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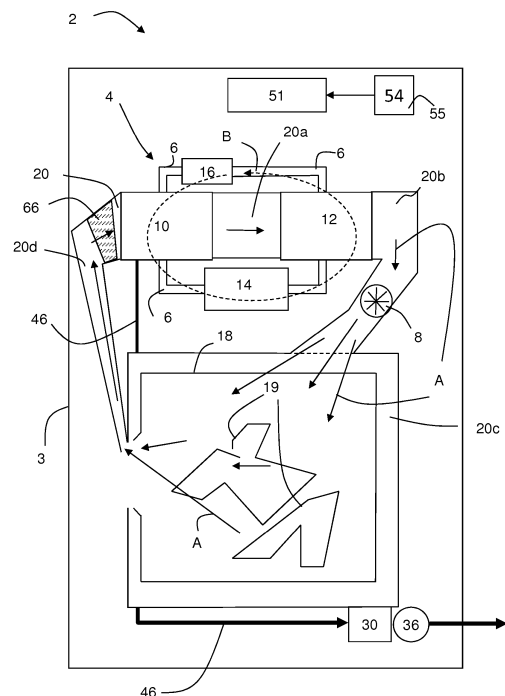
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(54) **Laundry treatment apparatus and method of operating a laundry treatment apparatus**

(57) The invention relates to a laundry treatment apparatus, in particular a laundry dryer or a washing machine having a drying function, and to a method of operating such a laundry treatment apparatus. The laundry treatment apparatus comprises a cabinet (3), a control unit (51) controlling the operation of the laundry treatment apparatus (2), a laundry treatment chamber (18) for treating laundry (19) using process air (A), and a process air channel (20) for guiding the process air (A) from and to the laundry treatment chamber. The process air (A) is filtered by a removable filter device which is removable from an operational position within the cabinet (3). A filter compartment is arranged within the cabinet (3) for receiving the filter device. When the filter device is properly inserted in the filter compartment, the filter device is in its operational position. Furthermore, the laundry treatment apparatus comprises a detector unit (54) for detecting the filter device being in the operational position or in a non-operational position. The method comprises starting a laundry treatment program, and in case of detecting the non-operational position of the filter device during execution of the program a suspension of the program or of the presently executed subroutine is delayed by a predetermined time period.

Fig. 1



Description

[0001] The invention relates to laundry treatment apparatus, in particular a laundry dryer or a washing machine having a drying function, comprising a laundry treatment chamber for treating laundry using process air, a removable filter device for filtering the process air and a detector unit for detecting the position of the filter device. Furthermore, the invention relates to a method of operating such a laundry treatment apparatus.

[0002] DE 10 2008 045 525 A1 discloses a heat pump laundry dryer comprising a drum for drying laundry by using heated process air and comprising a process air channel for guiding the process air from and to the laundry treatment chamber. A removable air filter is disposed within the process air channel to filter the process air from lint which is exhausted from the drum. The air filter is inserted in a removable manner within a filter compartment disposed close to the drum. The laundry dryer also comprises a detector unit detecting the position of the air filter, i.e. detecting if the air filter is inserted in the filter compartment or not. A control unit is emitting a warning signal and stopping the operation of the laundry dryer if the detector unit is detecting that the air filter is not in its inserted position. Thus, the control unit avoids operating the laundry dryer when the air filter is not inserted correctly in the filter compartment.

[0003] It is an object of the invention to provide a laundry treatment apparatus and a method of operating a laundry treatment apparatus in such a manner that the apparatus contributes to an efficient operating performance.

[0004] The invention is defined in the independent claims 1, 5 and 22. Particular embodiments are set out in the dependent claims.

[0005] According to the invention, a laundry treatment apparatus comprises a control unit controlling the operation of the laundry treatment apparatus. The laundry treatment apparatus - in the following description denoted in brief "apparatus" - is in particular configured as a laundry dryer or a washing machine having a drying function (washer-dryer). Preferably, the apparatus has a heat pump system. For example, the apparatus is a heat pump laundry dryer or a heat pump washing machine having a drying function. Particularly, the heat pump system has a refrigerant loop, in which the refrigerant fluid is circulated through a first heat exchanger and a second heat exchanger. A compressor circulates the refrigerant fluid through the refrigerant loop and preferably a cooling fan unit is arranged for cooling the compressor. Alternatively the apparatus may be an exhaust-type dryer or washer-dryer or a closed-process air loop (condensate dryer or washer-dryer).

[0006] Furthermore, the apparatus comprises a cabinet and a laundry treatment chamber for treating laundry using process air. The process air is guided within a process air channel arranged within the housing or cabinet of the apparatus. The apparatus also comprises a removable filter device for filtering the process air from lint, fluff, particles or the like. The filter device is removable from an operational position within the cabinet to be cleaned by a user (fluff removal). For this purpose, a filter compartment is arranged within the cabinet for receiving the filter device. When the filter device is properly inserted in the filter compartment, then the filter device is in its operational position. Additionally, the apparatus comprises a detector unit for detecting the filter device being either in its operational position or in a removed non-operational position.

[0007] The process air channel may be provided such as to guide the process air from the outlet of the laundry treatment chamber to the inlet of the laundry treatment chamber to form a closed process air loop or circuit. In such closed process air loop the process air coming from the laundry treatment chamber is first cooled for dehumidifying and then heated before entering the laundry treatment chamber again. Cooling can be made by a heat exchanger which is cooled by flowing cooling air from the outside of the apparatus cabinet therethrough or by a refrigerant if the apparatus comprises a heat pump system. Heating of the process air can be made, by an electrical heater (resistor heater) and alternatively or additionally - if a heat pump is used - by a heat exchanger transferring heat to the process air.

[0008] Preferably the filter device is arranged upstream the process air cooling device (e.g. heat exchanger for cooling), preferably between the process air outlet of the laundry treatment chamber and the inlet of the heat exchanger.

[0009] Alternatively the process air channel may be provided as exhaust type process air channel in which a first portion of the channel guides the drying air coming from the ambient outside the apparatus cabinet over a heater to the inlet of the laundry treatment chamber. And a second portion of the channel guides the process air from the process air outlet of the laundry treatment chamber through the filtering device to the outside of the apparatus cabinet.

[0010] Preferably the removable filter device is arranged in an outlet section of the process air channel which is guiding the process air downstream the outlet of the laundry treatment chamber. Preferably the filter compartment is or is partially arranged in the process air channel or is forming part of the process air channel.

[0011] Preferably, a signal is applied or generated from the detector unit and supplied to the control unit to indicate the non-operational position and the operational position depending on the signal. As already mentioned, the operational position is an inserted position where the filter device is properly inserted in the filter compartment. The non-operational position is a non-inserted position where the filter device is not or not properly positioned in the operational position.

[0012] According to the invention, the operation of the apparatus comprises at least the following method features: a laundry treatment program is started, and after starting the program the position of the filter device is detected. In case of detecting the non-operational position of the filter device during execution of the program, a suspension of the program

or of the presently executed subroutine is delayed by a predetermined time period.

[0013] Considering this time delay the current program or subroutine is able to be executed without any suspension or interruption despite a non-operational position of the filter device. This continued or non-interrupted execution of a program or subroutine only requires that the filter device is re-inserted into its operational position within the predetermined time period. Thus, unnecessary suspensions of the apparatus operation can be avoided which supports the overall efficiency of the apparatus. This is particular useful in apparatus using a heat pump system as interruption of the heat pump system (deactivation of the compressor) might require an extended waiting time before the compressor can be restarted without damage or increased wearing.

[0014] For example, a user can start a program even if the filter device is not in its operational position. The program or subroutine will be suspended only after the operational position is not achieved within the predetermined time period. Consequently, a user can remove the filter device and re-insert it within the predetermined time period without any disturbance with regard to the executing program or subroutine. Particularly, in case the apparatus has a heat pump system it is possible to avoid any stop of this heat pump system if the filter device was disposed again in its operational position within the predetermined time period.

[0015] Advantageously, the described concept of time delay is applied to those operations where air filtering is basically required (e.g. drying programs). The method provides a time delay allowing the user to (re-)insert the filter device without any interruption of the operation.

[0016] The term "suspension" can have the meaning of stopping completely or pausing the currently executed program or subroutine. The term "subroutine" means preferably a part of the executed program, e.g. the drying cycle or the washing cycle within a washing and drying program.

[0017] In a preferred embodiment the suspension of the program or of the presently executed subroutine of the program is delayed by the predetermined time period if the following two conditions apply:

- the non-operational position of the filter device is detected during execution of the program, and
- the executed program or the presently executed subroutine of the program requires filtering the process air by the filter device.

[0018] Considering these conditions, the operation control is able to restrict a possible suspension to those programs or subroutines where air filtering is required (e.g. drying program or drying cycle within a washing and drying program).

[0019] If air filtering is not required during operation of an executed program/subroutine then this program/subroutine can be made continuously despite a detected non-operational position of the filter device, thus enhancing the operation efficiency of the apparatus.

[0020] Particularly, any other program or subroutine without the need of air filtering (e.g. washing program or washing cycle within a washing and drying program) is executed continuously regardless of a detected non-operational position of the filter device during such program/subroutine execution.

[0021] In particular, the control unit is adapted to control execution of a plurality of user-selectable programs or a plurality of subroutines within a program. In this regard, the method of operating the apparatus comprises preferably the following features in case of detecting the non-operational position of the filter device before starting the program:

- suspending the start (or the execution) of at least one of the selectable programs whereas starting or continuing the execution of at least one other program of the selectable programs, and/or
- suspending the start (or the execution) of a subroutine of a program whereas starting or continuing the execution of at least one other subroutine of the program.

[0022] This preferred operation control can be easily made by considering a signal indicating the position of the filter device before starting the selected program.

[0023] As already mentioned, the operation concept according to the invention comprises at least the following method features to achieve an efficient operating performance:

a laundry treatment program is started, and after starting the program the position of the filter device is detected. In case of detecting the non-operational position of the filter device during execution of the program, a suspension of the program or of the presently executed subroutine is delayed by a predetermined time period.

[0024] According to an alternative of the invention (claim 5), the control unit is adapted to control the execution of a plurality of user-selectable programs or a plurality of subroutines within a (laundry treatment) program, wherein the operation of the apparatus comprises in case of detecting the non-operational position of the filter device at least the following method features:

- suspending the start (or the execution) of at least one of the selectable programs whereas starting or continuing the execution of at least one other program of the selectable programs, and/or
- suspending the start (or the execution) of a subroutine of a laundry treatment program whereas starting or continuing the execution of at least one other subroutine of the laundry treatment program.

[0025] This operation concept has

- a first group of programs and/or subroutines whose start or execution will be suspended depending on the position of the filter device, and
- a second group of programs and/or subroutines who will be started or continuously executed independent on the position of the filter device.

[0026] The aforesaid term "group" means that the group has at least one member, i.e. at least one program and/or subroutine.

[0027] This alternative operation concept is advantageously provided in a laundry treatment apparatus where in at least one program and/or subroutine no drying or no intensive drying is required (e.g. washing program/subroutine in a washer-dryer or business refreshing program/subroutine). Since such programs/subroutines do not require drying, a position signal indicating the non-operational position of the filter device can be ignored by the control unit such that these programs/subroutines can be continuously executed. For example, a washing program without drying function can be executed continuously regardless of a detected non-operational position of the filter device. Similarly, a washing subroutine within a washing and drying program can be executed continuously until the drying subroutine is provided to start. Thus, unnecessary suspensions of the apparatus operation can be avoided which supports the overall efficiency of the apparatus. Particularly, in case the apparatus has a heat pump system it is possible to avoid any unnecessary stop of this heat pump.

[0028] All features and elements described above in relation to the first method can be combined in any embodiment and in any arbitrary combination of features, elements and embodiments with the alternative operation concept (method claim 5) and vice versa. In particular individual elements and features disclosed in the detailed description below can be combined with any of the first and alternative methods in any arbitrary combination.

[0029] With regard to this alternative operation concept, again a position signal can be applied or generated from the detector unit and supplied to the control unit to indicate the non-operational position and the operational position depending on the signal. As already mentioned, the operational position is an inserted position where the filter device is properly inserted in the filter compartment. The non-operational position is a non-inserted position where the filter device is not or not properly positioned in the operational position.

[0030] In a preferred embodiment of the described alternative operation concept, the suspension of the program or of the presently executed subroutine is delayed by a predetermined time period in case of detecting the non-operational position of the filter device during execution of the program. Considering this time delay the current program or subroutine is able to be executed without any suspension or interruption despite a non-operational position of the filter device. This continued or non-interrupted execution of a program or subroutine only requires that the filter device is re-inserted into its operational position within the predetermined time period. Thus, unnecessary suspensions of the apparatus operation even within programs/subroutines requiring basically air filtering can be avoided which supports the overall efficiency of the apparatus. The program or subroutine will be suspended only after the operational position is not achieved within the predetermined time period. Consequently, a user can remove the filter device and re-insert it within the predetermined time period without any disturbance with regard to the executing program or subroutine. Particularly, in case the apparatus has a heat pump system it is possible to avoid any stop of this heat pump system if the filter device was disposed again in its operational position within the predetermined time period.

[0031] In a further preferred embodiment of the described alternative operation concept, the suspension of the program or of the presently executed subroutine of the program is delayed by the predetermined time period if the following two conditions apply:

- the non-operational position of the filter device is detected during execution of the program, and
- the executed program or the presently executed subroutine of the program requires filtering the process air by the filter device.

[0032] Considering these conditions, the operation control is able to restrict a possible suspension to those programs or subroutines where air filtering is required (e.g. drying program or drying cycle within a washing and drying program). If air filtering is not required during operation of an executed program/subroutine then this program/subroutine can be made continuously despite a detected non-operational position of the filter device, thus enhancing the operation efficiency of the apparatus.

[0033] As already mentioned, preferably there exist one or more programs and/or subroutines which can be started or at least partially executed regardless of the detected non-operational position of the filter device. Starting or executing in this regard means that the program or subroutine can be started or executed without suspension and/or without delayed suspension. Examples for these programs or subroutines are:

- a business refresh program or subroutine,
- a laundry wash program or subroutine,
- a spin or rinsing program or subroutine,
- a deodorizing or sterilizing program or subroutine,
- an anti-crease or loosening program or subroutine, and
- a program or subroutine not requiring a process air flow through the laundry storing cabinet.

[0034] In a further embodiment, there exist one or more programs and/or subroutines which will be suspended, will not be started or will be continued for a predetermined time period if the non-operational position of the filter device is detected. Examples for these programs or subroutines are:

- a drying program or subroutine, and
- a set-up or warm-up subroutine for setting-up or warming-up a heat pump system of the apparatus.

[0035] Particularly, at least one laundry treatment program is composed of at least two subroutines, wherein

- at least one subroutine does not require the filter device being in the operational position and consequently will be efficiently executed without suspension, and
- at least one subroutine does require the filter device being in the operational position and consequently will be suspended or will be suspended after the predetermined time period, if the filter device is in the non-operational position.

[0036] In case the apparatus is configured as a washer-dryer, said program has preferably a wash subroutine and a dry subroutine, wherein the wash subroutine can be executed regardless of the operational position of the filter device and the dry subroutine will be executed/suspended depending on the detected position of the filter device.

[0037] In a further embodiment, the non-operational position of the filter device is detected and when after expiry of the predetermined time period the non-operational position of the filter device is detected again or is furthermore detected, the program or subroutine is suspended and the operation mode of the laundry treatment apparatus is changed to another operation mode. In other words, the operation mode "execution of a selected program/subroutine" is suspended and particularly changed to the operation mode "PAUSE" or "STOP".

[0038] Preferably the method further comprises at least one of the following operation steps:

- continuing the program or subroutine after the predetermined time period is expired, if the operational position of the filter device is detected, and/or
- ending the suspension and continuing the program or subroutine, if during the suspension it is detected that the filter device is in the operational position.

[0039] Thus, an automatic progress of the current program/subroutine is easily ensured in case the operational position of the filter device is detected subsequent to a prior detection of the non-operational position.

[0040] In an embodiment the method is operating such that the remaining time to the end of an executed program or subroutine is determined. If the determined time to the end is less than a predetermined final time, the suspension is suppressed and the program or subroutine is continued until the end of the current program/subroutine. Thus, the performance efficiency of the apparatus is additionally enhanced in case of relative small remaining operation times to the end of an executed program/subroutine if the non-operational position of the filter device is detected within this remaining time.

[0041] Prior to starting a program, the method is operating preferably as follows: A program selection (e.g. a drying cycle) and a program start command is detected or received. After then, the start command is ignored if the filter device is in the non-operational position. Alternatively, the start command is ignored if the filter device is in the non-operational position and the selected program requires the filter device being in the operational position. Since the start command is usually executed by the user he automatically recognizes a kind of warning (= the ignored start of the program selected by the user). In such manner, a user-optimized advice without any additional technical means can be realized regarding the non-operational position of the filter device.

[0042] Said user-optimized advice by ignoring a start command is preferably still enhanced by starting the selected

program after commanding the program start at least one time more, i.e. a second time or further time.

[0043] Particularly, in case of detecting the non-operational position of the filter device the user will be provided with a user information signal. Thus, it is very facile for the user to arrange the operational position of the filter device in due time, e.g. within the predetermined time period.

[0044] Preferably the user information signal comprises at least one of the following signals: A light signal, an acoustic signal, a display signal. For example, the user information signal is emitted via a display device or display unit arranged at the front of the apparatus cabinet.

[0045] It is preferred to provide the user information signal when the selected program is requested to start and/or when the non-operational position of the filter device is detected during execution of a program or subroutine.

[0046] In a preferred embodiment the method is providing at least two different levels of a user information signal, i.e. the profile of the user information signal is different depending on status or operation mode of the concerned program. Particularly, the method provides

- a first level user information signal when the filter device is in the non-operational position while the program or subroutine is executed, and
- a second level user information signal when the filter device is in the non-operational position and the execution of the program or subroutine is suspended.

[0047] For example, the first level user information signal indicates that the filter device should be inserted (= realizing the operational position) for proper operation of the apparatus and the second level user information signal indicates the suspension of the program or subroutine due to the missing operational position of the filter device. The first level user information signal can be an optical signal (e.g. yellow) and/or a smooth acoustic signal whereas the second level user information signal is an annoying optical signal (e.g. red) and/or an annoying acoustic signal.

[0048] In order to realize a facile detection of the position of the filter device the detector unit comprises preferably a sensor operated by moving the filter device. In a preferred embodiment the sensor comprises a switch which can be easily controlled by moving the filter device. Particularly, the switch is configured as a space-saving micro switch. Controlling the sensor can be easily done by disposing the sensor at the filter compartment.

[0049] Preferably the value of the predetermined time period for delaying the suspension is different depending on specific conditions or features. Particularly, this value depends on one or more of the following features:

- the program or subroutine being executed,
- a program option selected by the user,
- an operational condition of the laundry treatment apparatus, and
- a laundry load, a laundry humidity or a laundry type.

[0050] Reference is made in detail to preferred embodiments of the invention, examples of which are illustrated in the accompanying figures which show:

Fig. 1 a schematic view of a laundry treatment apparatus,

Fig. 2 a perspective view of the top section of a washer-dryer having a front top panel and a filter device in a non-operational position,

Fig. 3 an enlarged partial top view of the washer-dryer's top section according to Fig. 2, showing the filter device in a non-operational position,

Fig. 4 the enlarged partial top view of the washer-dryer's top section according to Fig. 3, showing the filter device in the operational position

Fig. 5 a perspective view of the filter device having mechanical means for removing the filter device at the apparatus' top section,

Fig. 6 the perspective view according to Fig. 5 showing the mechanical means in a disassembled state,

Fig. 7 a flow diagram showing one embodiment of the operation of a laundry treatment apparatus, and

Fig. 8 a continuation of the flow diagram according to Fig. 7.

[0051] Fig. 1 shows a schematically depicted laundry treatment apparatus 2 which in this embodiment is a heat pump washer dryer. The apparatus 2 comprises a cabinet 3 and a heat pump system 4, including a closed refrigerant loop 6 which comprises in the following order of refrigerant flow B: a first heat exchanger 10 acting as evaporator for evaporating the refrigerant and cooling process air, a compressor 14, a second heat exchanger 12 acting as condenser for cooling the refrigerant and heating the process air, and an expansion device 16 from where the refrigerant is returned to the first heat exchanger 10. Together with the refrigerant pipes connecting the components of the heat pump system 4 in series, the heat pump system forms the refrigerant loop 6 through which the refrigerant is circulated by the compressor 14 as indicated by dashed circular flow B.

[0052] The process air flow within the treatment apparatus 2 is guided through a compartment of the home appliance 2 for receiving articles to be treated, e.g. a drum 18. The articles to be treated are textiles, laundry 19, clothes, shoes or the like. In case of the apparatus being a washer dryer as in this detailed embodiment, the drum 18 is surrounded by a tub 17 in which the drum is rotatably mounted. At the bottom region of the tub 17 a sump 30 is provided. A drain pump 36 is in fluid connection with the sump 30 and is activated when the wash water or condensate is to be drained to the outside of the apparatus cabinet 2. The condensate formed at the first heat exchanger 10 is guided from the heat exchanger 10 via a drain pipe 46 to the sump 30.

[0053] The process air flow is indicated by arrows A in Fig. 1 and is driven by a process air blower 8. The process air channel 20 guides the process air flow A outside the drum 18 and includes different sections, including the section forming the battery channel 20a in which the first and second heat exchangers 10, 12 are arranged. The process air exiting the second heat exchanger 12 flows into a rear channel 20b in which the process air blower 8 is arranged. The air conveyed by blower 8 is guided downward in a descending channel 20c to the backside of the drum 18. The process air is filtered from lint, fluff and other particles by a filter device 66 (see details in Figs. 2 to 6). Preferably, the filter device 66 is disposed in the cabinet 3 such that the filter device can be accessed from outside without opening a door closing the drum 18.

[0054] A control unit 51 is disposed in the cabinet 3 of the apparatus 2 to control several parts and particularly to control and monitor the overall operation of the apparatus 2. The control unit 51 receives signals from a detector unit 54 comprising a sensor 55. The sensor 55 is operated by moving the removable filter device 66 between an operational position and a non-operational position. In the operational position, the filter device 66 is properly inserted in a filter compartment arranged within the cabinet 3. In the non-operational position, the filter device is removed from the operational position. Thus, the detector unit 54 is able to detect the filter device being in the operational position or in the non-operational position and to send corresponding signals to the control unit 51.

[0055] Fig. 2 shows the opened top section 58 of the apparatus 2 shown here in more detail and with the heat pump system 4 removed. This top section 58 is part of a washer-dryer having a washing and drying function. Several parts of this washer-dryer are not shown explicitly but have the same function as described above in relation to Fig. 1.

[0056] The top section 58 is assembled with the other parts of the cabinet 3 (not shown in Fig. 2) and comprises a front top panel 60 having a display 62 for user information and an input section 64 wherein here the details of the input section 64 are not shown (like indicators, switches, buttons, turning switch etc.). The front top panel 60 frames the casing of a filter device 66 which can be properly inserted in a filter compartment 68 to achieve its operational position (Fig. 4).

[0057] Fig. 2, Fig. 3 and Fig. 4 show an example for moving the filter device 66 between the non-operational position (Fig. 2, Fig. 3) and the operational position (Fig. 4). In Fig. 4 the filter device 66 is properly inserted in the filter compartment 68. This means that the detector unit 54 is detecting the operational position of the filter device 66. To remove the filter device 66 from its operational position, a press-button 70 can be actuated, i.e. pressed, by a user. This press-button is arranged at or next to a filter handle 72 in the front section of the filter device 66. Pressing the press-button 70 causes an unlocking of locking means 74. When the locking means 74 are in the unlocked state the filter device can be removed from the operational position. In order to realize an automatic movement from the operational position (Fig. 4) to the non-operational position (Fig. 3) guiding means 76 are disposed in a casing recess 77 at the casing of the filter device 66 (Fig. 5, Fig. 6). The guiding means 76 comprise a compression spring 78 which is in a pre-loaded state during the operational position of the filter device 66 (Fig. 4). When the locking means 74 are unlocked the pressure force of the pre-loaded compression spring 78 is pushing the filter device 66 automatically along a moving direction 79 into the non-operational position (Fig. 3). Starting from the non-operational position, the filter device 66 can be moved by the filter handle 72 along the moving direction 79 to the operational position according to Fig. 4, where the locking means 74 are transferred automatically into the locking state thereby locking the filter device 66 in the operational state.

[0058] The guiding means 76 further comprise a counter bearing 80 having a thorn 82 and a carrier 84 for carrying the counter bearing 80 and the compression spring 78 (Fig. 5, Fig. 6). In the assembled state the compression spring 78 is mounted at the thorn 82 (pin) and the counter bearing 80 and the carrier 84 are movable relative to each other in order to implement the biasing of the compression spring 78 by moving the filter device 66 from the non-operational position to the operational position (Fig. 3, Fig. 4).

[0059] The sensor 55 comprises a switch (e.g. micro switch) and is disposed at the filter compartment 68 in such a manner (not explicitly shown) that the properly inserted filter device 66 is pressing the sensor switch or keeping it

permanently actuated in one state releasing the 'locked' signal. If the filter device 66 is removed from the operational position, the sensor switch is no longer pressed or actuated and releases the 'unlocked' signal. Thus, the control unit 51 always receives the switch signals corresponding to the actual position of the filter device 66.

[0060] The functioning of the control unit 51 for considering the detected position of the filter device 66 and for controlling the operation of the apparatus 2 in dependency of said detected position will be explained by the flow diagrams according to Fig. 7 and Fig. 8. Along these flow diagrams the operation of a washer-dryer as an embodiment of an apparatus 2 is described.

[0061] When the washer-dryer is operated, it is regularly monitored and verified if the filter device 66 is in the non-operational position pos_nop (step S1). If the non-operational position pos_nop is detected, the further operation of the apparatus 2 depends on several conditions.

[0062] If there is no running set-up subroutine (denoted as "set-up phase") for setting-up the heat pump system 4 of the apparatus 2 (verified in step S2), the control unit 51 verifies, if a drying program dry_cycle or a drying subroutine dry_sub is executed (step S3). In this embodiment of operation control it is assumed that only a drying program or a drying subroutine basically requires filtering the process air A. Therefore, if there actually is no executed drying program or drying subroutine, the control unit 51 will not intervene into the operation despite detection of the non-operational position pos_nop of the filter device 66.

[0063] However, if a drying program or drying subroutine is actually in execution (step S3) a user information signal info_1 is provided. The content of this signal info_1 is a kind of first level. The user information signal is e.g. a light signal (particularly LED and/or icon symbol) and/or emission of an acoustic signal.

[0064] When a predetermined time period T1_pred is expired (step S4) it is verified, if the time to the end T_end of the drying program dry_cycle is less than a predetermined final time Tfin_pred (step S5). If the time T_end is not less than the predetermined final time Tfin_pred, the position of the filter device 66 is detected again (step S6) and in case of the detected non-operational position pos_nop the drying program or drying subroutine is suspended by changing its executing operation mode to the operation mode "STOP". Then, the control unit 51 is waiting for a command or action by the user.

[0065] If the filter device 66 is detected in step 6 as being in the operational position, then the drying program or drying subroutine is not suspended. Rather, a suspension is avoided because the user has moved the filter device 66 from the non-operational position pos_nop to the operational position within the predetermined time period T1_pred. Insofar, considering the predetermined time period T1_pred allows delaying a suspension of a presently executed program or subroutine.

[0066] If the time T_end until the end of the drying program is less than the predetermined final time Tfin_pred (step S5), the drying program will be executed until the end of the drying program because under this time condition it is more beneficial to enhance the apparatus efficiency by a non-interrupted program than to filter the process air A. In other words, the position of the filter device 66 will not be considered, thus suppressing a suspension of the drying program even if the non-operational position of the filter device 66 is detected.

[0067] If the set-up subroutine/set-up phase is detected in step S2, then it is verified in the subsequent steps S7, S8, S9 which kind of program is selected by the user. In this embodiment, a verification is made whether the user has selected a program within a group of programs containing a drying program (step S7), a washing-drying program (step S8) and a washing program (step S9). In other embodiments, additional or other programs and/or subroutines (e.g. business refreshing, laundry washing, spin or rinsing, deodorizing or sterilizing, anti-crease or loosening, program/subroutine not requiring a process air flow through the drum) are verified if these were selected by the user.

[0068] If a signal prog_select indicates a drying program dry_cycle as the selected program (step S7), the control unit 51 is waiting for a start command START by the user (step S10) as can be seen along the sequel SEQ-1 in Fig. 7 and Fig. 8. When the user tries to execute the start command START in step S10 this command will be ignored and a user information signal info_1 (e.g. a light signal, particularly LED and/or icon symbol and an acoustic signal) is emitted to inform and warn the user. If the user requests the start command START a second time (step 11), the drying program is started and executed. In this regard, a user information signal info_2 is emitted by maintaining the light signal already emitted by the signal info_1 before step 11. In step S12 it is verified, if the predetermined time period T2_pred for delaying a suspension of the drying program dry_cycle is expired. Depending on predetermined operation conditions, the predetermined time period T2_pred is different as compared to the predetermined time period T1_pred in step S4 or both predetermined time period T1_pred and T2_pred are equal.

[0069] After expiry of the predetermined time period T2_pred in step 12 it is verified in step 13 again, if the filter device 66 is in the operational position or in the non-operational position pos_nop. If the operational position was detected, the control unit 51 is waiting for requesting a start command START (step S14) by the user to execute the drying program dry_cycle. Alternatively, the execution of the drying program is continued automatically without request of any user input like a start command, if the operational position is detected in step S14. If the non-operational position pos_nop is detected in step S13 the drying program is suspended by changing its executing operation mode to the operation mode "PAUSE". In this regard, a user information signal info_3 is emitted to inform and warn the user. This signal info_3

comprises preferably a light signal (e.g. LED, icon symbol) and an acoustic signal as already mentioned with regard to the signals info_1 and info_2. Additionally, the signal info_3 comprises a verbal warning (e.g. "Check air filter presence") in the display 62. The signal info_3 can be regarded as a kind of a second level user information signal having more information with a stronger warning character as compared to the first level user information signal (e.g. info_1, info_2).

[0070] As soon as the operational position of the filter device 66 is detected (step S13) during the operation mode "PAUSE", the drying program dry_cycle is able to continue its execution - either by receiving the start command START (step S14) or automatically after detecting the operational position of the filter device 66.

[0071] If the signal prog_select indicates a washing-drying program wash-dry_cycle as the selected program, this program immediately starts after receiving a start command START (step S15). This is because within this program the first subroutine is a washing subroutine wash_sub which does not require air filtering. Therefore, this subroutine will be executed regardless of a detected non-operational position pos_nop of the filter device 66. However, the user will be informed and warned by emitting the user information signal info_1 (e.g. a light signal, particularly LED and/or icon symbol and an acoustic signal).

[0072] In step S16 it is verified if the washing subroutine wash_sub is finished. If this is the case, a drying subroutine dry_sub is provided for execution. This execution is dependent on a verification in subsequent step S17 as can be seen along the sequel SEQ-2 in Fig. 7 and Fig. 8.

[0073] If the non-operational position pos_nop is not detected in step S17 (i.e. the filter device 66 is detected being in the operational position), the drying subroutine dry_sub will be executed immediately and no command by the user is required. After that, if a non-operational position pos_nop of the filter device 66 is detected again during execution of the drying subroutine dry_sub, the further operation of the drying subroutine dry_sub occurs along the already explained steps S3 - S6.

[0074] In case the non-operational position pos_nop is detected in step S17, the further operation for executing and suspending the drying subroutine dry_sub will occur along the already explained steps S10 - S14.

[0075] If the signal prog_select indicates a washing program wash_cycle as the selected program (step S9), no air filtering is required in this program and consequently this program can be executed regardless of the detected position of the filter device 66. Therefore, this washing program will be executed upon the start command START is executed by the user (step 18).

Reference Numeral List

2	laundry treatment apparatus	77	casing recess
3	cabinet	78	compression spring
4	heat pump system	79	moving direction
6	refrigerant loop	80	counter bearing
8	blower	82	thorn / pin
10	first heat exchanger	84	carrier
12	second heat exchanger	A	process air flow
14	compressor	B	refrigerant flow
16	expansion device	dry_cycle	drying program
17	tub	dry_sub	drying subroutine
18	drum	info_1	user information signal
19	laundry	info_2	user information signal
20	process air channel	info_3	user information signal
20a	battery channel	PAUSE	operation mode
20b	rear channel	pos_nop	non-operational position
20c	descending channel	prog_select	selected program
20d	front channel	SEQ-1	sequel of control steps
30	sump	SEQ-2	sequence of control steps
36	drain pump	set-up phase	set-up subroutine (for a heat pump system)
46	drain pipe		
51	control unit	START	start command
54	detector unit	stat_sensor	status of sensor
55	sensor	STOP	operation mode
58	top section	S1 - S....	control steps
60	front top panel	T_end	time to end of program/subroutine
62	display		

(continued)

64	input section	Tfin_pred	predetermined final time
66	filter device	T1_pred	predetermined time period
5 68	filter compartment	T2_pred	predetermined time period
70	press-button	wash_cycle	washing program
72	filter handle	wash-dry_cycle	washing-drying program
74	locking means		
10 76	guiding means	wash_sub	washing subroutine

Claims

1. Method of operating a laundry treatment apparatus (2), in particular a laundry dryer or a washing machine having a drying function, wherein the laundry treatment apparatus (2) comprises:

a cabinet (3),
a control unit (51) controlling the operation of the laundry treatment apparatus (2),
a laundry treatment chamber (18) for treating laundry (19) using process air (A),
a process air channel (20) for guiding the process air (A) from and to the laundry treatment chamber (18),
a removable filter device (66) for filtering the process air (A), wherein the filter device (66) is removable from an operational position within the cabinet (3),
a filter compartment (68) arranged within the cabinet (3) for receiving the filter device (66), wherein when the filter device (66) is properly inserted in the filter compartment (68), the filter device (66) is in its operational position,
a detector unit (54) for detecting the filter device (66) being in the operational position or in a non-operational position (pos_nop),

wherein the method comprises:

starting a laundry treatment program (dry_cycle, wash_cycle, wash-dry_cycle),
in case of detecting the non-operational position (pos_nop) of the filter device (66) during execution of the program (dry_cycle, wash-dry_cycle), delaying suspension of the program (dry_cycle) or of the presently executed subroutine (dry_sub) by a predetermined time period (T1_pred, T2_pred).

2. Method according to claim 1, wherein the suspension of the program (dry_cycle) or of the presently executed subroutine (dry_sub) is delayed by the predetermined time period (T1_pred, T2_pred), if the following two conditions apply:

the non-operational position (pos_nop) of the filter device (66) during execution of the program (dry_cycle) is detected, and
additionally the executed program (dry_cycle) or the presently executed subroutine (dry_sub) of the program (wash-dry_cycle) requires filtering of the process air (A) by the filter device (66).

3. Method according to claim 1 or 2, wherein the method further comprises:

if the program (wash_cycle, wash-dry_cycle) or the presently executed subroutine (wash_sub) does not require the filter device (66), continuing the program (wash_cycle, wash-dry_cycle) or subroutine (wash_sub).

4. Method according to any of the preceding claims, wherein the control unit (51) is adapted to control execution of a plurality of user-selectable programs (wash_cycle, wash-dry_cycle, dry_cycle) or a plurality of subroutines (wash_sub, dry_sub) within a laundry treatment program (wash-dry_cycle), and wherein the method further comprises before starting the laundry treatment program (wash_cycle, wash-dry_cycle, dry_cycle) and in case of detecting the non-operational position (pos_nop) of the filter device (66):

suspending the start or suspending the execution of at least one of the selectable programs (dry_cycle) whereas starting or continuing the execution of at least one other of the selectable programs (wash_cycle, wash-dry_cycle), or

suspending the start or suspending the execution of a subroutine (dry_sub) of a laundry treatment program (wash-dry_cycle) whereas starting or continuing the execution of at least one other subroutine (wash_sub) of the laundry treatment program (wash-dry_cycle).

- 5 **5.** Method of operating a laundry treatment apparatus (2), in particular a laundry dryer or a washing machine having a drying function, wherein the laundry treatment apparatus (2) comprises:

a cabinet (3),
 a control unit (51) controlling the operation of the laundry treatment apparatus (2),
 10 a laundry treatment chamber (18) for treating laundry (19) using process air (A),
 a process air channel (20) for guiding the process air (A) from and to the laundry treatment chamber,
 a removable filter device (66) for filtering the process air (A), wherein the filter device (66) is removable from an operational position within the cabinet (3),
 a filter compartment (68) arranged within the cabinet (3) for receiving the filter device (66), wherein when the
 15 filter device (66) is properly inserted in the filter compartment (68), the filter device (66) is in its operational position,
 a detector unit (54) for detecting the filter device (66) being in the operational position or in a non-operational position (pos_nop),
 wherein the control unit (51) is adapted to control execution of a plurality of user-selectable programs (wash_cycle, wash-dry_cycle, dry_cycle) or a plurality of subroutines (wash_sub, dry_sub) within a laundry
 20 treatment program (wash-dry_cycle), and
 wherein the method comprises, in case of detecting the non-operational position (pos_nop) of the filter device (66),
 suspending the start or suspending the execution of at least one of the selectable programs (dry_cycle) whereas
 starting or continuing the execution of at least one other of the selectable programs (wash_cycle, wash-
 25 dry_cycle), or
 suspending the start or suspending the execution of a subroutine (dry_sub) of a laundry treatment program (wash-dry_cycle) whereas starting or continuing the execution of at least one other subroutine (wash_sub) of the laundry treatment program (wash-dry_cycle).

- 30 **6.** Method according to claim 5, wherein the method further comprises:

in case of detecting the non-operational position (pos_nop) of the filter device (66) during execution of the program, delaying suspension of the program (dry_cycle) or of the presently executed subroutine (dry_sub) of the program (wash-dry_cycle) by a predetermined time period (T1_pred, T2_pred).

- 35 **7.** Method according to claim 6, wherein the suspension of the program (dry_cycle) or of the presently executed subroutine (dry_sub) is delayed by the predetermined time period (T1_pred, T2_pred), if the following two conditions apply:

40 the non-operational position (pos_nop) of the filter device (66) during execution of the program (dry_cycle, wash-dry_cycle) is detected, and
 additionally the executed program (dry_cycle) or the presently executed subroutine (dry_sub) of the program (wash-dry_cycle) requires filtering of the process air (A) by the filter device (66).

- 45 **8.** Method according to any of the preceding claims, wherein one or more of the following programs or subroutines will be started or at least partially executed independent of the non-operational position (pos_nop) of the filter device (66):

a business refresh program or subroutine,
 a laundry wash program (wash_cycle, wash-dry_cycle) or subroutine (wash_sub),
 50 a spin or rinsing program or subroutine,
 a deodorizing or sterilizing program or subroutine,
 an anti-crease or loosening program or subroutine, and
 a program (wash_cycle) or subroutine (wash_sub) not requiring process air (A) flown through the laundry treatment chamber.

- 55 **9.** Method according to any of the preceding claims, wherein one or more of the following programs or subroutines will be suspended, will not be started or will be continued for a predetermined time period (T1_pred, T2_pred), if the non-operational position (pos_nop) of the filter device (66) is detected:

a drying program (dry_cycle) or subroutine (dry_sub), and
a set-up or warm-up subroutine (set-up phase) for setting-up or warming-up a heat pump system (4) of the laundry treatment apparatus (2).

10. Method according to any of the preceding claims, wherein at least one laundry treatment program (2) is composed of:

at least one subroutine (wash_sub) not requiring the filter device (66) being in the operational position and which can be executed without suspension, and
at least one subroutine (dry_sub) requiring the filter device (66) being in the operational position and which will be suspended or will be suspended after the predetermined time period (T2_pred), if the filter device (66) is in the non-operational position (pos_nop).

11. Method according to any of the preceding claims, wherein the method further comprises:

when the non-operational position (pos_nop) of the filter device (66) is detected and when after expiry of the predetermined time period (T1_pred, T2_pred) the non-operational position (pos_nop) of the filter device (66) is detected again or is furthermore detected, the program (dry_cycle) or subroutine (dry_sub) is suspended and the operation mode of the laundry treatment apparatus (2) is changed to another operation mode (STOP, PAUSE).

12. Method according to any of the preceding claims, wherein the method further comprises:

continuing the program (dry_cycle) or subroutine (dry_sub) after the predetermined time period (T1_pred, T2_pred) is expired, if the operational position of the filter device (66) is detected, or
ending the suspension and continuing the program or subroutine (dry_sub), if during the suspension it is detected that the filter device (66) is in the operational position.

13. Method according to any of the preceding claims, wherein the method further comprises:

determining the time to the end (T_end) of a program (dry_cycle) or subroutine (dry_sub), and
if the time to the end (T_end) is less than a predetermined final time (Tfin_pred), suppressing suspension and continuing the program (dry_cycle) or subroutine (dry_sub) until the end of the program (dry_cycle) or subroutine (dry_sub).

14. Method according to any of the preceding claims, wherein the method further comprises, prior to starting the program:

receiving a program selection (dry_cycle) and a program start command (START), and
ignoring the start command (START) if the filter device (66) is in the non-operational position (pos_nop), or
ignoring the start command (START) if the filter device (66) is in the non-operational position (pos_nop) and the selected program (dry_cycle) requires the filter device (66) being in the operational position.

15. Method according to any of the preceding claims, wherein, if the program start command (START) was ignored and the program start command (START) was given a second or further time, starting the selected program (dry_cycle).

16. Method according to any of the preceding claims, wherein the method further comprises:

providing a user information signal (info_1, info_2, info_3) in case of detecting the non-operational position (pos_nop) of the filter device (66).

17. Method according to claim 16, wherein the user information signal (info_1, info_2, info_3) comprises at least one of the following signals: a light signal, an acoustic signal, and a display signal.

18. Method according to claim 16 or 17, wherein the method further comprises: providing the user information signal (info_1, info_2, info_3)

when the selected program (dry_cycle, wash-dry_cycle) is requested to start, or
when the non-operational position (pos_nop) of the filter device (66) is detected during execution of a program (dry_cycle) or subroutine (dry_sub).

19. Method according to any of the preceding claims, wherein the method further comprises:

providing a first level user information signal (info_1, info_2) when the filter device (66) is in the non-operational position (pos_nop) while the program (dry_cycle) or the subroutine (wash_sub, dry_sub) is executed, and
providing a second level user information signal (info_3) when the filter device (66) is in the non-operational position (pos_nop) and execution of the program (dry_cycle) or the subroutine (dry_sub) is suspended.

20. Method according to any of the preceding claims, wherein the detector unit (54) comprises a sensor (55) operated by moving the filter device (66).

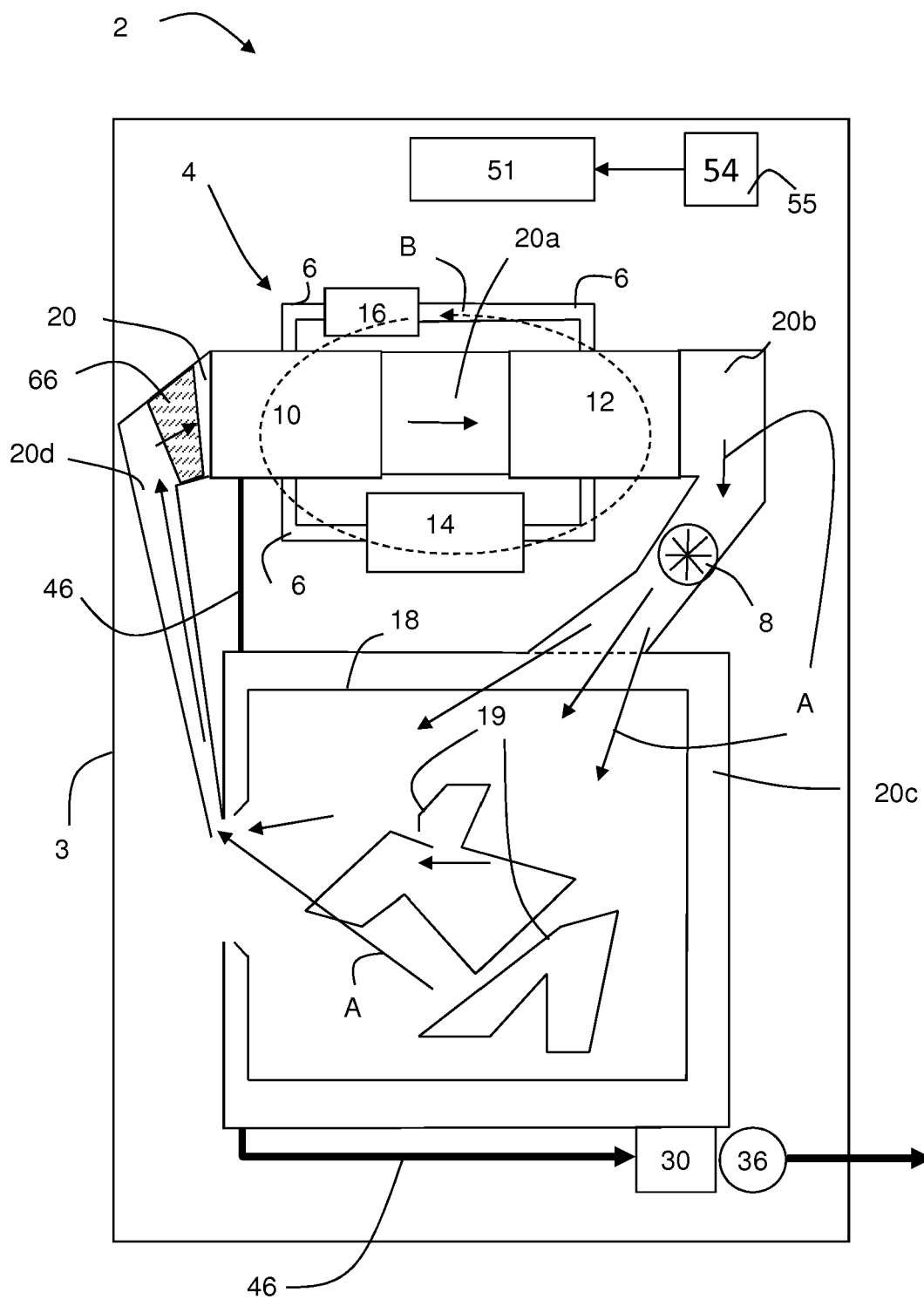
21. Method according to any of the preceding claims, wherein the predetermined time period (T1_pred, T2_pred) for delaying the suspension depends on one or more of the following:

the program (dry_cycle) or subroutine (dry_sub) being executed,
a program option selected by the user,
an operational condition of the laundry treatment apparatus (2), and
a laundry load, a laundry humidity or a laundry type.

22. Laundry treatment apparatus (2), in particular a heat pump laundry dryer or a heat pump washing machine having a drying function, wherein the laundry treatment apparatus (2) comprises:

a control unit (51) controlling the operation of the laundry treatment apparatus (2),
a laundry treatment chamber (18) for treating laundry (19) using process air (A),
a process air channel (20) for guiding the process air (A) from and to the laundry treatment chamber,
a removable filter device (66) for filtering the process air (A), wherein the filter device (66) is removable between an operational position and a non-operational position (pos_nop),
a filter compartment (68) for receiving the filter device (66) in its operational position, and
a detector unit (54) for detecting the filter device (66) being in the operational position or in the non-operational position (pos_nop),
wherein the control unit (51) is adapted to control the operation of the laundry treatment apparatus (2) according to any of the previous method claims.

Fig. 1



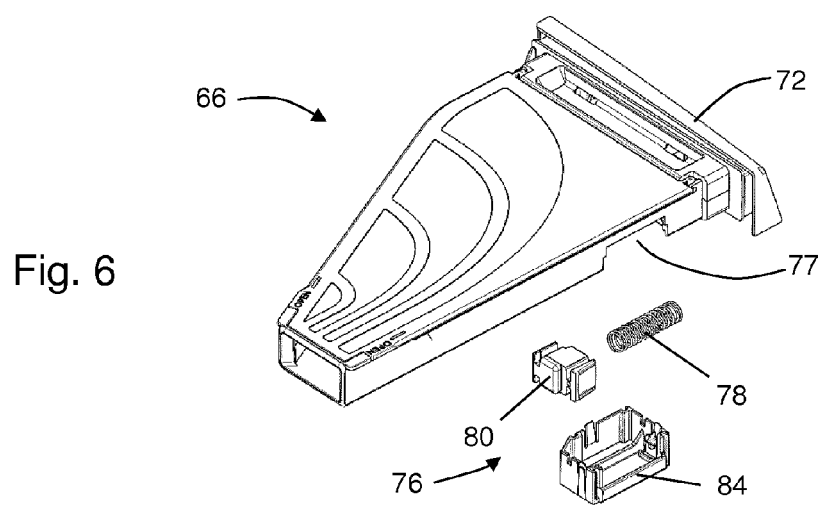
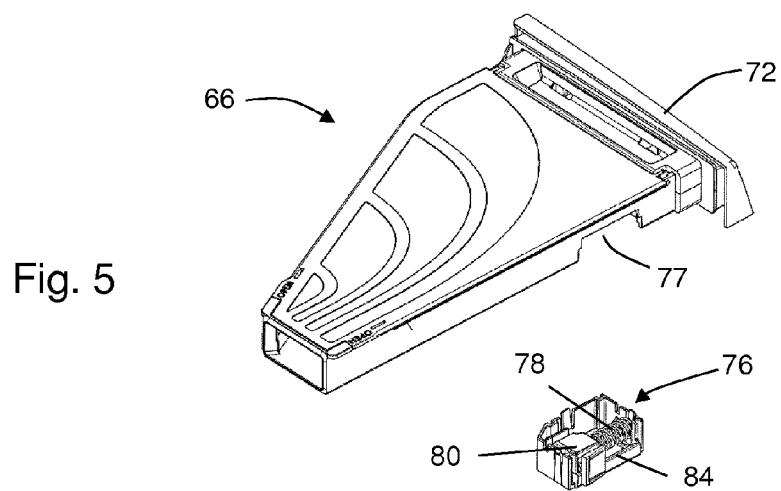
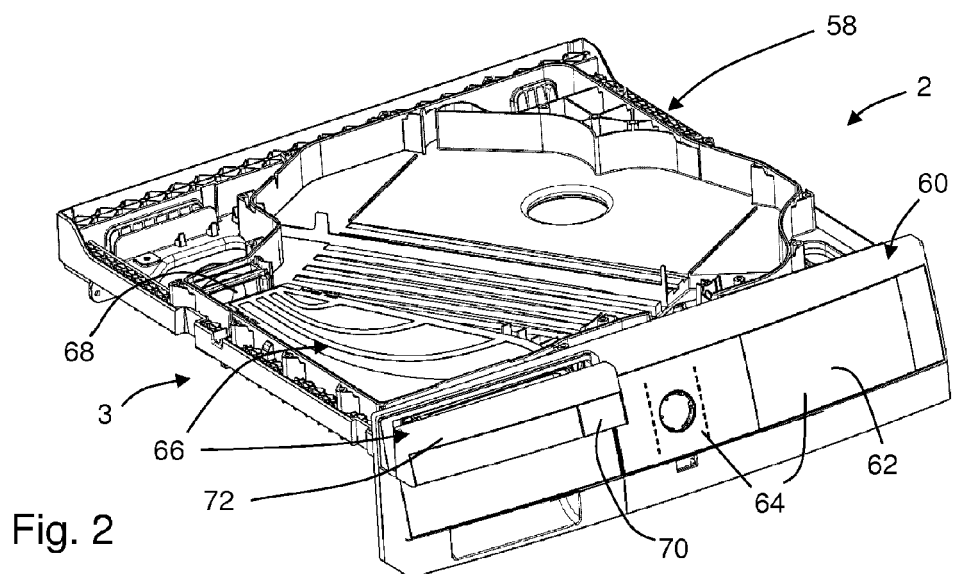


Fig. 3

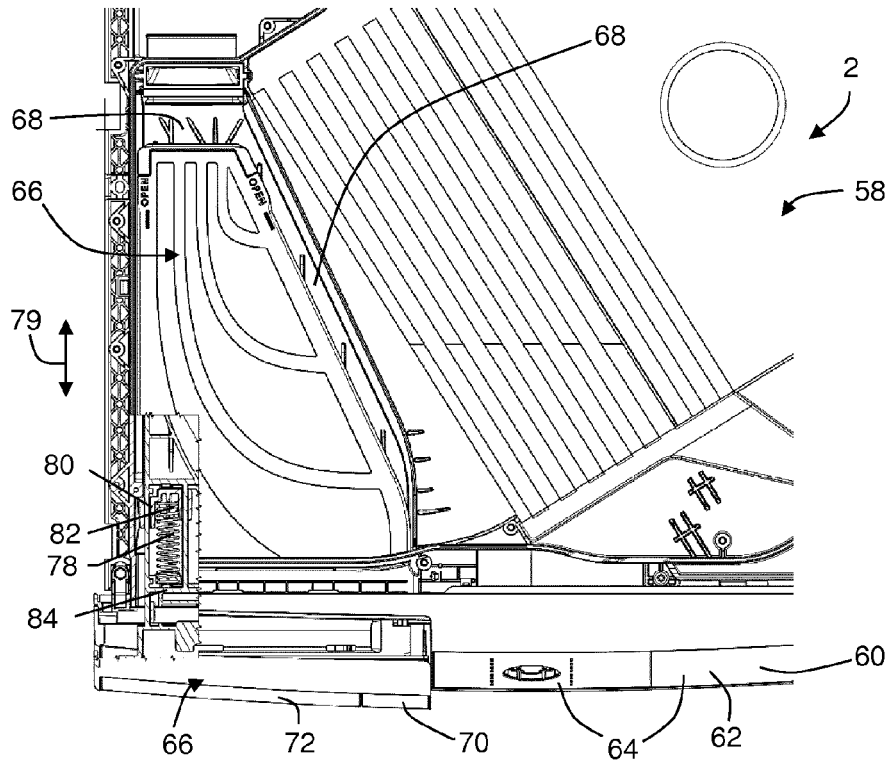
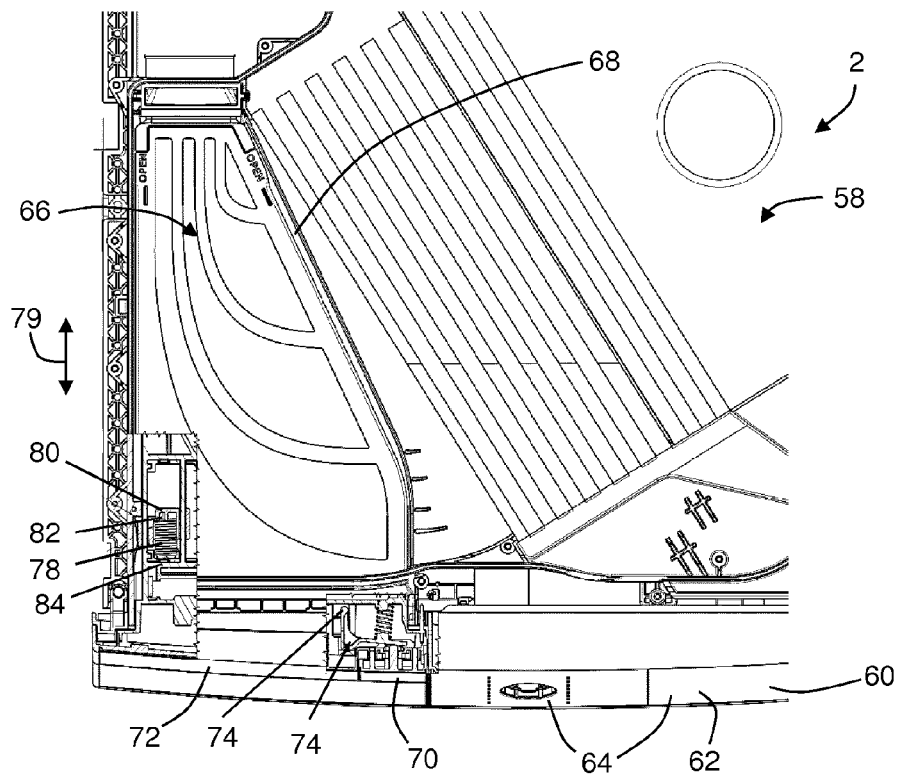
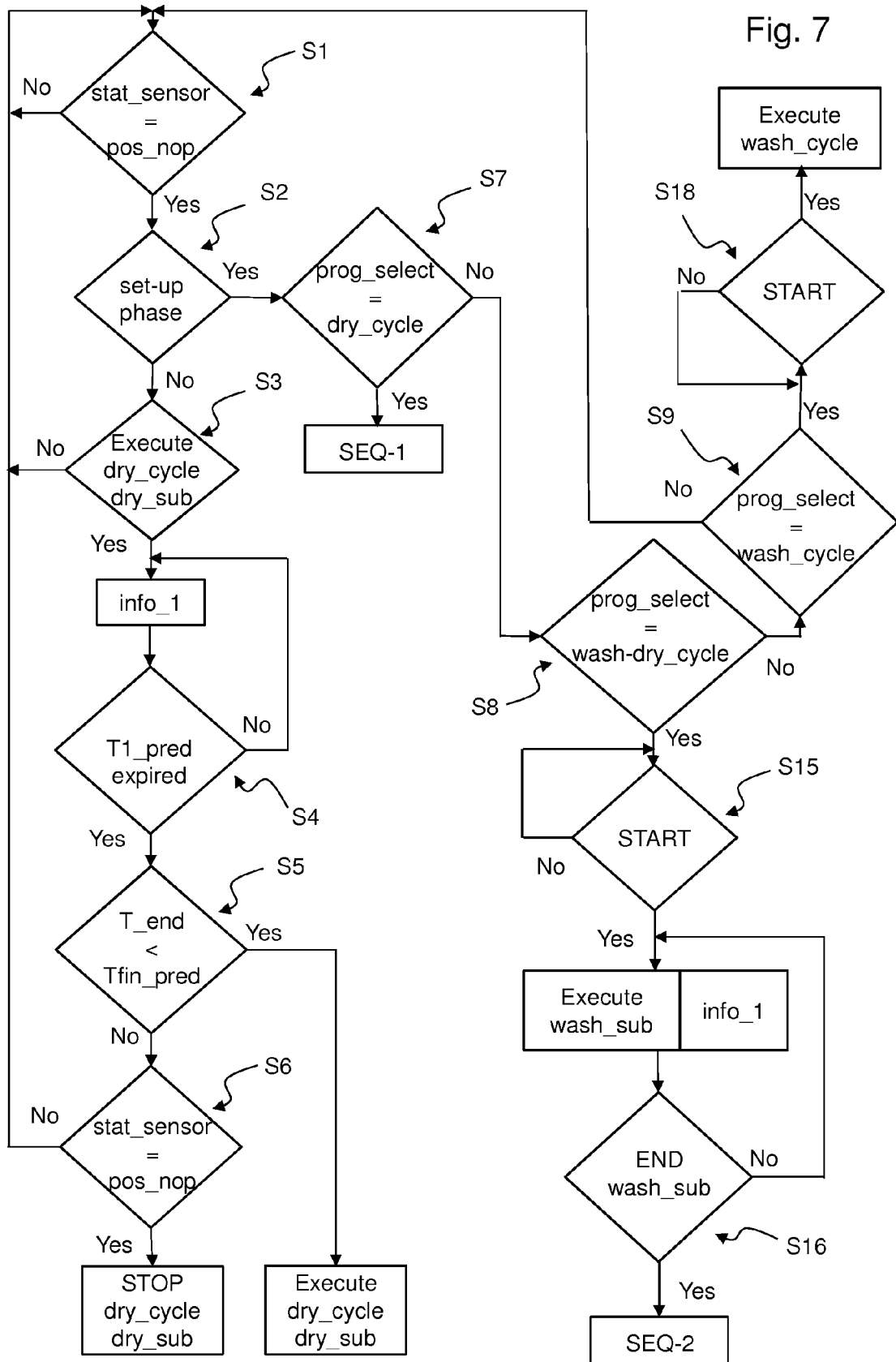
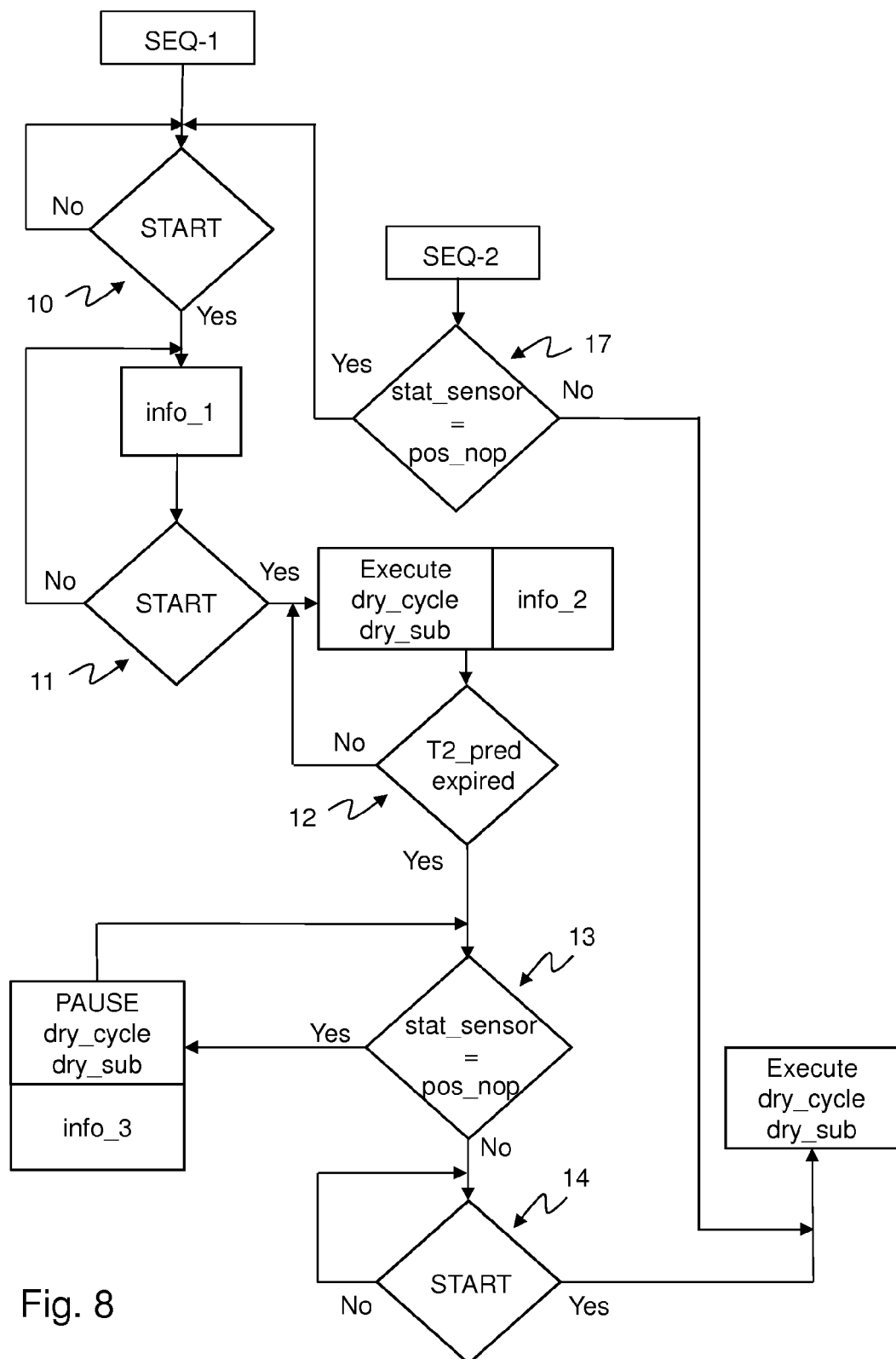


Fig. 4









EUROPEAN SEARCH REPORT

Application Number
EP 13 18 2327

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Place of search Munich		Date of completion of the search 28 February 2014	Examiner Weinberg, Ekkehard
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