The invention relates generally to controls for laundry machines or the like and more particularly to a control circuit for a laundry machine such as a washer, a dryer, or a combined washer and dryer, and to a switch device usable in such a control circuit.

The general object of the invention is to provide a novel control circuit for a laundry machine, which includes a motor protector and door switch combined in a single device to simplify the installation of the control circuit and reduce the cost thereof.

Another important object is to provide a novel switch device adapted to be actuated either manually or in response to an excess of current flowing through a mechanism with which it is connected.

A still further object is to provide a novel switch device of the foregoing character, which is provided with two sets of contacts and which is arranged, when actuated either manually or in response to an excess of current, to open one set of contacts and, when actuated manually, to close the other set.

Other objects and advantages will become apparent from the following description taken in connection with the accompanying drawings, in which:

Fig. 1 is a diagram of a control circuit for a laundry machine, embodying the features of the invention;

Fig. 2 is an elevational view of a control switch included in the circuit shown in Fig. 1 and showing the parts in the position occupied when the access door of the laundry machine is closed and normal current is flowing in the motor circuit.

Fig. 3 is a view similar to Fig. 2 but showing the parts in the position they occupy when the access door is opened;

Fig. 4 is a longitudinal sectional view taken on the line 4—4 of Fig. 3;

Fig. 5 is a view similar to Figs. 2 and 3 but showing the parts in the position they occupy when an excess current has occurred in the circuit for the drive motor of the machine; and

Fig. 6 is a view similar to Fig. 4 but taken on the line 6—6 of Fig. 5.

As mentioned above, the present invention is adapted for use in a laundry machine such as an automatic washer, a dryer, or a combined automatic washer and dryer. Particularly, it relates to a combined motor protector and door switch for use in such a machine. In the drawings, as a specific example, I have shown the invention used in connection with a dryer of the type adapted for home use and having electrical heating elements to provide the drying action.

In a laundry machine of the foregoing type, some type of overload protection is required in the circuit of the main drive motor for the machine to open the circuit for the motor in case of excess flow of current. The motor circuit also usually includes a safety device in the form of a door switch which opens the motor circuit to shut down operation thereof when the access door is opened. For overload protection, three main types of devices have heretofore been usually used, the three types being an ordinary plug fuse, a thermal switch incorporated in the motor, and a thermal reset device separate from the motor.

Of these three, the plug fuse is probably the simplest and least expensive. However, fuse replacements are dependent upon the judgment of the operator and it is frequently found that the operator will put in a fuse of too high a rating in order to keep the machine operating. The thermal switch in the motor is usually of the recycling type and, if the machine is unattended, damage may occur because of repeated attempts of the thermal switch to cause the motor to operate. A manually reset device separate from the motor is perhaps the best of these three, but it requires separate mounting and wiring and hence increases the cost of the machine. Such a machine of course includes a door switch in addition to any one of these three overload protection devices.

The ordinary door switch is merely a device for opening the motor circuit when the loading or access door is opened so that the machine will be shut down to avoid chance of accident to the operator when reaching inside of the machine. With such a switch, another set of contacts is usually provided in the circuit to turn on a light for illumination of the interior of the machine whenever the door is opened so that the operator can see the contents of the machine.

The present invention provides a device for use in the motor circuit of such a machine, which combines the functions of the door switch and those provided by the thermal reset device referred to above. By combining all these functions in one device, a single mounting therefor is required and the wiring for the machine is much simplified over that required for a thermal reset device separate from the door switch. Moreover a device embodying the features of the invention also includes a set of contacts adapted to turn on a light for illumination of the interior of the machine whenever the door is opened. The preferred embodiment of the device is similar to an ordinary plunger type door switch but has the added feature of combining the functions of the thermal reset device referred to above. In Fig. 1 of the drawings I have shown a control circuit for an electrically heated dryer and embodied in this circuit is a combined motor protector and door switch having the features mentioned above. A dryer of this character is usually adapted to be operated from a three-wire 220 volt line, the terminals of which are here indicated at 10, 11 and 12. In the preferred embodiment, one of the terminals, in this instance the terminal 10, is connected by a line 13 to an electrical heating element 14. The latter in turn is connected to a motor throw-out switch 15, by a line 16, which is adapted to open to break the circuit to the next element 14 when the motor falls below a predetermined speed of operation. The switch 15 thus opens the heater circuit when the motor circuit is opened by the door switch, as hereinafter described. This switch 15, in the case of the dryer, also prevents overheating of the machine by the heating elements when insufficient air is being circulated through the machine due to slowing down of a fan or blower driven by the main drive motor. The motor throw-out switch 15 is in turn connected by a line 17 to a thermostatically operated switch 20 mounted in the drying chamber of the dryer and adapted to open the circuit for the heating element when the temperature within the drying chamber exceeds a predetermined value.

The thermostatically operated switch 20 is connected to a terminal 21 of a switch 22 adapted to be operated by a timer 23. The timer 23 may be of the usual cam
operated type having cam means for closing the switch 22 for a predetermined period. The switch 22 is provided with a terminal 24 connected by a line 25 to another of the line terminals. In this instance, the line 25 is connected to the line terminal 12 so as to provide for 220 volts across the heating element 14.

The circuit shown in Fig. 1 also includes the main drive motor indicated at 26 and a timer motor 27 for driving the timer 23. In this instance, the motors 26 and 27 are in parallel with each other and are connected with the intermediate line terminal 11 by a line 30. The other sides of the motors 26 and 27 are connected by line 31 having a reset high limit thermostat 35 therein as a safety device which shuts down operation of both motors, should the temperature in the drying chamber exceed a predetermined high value. The line 31 connects the motors to a combined motor protector and door switch 32 to indicated generally at 32 and herein-after described in greater detail, and the latter is connected by a line 35 to a terminal 34 of a second timer operated switch 35. The second timer operated switch 35 is also connected to the line 25 extending to the line terminal 12 so that the two motors 26 and 27 are connected to receive current at 110 volts. As is usual in a dryer, the timer 23 is constructed so that the switch 22 controlling the heater element circuit is open, at the end of the drying period, prior to the time when the motors 26 and 27 are shut down by opening the timer switch 35. This provides for circulation of air through the drying chamber after the heating element has been shut off so as to cool down the laundry to permit it to be conveniently handled.

The dryer may also include one or more auxiliary devices such as a germicidal lamp 36 acting on the laundry during the drying period, and a flood lamp 37 which illuminates the interior of the drying chamber throughout the drying operation. An auxiliary circuit is provided for such devices and in this instance the two lamps 36 and 37 are placed in a line 40 connecting the motor lines 30 and 33 and, as long as the timer switch 35 is closed, the lamps 36 and 37 are operating.

The combined motor protector and door switch 32 is arranged to shut off operation of the motors 26 and 27 whenever the door of the dryer is opened or whenever an excess flow of current occurs through either of the motors. The switch 32 is provided with a terminal 41 connected by a line 42 to a terminal 43 connected to the line 33. So long as the door of the dryer, indicated at 43, is closed and the current flowing through the motors is normal, the switch 32 provides a connection between the terminals 41 and 42 to maintain the circuit for the motors closed. The switch 32 is constructed so that either when the door 43 is opened, or an excess current flows through either of the motors, the connection between the terminals 41 and 42 is opened so as to open the motor circuit. Such opening of the motor circuit does not affect the lamps 36 and 37 since the latter are connected by a line 40 to the line 33 beyond the motor switch, and the two lamps will continue to operate so long as the timer switch 35 is closed.

When the timer opens the switch 35 at the conclusion of the drying operation, the motor circuit as well as the lamp circuit is opened to stop operation thereof. However, it is desirable to operate the lamps, particularly the flood lamp 37, whenever the door 43 is opened, even though the motors 26 and 27 are shut off. To this end, the combined motor protector and door switch is provided with a second set of terminals 44 and 45 in a shunt circuit around the timer switch 35. Thus, the terminal 44 is connected by a jumper 46 with the terminal 42, while the terminal 45 is connected by a line 47 with the line 30. The switch 32 is arranged to connect the terminals 44 and 45 when the door 43 is opened. Thus a shunt circuit for the lamps 36 and 37 is provided in this instance by the downwardly extending portion of the line 33 leading to the terminal 43, the jumper 46, the terminal 44 which in this instance is connected by the switch 32 to the terminal 45 and then by the line 37 to the line 25 so that a circuit is thus provided to cause operation of the lamps 36 and 37 when the door 43 is opened, even though the timer switch 35 is open.

The combined motor protector and door switch 32 is adapted to be mounted in a similar manner to the ordinary door switch and in this instance is shown as being mounted in a frame portion 50 of the access opening of the dryer cabinet, as illustrated in Figs. 2 to 6. The switch comprises a body structure 51 adapted to be secured to the frame portion 50 and sidely supports a plunger 52. The plunger 52 is adapted to extend downwardly of the frame portion 50 for engagement by the door 43 and is urged in this direction by means of a spring 53 interposed between a collar formed on the plunger and the rear wall of the body structure 51. The plunger is arranged to have only a predetermined amount of movement but due to variations in the position in which it is mounted, the movement effected by the door 43 may be and preferably is greater than the movement of the plunger 52. For this reason, the plunger is provided with an over-travel device comprising a cap 54 mounted within a sleeve 55 on the end of the plunger 52. Between the cap 54 and a collar formed on the plunger is a spring 56 which is adapted to be compressed by movement of the cap 54 and 57. The spring 56 urges the plunger to provide movement of the door greater than the movement of the plunger 52. The sleeve 55 at its inner end is provided with an inturned flange 57 adapted to abut the collar on the plunger to limit outward movement of the sleeve 55 and cap 54.

Movable mounted on the plunger 52 is a carriage in the form of a bimetallic element 60 having a pair of arms 61 embracing the plunger 52. The bimetallic element 60 is provided with a pair of contacts 62 movable with the element and normally engaged with a first pair of fixed contacts 63 respectively mounted on the terminals 41 and 42. The bimetallic element 60 is adapted to be held in a fixed position relative to the plunger 52 by a locking means rigidly mounted on the plunger 52. The locking means is provided with a pair of legs 64 having out-turned end portions engageable with the ends of the arms 61 of the bimetallic element 60. When the legs 64 are engaged with the arms 61, the bimetallic element 60 limits the movement relative to the plunger and, when the door is closed as shown in Fig. 2, the contacts 62 are held in engagement with the contacts 63 which are in the motor circuit. Thus the current flowing through the motors 26 and 27 passes through the bimetallic element 60.

If the motor current becomes excessive for any reason, such excess current causes the bimetallic element 60 to expand to cause the arms 61 to move laterally outward out of engagement with the legs 64 of the locking means. The bimetallic element is then free to move on the plunger, and such movement is effected by a pair of springs 65 connected to an anchoring means 66 formed on the plunger 52. With the plunger held in its inner position when the door 43 is closed, the excess current in the motor circuit thus releases the bimetallic element from its locking means and permits the springs 65 to draw the bimetallic element along the plunger 52 to the right as shown in the drawings. Such movement of the bimetallic element moves the movable contacts 62 thereon out of engagement with the fixed contacts 63 to open the motor circuit as illustrated in Figs. 5 and 6.

As heretofore mentioned, the motor circuit is also adapted to be opened when the door 43 is opened. Thus upon opening the door 43, the plunger 52 is moved to the right, as shown in the drawings, by the spring 53, and the movement of the plunger carries the bimetallic element 60 with it so that the contacts 62 are moved out.
I claim:

1. A laundry machine having a drive motor, a timer motor, a motor circuit for said motors having a timer operated switch therein for energizing and deenergizing said motors, and an access door for said machine, said circuit including a control switch having contacts movable to open said circuit and thereby deenergize both of said motors in response to opening of motor circuit and having current responsive means for opening said contacts in response to flow of excessive current in said circuit.

2. A laundry machine having a drive motor, a timer motor, a motor circuit for supplying current to said motors, an access door for said machine, and a combined motor protector and door switch comprising a pair of movable contacts normally in circuit closing position when said door is closed, current responsive means movable on flow of excessive current in said circuit for effecting movement of said contacts out of circuit closing position, and door operated means carrying said current responsive means and movable in response to opening the door to move said contacts out of circuit closing position.

3. A laundry machine having a drive motor, a timer motor, an electrical circuit for supplying current to said motors, an access door for said machine, and a control switch in said circuit having a spring operated plunger and a spring operated bimetallic element in said circuit and releasable to open said circuit, said element being carried by said plunger, said control switch being adapted to open said circuit to deenergize both of said motors when the door is opened to permit movement of said plunger and when said element is released by an excess of current.

4. A laundry machine having a drive motor, a timer motor, an electrical circuit for supplying current to said motors, an access door for said machine, and a control switch normally closed when said door is closed, said switch having a member responsive to movement of said door and a current responsive element movable in response to an excess of current in said circuit to open said circuit, said element being carried by said member and movable therewith in response to opening of said door to open said circuit upon opening said door.

5. A laundry machine having a drive motor, a timer motor, an electrical circuit for supplying current to said motors, an access door for said machine, and a control switch having a pair of fixed contacts in said circuit, a pair of movable contacts engageable with said fixed contacts, said movable contacts normally engaging said fixed contacts when said door is closed, a current responsive element carrying said movable contacts and movable in response to an excess of current in said circuit to disengage said movable contacts from said fixed contacts and thereby open said circuit, a movable member carrying said element, and means for moving said member, said member being movable in response to opening said door to disengage said movable contacts from said fixed contacts and thereby open said circuit.

6. A laundry machine having a drive motor, a timer motor, a motor circuit for supplying current to said motors, an auxiliary electrical device, an auxiliary circuit for supplying current to said device, an access door for said machine, and a control switch having a first pair of fixed contacts in said motor circuit, a second pair of fixed contacts in said auxiliary circuit, a pair of movable contacts shiftable from engagement with said first pair to engagement with said second pair, a current responsive element carrying said movable contacts and movable in response to an excess of current in said motor circuit to disengage said movable contacts from said first pair of fixed contacts and thereby open said motor circuit, and a member carrying said element and movable in response to opening said door to disengage said movable contacts from said first pair of fixed contacts to open said motor circuit and to engage said movable con-
tacts with said second pair of fixed contacts to close said auxiliary circuit through said second pair of contacts.

7. A laundry machine having a drive motor, a timer motor, a motor circuit for said motors and adapted when opened to deenergize both of said motors and including a timer operated switch for opening said motor circuit, a lamp for the interior of the machine, a lamp circuit for said lamp connected in an externally controlled by but having a shunt around said timer operated switch, an access door for said machine, and a control switch having first and second pairs of fixed contacts respectively connected in said motor circuit and in said shunt, a pair of movable contacts shiftable between said fixed contacts, a current responsive element carrying said movable contacts and movable when said timer operated switch is closed, in response to an excess of current in said motor circuit to open said motor circuit, and a plunger carrying said element and movable in response to opening said door to open said motor circuit, said movable contacts when shifted by opening the door engaging said second pair of fixed contacts to close said lamp circuit through said shunt to energize said lamp when said timer operated switch is open.

8. A door switch comprising a pair of fixed contacts, a pair of movable contacts movable into and out of engagement with said fixed contacts, a current responsive element carrying said movable contacts and normally holding the latter in engagement with said fixed contacts when the door is closed, said element being releasable upon an excess of current flowing therethrough and included means for moving said movable contacts out of engagement with said fixed contacts, a plunger carrying said element and adapted to be engaged by the door and held thereby in a position where said movable contacts are normally in engagement with said fixed contacts, and spring means for moving said plunger to another position in response to opening of the door, thereby moving said movable contacts out of engagement with said fixed contacts with said element remaining in unreleased position on said plunger.

9. A door switch comprising a pair of fixed contacts, a door operated plunger, a current responsive element mounted on said plunger and having a pair of movable contacts normally engaging said fixed contacts when the door is closed, said plunger being movable in response to opening the door to move said movable contacts out of engagement with said fixed contacts, and said means being operable in response to an excess of current carried thereby to move said movable contacts out of engagement with said fixed contacts with the plunger remaining stationary.

10. A door switch comprising a pair of fixed contacts, a door operated plunger, a current responsive element longitudinally movably mounted on said plunger and having a pair of movable contacts engageable with said fixed contacts, spring means for moving said element on said plunger, locking means for holding said element against movement on the plunger with said movable contacts normally in engagement with said fixed contacts when the door is closed, said element being adapted in response to the flow of excess current through said element to effect movement thereof relative to said plunger longitudinally thereof to shift said movable contacts out of engagement with said fixed contacts, said element and said movable contacts being moveable with said plunger and in longitudinal movement thereof in response to opening the door to move movable contacts out of engagement with said fixed contacts.

11. A door switch comprising a pair of fixed contacts, a door operated plunger movable in one direction on closing the door, a bi-metallic element movably mounted on said plunger and spring means adapted to move said plunger in the opposite direction when the door is opened, a bi-metallic element movably mounted for movement in said directions on said plunger and having a pair of movable contacts engageable with said fixed contacts, spring means tending to move said element relative to said plunger in said opposite direction to move said movable contacts out of engagement with said fixed contacts, and locking means rigidly mounted on said plunger for holding said movable contacts in engagement with said fixed contacts when the door is closed, said element being adapted upon an excess of current flowing therethrough to be released from said locking means to permit said movable contacts to be moved out of engagement with said fixed contacts by said spring means with the door closed, and said plunger being movable in said opposite direction thereby moving said movable contacts out of engagement with said fixed contacts when the door is opened.

12. A door switch according to claim 11, in which said spring means is stronger than said plunger spring to prevent said element from reengaging said locking means after release of said element upon opening the door.

13. A door switch comprising a first pair of fixed contacts, a second pair of fixed contacts spaced from said first pair, a door operated plunger, a current responsive element movably mounted on said plunger and having a pair of movable contacts positioned between said first and second pairs of fixed contacts, locking means for holding said element against movement on the plunger with said movable contacts in engagement with said first pair of fixed contacts when the door is closed, said element being releasable from said locking means in response to flow of excess current through said element and spring means for effecting movement of said movable contacts out of engagement with said first pair of fixed contacts, said element and said movable contacts being movably with said plunger on opening the door to move said movable contacts from said first pair of fixed contacts to said second pair of fixed contacts.

14. A door switch comprising a first pair of fixed contacts, a second pair of fixed contacts spaced from said first pair, a door operated plunger movable in one direction on closing the door, a bi-metallic element movably mounted on said plunger and having a pair of movable contacts positioned between said pairs of fixed contacts, spring means tending to move said element relative to said plunger to move said movable contacts from said first pair of fixed contacts to said second pair, and locking means rigidly mounted on said plunger for holding said element against movement relative to said plunger and thereby holding said movable contacts in engagement with said first pair of fixed contacts when the door is closed, said element being adapted upon an excess of current flowing therethrough to be released from said locking means to permit said element to move relative to said plunger and said movable contacts to be moved from said first pair of fixed contacts by said spring means, and said plunger being releasable from said locking means thereby moving said movable contacts from said first pair of fixed contacts to said second pair when the door is opened.

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