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(54) **METHOD AND APPARATUS FOR IMPROVED USE, MAINTENANCE AND MANAGEMENT OF FLOOR MAINTENANCE EQUIPMENT**

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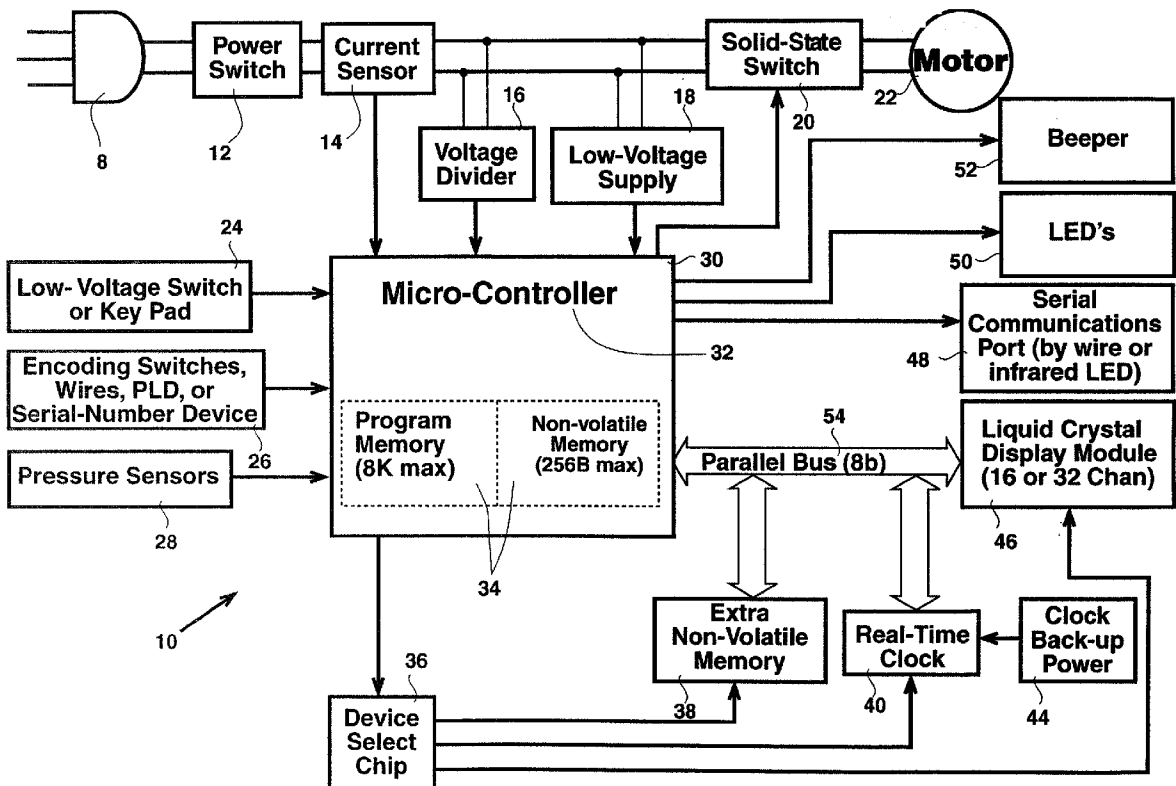
(57) **ABSTRACT**

A control unit for improving the use, simplifying the maintenance, and organizing the management of floor maintenance equipment. The control unit can include a processing unit, a mechanical input channel, a memory system, other input means, communication means, data output means, and sensors. The control unit is electrically interconnected with the floor maintenance equipment so that operations can be controlled and data can be stored regarding the use of the equipment. This data is also able to be exported from the memory system to a computer, such as one connected to the Internet.

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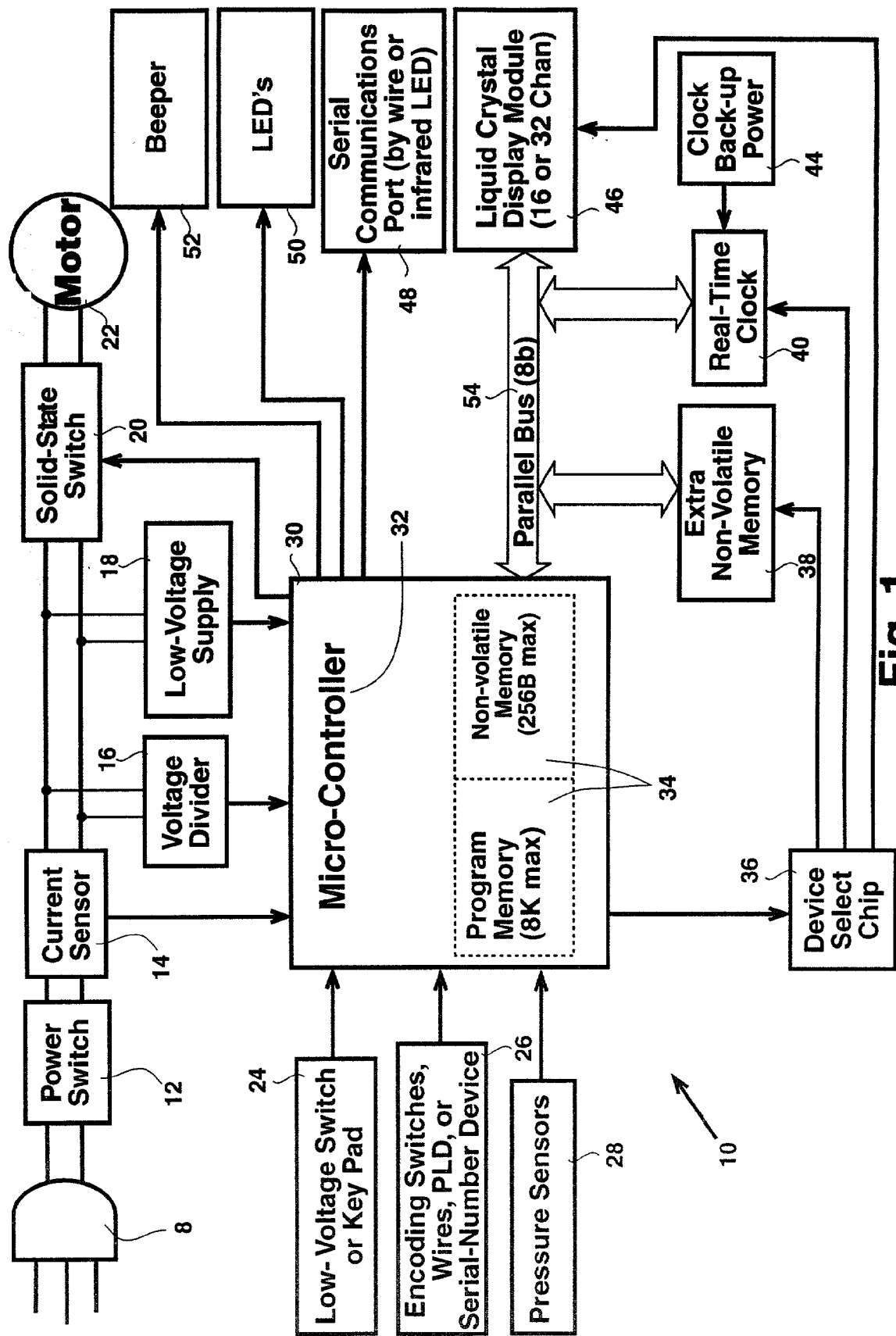


Fig. 1

## METHOD AND APPARATUS FOR IMPROVED USE, MAINTENANCE AND MANAGEMENT OF FLOOR MAINTENANCE EQUIPMENT

### PRIORITY

[0001] This application claims priority from the provisional patent application, serial No. 60/285,579, filed on Apr. 20, 2001, entitled Method and Apparatus for Improved Use, Maintenance and Management of Floor Maintenance Equipment, the disclosure of which is incorporated herein by reference.

### DESCRIPTION

#### BACKGROUND OF THE INVENTION

##### [0002] 1. Field of the Invention

[0003] The present invention generally relates to floor maintenance equipment, and more particularly relates to methods and apparatuses utilized to improve the use, the maintenance, and the management of floor maintenance equipment.

##### [0004] 2. Background Information

[0005] There are many instances whereby the use, maintenance and management of the use and maintenance of floor maintenance equipment ("equipment") could be improved.

[0006] Safety issues are one possible area of improvement. The potential unauthorized use of equipment by individuals who are not competent to use the equipment could lead to injury or property damage. For instance, a child could be injured by using the equipment. Another example would be if an untrained person were to use the equipment in a dangerous manner, or where the untrained person attempts to use the equipment in a manner for which it was not designed, thereby damaging the equipment.

[0007] Productivity issues are another potential area of improvement. If a manager was able to track the use and maintenance of such equipment, the manager would be better able to make his/her employees more productive. This could be through making the employees more efficient, or through maintaining the equipment as needed to maintain operation of the equipment while minimizing "down-time."

[0008] Maintenance issues are another potential area of improvement. Many times, equipment is not maintained properly. Equipment often times contains consumable components which need to be examined, if not replaced, in regular intervals. Simplifying the maintenance process would be a tremendous benefit.

[0009] These issues are not properly addressed in the prior art.

#### SUMMARY OF THE INVENTION

[0010] The present invention is a method and apparatus for improving the use, simplifying the maintenance, and organizing the management of floor maintenance equipment.

[0011] One embodiment of the invention is an improvement to a floor maintenance tool. Floor maintenance tools can include a number of different designs, typically each of

which has a motor and a tool head. The motor and tool head combination can form a vacuum cleaner, a buffer, a sander, a waxer, and other floor maintenance tools. For purposes of consistency, a vacuum cleaner will be referenced as a typical floor maintenance tool of the application.

[0012] The improvement in its most basic form is a lockout switch which shuts off electricity to the electric motor of the floor maintenance tool unless is deactivated. The lockout switch is associated with a control unit which activates or deactivates the lockout switch based on actions of the user. The device also includes predetermined control parameters by which the control unit operates to deactivate or activate the lockout switch. The control unit can be a mechanical input device in which a user enters an access code, or a password, or inserts a key or its equivalent to unlock the device. Such use of an access code, a password, or a key, deactivates the lockout switch, and allows the user to turn on the floor maintenance tool. In this case, entry of the access code, password, or key type device is the control parameter. The control unit could also be a digital input device in which the user enters an alphanumeric access code, which deactivates the lockout switch and allows the user to turn on the floor maintenance tool.

[0013] The control unit of the improved floor maintenance tool can include an electronic system which includes memory storage, a timer, a computation unit, and one or more system sensors which sense a condition in one or more systems of the floor maintenance tool, and makes a computation based on the condition being sensed, and sends output to a display unit, the output contents being based on the predetermined condition rules. These predetermined condition rules can be related to motor temperature, motor RPM, motor amps, airflow, air pressure, belt condition, or other parameters of interest.

[0014] In a floor maintenance tool with such an electronic system, one configuration of the invention could sense the temperature of the motor, and compare the sensed temperature with an acceptable range of temperatures which had been entered as a predetermined condition rule. If the temperature was out of range, the computation unit would send an appropriate message to the display unit. For example, the message could state that the motor is overheating. The "message" could also be a flashing light. Another condition which could be sensed is airflow in an air conduit system, such as in a vacuum cleaner. The airflow would be sensed and compared in the computation unit with an acceptable range of airflow, which had been entered as a predetermined condition rule. If the airflow is out of range, an alarm message would be sent to the display unit. Besides having an alarm message, the computation unit could have the logic to activate the lockout switch, and shut off electricity to the electric motor of the floor maintenance unit if the condition sensed was far enough out of range.

[0015] One way to achieve this is to enter a first acceptable range of airflow, and a first range of unacceptable airflow. If the airflow is below the first acceptable range of airflow and within the first unacceptable range of airflow, then the computational unit sends a warning message to the display unit. However, if the airflow is below the first unacceptable range of airflow, then the computational unit would activate the lockout switch and shut off electricity to the electric motor unit it is deactivated.

[0016] One version of the device could also sense whether the motor is on or off, and keep a record in storage of the total time that the motor had been operated. This motor time could be compared to replacement schedules for various system components, and when sufficient motor time had accumulated, the system components would be signaled by way of the display unit that their time for replacement had arrived or passed. The display unit would thus display messages concerning the need to replace certain components, such as belts, brushes, filters, etc. The control unit of such a floor maintenance tool could also be configured so that stored information on motor hours and component change out time is downloadable to an external analysis device. Thus, this data could be accessed by a handheld PDA, a laptop computer, a desktop computer, or other devices which would record, analyze, and make the information available to the user. The device of the invention could also be configured with sensors for various components to sense when the components had been changed, so that this information would update the calculation of component change out time compared to motor run time.

[0017] Still other objects and advantages of the present invention will become readily apparent to those skilled in this art from the following detailed description wherein we have shown and described only the preferred embodiment of the invention, simply by way of illustration of the best mode contemplated by carrying out our invention. As will be realized, the invention is capable of modification in various obvious respects all without departing from the invention. Accordingly, the drawings and description of the preferred embodiment are to be regarded as illustrative in nature, and not as restrictive.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0018] FIG. 1 is a schematic view of one embodiment of the present invention.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] While the invention is susceptible of various modifications and alternative constructions, certain illustrated embodiments thereof have been shown in the drawings and will be described below in detail. It should be understood, however, that there is no intention to limit the invention to the specific form disclosed, but, on the contrary, the invention is to cover all modifications, alternative constructions, and equivalents falling within the spirit and scope of the invention as implied or defined in this disclosure and drawings.

[0020] The present invention is a method and apparatus for improving the use, the maintenance, and the management of floor maintenance equipment. In the preferred embodiment, the present invention would comprise a control unit for integration into or attachment to a piece of floor maintenance equipment. This disclosure will discuss this piece of floor maintenance equipment as if the piece was a vacuum cleaner, however, all other forms of floor maintenance equipment and such equipment (both indoors and outdoors) are also included in this disclosure, including but not limited to: vacuum cleaners, floor polishers, burnishers, extractors, spotters, leaf blowers, and the like.

[0021] One embodiment of the present invention would be a vacuum cleaner having a control unit controlling the

operation of the vacuum. This control unit could have a mechanical input channel for allowing a user to input information into the control unit. Examples of such input include: (1) the entry of a password unlocking operation of the vacuum cleaner, (2) the entry of features wished to be enabled, (3) the entry of personal identification numbers (for tracking usage by a particular operator), (4) input of reference information for tracking use of the vacuum cleaner, for instance client codes representing what client, what building and what location within a building that the vacuum cleaner was used, (5) input of changes to the consumable components of the equipment (i.e., when a filter is changed, when a switch has been replaced, etc.), (6) input of requests to retrieve information stored in the control unit, (7) input of information clearing the memory of the control unit, and (8) etc. This mechanical input channel may include input means such as switches, buttons, keypads, etc.

[0022] The control unit could further have a memory system such as ROM (flash, NVRAM, or standard ROM, etc.), RAM (DRAM, SRAM, flash, etc.), or some other form of storage (hard disk, optical disk, etc.). This memory system would be used to store program operations, error codes, data, etc. For instance, the memory system could store the information inputted via the mechanical input channel.

[0023] The control unit could further have a processing unit which may comprise a microprocessor/microcontroller; may utilize a programmable logic device such as a PROM (programmable read only memory), PLA (programmable logic array) and/or PAL/GAL (programmable array logic/generic array logic); or may utilize a field programmable gate array (FPGA).

[0024] The control unit may further have other input means, through any number of various channels, from a radio frequency (RF) channel, an ultrasonic (US) channel, cable connections to computers, docking station connections, etc.

[0025] The control unit may have global positioning unit capabilities in combination with a radio frequency transmitter (or similar link) for allowing a manager to track the movement of the vacuum cleaner through a building, or to allow the manager to locate a stolen or misplaced unit. Optionally, a manager would have the ability to "lock-out" other users of the vacuum in the case of a stolen unit—thereby rendering the unit inoperative.

[0026] The control unit may have the ability to communicate, preferably through a communication means, with other control units, computers, hand-held units (i.e., PDA's), etc. This would allow the control unit to transmit real time data, including who was operating the vacuum, where they are, how long they have been working, whether any alarm conditions have been triggered by the vacuum cleaner, etc. This data would be collected and either displayed instantaneously in a real-time mode, or stored for later playback, display, and analysis. This data could be transmitted to a central location for likewise display and analysis. For instance, error codes could be transmitted to the manufacturer or authorized repair facility for feedback purposes; consumable condition codes and the percent of the consumable remaining (based upon a predetermined standard—i.e., a typical brush fails after X hours) could be transmitted to a pre-selected supplier of the consumables thereby "ordering"

replacement consumables (such as brushes, switches, filters); and performance data, such as the number of hours the employee actually vacuumed and GPS data, could be transmitted to the manager for determining hours worked and where the employee vacuumed or could be used to calculate the square footage the employee vacuumed. Data could also be transmitted to a central location where it would be analyzed and the manager would be contacted and informed as needed or where the data could be displayed in an electronic form (such as hyper text markup language) for later review by the manager. Also through such communication, a remote user (such as the manufacturer) may be able to review the conditions of the vacuum cleaner and troubleshoot problems being experienced by the user.

**[0027]** The control unit would have any number of data output means for exporting data to another location or computer for analysis. For instance, radio frequency communications, infrared communications, ultrasonic communications, cabling (USB, Firewire, RAM card, parallel port, serial port, etc.), memory sticks, docking station capabilities, etc. This would allow the operator to export data generated by the control unit into a separate computer system for analysis, report generating, etc. For instance a docking station could be provided which the equipment plugs into. While plugged into the docking station, the equipment could export data into a computer system. Likewise, data could be uploaded back into the equipment for later use and function. Data exported could be transmitted to a Internet or intranet server where it could be displayed and sorted by location, user, etc. and compiled into a central manager database.

**[0028]** The control unit may have any number of sensors (including but not limited to: air pressure, consumable component condition/state/operation, airflow, temperature, voltage, amperage, and load) for inputting additional data into the control unit. Examples of the benefits and uses of such sensors include sensing if there is a problem with the vacuum cleaner (clogged hose, plugged filter, improperly installed cap, broken or jammed beater bar, electrical problem, etc.); sensing if the motor is overheating; and sensing when the filter/belt/switch/motor needs to be repaired or replaced. The sensors will relay information collected about sensed conditions to the control unit for processing.

**[0029]** If the control unit determines that a triggering event or condition has occurred, the control unit may have the ability to shut down or reduce the operability of the vacuum cleaner. For instance, if the control unit determines that the airflow through the hose of the vacuum motor has been reduced to a critical point (indicating a possible plugged hose), the control unit could sound an alarm and/or shut down the vacuum cleaner. An alarm code or other information could then be displayed to the operator, thereby assisting the operator in fixing the problem and getting the device running again (if possible). The information could be delivered to the operator through use of audio or visual cues. Additionally, this information could be transmitted to a manager or central location for informational purposes, ordering supplies or dispatching a repairman to repair the unit. Alarms could be stored for later retrieval.

**[0030]** Specific embodiments of the present invention include, but are not limited to, the following:

**[0031]** Password lock out control unit embodiments. In this embodiment the control unit includes a power interrupt

is located between the equipment's electrical components, i.e., motor(s), and the equipment's power source, i.e., wall receptacle, battery, etc. In this embodiment, an access pass code is stored in the memory system. When an authorized user wishes to use the equipment, the user must first enter into the control unit the appropriate pass code. If the entered pass code matches the stored pass code then the equipment will be powered. Without the correct pass code, the equipment will not be powered and will be inoperable. This entered pass code could be entered any number of ways, but most likely would be through the mechanical input channel. A related embodiment would have the pass code locking out more advanced features. For instance, no pass code might be needed to operate the equipment in general, but if "Feature X" is to be utilized, then the appropriate pass code must first be entered.

**[0032]** Use tracking embodiments. Another embodiment of the present invention utilizes the invented control unit to track the use of the equipment. For instance, when the operator/user starts to use the equipment, the user would key in to the mechanical input channel his/her pass code. Keying in the pass code would then start a timer and would cause the date and time to be stored in the memory system. Likewise, when the user stopped operation of the equipment the control unit could stop the time and log the elapsed time of use, etc. This information being of use as production data, for instance at the end of the workday the user's manager could check how many hours of vacuuming a vacuum specialist put in. In a related embodiment, the user could also enter information about a client (client code), a project (project code), a location (location code), etc. Thus, the manager could track the specifics of who, what, where, and when user utilized the equipment. This feature would have great quality and production control benefits. Supplementation of this feature with GPS (global positioning satellite) data in conjunction with a graphical display, such as that provided by a computer, could allow a manager to further check the work of the user, noting if the user forgot to clean any areas of the building. If the control unit was attached to a communication means, for instance a transmitter or a docking station, this information could be transmitted to a separate location, for instance the "home office" for review.

**[0033]** Service tracking embodiments. In this embodiment the data collected is stored for use in servicing the equipment. For instance, the number of hours the equipment is used can be logged to allow the servicer to determine the life span of certain parts, i.e., "Part X" typically fails after X hours of operation. Such data could also be used in routine maintenance. For instance, a servicer when repairing the equipment for an unrelated issue could note the "Component X" has exceeded its recommended hourly use and thereby go ahead and reduce the likelihood of future downtime by replacing "Component X."

**[0034]** Service reminder embodiments. The invented control unit could serve to remind the operator or the operator's manager that service is due, suggested or necessary. For instance, a vacuum cleaner could have a reminder built therein which reminds the operator to change the filter bag every X hours. Such an embodiment would utilize a control unit having the critical information (number of hours, sensor fault range, etc.) stored in the memory system. Then when the control unit determines that the appropriate condition(s) are met, for instance a sensor could sense that the filter bag

was full or a time sensor could sense that the equipment had been operated for X hours, the control unit would then alert the appropriate individual that the condition has been met. Examples of such an alert could include audible alarms, visual displays, notes within printed out reports, etc.

[0035] Referring now to FIG. 1, shown is another embodiment of the present invention. The device 10 is able to be electrically connected with a power source through use of a standard electrical plug 8. A power switch 12 is provided, as is a current sensor 14. A solid-state switch 20 is provided in-line (as shown) with a motor 22. This embodiment utilizes a voltage divider 16 and a low-voltage supply 18. Input can be obtained through a low-voltage switch or keypad 24, encoding switches, wires, PLD, or Serial-Number Device 26, or pressure sensors 28. The control unit 30 has a micro-controller (processing unit) 32 as well as a memory system 34 (program memory (8K max.), non-volatile memory (256B max.)). A device select chip 36 is provided, as is extra non-volatile memory 38, a real-time clock 40, and a clock back-up power 44. A parallel bus 54 may also be present connecting the extra non-volatile memory 38 and real-time clock 40 to the control unit 30. The parallel bus 54 may also connect with a liquid crystal display module (16 or 32 char.) 46. Also connecting with the control unit 30 are a serial communications port (by wire or infrared LED) 48, LED's 50, and a beeper 52.

[0036] While there is shown and described the present preferred embodiment of the invention, it is to be distinctly understood that this invention is not limited thereto but may be variously embodied to practice within the scope of this disclosure and drawings.

We claim:

1. A safety device for interrupting current flow between a power source and at least one electrical motor of a piece of floor maintenance equipment, said safety device comprising:

- a control unit for controlling said safety device;
  - a memory system for storing an operation code; and
  - a mechanical input channel for allowing an operator to enter an access code into said control unit;
- wherein said control unit compares said access code to said operation code;
- wherein if said access code matches said operation code current flow to said electrical motor is established;
- wherein if said access code does not match said operation code current flow to said electrical motor is left interrupted.

2. A safety device for blocking use of at least one electrically controlled feature of a piece of floor maintenance equipment, said safety device comprising:

- a control unit for controlling said safety device;
  - a memory system for storing a feature code; and
  - a mechanical input channel for allowing an operator to enter an access code;
- wherein said control unit compares said access code to said feature code;

wherein if said access code matches said feature code said operator is allowed to utilize said electrically controlled feature;

wherein if said access code does not match said feature code operator is not allowed to utilize said electrically controlled feature.

3. A data collecting device for use with a piece of floor maintenance equipment, said data collecting device comprising:

- a memory system for storage of data;
- a mechanical input channel for allowing an operator to enter operator data, said operator data stored in said memory system;
- a data output means for output of said memory system stored data to a computer.

4. The data collection device of claim 3, wherein said operator data comprises coding information representing a particular individual operator thereby allowing for the tracking of what individual operator has operated said equipment.

5. The data collection device of claim 3, wherein said operator data comprises coding information representing a particular location thereby allowing for the tracking of what locations said equipment has been utilized.

6. A data collecting device for use with a piece of floor maintenance equipment, said data collecting device comprising:

- a memory system for storage of data;
- a sensor, said sensor creating sensor data, said sensor data stored in said memory system;
- a data output means for output of said memory system stored data.

7. The data collecting device of claim 6, wherein said memory system stored data is outputted to a computer.

8. The data collecting device of claim 6, wherein said sensor is a temperature sensor.

9. The data collecting device of claim 6, wherein equipment is a vacuum cleaner having a vacuum cleaner bag, wherein said sensor senses when said vacuum cleaner bag is full.

10. The data collecting device of claim 6, wherein said sensor senses when the equipment is about to fail.

11. The data collecting device of claim 6, wherein said sensor is a time sensor.

12. The data-collecting device of claim 6, wherein said sensor is a global position sensor sensing the location of said equipment.

13. A reminder device for use with a piece of floor maintenance equipment, said data collecting device comprising:

- a control unit for controlling said reminder device;
- an alert system for alerting the operator of said equipment that a use threshold has been met;
- a memory system for storing a predetermined use threshold; and
- sensor means for sensing the use of said equipment and creating sensor data reflecting said use, said sensor data stored in said memory system;

wherein said control unit monitors the use of said equipment by comparing said sensor data to said predetermined use threshold, wherein when said sensor data meets said use threshold said control unit triggers said alert system to alert said operator that said use threshold has been met.

**14.** The reminder device of claim 13, further comprising a second predetermined use threshold stored in said memory system, wherein if said second threshold is met the control unit terminates operation of said equipment.

**15.** The reminder device of claim 13, wherein said equipment is a vacuum cleaner, wherein said use threshold relates to hours of use of said vacuum cleaner, and wherein said alert system is utilized to remind said operator to replace the vacuum cleaner's filter.

**16.** The reminder device of claim 13, wherein said threshold relates to the temperature of said equipment.

**17.** The reminder device of claim 13, wherein said control unit monitors the use of said equipment by comparing said sensor data to said predetermined use threshold, wherein when said sensor data meets said use threshold said control unit transmits said sensor data to a computer.

**18.** The reminder device of claim 13, wherein said threshold relates to consumable components and wherein when said sensor data meets said use threshold said control unit transmits said sensor data to a computer which orders replacement components.

**19.** A tracking device for tracking the use of a piece of floor maintenance equipment being used to clean a building, said data collecting device comprising:

a memory system for storage of data;

a global positioning satellite receiver for receiving global position data from a global positioning satellite system, said global position data stored in said memory system;

a data output means for output of said memory system stored data to a display device attached to a computer, wherein an individual can view said display device to confirm where within a building said equipment was utilized.

**20.** An improved floor maintenance tool, in which the floor maintenance tool includes an electric motor and a tool head, in which the improvement comprises:

a lockout switch which shuts off electricity to the electric motor of said floor maintenance tool unless deactivated; and

a control unit, which activates or deactivates said lockout switch based on predetermined control parameters.

**21.** The improved floor maintenance tool of claim 20 which said control unit is a mechanical input device in which a user enters an access code, which deactivates said lockout switch and allows said user to turn on said floor maintenance tool, and entry of said access code is a control parameter.

**22.** The improved floor maintenance tool of claim 20 which said control unit is a digital input device in which a user enters an access code, which deactivates said lockout switch and allows said user to turn on said floor maintenance tool, and said access code is a control parameter.

**23.** The improved floor maintenance tool of claim 22 which said control unit includes memory storage, a timer, and a computation unit, and one or more system sensors which sense a condition in one or more systems of said floor maintenance tool, and makes a computation based on said condition, and sends output to a display unit based on predetermined condition rules.

**24.** The improved floor maintenance tool of claim 23 which the system to be sensed is the motor of said tool, and the condition to be sensed is a temperature of said motor, in which said computation unit compares said temperature of said motor with an acceptable range of temperatures entered as a predetermined condition rule, and is out of range, sends an alarm message to said display unit.

**25.** The improved floor maintenance tool of claim 23 which the system to be sensed is an air conduit, and the condition to be sensed is an airflow in air conduit, in which said computation unit compares said airflow in said air conduit with an acceptable range of airflow entered as a predetermined condition rule, and if out of range, sends an alarm message to said display unit.

**26.** The improved floor maintenance tool of claim 25, in which said computation unit activates said lockout switch and shuts off electricity to said electric motor of said floor maintenance tool until deactivated.

**27.** The improved floor maintenance tool of claim 25 in a first acceptable range of airflow is entered, and a first range of unacceptable airflow is entered as predetermined condition rules, and if said airflow is below said first acceptable range of airflow and within said first unacceptable range of airflow, said computation unit sends a warning message to said display unit, and if said airflow is below said first unacceptable range of airflow, said computation unit activates said lockout switch and shuts off electricity to said electric motor of said floor maintenance tool until deactivated.

**28.** The improved floor maintenance tool of claim 23 in which the system to be sensed is the motor, and the condition to be sensed is the on or off condition of the motor, in which said computation unit records in memory a total of the time said motor has been in an on condition since the time in memory has been reset, and on command, said computation sends said total time on motor to said display unit.

**29.** The improved floor maintenance tool of claim 28 which further includes one or more sensors on system components, and maintains a record of time in use for the system components being sensed by use of the time recorded for motor use, and compares the time in use for a component against a change out time, which is entered as a predetermined condition rule, and if a change out time has been passed, sends an alarm message to said display unit.

**30.** The improved floor maintenance tool of claim 29 in which said control unit is configured so that stored information on motor hours and component change out time is downloadable to an external analysis device.

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