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(54) **Washing machine test method**

Waschmaschinentestverfahren

Procédé de test de la machine à laver

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Description

Field of Invention

[0001] The present invention relates to a method for testing the operation of washing machines, see EP-A-1 696 067.

Prior Art

[0002] Concerning the electronic household appliances, one or more components thereof may become malfunctioning, either because of environmental conditions of the respective appliance, or because of user faults. A household appliance having a malfunctioning component mostly fail to operate. When a problem is encountered in a household appliance according to the prior art, it is brought to technical service in order to troubleshoot and solve the problem. This, in turn, results in energy and time loss.

[0003] In the patent document DE102006049628A1 according the prior art is disclosed a washing machine of which a heater is tested. The functionality of said heater is tested using a robot. In that method, however, the test cannot be conducted at everywhere since a robot is used, and therefore that test method is expensive.

[0004] In another patent document W02008154711A2 according the prior art is disclosed a washing machine system. The time to run the machine can be set by a user, using a timer button. The washing machine can also be switched to a self-check mode using this button. In said check mode, the functioning of various components of the machine is tested automatically by the machine.

Brief Description of Invention

[0005] The present invention discloses a test method for washing machines comprising at least one control element; at least one warning element providing the user with information on the operative state of the machine; at least one heating element heating the water to be used in the machine; at least one temperature sensor measuring the temperature of heated water; at least one electronic control unit regulating the operation of the machine, and at least one door through which items to be washed are placed.

[0006] Said method comprises the steps of- initiating the test process once the closing of the door and the use of the control element in a determined order and/or combination are detected by the electronic control unit; checking if there is present a required amount of water in the machine for the test; supplying water if the amount thereof is not adequate; measuring again the amount of water; terminating the test if there is not present an adequate amount of water by providing a 'water failure indicator' or 'valve failure indicator'; checking the operation of the temperature sensor in the machine by measuring

the temperature of the water in the machine if there is present an adequate amount of water in the machine before or after water is supplied to the machine; terminating the test by sending a failure signal to the warning element if no signal is supplied from the temperature sensor to the electronic control unit; measuring the temperature of water in the machine and storing this measured value if a signal is received from the temperature sensor; activating the heater in the machine throughout a predetermined time interval; measuring back the temperature value of water in the machine at the end of this time interval; comparing the finally-measured temperature value to an initial temperature value stored in the electronic control unit; and inferring a failure in the operation of the heater and/or temperature sensor if the difference between these two temperature values is lower than a predetermined threshold value.

[0007] According to the present invention, when a failure is detected in the machine, a warning is indicated on the warning element of the machine so that the person conducting the test sees the presence of a failure.

Object of Invention

[0008] The object of the present invention is to develop a method for testing the heater and temperature sensor of a washing machine.

[0009] Another object of the present invention is to develop a method for detecting any heater failure and temperature sensor failure in the washing machine without having to bring the machine to a technical service.

[0010] A further object of the present invention is to develop a method by which the operation of the heater and temperature sensor is tested by an authorized person.

[0011] Said objects are achieved by the test method according to claim 1.

Description of Figures

[0012] Illustrative embodiments of the washing machine test method according to the present invention are illustrated in annexed figures briefly described hereunder.

Figure 1 is a perspective illustration of the washing machine.

Figure 2 is a cross-sectional illustration of the washing machine.

Figure 3 is a flowchart of the test method.

[0013] The parts in said figures are individually referenced as following.

washing machine	(M)
temperature value	(T_0, T_1)
control element	(1, 2)

(continued)

door	(3)
warning element	(4)
heater	(5)
temperature sensor	(6)
initiation	(10)
door locking	(11)
lock check	(12)
water-level check	(13)
sensor check	(14)
temperature storing	(15)
heater activating	(16)
new temperature storing	(17)
temperature comparing	(18)
water supplying	(19)
water-level recheck	(20)
failure sending	(21)
water-failure sending	(22)
lock-error sending	(23)
completion	(24)

Description of Invention

[0014] In electronic household appliances, one or more components thereof may become malfunctioning, either because of environmental conditions of the respective appliance, or due to user faults. Particularly, when the water used in washing machines has a high limescale content, the latter deposits on the heating element and/or temperature sensor and causes these components to fail. These components may also fail due to environmental factors, user faults and/or production errors. Thus, a method is developed with the present invention for testing these components.

[0015] The washing machine (M), illustrated as a clothes washer in figures 1 and 2, comprises at least one control element (1, 2), which controls the operation of the machine (M) and may be in the form of at least one button or switch; at least one warning element (4) providing the user with information on the operative state of the machine (M); at least one heater (5), preferably in the form of at least one resistance to heat the water to be used in the machine (M); at least one temperature sensor (6) measuring the temperature of heated water; at least one electronic control unit (not illustrated in figures) regulating the operation of the machine (M), and at least one door (3), through which items to be washed are placed into the machine (M). Said warning element (4) may comprise at least one speaker alerting the respective user in an audible manner, and/or at least one indicator (e.g. display, illuminant) warning the respective user visually.

[0016] According to the test method developed with the present invention, first the door (3) of the machine (M) is closed in order to test the heater (5) and temperature sensor (6) of the machine and the control elements

(1, 2) are run in a predetermined order and/or combination. With this order and/or combination being detected by at least one control unit (not illustrated in figures) on a software basis, the test process, with an exemplary flowchart shown in Figure 3, is initiated (10). First, it is checked if there is present a required amount of water (13) in the machine (M) (13), and if this amount is inadequate, water is supplied to the machine (19). The water amount in the machine (M) is measured again (20), and if the water amount supplied is not adequate, the test is terminated (24) by indicating a water-failure or valve-failure (22) on the warning element (4). If there is present an adequate amount of water in the machine (M) before or after water is supplied (19) to the machine (M), it is checked if the temperature sensor (6) in the machine (M) is active or not (14). For this check, the temperature sensor (6) is required to measure the temperature of water taken into the machine (M) and transmit this data to the control unit in the form of a signal. If no signal is transmitted from the temperature sensor (6) to the control unit, a failure signal is sent to the warning element (4) and the test is terminated (24). If a signal is received from the temperature sensor (6), the temperature of water in the machine (M) is measured and transmitted to the control unit (15). The temperature value (T_0) sent to the control unit is stored in the control unit. Then, the heater (5) of the machine (M) is activated for a predetermined amount of time (preferably between 10 to 30 minutes and specifically 15 minutes), such that the water present in the machine (M) is heated (16). At the end of this period, the temperature value (T_1) of water in the machine (M) is measured again (17), and this value (T_1) is compared to the initial temperature value (T_0) stored in the control unit (18). Thus, it is checked if there is a failure in the heater (5) and/or temperature sensor (6). If the difference between these two temperature values ($T_1 - T_0$) is lower than a predetermined threshold value (preferably 1-3°C, and specifically 2°C), it is inferred that a failure exists in the heater (5) and/or temperature sensor (6), and the test is terminated (24) by transmitting a failure signal (21) to the warning element (4). If said difference ($T_1 - T_0$) is higher than the threshold value, the test is completed (24).

[0017] According to a preferred embodiment of the present invention, the door (3) of the machine (M) is automatically locked once the test process is initiated (10), and it is checked if the lock is activated or not (12). If the lock has achieved its activated state, it is switched to the step of measuring the water level in the machine (13), whereas if the lock is not activated, the test is terminated (24) by providing a lock error indication (23).

[0018] According to an alternative embodiment of the present invention, the test process is conducted remotely via a network. In this embodiment, the test results are transmitted to the person conducting the test via the network.

[0019] In terms of the present invention, the control elements are to be used in a determined order and/or combination to have the machine (M) switched to the test

mode. This, in turn, makes sure that the test process is conducted at places and times only, which the authorized persons determine. Thus, it is both ensured to test the machine (M) *in situ* (e.g. at home), and to prevent the machine (M) from being switched to the test mode by unauthorized persons.

Claims

1. A test method for a washing machine (M) comprising at least one control element (1, 2); at least one warning element (4) providing a user with information on the operative state of the machine; at least one heating element (5) heating the water to be used in the machine; at least one temperature sensor (6) measuring the temperature of heated water; at least one electronic control unit regulating the operation of the machine, and at least one door (3) through which items to be washed are placed, the method being **characterized by** comprising the steps of

- initiating the test process (10), once the closing of the door (3) and the use of the control element (1, 2) in a determined order and/or combination are detected by the electronic control unit;
- checking if there is present a required amount of water (13) in the machine (M) for test purposes;
- supplying water (19) to the machine (M) if the amount thereof is not adequate;
- measuring again the amount of water (20) in the machine (M);
- terminating the test (24) if there isn't present an adequate amount of water in the machine (M) by providing a 'water failure' or a 'valve failure' indication (22) on the warning element (4);
- checking the operation of the temperature sensor (6) (14) in the machine (M) by measuring the temperature of water in the machine (M) if there is present an adequate amount of water in the machine (M) before or after water is supplied (19) to the machine (M);
- terminating the test (24) by sending a failure signal (21) to the warning element (4) if no signal is supplied from the temperature sensor (6) to said electronic control unit;
- measuring the temperature of water in the machine (M) and storing this measured value (T_0) (15) if a signal is received from the temperature sensor (6);
- activating the heater (5) (16) of the machine (M) throughout a predetermined time interval;
- measuring again the temperature value (T_1) of water (17) in the machine (M) at the end of this time interval;
- comparing the finally-measured temperature value (T_1) to the initial temperature value (T_0)

(18) stored in the electronic control unit; and
- inferring a failure in the operation of the heater (5) and/or temperature sensor (6) if the difference between these two temperature values ($T_1 - T_0$) is lower than a predetermined threshold value.

2. The method according to Claim 1, **characterized in that** the predetermined time interval is between 10 to 20 minutes.
3. The method according to Claim 2, **characterized in that** the predetermined time interval is 15 minutes.
4. The method according to Claim 1, **characterized by** comprising the step of sending a failure signal to the warning element (4) (21) if the difference between the temperature values ($T_1 - T_0$) in the step of comparing the temperature values (18) is lower than the threshold value, and the step of terminating the test (24).
5. The method according to Claim 1, **characterized by** comprising the step of completing the test process (24) if the difference between the temperature values ($T_1 - T_0$) in the step of comparing the temperature values (18) is higher than the threshold value.
6. The method according to Claim 1, **characterized in that** the predetermined threshold value is between 1°C to 3°C.
7. The method according to Claim 6, **characterized in that** the predetermined threshold value is 2°C.
8. The method according to Claim 1, **characterized by** further comprising the step of checking the lock (12) of the machine (M) door (3) once it (12) is locked (11) following the step of initiating the test process (10).
9. The method according to any of the preceding claims, **characterized in that** the test process is initiated via a remote control method.
10. The method according to Claim 9, **characterized in that** the test results are transmitted via a network.

Patentansprüche

1. Testverfahren für eine Waschmaschine (M) mit zumindest einem Steuerelement (1, 2); mit zumindest einem Warnelement (4), welches den Benutzer mit Informationen über den operativen Zustand der Maschine versorgt, mit zumindest einem Heizelement (5), welches das zu verwendende Wasser in der Maschine aufheizt; mit zumindest einem Temperatur-

sensor (6), welcher die Temperatur des aufgeheizten Wassers misst; mit zumindest einer elektronischen Steuereinheit, welche den Betrieb der Maschine steuert, und mit zumindest einer Tür (3), durch welche zu waschende Gegenstände eingelegt werden, das Verfahren **dadurch gekennzeichnet, dass** es die folgenden Schritte aufweist

- Initiieren des Testprozesses (10), sobald das Schließen der Tür (3) und die Verwendung des Steuerelements (1, 2) in einer vorgegebenen Reihenfolge und/oder Kombination von der elektronischen Steuereinheit erfasst wurde oder wird; 10
- Prüfen, ob eine benötigte Menge von Wasser (13) in der Maschine für den Testvorgang oder den Testzweck vorhanden ist; 15
- Zuführen von Wasser (19) in die Maschine (M), wenn die Menge nicht ausreichend ist;
- erneutes Messen der Wassermenge (20) in der Maschine (M); 20
- Beenden des Tests (24), wenn keine adäquate Menge von Wasser in der Maschine (M) ist, durch Bereitstellen einer Kennzeichnung (22) für einen "Wasserfehler" oder einen "Ventilfehler" auf dem Warnelement (4); 25
- Testen der Betriebsweise des Temperatursensors (6, 14) in der Maschine (M) durch Messen der Temperatur des Wassers in der Maschine (M), wenn eine adäquate Menge von Wasser in der Maschine (M) befindlich ist, bevor oder nachdem Wasser der Maschine (M) zugeführt wird (19); 30
- Beenden des Tests (24) durch Senden eines Fehlersignals (21) zu dem Warnelement (4), wenn kein Signal von dem Temperatursensor (6) zu der elektronischen Steuereinheit gelangt oder ihr zugeführt wird; 35
- Messen der Temperatur des Wassers in der Maschine (M) und Speichern dieses gemessenen Wertes (T_0 , 15), wenn ein Signal von dem Temperatursensor (6) erhalten wird; 40
- Aktivieren der Heizung (5, 16) der Maschine (M), über einen vorgegebenen Zeitabschnitt;
- erneutes Messen des Temperaturwerts (T_1) des Wassers (17) in der Maschine (M) am Ende dieses Zeitintervalls oder dieses Zeitabschnitts; 45
- Vergleichen des zuletzt gemessenen Temperaturwerts (T_1) mit dem anfänglichen Temperaturwert (T_0 , 18), der in der elektronischen Steuereinheit gespeichert ist; und 50
- Annehmen eines Fehlers in der Betriebsweise der Heizung (5) und/oder des Temperatursensors (6), wenn die Differenz zwischen diesen beiden Temperaturwerten ($T_1 - T_0$) kleiner ist als ein vorgegebener Schwellenwert. 55

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet,**

zeichnet, dass die vorgegebene Zeitspanne zwischen 10 min und 20 min ist.

3. Verfahren nach Anspruch 2, **dadurch gekennzeichnet, dass** die vorgegebene Zeitspanne 15 min ist. 5
4. Verfahren nach Anspruch 1, **gekennzeichnet durch** den Schritt des Sendens eines Fehlersignals an das Warnelement (4, 21), wenn die Differenz zwischen den Temperaturwerten ($T_1 - T_0$) in dem Schritt des Vergleichens der Temperaturwerte (18) kleiner ist als der Schwellenwert, und ein Schritt des Abschließens des Tests (24) vorgesehen ist. 10
5. Verfahren nach Anspruch 1, **gekennzeichnet durch** das Vorhandensein eines Schritts der Vervollständigung des Testverfahrens (24), wenn die Differenz zwischen den Temperaturwerten ($T_1 - T_0$) in dem Schritt des Vergleichens der Temperaturwerte (18) höher ist als der Schwellenwert. 15
6. Verfahren nach Anspruch 1, **gekennzeichnet durch** den vorgegebenen Schwellenwert, der zwischen 1°C und 3°C ist oder liegt. 20
7. Verfahren nach Anspruch 6, wobei der vorgegebene Schwellenwert 2°C ist. 25
8. Verfahren nach Anspruch 1, **gekennzeichnet durch** den Schritt des Prüfens eines Verschlusses (12) der Tür (3) der Maschine (M), wenn das Schloss oder der Verschluss (12) verriegelt ist (11), mit der Folge des Schritts des Beginnens des Testverfahrens (10). 30
9. Verfahren nach einem der vorigen Ansprüche, wobei das Testverfahren über eine Fernsteuerungs-Methode begonnen oder initiiert wird. 35
10. Verfahren nach Anspruch 9, wobei die Testergebnisse über ein Netzwerk übertragen werden. 40

Revendications

1. Procédé de contrôle pour une machine à laver (M) comprenant au moins un élément de commande (1, 2) ; au moins un élément d'avertissement (4) fournissant à un utilisateur une information sur l'état de fonctionnement de la machine ; au moins un élément chauffant (5) chauffant l'eau à utiliser dans la machine ; au moins un capteur de température (6) mesurant la température de l'eau chauffée ; au moins une unité de commande électronique régulant le fonctionnement de la machine, et au moins une porte (3) à travers laquelle les articles à laver sont placés, le procédé étant **caractérisé en ce qu'il**

comprend les étapes de

- lancement du processus de contrôle (10), une fois que la fermeture de la porte (3) et l'utilisation de l'élément de commande (1, 2) dans un ordre et/ou une combinaison déterminés sont détectées par l'unité de commande électronique ;
 - vérification qu'une quantité d'eau requise (13) est présente dans la machine (M) à des fins de contrôle ;
 - fourniture de l'eau (19) à la machine (M) si sa quantité n'est pas adéquate ;
 - mesure à nouveau de la quantité d'eau (20) dans la machine (M) ;
 - cessation du contrôle (24) si une quantité adéquate d'eau n'est pas présente dans la machine (M) en donnant une indication « défaillance d'eau » ou « défaillance de vanne » (22) sur l'élément d'avertissement (4) ;
 - vérification du fonctionnement du capteur de température (6) (14) dans la machine (M) en mesurant la température de l'eau dans la machine (M) si une quantité adéquate d'eau est présente dans la machine (M) avant ou après que l'eau est fournie (19) à la machine (M) ;
 - cessation du contrôle (24) en envoyant un signal de défaillance (21) à l'élément d'avertissement (4) si aucun signal n'est fourni du capteur de température (6) à ladite unité de commande ;
 - mesure de la température de l'eau dans la machine (M) et stockage de cette valeur mesurée (T_0) (15) si un signal est reçu du capteur de température (6) ;
 - activation du chauffage (5) (16) de la machine (M) pendant la durée d'un intervalle de temps prédéterminé ;
 - mesure à nouveau de la valeur de température (T_1) de l'eau (17) dans la machine (M) à la fin de cet intervalle de temps ;
 - comparaison de la valeur de température finalement mesurée (T_1) à la valeur de température initiale (T_0) (18) stockée dans l'unité de commande électronique ; et
 - déduction d'une défaillance dans le fonctionnement du chauffage (5) et/ou du capteur de température (6) si la différence entre ces deux valeurs de température ($T_1 - T_0$) est inférieure à une valeur seuil prédéterminée.
2. Procédé selon la revendication 1, **caractérisé en ce que** l'intervalle de temps prédéterminé est entre 10 et 20 minutes.
 3. Procédé selon la revendication 2, **caractérisé en ce que** l'intervalle de temps prédéterminé est de 15 minutes.
 4. Procédé selon la revendication 1, **caractérisé en ce**

qu'il comprend l'étape d'envoi d'un signal de défaillance à l'élément d'avertissement (4) (21) si la différence entre les valeurs de température ($T_1 - T_0$) dans l'étape de comparaison des valeurs de température (18) est inférieure à la valeur seuil, et l'étape de cessation du contrôle (24).

5. Procédé selon la revendication 1, **caractérisé en ce qu'il** comprend l'étape d'achèvement du processus de contrôle (24) si la différence entre les valeurs de température ($T_1 - T_0$) dans l'étape de comparaison des valeurs de température (18) est plus élevée que la valeur seuil.
6. Procédé selon la revendication 1, **caractérisé en ce que** la valeur seuil prédéterminée est entre 1 °C et 3 °C.
7. Procédé selon la revendication 6, **caractérisé en ce que** la valeur seuil prédéterminée est de 2 °C.
8. Procédé selon la revendication 1, **caractérisé en ce qu'il** comprend en outre l'étape de vérification du verrou (12) de la porte (3) de la machine (M) une fois qu'il (12) est verrouillé (11) après l'étape de lancement du processus de contrôle (10).
9. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le processus de contrôle est lancé via un procédé de télécommande.
10. Procédé selon la revendication 9, **caractérisé en ce que** les résultats de contrôle sont transmis via un réseau.

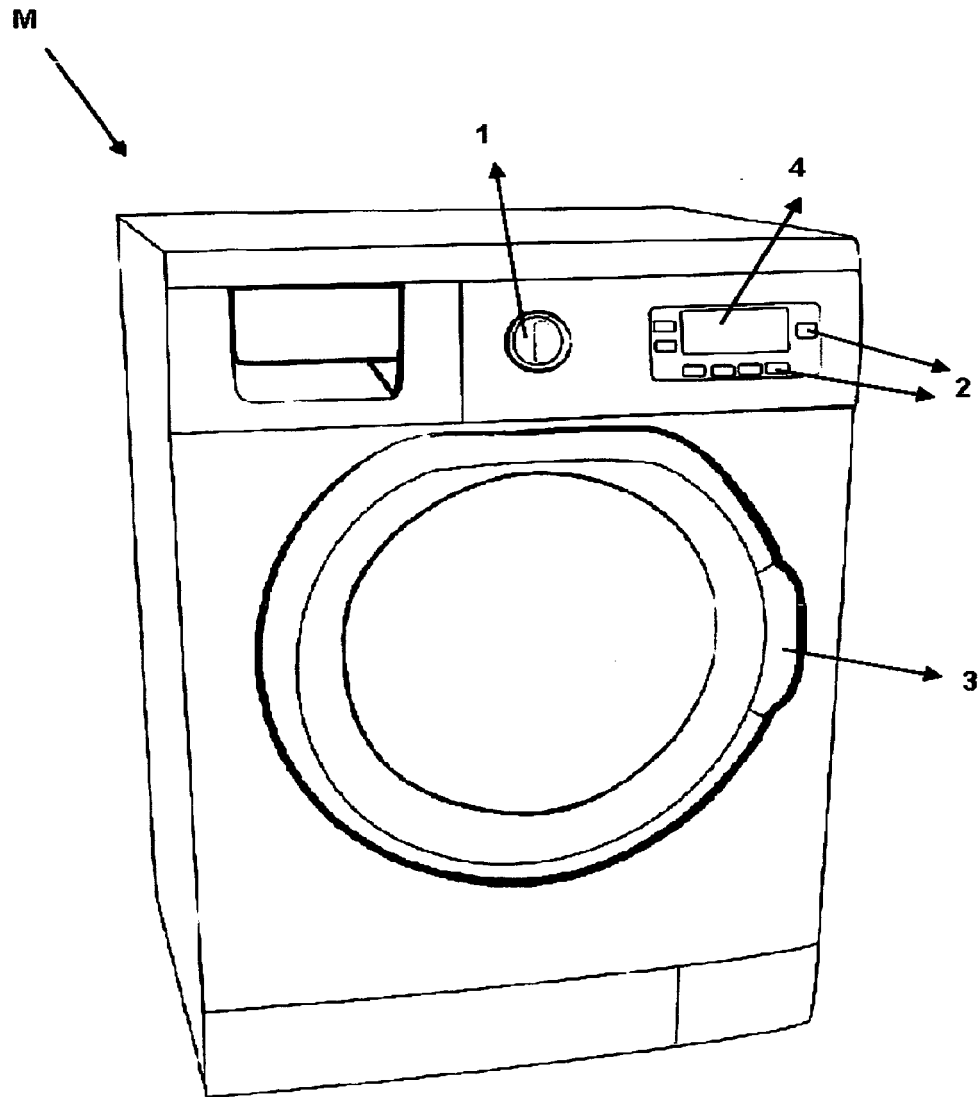


Figure - 1

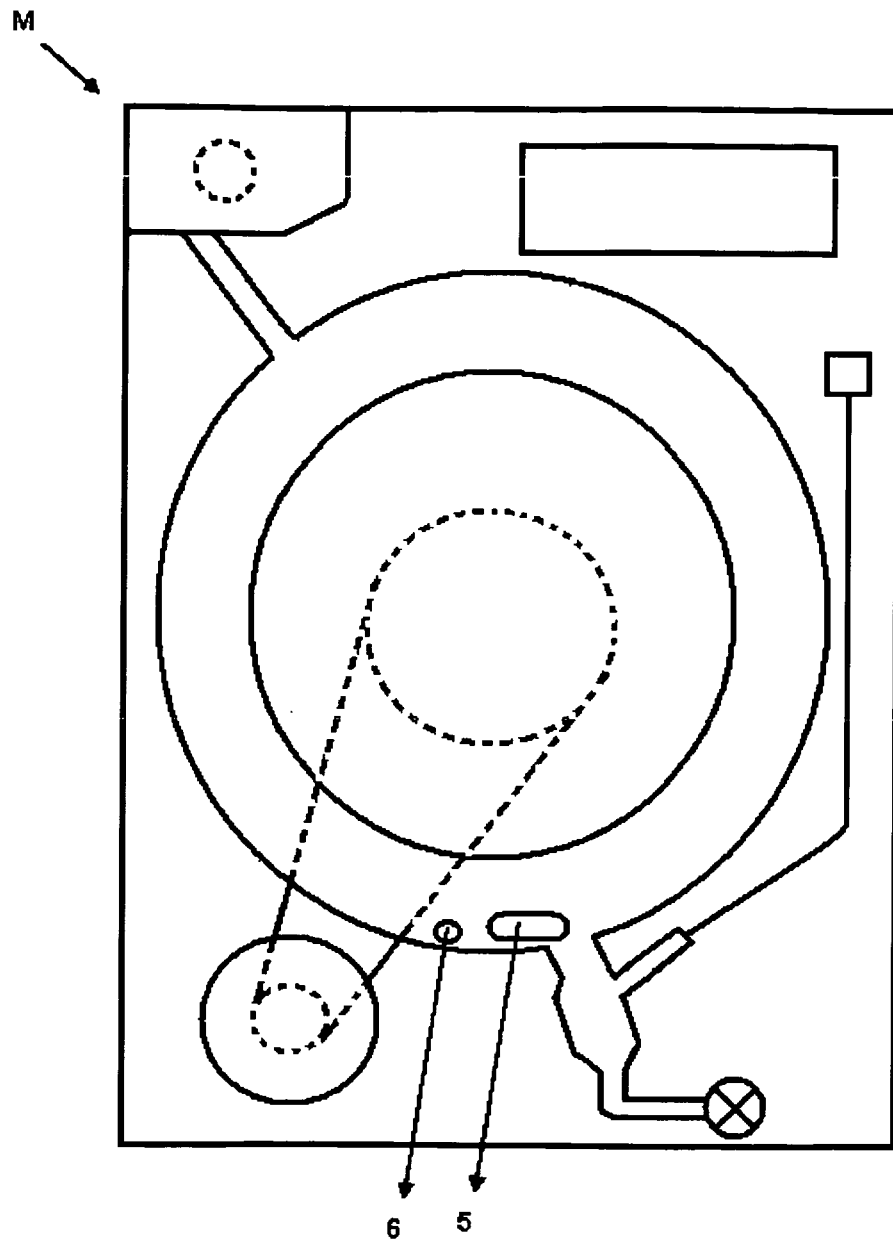


Figure - 2

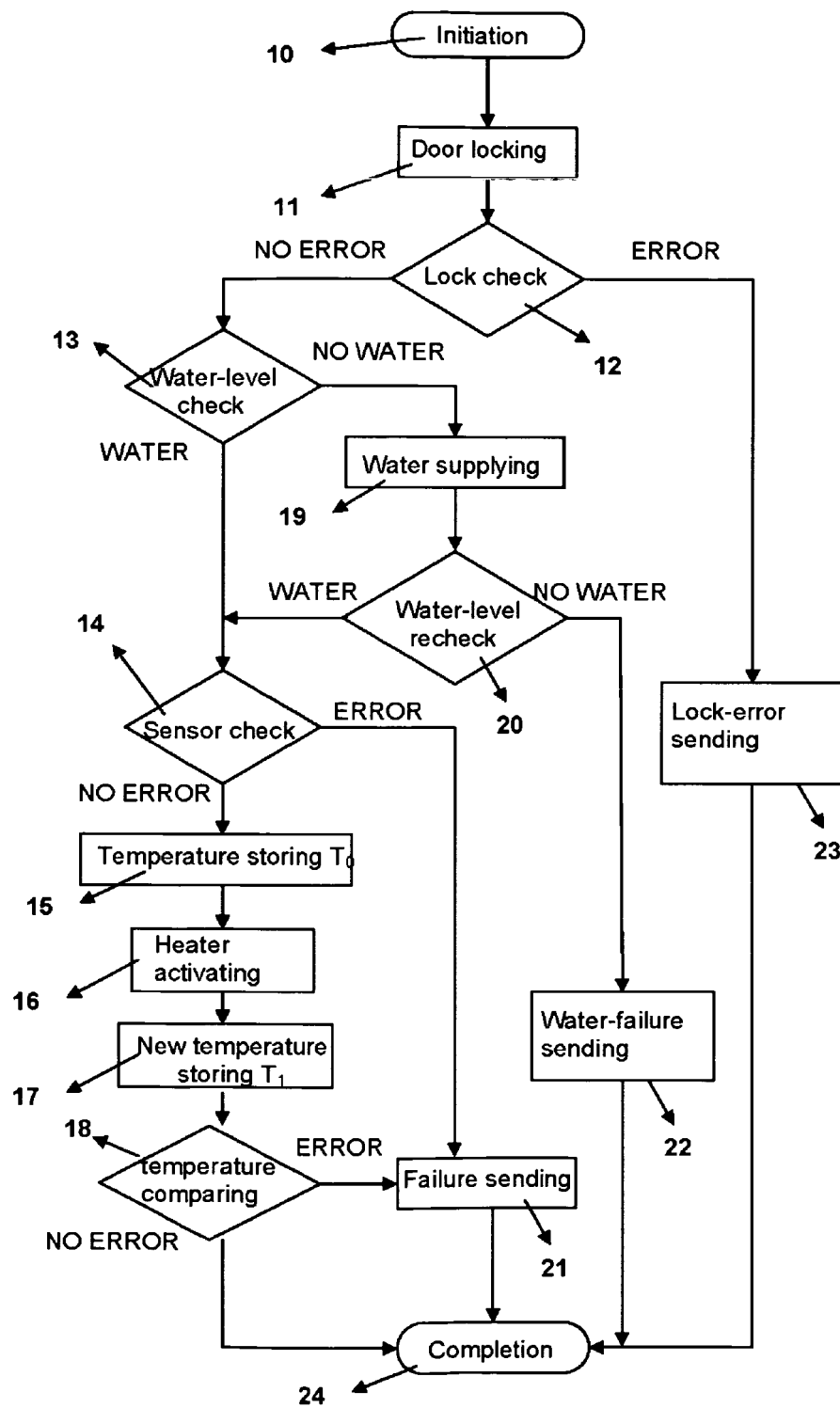


Figure - 3

REFERENCES CITED IN THE DESCRIPTION

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