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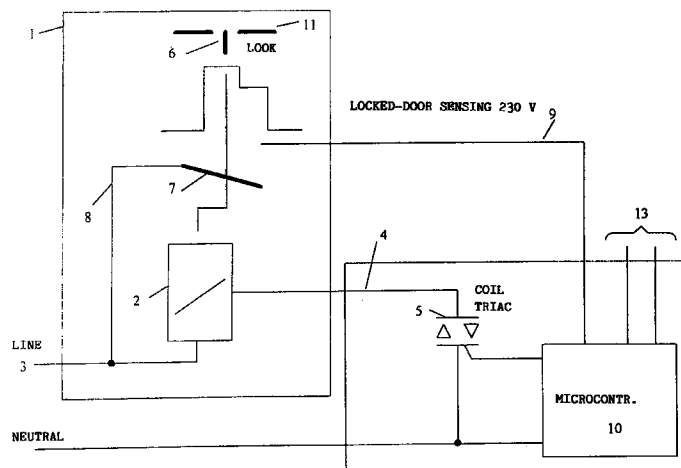
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33170 Pordenone (IT)**(54) Washing machine with instant-action door interlock arrangement**

(57) Washing machine comprising a drum, a loading opening and a related door, a door interlock arrangement provided with electronic control means, an electromagnet with a moving element, a switch means actuated by said moving element which is capable of being displaced by said electromagnet on the basis of the commands issued by an appropriate current control device placed on the respective power-supply line, said device being adapted to be controlled by said electronic control means. When the loading door is closed and the

moving element is displaced into either its first or second extracted position, the element itself is caused to engage an appropriate catch means provided in the machine so as to prevent the door from opening. Under pre-defined conditions, the electronic control means act on the current control device that generates at least an electric pulse which is transmitted to the electromagnet to cause the moving element to engage said catch means.

**FIG 1****EP 0 808 935 A2**

Description

The present invention generally refers machines for washing clothes, in particular clothes washing machines of the front-loading type, provided with an improved type of safety door interlock arrangement.

Household-type washing machines are known in the art which are provided with door interlock arrangements of various type and with different characteristics. According to their mode of operation, all such arrangements can be grouped into following homogeneous categories:

1) Door kept locked throughout the entire working cycle of the machine and finally released with a certain delay (1 to 2 minutes) with respect to the moment in which the power supply is disconnected, ie. the machine is de-energized.

This type of door interlock arrangement protects the user against his or her being able to gain access to machine parts which are moving at any hazardous speed (such as the drum rotating at spin-extraction speed) and, furthermore, during the entire washing cycle in the case of failures which are likely to occur in clothes washing machines provided with electronically controlled drive motors.

However, such a type of door interlock arrangement has a couple of major drawbacks, the first one of which practically forces the user to wait for 1 to 2 minutes when he or she for any reason wishes to open the door of the machine during the washing cycle, even during those phases thereof in which the rotating speed of the drum is not hazardous, ie. reasonably low.

The second drawback occurs when the main on-off switch of the machine is turned on while the loading door of the machine is open. In fact, under such circumstances the washing machine would start immediately upon closing the door, thereby activating the cycle phase that is set at that moment on the programme selector switch and at the same time locking the door in its closed condition. It will be appreciated that such an operation may not be done intentionally, ie. may occur accidentally, and may therefore give rise to hazardous situations involving serious accidents to children or animals that may have accidentally crept into the drum of the washing machine when its loading door was open and its drum at a standstill.

2) Door kept locked only when the drum rotates at a dangerously high speed (during spin-extraction phases), wherein the interlock arrangement is provided with delayed door release feature allowing the door to be only opened after a certain period of time has elapsed from the moment at which the power supply to the machine has been disconnected.

Such a type of door interlock arrangement is

only effective in protecting the user against accidents that may occur when opening the door of an operating washing machine during spin-extraction phases (since no actual danger practically exists in the other phases of the washing cycle) and has further the advantage of enabling the loading door of the machine to be immediately opened in all other phases of the same washing cycle. It however has a major drawback in that it is not effective in preventing accidents of the type described above in connection with the second major drawback of the door interlock arrangement described under 1) above from occurring.

3) Door locked by the action of an electromagnet. This arrangement enables the door of the machine to be opened in all cycle phases that do not involve any dangerously high rotating speed of the drum.

When the drum is due to rotate at a dangerously speed, other arrangements are provided inside the clothes washing machine itself to prevent it from being impossible for the door interlock arrangement to be de-energized through the usual operations and, therefore, the loading door of the machine to be opened.

Such a door interlock arrangement, however, has a third major drawback in that, should the coil of the same door interlock arrangement happen to become energized accidentally, eg. due to a short-circuit condition of the Triac, the washing machine remains electrically energized as well, so that it is still enabled to carry out all the various operations and working steps provided for by the washing cycle that is being performed (including therefore also those steps and phases involving hazardous operating conditions), while the door can in fact be opened all the time.

It should further be noticed that in some of the afore described cases it is necessary for a certain time to be allowed to elapse before being able to open the door after the machine has been de-energized, ie. the power supply to the machine has been switched off, due to well-known reasons of safety.

Such a delay in the time at which the loading door of the machine can be opened after switching off is implemented through the provision of appropriate delaying devices, wherein PTC devices are in particular used here as a preferred solution.

However, there are during the operation of a washing machine a plurality of phases which do not fall within the category of those phases that are normally considered as involving some hazardous situations in connection with the possibility for the machine door to be opened inadvertently or abruptly, among which following ones can be cited:

- too high a temperature of the washing liquor;
- too high a rotation speed of the drum;
- washing liquor in the drum reaching a level above the lower edge of the door opening.

During said non-hazardous phases, no possibility exists for the door of the machine to be opened if prior-art solutions of the afore described type are used, whereas it would on the contrary be quite a desirable feature, especially in connection with current models of clothes washing machines provided with electronic data storage, processing, control and regulation means, to have the possibility of opening the machine door at any moment during the operation of the same machine, with the obvious exception of the above cited periods of 'hazardous' operation.

The European patent specification no. 0 384 148 to the same Applicant discloses a door interlock arrangement for clothes washing or clothes drying machines which comprises an electromechanical actuator associated to a latch or bolt interacting with the lock of the loading door, so as to lock and unlock the same loading door, said door interlock arrangement further comprising an electrical contact connected in the electric circuit of the electromechanical actuator and adapted to energize and de-energize the same actuator.

However, such a solution is not effective in reliably ensuring that an accidental signal, typically of an impulsive type, that may anyhow reach said electromechanical actuator would not actuate the same, which thing could practically mean that the door of the machine is enabled to be opened immediately while the machine is still operating under hazardous conditions.

It therefore would be desirable, and it is actually a main purpose of the present invention, to provide a clothes washing machine which is equipped with a door interlock arrangement and control and actuation means such as to provide for the loading door to be locked, under delayed release thereafter, only during those phases involving a hazardous speed, while enabling the same door to be freely and immediately opened during the remaining phases of the cycle, thereby eliminating one of the afore cited drawbacks.

Such a door interlock arrangement shall furthermore be constructed so as to be able to prevent, after the machine has been switched on, but before the door is closed, the electric loads thereof from being energized, thereby preventing them from being started or actuated and, therefore, eliminating another of the afore cited drawbacks.

Safety conditions as provided for by the applying standard regulations must furthermore be ensured, according to which a single command pulse that may be transmitted to the electrically operated door-release device shall not be sufficient to cause it to actually release the door. A construction shall also be provided so that a possible interruption of the power supply to the electromagnet, ie. a de-energization thereof, owing to some failure whatsoever (eg. a short-circuit condition in a Triac) is not capable of affecting the overall safety of the machine in any way.

Said door interlock arrangement shall further be of simple, inexpensive construction, shall be capable of operating reliably, and shall make use of readily avail-

able, normally used techniques.

All such aims are reached in a clothes washing machine comprising a door interlock arrangement, control and command means and related circuit configurations as recited in the appended claims.

The invention will anyway be more readily and clearly understood from the description that is given below by way of non-limiting example with reference to the accompanying drawings, in which:

- Figure 1 is a view showing the simplified wiring diagram of a door interlock arrangement according to the present invention;
- Figure 2 is a view showing the wiring diagram of Figure 1, to which some further connections have however been added for improvement.

The solution according to the invention basically consists in making use of and combining the:

- storage and control possibilities offered by the electronic components which many types and models of clothes washing machines are currently being provided with,
- the absolutely traditional possibility of opening the loading door of the machine by acting on the handle of the door lock located on a side of said loading door or, alternatively, by acting on an appropriate control means, which usually means pushing on a push-button, located on the control panel of the machine, and
- the possibility of enabling, by means of an appropriate servo-control, the door to be opened manually only when the machine is going through pre-defined operational phases and conditions, as verified by the above cited electronic devices.

Referring now to Figure 1, it can be noticed that the door interlock arrangement 1, which is normally positioned in the machine on the inner surface of the frame defining the clothes loading opening of the machine that is closed by the door, comprises an electric actuator 2, which is typically an electromagnet, but may be formed as well by any other device offering equivalent performance profiles in terms of instantaneous or almost instantaneous operation capabilities, said actuator being energized through a first conductor 3 that is connected to the power supply, and a second conductor 4 that is connected to a current control device 5, typically a Triac.

Such a door interlock arrangement is adapted to be energized by electric pulses, wherein at each pulse a moving element 6 extends from the door interlock arrangement, said moving element being adapted to extend to progressively more or less protruding positions in accordance with the number and the polarity of the pulses received, as well as to retract to a withdrawal position in which said moving element is fully disen-

gaged from the rest of the machine.

Said extended positions are at least in the number of two.

On the machine door there is provided, in correspondence of the position in which said moving element is located, an appropriate catch means 11 adapted to engage said moving element when the latter extends to its first or second extracted position, thereby preventing the door from being opened, whereas in the retracted position of said moving element said catch means is disengaged, thereby enabling the door to be opened.

Connected to and actuated by said moving element there is provided a switch 7 which is closed when the moving element is in its first or its second extracted position, and is on the contrary opened when the moving element moves back to its retracted position.

A terminal 8 of said switch connects to the power supply, while the other terminal 9 thereof is connected to a control and command device 10, to which also said current control device 5 is connected along, via further connections 13, also other operational and sensing devices of the machine.

A plurality of signals that may possibly be present at said connections 13 relating to operating conditions that have been previously defined as "non hazardous" and are therefore compatible with an immediate or instantaneous opening of the door, are stored in the control and command device 10.

Said control device is then constructed so as to enable following operational sequences and modes:

A) When the machine is operating, the signals that are present at the connections 13 inform the control device 10 on the conditions of the machine and are automatically and periodically compared with the previously stored conditions referring to non-hazardous operating conditions and modes. When such a comparison gives an identity of conditions as an outcome, this means that the machine is operating in a manner that has been previously defined as "non-hazardous".

In this case, the control device 10 sends a signal to the current control device 5 so as to enable it to transmit appropriate pulses to the electromagnet 2 to cause the moving element 6 to retract into the electromagnet, thereby enabling the door to be immediately opened, without any further delays and resulting waste of time.

Since standard regulations require that a single fortuitous pulse that may reach the electromagnet shall not be able to enable the door to be opened, the expedient is advantageously adopted according to which said control device 10 is arranged so as to send at least two distinct signals to the current control device 5, so that the moving element will be caused to retract and the door will be able to be opened only with two distinct current commands, since a single current command acting in the direction of a retraction of the moving element into the

first extraction position thereof is not yet sufficient to enable the door to be opened, considering that in said first extraction position of said moving element, the latter is still engaging the afore cited catch means 11.

B) If on the contrary the afore mentioned comparison fails to confirm an existing correspondence of the received signals with the afore cited stored conditions, the control device 10 is adapted to send appropriate signals to the current control device 5 so that the latter is caused to transmit at least a pulse to said actuator so as to cause the moving element to extend into its respective extraction position, thereby preventing the door from being opened in the presence of hazardous operating conditions, ie. in the presence of all those conditions that have not previously been defined as "non hazardous".

Under these conditions, the terminal 9 of the switch 7 sends an appropriate electric signal to the control device 10, which is capable of verifying the congruity between the door locking command transmitted and the confirmation that the door has been actually locked.

Should such a congruity fail to be confirmed, the possibility exists for the same information to be used for bringing about further warning and/or safety functions and measures.

The above described invention enables some advantageous improvements to be implemented. So for instance, with reference to Figure 2, a first such improvement can be noticed to consist in arranging between a plurality of loads 20 and the related power-supply line 21 an appropriate switch 22 of the normally open type, which is adapted to be closed by the action of the prong 23 of the door when the latter is shut.

Furthermore, the pole of said switch 22 opposite to the live pole thereof is connected via the connection 25 to said control device 10. Such an arrangement enables both the loads 20 to be only energized when the loading door is closed and the control device 10 to be informed, via said connection 10, on the closed state of said loading door, so as to enable the selected operational programme of the machine to be started.

Referring again to Figure 2, the second improvement can be noticed to essentially consist in the provision of a indicating device 27 arranged through an appropriate connection 26 between said connection 9 (connecting the switch 7 to the device 10) and the other pole of the power supply with respect to the power supply to the connection 8.

When so connected, such an indicating device enables the user of the machine to immediately make out whether said door interlock arrangement is locking due to the position of the moving element 6 thereof and, therefore, to know whether in that very moment it is possible for the door to be opened or not. In a quite obvious manner, should said indicating device 27, which shall

preferably be of the illuminating type, inform that the loading door is locked, the user will immediately conform to the situation and, in particular, will therefore avoid tampering in an effort to force the loading door open, as well as running into hazardous situations.

It will be readily appreciated that each and any washing machine can be provided with a door interlock arrangement and associated control devices that may also be made according to technical solutions differing from the above described one, without actually departing from the scope of the present invention.

Claims

1. Clothes washing machine comprising a wash tub accomodating a drum, with an opening provided to gain access into said drum and a door provided to close said opening, a door interlock arrangement (1) that includes electronic control and command means (10), an electric actuator (2) provided with a moving element (6), a switch (7) actuated by said moving element, which is adapted to extend from and retract into said electromagnet according to the commands imparted to the latter, characterized in that:
 - said electric actuator is actuated by an appropriate current control device (5) provided in the respective power-supply line, said device being adapted to be controlled by said control and command device (10),
 - said actuator is actuated by appropriate electric signals, wherein the moving element (6) is adapted to extend into two distinct, successive extracted position, as well as to move back to a retracted position, according to the number and polarity of the signals received by said current control device (5),
 - when the door is closed and said moving element (6) is subsequently caused to extend to any of the above mentioned extracted positions, the same moving element engages an appropriate catch means (11) provided on the machine so as to positively prevent the door from being opened.
2. Clothes washing machine according to claim 1, characterized in that when the door is closed and said moving element is subsequently caused to move back to its retracted position in said electromagnet, the same moving element disengages said catch means provided on the door of the machine, so that the same door is enabled to be opened.
3. Clothes washing machine according to claim 1 or 2, characterized in that upon occurrence of pre-defined operating conditions in the machine, said

electronic control and command means (10) act on said current control device (5) so as to cause it to generate at least an electric pulse that is transmitted to said actuator to cause said moving element to engage said catch means.

4. Clothes washing machine according to claim 3, characterized in that upon cessation of said pre-defined operating conditions of the machine, said electronic control and command means act on said current control device (5) so as to cause it to generate two electric pulses that are transmitted to said actuator to cause said moving element to fully disengage said catch means.
5. Clothes washing machine according to claim 3 or 4, characterized in that it comprises an electrically energized indicating device (27) which is connected with a terminal thereof to a power-supply source (8) via an electric switch (7) that is adapted to be closed by said moving element (6) when the latter is extended to engage said catch means (11).
6. Clothes washing machine according to any of the preceding claims, characterized in that it is provided with a switch (27) arranged in such a manner as to automatically and correspondingly connect a plurality of electric loads and/or functions (20) of said machine to the power supply when said door is closed.
7. Clothes washing machine according to any of the preceding claims, characterized in that, when said door is closed, an electric signal is automatically sent via appropriate switching and connecting means (22, 23, 25) to said control and command means (10) which therefore enable the machine to perform its working programmes.

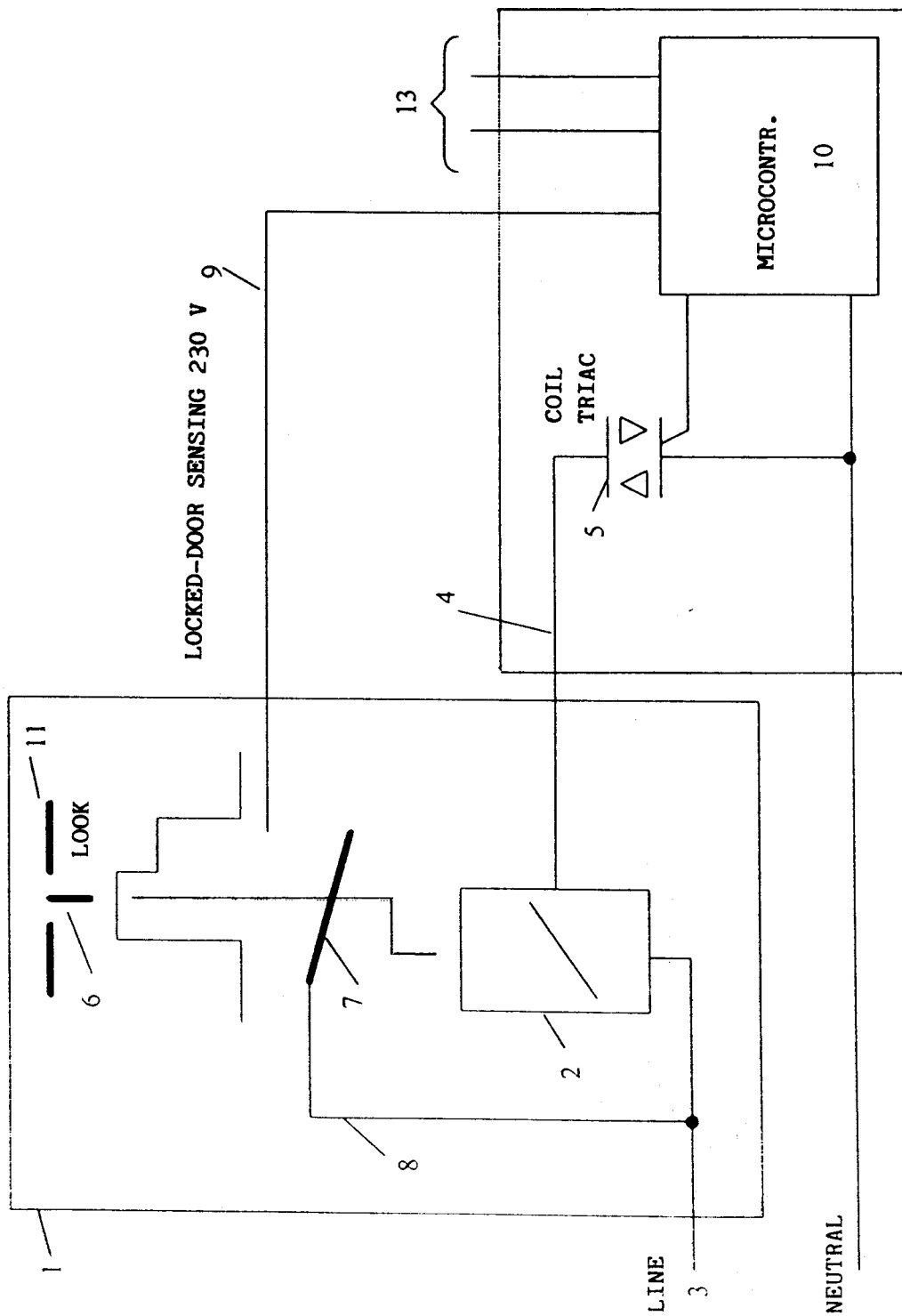


FIG 1

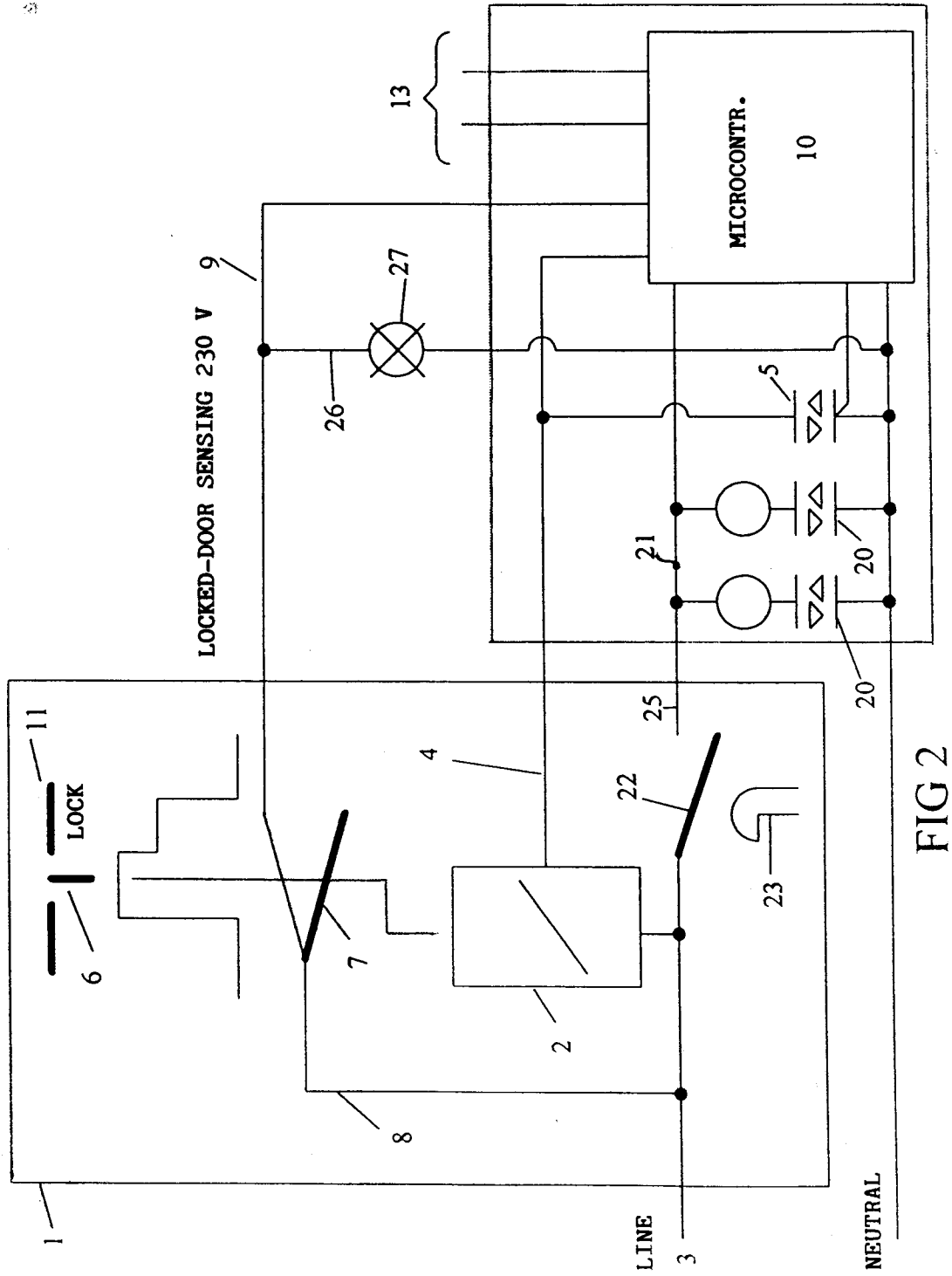


FIG 2