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(54) **Method of contrplling drying operation of a drier**

(57) A method of controlling drying operation of a laundry drier comprises measuring exhaust air temperature at the start of the drying operation and periodically switching part of the heating equipment on and off during an initial phase of the drying operation. After the initial phase, the temperatures and, onward from a value of for example 30%, the residual moisture content of the laundry are repeatedly measured at three positions ahead of the heating equipment, ahead of an air outlet of the drier drum and behind an air outlet of the drum. The process course is modified section-by-section in dependence on the difference values of the measured temperatures, the residual moisture content and further process variables such as elapsed time, laundry type, laundry quantity and initial residual moisture on attainment of predetermined threshold values.

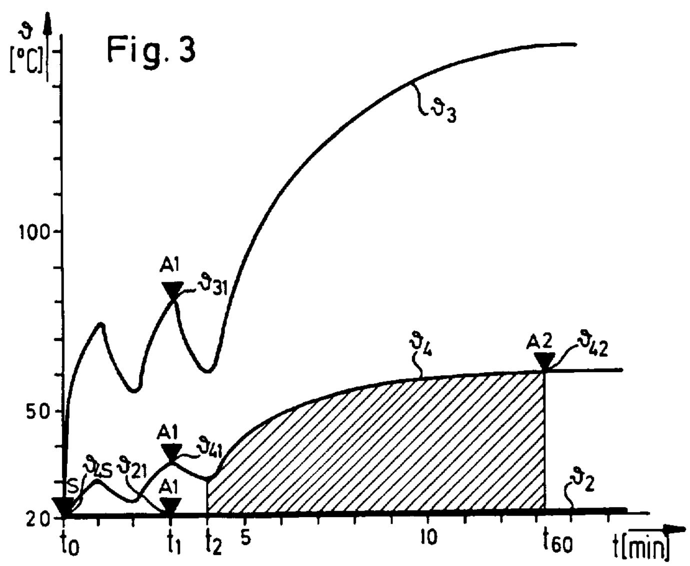

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Fig. 1

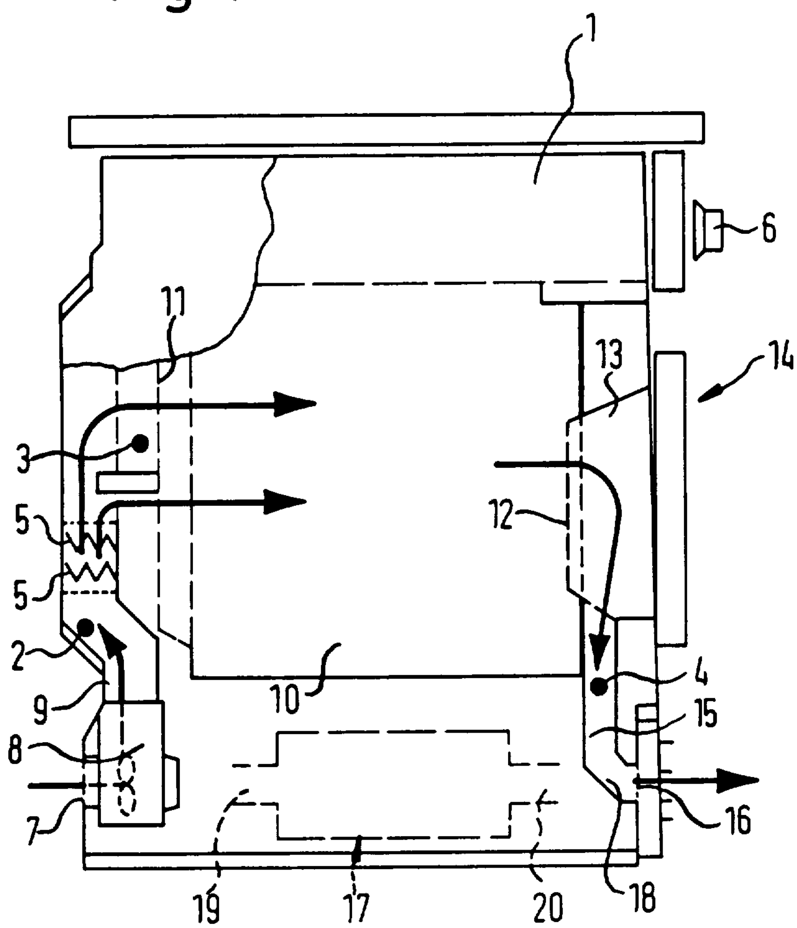


Fig. 2

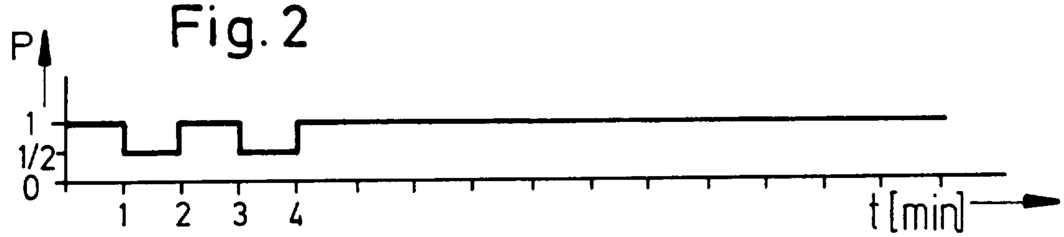


Fig. 3

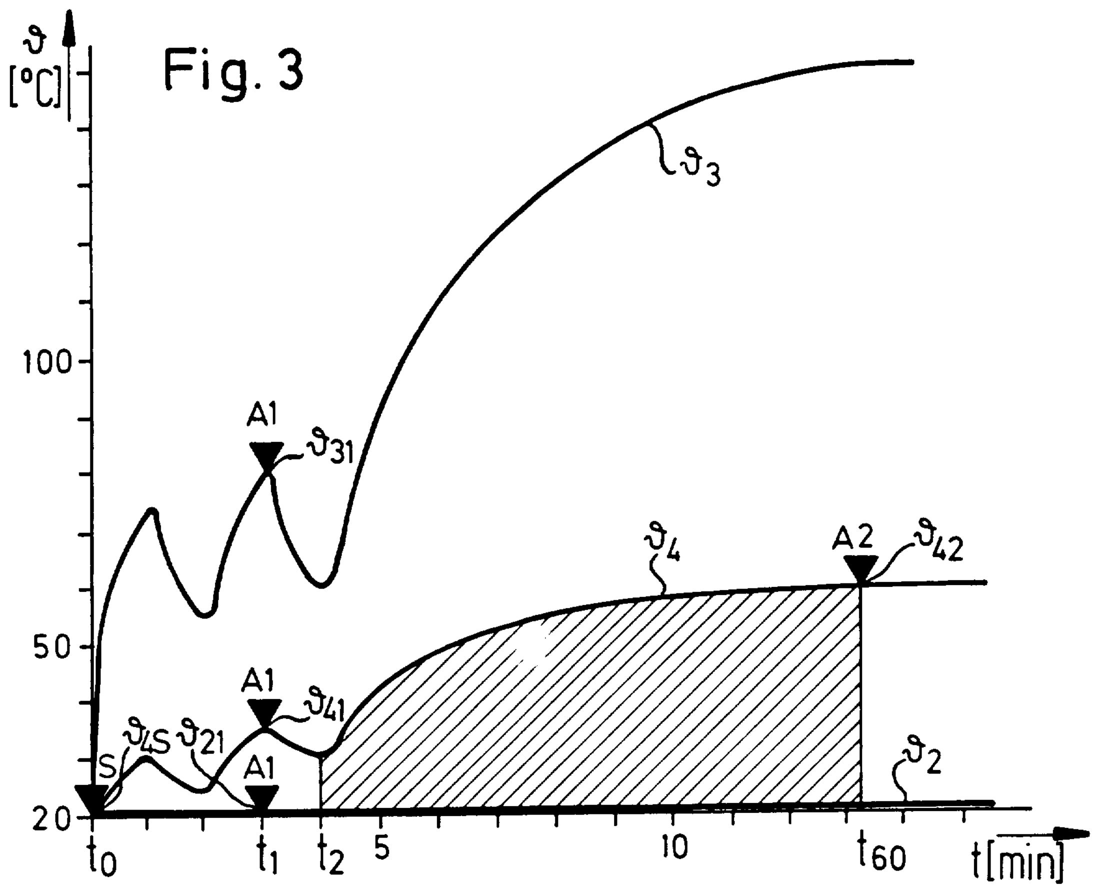
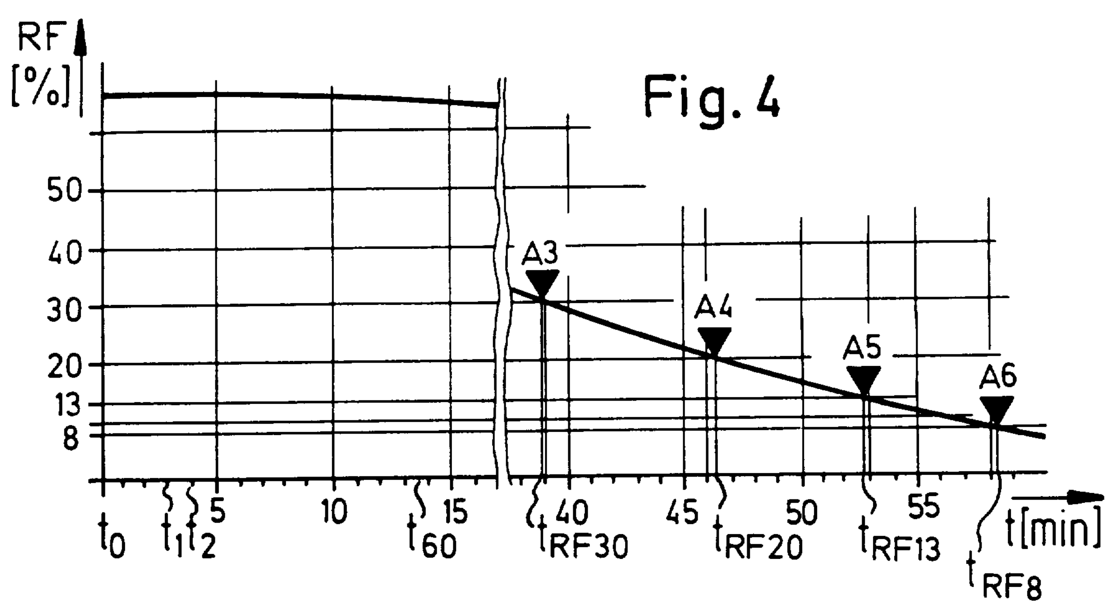


Fig. 4



METHOD OF CONTROLLING DRYING OPERATION OF A LAUNDRY DRIER

The present invention relates to a method of controlling drying operation of a laundry drier.

In German published specification 37 03 671 there is disclosed a method of controlling drying processes, which begins with a heating phase up to the target temperature, for example 60°C, during which a positive temperature gradient is ascertained. A negative temperature gradient is ascertained in a subsequent intermediate cooling phase. Since a sufficiently accurate estimation of the duration of drying to the beginning of the drying process is not possible, a fictional time statement on the forseeable end of the drying process is made initially. This statement is based on previous experience. The negative temperature gradient permits computation of the forseeable drying duration which, though still subject to uncertainties, can reduce the tolerance range of the remaining time indication replacing the fictional time statement. The parameter "kind of laundry", which influences the drying process, must be communicated to the drier control by way of operator input before the beginning of the drying process. In the mentioned published specification, nothing is stated about the influence of the laundry quantity on the drying process. The rest of the drying process is then controlled in known manner on the basis of constantly measured residual moisture. Ascertaining of the remaining time is carried out by computation of the negative residual moisture gradient with consideration of a target residual moisture and the preset "kind of laundry" parameter. Drying processes which go beyond a residual moisture measurement value, of for example, 8% (corresponding to "slightly moist") must then be controlled in time, for which purpose the remaining duration is extrapolated from the previously computed residual moisture gradients.

The known method has the disadvantage of having to wait for a heating phase of 10 to 15 minutes before a resonably reliable value for the remaining time of the drying process can be computed. Moreover, the uncertain residual moisture measurement outside a relatively reliable measurement value range between the limit values of about 30% to about 8% is problematic. The reliability of control of the drying process solely on the basis of measured residual moisture values is in general too low. This is due in part to the quantity of laundry being a reliably measurable correction parameter. Apart from that, several outer field parameters cannot be reacted to, because the known static control method cannot, during the early phase of a drying process, take into account different ambient temperatures, different initial residual moisture values or possible preliminary heating of the drier due to preceding drying processes. For about 10 to 15 minutes, the process control and the residual time indication have to rely on pure estimations or uncertain empirical values. The measurements of the positive and negative temperature gradients undertaken within this phase are also influenced by such uncertainties and suffer from errors which falsify the process course.

There is thus a need for a method of ascertaining the required drying time for a laundry in a laundry drier by technically simple and inexpensive measures without external influences, for example variable ambient temperatures or different initial residual moisture values, being able to put into question the accuracy of the process course, the drying time determination and the residual time indication.

Although such a problem is addressed by German patent application P 44 42 250.4, the computation power required in this control method is appreciable and should preferably be replaced by stored standardised process courses, which according to experience are repetitive and which can be varied in dependence on the parameters of the instantaneous drying process by relatively few measurement values.

According to the present invention there is provided a method of controlling drying processes in a domestic laundry drier comprising at least one laundry drum which is rotatable about an horizontal axis and has a feed air entry and an exhaust air exit, a blower in the air channel, heating equipment in front of the feed air entry, temperature sensors and moisture sensors, a storage device for measurement values and process course variants, and an electronic program control device, characterised in that the exhaust air temperature at the exhaust air exit is measured at the starting instant of the drying process, that a part of or the entire heating equipment is switched on and off periodically during at least one time section at the beginning of the drying process, that air temperature measurements are made at the entry of the heating equipment, before the feed air entry and directly behind the exhaust air exit after the end of a starting phase, the duration of which is measured by the time span of one to three heating periods, that differences are formed from the measurement values on the one hand in the exhaust air and at the entry of the heating equipment and on the other hand in the feed air and at the entry of the heating equipment and are stored, that process variables, such as the actually lapsed time since the start of the program, temperature values and moisture values of the laundry to be dried, are measured constantly or at least periodically at frequencies of several times per second, and a respective call-up of several stored process courses goes out to the storage device unit for issue and processing in the program control device each time preset threshold values are reached, which are dependent on entered program parameters concerning the kind and quantity of the laundry and/or initial residual moisture.

The immediate measurement of the exhaust air temperature at the instant of starting registers the existing drier temperature, which - in the case of an exhaust air drier - includes the ambient temperature in view of induction of ambient air by the drier. Uncertainties about outer field parameters of that nature are therefore eliminated. Air temperatures measured at the three mentioned positions in the initial phase of the periodic switching on and off of the heating equipment or a part thereof provide information about the thermal transmission function, which can be formed as a quotient of an input magnitude and an output magnitude. The thermal input magnitude is formed from the difference of the temperatures at the entry to the heating equipment and at the feed air entry of the drum. This magnitude is very pronounced in the case of an exhaust air drier, which inducts air from the surroundings and exhausts the air back into the surroundings, and also in the case of a condensation drier which has a closed process air channel, but has a condensation cooler between the exit of the drum and the entry of the heating equipment. The thermal output magnitude represents the behaviour of the heat consumer, namely the laundry charge, and is formed from the differences of the temperatures measured at the exit of the drum and the entry of the heating equipment and/or at the exit of the drum and the entry of the drum. This thermal transmission function formed from the thermal input and output magnitudes automatically takes into consideration all outer field conditions, such as mains voltage fluctuations, kind and quantity of laundry and initial residual moisture, the individual measurement values of which influence the thermal input magnitude as well as the thermal output magnitude. For example, the thermal output magnitude rises faster with increase in the heating power - dependent on the mains voltage - and with decrease in the quantity of laundry and initial residual moisture. The thermal transfer function permits a first estimation of the program duration which is to be expected and which can replace an empirical value, indicated during the first time section of the drying process, for the duration of drying.

In the continuation of the drying process, measurement values of the temperature and their differences, measured moisture values and actual elapsed times influence the drying process through utilisation in calling up stored process courses and in varying these process courses by application of actual measurement values departing from typical parameter measurement values. These variations are also expressed as varied residual time indications to be corrected.

Preferably, the elapsed time since program start to attainment of a mean measurement value of the exhaust air temperature for the first time during a quasi-static phase, in which heat input by the heating equipment is about in balance with heat extraction due to evaporation of moisture from the laundry, is registered and stored as a process variable. This time instant is suitable for use in taking a decision as to which of the stored process courses is appropriate for further treatment of the laundry. At this instant, the relevant decision data are present, i.e. parameters in respect of quantity of laundry, initial residual moisture, drier temperature, ambient temperature, heating power, and residual time, which has been computed in error due to initial measurement inaccuracies, by comparison with actually elapsed time. At this instant, a first correction possibility is available from monitoring rise in the exhaust air temperature until the quasi-static phase is reached.

Advantageously, the elapsed time from program start to attainment of a mean measurement value for a predetermined residual moisture of the laundry - which is classified as reliably measurable, for physical reasons, for the first time in the course of the drying process - is registered and stored as a process variable. Any residual moisture values, which lie above this mean measurement value, for example about 30%, cannot be ascertained reliably and therefore cannot be used in control of the drying process free of doubt. Since the temperatures at the afore-mentioned positions are periodically monitored until first registration of the elapsed time to reaching this residual moisture value, the drying process can continue unchanged insofar as there are no disturbances causing deviation in temperature. The attainment of the mean measurement value of about 30% for the residual moisture permits, after a phase of exclusive subtraction of time steps since reaching the quasi-static phase, checking of the residual time values indicated so far. The measurement instant on reaching the residual moisture of 30% also provides information about the composition of the laundry with respect to the types of fabric. For example, moisture is more difficult to evaporate from a tight cotton weave of thick threads then from a thinner and lighter cotton weave. To a lesser extent, the quasi-static phase also becomes longer with a high proportion of large laundry items by comparison with smaller laundry items, which separate more easily and more frequently during the tumbling and are more exposed to the hot air current than large laundry items. The measurement value of about 30% for residual moisture will be reached earlier or later in dependence on the type of laundry. A new process course following a previous process course is therefore started only earlier or later.

The new process section can run until attainment of a mean measurement value, for example about 20%, for the first time for a predetermined residual moisutre content which corresponds to a determination of the term "mangle moist". The elapsed time since reaching that mesurement value for the residual moisutre (30%) which is measurable reliably for the first time is registered and stored. At this newly ascertained instant, a new process section can be initiated.

Advantageously, the drying process is controlled correctly in sequence by a further process variable which identifies the elapsed time from attainment of the measurement value for the residual moisture content measurable reliably for the first time to attainment of a mean value, for example about 13%, for the first time for a predetermined residual moisture value which corresponds to a determination of the term "ironing moist". This magnitude, too, is registered and stored. The drying process can thereby be corrected in a further process section should an erroneous judgement of the previous process sections have been made.

Preferably, the last process section, which was determinable by definitively ascertainable facts, should be capable of being influenced by a process variable which is determined by the actually elapsed time from reaching the measurement value for the residual moisture content measurable reliably for the first time to reaching a mean measurement value, for example about 8%, for the first time for a predetermined residual moisture value which corresponds to a determination of the term "slightly dry". This measurement value, too, can be registered and stored. It, too, is suitable for correcting the associated process section in like manner as for the previous process sections.

For preference, mean values of a limited number of individual measurement values, which are returned periodically since a start signal, are formed and stored as the measurement values of temperature and moisture. According to experience, the measurement values for temperature and moisture vary within short time spans, so that an individual measurement in some circumstances could give a false picture of the prevailing state. For example, temperature values could be detected 60 times per second. For example, four measurements, which can be randomly distributed over a short time span of at most 4 seconds, result in a good basis for obtaining a mean value which at least approximately reflects the prevailing state. The indicated time span for the measurement portion should preferably not be longer than four seconds, or errors may result. The minimum time span for 60 measurements per second can therefore be about 67 milliseconds in the case of measurements following one directly on the other. Advantageously, the afore-mentioned differences are formed from the temperature measurement mean values and stored.

To increase the measurement accuracy, it is of advantage if, in the case of storage means able to store only whole number measurement values, the measurement values of the temperatures of the exhaust air and at the entry of the heating equipment are doubled before the difference formation. Fractions of a measurement value can then be doubled to the next higher uneven whole number, so that inaccuracies due to disregarding of fractions are avoided.

For the calling-up of stored process courses it is of particular advantage if respectively different control signals are given to a fuzzy processor each time measurement values are reached and if the fuzzy processor calls up a predetermined process course in dependence on the content of the respective control signal and issues a value for the duration of the drying process. For the individual process sections different standarised process courses can be stored, which can likewise be varied by continuously measured parameters. On calling-up of such a process course, a value for the duration of the drying process or for the remaining time (duration of the drying process, less elapsed time since the start of the program) can be issued at the same time.

The accuracy of the drying process can be further increased if the fuzzy processor varies the threshold values of the temperature differences in targeted manner in dependence on an automatically ascertained or entered value for the laundry quantity. Values to be entered for the quantity are dependent on the capability of operator for accurate estimation. It has already been explained that temperature courses observed in the starting phase of the drying process permit drawing of a conclusion, which can be more accurate than operator estimation, of the laundry quantity. It is therefore of advantage if a value, which is ascertained in such a manner, for the quantity has an influence on the threshold value of the temperature difference to be observed.

It is also of advantage if the processor computes a residual time and delivers it to an output unit in dependence on the called-up process course and on the value for the duration of the drying process as well as on parameters for kind and/or quantity of laundry and drying target.

In addition, the processor can advantageously vary the threshold values of the residual mositure, for which the time registration takes place, in targeted manner in dependence on an automatically ascertained or entered value for the laundry quantity. Since the drying behaviour of laundry charges of different size is different, the start condition for the respective process course, namely the reaching of the threshold value of the residual moisture, can be arranged to be variable while maintaining the stored process courses for the individual process section. For an indication of the residual time, it is of particular advantage if the issued residual time is corrected decrementally by subtraction of the time progress until its renewed computation by reason of new control signals and measurement values. Because of the relatively high inaccuracy and the length of the drying process still to be worked through, it may be desirable to determine the decrements to an absolute remaining time from approximately 30 minutes to 5 minutes, whilst towards the end (from about 30 minutes of residual time) the computation accuracy and the shortness of the remaining time justify decrements of one minute. Alternatively, the individual decrements can be shorter or longer than the envisaged decrements according to correction requirement. In the case of a computed correction which required a greater residual time indication than the actual indication, it is of advantage for the avoidance of irritation to the operator to allow the previous residual time indication to remain until the correction value is lower than the indicated residual time by the envisaged decrement.

It is of particular advantage in the operation of the drier if the processor stores empirical values for the composition of the respective drying process and for its duration in dependence on entered program parameters from drying processes that have taken place earlier. Then, an empirical value, which is depeneent on the entered kind and/or quantity of laundry and on the entered drying target, can be issued for the entire program course duration from the start of the program course. Since experience over a longer time, i.e. over several drying processes of like kind, can result in greater target accuracy for the duration of the respective drying process, the chance of indicating an accurate program course duration at the beginning of the drying process becomes greater with increasing learning experience.

It is therefore of particular advantage if the empirical value is compared with program course time spans ascertained subsequently for programs running with parameters of like kind on the basis of the computations of the processor, corrected and the corrected empirical value is exchanged against the previous empirical value in the storage means. It is expedient for the correction of the empirical value if this and a certain number of subsequently ascertained program course time spans are averaged.

Examples of the method according to the present iunvention will be more particularly described with reference to the accompanying drawings, in which:

Fig. 1 is a schematic side view of a laundry drier for performance of a method exemplifying the invention;

Fig. 2 is a diagram illustrating power stages of heating equipment, as a function of time, of the drier;

Fig. 3 is a diagram showing temperatures measured at three measurement points, which are indicated in Fig. 1, as a function of time; and

Fig. 4 is a diagram illustrating the change in residual moisture content as a function of time, and laundry dried in the drier.

Referring now to the drawings it should be noted that the residual moisture values indicated for the illustrated example relate to a base of 0% relative humidity, for which an absolute water content is contained in any desired fabric at a temperature of 20°C and a relative humidity of 65% of the ambient air.

The laundry drier illustrated in Fig. 1 has in the upper part program control equipment 1, which is settable by an operating knob 6 and contains a fuzzy processor control (not shown). A feed air opening 7, which is connected by way of a blower 8, a feed air channel 9 and heating equipment 5 to an entry 11 of a laundry drum 10, is arranged at the lower rear side of the drier. The exit 12 of the drum 10 is connected by way of the pot 13 of a loading door 14 and an exhaust air channel 15 with an exhaust air outlet 16 at the front side of the drier.

For possible closing of the drying air circuit by way of a condenser 17 (illustrated in dashed lines), the blower 8 and an elbow 18 of the exhaust air channel 15 are turned around and connected to respective connecting stub pipes 19 and 20 of the condenser 17.

A fresh air temperature transmitter 2, which in the case of an exhaust air drier measures the temperature of the inducted ambient air, is installed in the feed air channel 9 upstream, in flow direction, of the heating equipment 5, which is switchable in two heating stages. In the case of a condensation drier, the temperature transmitter 2 measures the exit air, which in a given case is loaded with residual heat, of the condenser 17. A feed air temperature transmitter 3 is arranged in the feed air channel between the heating equipment 5 and the entry 11 of the drum 10 and measures the temperature of the feed air heated by the heating equipment 5. A temperature transmitter 4, which measures the temperature of the exhaust air, is arranged in the exhaust air channel 15 in flow direction behind the exit 12 of the drum 10.

The diagram of Fig. 2 shows that the heating equipment 5 is switched periodically between the full and half heating power at the beinning of a drying process. This is preferably performed twice each time during the first four minutes. As a result, a movement up and down, which is clearly visible in the diagram of Fig. 3, of the temperature ϑ_3 measured at the temperature transmitter 3 takes place, thus the temperature at the feed air entry of the drum 10. From the instant t_2 = 4 minutes onwards, heating is performed continuously at full power until the temperature transmitter 3 ascertains an impermissibly high temperature in order to then switch back and forth between full and half heating power according to whether reaching or falling below a highest or lowest permitted temperature.

At the starting instant t_0 of the drying process, the exhaust air temperature ϑ_{4S} is measured by the temperature transmitter 4 at the exhaust air exit. This temperature represents the initial state of the drier and takes into consideration the temperature of the ambient air inducted into the opening 7. Since the heating equipment 5 is still cold at this instant, the measured temperature relates only to the state of the ambient air and a possible preheating of the drier due to a previously performed drying process. At the starting instant t_0, the heating equipment 5 is switched to full heating power and a drive (not shown) for the blower 8 and drum 10 is switched on.

On starting from the cold state of the drier, the quantity of heat introduced by the heating equipment 5 must initially also heat up those parts of the drier which come into contact with the warm air current, together with the laundry. In the diagram of Fig. 3, the temperature ϑ_3 at the transmitter 3 in the feed air entry 11 reaches about 75° after one minute, whilst the temperature ϑ_4 at the transmitter 4 in the exhaust air exit 12 reaches only about 30°. In the next minute interval, the heating equipment 5 is switched back to half heating power, whereby the temperatures ϑ_3 and ϑ_4 fall again, the former to about 55° and the latter to about 25°. During the next full switching-on period of the heating equipment 5 in the third minute period, the temperature ϑ_{31} is about 80° at the instant t_1, whilst the temperature ϑ_{41} is about 35°. The temperature ϑ_{21} at the transmitter 2 in front of the entry of the heating equipment 5 at this instant still presumably amounts to 20°C, which is the temperature of the inducted ambient air. In the course of the drying process, the temperature of the ambient air rises, because the drier delivers at least a part of the drying heat into the place of installation. This applies even to exhaust air driers, in which the warm exhaust air is conducted into the open through an exhaust air hose. Leakage losses and feedback effects lead to the ambient air being heated. The heating of the ambient air is, however, appreciably greater in the case of a condensation drier, the condenser 17 of which is cooled by cooling air which takes a quantity of heat from the condenser and transfer it to the environment.

At the instant t_1, at which the temperatures ϑ_{21}, ϑ_{41} and ϑ_{31} are measured and averaged, the differences $\vartheta_{4-2} = \vartheta_{41} - \vartheta_{21}$, $\vartheta_{3-4} = \vartheta_{31} - \vartheta_{41}$ and $\vartheta_{3-2} = \vartheta_{31} - \vartheta_{21}$ are also formed. From the now present variables, the starting temperature ϑ_{4s}, the stated temperature differences and the so far elapsed time for $t_1 = 3$ minutes, the fuzzy processor computes a total drying time which together with an algorithm 1, which is now called up for each call-up A1, for the preceding process section is used for correction of the hitherto estimated residual indication. The residual time to be indicated is computed by the following equation:

$$t_{Rest} = t_{Fuzzyges} x f_1 - t_{Plz} + t_1 \quad (1)$$

In this equation

t_{Rest} signifies the residual time, to be indicated, to a selected drying target (degree of drying),

$t_{Fuzzyges}$ signifies the total drying time computed by the processor on the basis of the variables present at the instant of the call-up,

f_1 is a correction factor, which is dependent on the drying target, as percentage for the different drying targets of "mangle moist", "ironing moist" for cotton, "ironing moist" for delicate textiles, "slightly dry" for cotton and "slightly dry" for delicate textiles,

t_{Plz} is the actually elapsed process running time, and

t_1 is a constant for the drying targets "very dry" and extra dry".

This computation is used together with the algorithms for the call-ups A1, A2 and A3.

For the call-up A2, a threshold value of, for example 60°C is made effective, which must be reached by the temperature ϑ_4 after the instant $t_2 = 4$ so that the fuzzy algorithm 2 is called up (elapsed process running time). For correction of the residual time to be indicated, the actually elapsed time t_{60} from the program start to attainment of the mean measurement value of the exhaust air temperature ϑ_{42} = 60° for the first time is now registered, stored and used for correction. The so-called quasi-static phase of the drying process begins at this exhaust air temperature ϑ_{42} = 60°. Within this phase, the heat input by the heating equipment remains about equal to the heat extraction by evaporation of moisture from the laundry. At the end of the quasi-static phase, the temperature ϑ_4 of the exhaust air rises to above 60°. For gentle treatment of the laundry, certain threshold values of the exhaust air temperature should not be exceeded, for which purpose the heating equipment 5 can be switched back to half power or switched off entirely.

In the course of the quasi-static phase of the drying process, a measuring device (not shown), which operates by the conductance value measurement method, for direct measurement of the residual moisture present in the laundry is switched to be effective. As soon as this device, which is interrogated several times per second similarly to the temperature transmitters and the measurement value of which is averaged correspondingly, has ascertained the residual moisture value RF = 30%, the elapsed time to reaching this mean value for the first time is registered, stored and drawn on for correction of the residual time indication (equation 1) in the fuzzy processor on the call-up A3 of the algorithm 3.

For computation of the residual times from the call-ups A4 to A6 onwards, the following equation 2 applies:

$$t_{Rest} = t_{Fuzzyrest} x (1-f_2) + t_1 + 8 \text{ min} \qquad (2)$$

In this equation

t_{Rest} signifies the residual time to the chosen drying target,

$t_{Fuzzyrest}$ signifies the residual time, which is computed by the processor with the application of the present variables, until the reaching of a residual moisture content of 8%,

f_2 is a correction factor dependent on the drying target, and

t_1 is a constant for the drying targets "very dry" and "extra dry".

Since the temporal course of the reduction in the residual moisture in the range between 30% and 8% can be assumed with adequate accuracy to be a straight line, the same equation 2 applies for the drying portions from the call-up A4 onwards.

Expediently, a possibility is provided of filing further correction factors, which could act on the input variables ϑ_{4s}, ϑ_{21}, ϑ_{31}, ϑ_{41}, ϑ_{42}, t_{60}, t_{RF30}, t_{RF20}, t_{RF13} and t_{RF8} or on the initial variables $t_{Fuzzyges}$, t_{Rest} and $t_{Fuzzyrest}$, in a storage region associated with the processor.

The following procedure is used for the correction of the indication:

After the respective algorithm call-ups to the processor, the remaining residual times are computed as described and the results are indicated. From this instant onwards to the next call-up, the residual indications above 30 minutes are decremented in 5 minute steps, wherein the display takes place in whole-numbered values divisible by five. After reaching a residual time indication of 30 minutes, the display is decremented in one-minute steps. If only two places are provided for display of the residual time, the number 99 is indicated for residual times greater than 95 minutes and a flashing decimal point denotes that the time is estimated and lies above 99 minutes.

When a departure from the instantaneously indicated residual time results from new estimation of the respective residual time or transition into the time-controlled section after reaching the residual moisture RF = 0%, either the display jumps over to a new smaller display value insofar as the display is greater than the still remaining residual time or the display value remains the same until agreement of display and prediction when the display value is smaller than the computed remaining residual time. Then, however, the righthand decimal point flashes as an indication of the transient inaccuracy.

To reach the drying targets "very dry" and "extra dry", a time control is connected because of the assumed linearity of the still remaining drying course. During these time-controlled program sections, the display is decremented to 0. At the end of a cooling-down phase, which is included in the residual time computation, the residual time display is switched off. It is thus readily recognisable that the drying program is completed. A crease-protection phase then follows, but this is not part of the actual drying process.

CLAIMS

1. A method of controlling drying operation of a laundry drier comprising a laundry drum provided with an inlet for drying air and with an outlet for exhaust air, heating means for heating the drying air upstream of the inlet, storage means for storing measurement values and different operational courses, and electronic program control means, the method comprising the steps of measuring the exhaust air temperature downstream of the outlet at the time of starting a drying operation by the drier, periodically switching on and off at least part of the heating means during at least one time period at the start of the drying operation, measuring the drying air temperature at a position upstream of the heating means and a position downstream of the heating means but upstream of the inlet and the exhaust air temperature at a position downstream of the outlet after elapsing of an initial operating phase substantially corresponding to the time span of one to three switch-on periods of the heating means, determining and storing the differences between the three temperatures measured in the initial phase, measuring other variables of the drying operation either continuously or several times per second, and effecting call up of stored operational courses for issue to and processing in the program control means on attainment of predetermined threshold values dependent on at least one program parameter input into the control means.

2. A method as claimed in claim 1, wherein at least one parameter comprises category of laundry, quantity of laundry and initial

moisture content of the laundry.

3. A method as claimed in claim 1 or claim 2, wherein said variables comprise at least one of elapsed time since start of the drying operation, a temperature value and laundry moisture content.

4. A method as claimed in any one of the preceding claims, wherein said variables comprise elapsed time from start of the drying operation to first attainment of a given mean measurement value of the exhaust air temperature during a quasi-static phase in which heat input by the heating means is substantially in balance with heat extraction due to evaporation of moisture from the laundry.

5. A method as claimed in claim 4, wherein the mean measurement value is substantially 60°C.

6. A method as claimed in any one of the preceding claims, wherein said variables comprise elapsed time from start of the drying operation to first attainment of a given mean measurement value for a predetermined residual moisture content of the laundry.

7. A method as claimed in claim 6, wherein the predetermined residual moisture content is represented by a value which is classified as reliably measurable, for physical reasons, for the first time in the course of the drying operation.

8. A method as claimed in claim 6 or claim 7, wherein the mean

measurement value for the moisture content is substantially 30 percent.

9. A method as claimed in any one of claims 6 to 8, wherein said variables comprise elapsed time from attainment of said mean measurement value for moisture content to first attainment of a given mean measurement value for a reduced residual moisture content of the laundry corresponding to a predetermined definition of "mangle moist".

10. A method as claimed in claim 9, wherein the mean measurement value for said reduced residual moisture content is substantially 20 percent.

11. A method as claimed in any one of claims 6 to 8, wherein said variables comprise elapsed time from attainment of said mean measurement value for moisture content to first attainment of a given mean measurement value for a reduced residual moisture content of the laundry corresponding to a predetermined definition of "ironing moist".

12. A method as claimed in claim 11, wherein the mean measurement value for said reduced residual moisture content is substantially 13 percent.

13. A method as claimed in any one of claims 6 to 8, wherein said variables comprise elapsed time from attainment of said mean

mean measurement value for moisture content to first attainment of a given mean measurement value for a reduced residual moisture content of the laundry corresponding to a predetermined definition of "slightly dry".

14. A method as claimed in claim 13, wherein the mean measurement value for said reduced residual moisture content is substantially 8 percent.

15. A method as claimed in any one of the preceding claims, wherein each of said three measured temperatures and a measured variable representing laundry moisture content is represented by the mean value of a plurality of measurement values obtained periodically since starting of the drying operation.

16. A method as claimed in any one of the preceding claims, wherein the determined differences are differences between mean values.

17. A method as claimed in claim 16, comprising the step of doubling the values of the first and third of said three measured temperatures before determining the differences between those temperatures.

18. A method as claimed in any one of the preceding claims, wherein the control means comprises a fuzzy processor and the method comprises the step of issuing a respective control signal to the processor on each occasion a predetermined measurement value is reached, the processor being arranged to effect call up of a

respective program course on receipt of each control signal and to issue a value for the duration of the drying operation.

19. A method as claimed in claim 18, wherein the threshold values are for said determined temperature differences and the processor is arranged to vary the threshold values in dependence on a value indicative of laundry quantity.

20. A method as claimed in claim 18 or 19, when appended to any one of claims 9 to 14, wherein the processor is arranged to vary to a threshold value, which denotes said first attainment, in dependence on a value indicative of laundry quantity.

21. A method as claimed in any one of claims 18 to 20, wherein the issued duration value is a residual time value which is corrected decrementally by substraction based on the progress of time until renewed calculation thereof on receipt of a new control signal.

22. A method as claimed in any one of claims 18 to 21, wherein the processor is arranged to issue a duration value for the entire drying operation at the start thereof, the value being empirically determined in dependence on at least one of category and quantity of laundry and on desired final moisture content of the laundry.

23. A method as claimed in claim 22, comprising the step of storing the empirically determined duration value, comparing the stored duration value with the duration values of subsequently performed program courses based on corresponding parameters, and correcting the

stored value in dependence on the duration values of said subsequent program courses.

24. A method as claimed in claim 23, wherein the stored value is corrected in dependence on the mean of the duration values of a predetermined number of said subsequent program courses.

25. A method as claimed in claim 1 and substantially as hereinbefore described with reference to the accompanying drawings.

Patents Act 1977 **Examiner's report to the Comptroller under Section 17** **(The Search report)**	Application number GB 9526725.8
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Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) WPI	Documents considered relevant following a search in respect of Claims :- 1 TO 25

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Category	Identity of document and relevant passages	Relevant to claim(s)
E, A	US 5454171 (TOSHIBA)	
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