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ELECTRIC ALARM CIRCUIT

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Our invention has relation to improvements in electric alarm circuits and it consists in the novel features of construction more fully set forth in the specification and pointed out in the claims.

The invention is particularly directed to an alarm circuit that may be connected to the various power circuits in buildings and residences primarily for sounding, or otherwise giving an alarm in case of fire, and secondarily for permanently opening a circuit that has been shorted.

The objects of the invention are to provide a comparatively simple alarm circuit that is certain in its operation; one that embodies means for disconnecting from the line any circuit of a series that has been shorted so that the operation of the alarm in other circuits may not be impaired; one in which a single switch is capable of responding either to heat or a short in any of the power circuits; one in which the action is produced by a relay in each power circuit, said relay being associated with a fuse, the replacement of which automatically sets the relay. Further and other advantages will be better apparent from a detailed description of the invention in connection with the accompanying drawing in which:

Figure 1 is a diagrammatic view of our improved alarm circuit applied to two power circuits connected in parallel; Fig. 2 is a cross-sectional detail through a part of the panel on which the associated relays and fuse plugs are mounted; Fig. 3 is a side elevation with parts broken away of our specially designed oscillating switch for selectively closing the proper circuit depending on whether the switch has been actuated by a fire or by a short circuit.

Referring to the drawing, the power or work circuits comprise conductors 1, 2, and 2', conductor 1 being directly connected to line wire L and conductor 2 being connected to line wire L' by a conductor 3 and a conductor 4 between which fuses 5 and 6 are connected in series. Conductor 2' is similarly connected to line wire L' by conductors 3' and 4', between which are fuses 5' and 6'. Fuses 5 and 5' are capable of carrying a heavier load (approximately 20 amp.) than the fuses 6 and 6' (10 amp.). The adjacent ends of fuses 5 and 6 are connected to a single pole switch 7 by a conductor 8, and adjacent ends of fuses 5' and 6' are connected to a single pole switch 7' by a conductor 8'. Switches 7 and 7' are normally held out of contact with contacts 9 and 9' by triggers 10 and 10' which comprise

armatures within coils 11 and 11'. Corresponding ends of coils 11 and 11' are connected to line wire L' by conductors 12 and 12' respectively, while the opposite corresponding ends of coils 11, 11' are connected to armatures 10, 10' respectively. The switches 7, 7' and associated parts just described constitute relays for connecting their respective power circuits to the alarm circuit should a fire or a short circuit occur in one of the power circuits, as will be more apparent hereinafter. Our alarm circuit is primarily intended to give an alarm in case of a fire, consequently, thermostatic switches of any common type are distributed throughout the building that is protected by our invention. Each thermostatic switch 13 is connected in series with a flasher, or blinker, comprising contacts 14 and 15, and a coil of nichrome wire 16 which is designed, on being heated by a flow of current, to separate the contacts, thus interrupting the flow of current. As the coil cools, the contacts again come together, producing a continuously interrupted flow of current across the conductors of the circuit.

The foregoing description shows that fuses 6 and 6' and coils 11 and 11' are in parallel-series connection with the power circuit and that when these circuits are operating under load, current will flow through the fuses 6 and 6'. However, when either of the thermostatic switches 13 are closed there will be a heavy current flow through either fuse 6 or 6' because the flasher coil 16 is of low resistance and the fuses 6 and 6', depending on which switch 13 is closed, will be blown and cause the current to flow through either coil 11 or 11'. Assuming that the thermostatic switch 13 in the power circuit comprising conductors 1 and 2 closes, the coil 11 will be energized and will withdraw the trigger 10 from the switch 7, allowing said switch to be closed on the contact 9 under the influence of a spring 17 (see Fig. 2).

At this point it should be pointed out that a transformer T has its primary winding connected across the line by means of conductors 18 and 19 leading to one end of said winding and conductor 20 leading from the other end of the winding to a trigger armature 21 normally operating to hold the switch 22 out of engagement with a contact 23, the pivot end of switch 22 being connected to line wire L by a conductor 24. Thus, the transformer primary winding is connected directly across the 110 volt line. The secondary winding of the transformer T is connected to the primary winding by a conductor 25 and at the opposite

end to a coil 27 by a conductor 26, the opposite end of said coil being connected to the switch contact 28 by a conductor 29. A switch lever 30 has its free end normally engaged with contact 23 and its pivot end connected by a conductor 31 to each of the contacts 9 and 9'. It is thus apparent that the circuit of the transformer secondary is closed when either of the switch levers 7, 7' engage contact 9 or 9'. We have assumed that the switch 7 has been closed on the contact 9 and we will trace the transformer secondary circuit through this connection: from one end of the transformer secondary through conductor 26 to the coil 27, thence through conductor 29 to contact 23, switch lever 30 through conductor 31 to contact 9; the path of the current is then through switch lever 7, conductor 8, fuse 5, conductor 3, to conductor 2, through the closed switch 13 and flasher (elements 14, 15, and 16) to conductor 1 and line wire L to conductor 24, switch lever 22, armature 21, conductor 20 and transformer secondary. The actuation of the switch lever 7 breaks the connection between the power or work circuit and the line and connects the transformer secondary in series with the power circuit. This results in the flow of a low voltage current from the transformer secondary through the coil 27 and the flasher (elements 14, 15, and 16) causing current to intermittently pass through the coil 27 and intermittently attract armature 32 depending from float 33 within casing 34.

The casing 34 and its associated parts about to be described comprise an oscillating switch for selectively closing the alarm circuit, or the safety circuit about to be described. The casing 34 has a well 35 depending from it normally filled with mercury to the level indicated by x in the diagram and a partition 36 divides the casing into two compartments 37 and 38. There is a small port 36' at the bottom of the partition 36. Compartment 37 houses the float 33 with its depending armature 32 extending into the well 35 and compartment 38 has contacts 39 and 40 extending into it, the latter being somewhat longer, and of course, closer to the level of the mercury when the thermostatic switch is inactive. There is also a contact 41 extending into the bottom of the well 35 and making permanent electric connection with the mercury. The intermittent flow of low voltage current through the coil 27 causes the float 33 to bob up and down, or oscillate in the mercury, displacing some of the mercury which splashes over the partition 36 into compartment 38, raising the level therein until the mercury touches contact 40. When this contact is made between the mercury and the contact 40, the oscillating switch circuit which closes the alarm circuit is activated. This oscillating switch circuit is as follows: from conductor 18 to contact 41 through the mercury in casing 34 to contact 40, through conductor 42 to the thermo-electric element 43, through conductor 44 to coil 45 associated with armature 21, through said armature and switch 22 to conductor 24 and line wire L. The thermo-electric switch comprises a high resistance coil 46 and a pair of contacts 47, 47 in parallel therewith and adapted to be closed by the warping action produced when the coil 46 becomes sufficiently heated. The coil 46 is of sufficiently high resistance so there will not be enough current flowing through coil 45 to attract armature 21 until the contacts 47, 47 have been brought together. The reason for this is to guard against an accidental closing of switch 22 with contact 23. It will take approximately 40 seconds for the coil 46 to become sufficiently heated to close the

gap between contacts 47, 47 and allow sufficient current to flow through the coil 45 to attract the same and release the switch lever 22 so that it may close against the contact 23. This circuit just traced may be termed the alarm relay circuit as it operates the relay comprising elements 21, 22, 23, and 45 to close the alarm circuit which comprises conductor 24, switch lever 22, contact 23, conductor 46, bell (or other alarm) B, conductor 48, conductor 18 and line wire L'. Obviously, the release of switch lever 22 opens the transformer primary circuit. Thus, it is apparent that if any of the thermostatic switches 13 are closed and remain closed for an appreciable length of time, the alarm relay is actuated to close the alarm circuit, producing the alarm at the fire department, or in other suitable places.

Some provision must be made for preventing the alarm circuit from being actuated, or put out of commission, by a short in any of the power circuits. We therefore embody in the invention a safety circuit should a permanent short develop in any of the power circuits as follows. We will assume that conductors 1 and 2 comprising one of the power circuits are shorted so as to cut out the resistance of the load on this circuit. This will cause a current flow as before through fuses 5 and 6 resulting in the blowing of the lower capacity fuse 6, whereupon the current will then flow through coil 41 and actuate armature 10 connecting switch lever 7 with contact 9 as before. This will produce a steady flow of current through coil 27 instead of an intermittent current and the float 33 will be drawn downwardly into the mercury in casing 34 and held down so as to cause the displaced mercury to contact with the terminal 39 which is connected to a high resistance coil 49 similar to coil 45. The coil 49 is also connected to conductor 31 by a conductor 50 so that there will be a flow of current at line voltage through the coil 49. As this coil becomes heated, contacts 51, 52 will be warped together thus providing a shunt path for the current through contacts 51, 52, conductor 53 and coil 54 which is adapted to actuate an armature 55 cooperatively connected with switch lever 30. It may be mentioned at this time that the gap between contacts 51 and 52 is shorter than the gap between contacts 47, 47 so that, although current is flowing through resistance 46 at the same time current is flowing through resistance 49, the alarm circuit will not be closed because the safety switch actuating circuit, including contacts 51 and 52 will first close and provide a comparatively low resistance circuit for the current. The energizing of coil 54 attracts the armature 55 and moves the switch lever away from contact 23 and into engagement with contact 57. Since contact 57 is connected by a conductor 58 and conductor 18 to line wire L', and switch lever 30 is connected by conductor 31, switch lever 7 and the shorted power circuit to line wire L, there will be an excessive current flow through this power circuit resulting in the blowing of the heavier fuse 5, thus opening this particular power circuit. Of course, when this circuit is opened, safety switch lever 30 is restored to its normal position in contact with the contact 23 and the entire alarm circuit again becomes inactive and in condition for service in the event thermostatic switch 13 in any other of the power circuits is closed. Thus, a short circuit does not interfere with the operation of my improved alarm circuit, but merely results in the particular power circuit having the short being temporarily disconnected from service.

The fuse plugs 6 and 6' are mounted in a conventional manner on a panel 59, as are also fuse plugs 5, 5'. Switch levers 7, 7' are mounted on panel 60 secured in spaced relation to the panel 59. The upper part of the switch levers 7, 7' are each forked so as to receive a pin *p* which is adapted to make contact between fuse 6 or 6' and the holding clip 61 for fuse 5 or 5'. A contact 62 connects clip 61 with a connecting post 63 extending between panels 59 and 60, and a yielding contact 64 connects the post 63 with pin *p*. The pin *p* has a coiled spring 65 mounted on it between the panel 60 and a sleeve 66, said spring being held under tension when the fuse plug 6 is in place. When the switch lever 7 is set as shown in the diagram (Fig. 1 and Fig. 2), it is spaced from the shoulder 66' so that on retracting the trigger armature 10, it may be forced into contact with the contact 9 under the tension of the spring 17. As we have seen, when this contact is made between switch lever 7 and contact 9 the fuse 6 has been blown and it must be replaced in order to restore the circuit to operative condition. In removing the plug 6 the spring 65 forces the pin *p* into the socket of fuse plug 6, shoulder 66 rocking the lever 7 behind the armature trigger 10, thus resetting the relay. When the new fuse plug 6 is put into the plug socket the pin *p* will be forced through the panel 60 to a greater extent and shoulder 66 will be withdrawn from contact with the switch lever 7, allowing said lever freedom to again snap into engagement with contact 9.

We will assume that switch levers 7 and 7' are set as shown in the diagram of Fig. 1 and in Fig. 2, and that the switch lever 22 is also set as shown in the diagram. The circuits are now in condition for operation and if either thermostatic switch 13 is closed by the heat caused by a fire in the building, current will of course flow through that particular power circuit intermittently because of the action of the flasher contacts 14 and 15. The resistance of the flasher coil 16 is low so that on the first current impulse the fuse 6 or 6' will be blown, thus insuring an intermittent flow of current through switch 7, armature 10 and coil 11, which is energized to release the switch 7, whereupon it is forced by the spring 17 (Fig. 2) into engagement with contact 9. This movement of the switch 7 brings into action the oscillating switch comprising the casing 34 and associated parts. The actuating current for the oscillating switch comes from the secondary of transformer T, the circuit including coil 27, switch lever 30, contact 9, switch lever 7, flasher contacts 14 and 15, line wire L, switch 22, armature 21, conductors 20 and 25, as above pointed out. We thus have a small current flow from the secondary of transformer T impressed on the coil 27 which produces an oscillating movement of the float 33 due to the fact that flashers (14, 15, and 16) are in the circuit. This constantly oscillating float agitates the mercury 37 so that it will make contact with element 40, thus closing, as above pointed out, the circuit through coil 46 and through coil 45, which has the line voltage impressed on it as heretofore shown. Owing to the resistance of the coil 45 there will not immediately be sufficient current flow through the coil 45 to actuate the armature 21, but when coil 46 has heated sufficiently to close the gap between the contacts 47, 47 resistance in the circuit is reduced and the armature 21 actuated to release switch 22 which (under the influence of a spring not shown) engages contact 23 to close the alarm circuit and

cause the alarm B to be sounded. The action just described takes place in case of a fire in the building and the consequent closing of thermostatic switches 13.

Should the power circuit, comprising conductors 1 and 2, or 1 and 2', be shorted it is obvious that the flasher will not come into operation but the flow through the circuit will be steady so that the float 33 instead of oscillating will be held down by continuous energy in the coil 27. The downward movement of the float 33 displaces enough mercury to raise the level in the well 38 high enough to contact with the element 39 as well as the element 40. Thus the current will flow through coil 49 of the safety circuit (as above described), and when this coil has heated sufficiently to close the gap between contacts 51 and 52 the current will flow through coil 54, energizing said coil to actuate the armature 55 into engagement with contact 57. Since contact 57, as above pointed out, is connected to line wire L', and since the switch 30 is connected in the shorted power circuit, there will immediately be a heavy flow of current through 20 ampere fuse 5 causing this fuse to be blown to put the circuit out of commission before the alarm circuit has been actuated. The reason the alarm circuit is not actuated is because contacts 51 and 52 come together before contacts 47, 47 can come into engagement.

The foregoing shows clearly that we have a positively acting alarm circuit to indicate the presence of a fire in a building equipped with our device, safety means being embodied to not only prevent the sounding of an alarm but also to put the particular circuit affected out of commission in case of a short developing in said circuit.

Having described our invention, we claim:

1. A composite work circuit and alarm circuit comprising a work circuit including a fuse in series therewith, a relay having its winding in shunt to the fuse, a normally open alarm switch, a flasher switch having flasher contacts and flasher contacts control means, a connection to the work circuit including in series the alarm switch, the flasher contacts, the flasher control means and the fuse, whereby when the alarm switch closes or upon the occurrence of a short in the work circuit the fuse will blow and remove the shunt across the relay winding, an oscillating switching means comprising means for closing one circuit only upon oscillation thereof or this one circuit and another circuit upon permanent operation thereof, electromagnetic means for operating the switching means, means operated by the relay when its winding is energized for connecting the work circuit with the switching means operating means, whereby in case of the closure of the alarm switch the switching means will be oscillated while in case of a short in the work circuit the switching means will be permanently operated, an alarm and means controlled by said circuits to differentiate between the closure of said one circuit or the closure of both circuits and operate the alarm only on the closure of said one circuit.

2. A composite work circuit and alarm circuit comprising a work circuit including a fuse in series therewith, a relay having its winding in shunt to the fuse, a normally open alarm switch, a low voltage switch having flasher contacts and flasher contacts control means, a connection to the work circuit including in series the alarm switch, the flasher contacts, the flasher control means and the fuse, whereby when the alarm switch closes or upon the occurrence of a short

in the work circuit the fuse will blow and remove the shunt across the relay winding, an oscillating switching means comprising means for closing one circuit only upon oscillation thereof or this
5 one circuit and another circuit upon permanent operation thereof, electromagnetic means for operating the switching means, means operated by the relay when its winding is energized to disconnect the working circuit from its high voltage
10 power source and connect the work circuit with a low voltage power source and the switching means

operating means, whereby in case of the closure of the alarm switch the switching means will be oscillated while in case of a short in the work circuit the switching means will be permanently operated, an alarm and means controlled by said circuits
5 to differentiate between the closure of said one circuit or the closure of both circuits and operate the alarm only on the closure of said one circuit.

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