May 3, 1949. E. J. POITRAS 2,469,001

ABNORMAL TEMPERATURE AND GROUND DETECTOR ALARM SYSTEM

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Fig. 2.

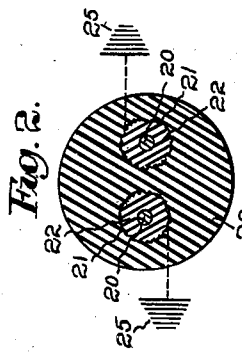
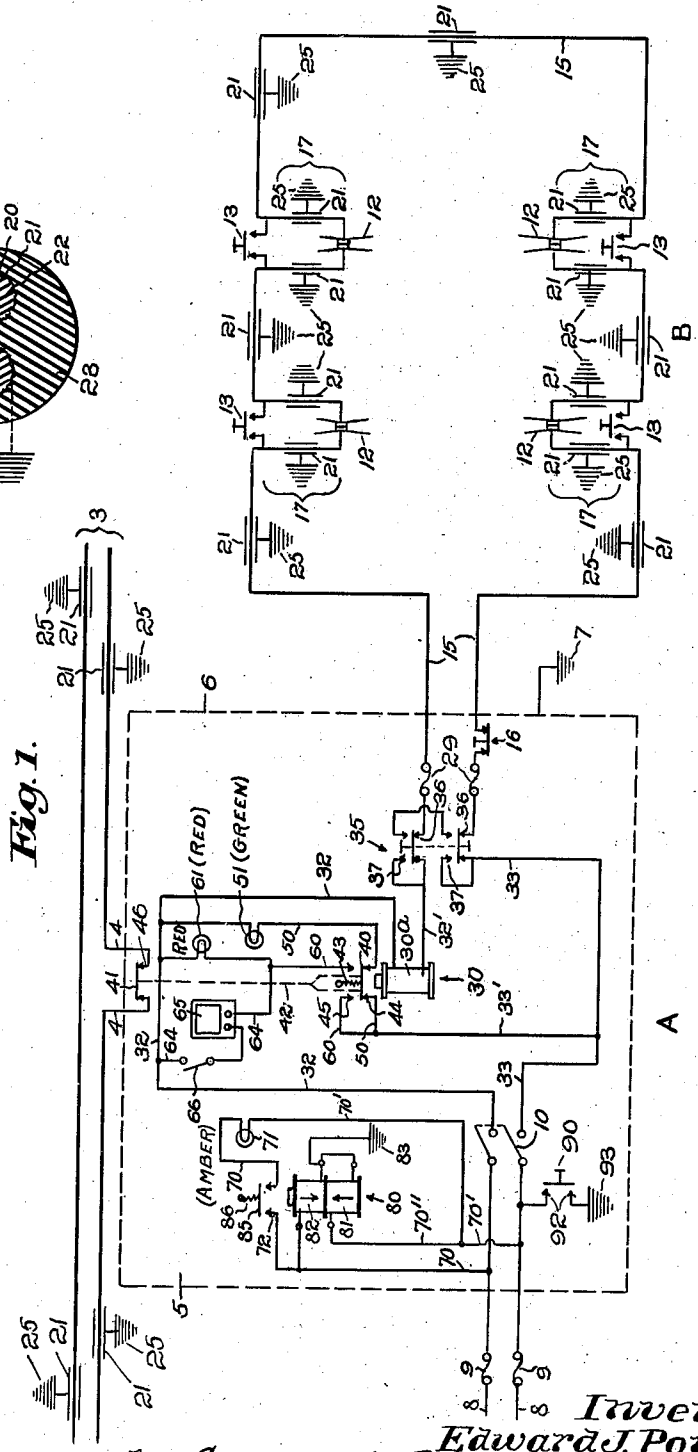


Fig. 1.



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ABNORMAL TEMPERATURE AND GROUND DETECTOR ALARM SYSTEM

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7 Claims. (Cl. 177—311)

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My present invention relates to detecting and signaling abnormal operational conditions, particularly those characterized by undue heating. Being especially applicable to electric alarm system to be actuated in response to such condition as an overheated journal box, the invention finds important use for railway cars and locomotives. It has as a main object to make provision for readily indicating the existence of an unresponsive condition in the alarm system and for determining the location and nature of the trouble.

In the drawing illustrating one embodiment of a system in accordance with the invention:

Fig. 1 is a schematic view and wiring diagram of typical apparatus and manner of arrangement in the system; and

Fig. 2 is an enlarged cross-section of a conductor cable appropriate for use in the system, particularly the portion seen at the right in Fig. 1.

Further by way of general explanation, it will be appreciated that in train operation stringent safety requirements make it highly desirable that railway signals shall be "fail-safe." By this I mean that the signal system should be such that in the event of becoming unresponsive to the expected operation, the unresponsive condition shall be promptly evident to those in charge of operations. My invention accordingly provides for fail-safe operation and simplified servicing of an alarm system through novel construction and arrangement enabling a systematic check as to the location, cause and nature of the operative interruption or failure. As will be apparent from the following description in connection with the drawing, the invention contemplates certain safe operation tests as to the instant status both of the system as a whole and of various component elements.

Referring now to Fig. 1, a main or general alarm circuit is indicated generally at 3. This may be understood for example as the usual or any preferred alarm circuit of one or more railway cars, generally extending to the locomotive in the case of a train. The detector and condition-testing means of the system are in this instance adapted to impose signals upon the general alarm circuit 3 as through leads 4 in series connection with that circuit. This general or train alarm circuit 3 desirably has grounded shielding 21, 25 similarly as will be explained with reference to unit B of Fig. 1 and to Fig. 2. If desired a special alarm circuit may be provided in lieu of the regular train alarm circuit 3, and the detector and fail-safe system to be described may be employed for

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electric alarm circuits other than for railway use. It will also be understood that the system is susceptible of use where conditions other than temperature are to be detected or controlled, as for instance for warning of or response to conditions of abnormal pressures, excess or deficient humidity and others.

In Fig. 1 two main units or sections are evident, respectively designated as a whole at A and B. The unit A comprises a control panel 5 at which the dotted line 6 represents a shielding enclosure with grounding as at 7. The unit or section B, to be referred to as the detector circuit, is typical of the circuit at the location from which the overheated or other undesired operative condition is to be determined, such as a hot box at a car axle. A group of four journal boxes, for example, are indicated in connection with unit B. These may be on one truck of a railway car, on a number of trucks of the given car, or on different cars in a train. It is contemplated with reference to railway installations that a panel such as represented at A will be conveniently located at each car and also at the locomotive, but if preferred in some instances two or more cars may be arranged for signaling to an alarm station at one of them. The relays for the various cars of a train, such as that at 46 associated with the leads 4, 4 to the train alarm 3, desirably are placed in series throughout the train. This enables the complete train to be continuously monitored in a fail-safe system, in a similar manner as for the alarm at each car with respect to the individual journals thereof.

Leads 8 from a suitable power source for the alarm system are indicated at the left in Fig. 1, extending through fuses 9 to a main power switch 10 at the panel 5. The power source is ungrounded, as usually preferred in railway uses, and as will be apparent the present system desirably includes provision for detecting grounds. The advantages of an ungrounded system in this connection will be evident from the subsequent description, noting that in general one ground can occur without causing trouble, at least two simultaneous grounds having to occur before an inoperative condition can arise in any part of the system. The main switch 10 shown as a double-pole single-throw type is adapted when closed to energize the entire apparatus of the panel or board 5 and also the circuit of the one or more detector units or sections B. With reference to the control unit A and the panel 5, it will be noted that the main switch 10 serves to separate two circuits at the panel and also that

one circiut portion at the panel, that appearing directly above the switch in Fig. 1, is not influenced by the opening or closing of this switch.

Considering first a typical detector circuit such as represented by unit B, at the right in Fig. 1 this comprises one or more and generally a series of thermal switches 12, one for each location to be protected against an overheated state, such as a "hot box." Four such switches 12 are indicated in Fig. 1, as for example at the outer ends of the axles of a four-wheel truck, or they may be regarded as on different trucks. In railway applications there usually will be eight, twelve or other number of these thermal switches to each car. Each switch 12 normally is closed as seen in Fig. 1 and is designed to open in response to rise in temperature. For railway use as referred to these thermal switches 12 are set to open when the corresponding journal box temperature reaches a point dangerous to train operation, which is usually in the neighborhood of of 350° F. The individual switches may be of any known or preferred construction, but preferably are such as disclosed and claimed in the patent to W. J. Turenne No. 2,090,407, dated August 17, 1937, and are so indicated by the switch symbols 12 of Fig. 1.

The thermal switches 12 of the group B, or of any number of groups associated with a given control panel A, are electrically connected in series as by the line indicated at 15. Thus on heat actuation of any switch 12 the series circuit at B is opened. As previously noted the series relation of the individual journal-located thermal switches 12 to their control panel A is similar as for the several panels A in series relation to the general train alarm circuit 3 and the master panel therefor at the locomotive or elsewhere.

Adjacent each thermal switch 12 is a test pushbutton 13. These are of the normally open circuit-maker type. Each is shunted across the corresponding switch 12 and thus when pushed has the same effect for test purposes as the normal closed status of the associated switch. An open condition of any switch 12 may thereby be determined and the particular switch identified. That is, pushing of the button 13 for any particular open switch 12 re-establishes the circuit.

A reverse test, for the normal status of the detector circuit and for the associated alarm circuits to be described, as to readiness to respond to an overheated condition, is afforded as by means of a master pushbutton 16 placed in the detector line 15 at any convenient point, as for example at the panel 5 of the control unit A. As seen in Fig. 1 the button 16 is a normally closed circuit-breaker type. It is adapted to simulate the opening of a thermal switch 12 and thus serves to check the responsiveness of the system for such occurrence.

It will be appreciated that alarm system installations such as for railway rolling stock are subject to severe operating conditions and varying weather effects. Accordingly the invention importantly includes provision for detecting wiring failures, particularly in the detector circuits and at the regions served by them. For this purpose the line 15 for each detector circuit B is constituted by cable means in which the one or more conductors are individually constructed and arranged for automatic grounding in case of insulation failure. Further, these cables, or at least the portions extending from a car to the journal boxes as generally indicated at the regions 17 on Fig. 1, are flexible, to afford the desired non-rigid connections as between the car body and truck-borne parts.

In the illustrative example of Fig. 2 each conductor 20, 20 is placed within a shield 21, 21, a metallic sheath-like enclosure or partial enclosure separated from the conductor by insulation 22. The one or more individually shielded conductor elements 20—21 are in turn enclosed in an insulating and protective rubberous or like case 23. Each conductor 20 and its shield 21 are so related that breakdown of the insulation 22 between them as the result of flexure, heating, aging, or other use condition will cause the wire 20 to be shorted against the encompassing shield 21.

As indicated at the various points designated 25 on unit B of Fig. 1, also on Fig. 2, the shield elements 21 of the cable are grounded. And through the alarm circuits to be described this grounding of the conductor shielding 21 in its entirety is utilized as an element of the protective or fail-safe circuit here concerned, effecting a characteristic response in the event of shorting of a conductor 20 to its shield 21 as referred to. The points of grounding 25 for the shield are provided in such number and are so distributed, particularly at the regions 17 adjacent journal boxes, that a conductor shorting at substantially any location in the circuit of a unit B will give the desired warning indication. The same likewise applies to a grounding short in the train line 3 or within the shielding of a panel A.

The grounded-shield line 15 of the detector unit B extends to the control unit A, herein through the master test button 16 previously mentioned and through fuses 29 to protect the circuit B for mover loads. In the unit A one circuit subject to the main switch 10 comprises a relay 30, the coil 30*a* of which is in series with the unit B circuit. This relay controls the status of certain indicator or alarm means preferably both visual and audible and also controls the imposing of a signal onto the main or general alarm circuit 3, all in response to a call from some point in a detector circuit B. From the main power switch 10 one lead 32 runs to the coil 30*a* of the relay 30, and thence to one side of the detector circuit 15. Another lead 33 from the other side of the power line at switch 10 is adapted for connection with the other side of the detector circuit 15, herein through the master pushbutton 16 previously mentioned.

Between a portion 32' of the lead 32 from the relay coil 30*a* and an adjacent portion of the other main lead 33 there is interposed a double-pole double-throw pushbutton indicated generally at 35. In the normal position shown the lower pairs 36 of two sets of pushbutton contacts are closed to connect the relay into the detector circuit B. The other contact pairs 37 shown in the normal open condition are serially connected to by-pass the lower contact pairs 36, for cutting out the detector circuit B and directly closing the circuit of relay 30 when the button 35 is pressed. Accordingly the button 35 provides a test for the over-all ready condition of the alarm circuits to be described, for continued or resumed normal operation thereof as when no overheated condition is present.

The relay 30 responsive to the detector circuit B in turn selectively controls a plurality of parallel and alternate alarm circuits. The relay 30 is double, having two armature members 40 and 41 arranged for simultaneous actuation as indicated by the mechanical connection shown

dotted at 42. Spring means as at 43 biases the armatures 40, 41 in the upward direction in Fig. 1. The relay armature 40 is a double-pole double-throw type adapted to close the circuit across one pair of contacts 44 when the relay coil 30a is energized, and to make contact across another adjacent pair of contacts 45 upon de-energizing of the relay and freeing of the armature to the action of the spring means 43. Simultaneously with the normal relay-energized closing of the contacts 44 by the armature 40, the other armature 41 normally closes a pair of contacts 46 for completing the circuit through the leads 4 in series in the general or train circuit 3. Breaking of the circuit at 46 under de-energizing of the relay 30 accordingly will impose a signal on the general alarm circuit 3.

The parallel indicator or alarm circuits subject to the relay 30 at the panel 5 extend between a branch 33' of the lead 33 and the other lead 32. First, there is a connection 50 from the branch 33' and through the lower relay contacts 44 (normally closed by the armature 40) and through a lamp 51 and thence to the other lead 32. This lamp is of a distinctive color, preferably green as indicated, significant of a normal "safe" or operative condition of the system and of the equipment of which the overheated condition is to be detected. It will be seen that with the relay coil 30a energized as under the normal closed status of the thermal switches 12 the green light 51 is on.

Second, an alternate parallel circuit between the branch 33' and the lead 32 comprises a connection 60 through the upper contacts 45 (open when the relay is energized) and through a lamp 61 to the lead 32. The lamp 61 is of another color, preferably red as indicative of a danger condition at some region subject to the thermal detection. Upon de-energizing of the relay coil 30a the circuit is broken at the normally closed contacts 44, extinguishing the green light, and is made at the opposite contacts 45, lighting the lamp 61 (red). At the same time the circuit is broken at the relay contacts 46, at the upper part of the Fig. 1 diagram, thereby imposing a signal on the main alarm circuit 3 as previously mentioned.

Third, there desirably is an audible alarm circuit arranged in parallel with the visual "red" light circuit, for simultaneous operation therewith. In Fig. 1 this comprises a connection 64 from the "red" lamp connection 60 through a buzzer or the like 65 and thence through an on-off manual switch 66 to the lead 32. Thus, assuming the optional-use switch 66 is closed the budzer 65 is sounded at any time when the danger warning lamp 61 (red) is on. The switch 66 also enables the buzzer 65 to be turned off when the danger call has been observed should it be desired to avoid further audibility while the trouble is receiving attention.

The apparatus at the panel 5 as herein illustrated further comprises the circuit previously referred to as not subject to the main power switch 10. This circuit, seen at the left in Fig. 1, comprises branch leads 70 and 70' from the respective sides of the main power line 8. The branch 70' extends through a further lamp 71 and thence through a pair of contacts 72 and to the branch lead 70. The lamp 71 is of another distinctive color as for example amber. This "amber" signal circuit is arranged in association with a relay device indicated generally at 80, to give warning of the presence of a grounding short in the system, as in any detector circuit such as the unit B by insulation failure at a conductor 20 or in the train circuit 3, or at the panel 5 through the grounded shield 6, 7 of the latter.

For this purpose the relay 80 is of a differential type comprising two opposed normally balanced coils 81, 82 having an equal number of turns oppositely wound. The circuit of the relay coils comprises a branch 71'' from the lead 70' to one end of one coil, herein coil 81. From the latter the circuit extends reversely through the other coil 82 and thence to the other branch lead 70. The common connection of the coils is connected to ground as at 83. Normally, in the absence of any shorting-to-ground condition in the circuits, the two coils 81, 82 balance each other and there is zero force effective on the relay armature 85; the latter therefore normally opens the contacts 72 as shown, under the influence of a spring 86, and the light 71 (amber) is off, signifying no grounding short. But should any conductor of the circuits come into electrical contact with the enclosing grounded shielding through insulation failure as between a wire 20 and the shield 21 therefor, or at the grounded shielding 6 of the panel 5, the differential relay 80 is thrown into unbalance by reason of the current flowing through only one of the coils 81 or 82, the other coil being in effect by-passed by the grounding condition. The differential-relay armature 85 accordingly closes the circuit at the contacts 73 and through the lamp 71 (amber), so lighting the latter and indicating of the grounding occurrence.

Means desirably is provided for testing the described grounding circuit, for determining the readiness for response to an insulation failure or other shorting to ground. For this purpose I have indicated at the lower left in Fig. 1 a single-throw pushbutton 90 having contacts 92 connectable serially between ground as at 93 and one side of the main power line 8, herein the side to which the lead 33 is connected. This test button 90 is normally open. When depressed it closes at the contacts 92 a test circuit simulative of a shorting to ground. Since this circuit including the test button 90 is associated with the circuit of the differential-relay 80, a test ground condition is created thereat, responsiveness in this relation being indicated by the attendant lighting of the lamp 71 (amber).

From the foregoing it is evident that the system of the invention novelly provides for grounded shielding of alarm conductors and associated equipment such as junction boxes and the like in a manner to detect and warn of a ground in the system. Other important features of the invention include the means associated with thermally responsive switches as at journal boxes for readily checking as to which such box is in an overheated state, and various means for testing as to circuit continuity and as to the over-all operativeness of the alarm system.

The operation of the circuit components will be evident from the foregoing description of their interconnections and with reference to the illustrative embodiment of the drawing. The several lamps and signals indicate the corresponding conditions which may arise, while manipulation of the described pushbuttons tests the associated function. The information available by signals, both in actual operation and in test therefor, may be summarized thus:

With the power switch 10 open lamp 71 (amber) should be off, indicating operativeness of the local ground detector circuit, correct balancing

at the differential relay 80 and proper operative status of all parts associated with the system portion 70—86. A test for this may be had by the button 90 pushing of which should light the lamp 71 (amber) as indicative of readiness to signal a ground occurrence. Further, with the power switch 10 closed the lamp 71 (amber) should remain off, indicating no ground condition in the circuit beyond the switch 10. The test in this connection is the same as just stated.

With the main switch 10 closed, lighting of the lamp 51 (green) indicates that all thermal switches 12 are closed (assuming test buttons 13, 16 and 35 are normal) and hence that there is no overheated condition at any region subject to the system. At such time general readiness of a circuit B may be tested by master pushbutton 16, producing an effect analogous to opening of a thermal switch 12 and thereby changing from the visual indication at the lamp 51 (green) to that at the lamp 61 (red) and giving the audible signal at the buzzer 65, if in use.

Assume now that the system is in intended operation as upon a train, the main switch 10 being closed. The light 51 (green) is on, the lights 61 and 71 (red and amber respectively) are off and the buzzer 65 if in use is silent. If now the lamp 51 (green) goes off, the parallel lamp 61 (red) comes on, the buzzer 65 sounds and the remote signal as at the locomotive is given over the alarm circuit 3 (the buttons 13 and 35 being normal), then the indication is that a thermal switch 12 may be open under a hot-box condition. Thereupon a test of the actual condition may be made by successively manipulating buttons 13, until the lamp 51 (green) lights, the parallel lamp 61 (red) goes out and the buzzer if in use ceases. In this manner the particular overheated bearing is determined and isolated.

On obtaining a "danger" indication as last above mentioned, that is, by lighting of the lamp 61 (red) sounding of the buzzer and signalling to the locomotive, the operativeness of the alarm circuit may be tested as to whether the "danger" indication is due to something thereat rather than in the detector circuit, by manipulating button 35. This should re-establish the "clear" indication by relighting of the lamp 51 (green), showing the alarm circuits of unit A as being duly operative.

Thus all portions of the system as a whole are subject to operative test under substantially any condition or combinations of conditions of the component parts, and maximum assurance of "fail-safe" operation is afforded.

Through the use of an ungrounded power source and the described provisions for grounded shielding encompassing the conductors in the various circuits, the system is made to include detection and signaling of grounds. And by reason of the ungrounded system "fail-safe" operation is promoted to the further extent that one ground can occur without interference with the continued intended functioning of the system. It is expected that the maintenance personnel will remove such ground before a second one has a chance to develop. For instance, the instructions to the operating personnel are understood to be that when the lighting of a lamp 71 (amber) of a control panel A indicates a ground condition, the proper person will determine by the described test means whether the ground is in a detection circuit B under that control panel A and will remedy the fault immediately, before development of a second ground could cause one or more of the thermostatic switches 12 to be by-passed in such detector circuit B.

My invention is not limited to the particular embodiment thereof illustrated and described herein, and I set forth its scope in my following claims.

I claim:

1. In an alarm system for warning of an abnormal operating condition, an electrical switch responsive to the abnormal condition, an electric conductor in circuit with the switch, the conductor having grounded conductive metallic shield means substantially encompassing and normally insulated from it, an alarm device actuated in response to operation of the switch due to an abnormal operating condition, and ground detector means responsive to a shorted condition as between the conductor and the shield means.

2. In an alarm system, a detector circuit containing in series with it one or more condition-responsive switches and connective conductors, grounded conductive metallic shield means individually encompassing and normally insulated from the conductors, ground detector means responsive to a shorting of a conductor to the shield means, and auxiliary manual means at the one or more switch locations for determining the continuing non-grounded status of the particular switch or switches.

3. In an alarm system, a detector circuit containing in series with it one or more thermal switches and connective conductors, grounded shield means individually encompassingly adjacent and normally insulated from the conductors, an alarm operable in response to action of a thermal switch of the detector circuit, a normally ungrounded circuit including a power source, a differential relay and a signal device controlled by the relay, and means including a ground connection to the relay whereby shorting of a conductor to the grounded shield means causes the relay to actuate the signal device.

4. In a railway journal-box alarm system, detector means comprising thermally responsive units serially interconnected through encompassingly insulated non-grounded electric conductors, grounded conductive metallic shielding encompassing each conductor, said conductors connectible to an ungrounded power source, alarm means for operating in response to action of a thermally responsive unit of the detector means, and a ground detector means responsive to a grounded condition of the electric conductors.

5. In an alarm system according to claim 4, the combination and arrangement in which the ground detector means comprises an ungrounded power source, and differential relay coils are connected across the power source and center tapped to ground.

6. An electrical alarm system particularly adapted for railway use to warn of an abnormal operating condition such as a hot-box, the system comprising, in combination, a general alarm circuit extending along one or more railway cars, a plurality of normally closed electrical switches respectively subject to the condition to be warned of at a like number of locations, electric conductors serially connecting the switches and having grounded conductive metallic shield means normally insulated therefrom, a relay also in series with the switches and with a power source, signal means controlled by the relay including local signal devices informing of a normal and of an abnormal status of the switches and conjoint means to impose a signal on the general alarm circuit,

and a relay and a signal device controlled thereby in accordance with the absence or the existence of a shorting of a conductor across to the shield means therefor.

7. In a system for warning of overheated railway journal boxes, a general alarm circuit extending along one or more railway cars, normally closed thermal switches in heat-subject relation to the respective journal boxes, insulated electric conductors serially connecting the thermal switches, grounded conductive metallic shield means encompassing and normally held out of electrical contact with the conductors by the insulation thereof, a relay and a signal device controlled thereby according to the absence or the existence of a shorting of a conductor to the shield means, a further relay also in series with the switches and a power source, and signal means controlled by the relay including local signal devices and conjoint means to impose a signal on the general alarm circuit.

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