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(54) **Sootblower with single traveling limit switch utilizing state logic controls**

(57) The present invention provides a system for controlling a retractable sootblower having a frame, a movable carriage, a limit switch mounted on the movable carriage, a first switch control device, and a second switch control device. The frame supports the movable carriage, allowing the movable carriage to move between an extended and retracted position. The limit switch is mounted on the carriage and configured to sense both the first switch control device and the second switch control device. The first switch control device is positioned such that the limit switch will sense the first switch control device when the carriage is in the extended position. The second switch control device is positioned such that the limit switch will sense the second switch control device when the carriage is in the retracted position. The sootblower also includes a motor for driving the movable carriage between the extended and retracted positions, and a controller electrically coupled to the limit switch and configured to reverse the motor travel in response to the limit switch sensing the first switch control device.

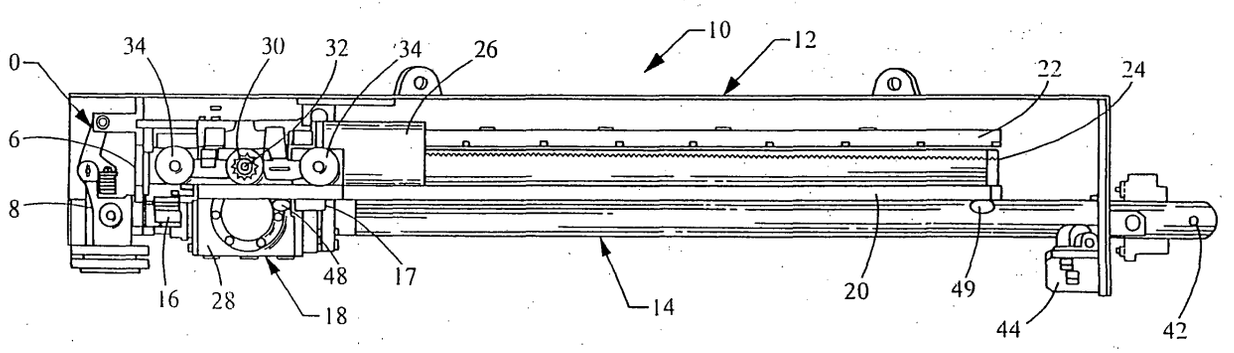

Fig. 1

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Description

BACKGROUND

1. Field of the Invention

[0001] The present invention relates to a sootblower

2. Description of Related Art

[0002] Sootblowers are well known in the art for cleaning the inside surfaces of large scale boilers and other combustion devices. The combustion of fuels used to power industrial boilers creates soot, ash and slag that accumulate on the inner surfaces of the boiler. As contaminants build on the inside surface of the boiler, the efficiency of the boiler decreases. Therefore, a sootblower is used to clean the inside surface of the boiler. One type of sootblower is the long retracting type, including the assignees long running "IK" series of sootblowers. Generally, retracting sootblowers include a tubular lance mounted to a movable carriage which moves along the frame of the sootblower. The lance tube fits over a fixed feed tube through which steam or other cleaning media is supplied as controlled by a poppet valve. The carriage moves forward to extend the tubular lance through a wall port in the boiler wall. The tubular lance includes nozzles to spray a cleaning medium such as steam to clean the inner surfaces of the boiler and remove the contamination. The cleaning cycle typically includes the extension and retraction of the lance tube into the boiler while the lance tube rotates, causing the cleaning jet to trace a helical pattern.

[0003] Typically, an electric motor mounted to the sootblower carriage is used to drive the carriage to extend and retract the lance tube. To control the distance that the motor drives the carriage and to prevent the motor from stalling when the carriage reaches its physical travel limits, two limit switches are mounted to the sootblower frame. The limit switches are positioned at the fully retracted and extended positions of the carriage. As the carriage moves forward, to extend the lance into the boiler, the forward limit switch is activated, reversing the direction of the motor. After the carriage has fully retracted, the carriage interacts with a second limit switch, stopping the motor's operation until another cleaning operation is initiated. The environment surrounding industrial boilers is extremely harsh. Temperatures around and near the boiler are extremely high. In addition, gasses which escape from the boiler are highly corrosive. Conventionally; limit switches, particularly limit switches located near the boiler will have become typically high maintenance components requiring frequent service.

[0004] In view of the above, it is apparent that there exists a need for an improved system for controlling the motion of a retracting type sootblower.

SUMMARY

[0005] In satisfying the above need, as well as overcoming the enumerated drawbacks and other limitations of the related art, the present invention provides a system for controlling a retractable sootblower having a frame, a movable carriage, a limit switch mounted on the movable carriage, a first switch control device, and a second switch control device. The frame supports the movable carriage, allowing the movable carriage to move between an extended and retracted position. The limit switch is mounted on the carriage and configured to sense both the first switch control device and the second switch control device. The first switch control device is positioned such that the limit switch will sense the first switch control device when the carriage is in the extended position. The second switch control device is positioned such that the limit switch will sense the second switch control device when the carriage is in the retracted position. The sootblower also includes a motor for driving the movable carriage between the extended and retracted positions, and a controller electrically coupled to the limit switch and configured to reverse the motor travel in response to the limit switch sensing the first switch control device.

[0006] The first and second switch control devices are mounted to the frame. Further, the first and second switch control devices have an adjustable position and may include a magnet as the limit switch may be a magnetic proximity switch. The limit switch should be mounted inside the frame and preferably mounted close to the carriage pinion shaft center line.

[0007] Further, a method for controlling the retractable sootblower is also provided. The method includes initiating forward travel of the carriage, dispersing a cleaning medium from the lance tube, sensing the limit switch is proximate the first switch control device, reversing the direction of travel of the carriage, and sensing the limit switch is proximate to a second switch control device. In addition, the method may include the steps of first, setting a forward state after the limit switch is not proximate to a second switch control device. Second, reversing the direction of travel after sensing the limit switch is proximate to a second switch control device. Third, setting a reverse state after sensing the limit switch is not proximate to the first switch control device. Fourth, setting a rest state after sensing the limit switch is proximate to a second switch control device.

[0008] Further objects, features and advantages of this invention will become readily apparent to persons skilled in the art after a review of the following description, with reference to the drawings and claims that are appended to and form a part of this specification.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 is a pictorial view of a sootblower in accordance with the present invention;

[0010] FIG. 2 is a schematic view of a control system of a sootblower, in accordance with the present invention; and,

[0011] FIG. 3 is a block diagram of a method for controlling a sootblower.

DETAILED DESCRIPTION

[0012] Now referring to Figure 1, a sootblower embodying the principles of the present invention is illustrated therein and designated at 10. As its primary components, the sootblower 10 includes a frame 12, a carriage assembly 18, a lance tube 14, and a motor 26. The frame 12 is generally a rectangular shape and forms a housing for the entire unit. Carriage assembly 18 is guided along two pairs of tracks 20, 22 located on the top and bottom of the frame 12. The upper tracks 22 support a toothed rack 24. The toothed rack 24 enable longitudinal movement of the carriage 18. The motor 26 drives the gear box 28 of the carriage assembly 18 to extend and retract the lance tube 14. The carriage 18 includes a pinion gear 30 which engages the toothed rack 24 to move the carriage 18 and lance tube 14. The support rollers 34 are attached to the carriage 18 and engage the guide tracks 20 and 22 to support the carriage 18. The motor 26 is preferably a three-phase motor allowing for the motor 26 to be driven in either rotational direction.

[0013] A feed tube 16 is connected between the poppet valve 38 and the lance tube 14. The feed tube 16 is supported by a bracket 36 and conducts the flow of cleaning medium from the poppet valve 38 to the lance tube 14. The poppet valve 38 is actuated through linkages 40 which are engaged by the carriage assembly 18 to begin discharge of cleaning medium upon extension of the lance tube 14. Further, the linkage 40 cuts off the flow of cleaning medium once the lance tube 14 and carriage 18 are retracted. The cleaning medium flows from the feed tube 16 through the lance tube 14 and exits the end of lance tube 14 through nozzles 42. A front roller bracket assembly 44 supports the lance tube 14 as it is extended and retracted.

[0014] The sootblower includes a limit switch 17 mounted to the carriage 18. When the carriage 18. and the lance tube 14 are completely extended, the limit switch 17 is proximate to a first switch control device 49. Alternatively, when the lance tube is fully retracted, the carriage 18 is positioned such that the limit switch 17 is proximate a second switch control device 48. Using signals from the limit switch 17, a determination can be made when to drive the motor 26 in a forward or reverse rotation. The limit switch 17 can be a proximity switch, such as, GO® switch manufactured by Top Worx, Louisville, Kentucky. Using such a switch, the first and second switch control device 48, 49 may be permanent magnets. The magnets may be placed directly on the frame or mounted to a bracket allowing adjustability of the first and second switch control devices 48, 49. The lance tube may become damaged or bent during operation, Therefore, it is preferable for the limit switch 17 to be mounted inside the frame 12 and particularly, mounted close to the center line of the carriage pinion shaft 32, thereby reducing the possibility of limit switch misalignment or damage if the lance tube 14 is displaced or damaged.

[0015] Now referring to Figure 2, the sootblower control system is provided in more detail. The control system includes a controller 50, a control panel interface 54, motor power 60, a motor starter 52, and sootblower components 58. The controller 50 is a programmable controller, such as, the EASY 619ACRC manufactured by Moeller Electric Corporation, Franklin, Massachusetts. Although, other controllers including programmable logic controllers (PLCs) may be used. The control panel interface 54 provides power signal 62 and a common signal 64 to power the controller 50. The control panel interface 54 also includes an input device, shown as, a pushbutton 56 for initiating a cleaning cycle of the sootblower. The pushbutton 56 communicates with the controller 50 along lines 66 and 68. Other devices may also be used to initiate a cleaning cycle including an automatic control system.

[0016] The controller 50 communicates with the motor starter 52 to initiate forward rotation of the motor 26 as indicated by line 74 to extend the lance tube 14. Alternatively, the controller 50 may communicate with the motor starter 52 as indicated along line 76 to drive the motor 26 in a reverse rotation causing retraction of the lance tube 14. Motor power source 60, generally 460 volts AC three-phase, is provided to the motor starter 52 along line 72. The motor starter 52 can change the motor rotation from forward to reverse by switching two of the three phases of the motor power. The control panel interface 54 also provides forward and reverse travel indication along line 70 from the motor starter 52 depending on which contactor is energized, forward or reverse. The motor starter 52 provides the motor power in the correct phase orientation for forward or reverse rotation to the motor 26 along line 78. In addition, the controller 50 receives input from the limit switch 17 along line 80 to determine when to drive the motor 26 in a forward or reverse rotation. The controller 50 is also available to control peripheral devices such as an optional pressure switch 88 or an optional blowing solenoid 82 to enhance the performance of the sootblower during the cleaning operation.

[0017] Now referring to Figure 3, a process is provided for controlling the forward and reverse rotation of the motor 26 to extend and retract the lance tube 14 during the cleaning operation. The control process begins at block 100. In block 102, the controller 50 sets a rest control state. In block 104, the controller 50 determines if a start signal has been received, such as the pushbutton 56 being depressed. If the start signal is not received, the controller 50 continues to monitor for a start signal as indicated by line 108. If a start signal has been received, the process follows line 106 and the controller

50 initiates forward travel of the carriage 18 and lance tube 14 as indicated by block 110. In block 112, the controller 50 monitors the limit switch 17 to determine if the limit switch 17 is not proximate to the second switch control device 48. If the limit switch 17 is proximate to the second switch control device 48, the controller 50 continues to monitor the limit switch 17 as indicated by line 116. Alternatively, if the limit switch 17 is not proximate to the second switch control device 48, the process follows line 114 and the controller 50 sets a forward control state as indicated by-block 118.

[0018] In block 120, the controller 50 monitors the limit switch 17 to determine if the limit switch 17 is proximate to the first switch control device 49. If the limit switch 17 is not proximate to the first switch control device 49, the controller 50 continues to monitor the limit switch 17 as indicated by line 124. If the limit switch 17 is proximate to the first switch control device 49, the process continues along line 122 and the controller 50 reverses the direction of travel of the motor 26 thereby retracting the carriage 18 and lance tube 14, as indicated by block 126.

[0019] In block 128, the controller 50 monitors the limit switch 17 to determine if the limit switch 17 is not proximate to the first switch control device 49. If the limit switch 17 is proximate to the first switch control device 49, the controller 50 continues to monitor the limit switch 17 as indicated by line 132. Alternatively, if the limit switch 17 is not proximate to the first switch control device 49, the process continues along line 130 and the controller 50 sets a reverse control state as indicated by block 134.

[0020] In block 136, the controller 50 monitors the limit switch 17 to determine if the limit switch 17 is proximate to the second switch control device 48. If the limit switch 17 is not proximate to the second switch control device 48, the controller 50 continues to monitor the limit switch 17 as indicated by line 140. Alternatively, if the limit switch 17 is proximate to the second switch control device 48, the process follows along line 138 signifying the end of a cleaning operation and the controller 50 sets a rest control state as indicated by block 102.

[0021] As a person skilled in the art will readily appreciate, the above description is meant as an illustration of an implementation of the principles of this invention. This description is not intended to limit the scope or application of this invention in that the invention is susceptible to modification, variation and change, without departing from spirit of this invention, as defined in the following claims.

Claims

1. A retractable sootblower of the type having a frame, a movable carriage supported by the frame, a lance tube being movable with the carriage and having an extended and retracted position, a motor for driving the movable carriage and lance tube between the extended and retracted positions, the retractable sootblower comprising:

a limit switch mounted on the carriage for movement therewith along the frame;
a first switch control device positioned such that the limit switch will sense the first switch control device when the lance tube is in the extended position;
a second switch control device positioned such that the limit switch will sense the second switch control device when the carriage is in the retracted position; and
a controller electrically coupled to the limit switch and configured to reverse the motor travel in response to the limit switch sensing the first switch control device.

2. The retractable sootblower of claim 1, wherein the limit switch is a proximity switch.

3. The retractable sootblower according to claim 1, wherein the first switch control device is mounted to the frame.

4. The retractable sootblower according to claim 1; wherein the second switch control device is mounted to the frame.

5. The retractable sootblower according to claim 1, wherein the position of the first switch control device is adjustable.

6. The retractable sootblower according to claim 1, wherein the position of the second switch control device is adjustable.

7. The retractable sootblower according to claim 1, wherein the first switch control device includes a magnet.

8. The retractable sootblower according to claim 1, wherein the second switch control device includes a magnet.

9. The retractable sootblower according to claim 1, wherein the limit switch is mounted inside the. frame.

10. The retractable sootblower according to claim 9, wherein the limit switch is mounted close to the carriage pinion shaft center line.

11. The retractable sootblower according to claim 1, wherein the controller is configured to store a forward state, a reverse state, and a rest state.

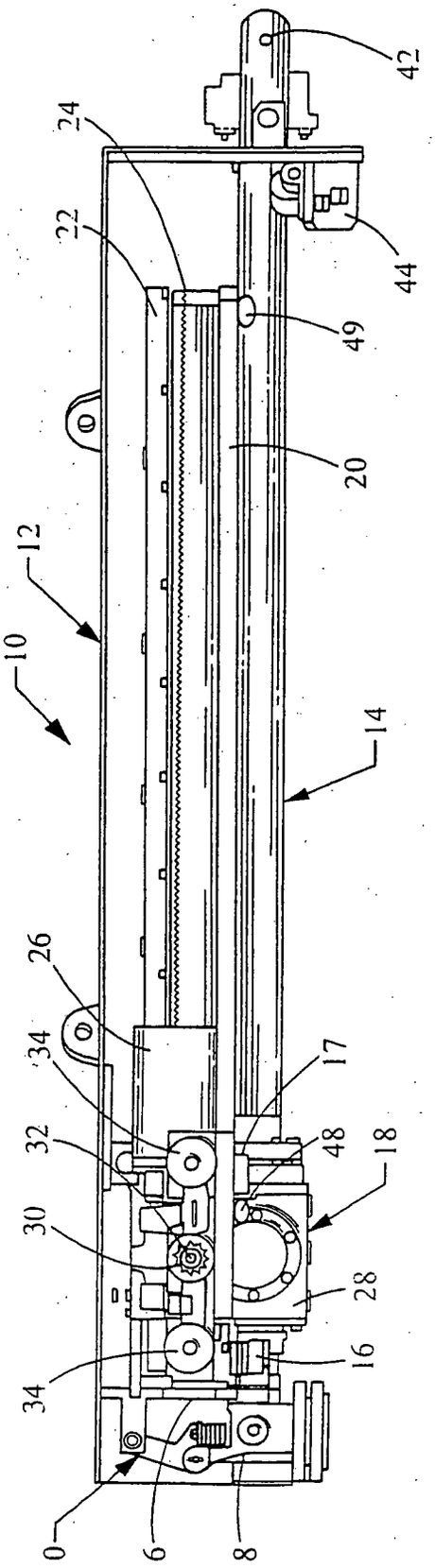
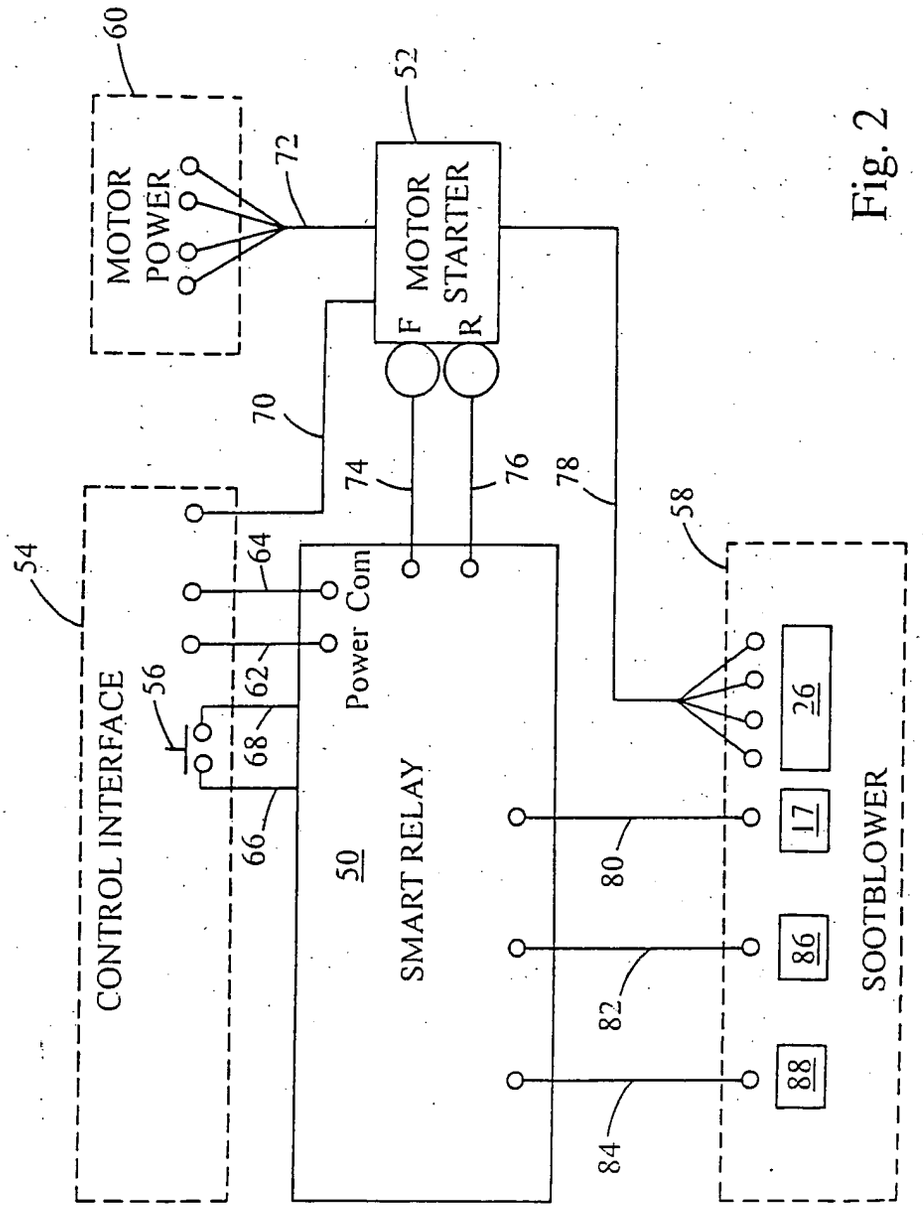


Fig. 1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52
MOTOR STARTER
F
R
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74
76
78
58
54
64
CONTROL INTERFACE
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62
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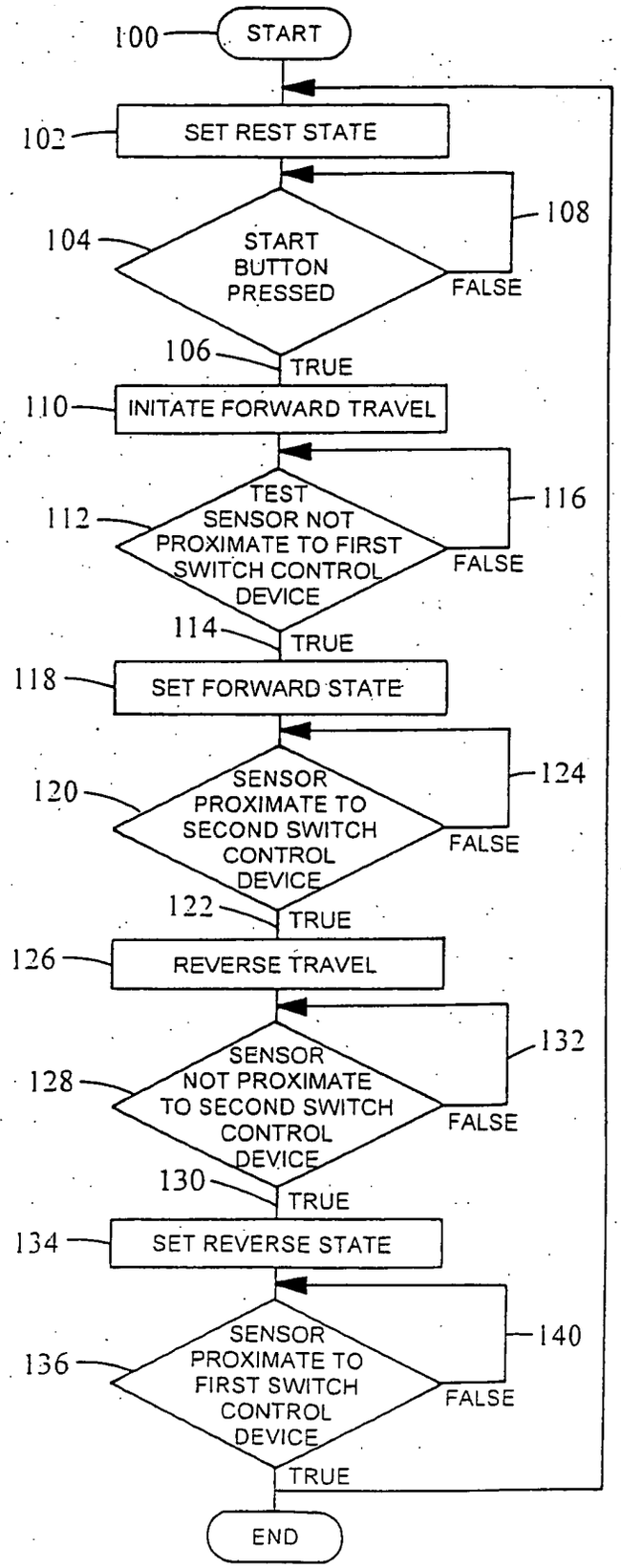
66
Power Com
50
SMART RELAY
80
82
84
26
17
86
88
SOOTBLOWER

Fig. 2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SET REST STATE
104
START BUTTON PRESSED
108
FALSE
106
TRUE
110
INITATE FORWARD TRAVEL
112
TEST SENSOR NOT PROXIMATE TO FIRST SWITCH CONTROL DEVICE
116
FALSE
114
TRUE
118
SET FORWARD STATE
120
SENSOR PROXIMATE TO SECOND SWITCH CONTROL DEVICE
124
FALSE
122
TRUE
126
REVERSE TRAVEL
128
SENSOR NOT PROXIMATE TO SECOND SWITCH CONTROL DEVICE
132
FALSE
130
TRUE
134
SET REVERSE STATE
136
SENSOR PROXIMATE TO FIRST SWITCH CONTROL DEVICE
140
FALSE
TRUE
END

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 05 00 4051

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	31 March 2005	Bain, D

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X : particularly relevant if taken alone
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