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(54) **Title**: SMART FIRE WARNING FOR LOW VOLTAGE ELECTRICAL PANELS

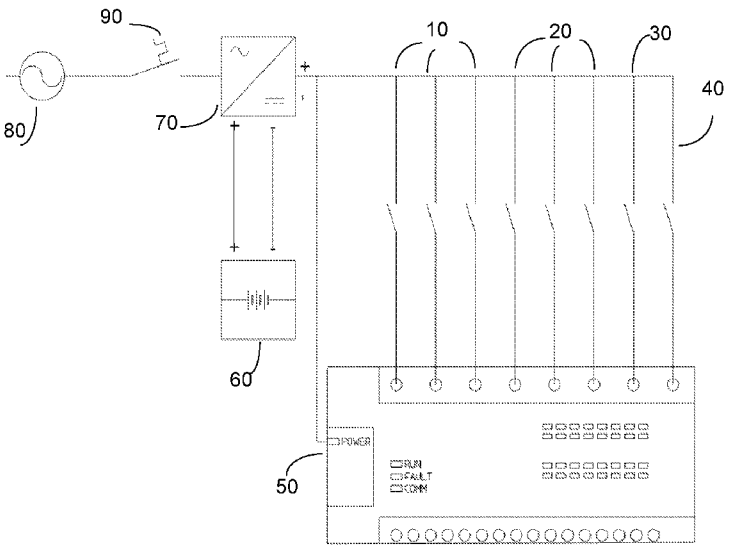


Fig. 1

(57) **Abstract**: System for preventing fire in a low voltage electrical panel, comprising a voltage source (70); a controller (50) for triggering fire alarm procedures; and at least one linear heat detection cable (10); wherein the linear heat detection cable (10) is arranged so as to cover all parts of the low voltage electrical panel that can form heat sources; and wherein the controller (50) will trigger fire alarm procedures if the linear heat detection cable (10) is tripped. Such a system can detect a heat buildup in the low voltage electrical panel and can thus raise an alarm before a fire occurs. Repairs can then be carried out in time, preventing the fire and saving assets and possibly even lives. The system is moreover simple to install and operate, and offers very low maintenance costs.

WO 2017/158508 A1

Smart Fire Warning for Low Voltage Electrical Panels

DESCRIPTION

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the priority of United Arab Emirates Patent Application No. 296/2016, filed on March 16, 2016.

FIELD OF THE INVENTION

The present invention relates to a fire prevention system and method for low voltage electrical panels. Such panels are commonly used in electrical distribution substations.

DESCRIPTION OF RELATED ART

Various types of fire warning or detection systems are commonly used, such as e.g. heat detectors, fixed temperature detectors, smoke detectors, ionization smoke detectors, photoelectric beam smoke detectors, laser smoke detectors, spot type detectors or flame detectors. All these devices are only able to react to a fire after it has started, e.g. after a certain minimum amount of smoke has been produced. Preventive, proactive measures are thus not possible.

Alternatively, rate-of-rise detectors or spot heat detectors can be used. However, such detectors can only cover a single heat source each. A fire warning arrangement for a situa-

tion with multiple heat sources, e.g. a low voltage electrical panel, would thus require many such devices, resulting in high complexity and thus high initial and maintenance costs.

OBJECT OF THE INVENTION

It is, therefore, an object of the present invention to provide a smart, improved fire warning system and method suitable for low voltage electrical panels.

BRIEF SUMMARY OF THE INVENTION

This aim is achieved by the invention as claimed in the independent claims. Advantageous embodiments are described in the dependent claims, the disclosure of which is hereby incorporated into the description by reference. Even if no multiple back-referenced claims are drawn, all reasonable combinations of the features in the claims shall be disclosed.

The object of the invention is thus achieved by a fire prevention system for a low voltage electrical panel, comprising a voltage source; a controller for triggering fire alarm procedures; and at least one linear heat detection cable; wherein the at least one linear heat detection cable is configured for covering all parts of the low voltage electrical panel that can form heat sources; and wherein a first conductor of the linear heat detection cable is connected to the voltage source and a second conductor of the linear heat detection cable is connected to an input of the controller; such that the controller will trigger fire alarm procedures if the linear heat detection cable is tripped.

A linear heat detection cable consists of two electrical conductors insulated electrically and thermally by polymer plastic. The insulation melts at a temperature threshold predetermined by the cables' manufacturers, resulting in an electrical contact being made.

Such a system can detect a heat buildup in the low voltage electrical panel (which may cause a fire), and can thus raise an alarm before a fire occurs. Repairs can then be carried out in time, preventing the fire and saving assets and possibly even lives. The system is moreover simple to install and operate, and offers very low maintenance costs, since linear heat detection cables are almost maintenance-free.

It is highly advantageous to include at least two linear heat detection cables; wherein the second linear heat detection cable has a higher temperature threshold than the first linear heat detection cable; wherein a first conductor of the second linear heat detection cable is connected to the voltage source and a second conductor of the second linear heat detection cable is connected to a second input of the controller; and wherein the controller is configured to trigger a first alarm procedure if the first linear heat detection cable is tripped, and a second alarm procedure if the second heat detection cable is tripped.

Thus, the first linear heat detection cable triggers an advance warning that part of the panel is overheating, and the second linear heat detection cable triggers a more serious warning that severe overheating is occurring, which would probably lead to a fire without direct intervention.

Preferably, the controller is configured to electrically disconnect at least the low voltage electrical panel if the second heat detection cable is tripped. This is an important safety measure and also might reduce heat buildup in the panel.

In a further embodiment, a third linear heat detection cable is provided; wherein the third linear heat detection cable is configured to be routed around the surroundings of the low voltage electrical panel in order to detect fire originating outside the panel; and wherein the controller is configured to trigger a third alarm procedure if the third heat detection cable is tripped.

Such an arrangement allows to separately detect fires that originate from outside the panel, thus allowing for different alarm procedures appropriate to the respective situation. The knowledge of the origin of the fire may additionally be of value for insurance purposes or in legal disputes.

The temperature threshold of the first linear heat detection cable is preferably 105 °C; and the temperature threshold of the second and third linear heat detection cables is preferably 138 °C.

The object of the invention is further achieved by an electrical low voltage panel comprising a fire prevention system as described above. Such a panel preferably operates at voltages between 300 and 500 V and can be employed advantageously in an electrical distribution substation.

The object of the invention is further achieved by a method for fire prevention in a low voltage electrical panel, comprising the following steps: A voltage source, a controller for triggering fire alarm procedures, and at least one linear heat detection cable are provided. Said at least one linear heat detection cable is arranged to cover all parts of the low voltage electrical panel that can form heat sources, especially the load feeders. A first conductor of the linear heat detection cable is connected to the voltage source, and a second conductor of the linear heat detection cable is connected to an input of the controller. If a voltage is applied to said input of the controller, fire alarm procedures are triggered.

In an advantageous embodiment, a second linear heat detection cable having a higher temperature threshold than the first linear heat detection cable is provided. Said second linear heat detection cable is arranged alongside the first linear heat detection cable. A first conductor of the second linear heat detection cable is connected to the voltage source and a second conductor of the second linear heat detection cable is connected to a second input of the controller. A first alarm procedure is triggered if the first linear heat detection cable is tripped, and a second alarm procedure is triggered if the second heat detection cable is tripped.

Preferably, at least the low voltage electrical panel is electrically disconnected if the second heat detection cable is tripped.

In a further embodiment, a third linear heat detection cable is provided. This third linear heat detection cable is arranged around the surroundings of the low voltage electrical panel. A first conductor of the third linear heat detection cable is connected to the voltage source and a second conductor of the third linear heat detection cable is connected to a third input of the controller. A third alarm procedure is triggered if the third heat detection cable is tripped, indicating a fire originating from outside the panel.

It has proven advantageous to provide the first linear heat detection cable with a temperature threshold of preferably 105 °C and, if desired, to provide second and third linear heat detection cables with temperature thresholds of preferably 138 °C.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

Other objects and advantages of the present invention may be ascertained from a reading of the specification and appended claims in conjunction with the drawing therein.

For a more complete understanding of the present invention, reference is established to the following description made in connection with an accompanying drawing in which:

Fig. 1 shows a schematic of the control circuit of a fire warning system according to an embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

The system aims to prevent a fire in, for example, electrical low voltage panels (400 V) in electrical distribution substations (e.g. 300 kVA to 1500 kVA; 22/11/6.6-0.4 kV) by detecting unusual heat buildup at an early stage, i.e. before the fire has started. If required, it can also disconnect the electricity power supply. The system may comprise the following components, as shown in Fig. 1:

1. A voltage source

This is usually an electrical power connection to e.g. a standard 220 V AC power source 80 and a DC converter 70. The DC converter 70 may include a battery charger, and a rechargeable battery 60 for power supply in the event of outages may also be provided.

2. Linear heat detection cables

Linear heat detection cables 10, 20, 30 comprise two electrical conductors insulated electrically and thermally by polymer plastic. The insulation breaks at a temperature threshold predetermined by the cables' manufacturers. The cables typically have temperature thresholds of 105 and 138 °C. They can be arranged to cover all parts of a low voltage electrical panel that can form heat sources, especially all the load feeders.

3. Control panel

This electrical panel contains as its main component a controller 50 with a set of inputs and outputs, which is able to communicate with e.g. a SCADA (supervisory control and data acquisition) or SMS (safety management system) system. It may further contain or be connected to a voltage source as described above. A 6 A molded case circuit breaker (MCCB)

90 may also be provided to protect the components of the control panel from overloads or short circuits.

Features and Operation:

1. Two linear heat detection cables 10, 20 are arranged in the low voltage distribution panel. They can be arranged, for example, either horizontally or vertically, in such a way that they match the internal layout of the panel. Typically, this arrangement is per electrical phase, i.e. in a common three-phase system, six such cables are used.
2. Within the panel, the linear heat detection cables are routed such that they pass by all possible sources of heat that could cause a fire, e.g. all the load feeders. They may also be routed past all areas containing flammable material (if present).
3. The two cables have different temperature thresholds: a 105 °C cable 10 is used for early stage warning, while a 138 °C cable 20 is used for a second stage warning.
4. A third linear heat detection cable 30 may be routed around the interior of the electrical distribution substation (i.e. outside the low voltage panel) in order to be able to detect fire sources external to the low voltage panel.
5. For each linear heat detection cable, a first conductor is connected to a voltage source 70 and a second conductor is connected to a corresponding controller 50 input.
6. If the temperature of the first linear heat detection cable 10 reaches 105 °C, the insulation melts and the two conductors touch each other. Thus, an electrical connection is made and the voltage reaches the corresponding controller input. The controller 50 then initiates an alarm procedure, typically either a SCADA or an SMS alarm notification, informing about overheating inside the low voltage distribution panel.
7. If the temperature of the second linear heat detection cable 20 reaches 138 °C, the insulation melts, the two conductors touch each other, an electrical connection is made and the voltage reaches the corresponding controller input. The controller 50 then initiates a second alarm procedure, typically either a SCADA or an SMS alarm notification, informing about extreme overheating inside the low voltage distribution panel. The controller 50 may also be configured to remotely switch off the electrical power supply to the low voltage panel in this situation.

8. If the temperature of the third linear heat detection cable 30 reaches 138 °C, the insulation melts, the two conductors touch each other, an electrical connection is made and the voltage reaches the corresponding controller input. The controller 50 then initiates a third alarm procedure, typically either a SCADA or an SMS alarm notification, informing about a fire originating outside the low voltage electrical panel.

9. Additionally, the low voltage distribution panel may have a panel door switch 40 for security purposes. The panel door switch 40 can be connected to a further input of the controller 50, in order to indicate when the access door to the low voltage panel is open, e.g. for maintenance purposes. In certain embodiments, the controller 50 may be configured to ignore other inputs while the panel door is open, or, for example, to send an additional SCADA or SMS notification stating that the access door to the low voltage panel is open.

While the present invention has been described and illustrated in conjunction with a number of specific embodiments, those skilled in the art will appreciate that variations and modifications may be made without departing from the principles of the invention as herein illustrated, as described and claimed. The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are considered in all respects to be illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims, rather than by the foregoing description. All changes which come within the meaning and range of equivalence of the claims are to be embraced within its scope.

Reference Symbols

10 linear heat detection cable (overheating)

20 linear heat detection cable (extreme overheating)

30 linear heat detection cable (external fire)

40 panel door switch

50 controller

60 rechargeable batteries

70 DC power supply and battery charger

80 AC power source

90 MCCB

CLAIMS

1. Fire prevention system for a low voltage electrical panel, comprising:

a voltage source (70);

a controller (50) for triggering fire alarm procedures; and

at least one linear heat detection cable (10);

wherein the at least one linear heat detection cable (10) is configured for covering all parts of the low voltage electrical panel that can form heat sources; and wherein

a first conductor of the linear heat detection cable (10) is connected to the voltage source (70) and a second conductor of the linear heat detection cable (10) is connected to an input of the controller (50);

such that the controller (50) will trigger fire alarm procedures if the linear heat detection cable (10) is tripped.

2. System according to the claim 1,

characterized by

at least two linear heat detection cables (10, 20); wherein

the second linear heat detection cable (20) has a higher temperature threshold than the first linear heat detection cable (10); wherein

a first conductor of the second linear heat detection cable (20) is connected to the voltage source (70) and a second conductor of the second linear heat detection cable (20) is connected to a second input of the controller (50); and wherein

the controller (50) is configured to trigger a first alarm procedure if the first linear heat detection cable (10) is tripped, and a second alarm procedure if the second heat detection cable (20) is tripped.

3. System according to the claim 2,

wherein the controller (50) is configured to electrically disconnect at least the low voltage electrical panel if the second heat detection cable (20) is tripped.

4. System according to claim 2 or 3,

characterized by

a third linear heat detection cable (30); wherein

the third linear heat detection cable (30) is configured to be routed around the surroundings of the low voltage electrical panel in order to detect fire originating from outside the panel; and wherein

the controller (50) is configured to trigger a third alarm procedure if the third heat detection cable (30) is tripped.

5. System according to any one of claims 1 to 4,

wherein the temperature threshold of the first linear heat detection cable (10) is 105 °C;

wherein the temperature threshold of the second linear heat detection cable (20), if present, is 138 °C;

and wherein the temperature threshold of the third linear heat detection cable (30), if present, is 138 °C.

6. Electrical low voltage panel comprising a fire prevention system according to any one of claims 1 to 5.

7. Electrical low voltage panel according to claim 6, wherein said low voltage electrical panel operates at 300-500 V.

8. Electrical low voltage panel according to claim 6 or 7, wherein said low voltage electrical panel is part of an electrical distribution substation.

9. Method for fire prevention in a low voltage electrical panel, comprising the following steps:

providing a voltage source (70), a controller (50) for triggering fire alarm procedures and at least one linear heat detection cable (10);

arranging said at least one linear heat detection cable (10) to cover all parts of the low voltage electrical panel that can form heat sources;

connecting a first conductor of the linear heat detection cable (10) to the voltage source (70) and a second conductor of the linear heat detection cable (10) to an input of the controller (50); and

triggering fire alarm procedures if a voltage is applied to said input of the controller (50).

10. Method according to claim 9,

wherein a second linear heat detection cable (20) is provided; the second linear heat detection cable (20) having a higher temperature threshold than the first linear heat detection cable (10); wherein

the second linear heat detection cable (20) is preferably arranged alongside the first linear heat detection cable (10); wherein

a first conductor of the second linear heat detection cable (20) is connected to the voltage source (70) and a second conductor of the second linear heat detection cable (20) is connected to a second input of the controller (50); and wherein

a first alarm procedure is triggered if the first linear heat detection cable (10) is tripped, and a second alarm procedure is triggered if the second heat detection cable (20) is tripped.

11. Method according to claim 10, comprising the additional step of

electrically disconnecting at least the low voltage electrical panel if the second heat detection cable (20) is tripped.

12. Method according to claim 10 or 11,

wherein a third linear heat detection cable (30) is provided; wherein

the third linear heat detection cable (30) is arranged around the surroundings of the low voltage electrical panel; wherein

a first conductor of the third linear heat detection cable (30) is connected to the voltage source (70) and a second conductor of the third linear heat detection cable (30) is connected to a third input of the controller (50); and wherein

a third alarm procedure is triggered if the third heat detection cable (30) is tripped.

13. Method according to any one of claims 9 to 12,

wherein the temperature threshold of the first linear heat detection cable (10) is 105 °C;

wherein the temperature threshold of the second linear heat detection cable (20), if present, is 138 °C;

and wherein the temperature threshold of the third linear heat detection cable (30), if present, is 138 °C.

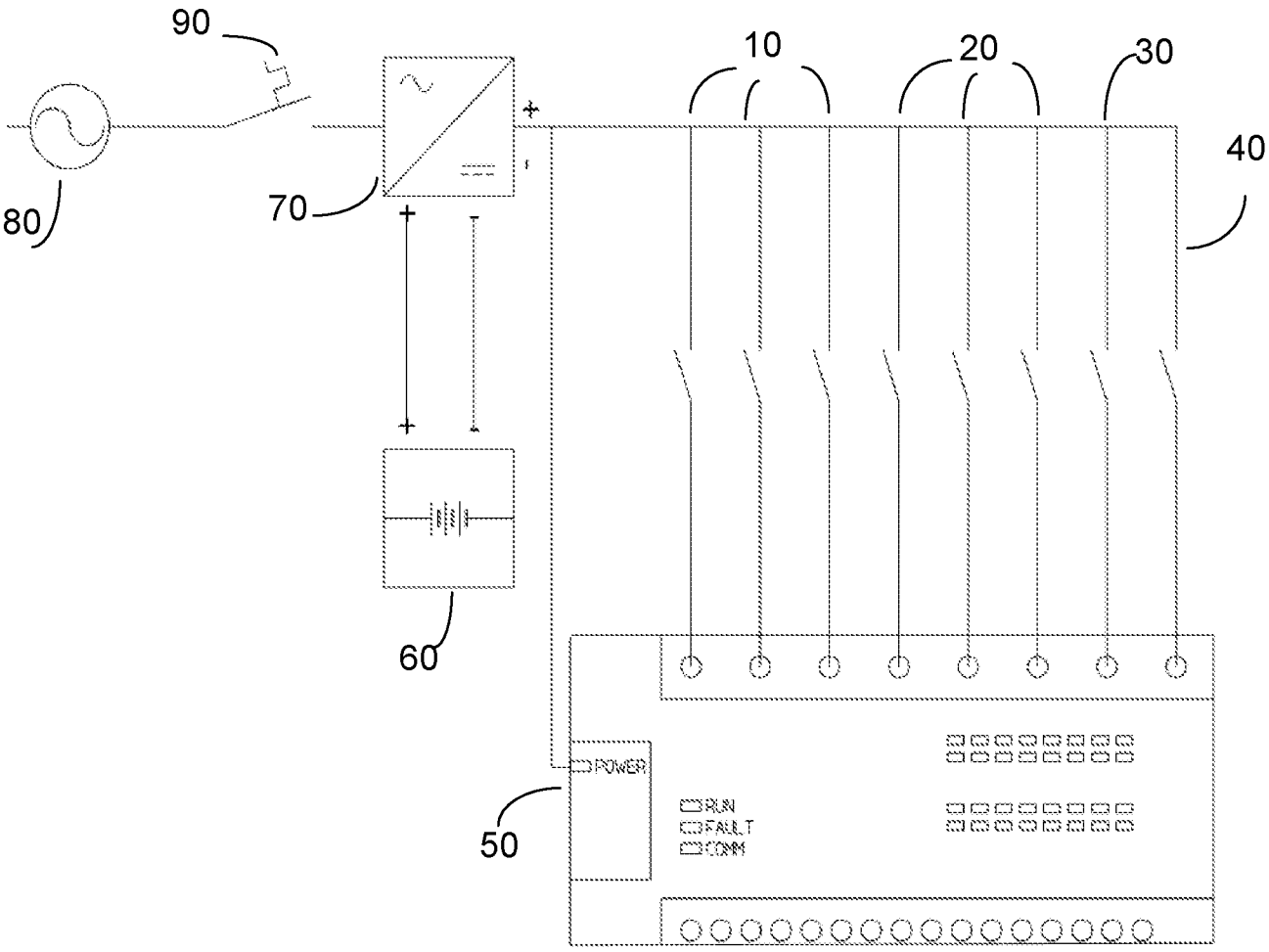


Fig. 1

INTERNATIONAL SEARCH REPORT

International application No.

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A. CLASSIFICATION OF SUBJECT MATTER

IPC: ***G01K 3/00*** (2006.01); ***G08B 17/06*** (2006.01); ***H02B 13/025*** (2006.01); ***H02H 7/22*** (2006.01)

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)

G01K, G08B, H02B, H02H

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)

EPODOC WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 102636734 A (GUANGXI DAKE BUILDING INTELLIGENT ENGINEERING CO., LTD) 15 August 2012 (15.08.2012) Fig 4 and description of English machine translation	1,9
A	CN 202485830 U (SHANGHAI MUNICIPAL ELECTRIC POWER COMPANY, SHANGHAI OUYI INTELLIGENT NETWORK CO., LTD) 10 October 2012 (10.10.2012) Fig and description of Englisch machine translation	1-13
A	US 2185944 A (HOLMES WILLIS GERALD) 02 January 1940 (02.01.1940) Whole document	1-13

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

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"&" document member of the same patent family

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INTERNATIONAL SEARCH REPORT
Information on patent family members

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Patent document cited in search report			Patent family member(s)			Publication date
CN	A	102636734	CN	A	102636734	2012-08-15
CN	U	202485830	CN	U	202485830	2012-10-10
US	A	2185944	US	A	2185944	1940-01-02