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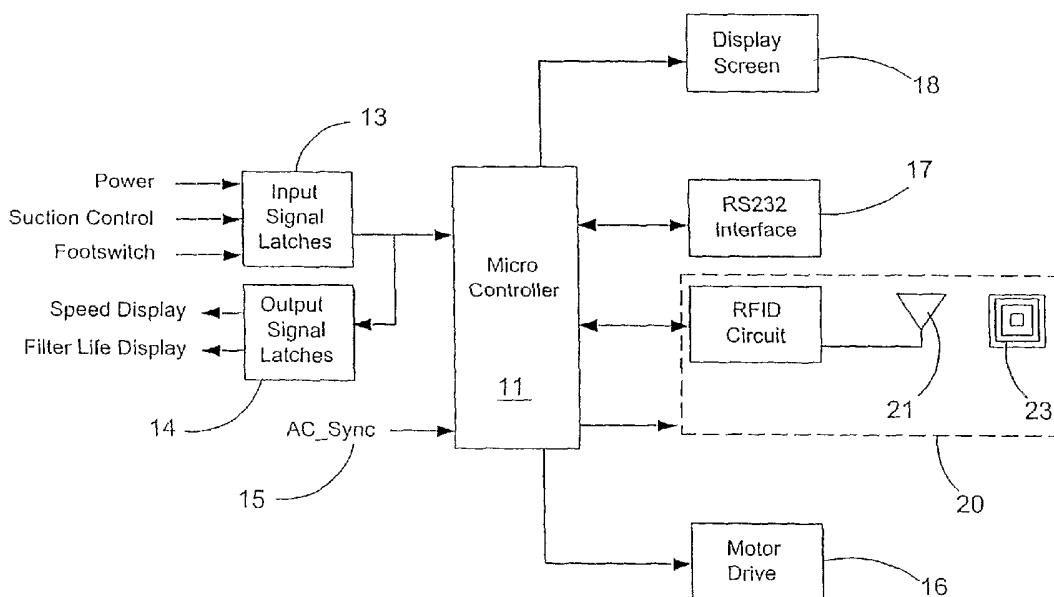
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(54) Title: A FLUID EVACUATION SYSTEM WITH TWO-WAY COMMUNICATION FILTER



(57) Abstract: An evacuation system includes at least one fluid intake, at least one fluid outlet, at least one operational component, such as an evacuation motor, and a first read/write device for transmitting, receiving, or storing information. The evacuation system also includes a filter having a second read/write device (23) for transmitting information to the first read/write device (21). A micro-controller (11), which is in functional communication with the first read/write device and the operational component, interprets the information received by said first read/write device and controls the operational component based on said interpreted information.



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A FLUID EVACUATION SYSTEM WITH TWO-WAY COMMUNICATION
FILTER

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BRIEF DESCRIPTION OF THE DRAWINGS

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functionally connected to a filter;

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Figure 5 is a circuit diagram of a two way read/write circuit connected to a microcontroller of an evacuation system;

Figure 6 is a circuit diagram showing a display panel and a two-way read/write circuit connected to a microcontroller of an evacuation system; and,

Figure 7 illustrates screen shots displayed on a display panel of an evacuation system.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

Initially, it should be appreciated that like drawing numbers on different drawing views identify identical structural elements. It also should be appreciated that figure proportions and angles are not always to scale. Further, it should be understood that the evacuation system is not limited to the disclosed embodiments. Various modifications and equivalent arrangements may be included within the spirit and scope of the appended claims.

Referring to the drawings, Figure 1 is a partial schematic drawing of an evacuation system 10 for evacuating suspended particulates from a fluid stream . It should be understood that the fluid stream may be comprised of liquids, gases, and/or solids. Further, the suspended particles may be visible or microscopic particles; organic or inorganic matter. In one embodiment, the suspended particles in a fluid stream are in the form of smoke. Evacuation system 10 includes at least one fluid intake, at least one exhaust outlet and an evacuation motor unit (not shown). As shown, a microcontroller 11 is in functional communication with components of evacuation system 10 such as input signal latches 13, output signal latches 14, an alternate circuit (A/C) synchronization system 15, a motor drive 16 and a remote switch interface 17. Microcontroller 11 is also in functional communication with a display screen 18. In addition, microcontroller 11 is functionally connected to a two-way read/write circuit 20. In the embodiment shown in

Figure 1, read/write circuit 20 includes an antenna 21 which may be present if read/write circuit 20 is a radio frequency identification tag ("RFID") reader/writer. The read/write circuit 20 may be based on the ISO 15693 standard for communicating with tags at 13.56 MHz. Further, the interface between microcontroller 11 and read/write circuit 20 may include a 3-wire serial interface having a bi-directional clock controlled by microcontroller 11 during command/data write operations and by read/write circuit 20 during data read operations. In one embodiment, evacuation system 10 includes a control panel (not shown). The control panel and display screen 18 may combined into one integral component. In another embodiment, evacuation system 10 is in functional communication with a filter 22 which includes a second two-way read/write circuit such as RFID tag 23.

A suitable read/write circuit component is the TI S6700 ASIC from Texas Instruments or similarly equivalent devices. In an alternate embodiment, read/write circuit 20 may include a direct-wired connection between microcontroller 11 and a downstream component, such as filter 22.

Microcontroller 11 contains at least one program configured to control the functionally connected components as well as, when necessary, determining changes in functional or operational parameters of the functionally connected components. As used herein the phrase "functionally connected" shall mean that components, for example, microcontroller 11 and read/write circuit 20, are connected in such a way that signals, data, controls and other applicable modes of information are transmitted therebetween using either suitable direct wired connections or a form of wireless or radio transmission and reception. In one embodiment, in which read/write circuit 20 is an RFID tag reader/writer, an antenna is used to functionally communicate with an RFID tag on another component. Microcontroller 11 may include an external electrically erasable programmable read-only memory (EEPROM) to hold the required programs. An internal EEPROM may be used as it requires fewer I/O pins and makes available more memory. In an alternate embodiment, microcontroller 11 may be in functional communication with a data port, such as a USB connection, to allow changes or replacement of a program.

In another alternate embodiment, read/write circuit 20 and read/write circuit of filter 22 may transfer information using short-distance radio communication. According to this kind of radio communication method, cordless communication between equipment and a terminal can be established. For example, short-distance radio communication can be used for the following: data exchange between pieces of portable information equipment; and transmission of data and sound between a main body of a telephone (or a portable music player) and a headset, between a main phone and a cordless handset, and between others. One representative type of short-distance radio communication is Bluetooth.

Figures 2 and 3 illustrate schematically two configurations of read/write circuit 20 functionally connected to filter 22 and RFID tag 23. In Figure 2, antenna 21 is arranged such that the planes formed by antenna 21 and RFID tag 23 are parallel to each other. Although this configuration allows for two-way communication between distances of up to 8 inches, the presence of metal or other conductive material between antenna 21 and tag 23 interferes with communication between the two components.

Figure 3 illustrates an orientation in which antenna 21 is looped around a filter housing (not shown) in a substantially perpendicular orientation in relation to tag 23. While this orientation reduces effective communication range, it allows for designs such that tag 23 is about 0.5 inch from at least a part of antenna 21. As shown in Figure 2, antenna 21 is arranged parallel to at least a part of tag 23. Suitable RFID tags include the TI-IT HF-I transponder family of tags from Texas Instruments. Persons of ordinary skill in the art will recognize the more than one RFID tag 23 may be used with filter 22. Also, the two-way read/write circuit of filter 22, such as RFID tag 23, can be used to transmit command and control instructions to microcontroller 11.

Figure 7 is a collection of screen shots presented on display screen 18, such as an LCD screen, to inform the system user of various operational or structural parameters or data including, but not limited to, type of filter used, filter life remaining, filter life

consumed, evacuation motor suction setting, filter lot number, filter manufacturing date, authentication code(s), evacuation motor brush life, and an error message. It will be obvious to those skilled in the art that other messages, including set up parameters such as off/standby/on message(s), flow rate and/or motor speed, mode selection, and filter
5 overuse (use past rated filter life) may be displayed on the display screen. An authentication code (for example, to allow or disallow operation of the evacuation system), first written into a filter read/write circuit, may be transmitted to microcontroller 11 to command that a certain flow rate or flow rate range be used for that filter. It will be recognized that the functional communication between RFID tag 23 of filter 22 and
10 microcontroller 11 through read/write circuit 20 enables the above operation and/or structural parameters to be transmitted to and from filter 22 and microcontroller 11.

Typically, display screen 18 may be mounted on a evacuation boom in an easily visible position such as that disclosed in U.S. Patent No. 6,524,307 to Palmerton, et al.
15 Alternatively, display screen 18 may be detached and mounted on a wall, in a separate control room, operating room or on a stand-alone evacuation unit that intakes air to filter smoke and/or particulate matter and evacuates it back into a room. In one embodiment, display screen 18 is integral with an evacuation system control panel.

20 Figure 6 is a circuit diagram showing several of the circuits leading from microcontroller 11. Read/write circuit 20 is shown to include antenna 21. Display screen 18 is also shown connected to microcontroller 11.

Typically, microcontroller 11 contains programming to calculate and display the
25 remaining filter life. The established or rated filter life is written into RFID tag 23, along with such information as filter type or name, manufacturer, and manufacturing lot number. When a new filter is inserted into the evacuation system, microcontroller 11 reads and stores this information through read/write circuit 20 after powering RFID tag 23 through antenna 21 of read/write circuit 20. Some or all the information is displayed
30 as seen in the screen shots of Figure 7. Displayed calculations such as remaining filter life may be based on a simple calculation loop. Established filter life may be based on a

particular evacuation motor speed or intake flow rate which is a function of evacuation motor speed. At a preset time interval, the motor speed or flow rate is sensed or calculated and recorded by the program in microcontroller 11. In the same operation, the number of minutes or seconds is subtracted from the rated filter life. Thus, if a filter life for a particular filter is rated at 10 hours (600 minutes), after one minute of operation, remaining filter life would be 559 minutes. In one embodiment, this calculation may be adjusted by the actual flow rate. Thus, if the flow rate used to establish the rated filter life is 10 CFM, a flow rate of 5 CFM would increase filter life to 20 hours which would be calculated and stored in microcontroller 11 memory and displayed. Similarly, if the actual flow rate is 20 CFM, the actual filter life would be 300 minutes (5 hours). In one embodiment, if an evacuation system is operated at different flow rates, the displayed remaining filter life is based on the current operating flow rate.

In an alternate embodiment, filter life may be based on time of use. In this embodiment, microcontroller 11 and/or RFID tag 23 may include a clock or timer function to determine the length of time of filter use.

Each recorded change in filter life is also transmitted through read/write circuit 20 to RFID tag 23 where it may be saved. Consequently, if filter 22 is moved from one evacuation unit to another compatible unit, that second unit would read the remaining filter life on the transferred filter. Remaining filter life may be displayed in several ways, including but not limited to, a percentage of rated filter life, actual remaining filter life, and consumed filter life. Similarly, diagnostic parameters, such as motor brush life and filter history, may be calculated and displayed using similar calculations.

The microcontroller 11 and/or RFID tag 23 may also include a reset feature in which an evacuation system is powered into a standby or operational mode but no smoke or other particulates are actually evacuated through filter 22. In such a situation, a recorded filter life may be reset to the full rated life. Other possible displays include but are not limited to, error messages indicating filter or diagnostic errors, authentication codes, filter history, evacuation flow rate, suction speed, and/or motor speed. Some or all

of these operational and structural parameters may be transmitted and saved onto RFID tag 23 or equivalent components.

In one embodiment, RFID tag 23 of filter 22 contains control information that when transmitted to microcontroller 11, details particular operational parameters to be enabled. For example, certain filters 22 may be designed for certain flow rates. Commands transmitted from RFID tag 23 may then be transmitted to microcontroller 11 to operate the evacuation motor at those specific flow rates or within a certain flow rate range.

Up to this point, the evacuation system was described in detail with reference to specific embodiments. The described embodiments were presented in the form of exemplification and should not be interpreted in a limited manner. Changes and modifications to these embodiments should be readily apparent to those having ordinary skill in the art.

We claim:

1. A method for controlling a system for evacuating suspended particulates from a fluid having at least one fluid intake, at least one fluid outlet, a first read/write device,
5 and a controller coupled to said first read/write device, said method comprising:
 inserting a filter into said evacuation system, said filter including a second read/write device having information stored thereon;
 transmitting said information from said second read/write device to said first read/write device;
10 interpreting said information with said controller;
 setting at least one operational parameter of said evacuation system based on the interpreted information.
2. The method according to claim 1 wherein each of said first and second read/write
15 devices are wireless communication devices.
3. The method according to claim 2 wherein said second read/write device is an RFID tag.
- 20 4. The method according to claim 2 wherein said first and second read/write devices transfer information by short distance radio communication.
5. The method according to claim 1 wherein said information stored on said second read/write device represents filter type.
25
6. The method according to claim 1 wherein said information stored on said second read/write device represents filter life.
7. The method according to claim 6 further comprising calculating changes in filter life
30 with controller and transmitting said changes in filter life to said second read/write device.

8. The method according to claim 1 further comprising displaying said information on a display screen coupled to said controller.

5 9. The method according to claim 1 wherein said at least one operational parameter is evacuation motor flow rate.

10. The method according to claim 1 wherein said at least one operational parameter is evacuation motor on/off.

10

11. A system for evacuating suspended particulates from a fluid comprising:

at least one fluid intake;

at least one fluid outlet;

at least one operational component;

15 a first read/write device for transmitting, receiving, or storing information;

a filter having a second read/write device coupled thereto, said second read/write device adapted to transmit information to said first read/write device;

20 a microcontroller in functional communication with said first read/write device and said at least one operational component, wherein said microcontroller interprets the information received by said first read/write device and controls said at least one operational component based on said interpreted information.

12. The evacuation system of claim 11 wherein said operational component is an evacuation motor.

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13. The evacuation system of claim 11 wherein each of said first and second read/write devices is a wireless communication device.

14. The evacuation system of claim 13 wherein said second read/write device is an RFID tag.

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15. The evacuation system of claim 13 wherein said first and second read/write devices transfer information by short distance radio communication.

5 16. The evacuation system of claim 11 wherein said information stored on said second read/write device represents filter type.

17. The evacuation system of claim 11 wherein said information stored on said second read/write device represents filter life.

10 18. The evacuation system of claim 17 wherein said microcontroller is adapted to calculate changes in filter life and said first read/write device is adapted to transmit said calculated changes in filter life to said second read/write device.

15 19. The evacuation system of claim 11 further comprising on a display screen coupled to said microcontroller for displaying said information.

20. A system for evacuating suspended particulates from a fluid comprising:

at least one fluid intake;

at least one fluid outlet;

20 at least one operational component;

a RFID tag reader/writer;

a filter having a RFID tag attached thereto for transmitting information to said RFID tag reader/writer;

25 a microcontroller in functional communication with said RFID tag reader/writer and said at least one operational component, wherein said microcontroller interprets the information received by said RFID tag reader/writer and controls said at least one operational component based on said interpreted information.

30 21. The evacuation system of claim 20 wherein said operational component is an evacuation motor.

22. The evacuation system of claim 20 wherein said microcontroller is adapted to calculate changes in filter life and said first read/write device is adapted to transmit said calculated changes in filter life to said second read/write device.

5 23. The evacuation system of claim 20 further comprising on a display screen coupled to said microcontroller for displaying said information.

24. A system for evacuating suspended particulates from a fluid comprising:

at least one fluid intake;

10 at least one fluid outlet;

an evacuation motor for transferring fluid from said at least one fluid intake to said at least one fluid outlet;

a read/write device for transmitting, receiving, or storing information;

a display panel for displaying said information;

15 a microcontroller in functional communication with said read/write device and said display panel, said microcontroller adapted to convert the information from said read/write device into information capable of being displayed on said display panel.

20 25. The evacuation system of claim 24 further comprising a filter having a second read/write device in functional communication with said read/write device of said evacuation system.

26. The evacuation system of claim 25 wherein each of said read/write device of said evacuation system and said second read/write device is a wireless communication device.

25

27. The evacuation system of claim 26 wherein said second read/write device is an RFID tag.

28. The evacuation system of claim 25 wherein said second read/write device is adapted to transmit information regarding characteristics of said filter to said read/write device of said evacuation system.

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29. The evacuation system of claim 28 wherein said microcontroller calculates and controls at least one operational parameter of said evacuation motor based on said information transmitted from said second read/write device.

5

30. The evacuation system of claim 28 wherein said filter characteristic is filter life.

31. The evacuation system of claim 28 wherein said filter characteristic is remaining filter life.

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32. The evacuation system of claim 28 wherein said filter characteristic is consumed filter life.

33. The evacuation system of claim 28 wherein said filter characteristic is manufacturing history of said filter.

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34. The evacuation system of claim 28 wherein said filter characteristic is a filter overuse signal.

35. The evacuation system of claim 29 wherein said at least one operational parameter is evacuation motor speed.

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36. The evacuation system of claim 29 wherein said at least one operational parameter is evacuation motor flow rate.

25

37. The evacuation system of claim 29 wherein said at least one operational parameter is standby/operational status.

38. The evacuation system of claim 29 wherein said at least one operational parameter is a diagnostic parameter.

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39. The evacuation system of claim 38 wherein said diagnostic parameter is motor brush life.

40. The evacuation system of claim 28 wherein said filter characteristic is an authentication code read and authenticated by said microcontroller, whereby said microcontroller acts to allow or disallow operation of said evacuation system based on said authentication code.

41. The evacuation system of claim 26 wherein said second read/write device transfers information by short distance radio communication. 42. A system for evacuating suspended particulates from a fluid comprising:

at least one fluid intake;

at least one fluid outlet;

at least one operational component;

a first read/write device for transmitting, receiving, or storing information;

a filter having a second read/write device attached thereto, said second read/write device adapted to transmit and receive information from said first read/write device;

a microcontroller in functional communication with said first read/write device and said at least one operational component, wherein said microcontroller calculates remaining filter life and sends a signal representative of said remaining filter life to said second read/write device via said first read/write device.

43. A filter for use in a system for evacuating suspended particulates from a fluid having a first read/write device and a microcontroller, said filter comprising:

a second read/write device coupled thereto, said second read/write device storing information regarding at least one filter characteristic, wherein said second read/write device is adapted to transmit said information to said first read/write device for use by said microcontroller in controlling said evacuation system.

44. The filter of claim 43 wherein said second read/write device is a wireless communication device.

45. The filter of claim 44 wherein said second read/write device is an RFID tag.

46. The filter of claim 43 wherein said microcontroller calculates and controls at least
5 one operational parameter of said evacuation motor based on said information transmitted
from said second read/write device.

47. The filter of claim 43 wherein said at least one filter characteristic is filter life.

10 48. The filter of claim 47 wherein said at least one filter characteristic is remaining
filter life.

49. The filter of claim 47 wherein said at least one filter characteristic is consumed
filter life.

15

50. The filter of claim 43 wherein said at least one filter characteristic is
manufacturing history of said filter.

51. The filter of claim 43 wherein said at least one filter characteristic is a filter
20 overuse signal.

52. The filter of claim 46 wherein said at least one operational parameter is
evacuation motor speed.

25 53. The filter of claim 46 wherein said at least one operational parameter is
evacuation motor flow rate.

54. The filter of claim 46 wherein said at least one operational parameter is
standby/operational status.

30

55. The filter of claim 46 wherein said at least one operational parameter is a diagnostic parameter.

56. The filter of claim 43 wherein said at least one filter characteristic is an authentication code read and authenticated by said microcontroller, whereby said
5 microcontroller acts to allow or disallow operation of said evacuation system based on said authentication code.

57. The filter of claim 44 wherein said second read/write device transfers information by
10 short distance radio communication.

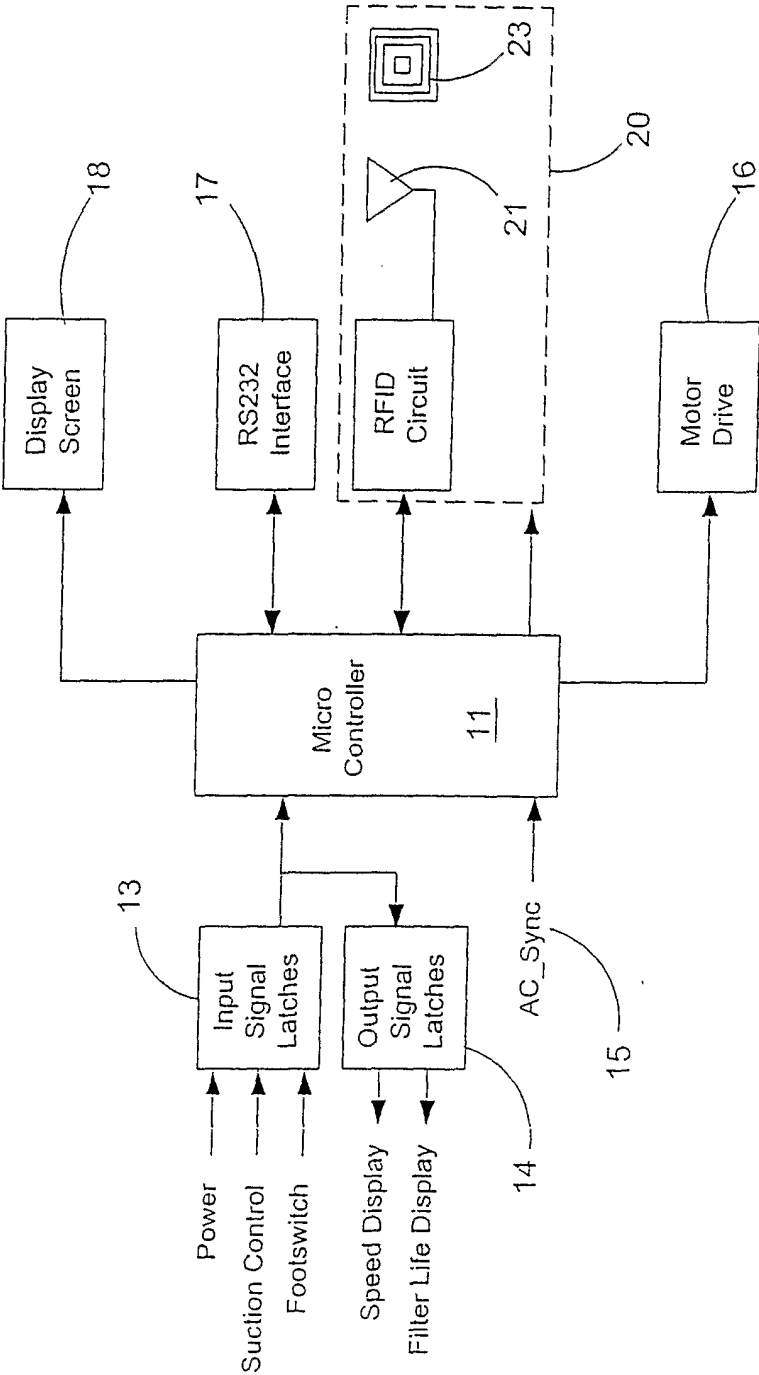


Fig. 1

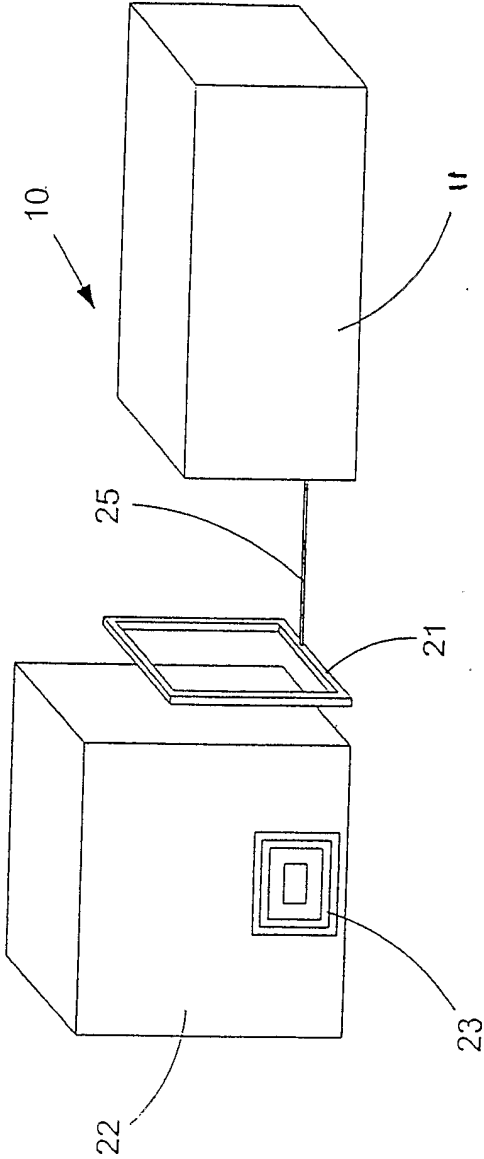


Fig. 2

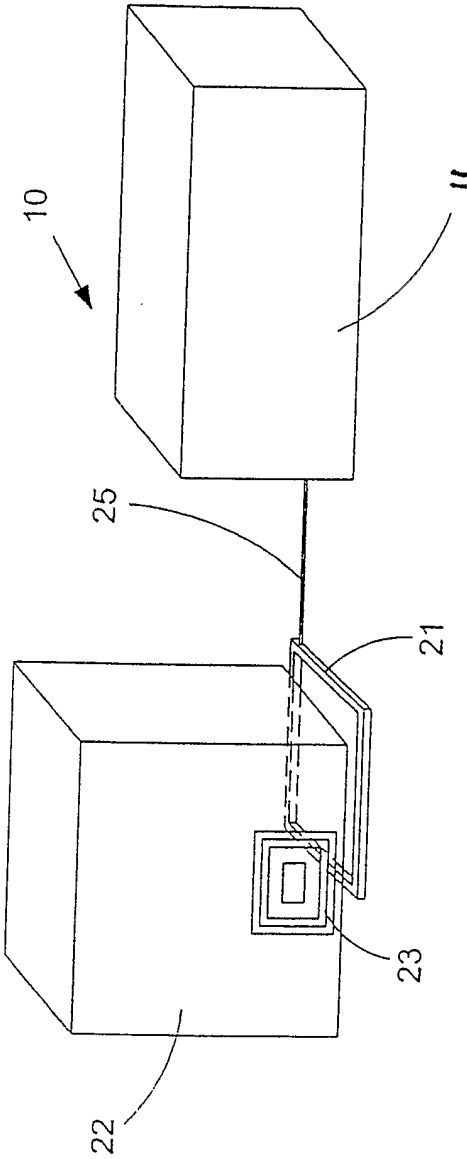


Fig. 3

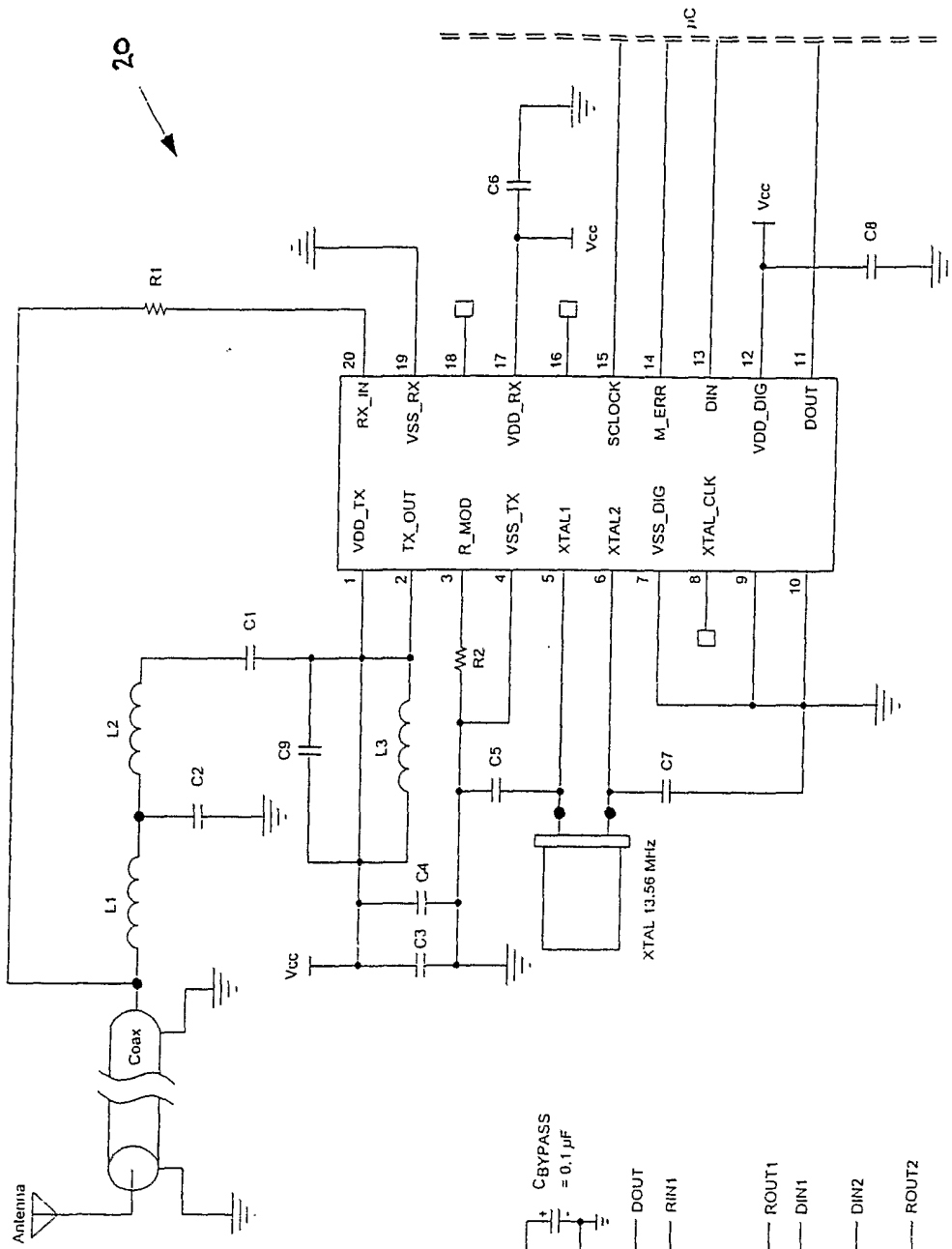
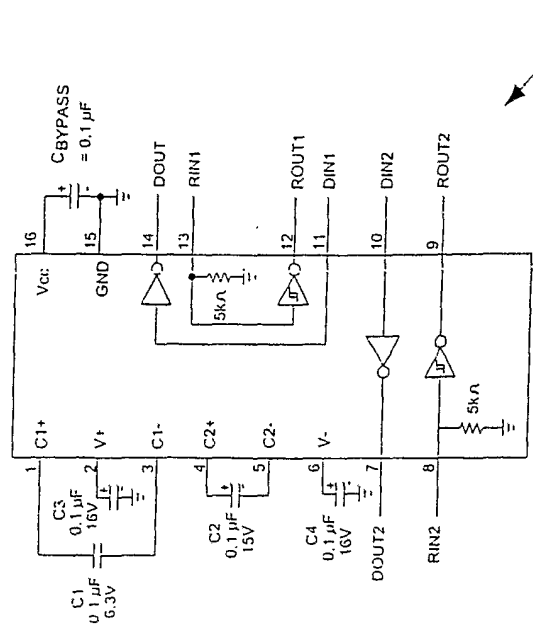
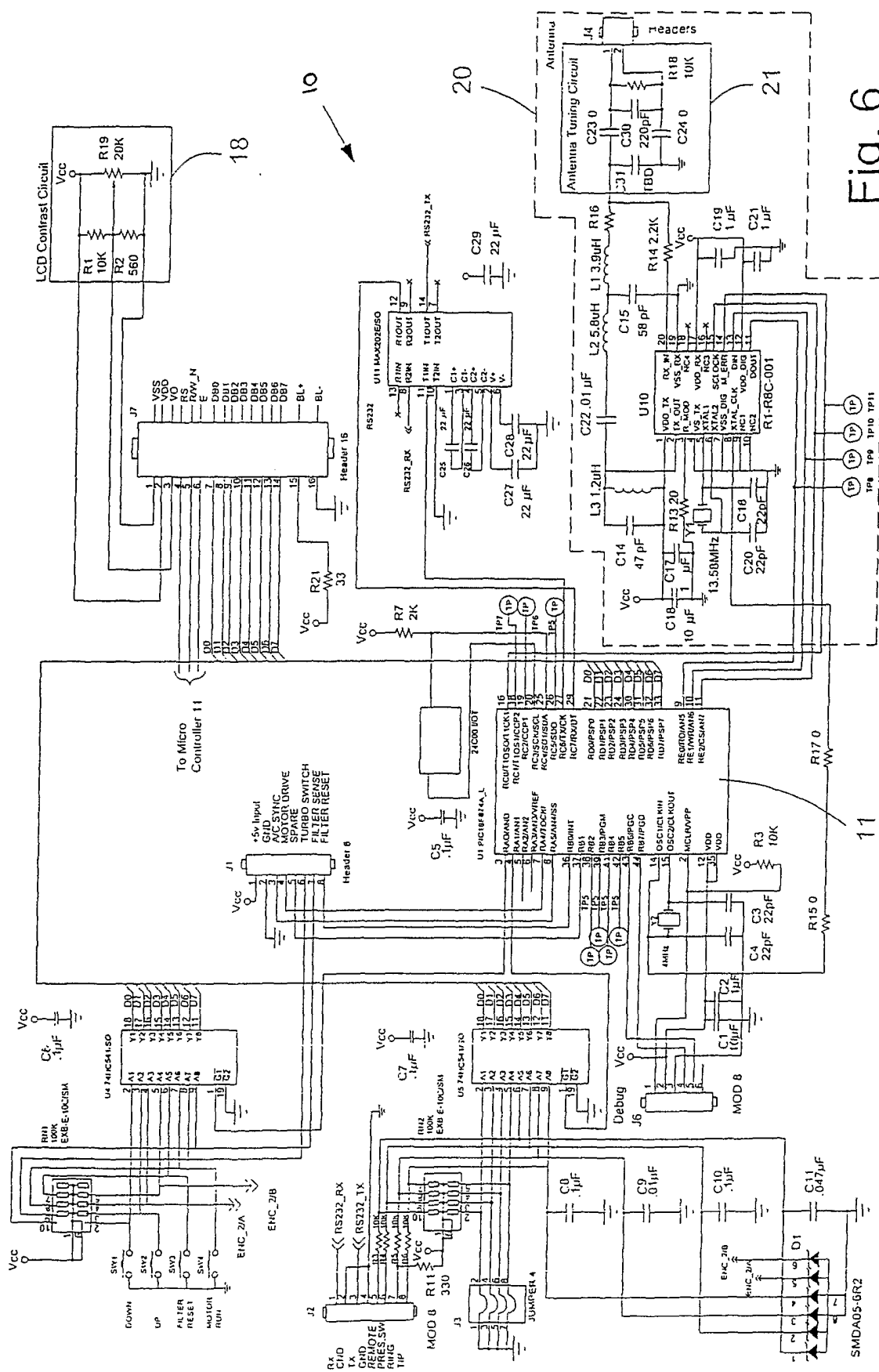


Fig. 5

Fig. 4



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69.

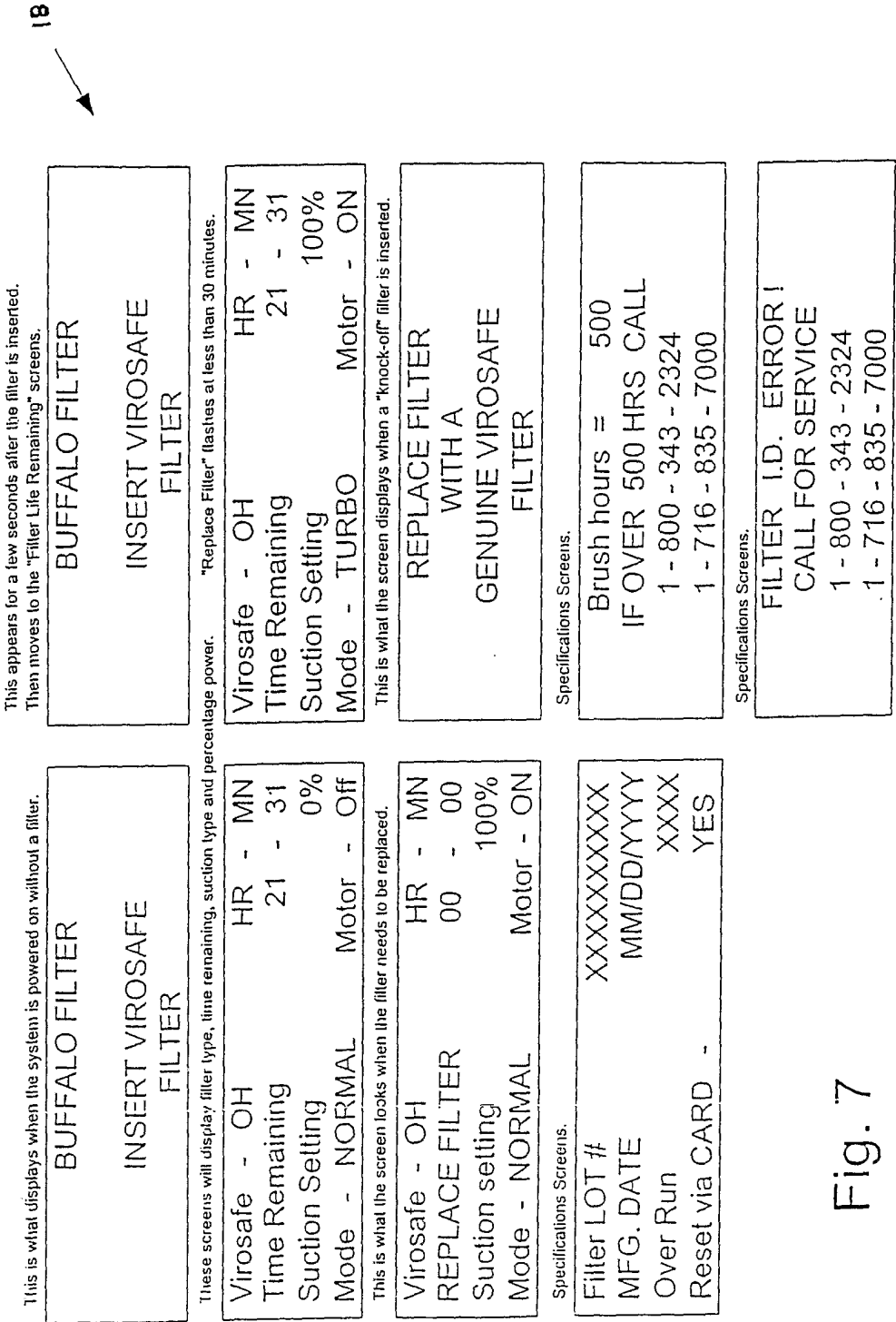


Fig. 7

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2006/012517

A. CLASSIFICATION OF SUBJECT MATTER
 INV. G05B19/12 B01D41/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G05B B01D G06K G08C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data, INSPEC, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	page 3, line 15 - page 4, line 19; figures 1a, 2a page 5, lines 1-10 page 7, lines 12-29 page 9, line 18 page 13, lines 1-20	6, 7, 17, 18, 22, 30-32, 42, 47-49
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Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International application No

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	PATENT ABSTRACTS OF JAPAN vol. 2003, no. 12, 5 December 2003 (2003-12-05) & JP 2004 342510 A (SEKISUI CHEM CO LTD), 2 December 2004 (2004-12-02) abstract -----	6,7,17, 18,22, 30-32, 42,47-49
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