

[54] SWITCH FAILURE MONITORING DEVICE

[75] Inventor: **Mohammed H. Zanboorie,**
Rockville, Md.

[73] Assignee: **The United States of America as
represented by the Secretary of the
Department of Health Education and
Welfare, Washington, D.C.**

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[56]

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Primary Examiner—J. D. Miller

Assistant Examiner—Harry E. Moose, Jr.

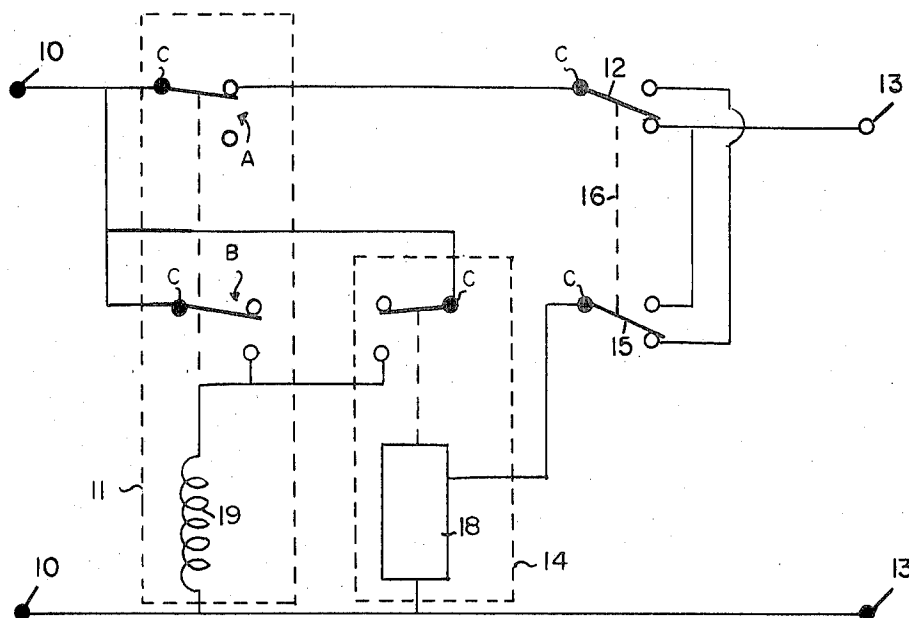
Attorney, Agent, or Firm—Browdy and Neimark

[57]

ABSTRACT

A switch failure monitoring device comprising two switches which are ganged together so that they operate substantially simultaneously; should either of them function incorrectly then a relay removes potential from the load.

5 Claims, 3 Drawing Figures



SWITCH FAILURE MONITORING DEVICE

FIELD OF THE INVENTION

The present invention relates essentially to a switch failure monitoring device and, more particularly, to a switch failure monitoring system having a monitoring switch and a monitored switch, so connected that unless both of these switches are operated substantially simultaneously, a power relay will function to remove potential from the monitored switch and its load, thereby protecting operating personnel.

BACKGROUND OF THE INVENTION

In dangerous types of industrial machinery, such as punch presses, sheet metal shears, and the like, it is desirable that the control system thereof be designed in such a manner that both hands of the operator are required to initiate an operation and hence are out of the danger area. Since it is inherently impossible for a person to actuate two switches simultaneously, it is common practice in control systems of such kind to provide a means for establishing a time interval during which the two switches must be actuated to initiate the operation.

However, it has been found that in practice the desired safety is not achieved with prior art constructions. For example, certain operators will "cheat" the system and maintain one of the switch units in a permanently closed position, such as by stretching a piece of adhesive tape or the like across one of the switch units in a position maintaining the operating button thereof depressed, so that in this way one of the switch units is always maintained closed, and with such an expedient an operator can have one hand free so that he still can be injured.

Additional problems can occur in the failure of prior control devices. Thus, recent failure of interlocks in cabinet radiographic units have resulted in a severe damage to the operators. Failure of the safety interlocks on some microwave ovens of the same model have resulted in "recall" of these units including a massive program to locate these ovens and to correct the failure before serious damage occurs to users.

SUMMARY OF THE INVENTION

The present invention overcomes many of the weaknesses and shortcomings of similar prior art safety devices by providing an effective and foolproof monitoring device to insure that the operation of two switches is performed properly to thereby protect personnel.

It is, accordingly, an object of the present invention to overcome the defects of the prior art, such as indicated above.

It is another object to protect operating personnel of microwave ovens and cabinet radiographic units.

It is another object of the present invention to provide an improved safety interlock system.

Another object of the present invention is the provision of a switch monitoring device to protect operating personnel.

Still another object of the invention is the provision of a monitoring switch to monitor another switch, both of which must be operated substantially simultaneously.

Yet another object of the invention is the provision of a monitoring device having a time delay means for

removing potential from the monitored switch and its load should either switch function improperly.

Another object of the invention is the provision of a switch monitoring device which, in case of improper operation, removes potential from the load and maintains the disconnection until the fault is corrected.

The present invention is very important from a public health standpoint. Thousands of microwave ovens, cabinet radiograph units, and many other types of equipment require the use of interlock safety switches to protect the user from accidental exposure to radiation.

BRIEF DESCRIPTION OF DRAWING

Other objects and many of the attendant advantages of the invention will be readily appreciated as the same becomes better understood by reference to the following detailed description of an embodiment when considered in connection with the accompanying drawings in which like reference numerals designate like parts throughout the figures thereof and wherein

FIG. 1a shows a simple block diagram of a part of a system without the present invention.

FIG. 1b shows a block diagram of a system like that of FIG. 1a to which an embodiment of the invention has been added.

FIG. 2 shows a circuit diagram of an embodiment of the invention.

DETAILED DESCRIPTION OF EMBODIMENT

Referring to the drawings, there is shown in FIG. 1a a prior art system including an input terminal 10 for the application of potential from within the system, through a switch 12, to an output terminal 13. The output terminal 13 is connected to some form of load or energy consuming device within the system, not shown, such as the radiation generating load of a microwave oven or that of a cabinet radiographic unit.

Looking now at the drawing of FIG. 1b, there is shown the same input terminal 10 for the application of potential to the device comprising the invention. Connected to the input terminal 10 is a power relay 11, of any conventional design, and the output of this relay is series connected to a monitored switch 12, which may be either single or double pole, to apply potential to an output terminal 13 connected, as in FIG. 1a, to a load or energy consuming device.

Located to form a circuit connected to power relay 11, and monitored switch 12, is another series circuit comprising a time delay relay 14, of any conventional designs, and a monitoring switch 15, the time delay relay 14 being connected to the power relay 11 and the monitoring switch 15 being connected to monitored switch 12. A common barrier-type connection 16 joins monitored switch 12 and monitoring switch 15 to affect substantially simultaneous operation of the two switches. Thus unless the monitored switch 12 performs in a proper manner when it is operated, the monitoring switch 15 functions to remove potential from the load, as will be described more fully hereinafter.

Looking now at the circuit diagram of FIG. 2, it will be noted that the component parts bear the same identifying numerals as used in FIG. 1. Switches 12 and 15 each have one set of contacts. Each set of contacts has a common terminal C and two output terminals which are cross connected so that, in the energized condition as shown in FIG. 2, monitored switch 12 normally applies potential to output terminal 13, and monitoring

switch 15 normally does not apply potential to time delay relay 14. Should monitored switch 12 not operate, but monitoring switch 15 does operate, then potential is applied to time delay relay 14, and conversely, if switch 12 operates properly but switch 15 does not, then again the time delay relay 14 is energized.

The time delay relay 14 is so designed as not to function if it is energized only briefly, as by transients, but will reliably perform if the potential persists past a predetermined time duration. Relay 14 (shown in its unenergized condition in FIG. 2) has a coil and time delay mechanism designated by 18 and one set of contacts; one contact terminal of this set of contacts is left unconnected, the other contact terminal is connected to the coil of power relay 11, and the contactor arm terminal C is connected to the potential terminal 10, so that when it is energized the delay relay 14 applies power to the activating coil 19 of the power relay 11.

Power relay 11 has two sets of contacts, A and B, with the common terminal C of each set connected to input terminal 10. In its unenergized condition, as shown in FIG. 2, one contact terminal of set A applies potential from the potential terminal 10 to the common terminal C of switch 12, and the other contact terminal is left unconnected; one contact terminal of set B is left unconnected, and the other contact terminal is connected to its relay activating coil 19. As will be understood hereinafter, when contacts B are closed, power relay 11 will remain activated as long as potential is applied to input terminal 10.

Under normal conditions, when the two switches 12 and 15 are operating properly, current passes through normally closed contacts A of the unenergized power relay 11, through monitored switch 12, through output terminal 13, and on to the load.

The switch failure monitoring device of the present invention is built so that the two separate switches, the monitoring and the monitored, must be mechanically actuated at approximately the same time. This actuation renders the contactors of each switch as shown in the schematic diagram of FIG. 2, in the same mode, i.e., both are in normally open or in normally closed position, and thus line voltage will normally not appear across the time delay relay. During the transition period, when both switches are in the process of being actuated, the line voltage will momentarily be applied to the time delay relay until both switches are properly actuated. The length of time in which power is applied to the delay relay in this way is normally not long enough to activate it. However, if either switch failed to operate properly, so that the contactors are not in the same mode, line voltage will be applied to the time delay relay.

When the specified time required for the time delay relay to operate has elapsed, it will close its contacts and apply the line voltage to the power relay. The power relay will thus be energized causing its contacts A to open and thereby cut out the power supplied to the load, while causing its normally open contacts B to close and thereby sustain the line voltage across its coil so that the power relay is kept energized. The power relay will remain energized as long as the line voltage is applied to its coil. Therefore, if any of the two switches are not functioning normally, the switch failure monitoring device will render the system inoperative until the cause of the failure is corrected. Also, if an operator attempts to "cheat" the system by taping

either switch 12 or 15 closed, then the power relay will be energized preventing application of power to the output terminal 13.

It should be noted that when the line voltage is disconnected from the coil of the power relay, the monitoring device will automatically reset itself and will function as described above when the line voltage is reconnected. The elements of the system are all available and a suitable time delay relay having a desired time lag may be selected from those available.

From the above description of the structure and operation of the present invention it is obvious that the device provides many improvements over the weaknesses and shortcomings of similar prior art systems. Thus, the invention offers reliable, speedy, and adequate protection to operating personnel so that they will not be endangered by failure of removal of potential from equipment which was thought to be unenergized.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. An electrical circuit for deenergizing a load device in case of improper functioning in microwave ovens and cabinet radiographic units comprising:

an operating circuit;

a monitoring circuit connected to the operating circuit;

first means in the operating circuit for removing potential therefrom;

first switch means in the operating circuit for applying potential to a load device, said first means being a power relay connected in series with said first switch;

second switch means in the monitoring circuit; and time delay means in the monitoring circuit connected between the second switch and the power relay and arranged to energize the first means should either the first or second switches fail to function or should one of said switches be activated prematurely irrespective of whether a continuity through the load is maintained.

2. The device of claim 1 wherein the first and second switches are actuated by a common barrier for substantially simultaneous operation.

3. The device of claim 2 wherein the time delay means is a relay which operates after it has been energized for a predetermined length of time.

4. The device of claim 3 wherein the power relay has a plurality of contacts, one set of which removes potential from the operating circuit, and another set maintains potential on the relay.

5. A safety circuit comprising:

a power relay connected to a source of potential;

a monitoring switch connected to the power relay for applying potential to a load;

a monitor switch connected by a common barrier to the monitored switch so that the switches operate substantially simultaneously; and

a time delay relay connected between the monitoring switch and the power relay whereby should either switch fail to function normally or be prematurely activated the time delay relay will energize the power relay to remove potential from the load irrespective of whether a continuity through the load is maintained.

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