US 20070157643A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2007/0157643 A1

Athanasiou (43) Pub. Date: Jul. 12, 2007

(54) **HOUSEHOLD APPLIANCE AND METHOD FOR DETERMINING A CAUSE OF FAILURE ON THIS APPLIANCE**

(75) Inventor: **Athanasios Athanasiou**, Giengen (DE)

Correspondence Address:
BSH HOME APPLIANCES CORPORATION
INTELLECTUAL PROPERTY DEPARTMENT
100 BOSCH BOULEVARD
NEW BERN, NC 28562 (US)

(73) Assignee: **BSH Bosch und Siemens Hausgerate GmbH**, Munich (DE)

(21) Appl. No.: **10/582,922**

(22) PCT Filed: **Dec. 7, 2004**

(86) PCT No.: **PCT/EP04/53307**

§ 371(c)(1),
(2), (4) Date: **Jun. 13, 2006**

(30) **Foreign Application Priority Data**

Dec. 15, 2003 (DE)..... 103 58 732.2

Publication Classification

(51) **Int. Cl.**
F25D 21/06 (2006.01)

(52) **U.S. Cl.** **62/152**

(57) **ABSTRACT**

A household appliance comprises at least one sensor for detecting an operating parameter of the household appliance, a memory for periodically recording the value of the operating parameter detected by the sensor, and comprises an interface for reading out the contents of the memory. In the event of a failure, the memory is read out in order to deduce a possible cause of failure from the stored parameter values.

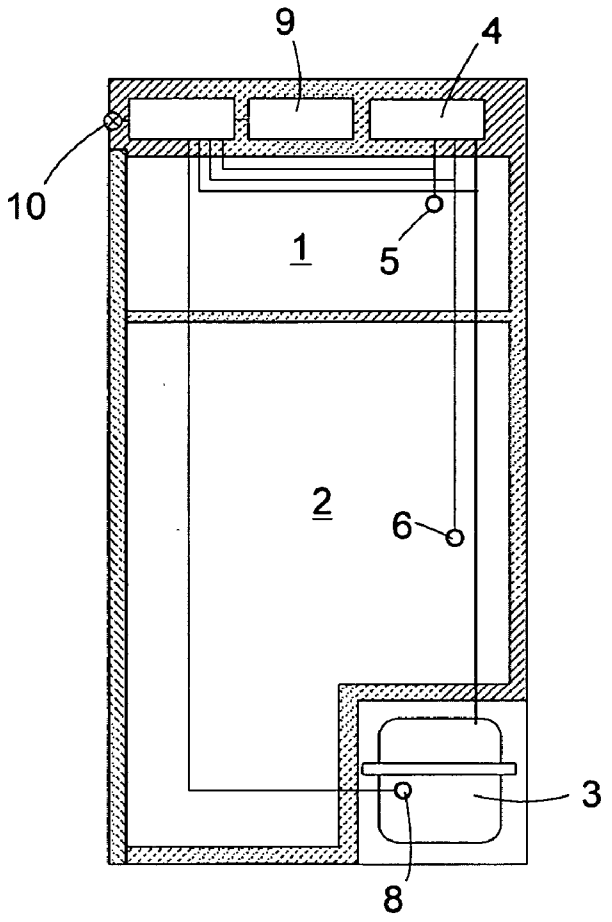
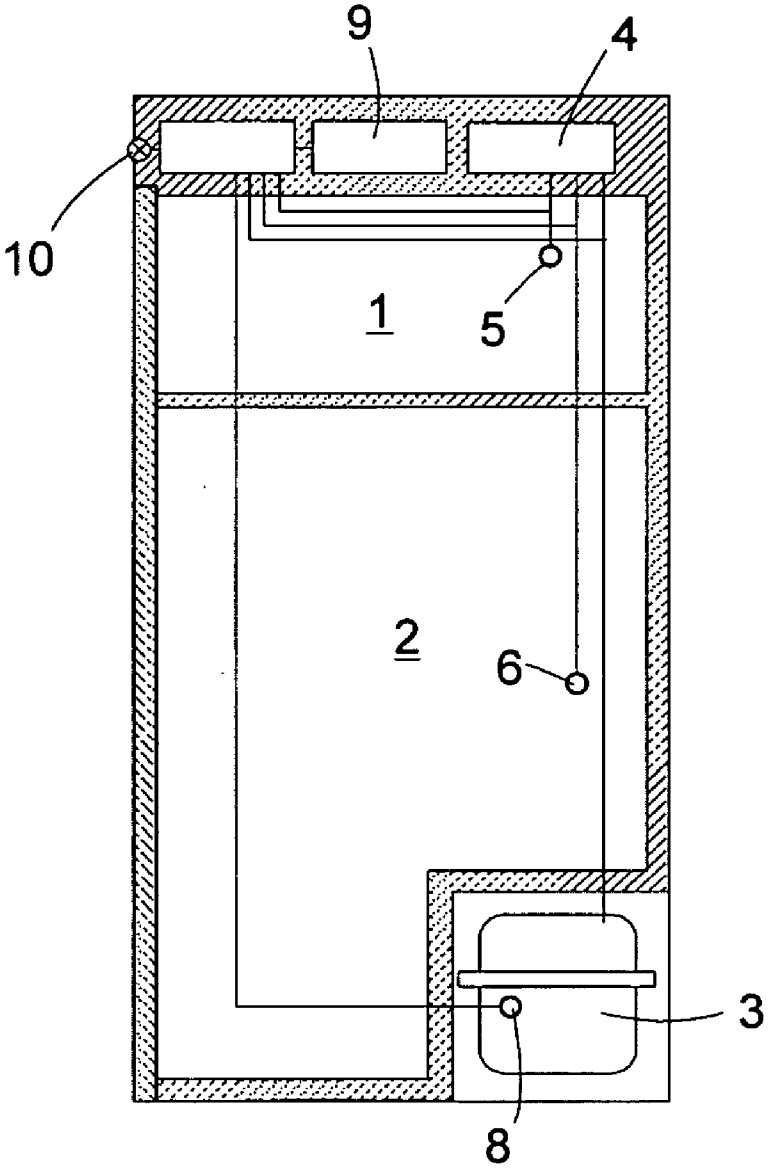


Fig. 1



HOUSEHOLD APPLIANCE AND METHOD FOR DETERMINING A CAUSE OF FAILURE ON THIS APPLIANCE

[0001] The present invention relates to a household appliance and a method for determining the cause of failure on such an appliance.

[0002] The more technically complex a household appliance, the more numerous are the failure patterns which can occur on such an appliance and consequently the causes which can form the basis of such a failure. This is disturbingly noticeable especially in appliances in the upper price bracket both for the user and for the manufacturer. Compared with appliances in the lower and middle price brackets, appliances of this type are necessarily distinguished by additional functions which are frequently the result of comparatively recent technical developments which have not yet achieved the same degree of maturity and reliability as functions which have formed the standard equipment of these appliances for many years. This problem is further exacerbated by the fact that customer service staff who may be responsible for repairing faults in this equipment cannot be familiar with new developments to the same extent as old established technology, so that the risk of an incorrect diagnosis and consequently an unsuccessful repair attempt is comparatively high.

[0003] In household appliances using technology which has been tried and tested for a long time, sporadic malfunctions occur occasionally, which are particularly frustrating for the user since it is almost impossible to make a specific diagnosis of such a fault which evades observation by customer service staff and for which components suspected of being the cause can frequently only be exchanged for good measure in the hope of eliminating such a fault without then being able to be certain however that the fault has actually been rectified.

[0004] It is known to use a so-called diagnostic box for fault diagnosis on a household appliance, a device which is connected to an interface of the household appliance provided for this purpose and repeatedly reads out measured values detected by various sensors of the household appliance from which it is expected that an indication of the cause of a fault can be obtained. Such a device must be installed by customer service in each case. This naturally only occurs when a fault has already occurred. If the fault is sporadic and is not repeated as long as a customer service employee with the diagnostic box is on site, its use is in vain and a repair can be made in any case on suspicion as specified above.

[0005] It is the object of the invention to provide a household appliance and a method for determining a cause of failure on the household appliance which allows an exact diagnosis and consequently a targeted successful repair even in the event of sporadic faults or new types of functions for which the individual customer service engineers are not yet familiar in detail with the possible causes of faults.

[0006] The object is solved on the one hand by a household appliance having at least one sensor for detecting at least one operating parameter of the household appliance, a memory connected permanently to the sensor for periodically recording the value of the operating parameter detected by the sensor and an interface for reading out the content of the memory.

[0007] The memory allows the function of the device to be monitored continuously in principle over an arbitrarily long period of time according to the capacity of the memory so that comprehensive data are available for determining the cause of a fault, which can extend over a substantially longer period of time than that which a service engineer can reasonably stay on site to observe the appliance. Naturally, not only a single parameter will preferably be recorded but a plurality of interrelated parameters so that a cause of a fault can be concluded not only from the detected values of the operating parameters but also from a regular deviation of the relationships of the operating parameters among one another.

[0008] The interface for reading out the contents of the memory is preferably an interface to a data network, especially to a telephone network. Such an interface can be used to transmit the recorded data from the location of the appliance to a remote service centre where the evaluation can be made. Such an evaluation, which can be made by a computer-supported expert system or by experienced engineers, enables the possible causes of failure to be limited before the visit of a customer service employee to the location of the appliance so that the employee can estimate in advance which replacement parts may be needed and can take these with him so that the repair can presumably be successfully completed with a single visit. In addition, such a preliminary analysis makes the work of the customer service engineer more efficient on site since he can systematically check through the causes of failure which have been identified as possible beforehand. Since the customer service engineer himself does not need to probe possible causes of failure, a comparatively low degree of experience is sufficient, which is of considerable advantage especially in the repair of appliances having new types of functions which have not yet achieved major penetration of the market.

[0009] Naturally, the interface could also be used to connect a diagnostic box thereto, where in this case the diagnostic box must be designed not only to read out the measured values recorded continuously by at least one sensor but also the contents of the memory.

[0010] The interface to the data network should preferably be cordless to allow comfortable use. This interface can, for example, comprise a terminal of a cellular radio system or an infrared interface or a short-range radio interface, possibly using the bluetooth standard which communicates with a complementary interface connected to a long-range data network for transmission to the service centre.

[0011] The method according to the invention comprises the steps of periodically detecting at least one operating parameter of the household appliance and recording the detected value in a memory, reading out the memory in the case of a fault and tracing the cause of the fault from the parameter values which are read out.

[0012] If the amount of data of the values to be recorded is small, in principle a memory could be used whose capacity is sufficient for the amount of data accumulating during the expected lifetime of the appliance. Preferably, however the recorded parameter values are automatically deleted after a predetermined time to make memory space available for the most recent parameter values. It can be appropriate to carry out this deletion in several steps, by first merely decimating the recorded parameter values after a first predetermined memory time and only definitively deleting them at a later time. The decimation can take place in several steps if desired.

[0013] Further features and advantages of the invention are obtained from the following description of an exemplary embodiment with reference to the appended figure.

[0014] FIG. **1** is a schematic diagram of a refrigerating device as a first embodiment of the present invention.

[0015] The invention is explained hereinafter specially with reference to a refrigerating device but it is understood that it can be applied without substantial modifications to any other household appliance such as a washing machine or a dishwashing machine.

[0016] FIG. **1** is a highly schematic diagram of a refrigerating device comprising a freezing compartment **1** and a normal chilled compartment **2** and, representing various possible functional groups of the refrigerating device to be monitored, a compressor **3**. Control electronics **4** control the operation of the compressor **3** in a conventional fashion using measured temperature values recorded using temperature sensors **5**, **6** in the freezing compartment I or the normal chilled compartment **2**. A monitoring and diagnostic electronic system **7** and the control electronics **4** are arranged on two different printed circuit boards here. This separation has the advantage that the operation of the refrigerating device can be controlled by conventional control electronics **4** not according to the invention so that a standard model of monitoring and diagnostic electronics **7** can be used for a plurality of different types of refrigerating devices.

[0017] The monitoring and diagnostic electronics **7** is connected to the same sensors for detecting operating parameters as the control electronics **4**, in this case to the temperature sensors **5**, **6** and optionally to other sensors, e.g. a temperature sensor **8** which is disposed at the compressor **3** for monitoring its temperature. If the control electronics **4** is implemented as a microcontroller system comprising a microcontroller and a random access memory connected to the microcontroller by means of a bus, the monitoring and diagnostic electronics **7** can also be connected to this bus in order to read values of variables used by the control electronics **4**, logic flags or other operating parameters of the refrigerating device, input by the control electronics **4** into the memory cells of this random access memory and in this way obtain data which make it possible to check the correct functioning of the control electronics **4**.

[0018] Connected to the monitoring and diagnostic electronics **7** is an EEPROM 9 into which the monitoring and diagnostic electronics **7** inputs data detected at regular time intervals. The storage capacity of the EEPROM 9 is dimensioned depending on the frequency with which the data are recorded and their scope so that data recorded over a time interval of one to several days can be recorded therein. If the parameter values are recorded every two minutes, for example, with suitable data compression a EEPROM 9 of 512 KByte is sufficient to log all the operating parameters of a refrigerating device relevant to diagnosis during a period of 30 days.

[0019] The EEPROM 9 can be composed of a plurality of memory modules mounted on a common printed circuit board. In this case, the same printed circuit board having a plurality of receiving locations prepared for the memory modules can be used for a plurality of different models of household appliances; depending on the number of parameters to be recorded on different models of household appliances, their memory requirement and the desired time resolution or memory duration, a different number of these receiving locations can be loaded with memory modules on the finished appliance.

[0020] Instead of an EEPROM, a battery-buffered RAM can also be used for storing the parameter values.

[0021] Data more than 30 days old are no longer considered to be relevant for the fault diagnosis and are overwritten page-wise with new data. If storage over longer time intervals is desired, it can also be provided that after a predetermined storage time, the monitoring electronics **7** first reads old data out from the EEPROM 9, decimates this, in each case discarding the data from n-1 measuring time points and retaining the n-th time point, thereby overwriting older data.

[0022] The monitoring electronics **7** can be fitted with a user interface which allows a user to specify areas of the EEPROM 9 content corresponding to specific monitoring time intervals which are to be excluded from decimation and deletion possibly because they document the occurrence of a sporadic fault.

[0023] The monitoring electronics **7** is connected to a cordless interface, here an infrared interface **10** via which it can receive an inquiry request of an external reader (not shown) and deliver the content of the EEPROM 9 via the interface **10** to the reader as a response to this request. The reader can, for example, be a laptop of a customer service employee fitted with a complementary interface which visualises the received data and thus makes it easier for the customer service employee to identify regular deviations of this data. The reader can also be a computer of the user which is fitted on the one hand with an interface complementary to the IR interface **10** and on the other hand with an interface to a telephone network via which it transmits data received by the monitoring electronics **7** to a remote service centre. These data allow the service centre to determine the cause of the fault.

[0024] Instead of being connected to the IR interface **10**, the refrigerating device itself can also be equipped with an interface to a telephone network, to a local data network of the user or the like. As part of the increasing networking of household appliances among one another or with the internet, an increasing number of devices is fitted with these interfaces so that the present invention can be achieved on those devices with a minimum financial expenditure and at the same time, a high degree of comfort.

1-9. (canceled)

10. A household appliance having at least one sensor for detecting at least one operating parameter of the household appliance, a memory connected permanently to the sensor for periodically recording the value of the operating parameter detected by the sensor and an interface for reading out the content of the memory.

11. The household appliance according to claim 10, wherein the first interface includes an interface to a data network, especially to a telephone network.

12. The household appliance according to claim 10, wherein the data network includes a telephone network.

13. The household appliance according to claim 10, wherein the first interface includes a cordless interface.

14. The household appliance according to claim 10, wherein the household appliance includes a housing and the memory is built in the housing.

15. The household appliance according to claim 10, wherein the household appliance includes at least one of a refrigerating device, a dishwasher, and a washing machine.

16. A method for determining a cause of failure on a household appliance, the method comprising the following acts:

periodically detecting at least one operating parameter of the household appliance and recording the detected value in a memory at least during normal operation of the household appliance;

reading out the memory in the case of a fault;

tracing the cause of the fault from the parameter values which have been read out.

17. The method according to claim 16, further comprising deleting the recorded parameter values after a predetermined storage time and the released memory space is overwritten.

18. The method according to claim 16, wherein the recorded parameter values are decimated after a first predetermined storage time and deleted after a second predetermined storage time.

19. The method according to claim 16, further comprising transferring the recorded parameter values from the household appliance to a separate device and performing the act of tracing the cause of the fault at the separate device.

* * * * *