United States Patent

Buerki

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[54] **SYSTEM FOR DETECTING SAFETY SWITCH FAILURE**

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[52] **U.S. Cl.** .....**219/10.55,** 317/40 R, 317/60 R

[51] **Int. Cl.**.....**H05b 9/06,** H02h 5/04, H02h 1/00

[58] **Field of Search** .....219/10.55; 317/40 R, 60 R

[56] **References Cited**

UNITED STATES PATENTS

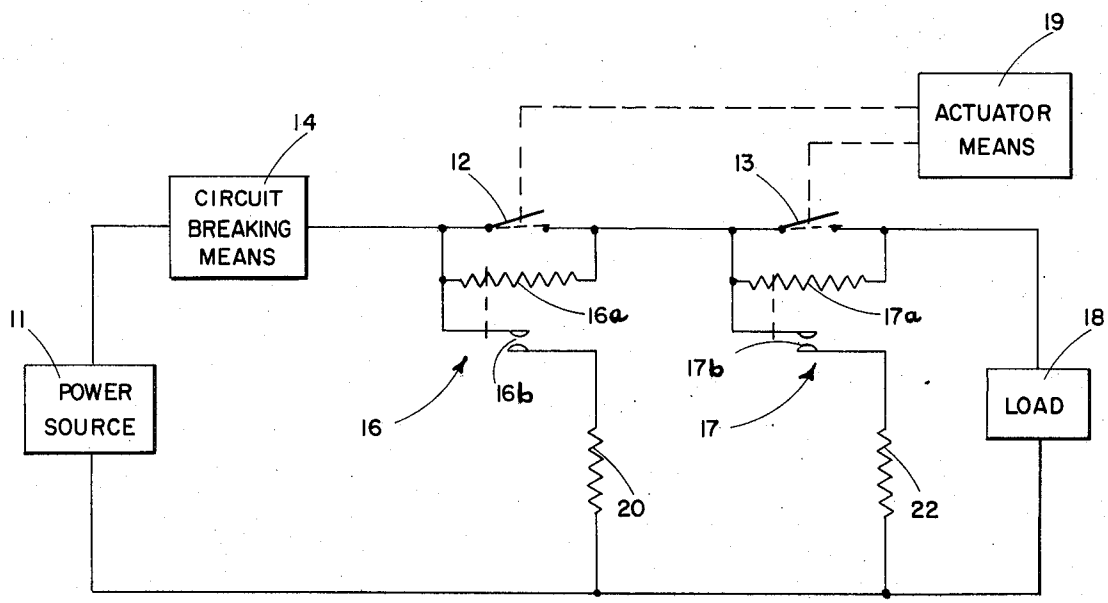
2,758,255	8/1956	Lytle	317/40 R
3,480,753	11/1969	Wilson et al.	219/10.55
3,619,722	11/1971	Gill et al.	317/40 R
3,656,023	4/1971	Hadfield	317/40 R

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[57] **ABSTRACT**

In a device such as a microwave oven, a pair of interlock switches are placed in series with the power supply to the energy generator, these switches being interlocked with the oven door which seals the microwave compartment such that when the door is opened, both switches which are in series with each other will also open to cut off the supply of power. Each of the switches has a detection circuit connected thereacross so that in the event that such switch should fail and not open when the door opens, a switch mechanism will be actuated so as to actuate circuit breaking means to interrupt the supply of power to the energy generator.

7 Claims, 2 Drawing Figures



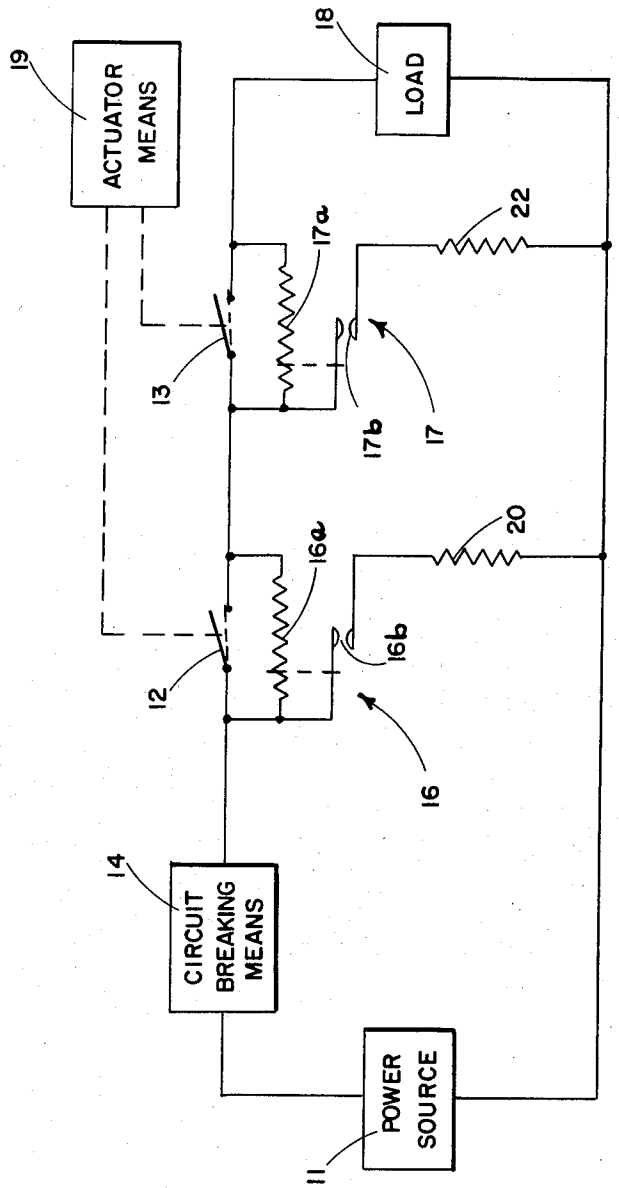

ACTUATOR MEANS
19
LOAD
18
22
17a
13
17b
17
20
16a
16b
12
16
CIRCUIT BREAKING MEANS
14
POWER SOURCE
11

FIG. 1

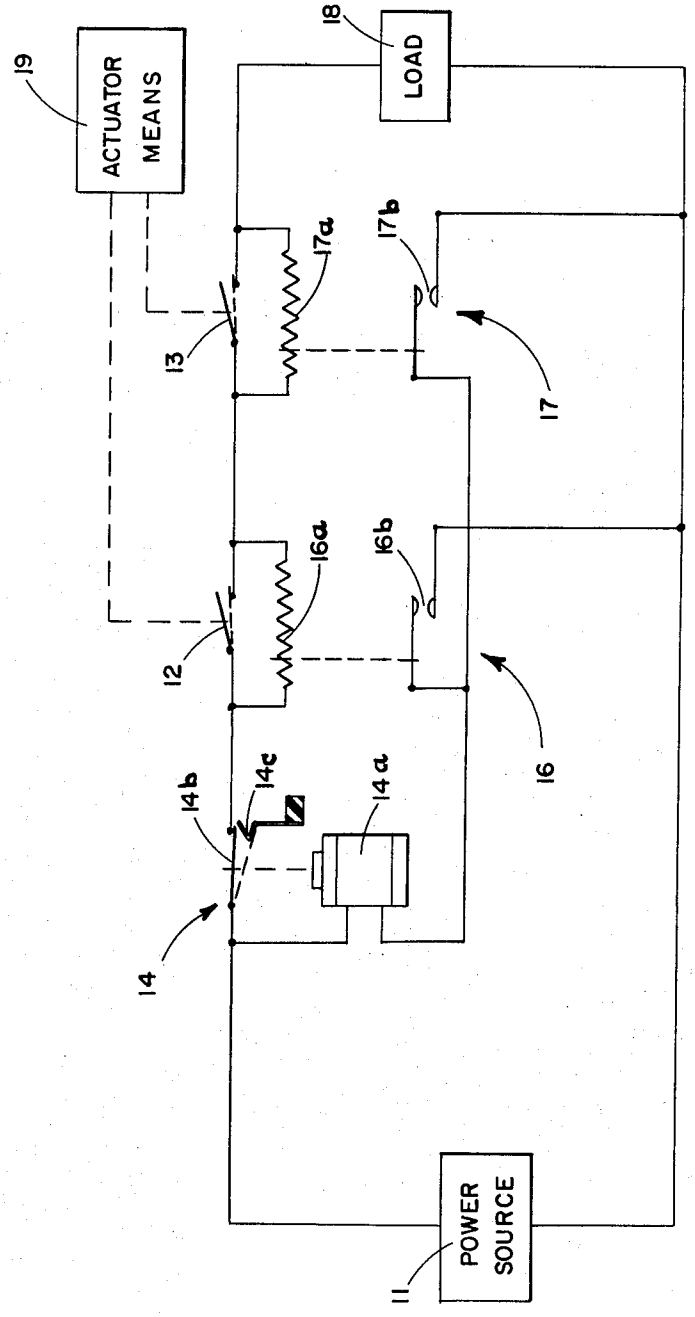

18
LOAD
19
ACTUATOR MEANS
17a
17b
13
17
16a
16b
12
16
14b
14c
14a
14
POWER SOURCE
11

FIG. 2

SYSTEM FOR DETECTING SAFETY SWITCH FAILURE

This invention relates to interlock systems for electrical power supplies, and more particularly to a device for detecting the failure of an interlock switch to insure against hazardous operation of equipment such as a microwave oven.

In the use of microwave ovens, a radiation hazard is presented to operating personnel in the event that microwave energy should inadvertently radiate outside of the oven. In order to minimize such hazard, most microwave ovens have a pair of safety interlock switches which are connected in series with each other and placed in the power line for the microwave energy generator. Both of these interlock switches generally are operated to open whenever the door to the oven is opened. In the event, however, that one of the switches should fail, no warning or indication of such condition is provided to the operator such that only a single switch is then in the circuit to cut off the power when the door is opened. This of course obviates the extra protection originally intended in the design of the oven and thus increases the risk of hazard to an undesirable degree.

The device of this invention avoids such hazard by detecting the failure of either of the interlock switches (or additional interlock switches which may be used) and providing an unequivocal indication of such failure to the operator by operating circuit breaking means to interrupt the supply of power to the microwave energy generator.

It is therefore an object of this invention to minimize the radiation hazard in the operation of equipment such as a microwave oven.

It is a further object of this invention to provide an immediate and positive indication of the failure in the operation of a power interlock switch.

Other objects of this invention will become apparent as the description proceeds in connection with the accompanying drawings, of which:

FIG. 1 is a schematic diagram illustrating a first embodiment of the system of the invention, and

FIG. 2 is a schematic drawing illustrating a second embodiment of the system of the invention.

Briefly described, the system of the invention includes a detection and switching circuit which is connected to each of the interlock switches of the equipment, these interlock switches normally being connected in series with each other between the load which may comprise a microwave energy generator for an oven and the power source for such load. The detection circuits receive no energy from the power supply when the load is normally receiving energy therefrom. In the event, however, that either one of the interlock switches should fail to open when the door or other actuating mechanism associated with the load is operated, the detection circuit associated with the normally functioning interlock switch will provide a signal to actuate its associated switching circuit , this switching circuit operating to actuate a circuit breaking device so as to interrupt the supply of power to the load. In one embodiment this end result is achieved by causing the switching circuit to place a heavy load on the power source so as to actuate a circuit breaker or blow a fuse. In another embodiment, the switching circuit actuates a manual reset relay located in the power circuit.

Referring now to FIG. 1, one embodiment of the system of the invention is illustrated. With the equipment in normal operation, interlock switches **12** and **13** are closed as indicated by the dotted lines shown in the figure, and power is supplied from power source **11** through circuit breaking means **14** which may comprise a fuse or a resettable circuit breaker, and switches **12** and **13** to load **18**. Load **18** may comprise a microwave energy generator for a microwave oven with switches **12** and **13** being interlock switches which operate to close when the door of the oven is closed and which open when the door is opened. This type of interlock mechanism is common to most microwave ovens and may operate in response to a door latching mechanism. Whenever the door is opened both switches will open to provide a double safety factor to assure that no microwave energy escapes from the oven. With both switches **12** and **13** open, current from power source **11** flows through the thermal resistive elements **16***a* and **17***a* of detector switching circuits **16** and **17**. Resistive elements **16***a* and **17***a* have a relatively high resistance so that a very low current flows through load **18**, this current being so small as to be inadequate to cause operation of the load circuit. The power supply voltage is divided equally between the two resistive elements **16***a* and **17***a*, this voltage being inadequate to operate the thermal switch contacts **16***b* and **17***b* which operate in response to the heating of resistive elements **16***a* and **17***a* to form thermal relays.

In the event however that switch **12** should fail to open when the oven door is opened, e.g., the switch should permanently remain in the closed position, then substantially the entire power source voltage will appear across resistive element **17***a*, this voltage being sufficient to generate enough heat to close thermal relay contacts **17***b*. This will provide a heavy load across power source **11** through the various switch contacts and circuit breaking means **14**, and current limiting resistor **20**, this current being high enough to actuate the circuit breaking means **14**, thereby preventing further operation of the equipment until the faulty switch **12** is replaced. Current limiting resistor **20** limits the current to a value that will actuate the circuit breaking means but will not place an undue load on other electrical components. This resistor may be omitted.

Similarly, if switch **13** should fail, i.e., not open when the oven door is opened, thermal relay **16** will be actuated in similar fashion to cause the actuation of the circuit breaking means, thus requiring replacement of switch **13** for proper operation of the equipment.

Referring now to FIG. **2**, a second embodiment of the system of the invention is schematically illustrated. This second embodiment differs from the first in that a manual reset relay is used as the circuit breaking means **14** so that a heavy load is not thrown on the power source when a failure of one of the interlock switches is sensed. As can be seen in the figure, circuit breaking means **14** comprises a manual reset relay having a relay coil **14***a* which operates contact arm **14***b*. Further included is a latching mechanism **14***c* which latches contact arm **14***b* in the open condition whenever the relay coil **14***a* operates. A mechanical manual reset of latching mechanism **14***c* is required to release contact arm **14***b* to its normally closed condition. Such manually reset relays are generally commercially

available. Relay coil **14***a* is connected between one side of power source **11** and one of the contacts of each of relay contact pairs **16***b* and **17***b*. The other contacts of each of relay contacts **16***b* and **17***b* are connected to the other side of power source **11**. When either of contacts **16***b* or **17***b* is closed in response to a thermal actuation signal from an associated resistive element **16***a* or **17***a*, relay coil **14***a* will be actuated by virtue of the current supplied thereto from power source **11**. This will cause contact arm **14***b* to be drawn to the open position where it will be held by latching mechanism **14***c*. This will interrupt the supply of power from power source **11** to load **18** until the relay is manually reset. In any event, as long as one of the interlock switches **12** or **13** fails to open in response to actuator means **19**, relay **14** will continue to be actuated so as to interrupt the supply of power to the load.

It thus can be seen that in the event of the failure of either of the interlock switches, the equipment will be placed out of operation until this condition is cured, so that hazard to operating personnel will be minimized. If so desired, warning lamps can be placed across resistive elements **16***a* and **17***a* to indicate the interlock switch failure condition. It is also to be noted that the system could also be operated with more than two interlock switches to indicate a failure of any one of the switches in the series by appropriately designing the detector switching circuits to operate with the voltage presented thereacross when any one of the interlock switches should fail.

While the system of this invention has been described and illustrated in detail, it is to be clearly understood that this is intended by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of this invention being limited only by the terms of the following claims.

I claim:

1. In an interlock system including a pair of interlock switches connected in series with each other between a power source and a load, such interlock switches operating to interrupt the supply of power to the load in response to a predetermined actuation, the improvement comprising means for detecting the failure of one of said interlock switches to operate in response to said actuation including:

a detection device connected across each of said switches for sensing the failure of the other of said switches to open in response to said actuation,

circuit breaking means interposed between said power source and said load, and

switch means responsive to each of said detection devices,

said switch means operating when the detection device connected across one of said interlock switches detects the failure of the other of said interlock switches to open, thereby actuating said circuit breaking means to interrupt the supply of power to said load.

2. The system of claim **1** wherein said detection device and said switching means comprise thermal relays.

3. The system of claim **1** wherein said load comprises a microwave energy generator for a microwave oven.

4. The system of claim **3** wherein said actuator means comprises the door mechanism of said microwave oven.

5. The system of claim **1** wherein said circuit breaking means comprises a fuse, said switch means operating to place a load on said power source so as to blow said fuse.

6. The system of claim **1** wherein said circuit breaking means comprises a circuit breaker, said switch means operating to place a load on said power source so as to actuate said circuit breaker.

7. The system of claim **1** wherein said circuit breaking means comprises a manual reset relay, said switch means being connected between said power source and the coil of said relay.

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