no damage to the measuring circuit is caused in the case of a conductive connection between the non-referenced contact and the contact of the measuring circuit.

In a further embodiment, there is a measuring circuit between a measuring contact and one of the battery contacts, which is expedient in particular in the case of batteries with large spatial dimensions. Batteries are generally installed horizontally, such that all battery terminals are at the same height above the water level. An accident may result in an inclined position, in which case one of the battery terminals then has significantly more contact over time with the infiltrating water and then the storage is shut down well before water the second storage terminal comes into contact with the water.

In a further embodiment, only the two storage terminals are used as measuring contacts. This method presupposes that the impedance active at the storage terminals in the fault-free state is known, which is difficult in particular in systems with different degrees of expansion. If there is then a significant impedance change, the battery terminals are shut down.

A further embodiment consists in the use of measuring contacts that are not connected at all to the contacts of the electrical storage. These contacts can then be arranged in the boat such that they determine the water contact before the terminals of the electrical storage come into contact with the water. The evaluation circuit can be located inside or outside the storage.

The invention is used preferably in electrical storages located on boats, particularly preferably in electrical outboard motors. In particular in the case of outboard drives, in which the electrical storage or the battery is located in the outboard drive, the invention provides a considerable safety increase.

The method according to the invention for the safety shut-down of an electrical storage which has at least one storage element and a positive and a negative terminal is characterized in that it is detected whether one of the terminals has contact with water, and in the case of the detection of water the conductive connection between at least one of the terminals and the storage element is interrupted.

The detection of water preferably takes place by means of an electrical measuring method, in particular by measuring the electrical conductivity or the electrical resistance.

One of the objectives of the invention is to prevent contact corrosion in the case of contact of the terminals of the electrical storage with water. The electrical resistance is therefore advantageously determined in the environment of at least one of the terminals. The term "in the environment" is to be understood in particular to mean that the measurement is taken at a distance of less than 30 cm, less than 20 cm, or less than 10 cm from the terminal. Both measuring contacts are provided at a distance of less than 30 cm, less than 20 cm, or less than 10 cm from the terminal. One of the terminals itself is most preferably used as measuring contact, and the resistance between the terminal and the second measuring contact is detected.

The measuring contacts are preferably arranged spatially such that when the storage or other boat components is/are installed, there cannot be any undesired contact due to the tool used. Undesired contact in the case of electrical storage s can be prevented inter alia by placing a mechanical barrier between the terminals of the storage, which mechanical barrier rules out contact at a short, direct linear distance. In such a case it is expedient for the measuring contact to be located on the side of the barrier on which the storage terminal having no connection to the measuring circuit is also arranged.

The detected resistance value is compared for example with a reference value. When the deviation between measured resistance value and the reference value exceeds a certain threshold or when the absolute value of the measured resistance exceeds or falls below a certain threshold, this is interpreted as the presence of water, and one of the terminals or both terminals of the electrical storage is/are shut down.

The detection of water is preferably carried out by means of an alternating voltage measuring method in order to minimise galvanic contact corrosion. With use of an alternating voltage source, a capacitance can preferably be used as current-limiting impedance, such that an excessively high direct current towards the opposite terminal of the storage, which is not part of the sensor circuit, is impossible.

The presence of water at one or both terminals of the electrical storage can cause not only the described galvanic contact corrosion, but also damage to other components conductively connected to the electrical storage. When water is detected further electrical loads are therefore advantageously isolated from the electrical storage. In particular, it has proven to be favourable in such a case to also quickly isolate the electric motor from the electrical storage in order to prevent damage to the electric motor.

In another embodiment, a monitoring line is provided, via which all components connected to the electrical storage, in particular the electric motor, can be shut down. The monitoring line is used for safety shut-down when one of the terminals comes into contact with water.

In addition to the water detection according to the invention, the electrical storage is advantageously provided with further safety devices. The further safety devices preferably comprise means for detecting and for protecting against short circuits, overcharging or deep discharging of the electrical storage, and/or overheating of the battery cells and/or the electronic system. Some or all of the safety devices, for example the water sensor or the above-mentioned further safety devices, are particularly advantageously designed to be redundant. That is, some or all safety-relevant functions are provided twice. It is thus ensured that the failure of a safety device itself does not become a potential safety problem.

In a further advantageous embodiment of the invention, the electrical storage, in particular a battery, is equipped with a pyrotechnic fuse, which in the case of an accident reliably isolates the electric motor and/or other electrical components connected to the electrical storage from the electrical storage. The pyrotechnic fuse for example comprises a pyrotechnic, flammable or explosive substance. If the current flowing via the pyrotechnic fuse exceeds a certain limit value, an ohmic resistor in the fuse heats up to such an extent that the pyrotechnic substance is ignited and the electrically conductive connection is interrupted.

The invention and further advantageous details of the invention will be explained by way of example in greater detail hereinafter on the basis of the schematic drawing, wherein

FIG. 1 shows a battery according to the invention with a water sensor,

FIG. 2 shows an alternative embodiment of the invention,

FIG. 3 shows a variant of the invention with two water sensors,

FIG. 4 shows a battery according to the invention with mechanical protection in order to avoid undesired short circuits, and

FIG. 5 shows a further variant of the invention.

FIG. 1 shows the housing 1 of an electrical storage, in particular a battery or an accumulator, which has a plurality of storage elements, in particular galvanic cells. The cells 2 are connected to a positive terminal (plus terminal) 3 and to a negative terminal (minus terminal) 4. A shut-down device 9 with two switches 10, 11, which are arranged in the line between the cells 2 and the plus terminal 3 and in the line between the cells 2 and the minus terminal 4, is located in the connection between the cells 2 and the terminals 3, 4. By opening the switches 10, 11, the electrically conductive connection between the cells 2 and the terminals 3, 4 can be interrupted and the terminals 3, 4 can be disconnected from the power supply.

The electrical storage is preferably used as a voltage source for an electric drive on a boat, in particular for outboard motors.

A water sensor 5 is provided in the housing 1. The water sensor 5 comprises a measuring circuit 8 and also two measuring contacts 6, 7, which are arranged outside the housing 1 or on the exterior thereof. The measuring circuit 8 is connected via a control line 12 to the switches 10, 11.

The measuring circuit 8 determines the electrical resistance between the two measuring contacts 6, 7. When the measuring contacts 6, 7 come into contact with water, the electrical resistance between the measuring contacts 6, 7 thus changes. This change is interpreted by the measuring circuit 8 as the presence of water, and the switches 10, 11 are controlled and opened via the control line 12. The terminals 3, 4 of the electrical storage are thus disconnected from the power supply so as to avoid contact corrosion and minimise further consequential damage.

FIG. 2 shows an alternative embodiment of the invention. This differs from the version shown in FIG. 1 in that the minus terminal 4 serves as measuring contact. In addition, like components are characterised in all figures by like reference numerals.

Water is detected in this case by measuring an electrical variable, for example the electrical resistance, between the minus terminal 4 and the second measuring contact 7. This approach has the advantage that water is detected in the immediate vicinity of one terminal 4 of the electrical storage.

FIG. 3 illustrates a further embodiment in which two water sensors 5, 13 are provided. The water sensor 5 is, as described with reference to FIG. 2, connected to the minus terminal 4 of the electrical storage. The minus terminal 4 is used as one of the two measuring contacts of the water sensor 5. The second water sensor 13 is designed accordingly, with the plus terminal 3 of the electrical storage being used as one of the measuring contacts 3, 14.

The measuring circuit 8 registers the presence of water in the region of the minus terminal 4; the measuring circuit 13 registers the presence of water in the region of the plus terminal 3. This

has advantages in the case of batteries with large spatial dimensions. Batteries are generally installed horizontally, such that all battery terminals 3, 4 are at the same height above the water level. An accident may result in an inclined position, in which case one of the battery terminals 3, 4 then has significantly more contact over time with the infiltrating water. The variant of the invention shown in FIG. 3 then allows a premature shut-down of the storage, well before the second storage terminal 3, 4 comes into contact with the water.

FIG. 4 illustrates an electrical storage according to the invention, in which a mechanical barrier 16 is provided so as to prevent any undesired contact between the battery terminals 3, 4 and the measuring contact 7 due to the tool used as the storage or other boat components is/are installed.

The electrical circuit shown in FIG. 4 corresponds to the circuit according to FIG. 2. A mechanical barrier 16, for example in the form of an elevation of the housing, is provided between the terminals 3, 4 of the electrical storage. The barrier 16 is designed such that it is located linearly in the straight-line connection between the two terminals 3, 4. In this way the undesired establishment of an electrically conductive connection between the two terminals 3, 4, for example by means of a tool, is prevented or at least hindered.

When the water sensor 5, as illustrated, is designed such that one of the terminals 4 serves as measuring contact, it is thus expedient to provide the measuring contact on the side of the barrier 16 on which the terminal 3 of the storage having no connection to the measuring circuit is arranged.

Lastly, FIG. 5 illustrates an embodiment of the invention in which, in the case of an accident in which the water sensor 5 detects the contact with water, not only the terminals 3, 4 but also further electrical components 17, 18, 19 are shut down.

The shown circuit of the water sensor 5 corresponds to the circuit shown in FIG. 2. Of course, the concept explained hereinafter can also be applied accordingly in circuits according to FIG. 1 or 3.

To this end, a monitoring line 20 is additionally provided, which is connected to a low-volt voltage source 21. In the example shown in FIG. 5 a motor controller 17, which controls an electric motor 18, and a further component 19 are connected to the battery terminals 3, 4. The monitoring line 12 is also connected to the motor control 17 and the further component 19. In addition, a switch 22 is provided in the monitoring line 20, via which switch the monitoring line 20 can be isolated.

In the case of a problem or accident determined by the water sensor 5, the measuring circuit 8 not only opens the switches 10, 11 in order to disconnect the battery terminals 3, 4 from the power supply, but the monitoring line 20 is also interrupted by opening the switch 22. As a result, a problem is signalled to the motor control 17 and the further component 19. The motor control 17 will shut down the electric motor 18, and the further component 19 is also switched off. In this way, not only is galvanic contact corrosion at the terminals 3, 4 prevented, but damage to the other components 17, 18, 19 conductively connected to the cells 2 is also counteracted.

Patentkrav

1. Båd med en elektrisk lagring som har mindst et lagringselement (2) og en positiv og en negativ pol (3, 4), idet polerne (3, 4) er i ledende forbindelse med lagringselementet (2), idet en vandsensor (5, 13) er tilvejebragt, som fastslår, om en af polerne (3, 4) er i kontakt med vand, og idet vandsensoren (5, 13) er i driftsforbindelse med en afkoblingsindretning (9), som tjener til at afbryde den ledende forbindelse mellem mindst en af polerne (3, 4) og lagringselementet (2), **kendetegnet ved, at**
vandsensoren (5, 13) har en første og en anden målekontakt (6, 7) og et målekredsløb (8) til at bestemme en elektrisk målestørrelse foreliggende mellem den første og den anden målekontakt (6, 7), idet den elektriske lagrings positive og/eller negative pol (3, 4) tjener som første og/eller anden målekontakt, **eller, at**
der i vandsensoren anvendes et optisk måleprincip, hvor tilstedeværelsen af vand bestemmes ved hjælp af en lyskilde og en lysmodtager.

2. Båd ifølge krav 1, **kendetegnet ved, at** målekredsløbet (8) er forbundet med den positive og den negative pol (3, 4) via en seriemodstand.

3. Båd ifølge et af de foregående krav, **kendetegnet ved, at** der mellem den elektriske lagrings poler (3, 4) er påført en spænding på mere end 60 V, mere end 100 V eller mere end 200 V.

4. Båd ifølge et af de foregående krav, **kendetegnet ved, at** den elektriske lagring er i form af en spændingskilde, især et batteri eller en akkumulator.

5. Båd ifølge et af de foregående krav, **kendetegnet ved, at** den positive og den negative pol (3, 4) tjener som målekontakter.

6. Båd ifølge et af de foregående krav, **kendetegnet ved, at** båden har en elektromotor.

7. Fremgangsmåde til sikkerhedsafkobling af en elektrisk lagring på en båd, som har mindst et lagringselement (2) og en positiv og en negativ pol (3, 4), hvor det detekteres, om en af polerne (3, 4) har kontakt med vand, og i tilfælde af detektering af vand afbrydes den ledende forbindelse mellem mindst en af polerne (3, 4) og lagringselementet (2),
kendetegnet ved, at
detekteringen af vand udføres ved hjælp af en elektrisk målefremgangsmåde, idet den elektriske lagrings positive og/eller negative pol (3, 4) tjener som første og/eller anden målekontakt,
eller, at
der i vandsensoren anvendes et optisk måleprincip, hvor tilstedeværelsen af vand bestemmes ved hjælp af en lyskilde og en lysmodtager.

8. Fremgangsmåde ifølge krav 7, **kendetegnet ved, at** den elektriske modstand bestemmes i omgivelserne af mindst en af polerne (3, 4), især bestemmes i en afstand på mindre end 30 cm, mindre end 20 cm eller mindre end 10 cm fra polen.

9. Fremgangsmåde ifølge krav 7 eller 8, **kendetegnet ved, at** detekteringen af vand udføres ved hjælp af en vekselspændingsmålefremgangsmåde.

10. Fremgangsmåde ifølge et af kravene 7 til 9, **kendetegnet ved, at** ved detektering af vand afbrydes yderligere elektriske brugere (17, 18, 19) fra den elektriske lagring.

Fig. 1

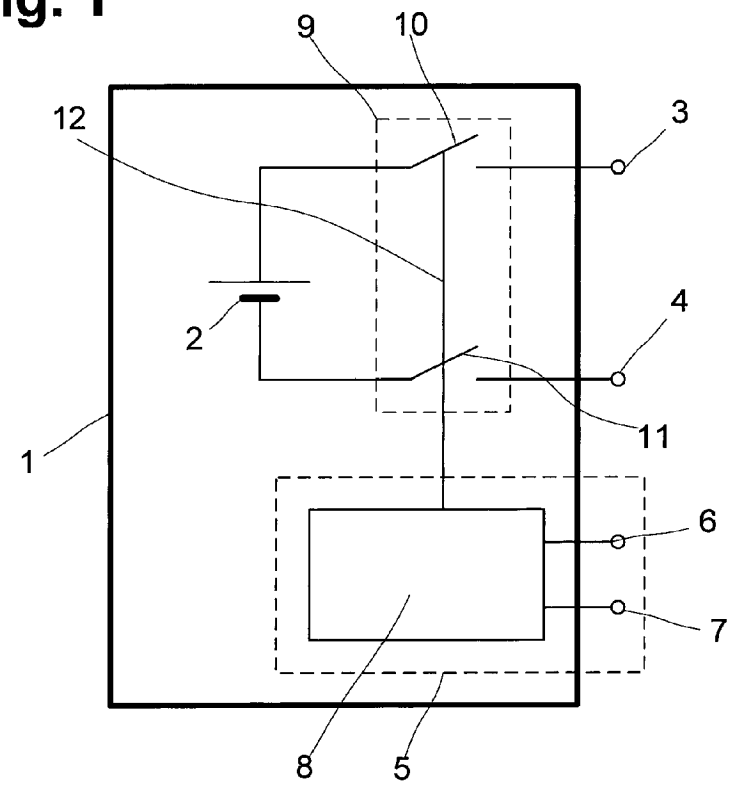


Fig. 2

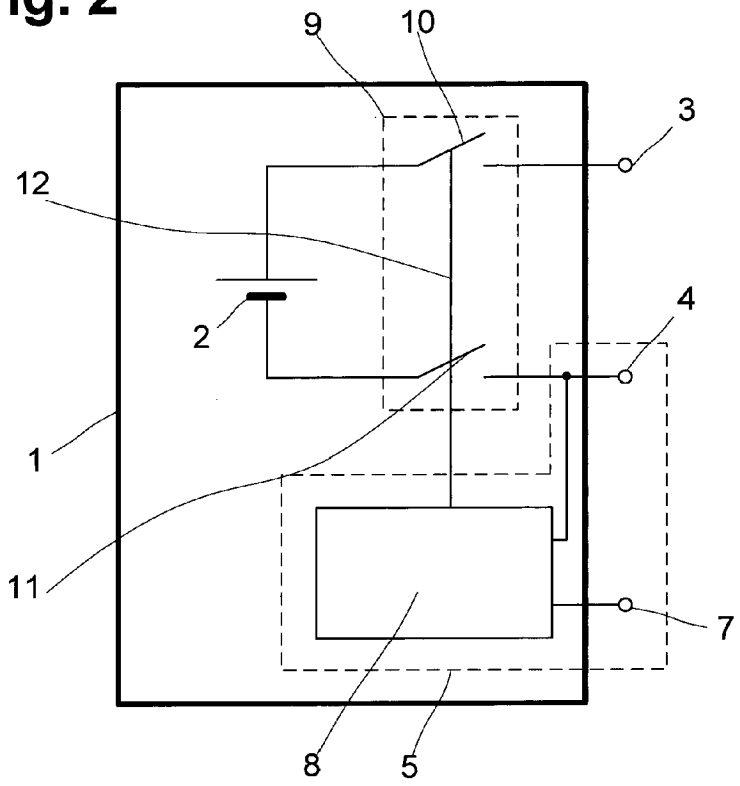


Fig. 3

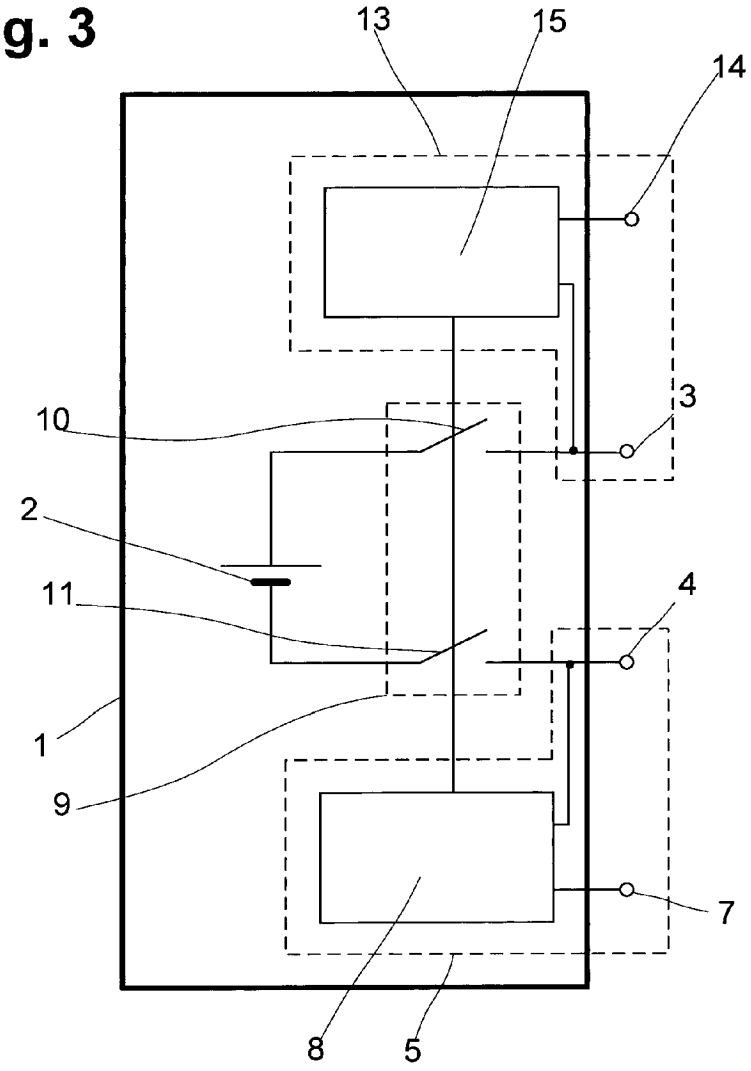
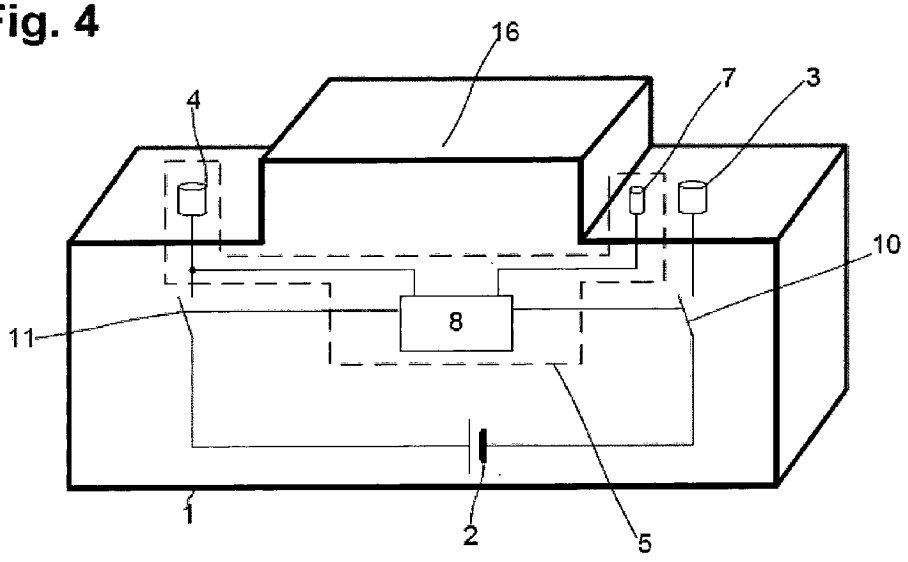


Fig. 4



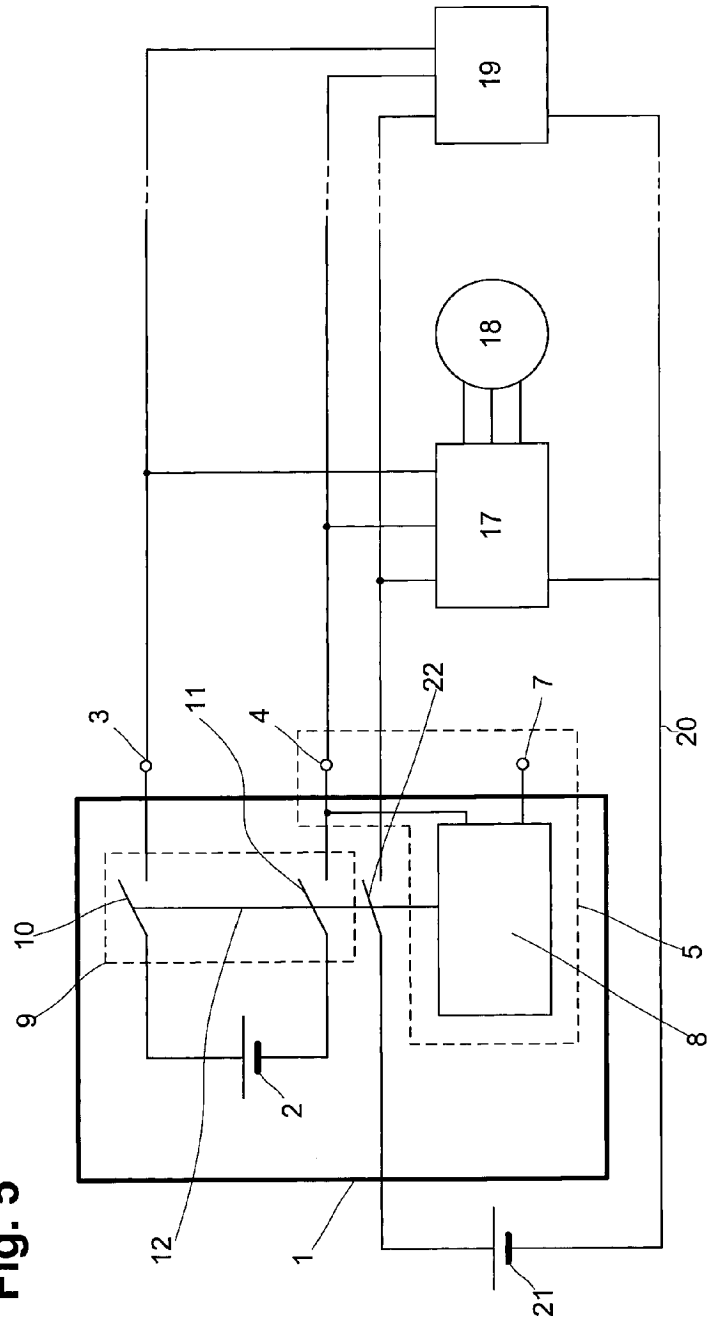


Fig. 5