



(11) **EP 2 426 250 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
07.03.2012 Bulletin 2012/10

(51) Int Cl.:
D06F 58/28 (2006.01)

(21) Application number: **11177888.2**

(22) Date of filing: **18.08.2011**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **07.09.2010 JP 2010199611**
07.09.2010 JP 2010199614

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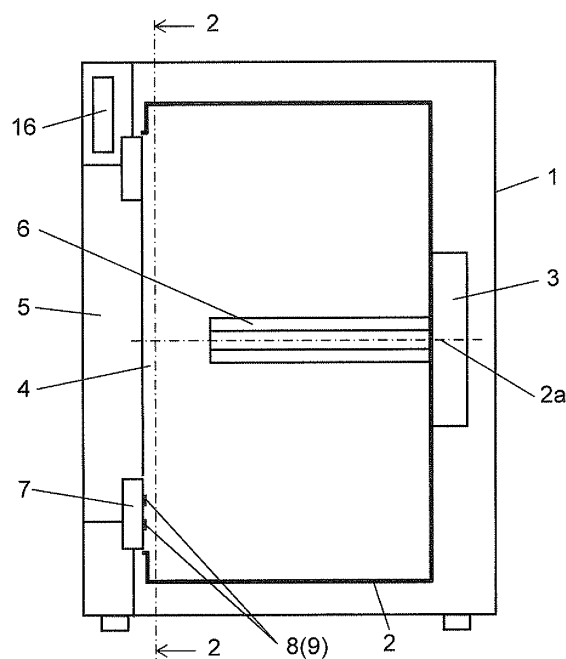
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(54) **Clothes dryer**

(57) A clothes dryer according to the present invention includes: a rotary drum; a motor; an inner circumferential plate; a pair of first electrodes and a pair of second electrodes provided on the inner circumferential plate; and at least a first resistance detection unit for detecting a change of a resistance value between the pair of first electrodes due to contact with the clothes in the rotary drum, and a second resistance detection unit for detecting a change of a resistance value between the pair of second electrodes due to contact with the clothes in the rotary drum. Further, the clothes dryer includes a control unit including a calculating unit connected to the first resistance detection unit and the second resistance detection unit for calculating a degree of dryness of the clothes in the rotary drum, based on at least one of signals from the first resistance detection unit and the second resistance detection unit.

FIG. 1



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a clothes dryer for drying clothes and the like in a rotary drum.

2. Description of the Related Art

[0002] For example, Unexamined Japanese Patent Publication No. 5-253397 (Patent Document 1) discloses a structure of a conventional clothes dryer.

[0003] Fig. 13 is a block circuit diagram of a clothes dryer described in the Patent Document 1.

[0004] As shown in Fig. 13, the conventional clothes dryer is provided with heater 51 having a positive temperature characteristic, on an inner circumferential plate having hot-air blowout ports. Further, hot air which has been heated by heater 51 is introduced into a rotary drum through the hot-air blowout ports, due to the rotation of a fan, thereby drying clothes. The temperature of this heated hot air is detected by lower temperature sensor 52a provided at a lower portion of the hot-air blowout ports in the inner circumferential plate and upper temperature sensor 52b provided at an upper portion of the hot-air blowout ports in the inner circumferential plate, wherein lower temperature sensor 52a and upper temperature sensor 52b are positioned near the rotary drum.

[0005] The values detected by lower temperature sensor 52a and upper temperature sensor 52b are transmitted to temperature detection unit 55, so that temperature detection unit 55 detects the temperature of the hot air. Resistance detection unit 53 detects the change of the resistance value of the clothes in the rotary drum which come into contact with electrode 54. Further, signals from resistance detection unit 53 and temperature detection unit 55 are inputted to control unit 56. Control unit 56 is constituted by a microcomputer or the like which includes resistance comparison unit 59, electrode detection-time comparison unit 58, calculating unit 60, temperature-difference detection unit 61 and the like and is adapted to perform control for energizing motor 57 and heater 51. In this case, temperature-difference detection unit 61 determines whether the volume of clothes is larger or smaller, based on the temperature difference in the clothes which has been detected by lower temperature sensor 52a and upper temperature sensor 52b. Electrode detection-time comparison unit 58 compares, through resistance comparison unit 59, the time period for which the resistance value detected from electrode 54 has continuously exceeded a set value for a predetermined time with plural set values and, further, determines the degree of moisture of the clothes based on the result of the comparison of data.

[0006] With reference to Fig. 14, the determination of the degree of moisture will be described below in detail.

[0007] Fig. 14 is a graph illustrating the relationship of the change of the resistance value detected from the electrode in the clothes dryer with time. As shown in Fig. 14, control is performed in such a way as to complete a drying operation, at time t8 after the elapse of predetermined delay time period T7 since time t6 at which resistance value R of electrode 54, which is detected due to contact thereof with clothes, has continuously exceeded predetermined value b for predetermined time period T5.

[0008] At this time, if the clothes contain a larger amount of moisture before the drying operation, this causes a delay in time t6 at which it is determined, through resistance comparison unit 59, that resistance value R has been continuously larger than set value b for predetermined time period T5, due to the degree of moisture. On the contrary, if the clothes do not contain a larger amount of moisture before the drying operation, this makes t6 earlier. Further, electrode detection-time comparison unit 58 makes a comparison between time t6 and plural set values, in order to determine the degree of moisture of the clothes before operations.

[0009] Further, calculating unit 60 determines the drying time period, by selecting, from preset values, delay time T7 appropriate to the degree of moisture of clothes which has been determined as described above and to the volume of the clothes which has been determined by temperature-difference detection unit 61. This enables setting the delay time period based on the volume of clothes and the degree of moisture thereof, which enables drying the clothes for an optimum operation time.

[0010] However, with such a conventional clothes dryer, it is difficult to detect the degree of dryness of clothes in the rotary drum in a stepwise manner, due to abrupt changes in electrode 54 which are caused by contact thereof with clothes during drying.

SUMMARY OF THE INVENTION

[0011] A clothes dryer according to the present invention includes: a rotary drum provided rotatably in a main body; a motor adapted to drive the rotary drum; an inner circumferential plate provided at a front portion of the main body; a pair of first electrodes and a pair of second electrodes provided on the inner circumferential plate, such that the electrodes come into contact with clothes in the rotary drum; and a control unit including at least a first resistance detection unit for detecting a change of a resistance value between the pair of first electrodes due to contact with the clothes in the rotary drum, a second resistance detection unit for detecting a change of a resistance value between the pair of second electrodes due to contact with the clothes in the rotary drum, and a calculating unit connected to the first resistance detection unit and the second resistance detection unit for calculating a degree of dryness of the clothes in the rotary drum, based on at least one of signals from the first resistance detection unit and the second resistance detection unit.

[0012] Thus, it is possible to detect the degree of dryness of clothes in the rotary drum, in a stepwise manner, which enables performing optimum drying operations by preventing excessive drying of clothes and insufficient drying of clothes.

BRIEF DESCRIPTION OF DRAWINGS

[0013]

Fig. 1 shows a schematic view of the structure of a clothes dryer according to a first exemplary embodiment of the present invention;

Fig. 2 shows a cross-sectional view of the clothes dryer, taken along 2-2 in Fig. 1;

Fig. 3 shows a system diagram illustrating the general outline of a control device in the clothes dryer;

Fig. 4 shows a schematic view illustrating the change of the number of electrode detection data per unit time, with respect to the volume of clothes, in the clothes dryer;

Fig. 5 shows a schematic view illustrating the temporal changes of the resistance value between electrodes and the number of electrode detection data per unit time, in the clothes dryer;

Fig. 6 shows a system diagram illustrating the general outline of a control device in a clothes dryer according to a second exemplary embodiment of the present invention;

Fig. 7A shows an output signal diagram resulted from frequency analyses on signals just after the start of an operation, in a case where the clothes in a rotary drum have a larger volume, in the clothes dryer;

Fig. 7B shows an output signal diagram resulted from frequency analyses on signals when the degree of dryness is about 90%, in a case where the clothes in the rotary drum have a larger volume, in the clothes dryer;

Fig. 7C shows an output signal diagram resulted from frequency analyses on signals when the degree of dryness is about 100%, in a case where the clothes in the rotary drum have a larger volume, in the clothes dryer;

Fig. 8A shows an output signal diagram resulted from frequency analyses on signals just after the start of an operation, in a case where the clothes in the rotary drum have a smaller volume, in the clothes dryer;

Fig. 8B shows an output signal diagram resulted from frequency analyses on signals when the degree of dryness is about 90%, in a case where the clothes in the rotary drum have a smaller volume, in the clothes dryer;

Fig. 8C shows an output signal diagram resulted from frequency analyses on signals when the degree of dryness is about 100%, in a case where the clothes in the rotary drum have a smaller volume, in the clothes dryer;

Fig. 9A shows an output signal diagram resulted from

frequency analyses on signals when the degree of dryness is about 60%, in a case where the clothes in the rotary drum have a larger volume, in the clothes dryer;

Fig. 9B shows an output signal diagram resulted from frequency analyses on signals when the degree of dryness is about 80%, in a case where the clothes in the rotary drum have a larger volume, in the clothes dryer;

Fig. 9C shows an output signal diagram resulted from frequency analyses on signals when the degree of dryness is about 60%, in a case where the clothes in the rotary drum have a smaller volume, in the clothes dryer;

Fig. 9D shows an output signal diagram resulted from frequency analyses on signals when the degree of dryness is about 80%, in a case where the clothes in the rotary drum have a smaller volume, in the clothes dryer;

Fig. 10 shows a fragmentary view of another example of electrodes in the clothes dryer, taken along 2-2 in Fig. 1;

Fig. 11 shows a cross-sectional view of another example of electrodes in the clothes dryer, taken along 2-2 in Fig. 1;

Fig. 12 shows a cross-sectional view of still another example of electrodes in the clothes dryer, taken along 2-2 in Fig. 1;

Fig. 13 shows a block circuit diagram of a conventional clothes dryer;

and

Fig. 14 shows a graph illustrating the relationship of the change of the resistance value detected from the electrode in the clothes dryer with time.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0014] Hereinafter, exemplary embodiments of the present invention will be described with reference to the drawings. Further, the present invention is not limited to these embodiments. Further, in the embodiments, an opening-portion side of a clothes dryer will be expressed as a front portion and a front surface, while its side opposite from the opening-portion side will be expressed as a rear portion and a rear side, in some cases.

FIRST EXEMPLARY EMBODIMENT

[0015] Fig. 1 is a schematic view of the structure of a clothes dryer according to a first exemplary embodiment of the present invention. Fig. 2 is a fragmentary view of the clothes dryer, taken along 2-2 in Fig. 1. Fig. 3 is a system diagram illustrating the general outline of a control device in the clothes dryer.

[0016] As shown in Fig. 1 to Fig. 3, the clothes dryer according to the present embodiment includes, in main body 1, at least rotary drum 2, motor 3, inner circumfer-

ential plate 7 having a pair of first electrodes 8 (hereinafter, referred to as first electrodes 8) and a pair of second electrodes 9 (hereinafter, referred to as second electrodes 9), and control unit 16.

[0017] As shown in Fig. 1 and Fig. 2, rotary drum 2 is shaped a substantially cylinder having a bottom (including a cylinder having a bottom) and is rotatably provided in main body 1 of the clothes dryer. Further, rotary drum 2 is driven to rotate around rotation axis 2a that is disposed in a substantially horizontal direction (including a horizontal direction), by motor 3 mounted on the rear surface of rotary drum 2. Motor 3, which is constituted by a brushless DC motor, for example, is controlled such that the speed of the rotation thereof can be freely changed, through inverter control.

[0018] As shown in Fig. 1, rotary drum 2 is provided, in its front-surface side, namely in the opposite side thereof from motor 3, with opening portion 4 for introducing and extracting clothes and the like (hereinafter, referred to as clothes) thereinto and therefrom, and this opening portion 4 is closed by openable door 5. On an inner peripheral side surface of rotary drum 2, there are provided, for example, a plurality of baffles 6 for stirring clothes, such that they protrude toward rotation axis 2a. Further, the clothes housed in rotary drum 2 are lifted up and stirred by baffles 6 provided in rotary drum 2, due to the rotation of rotary drum 2.

[0019] At a front portion of the inside of main body 1, there is provided inner circumferential plate 7 having an annular shape, for example, along the edge portion of opening portion 4, such that it faces opening portion 4 having a round shape which is provided in the front-surface side of rotary drum 2.

[0020] Further, as shown in Fig. 1, on the surface of rotary drum 2, at lower portions of inner circumferential plate 7, first electrodes 8 and second electrodes 9 are provided with a predetermined interval interposed therebetween, such that they come into contact with the clothes being stirred in rotary drum 2.

[0021] In this case, first electrodes 8 and second electrodes 9 are provided, such that they are different from each other, in terms of their positions on inner circumferential plate 7 or their electrode sizes or in terms of both of them. In other words, for example, first electrodes 8 and second electrodes 9 are formed, at different positions, to have respective shapes having different areas which come into contact with clothes. Further, first electrodes 8 and second electrodes 9 are provided, such that the first or second electrodes are provided at a lower portion of the inner circumferential plate which faces rotary drum 2, while the other electrodes, out of the first and second electrodes, are provided at an upper portion of the inner circumferential plate.

[0022] As shown in Fig. 2, more specifically, length L1 of first electrodes 8 in the circumferential direction of inner circumferential plate 7, namely in the direction of rotations of rotary drum 2, is made to be larger than length L2 of second electrodes 9.

[0023] Further, first electrodes 8 are provided with a predetermined interval interposed therebetween, at a lower portion of inner circumferential plate 7, namely, on vertical line A passing through rotation axis 2a of rotary drum 2. Further, second electrodes 9 are provided with a predetermined interval interposed therebetween, at a left portion of inner circumferential plate 7, namely on horizontal line B passing through rotation axis 2a of rotary drum 2. Thus, the clothes within rotary drum 2 come into contact with first electrodes 8 with a particularly higher frequency per unit time, while the clothes within rotary drum 2 come into contact with second electrodes 9 with a lower frequency per unit time. This can realize more accurate detection of the volume of the clothes.

[0024] Further, the placement and the shapes of first electrodes 8 and second electrodes 9 shown in Fig. 2 are particularly effective, for the direction of clockwise rotations of rotary drum 2. In cases of counterclockwise rotations, it is also possible to provide the same effects for the different direction of rotations of rotary drum 2, by providing second electrodes 9 at the opposite position across vertical line A.

[0025] Further, as shown in Fig. 1, control unit 16 is placed at an upper front portion of the inside of main body 1. Further, as shown in Fig. 3, control unit 16 is constituted by first resistance detection unit 10, second resistance detection unit 11, calculating unit 12, hot-air temperature control unit 13, quantity-of-circulated-air control unit 14, and drum rotation speed control unit 15. Control unit 16 turns on and off transistors 8B and 9B which are connected to plural first detection resistors 8A and plural second detection resistors 9A for changing over at least one of plural first detection resistors 8A or at least one of plural second detection resistors 9A for changing the degree of dryness set value to a desired value. Further, comparators 8C and 9C are caused to make comparisons between the resistance value of first electrodes 8 and the resistance value of first detection resistors 8A and between the resistance value of second electrodes 9 and the resistance value of second detection resistors 9A respectively, which enables control unit 16 to detect the degree of dryness of clothes. This enables drying clothes according to applications, such as courses for lower and higher rates of drying.

[0026] When damp clothes in rotary drum 2 contact with the intervals between first electrodes 8 and between second electrodes 9, they electrically conduct. The result of the comparison between the resistance value detected from first electrodes 8 and the resistance value of first detection resistors 8A is inputted to first resistance detection unit 10. The result of the comparison between the resistance value detected from second electrodes 9 and the resistance value of second detection resistors 9A is inputted to second resistance detection unit 11. On the contrary, if dry clothes come into contact with first electrodes 8 and second electrodes 9, they do not electrically conduct. Therefore, nothing is inputted to first resistance detection unit 10 and second resistance detection unit 11.

[0027] Signals of the results of the comparisons of data from first resistance detection unit 10 and second resistance detection unit 11 are inputted to calculating unit 12. Then, calculating unit 12 determines the degree of dryness of the clothes in rotary drum 2, based on at least one of the signals of the results of comparisons which have been inputted from first resistance detection unit 10 and second resistance detection unit 11. Further, when the determined degree of dryness is a desired degree of dryness, control unit 16 controls hot-air temperature control unit 13, quantity-of-circulated-air control unit 14 and drum rotation speed control unit 15. On the other hand, when it is not the desired degree of dryness, the drying of the clothes in rotary drum 2 is continued, until it is determined that the degree of dryness of the clothes is the desired degree of dryness.

[0028] At this time, hot-air temperature control unit 13 controls the temperature of drying air being heated by a heating portion (not illustrated), such as a heater. Further, quantity-of-circulated-air control unit 14 controls the quantity of drying air which is blown into rotary drum 2, through an air-blower portion (not illustrated), such as an air-blowing fan. Further, drum rotation speed control unit 15 controls a rotation speed of rotary drum 2 which is driven by motor 3.

[0029] With the aforementioned structure, the clothes dryer according to the present embodiment is capable of accurately detecting the degree of dryness of clothes in a stepwise manner and is capable of performing optimum drying operations by preventing excessive drying of clothes and insufficient drying of clothes.

[0030] Hereinafter, there will be described drying operations by the clothes dryer having the aforementioned structure, with respect to actions and effects thereof.

[0031] At first, if a drying operation is started, rotary drum 2 is rotated at a predetermined rotation speed with motor 3, and drying air at a predetermined temperature which has been heated by hot-air temperature control unit 13 is blown into rotary drum 2, by the air-blowing fan, through quantity-of-circulated-air control unit 14. Clothes introduced into rotary drum 2 are lifted up and stirred by baffles 6 due to the rotation action of rotary drum 2 and come into contact with the drying air to remove moisture therefrom, thereby carrying forward the drying.

[0032] When the clothes in rotary drum 2 come into contact with first electrodes 8 and second electrodes 9, this contact is detected as changes of the resistance values between first electrodes 8 and between second electrodes 9, due to the contact with the clothes containing moisture therewith. First resistance detection unit 10 makes a comparison, with comparator 8C, between the resistance value detected from first electrodes 8 and a predetermined resistance value of first detection resistors 8A which have been changed over through transistors 8B. Further, first resistance detection unit 10 counts the number of times the resistance value of first electrodes 8 has exceeded the predetermined resistance value of first detection resistors 8A. Similarly, second resist-

ance detection unit 11 makes a comparison, with comparator 9C, between the resistance value detected from second electrodes 9 and a predetermined resistance value of second detection resistors 9A which have been changed over through transistors 9B. Further, second resistance detection unit 11 counts the number of times the resistance value of second electrodes 9 has exceeded the predetermined resistance value of second detection resistors 9A.

[0033] If the number of counts per unit time is less than a predetermined value, it is determined that the clothes in rotary drum 2 are in a "damp state". Further, until the number of counts per unit time exceeds the predetermined value, drying air at a predetermined temperature is blown into rotary drum 2.

[0034] On the other hand, if the number of counts per unit time exceeds the predetermined value, it is determined that the clothes in rotary drum 2 are in a "dry state". Further, calculating unit 12 controls hot-air temperature control unit 13, quantity-of-circulated-air control unit 14 and drum rotation speed control unit 15. Further, calculating unit 12 detects the volume of the clothes in rotary drum 2, from the numbers of times first electrodes 8 and second electrodes 9 come into contact with the clothes in rotary drum 2 per unit time.

[0035] Next, hereinafter, with reference to Fig. 4 and Fig. 5, there will be described a method for detecting the volume of clothes in rotary drum 2 and the degree of dryness thereof.

[0036] Fig. 4 is a schematic view illustrating the change of the number of electrode detection data per unit time, with respect to the volume of clothes, in the clothes dryer. Fig. 5 is a schematic view illustrating the temporal changes of the resistance value between the electrodes and the number of electrode detection data per unit time, in the clothes dryer. In this case, "the number of electrode detection data per unit time" means the number(s) of times the resistance value(s) between first electrodes 8 and/or between second electrodes 9 has exceeded the predetermined resistance value of first detection resistors 8A and/or the predetermined resistance value of second detection resistors 9A per unit time, due to contact with clothes.

[0037] Fig. 4 illustrates number Wn of electrode detection data per unit time, with respect to volume Xn of clothes in rotary drum 2. Specifically, when the volume of the clothes in rotary drum 2 is a smaller volume, number Wd 17 of electrode detection data per unit time which is obtained from first electrodes 8 is smaller, and number We 18 of electrode detection data per unit time which is obtained from second electrodes 9 is also smaller. This enables making a determination that volume X1 of clothes is a smaller volume. This is caused by the fact that the clothes come into contact with both the electrodes with lower frequencies, regardless of which of first electrodes 8 and second electrodes 9 have a larger size and regardless of the placement of them, for example.

[0038] Further, when the volume of the clothes in rotary

drum 2 is a medium volume, number Wd 17 of electrode detection data per unit time which is obtained from first electrodes 8 is larger, while number We 18 of electrode detection data per unit time which is obtained from second electrodes 9 is smaller. This enables making a determination that volume X2 of clothes is a medium volume. This is caused by the fact that the clothes come into contact, with a higher frequency, with the electrodes having a larger size or the electrodes provided at positions which come into contact with clothes with higher frequencies, out of first electrodes 8 and second electrodes 9.

[0039] Further, when the volume of the clothes in rotary drum 2 is a larger volume, number Wd 17 of electrode detection data per unit time which is obtained from first electrodes 8 is larger, and number We 18 of electrode detection data per unit time which is obtained from second electrodes 9 is also larger. This enables making a determination that volume X3 of the clothes is a larger volume. This enables detecting the volume of the clothes in rotary drum 2 in three steps for smaller, medium and larger volumes, thereby enabling operations for drying clothes with higher efficiency according to the volume of clothes. This is caused by the fact that the clothes come into contact with both the electrodes with a higher frequency, regardless of which of first electrodes 8 and second electrodes 9 have a larger size and regardless of the placement of them, for example.

[0040] Next, Fig. 5 illustrates resistance value R 19 between a pair of electrodes and number Wn of electrode detection data per unit time, with respect to drying operation time t, wherein, when number Wn of electrode detection data has reached upper limit value Wmax, it is possible to detect that the clothes in rotary drum 2 are in a "dry state".

[0041] As shown in Fig. 5, at least one of plural first detection resistors 8A or at least one of plural second detection resistors 9A is changed over for changing the degree of dryness set value, according to the volume of clothes in rotary drum 2 and the desired degree of dryness of clothes at the start of an operation. For example, if number Wa 20 of electrode detection data per unit time reaches upper limit value Wmax at time t1, the degree of dryness of clothes is determined to be about 85%. Further, if number Wb 21 of electrode detection data per unit time reaches upper limit value Wmax at time t2, the degree of dryness of clothes is determined to be about 90%. Further, if number Wc 22 of electrode detection data per unit time reaches upper limit value Wmax at time t3, the degree of dryness of clothes is determined to be about 95%. This enables detecting the degree of dryness of the clothes in rotary drum 2 in plural steps (rates of drying), thereby enabling optimum drying operations by preventing excessive drying of clothes and insufficient drying of clothes.

[0042] As described above, in the clothes dryer according to the present embodiment, first electrodes 8 and second electrodes 9 are provided, such that they come

into contact with the clothes in rotary drum 2 different numbers of times per unit time. Further, at the start of a drying operation, calculating unit 12 performs a calculation for making a comparison between signals from first resistance detection unit 10 and second resistance detection unit 11 for detecting the volume of clothes in steps for larger and smaller volumes. Further, at least one of plural first detection resistors 8A or at least one of plural second detection resistors 9A is changed over according to the volume of clothes and the desired degree of dryness of clothes at the start of the operation. This enables setting the degree of dryness of clothes being subjected to the drying operation in steps for damp states and dry states. As a result thereof, it is possible to perform optimum drying operations, by preventing excessive drying and insufficient drying of clothes and the like.

[0043] Further, while, in the present embodiment, there has been described a case where the resistance values of first detection resistors 8A and second detection resistors 9A are set, such that the rates of drying of clothes are detected to be 85%, 90% and 95%, for numbers Wa 20, Wb 21 and Wc 22 of electrode detection data per unit time, respectively, the present invention is not limited thereto. The degree of dryness range can be arbitrarily set, by changing the resistance values of first detection resistors 8A and second detection resistors 9A according to applications. This enables detecting the degree of dryness in a stepwise manner according to applications and performing drying operations with arbitrary rates of drying.

[0044] Further, while, in the present embodiment, the degree of dryness of the clothes in rotary drum 2 is detected based on signals from first resistance detection unit 10 and second resistance detection unit 11, the present invention is not limited thereto. The degree of dryness of the clothes in rotary drum 2 can be detected, based on at least one of signals from first resistance detection unit 10 and second resistance detection unit 11. This enables accurately detecting the degree of dryness of clothes in a stepwise manner, thereby enabling optimum drying operations by preventing excessive drying of clothes and insufficient drying of clothes.

SECOND EXEMPLARY EMBODIMENT

[0045] Fig. 6 is a system diagram illustrating a general outline of a control device in a clothes dryer according to a second exemplary embodiment of the present invention. The present embodiment is different from the first exemplary embodiment, in that the resistance value detected from first electrodes 8 is directly inputted to first resistance detection unit 10, the resistance value detected from second electrodes 9 is directly inputted to second resistance detection unit 11, and the results thereof are inputted to frequency detection unit 27. Frequency detection unit 27 analyzes frequency components of signals detected by first resistance detection unit 10 and second resistance detection unit 11 and, based on the result

thereof, detects the degree of dryness of the clothes in rotary drum 2. Further, the other structures are the same as those in the first exemplary embodiment, and the detailed description of the first exemplary embodiment is used herein.

[0046] As shown in Fig. 6, the change of the resistance value between first electrodes 8 due to contact with clothes is detected by first resistance detection unit 10. The change of the resistance value between second electrodes 9 due to contact with clothes is detected by second resistance detection unit 11. Further, when damp clothes in rotary drum 2 come into contact with first electrodes 8 and second electrodes 9, they electrically conduct, and the changes of the resistance values between first electrodes 8 and between second electrodes 9 are inputted, as signals, to first resistance detection unit 10 and second resistance detection unit 11, respectively.

[0047] In this case, first resistance detection unit 10 and second resistance detection unit 11 are connected to frequency detection unit 27. Frequency detection unit 27 is constituted by first low-pass filter 23, second low-pass filter 24, signal waveform synthesis unit 25, and frequency analysis unit 26 which is connected at one side to signal waveform synthesis unit 25 and also is connected at the other side to calculating unit 12.

[0048] First low-pass filter 23 in frequency detection unit 27 is connected to first resistance detection unit 10, while second low-pass filter 24 in frequency detection unit 27 is connected to second resistance detection unit 11. Further, output signal 10A from first resistance detection unit 10 and output signal 11A from second resistance detection unit 11 are inputted to first low-pass filter 23 and second low-pass filter 24, respectively. However, the clothes in rotary drum 2 come into contact with first electrodes 8 and second electrodes 9 with non-constant frequencies per unit time, due to the shapes of the clothes (the degree of entanglements thereamong). Therefore, output signal 10A from first resistance detection unit 10 and output signal 11A from second resistance detection unit 11 have signal waveforms containing high-frequency components.

[0049] To cope therewith, using first low-pass filter 23 and second low-pass filter 24, the high-frequency components in output signal 10A from first resistance detection unit 10 and output signal 11A from second resistance detection unit 11 are attenuated. This enables extracting only certain frequency components except high-frequency components, as output signal 23A from first low-pass filter 23 and output signal 24A from second low-pass filter 24.

[0050] Output signal 23A and output signal 24A from first low-pass filter 23 and second low-pass filter 24, which are connected to signal waveform synthesis unit 25, are inputted to signal waveform synthesis unit 25. Further, output signal 23A and output signal 24A are synthesized in waveform, and signal waveform synthesis unit 25 outputs output signal 25A therefrom to frequency analysis unit 26.

[0051] Further, frequency analysis unit 26 outputs, to calculating unit 12, output signal 26A resulted from frequency analyses. Calculating unit 12 receives output signal 26A from frequency analysis unit 26 and performs calculations for determining frequency components and amplitude components therefrom. This enables determining the state of the clothes in rotary drum 2, as will be described later.

[0052] Next, hereinafter, there will be described a method for detecting the volume of clothes in rotary drum 2 and the degree of dryness thereof.

[0053] Figs. 7A to 7C are output signal diagrams resulted from frequency analyses on signals, in a case where the clothes in the rotary drum have a larger volume, in the clothes dryer. Figs. 7A to 7C illustrate examples of output signal values resulted from frequency analyses on detection signals from plural first electrodes 8 and plural second electrodes 9, in a case where the clothes in rotary drum 2 have a larger volume. Fig. 7A illustrates output signal value 28 just after the start of an operation, Fig. 7B illustrates output signal value 29 when the degree of dryness is about 90%, and Fig. 7C illustrates output signal value 30 when the degree of dryness is about 100%. Further, when there is no clothes in rotary drum 2 or when dry clothes come into contact with first electrodes 8 and second electrodes 9, first electrodes 8 and second electrodes 9 do not electrically conduct, since there is no moisture. Therefore, nothing is inputted to first resistance detection unit 10 and second resistance detection unit 11, which enables making a determination that there is no clothes in rotary drum 2 or the clothes in rotary drum 2 are dried.

[0054] As shown in Fig. 7A, in the case where the clothes have a larger volume, components of higher frequencies f_2 and f_3 (wherein frequencies f satisfy the relationship of $f_1 < f_2 < f_3$, in Figs. 7A to 7C) are detected, in output signal value 28, just after the start of the operation. This is because, just after the start of the operation (the clothes are in a damp state), the clothes come into contact with first electrodes 8 and second electrodes 9, and first electrodes 8 and second electrodes 9 electrically conduct with higher frequencies per unit time.

[0055] Further, as shown in Fig. 7B, in the case where the clothes have a larger volume, only a component of lower frequency f_1 is detected, in output signal value 29, when the degree of dryness is about 90%. This is because, for example, when the clothes have been dried with a degree of dryness of about 90%, even when the clothes come into contact with first electrodes 8 and second electrodes 9, first electrodes 8 and second electrodes 9 electrically conduct with lower frequencies per unit time, in comparison with those just after the start of the operation.

[0056] Further, as shown in Fig. 7C, in the case where the clothes have a larger volume, frequency components are no longer detected, in output signal value 30, when the degree of dryness is about 100%. This is because, for example, when the clothes have been dried with a

degree of dryness of about 100%, first electrodes 8 and second electrodes 9 no longer electrically conduct, even when the clothes come into contact with first electrodes 8 and second electrodes 9.

[0057] As described above, with the clothes dryer according to the present embodiment, in cases where the clothes in rotary drum 2 have a larger volume, the output signal values resulted from frequency analyses on the detection signals from plural first electrodes 8 and plural second electrodes 9 are varied, according to the degree of proceeding of drying operations (the degree of dryness of clothes). This enables determining the state of drying of clothes in rotary drum 2.

[0058] Figs. 8A to 8C are output signal diagrams resulted from frequency analyses on signals, in a case where the clothes in the rotary drum have a smaller volume, in the clothes dryer. Figs. 8A to 8C illustrate examples of output signal values resulted from frequency analyses on detection signals from plural first electrodes 8 and plural second electrodes 9, in a case where the clothes in the rotary drum 2 have a smaller volume.

[0059] As shown in Fig. 8A, in the case where the clothes have a smaller volume, components of lower frequencies f_1 and f_2 (wherein frequencies f satisfy the relationship of $f_1 < f_2 < f_3$, in Figs. 8A to 8C) are detected, in output signal value 31, just after the start of an operation, in comparison with cases where the clothes have a larger volume. This is because, just after the start of the operation (the clothes are in a damp state), the clothes come into contact with first electrodes 8 and second electrodes 9, and first electrodes 8 and second electrodes 9 electrically conduct with lower frequencies per unit time.

[0060] Further, as shown in Fig. 8B, in the case where the clothes have a smaller volume, only a component of lower frequency f_1 is detected, in output signal value 32, when the degree of dryness is about 90%. This is because, for example, when the clothes in rotary drum 2 have been dried with a degree of dryness of about 90%, even when the clothes come into contact with first electrodes 8 and second electrodes 9, first electrodes 8 and second electrodes 9 electrically conduct with lower frequencies per unit time, in comparison with those just after the start of the operation.

[0061] As shown in Fig. 8C, in the case where the clothes have a smaller volume, frequency components are no longer detected, in output signal value 30, when the degree of dryness is about 100%. This is because, for example, when the clothes have been dried with a degree of dryness of about 100%, first electrodes 8 and second electrodes 9 no longer electrically conduct, even when the clothes come into contact with first electrodes 8 and second electrodes 9.

[0062] As described above, with the clothes dryer according to the present embodiment, in cases where the clothes in rotary drum 2 have a smaller volume, the output signal values resulted from frequency analyses on the detection signals from a pair of first electrodes 8 and a pair of second electrodes 9 are varied, according to the

degree of proceeding of drying operations (the degree of dryness of clothes). This enables determining the state of drying of the clothes in rotary drum 2.

[0063] Hereinafter, there will be described the change of frequencies, due to the variations of the volume of clothes and the degree of dryness thereof.

[0064] Fig. 9A is an output signal diagram resulted from frequency analyses on signals, when the degree of dryness is about 60%, in a case where the clothes in the rotary drum have a larger volume, in the clothes dryer. Fig. 9B is an output signal diagram resulted from frequency analyses on signals, when the degree of dryness is about 80%, in a case where the clothes in the rotary drum have a larger volume, in the clothes dryer. Fig. 9C is an output signal diagram resulted from frequency analyses on signals, when the degree of dryness is about 60%, in a case where the clothes in the rotary drum have a smaller volume, in the clothes dryer. Fig. 9D is an output signal diagram resulted from frequency analyses on signals, when the degree of dryness is about 80%, in a case where the clothes in the rotary drum have a smaller volume, in the clothes dryer.

[0065] Figs. 9A to 9D illustrate examples of output signal values resulted from frequency analyses on detection signals from plural first electrodes 8 and plural second electrodes 9, with respect to the variations of the volume of clothes in rotary drum 2 and the state of drying thereof. In this case, output value y_1 refers to a relative electric current value resulted from dividing the voltage by the detected resistance.

[0066] As shown in Fig. 9A, in the case where the clothes have a larger volume, when the degree of dryness thereof is about 60% just after the start of an operation, components of higher frequencies f_2 and f_3 (wherein frequencies f satisfy the relationship of $f_1 < f_2 < f_3$, in Figs. 9A to 9D) are detected and, also, larger output value y_1 (wherein output values y satisfy the relationship of $y_1 > y_2$ in Fig. 9A to Fig. 9D) is detected, in output signal value 34 relating to frequencies. This is because, for example, in the case where the clothes have a larger volume and are in a damper state where the degree of dryness thereof is about 60%, the clothes come into contact with first electrodes 8 and second electrodes 9, and first electrodes 8 and second electrodes 9 electrically conduct with higher frequencies per unit time, and smaller resistance values are detected between the pair of first electrodes 8 and between the pair of second electrodes 9, due to the lower degree of dryness and the larger amount of moisture.

[0067] As shown in Fig. 9B, in the case where the clothes have a larger volume, when the degree of dryness thereof is about 80% just after the start of an operation, components of higher frequencies f_2 and f_3 are detected and, also, smaller output value y_2 is detected, in output signal value 35 relating to frequencies. This is because, for example, when the clothes have a larger volume and are in a dryer state where the degree of dryness thereof is about 80%, the clothes come into contact with plural

first electrodes 8 and plural second electrodes 9, and first electrodes 8 and second electrodes 9 electrically conduct with higher frequencies per unit time, and larger resistance values are detected between first electrodes 8 and between second electrodes 9, due to the higher degree of dryness and the smaller amount of moisture.

[0068] As shown in Fig. 9C, in the case where the clothes have a smaller volume, when the degree of dryness thereof is about 60% just after the start of an operation, components of lower frequencies f1 and f2 are detected and, also, larger output value y1 is detected, in output signal value 36 relating to frequencies. This is because, for example, when the clothes have a smaller volume and are in a damper state where the degree of dryness thereof is about 60%, the clothes come into contact with plural first electrodes 8 and plural second electrodes 9, and first electrodes 8 and second electrodes 9 electrically conduct with lower frequencies per unit time, and smaller resistance values are detected between first electrodes 8 and between second electrodes 9, due to the lower degree of dryness and the larger amount of moisture.

[0069] As shown in Fig. 9D, in the case where the clothes have a smaller volume, when the degree of dryness thereof is about 80% just after the start of an operation, components of lower frequencies f1 and f2 are detected and, also, smaller output value y2 is detected, in output signal value 37 relating to frequencies. This is because, for example, when the clothes have a smaller volume and are in a dryer state where the degree of dryness thereof is about 80%, the clothes come into contact with plural first electrodes 8 and plural second electrodes 9, and first electrodes 8 and second electrodes 9 electrically conduct with lower frequencies per unit time, and larger resistance values are detected between first electrodes 8 and between second electrodes 9, due to the higher degree of dryness and the smaller amount of moisture.

[0070] As described above, with the clothes dryer according to the present invention, respective detection signals from first electrodes 8 and second electrodes 9 are synthesized by signal waveform synthesis unit 25, and the synthesized signal waveform is subjected to frequency analyses by frequency analysis unit 26, in order to determine the state of drying of the clothes in rotary drum 2. This enables detecting the degree of dryness of the clothes in rotary drum 2 in a stepwise manner and, thus, enables performing optimum drying operations by preventing excessive drying of clothes and insufficient drying of clothes.

[0071] Further, while, in the present embodiment, there has been described a case where first low-pass filter 23 and second low-pass filter 24 are employed, the present invention is not limited thereto. In cases where there are a smaller amount of high-frequency components, it is not necessary to employ first low-pass filter 23 and second low-pass filter 24. This enables detecting the degree of dryness of the clothes in rotary drum 2 with a simpler structure.

[0072] While, in the aforementioned first and second exemplary embodiments, the placement of the electrodes in Fig. 2 has been described, it is also possible to employ the placement shown in Figs. 10 to 12. Therefore, with reference to Figs. 10 to 12, there will be described other examples of the placement of the electrodes.

[0073] Figs. 10 to 12 are fragmentary views of other examples of electrodes in the clothes dryer, taken along 2-2 in Fig. 1.

[0074] As shown in Fig. 10, first electrodes 8 and second electrodes 9 are formed, at different positions, to have respective areas with different sizes which come into contact with clothes. More specifically, length L3 of first electrodes 8 in the circumferential vertical direction of inner circumferential plate 7, namely length L3 thereof in the radial direction of rotary drum 2, is made to be larger than length L4 of second electrodes 9. Thus, the clothes in rotary drum 2 come into contact with the intervals between the respective pairs of electrodes at different numbers of times per unit time, thereby enabling detecting the volume of the clothes and the degree of dryness thereof in a stepwise manner.

[0075] Next, as shown in Fig. 11, first electrodes 8 and second electrodes 9 are provided at different positions on inner circumferential plate 7 which faces rotary drum 2. First electrodes 8 are provided at a lower portion of inner circumferential plate 7, namely below the horizontal line passing through rotation axis 2a of rotary drum 2. Second electrodes 9 are provided at an upper portion of inner circumferential plate 7, namely above the horizontal line passing through rotation axis 2a of rotary drum 2.

[0076] Further, first electrodes 8 are provided at a left portion of the inner circumferential plate, namely in the left side with respect to the vertical line passing through rotation axis 2a of rotary drum 2. Second electrodes 9 are provided at a right portion of inner circumferential plate 7, namely in the right side with respect to the vertical line passing through rotation axis 2a of rotary drum 2.

[0077] This can cause the clothes in rotary drum 2 to come into contact therewith at different numbers of times per unit time, which enables detecting the volume of clothes in steps for larger and smaller volumes and, also, enables detecting the degree of dryness of clothes in a stepwise manner.

[0078] As shown in Fig. 12, first electrodes 8 and second electrodes 9 are formed, at different positions, to have respective areas with different sizes which come into contact with clothes. More specifically, as shown in Fig. 12, length L1 of first electrodes 8 in the circumferential horizontal direction of inner circumferential plate 7, namely in the direction of rotations of rotary drum 2, is made to be larger than length L2 of second electrodes 9. Thus, the clothes in rotary drum 2 come into contact with the intervals between the respective pairs of electrodes at different numbers of times per unit time, thereby enabling detecting the volume of the clothes and the degree of dryness thereof in a stepwise manner.

[0079] Further, while, in the aforementioned embodi-

ments, the shapes of first electrodes 8 and second electrodes 9 are rectangular shapes, their shapes are not limited thereto. For example, first electrodes 8 and second electrodes 9 can be formed to have arc shapes along the edge portion of opening portion 4 which is centered on rotation axis 2a. This can increase their areas which come into contact with clothes.

[0080] Further, the present invention is also applicable to drum washers having functions of the clothes dryers which have been described in the aforementioned embodiments. This enables performing a series of actions from washing to drying, with a single drum washer, thereby enabling efficiently performing washing and drying of clothes. Further, other actions (such as washing, rinsing, dewatering) than drying operations are the same as conventional actions and will not be described herein.

Claims

1. A clothes dryer comprising
 - a rotary drum provided rotatably in a main body;
 - a motor adapted to drive the rotary drum;
 - an inner circumferential plate provided at a front portion of the main body;
 - a pair of first electrodes and a pair of second electrodes provided on the inner circumferential plate, such that the electrodes come into contact with clothes in the rotary drum; and
 - a control unit including at least a first resistance detection unit for detecting a change of a resistance value between the pair of first electrodes due to contact with the clothes in the rotary drum, a second resistance detection unit for detecting a change of a resistance value between the pair of second electrodes due to contact with the clothes in the rotary drum, and a calculating unit connected to the first resistance detection unit and the second resistance detection unit for calculating a degree of dryness of the clothes in the rotary drum, based on at least one of signals from the first resistance detection unit and the second resistance detection unit.
2. The clothes dryer according to claim 1, wherein the calculating unit performs calculation of a volume of the clothes in the rotary drum, based on a result of comparison of data from the first resistance detection unit and the second resistance detection unit.
3. The clothes dryer according to claim 2, wherein the first resistance detection unit receives a result of comparison between a resistance value detected by the pair of first electrodes and a resistance value of a first detection resistor, the second resistance detection unit receives a result of comparison between a resistance value detected by the pair of second electrodes and a resistance value of a second detection resistor, and

the calculating unit performs the calculation based on the results of comparisons from the first resistance detection unit and the second resistance detection unit.

4. The clothes dryer according to claim 3, wherein the calculating unit determines that the clothes in the rotary drum are large in the volume, when numbers of times per unit time that the pair of first electrodes and the pair of second electrodes come into contact with the clothes in the rotary drum are comparatively large, the calculating unit determines that the clothes in the rotary drum are moderate in the volume, when a number of times per unit time that the pair of first electrodes come into contact with the clothes in the rotary drum is comparatively large, but a number of times per unit time that the pair of second electrodes come into contact with the clothes in the rotary drum is comparatively small, and the calculating unit determines that the clothes in the rotary drum are small in the volume, when numbers of times per unit time that the pair of first electrodes and the pair of second electrodes come into contact with the clothes in the rotary drum are comparatively small.
5. The clothes dryer according to claim 3, wherein at least one of the first detection resistor and the second detection resistor is one of a plurality of resistors.
6. The clothes dryer according to claim 5, wherein the control unit changes a setting value of the degree of dryness by selecting at least one of the plurality of first detection resistors or at least one of the plurality of second detection resistors according to the volume of the clothes in the rotary drum and the degree of dryness of the clothes at the start of an operation.
7. The clothes dryer according to claim 1, wherein the control unit further includes a frequency detection unit for performing a frequency analysis on the changes in the resistance values detected by the first resistance detection unit and the second resistance detection unit, and the frequency detection unit detects the degree of dryness of the clothes in the rotary drum based on components of the detected frequencies.
8. The clothes dryer according to claim 7, wherein the frequency detection unit includes a signal waveform synthesis unit connected to the first resistance detection unit and the second resistance detection unit, and a frequency analysis unit having one side connected to the signal waveform synthesis unit and the other side connected to the calculating unit,

the signal waveform synthesis unit combines individually detected signals of the first resistance detection unit and the second resistance detection unit, and

the frequency analysis unit performs a frequency analysis on a waveform of the signal combined by the signal waveform synthesis unit, and detects the degree of dryness of the clothes in the rotary drum in a stepwise manner during a drying operation.

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9. The clothes dryer according to claim 7, wherein the calculating unit detects amplitudes of the components of the frequencies obtained by the frequency analysis of the frequency analysis unit, and calculates the degree of dryness of the clothes in the rotary drum, based on a result of detection data from the frequency analysis unit.

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10. The clothes dryer according to claim 9, wherein the calculating unit determines that there is no clothes in the rotary drum or the drying has been completed when the calculating unit does not detect any amplitude of the components, and the control units stops the operation.

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11. The clothes dryer according to claim 7, wherein the calculating unit detects a volume of the clothes in the rotary drum according to the components of the frequencies obtained by the frequency analysis of the frequency analysis unit.

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12. The clothes dryer according to claim 11, wherein the calculating unit determines that the clothes in the rotary drum are large in the volume when higher frequency components constitute a large proportion in the components of the frequencies, and the clothes in the rotary drum are small in the volume when the higher frequency components constitute a small proportion in the components of the frequencies.

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13. The clothes dryer according to claim 1, wherein the pair of first electrodes and the pair of second electrodes are different from each other in any or both of their positions on the inner circumferential plate and the electrode sizes.

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14. The clothes dryer according to claim 13, wherein the pair of first electrodes and the pair of second electrodes are formed different from each other in any of the lengths in a circumferential direction and the lengths in a radial direction of the inner circumferential plate.

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15. The clothes dryer according to claim 13, wherein either of the pair of first electrodes and the pair of second electrodes are provided at a lower portion of the inner circumferential plate facing the rotary drum, and the other pair of electrodes are provided at an

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upper portion of the inner circumferential plate.

FIG. 1

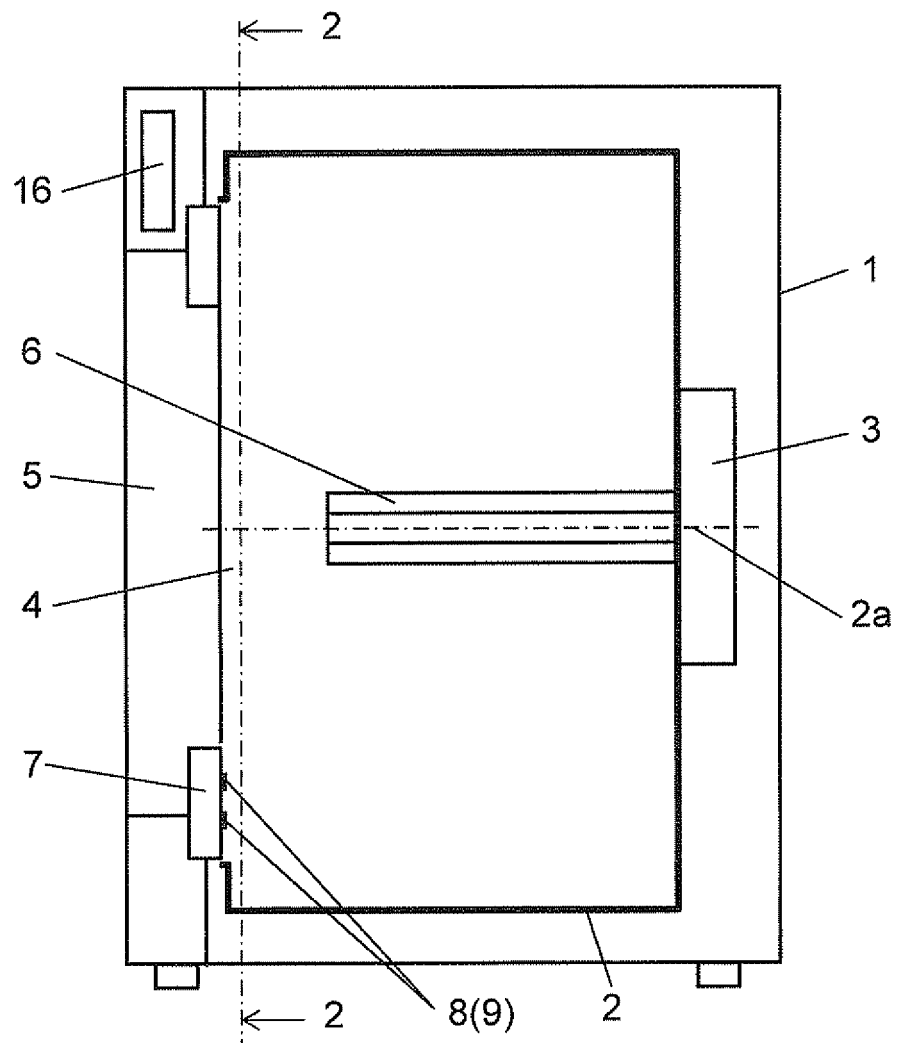


FIG. 2

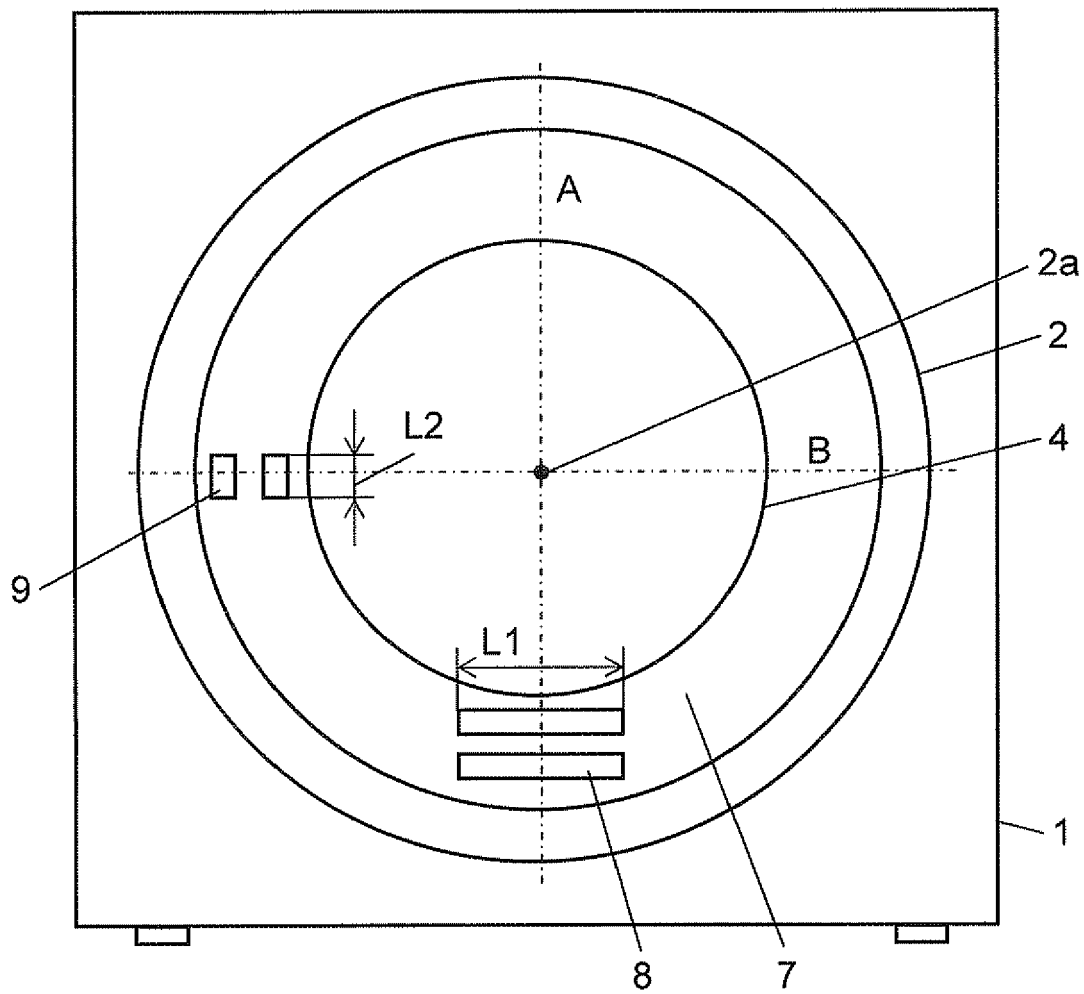


FIG. 3

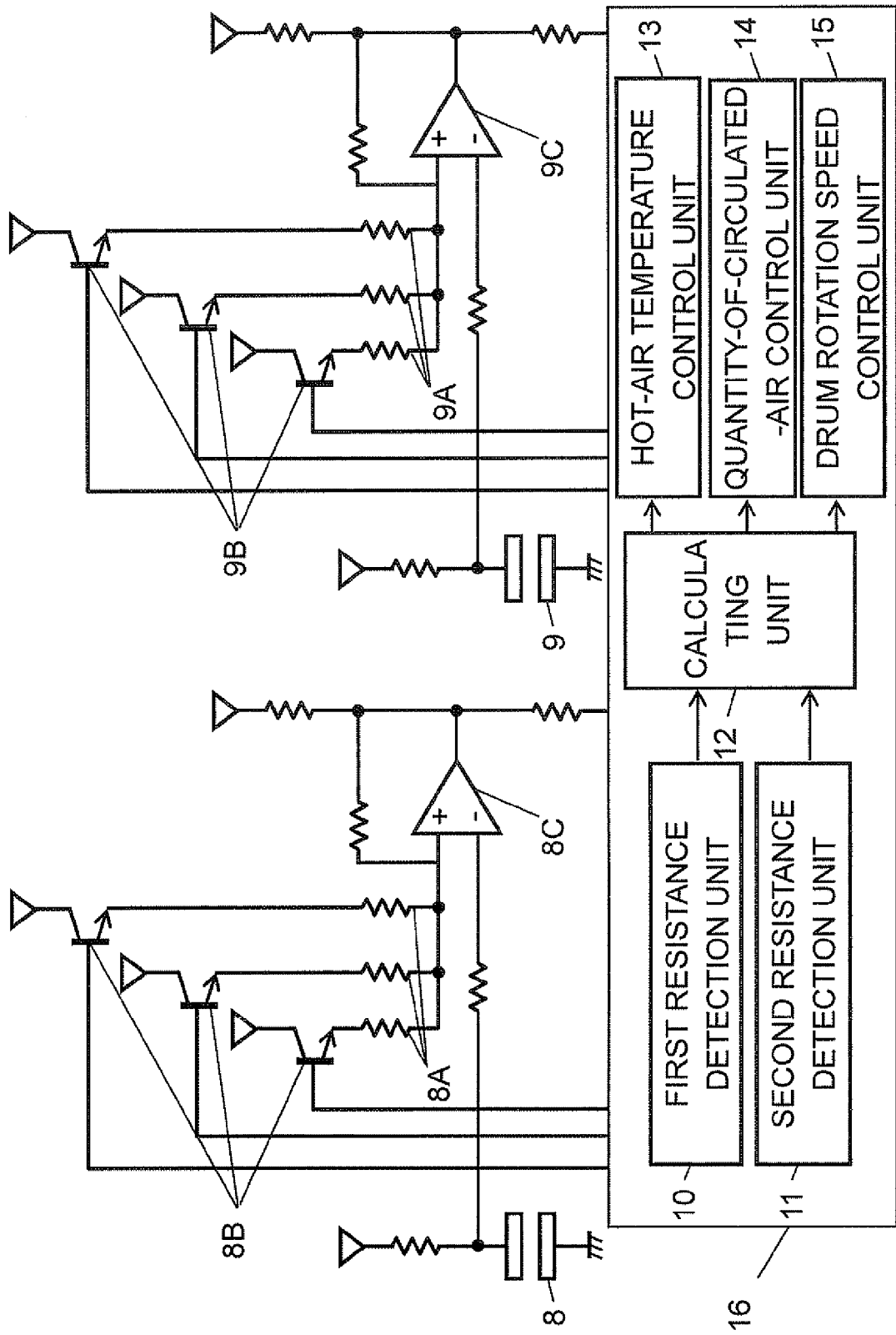


FIG. 4

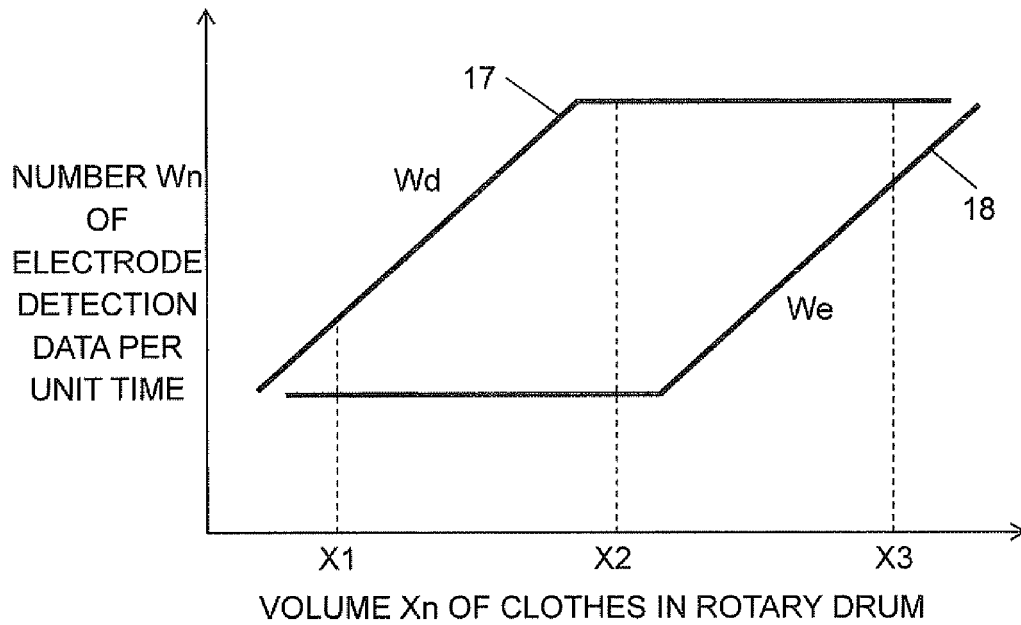


FIG. 5

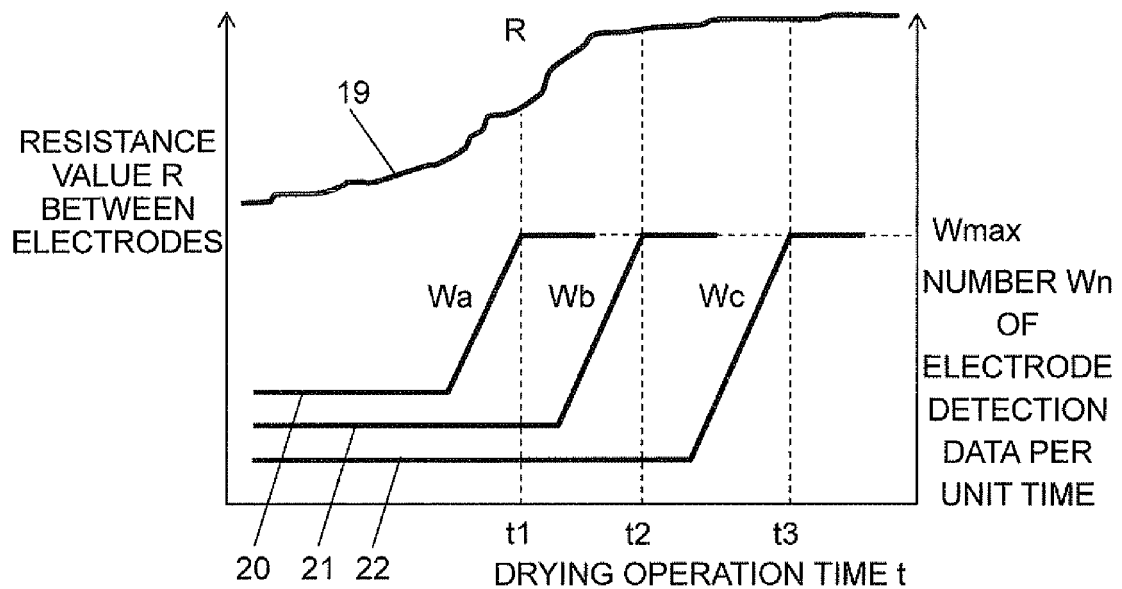


FIG. 6

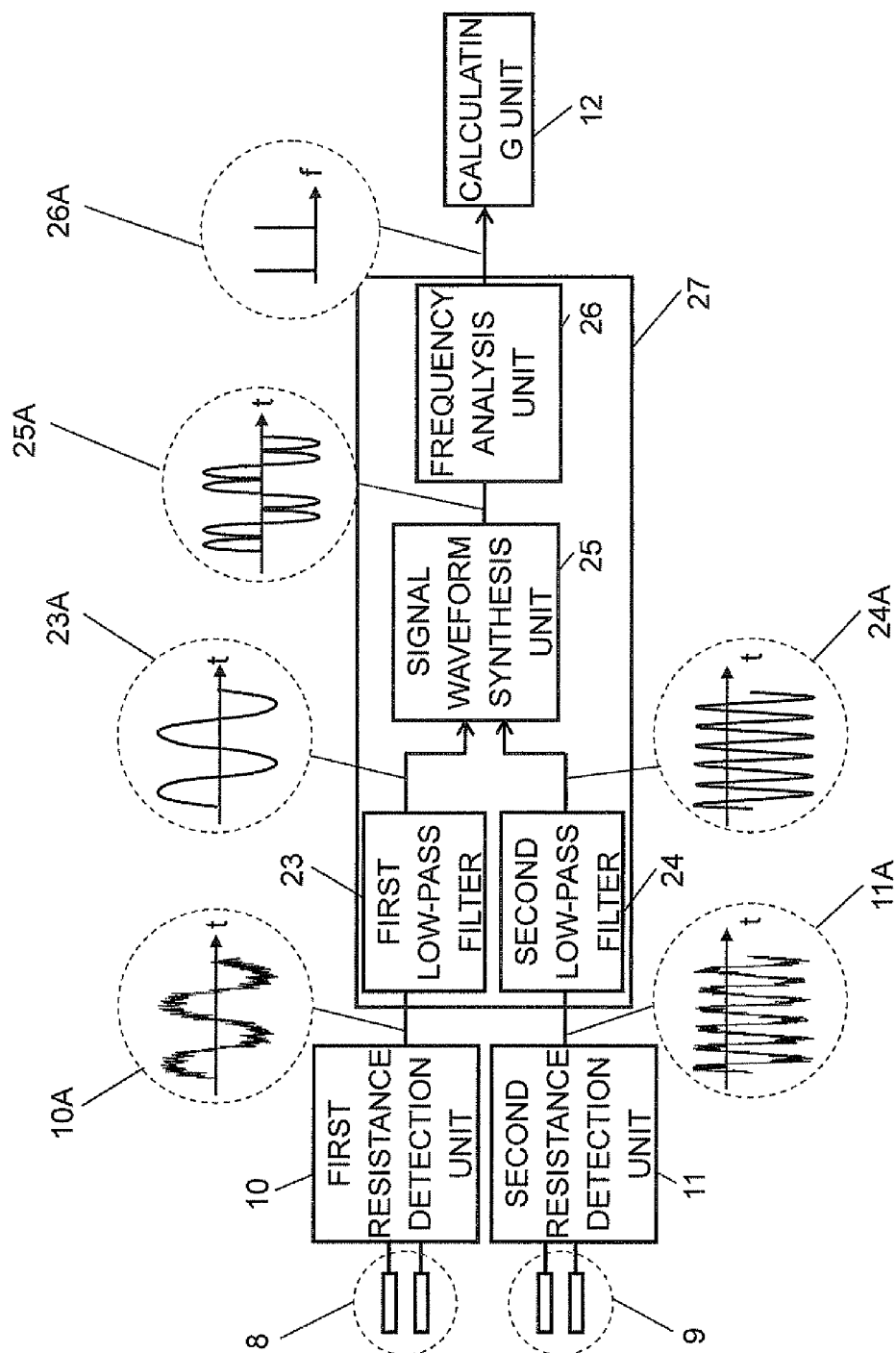


FIG. 7A

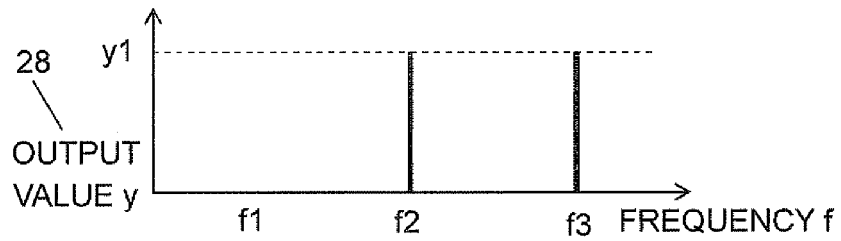


FIG. 7B



FIG. 7C



FIG. 8A

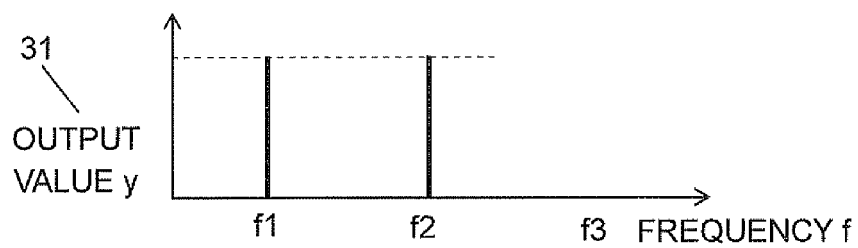


FIG. 8B

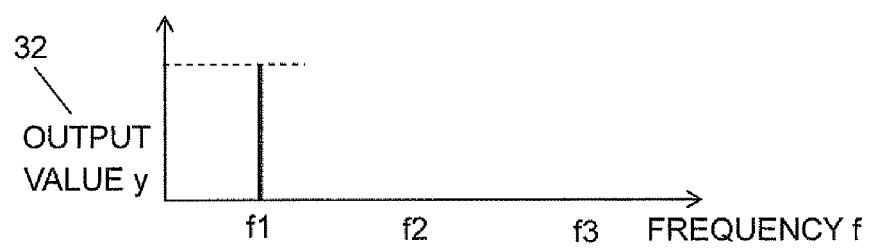
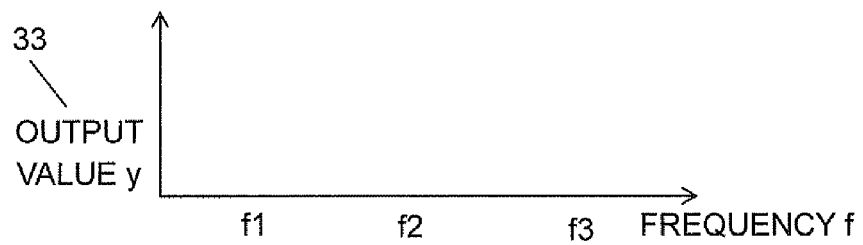


FIG. 8C



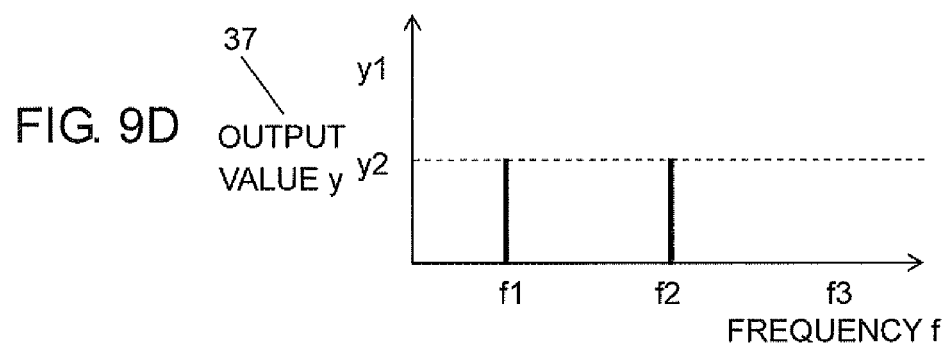
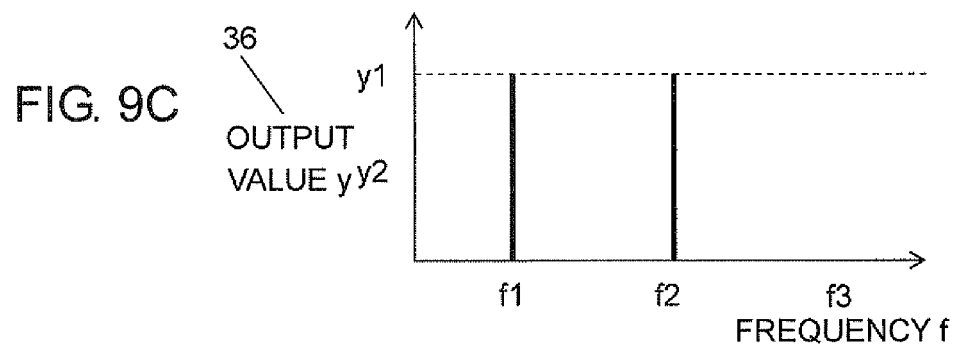
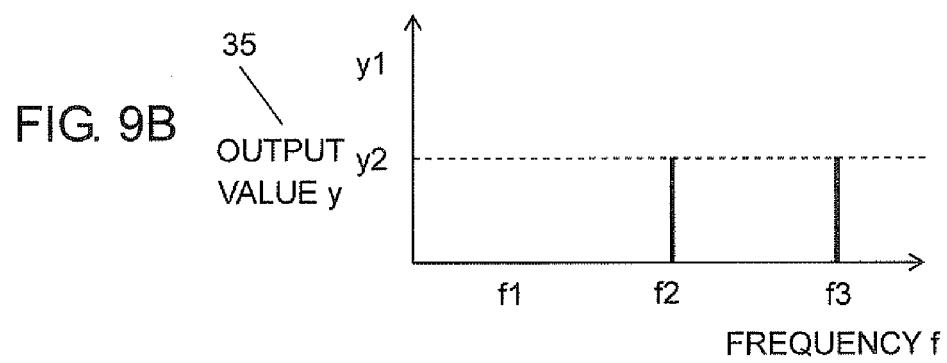
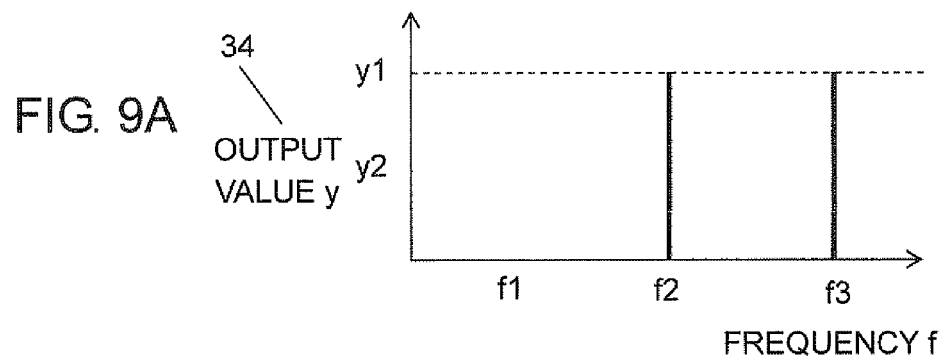


FIG. 10

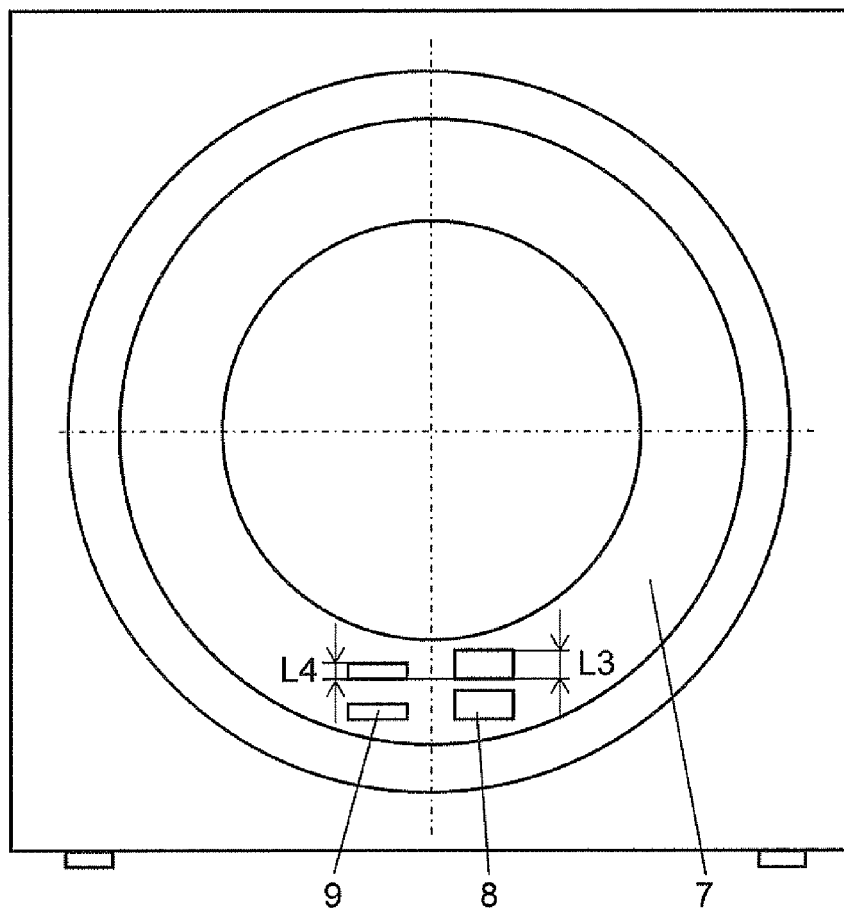


FIG. 11

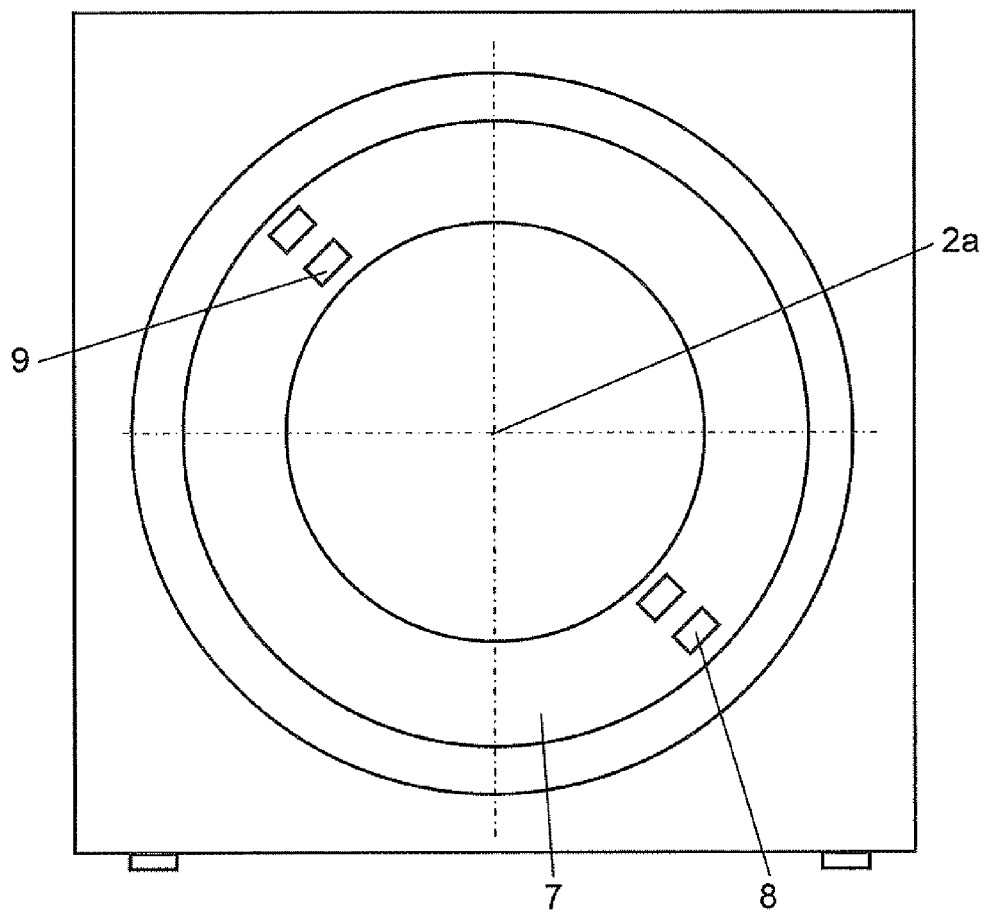


FIG. 12

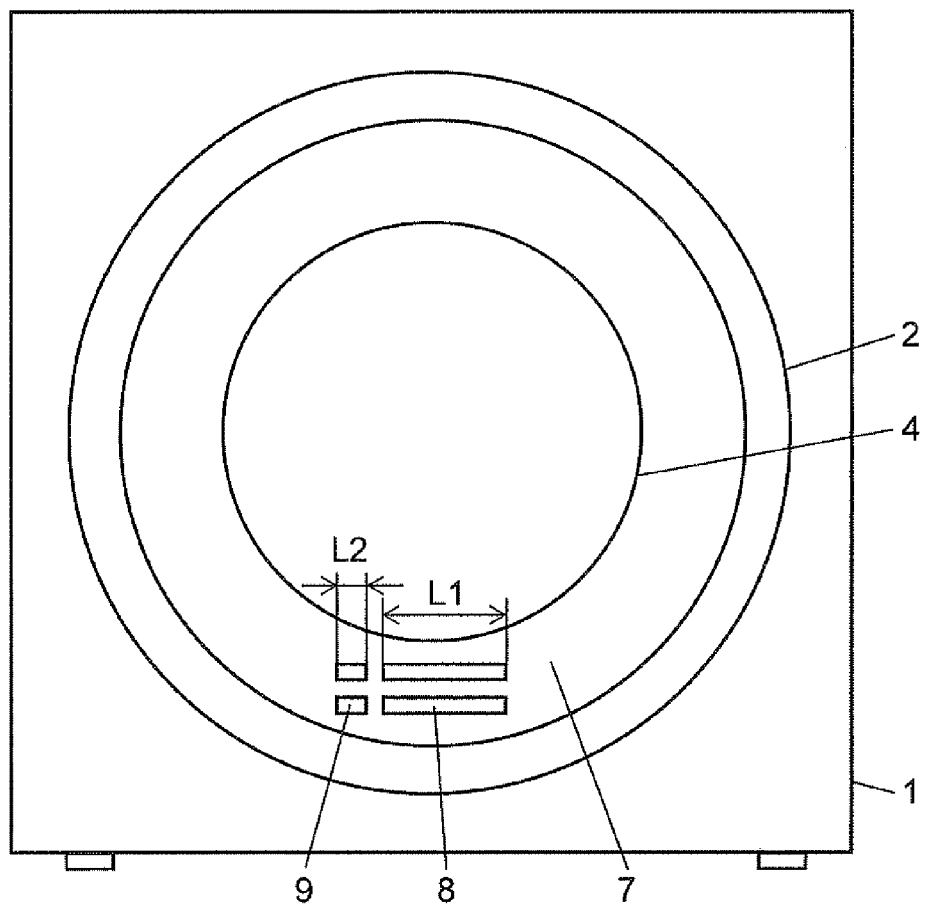


FIG. 13

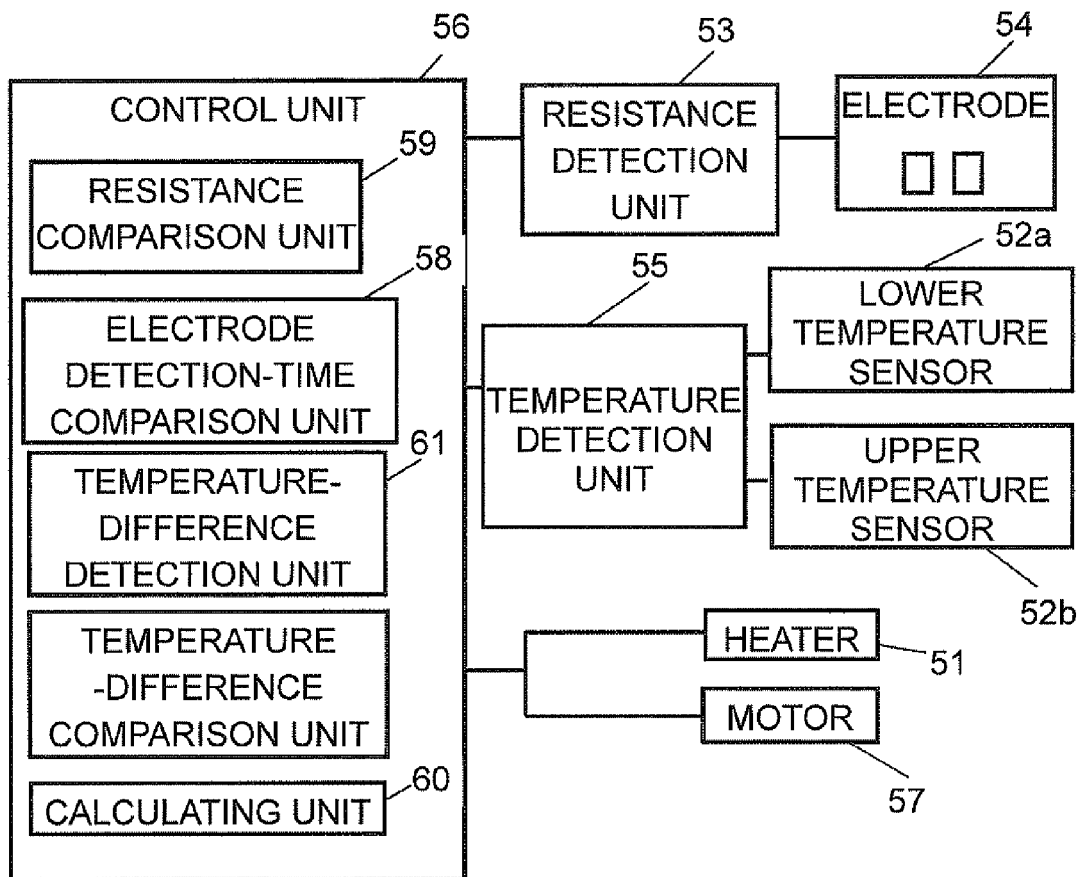
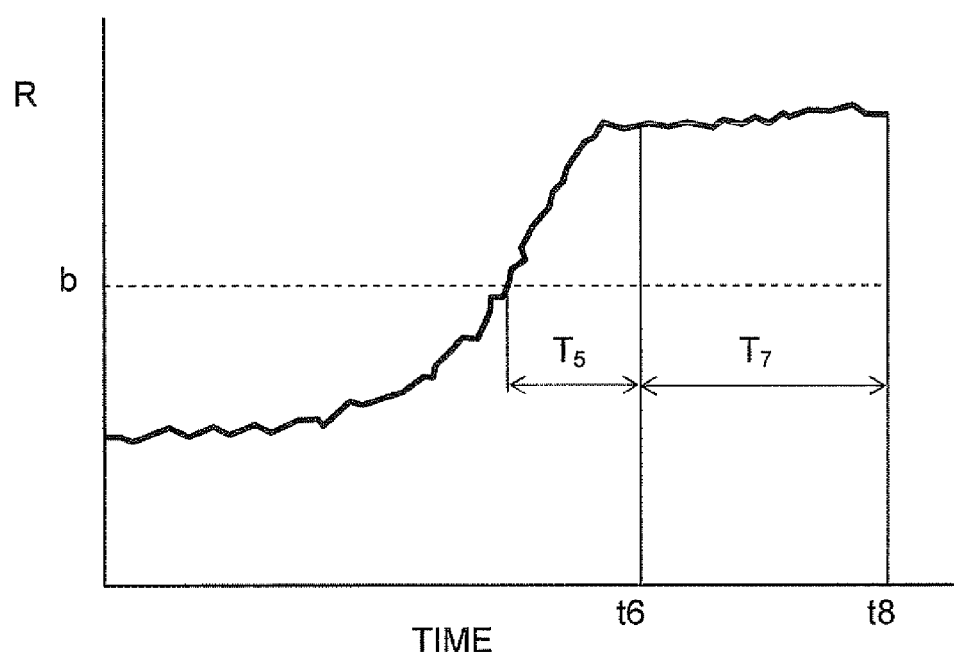


FIG. 14





EUROPEAN SEARCH REPORT

Application Number
EP 11 17 7888

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2006/230632 A1 (CHILES HOWELL H [US] ET AL) 19 October 2006 (2006-10-19) * paragraph [0028]; figures 1, 2 *	1,5	INV. D06F58/28
A	EP 1 657 352 A1 (SAMSUNG ELECTRONICS CO LTD [KR]) 17 May 2006 (2006-05-17) * paragraphs [0024], [0033], [0034]; figures 3, 6 *	1-15	
A	EP 0 226 209 A2 (TOSHIBA KK [JP]) 24 June 1987 (1987-06-24) * column 4, line 53 - line 55 * * column 5, line 4 - line 9 * * column 5, line 31 - line 38; figure 3 *	1-15	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			D06F
Place of search		Date of completion of the search	Examiner
Munich		15 November 2011	Westermayer, Wilhelm
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 11 17 7888

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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15-11-2011

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2006230632 A1	19-10-2006	CA 2539144 A1	18-10-2006
		US 2006230632 A1	19-10-2006

EP 1657352 A1	17-05-2006	CN 1773007 A	17-05-2006
		EP 1657352 A1	17-05-2006
		KR 20060044041 A	16-05-2006
		US 2006096117 A1	11-05-2006

EP 0226209 A2	24-06-1987	DE 3675746 D1	03-01-1991
		EP 0226209 A2	24-06-1987
		US 4738034 A	19-04-1988

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 5253397 A [0002]