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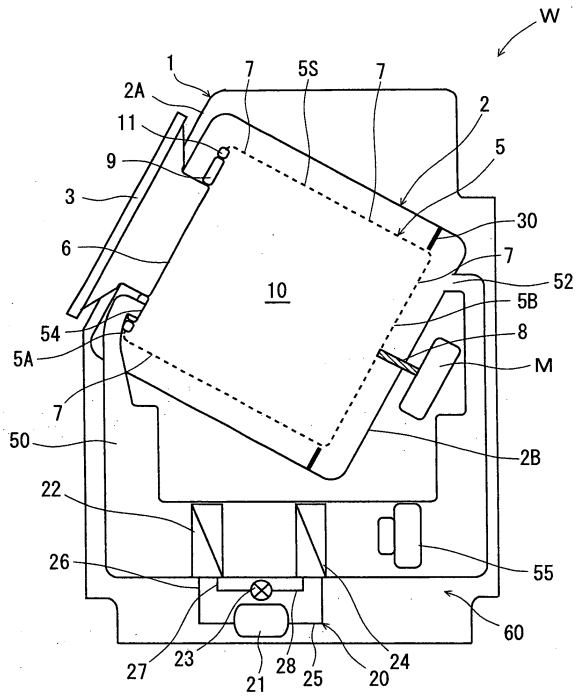
(54) Washing and drying machine

(57) A washing and drying machine has an object to improve a drying efficiency of a laundry and reduce a drying time, and includes an outer drum (2); an inner drum (5) rotated in this outer drum and having a substantially cylindrical shape to constitute a storage chamber (10) therein; a takeout port (6) which is constituted in one end surface of a cylinder of this inner drum in an axial direction and via which the laundry is to be taken or introduced; a plurality of through holes (7) which are formed around a side surface of the cylinder of the inner drum and in the other end surface of the cylinder in the axial direction and from which water is discharged during the washing and through which circulation air for drying circulates during the drying; and a blowing regulation unit (60) which blows the air for drying into the storage chamber (10) from the side of one end or the other end of the cylinder of the inner drum (5) in the axial direction and which allows the air to flow from the through holes (7) on the other end side or from the one end side and which inhibits outflow of the air for drying from the other through holes.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a washing and drying machine which includes a storage chamber for receiving a laundry and which washes and dries the laundry in this storage chamber.

[0002] In recent years, there has been provided a washing and drying machine which automatically washes and dries a laundry in a storage chamber for receiving the target. In such a washing and drying machine, a cylindrical inner drum provided with a large number of through holes through which air and water can circulate is installed in a cylindrical outer drum capable of receiving the water, and the inside of this inner drum is the storage chamber for receiving the laundry. The inner drum is held in the outer drum so that the inner drum can rotate around a cylindrical shaft of the inner drum connected to a shaft of a driving motor attached to a main body.

[0003] Then, when the target to be washed and a detergent having an amount corresponding to the laundry are introduced into the storage chamber and power supply and a start switch are turned on, first a washing having a plurality of different steps of washing, rinsing, water removal and the like is performed. In the washing and rinsing steps of this washing, a detergent solution or water is received in the outer drum, and the inner drum is rotated by a driving motor, whereby the laundry in the storage chamber is washed or rinsed, and then a discharge valve provided in a lower part of the outer drum is opened to discharge washing water or rinsing water. In the water removal step, the inner drum is rotated at a high speed by the driving motor, whereby the laundry including a water content are pressed onto a side surface of the inner drum to separate water from the laundry with a centrifugal force. Then, the water content separated from the laundry drops down to the outer drum via through holes provided in the side surface of the inner drum, and the water content is discharged from the washing and drying machine via the discharge valve.

[0004] When the water removal step of the washing ends, a drying for drying the laundry is then performed. In the drying, heated air is blown into the storage chamber via a blow-off port formed on the side of one end of a cylinder of the inner drum in an axial direction. The heated air blown into the storage chamber warms the laundry received in the storage chamber to evaporate moisture, whereby the laundry is dried. The air which has dried the laundry to contain the moisture flows from the plurality of through holes formed in the inner drum, and is blown from the outer drum via a suction port formed in the outer drum (e.g., Japanese Patent Application Laid-Open Nos. 8-229297 and 2006-75316).

[0005] Thus, in the conventional washing and drying machine, during the drying, the air in the storage chamber is blown from a large number of through holes formed in the inner drum, but the plurality of through holes are formed in the whole inner drum as described above, so that the heated air blown into the storage chamber via the blow-off port easily flows from the storage chamber via the through holes formed around the side surface of the inner drum. Then, much of this air does not return to the storage chamber again, and is blown from the outer drum via the suction port, so that the laundry in the storage chamber cannot sufficiently be brought into contact with the heated air. In consequence, a long time is required for drying the laundry, and an energy consumption for drying the laundry increases, which causes a problem that energy costs such as electric charges suddenly rise.

SUMMARY OF THE INVENTION

[0006] The present invention has been developed to solve such a conventional technical problem, and an object is to improve a drying efficiency of a laundry in a washing and drying machine, thereby reducing a drying time.

[0007] According to a first aspect of the invention, there is provided a washing and drying machine which washes laundry and dries it after end of the washing, comprising: an outer drum; an inner drum rotated in this outer drum and having a substantially cylindrical shape to constitute a storage chamber therein; a takeout port which is constituted in one end surface of a cylinder of this inner drum in an axial direction and via which the laundry is to be taken or introduced; a plurality of through holes which are formed around a side surface of the cylinder of this inner drum and in the other end surface of the cylinder in the axial direction and from which water is discharged during the washing and through which circulation air for drying circulates during the drying; blowing means for blowing, into the storage chamber, air for drying heated by heating means during the drying; and blowing regulation means for blowing the air for drying into the storage chamber from the side of one end or the other end of the cylinder of the inner drum in the axial direction, allowing the air to flow from the through holes on the other end side or from the one end side, and inhibiting outflow of the air for drying from the other through holes.

[0008] The washing and drying machine of a second aspect of the invention is characterized in that in the above invention, a partition wall which divides a space between the outer drum and the inner drum into the one-end side or the other-end side from which the air for drying flows and another part constitutes the blowing regulation means.

[0009] The washing and drying machine of a third aspect of the invention is characterized in that in the first aspect of the invention, an opening/closing member which openably closes the through holes around the side surface of the inner drum constitutes the blowing regulation means, and the opening/closing member opens the through holes during the washing, and closes the through holes during the drying.

[0010] The washing and drying machine of a fourth

aspect of the invention is characterized in that the above inventions comprises a refrigerant circuit in which at least a compressor, a radiator, a pressure reduction device and an evaporator are successively connected in an annular form via pipes, the radiator constitutes the heating means, the air for drying subjected to heat exchange between the air and the radiator is blown into the storage chamber during the drying, and the air blown through this storage chamber is subjected to heat exchange between the air and the evaporator.

[0011] According to the first aspect of the invention, the washing and drying machine which washes laundry and dries it after the end of the washing includes the outer drum, the inner drum rotated in this outer drum and having the substantially cylindrical shape to constitute the storage chamber therein, the takeout port which is constituted in one end surface of the cylinder of this inner drum in the axial direction and via which the laundry is to be taken or introduced, the plurality of through holes which are formed around the side surface of the cylinder of this inner drum and in the other end surface of the cylinder in the axial direction and from which the water is discharged during the washing and through which the circulation air for drying circulates during the drying, and the blowing means for blowing, into the storage chamber, the air for drying heated by the heating means during the drying. The machine also includes the blowing regulation means for blowing the air for drying into the storage chamber from the side of one end or the other end of the cylinder of the inner drum in the axial direction, allowing the air to flow from the through holes on the other end side or from the one end side, and inhibiting the outflow of the air for drying from the other through holes. This eliminates a disadvantage that the air for drying blown into the storage chamber from the one-end side or the other-end side of the cylinder of the inner drum in the axial direction flows from the storage chamber via the through holes formed around the side surface of the inner drum. A contact time between the laundry and the air for drying can be increased in the storage chamber.

[0012] In consequence, the laundry is sufficiently brought into contact with the air for drying, and a water content can efficiently be evaporated from the laundry, so that the drying of the laundry can be promoted to reduce a drying time.

[0013] Moreover, in the above invention, the partition wall which divides the space between the outer drum and the inner drum into the one-end side or the other-end side from which the air for drying flows and the other part constitutes the blowing regulation means as in the second aspect of the invention, whereby the contact time between the laundry and the air for drying can be increased with a simple constitution. In consequence, the laundry is sufficiently brought into contact with the air for drying, and the water content can efficiently be evaporated from the laundry, so that the drying of the laundry can be promoted to reduce the drying time. In particular, without increasing an amount of the air for drying to be blown into the storage chamber or raising a temperature of the air for drying, the contact time between the laundry and the air for drying is lengthened, and the drying time can be reduced while improving a drying efficiency, so that a power consumption can be reduced.

[0014] Furthermore, according to the second aspect of the invention, without attaching any special device, the outflow of the air for drying from the through holes around the side surface of the inner drum can be inhibited with a simple constitution of the partition wall as the blowing regulation means, so that a manufacturing cost of the washing and drying machine can be minimized.

[0015] In addition, as in the third aspect of the invention, the opening/closing member which openably closes the through holes around the side surface of the inner drum constitutes the blowing regulation means, and the opening/closing member opens the through holes during the washing, and closes the through holes during the drying. In consequence, while supplying and discharging water to and from the storage chamber during the washing without any trouble, it is possible to securely inhibit a disadvantage that the air for drying blown into the storage chamber during the drying flows from the through holes around the side surface of the inner drum.

[0016] In consequence, the laundry is sufficiently brought into contact with the air for drying, and the water content can efficiently be evaporated from the laundry, so that the drying of the laundry can be promoted to reduce the drying time. In particular, without increasing the amount of the air for drying to be blown into the storage chamber or raising the temperature of the air for drying, the contact time between the laundry and the air for drying is lengthened, and the drying time can be reduced while improving the drying efficiency, so that the power consumption can be reduced.

[0017] Furthermore, according to the above inventions, as in the fourth aspect of the invention, the washing and drying machine includes the refrigerant circuit in which at least the compressor, the radiator, the pressure reduction device and the evaporator are successively connected in the annular form via the pipes, the radiator constitutes the heating means, the air for drying subjected to the heat exchange between the air and the radiator is blown into the storage chamber during the drying, and the air blown through this storage chamber is subjected to the heat exchange between the air and the evaporator. In this case, heat obtained by the heat exchange between the evaporator and the air for drying is conveyed to the radiator, and the air for drying can be heated by use of this heat, so that an energy cost such as an electric energy cost can be reduced to realize a more efficient drying.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

FIG. 1 is a schematic constitution diagram showing

one embodiment of a washing and drying machine according to the present invention (Embodiment 1);
FIG. 2 is a diagram schematically showing a part of the washing and drying machine shown in FIG. 1;
FIG. 3 is a diagram showing another example of a water discharge passage shown in FIG. 2;
FIG. 4 is a diagram showing a flow of air for drying in a storage chamber of the washing and drying machine shown in FIG. 1;
FIG. 5 is a diagram showing a flow of air for drying in a storage chamber of a second washing and drying machine according to the present invention;
FIG. 6 is a diagram showing a flow of air for drying in a storage chamber of a third washing and drying machine according to the present invention;
FIG. 7 is a diagram showing a flow of air for drying in a storage chamber of a fourth washing and drying machine according to the present invention;
FIG. 8 is a diagram showing a flow of air for drying in a storage chamber of a fifth washing and drying machine according to the present invention;
FIG. 9 is a diagram showing a flow of air for drying in a storage chamber of a sixth washing and drying machine according to the present invention;
FIG. 10 is a diagram schematically showing a part of another embodiment of the washing and drying machine according to the present invention (Embodiment 2); and
FIG. 11 is a diagram showing a flow of air for drying in a storage chamber of a conventional washing and drying machine.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] The present invention has been developed to eliminate disadvantages that air for heating blown into a storage chamber of a conventional washing and drying machine flows from the storage chamber via through holes formed around a side surface of an inner drum and that a laundry in the storage chamber cannot sufficiently be brought into contact with the heated air for drying to eventually lengthen a drying.

[0020] While improving a drying efficiency of the laundry, an object to reduce a drying time is realized by providing an outer drum, an inner drum rotated in this outer drum and having a substantially cylindrical shape to constitute a storage chamber therein; a takeout port which is constituted in one end surface of a cylinder of this inner drum in an axial direction and via which the laundry is to be taken or introduced; a plurality of through holes which are formed around a side surface of the cylinder of this inner drum and in the other end surface of the cylinder in the axial direction and from which water is discharged during the washing and through which circulation air for drying circulates during the drying; and blowing regulation means for blowing the air for drying into the storage chamber from the side of one end or the other end of the cylinder of the inner drum in the axial direction, allowing the air to flow from the through holes on the side of the other end or one end, and inhibiting outflow of the air for drying via the other through holes. Embodiments of the present invention will hereinafter be described in detail with reference to the drawings.

(Embodiment 1)

[0021] FIG. 1 is a diagram showing a schematic constitution of a washing and drying machine W according to one embodiment of the present invention, and FIG. 2 is a diagram schematically showing a part of the washing and drying machine W. The washing and drying machine W for use in washing and drying a laundry such as clothing is provided with an opening/closing door 3 which is attached to an upper part of a side surface of a main body 1 forming an outer shell and which openably closes a takeout port 6 for taking or introducing the laundry. An operation panel (not shown) provided with various operation switches and a display section is provided on a side part of the opening/closing door 3 or an upper part of the main body 1.

[0022] In the main body 1, a cylindrical outer drum 2 capable of receiving water and made of a resin is provided so that a cylindrical shaft of this outer drum 2 is disposed in an oblique direction. Then, inside this outer drum 2, a substantially cylindrical inner drum 5 made of stainless steel is provided to serve as both a washing tank and a water removal tank. The inside of this inner drum 5 is a storage chamber 10 which receives the laundry. This storage chamber is also provided so as to dispose a cylindrical shaft of this drum in an oblique direction. This shaft is connected to a shaft 8 of a driving motor M attached to a side wall (on the right side of FIG. 1) of the main body 1, and the inner drum is rotatably held around the shaft 8 in the outer drum 2.

[0023] Furthermore, one end surface 5A (an upper left surface in FIG. 1) of the inner drum 5 is provided with the takeout port 6, and the inner drum 5 is rotatably supported by this takeout port 6 via a felt 11 and a support member 9. The support member 9 positioned under this takeout port 6 is provided with a blow-off port 54 of an air circulation path 50 described later. A plurality of through holes 7 .. through which air and water can circulate are formed around a cylindrical side surface 5S of the inner drum 5 and the other end surface 5B (a lower right surface in FIG. 1) in an axial direction. The water is discharged from the through holes 7 during a washing, and air for drying circulates through the holes during a drying.

[0024] The driving motor M is a motor for rotating the inner drum 5 around the shaft 8 disposed in the same oblique direction as that of the shafts of the outer drum 2 and the inner drum 5 during the washing and during the drying after end of the washing. This driving motor M is controlled by a controller (not shown) attached to one end of the shaft 8 as described later so as to rotate the inner drum 5 at a high speed at a water removal step of

the washing and rotate the inner drum 5 at a low speed as compared with the washing during the drying.

[0025] On the other hand, a water supply passage (not shown) for supplying water into the outer drum 2 is provided above the outer drum 2 of the main body 1, and one end of this water supply passage is connected to a water source such as tap water via a water supply valve. The other end of the water supply passage is connected to the outer drum 2 to open above the inner drum 5 in the outer drum 2. When the water supply valve is opened by the controller, water (city water) is supplied from the water source into the outer drum 2, and this water is also supplied to the storage chamber 10 via the through holes 7 .. around the side surface 5S of the inner drum 5.

[0026] Moreover, as shown in FIG. 2, a water discharge passage 12 as water discharge means for discharging the water from the outer drum 2 (including the storage chamber 10) is provided in a lower part of the main body 1, and one end of this water discharge passage 12 is drawn from the washing and drying machine W to open in a drain ditch or the like. Then, as shown in FIG. 2, the other end of the water discharge passage 12 is branched into two passages, and one passage 13 communicates with the lowermost part of the outer drum 2 on the side of the other end 2B of the outer drum 2 from a partition wall 30 described later and the other end surface 5B of the inner drum 5 via a water discharge valve 14 controlled to open and close by the controller. The other passage 15 communicates with a lower part of the outer drum 2 where the side surface 5S of the inner drum 5 is positioned on the side of one end 2A of the outer drum 2 from the partition wall 30 via a water discharge valve 16 controlled to open and close by the controller. A suction port 52 of the air circulation path 50 is formed in an upper part of the other end 2B of the outer drum 2.

[0027] On the other hand, returning to FIG. 1, a mechanical chamber 60 is constituted over a front side, a lower side and a rear side of the outer drum 2 in the main body 1, and this mechanical chamber 60 is provided with the air circulation path 50. One end of this air circulation path 50 opens via the suction port 52 formed in the upper part of the other end 2B of the outer drum 2, the passage extends from the one end under the outer drum 2, and the other end thereof opens via the blow-off port 54 formed below the takeout port 6 of the support member 9. In this air circulation path 50, a radiator 22 and an evaporator 24 of a refrigerant circuit 20 described later are provided. The radiator 22 is heating means of the present embodiment, and is installed on the side of the blow-off port 54 in the air circulation path 50. The evaporator 24 is disposed on the side of the suction port 52 in the air circulation path 50.

[0028] Moreover, in the air circulation path 50, a fan 55 is provided. This fan 55 is air blowing means for blowing air for drying heated by the radiator 22 from the blow-off port 54 of the air circulation path 50 to the storage chamber 10 in the inner drum 5 during the drying. In the present embodiment, the fan 55 is disposed on the side of the suction port 52 as an air upstream side of the evaporator 24 in the air circulation path 50.

[0029] That is, in the washing and drying machine W, during the drying, the air in the storage chamber 10 is circulated through the air circulation path 50 by the fan 55 to evaporate a water content included in the laundry, and moisture-containing air is sucked from the suction port 52 into the air circulation path 50 to blow the air to the evaporator 24. The air is subjected to heat exchange between the air and a refrigerant in the evaporator 24 to condense and remove the water content in the air. Afterward, the air is blown to the radiator 22. Then, the air for drying blown to the radiator 22 is subjected to heat exchange between the air and the refrigerant in the radiator 22, heated, then blown from the blow-off port 54 into the storage chamber 10 of the inner drum 5, and circulates through the storage chamber 10 to dry the laundry. Afterward, the air is sucked from the suction port 52 into the air circulation path 50 again.

[0030] Next, the refrigerant circuit 20 will be described. The refrigerant circuit 20 is constituted by successively connecting a compressor 21, the radiator 22, an expansion valve 23 as a pressure reduction device, the evaporator 24 and the like in an annular form via pipes. A predetermined amount of carbon dioxide (CO_2) as the refrigerant is introduced in the refrigerant circuit 20. Here, the compressor 21 for use in the present embodiment is a multistage (two-stage) compression type rotary compressor, and is provided with an electromotive element in a sealed container (not shown), and a first rotating compression element (a first stage) and a second rotating compression element (a second stage) driven by this electromotive element.

[0031] Then, a low-pressure refrigerant is introduced from a refrigerant introduction pipe 25 to the first rotating compression element of the compressor 21, and a high-temperature high-pressure refrigerant compressed by the second rotating compression element is discharged from the compressor 21 via a refrigerant discharge pipe 26. It is to be noted that the compressor 21 usable in the present invention is not limited to the multistage compression type rotary compressor of the embodiment, and various other compressors such as a scroll type compressor and a reciprocating compressor may be applied. The refrigerant introduced in the refrigerant circuit 20 is not limited to carbon dioxide, and any other existing refrigerant may be used.

[0032] The refrigerant discharge pipe 26 of the compressor 21 is provided on the side of the blow-off port 54 in the air circulation path 50, and connected to an inlet of the radiator 22 for heating the air. Then, a pipe 27 extending from the radiator 22 reaches the expansion valve 23, and a pipe 28 connected to an outlet of the expansion valve 23 is connected to an inlet of the evaporator 24 provided on an air blow-off side (an air downstream side) of the fan 55 of the air circulation path 50. An outlet of the evaporator 24 is connected to the refrigerant introduction pipe 25 of the compressor 21 to con-

stitute the annular refrigerant circuit 20.

[0033] It is to be noted that an operation of the washing and drying machine W of the present embodiment is controlled by the controller. This controller is control means for controlling the washing and drying machine W, and controls an operation of the driving motor M, opening/closing of the water supply valve of the water supply passage, opening/closing of the water discharge valves 14, 16 of the water discharge passage 12, an operation of the compressor 21, a diaphragm adjustment of the expansion valve 23, an air flow rate of the fan 55 and the like. Furthermore, the controller controls a temperature of the air for drying blown through the radiator 22 so that the laundry received in the storage chamber 10 does not change color thereof or is not impaired.

[0034] In addition, in this washing and drying machine W, it is most preferable that the heated air for drying blown from the blow-off port 54 to the storage chamber 10 is blown from the side of the one end 5A of the inner drum 5 provided with the blow-off port 54 through the storage chamber 10, and is blown from the storage chamber 10 via the through holes 7 .. formed in the other end surface 5B. At this time, the air for drying is sufficiently brought into contact with the laundry in the storage chamber 10, whereby the water content can efficiently be evaporated from the laundry.

[0035] However, in a conventional washing and drying machine, as shown by arrows in FIG. 11, during a drying, heated air blown from a blow-off port 54 to a storage chamber 10 easily flows from the storage chamber 10 via through holes 7 .. formed in a side surface of the inner drum 5, and this air in the storage chamber 10 is sucked from a suction port 52 formed in an outer drum 2 into an air circulation path 50 without returning again to the storage chamber 10. When the heated air for drying flows in this manner, the air for drying brought into contact with a laundry in the storage chamber is reduced, and a contact time between the air and the laundry shortens, so that it is difficult to evaporate a water content from the laundry. As a result, in the conventional washing and drying machine, a long time is required for drying the laundry.

[0036] The drying time lengthens in this manner, whereby an energy consumption for drying the laundry increases, and a problem occurs that energy costs such as electric charges soar. Furthermore, the air sucked from the suction port 52 into the air circulation path 50 becomes comparatively dry air which does not sufficiently contain moisture, so that a moisture removal efficiency in an evaporator 24 remarkably deteriorates, and a problem also occurs that an amount of the water content to be collected in the evaporator 24 is further reduced.

[0037] To solve the problem, as shown in FIG. 2, the washing and drying machine W of the present invention is provided with blowing regulation means for, during the drying, blowing the air for drying from the side of the one end 5A of the cylinder of the inner drum 5 in the axial direction into the storage chamber 10, allowing the air to flow from the through holes 7 .. on the side of the other end 5B, and inhibiting outflow of the air for drying from the other through holes 7 ... That is, during the drying, the blowing regulation means inhibits the air for drying from flowing from the through holes 7 .. on the side other than the other end 5B side, whereby the heated air for drying blown from the blow-off port 54 to the storage chamber 10 is blown from the one end 5A of the inner drum 5 provided with the blow-off port 54 toward the other end 5B, and allowed to flow from the through holes 7 .. formed in the other end surface 5B.

[0038] Specifically, in the washing and drying machine W of the present embodiment, the blowing regulation means is constituted of the partition wall 30 which divides a space between the outer drum 2 and the inner drum 5 into the other end 5B side from which the air for drying flows and the other part. This partition wall 30 is formed over the other end surface 5B of the inner drum 5, or over the whole inner peripheral surface of the outer drum 2 in the vicinity of the other end surface 5B on the side of the one end 5A from the other end surface. A small gap is formed between a distal end of this partition wall 30 and an outer peripheral edge of the other end surface 5B of the inner drum 5 or the side surface 5S so that the partition wall 30 does not disturb the rotation of the inner drum 5.

[0039] This partition wall 30 can eliminate a disadvantage that the air for drying blown to the storage chamber 10 from the blow-off port 54 formed on the side of the one end 5A in the axial direction of the cylinder of the inner drum 5 flows from the storage chamber 10 via the through holes formed in the side surface 5S, and is sucked from the suction port 52 into the air circulation path 50 without returning to the storage chamber 10 again as in a conventional example. That is, according to the constitution of the present embodiment, even when the air for drying once flows from the storage chamber 10 via the through holes 7 .. formed around the side surface 5S, the air is again returned into the storage chamber 10 by the partition wall 30, and securely flows from the storage chamber 10 via the through holes 7 .. formed in the other end surface 5B .

[0040] Therefore, the air for drying blown to the storage chamber 10 from the blow-off port 54 formed on the side of the one end 5A can be allowed to flow toward the other end 5B by this partition wall 30. In consequence, the laundry is sufficiently brought into contact with the air for drying, and the water content can efficiently be evaporated from the laundry.

[0041] Next, an operation of the washing and drying machine W having the above constitution will be described. When the laundry and a predetermined amount of a detergent corresponding to an amount of the laundry are introduced from the takeout port 6 into the storage chamber 10 of the inner drum 5, the opening/closing door 3 is closed and a power supply switch and a start switch among the operation switches are operated, the controller starts the washing. In consequence, the water supply valve of the water supply passage is opened to open the

water supply passage. In consequence, the water is supplied from the water source via the outer drum 2 and the through holes 7 .. of the inner drum 5. It is to be noted that at this time, the water discharge valves 14, ,16 of the water discharge passage 12 are closed.

[0042] Then, when a predetermined amount of warm water is received in the storage chamber 10 of the inner drum 5, the controller closes the water supply valve to close the water supply passage. In consequence, the supply of the water from the water source is stopped.

[0043] Subsequently, the controller energizes and starts the driving motor M. In consequence, the shaft 8 rotates, and the inner drum 5 attached to this shaft 8 starts rotating in the outer drum 2 to start washing steps of the washing. Then, when a predetermined time elapses from the start of the washing steps, the controller stops the driving motor M, and both the water discharge valves 14, 16 of the water discharge passage 12 are opened to discharge the water (washing water) from the storage chamber 10 of the inner drum 5 (i.e., from the outer drum 2). Here, as described above, the water discharge passage 12 is branched as described above, and the one passage 13 is provided so as to communicate with the lowermost part of the outer drum 2 on the side of the other end 2B of the outer drum 2 from the partition wall 30 and the other end surface 5B of the inner drum 5. Moreover, the other passage 15 is provided so as to communicate with the lower part of the outer drum 2 where the side surface 5S of the inner drum 5 is positioned on the side of the one end 2A of the outer drum 2 from the partition wall 30, whereby the water can securely be discharged from the outer drum 2. In particular, the partition wall 30 is provided as in the present invention, whereby the water discharged from the through holes 7 .. around the side surface 5S of the inner drum 5 and discharged downward along the inner peripheral surface of the outer drum 2 cannot be discharged from the one passage 13 owing to the partition wall 30 provided therein. However, the other passage 15 is provided, whereby the water can securely be discharged from the other passage 15, and remaining water in the outer drum 2 can be prevented.

[0044] Then, when the water is discharged from the storage chamber 10 (the outer drum 2), the driving motor M is again operated by the controller to remove the water from the laundry. When this water removal is executed for a predetermined time, both the water discharge valves 14, 16 of the water discharge passage 12 are closed to close the water discharge passage 12, thereby shifting to a rinsing step.

[0045] In this rinsing step, first the water supply valve of the water supply passage is opened to open the water supply passage. In consequence, the water is again supplied from the water source into the outer drum 2 and the storage chamber 10. Then, when a predetermined amount of water is supplied into the storage chamber 10 of the inner drum 5, the water supply valve is closed by the controller to close the water supply passage. In consequence, the supply of the water from the water source is stopped.

[0046] Then, a rotating operation of the driving motor M is repeated for a predetermined time to perform rinsing. Afterward, the driving motor M is stopped, and both the water discharge valves 14, 16 of the water discharge passage 12 are opened to discharge rinsing water from the storage chamber 10 (the outer drum 2) via the water discharge passage 12. When the rinsing water is discharged from the storage chamber 10 (the outer drum 2), the driving motor M is operated by the controller, and the inner drum 5 is rotated in the same manner as described above, thereby shifting to a water removal step of removing the water from the laundry.

[0047] Then, this water removal step is executed for a predetermined time, and then both the water discharge valves 14, 16 of the water discharge passage 12 are closed by the controller to close the water discharge passage 12. Furthermore, the controller starts the compressor 21, and starts the operation of the fan 55, and the driving motor M rotates the inner drum 5 to shift to the drying. The water discharge valves 14, 16 of the water discharge passage 12 are closed in this manner during the drying, whereby it is possible to prevent the disadvantage that the air for drying supplied to the storage chamber flows from the through holes 7 .. formed around the side surface 5S of the inner drum 5 to return to the outer drum 2 through the other passage 15 and the one passage 13, and again flows outward without returning to the storage chamber 10. It is to be noted that the present invention is not limited to the above constitution. For example, as shown in FIG. 3, instead of the water discharge valve 14 of the one passage 13, a check valve 18 is provided so as to set a direction in which the water of the outer drum 2 is discharged to a water discharge passage 12 (a lower direction in FIG. 1) to a forward direction. Moreover, instead of the water discharge valve 16 of the other passage 15, a water discharge valve 19 is provided in a water discharge passage 12 after both passages 13, 15 join each other (under both the passages 13, 15). Even in this case, a similar effect can be obtained.

[0048] On the other hand, when the compressor 21 is started, a refrigerant (CO_2) is sucked from the refrigerant introduction pipe 25, and compressed by the first rotating compression element of the compressor 21. The refrigerant compressed by the first rotating compression element and having an intermediate pressure is sucked into the second rotating compression element, subjected to second-stage compression to form a high-temperature high-pressure refrigerant gas, and discharged from the refrigerant discharge pipe 26.

[0049] The refrigerant gas discharged from the refrigerant discharge pipe 26 flows into the radiator 22 provided in the air circulation path 50. At this time, a temperature of the refrigerant flowing into the radiator 22 rises to about +85°C, and here such a high-temperature high-pressure refrigerant gas is subjected to heat exchange between the refrigerant and the air for drying circulated through

the air circulation path 50 to radiate heat, whereby the gas is cooled to about +50°C.

[0050] Afterward, a pressure of the refrigerant cooled by the radiator 22 is reduced by the expansion valve 23, and the refrigerant is then subjected to heat exchange between the refrigerant and the air for drying (moisture-containing air from the storage chamber 10) to evaporate in the evaporator 24 provided in the air circulation path 50. That is, in the refrigerant circuit 20, the moisture-containing air for drying from the storage chamber 10 is condensed by the evaporator 24 to remove the water content from the air. Moreover, the refrigerant circuit functions as a heat pump for pumping up heat from the air for drying owing to the refrigerant in the evaporator 24, and conveying the heat to the radiator 22 to heat the air for drying blown to the storage chamber 10.

[0051] Thus, the refrigerant circuit 20 is provided so that the water content of the air for drying from the storage chamber 10 is condensed and removed by the evaporator 24. At this time, the heat pumped up from the air is conveyed to the radiator 22 by the refrigerant, and used in heating the air for drying blown to the storage chamber 10, whereby an energy efficiency can be improved. In particular, the air for drying can be heated to a high temperature by the radiator 22 without using any special heating means such as an electric heater, so that an energy cost such as an electric energy cost can be reduced to more efficiently realize the drying.

[0052] Then, circulation is performed so that the refrigerant evaporated by the evaporator 24 is then sucked again into the compressor 21 through the refrigerant introduction pipe 25.

[0053] Moreover, the fan 55 is operated, whereby the moisture-containing air which has dried the laundry in the storage chamber 10 (the air for drying) flows from the storage chamber 10 through the storage chamber 10 and the through holes 7 .. formed in the other end 5B. Then, this air flows into the air circulation path 50 from the suction port 52 formed in the upper part of the other end 2B of the outer drum 2, and is sucked into the fan 55. Afterward, the air sucked into the fan 55 is blown toward the evaporator 24 provided on an air blow-off side of the fan 55, and flows around the evaporator 24. At this time, the moisture-containing air which has dried the laundry in the storage chamber 10 performs heat exchange between the air and the refrigerant flowing through the evaporator 24 while flowing through the evaporator 24, whereby the heat is taken by the refrigerant. At this time, the water content in the air is condensed on the surface of the evaporator 24. In consequence, the evaporator 24 condenses and removes the water content from the moisture-containing air which has dried the laundry, whereby the dried air can be obtained again.

[0054] It is to be noted that the water content condensed on the surface of the evaporator 24 then drops down as water droplets onto a drain pan (not shown) provided in a lower part of the evaporator 24, and is discharged from the evaporator via a drain pipe (not shown), the water discharge passage 12 and the like.

[0055] On the other hand, the heat of the dried air for drying from which the moisture has been removed by the evaporator 24 is taken by the refrigerant flowing through the evaporator 24, and the air is cooled to about +30°C. Afterward, the air flows around the radiator 22, performs heat exchange between the air and the high-temperature high-pressure refrigerant gas flowing through the radiator 22, is heated to about +75°C, and is blown into the storage chamber 10 from the blow-off port 54 formed under the support member 9 provided in an outer periphery of the takeout port 6 of the one end surface 5A of the inner drum 5.

[0056] The air for drying blown to this storage chamber 10 comes in contact with the laundry while flowing from the one end 5A side toward the other end 5B side in the storage chamber 10, warms the laundry to evaporate the water content, and dries the laundry.

[0057] At this time, the air for drying blown into the storage chamber 10 from the blow-off port 54 positioned in the lower part of this inner drum 5 on the one end 5A side does not flow from the through holes 7 .. formed around the side surface 5S owing to the presence of the partition wall 30 according to the present invention, and the air flows toward the other end 5B as shown by arrows in FIG. 4. In particular, even when the air for drying once flows from the storage chamber 10 through the through holes 7 .. formed around the side surface 5S, the air is securely returned into the storage chamber 10 again by the partition wall 30, and flows from the storage chamber 10 through the through holes 7 .. formed in the other end 5B. Therefore, in the storage chamber 10, a contact time between the laundry and the air for drying can be increased.

[0058] In consequence, the laundry can sufficiently be brought into contact with the air for drying to efficiently evaporate the water content from the laundry, so that the drying of the laundry can be promoted to reduce the drying time. In particular, without increasing an amount of the air for drying to be blown to the storage chamber 10 or raising the temperature of the air for drying, the contact time between the laundry and the air for drying can be lengthened, and the drying time can be reduced while improving the drying efficiency, so that the power consumption can be reduced.

[0059] Then, the water-containing air which has dried the laundry in the storage chamber 10 repeats such a cycle that the air flows from the through holes 7 .. formed in the other end surface 5B of the inner drum 5, and is sucked from the suction port 52 of the outer drum 2 into the air circulation path 50.

[0060] At this time, the air sucked from the suction port 52 into the air circulation path 50 according to the present invention is sufficient-moisture-containing air which has taken a water content from the laundry in the storage chamber 10. In particular, in the beginning of the drying, the air is brought close to a saturated state. In consequence, a moisture removal efficiency in the evaporator

24 improves, and an amount of the water content to be collected in the evaporator 24 increases. Therefore, the drying efficiency of the laundry can further be improved, and the drying time can be reduced.

[0061] Furthermore, in the present invention, the outflow of the air for drying from the through holes 7 .. around the side surface 5S of the inner drum 5 can be prevented with a simple constitution in which the partition wall 30 is provided without attaching any special device, so that a manufacturing cost of the washing and drying machine W can be minimized.

[0062] It is to be noted that in the present embodiment, the blow-off port 54 is formed in the lower part of the inner drum 5 on the one end 5A side, and the suction port 52 is formed in the upper part of the other end 2B of the outer drum 2 on the other end 5B side, whereby the air for drying heated by the radiator 22 of the air circulation path 50 is blown from the one end 5A side into the storage chamber 10, and allowed to flow from the through holes 7 .. on the other end 5B side. However, the present invention is not limited to this example, and is effective as long as the air for drying is blown into the storage chamber 10 from the one end 5A side or the other end 5B side in the axial direction of the cylinder of the inner drum 5, and allowed to flow from the through holes 7 .. on the other end 5B side or from the one end 5A side.

[0063] For example, as shown in FIG. 5, a blow-off port 54 may be formed in an upper part of one end 2A of an outer drum 2 on the side of one end 5A of an inner drum 5, and a suction port 52 may be formed in a lower part of the other end 2B of an outer drum 2 on the side of the other end 5B of the inner drum 5, which is a position above a water level of the supplied water during the washing, whereby as shown by arrows, the air for drying heated by a radiator 22 of an air circulation path 50 is blown into the storage chamber 10 from the upside, that is, the one end 5A, and allowed to flow from through holes 7 .. on the other end 5B side.

[0064] Moreover, as shown in FIG. 6, a blow-off port 54 may be formed in an upper part of the other end 2B of an outer drum 2 on the other end 5B side of an inner drum 5, and a suction port 52 may be formed in a lower part of one end 2A of the outer drum 2 on the side of one end 5A of the inner drum 5, whereby as shown by the arrows, air for drying heated by a radiator 22 of an air circulation path 50 is blown into a storage chamber 10 from an upper part of the other end 5B, and allowed to flow from the one end 5A.

[0065] Furthermore, as shown in FIG. 7, a blow-off port 54 may be formed in a lower part of the other end 2B of an outer drum 2 on the side of the other end 5B of an inner drum 5, which is a position above a water level of supplied water during a washing, and a suction port 52 may be formed in an upper part of one end 2A of the outer drum 2 on the side of one end 5A of the inner drum 5, whereby as shown by arrows, air for drying heated by a radiator 22 of an air circulation path 50 is blown into a storage chamber 10 from a lower part of the other end 5B, and allowed to flow from the one end 5A.

[0066] In addition, as shown in FIG. 8 or 9, a suction port 52 or a blow-off port 54 may be formed in a takeout port 6 of one end surface 5A of an inner drum 5, and the blow-off port 54 or the suction port 52 may be formed around a shaft 8 of the other end 2B of an outer drum 2 on the other end 5B side, whereby as shown by arrows in FIG. 8, 9, air for drying heated by a radiator 22 of an air circulation path 50 is blown around the center of the other end 5B, or from the takeout port 6 on the one end 5A side into a storage chamber 10, and allowed to flow from the takeout port 6 on the one end 5A side or from the through holes 7 .. of the other end 5B. The present invention is not limited to the above examples, and may be applied to another constitution.

(Embodiment 2)

[0067] It is to be noted that in Embodiment 1 described above, the blowing regulation means is constituted of the partition wall 30 for dividing the space between the outer drum 2 and the inner drum 5 into the other end 5B side from which the air for drying flows and the other part. However, the present invention is effective, even when an opening/closing member for openably closing through holes 7 .. around a side surface 5S of an inner drum 5 constitutes the blowing regulation means. FIG. 10 is a schematic diagram showing an outer drum 2 and the inside of the drum in a washing and drying machine Y according to this embodiment. In the present embodiment, an opening/closing member to openably close the through holes 7 .. around the side surface 5S of the inner drum 5 is constituted of a plurality of valves 80 ... It is to be noted that the washing and drying machine Y of the present embodiment is different from the washing and drying machine W of Embodiment 1 described above only in a constitution in which the opening/closing member is used as the blowing regulation means, and another constitution, operation and the like are similar to those of the washing and drying machine W. Therefore, description is omitted here, and an only operation of the valves 80 .. as the different respect will be described.

[0068] Here, the operation of the valves 80 .. constituted of a shape-memory alloy which functions in a predetermined temperature range (+40°C or more in the present embodiment) will be described. That is, the valves 80 .. of the present embodiment hold an opened state of the through holes 7 .. in a case where a temperature of the valves 80 .. is lower than +40°C, and the valves are deformed to close the through holes 7 .. in a temperature range of +40°C or more.

[0069] During a washing, the valves 80 .. have a temperature lower than +40°C, so that the through holes 7 .. around the side surface 5S of the inner drum 5 are opened. In consequence, during the washing, water can be supplied into and discharged from a storage chamber 10 without any trouble. During a drying, heated air is supplied to heat the storage chamber 10. When the temper-

ature of the valves 80 .. is in a temperature range of +40°C or more, the valves 80 .. function to close the through holes 7 .. around the side surface 5S of the inner drum 5. In consequence, it is possible to securely eliminate a disadvantage that the air for drying blown into the storage chamber 10 flows from the through holes 7 .. around the side surface 5S of the inner drum 5. The air for drying blown into the storage chamber 10 from a blow-off port 54 formed in one end 5A of the inner drum 5 can flow toward the other end 5B.

[0070] Therefore, in the same manner as in the above embodiment, the laundry can sufficiently be brought into contact with the air for drying, and a water content can efficiently be evaporated from the laundry, so that drying of the laundry can be promoted to reduce a drying time. In particular, without increasing an amount of the air for drying to be blown into the storage chamber 10 or raising the temperature of the air for drying, a contact time between the laundry and the air for drying is lengthened. While improving a drying efficiency, the drying time can be reduced, so that a power consumption can be reduced.

[0071] Moreover, the air sucked from a suction port 52 into an air circulation path 50 becomes sufficient-moisture-containing air which has taken the water content from the laundry in the storage chamber 10. In particular, in the beginning of the drying, the air can be brought close to a saturated state. In consequence, a moisture removal efficiency in an evaporator 24 improves, and an amount of the water content to be collected in the evaporator 24 increases. Therefore, the drying efficiency of the laundry can further be improved, and the drying time can be reduced.

[0072] It is to be noted that in the present embodiment, the valves 80 .. are constituted of the shape-memory alloy which functions in a predetermined temperature range (+40°C or more in the present embodiment). However, for example, even in a case where a member which operates with a centrifugal force (which closes through holes 7 .. with the centrifugal force) is constituted, a similar effect can be obtained.

[0073] Moreover, even the present embodiment is effective in a case where the air for drying is blown into the storage chamber 10 from the side of the one end 5A or the other end 5B in an axial direction of a cylinder of the inner drum 5, and allowed to flow from the through holes 7 .. on the other end 5B side or from the one end 5A side in the same manner as in the above embodiment. Various constitutions of the suction port 52 and the blow-off port 54 described above with reference to FIGS. 5 to 9 may be applied.

[0074] Furthermore, the washing and drying machine W or Y according to each of the above embodiments includes the refrigerant circuit 20, and the radiator 22 of the refrigerant circuit 20 heats the air for drying blown into the storage chamber 10. Afterward, the water content taken from the laundry in the storage chamber 10 is condensed and removed from the air in the evaporator 24. However, according to first to third aspects of the invention, instead of the refrigerant circuit 20, the air for drying is effectively heated with an electric heater or the like. Moreover, arrangement of the fan 55 in the air circulation path 50 is not limited to the embodiments, and the fan may be disposed between the radiator 22 and the evaporator 24, or installed on the side of the blow-off port 54 of the radiator 22.

Claims

1. A washing and drying machine which washes laundry and dries it after end of the washing, comprising:

   an outer drum;
   an inner drum rotated in the outer drum and having a substantially cylindrical shape to constitute a storage chamber therein;
   a takeout port which is constituted in one end surface of a cylinder of the inner drum in an axial direction and via which the laundry is to be taken or introduced;
   a plurality of through holes which are formed around a side surface of the cylinder of the inner drum and in the other end surface of the cylinder in the axial direction and from which water is discharged during the washing and through which circulation air for drying circulates during the drying;
   blowing means for blowing, into the storage chamber, air for drying heated by heating means during the drying; and
   blowing regulation means for blowing the air for drying into the storage chamber from the side of one end or the other end of the cylinder of the inner drum in the axial direction, allowing the air to flow from the through holes on the other end side or from the one end side, and inhibiting outflow of the air for drying from the other through holes.

2. The washing and drying machine according to claim 1, wherein a partition wall which divides a space between the outer drum and the inner drum into the one-end side or the other-end side from which the air for drying flows and another part constitutes the blowing regulation means.

3. The washing and drying machine according to claim 1, wherein an opening/closing member which openably closes the through holes around the side surface of the inner drum constitutes the blowing regulation means, and the opening/closing member opens the through holes during the washing, and closes the through holes during the drying.

4. The washing and drying machine according to any

one of claims 1 to 3, further comprising:

a refrigerant circuit in which at least a compressor, a radiator, a pressure reduction device and an evaporator are successively connected in an annular form via pipes,
wherein the radiator constitutes the heating means, the air for drying subjected to heat exchange between the air and the radiator is blown into the storage chamber during the drying, and the air blown through the storage chamber is subjected to heat exchange between the air and the evaporator.

FIG. 1

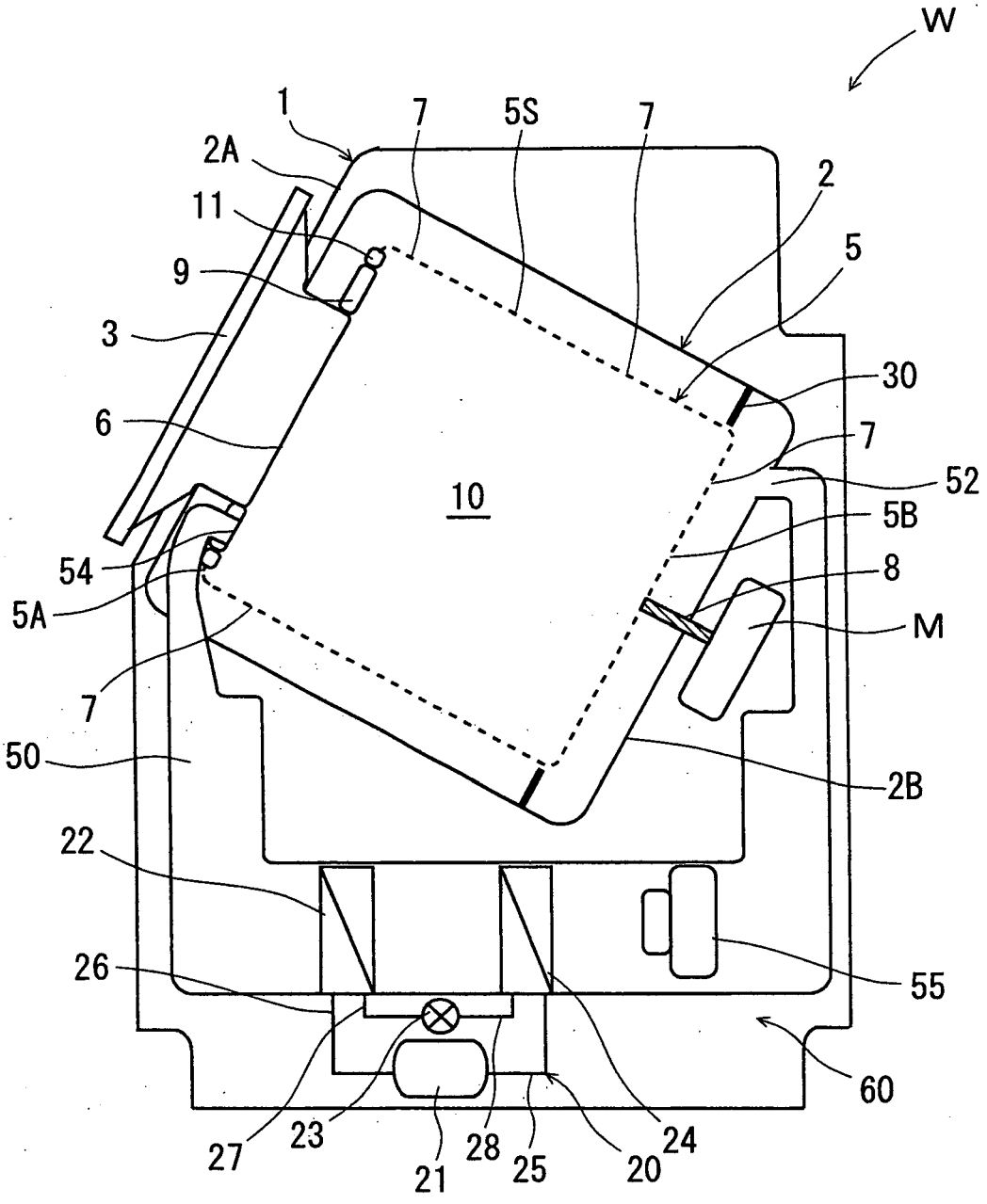

W
1
7
5S
7
2A
2
11
5
9
3
30
6
7
52
10
5B
54
8
5A
M
7
50
2B
22
26
55
60
27
23
21
28
25
20
24

FIG. 2

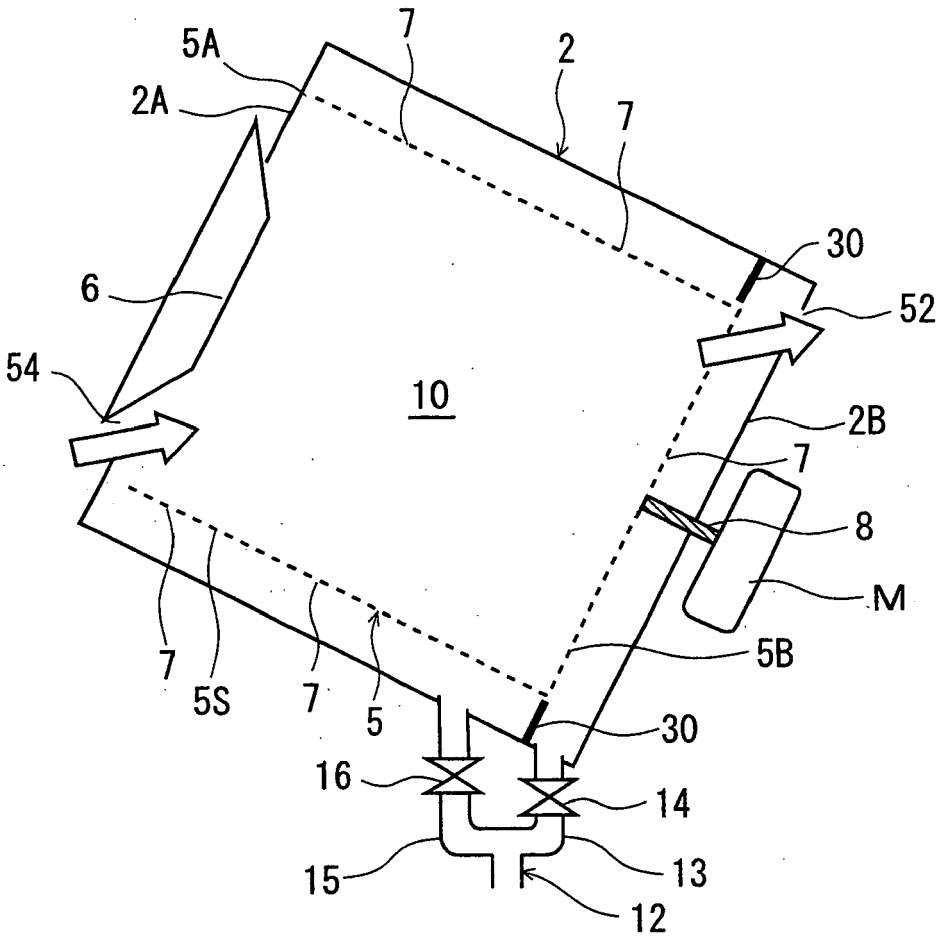


FIG. 3

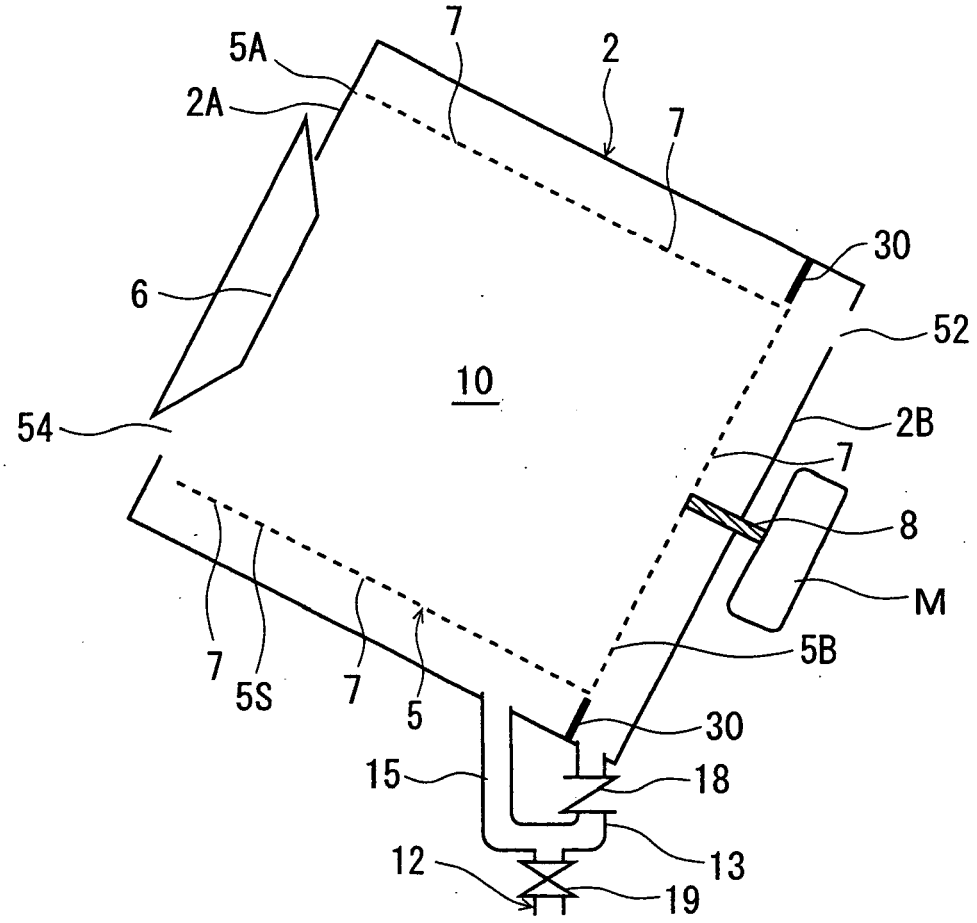


FIG. 4

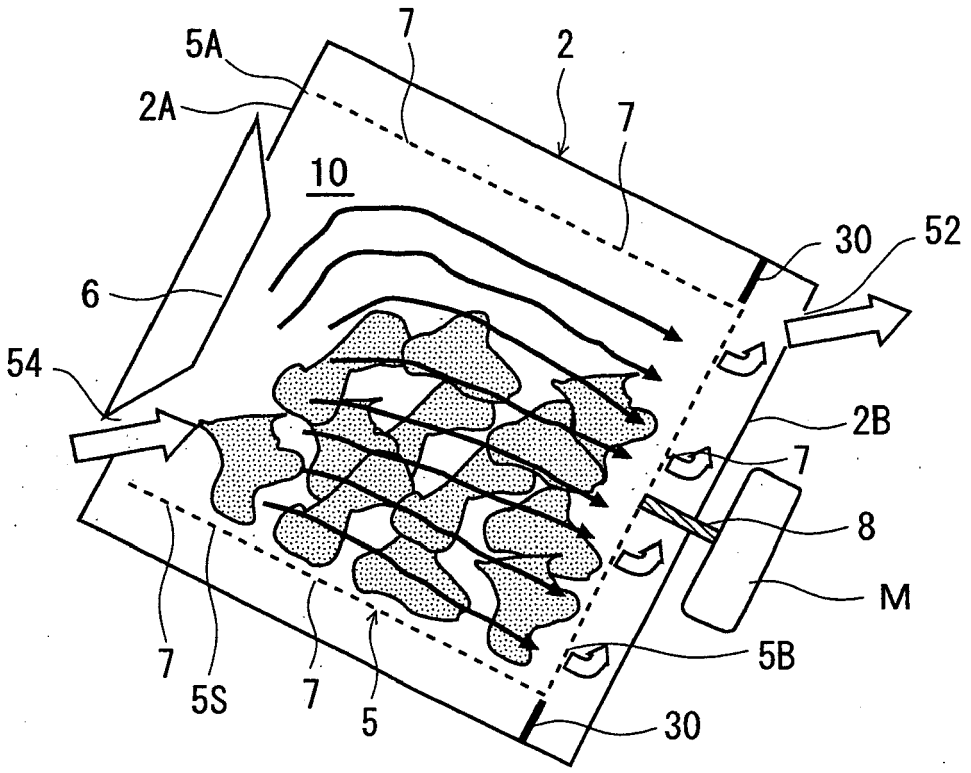


FIG. 5

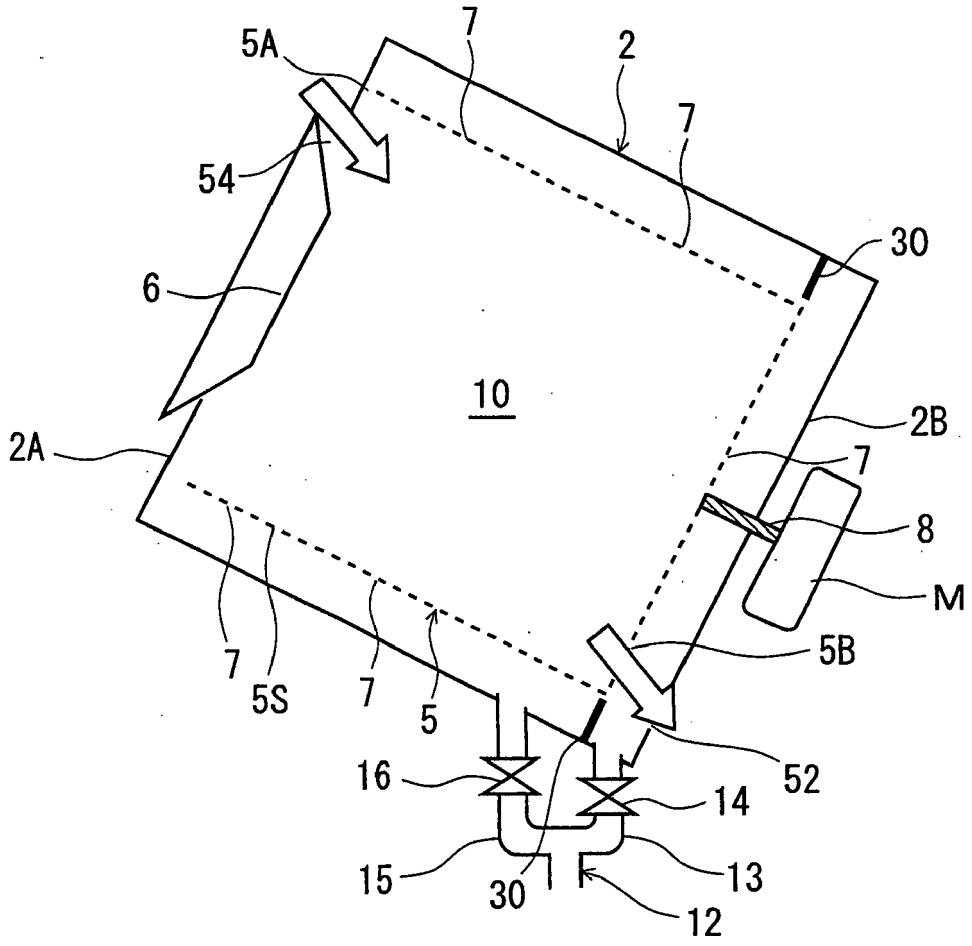


FIG. 6

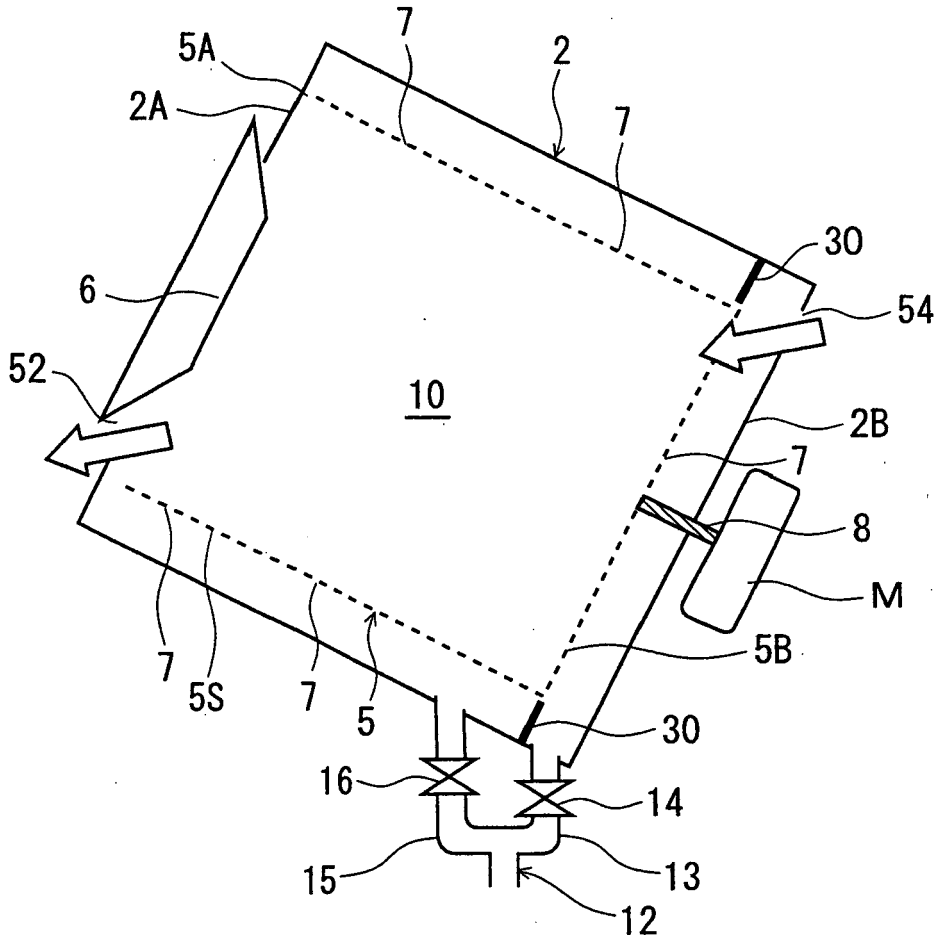


FIG. 7

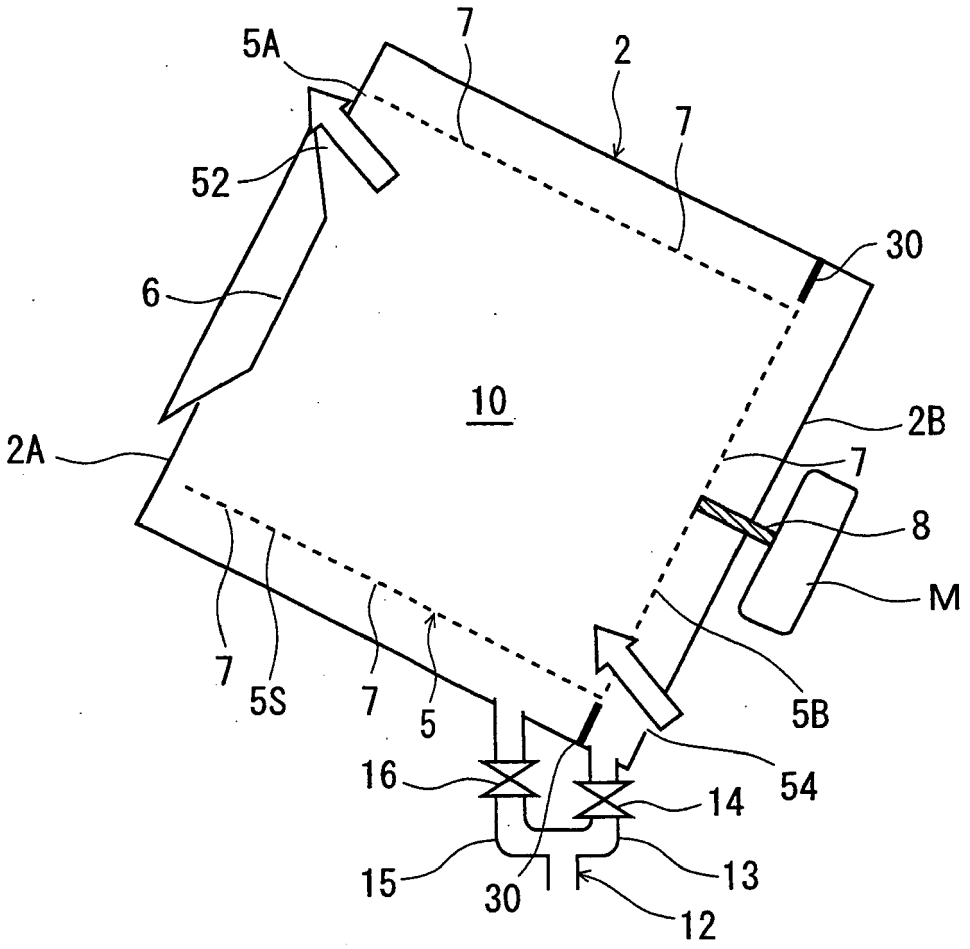


FIG. 8

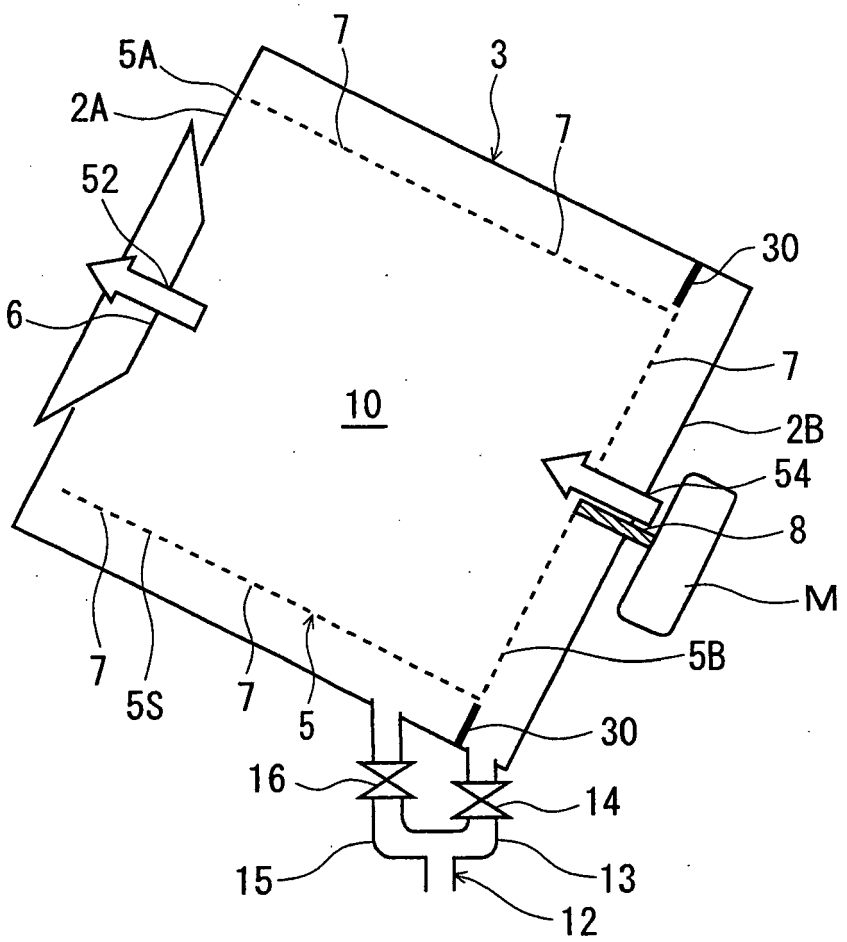


FIG. 9

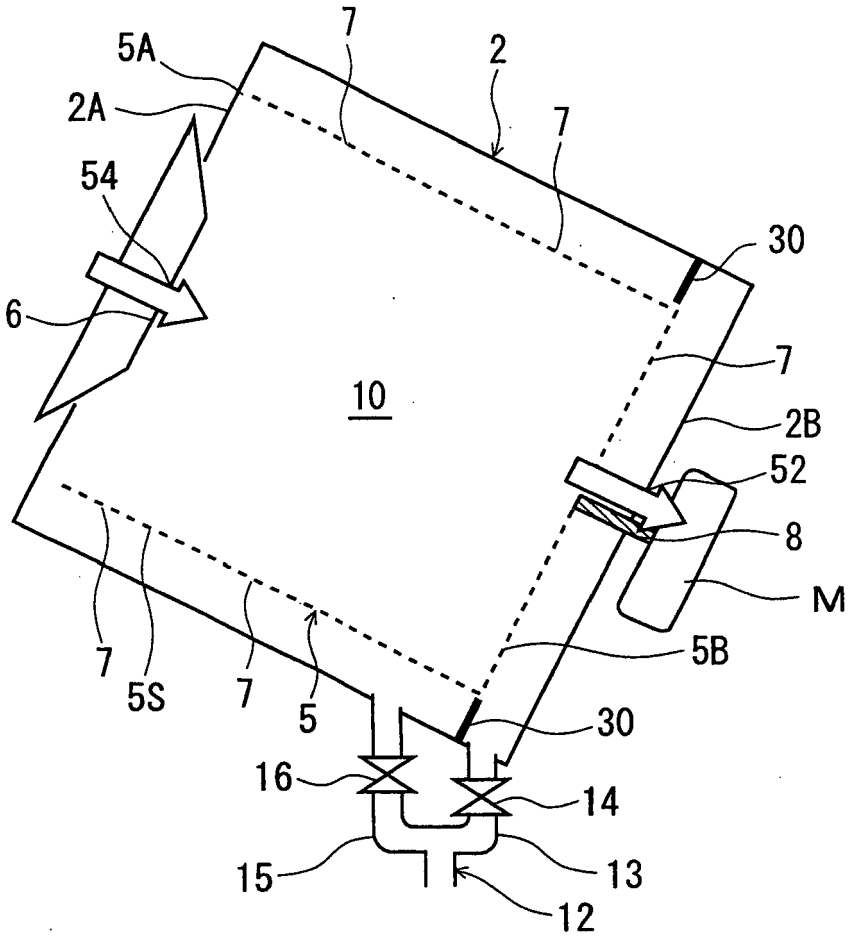


FIG. 10

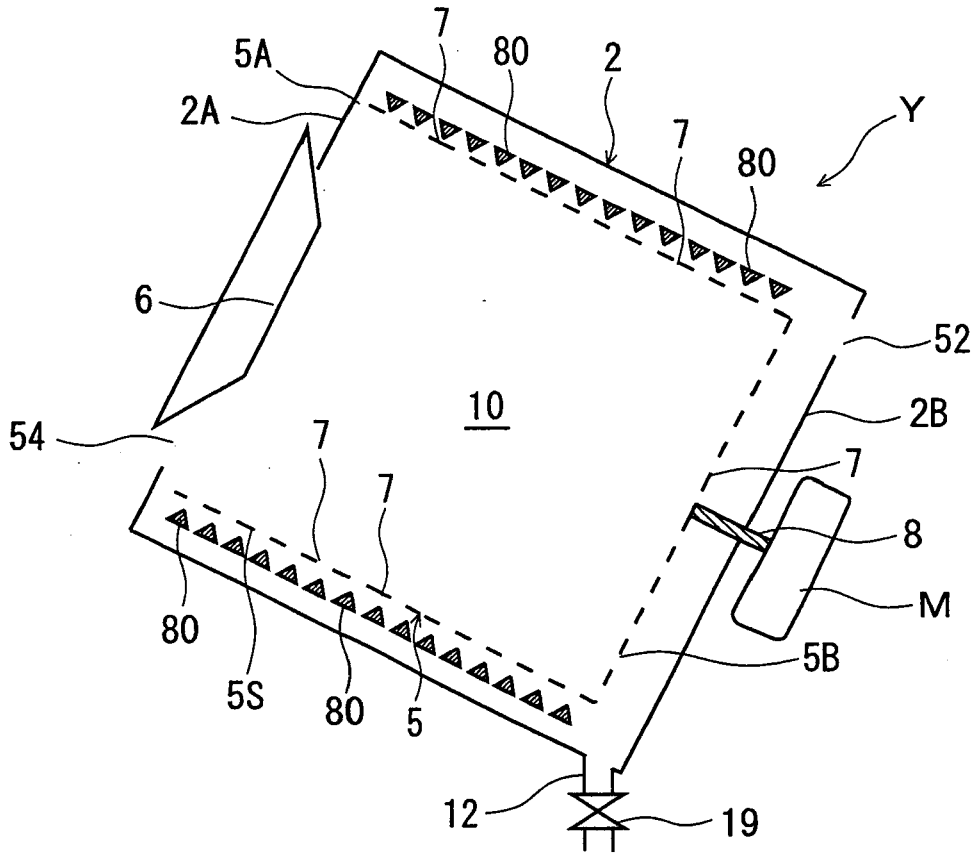
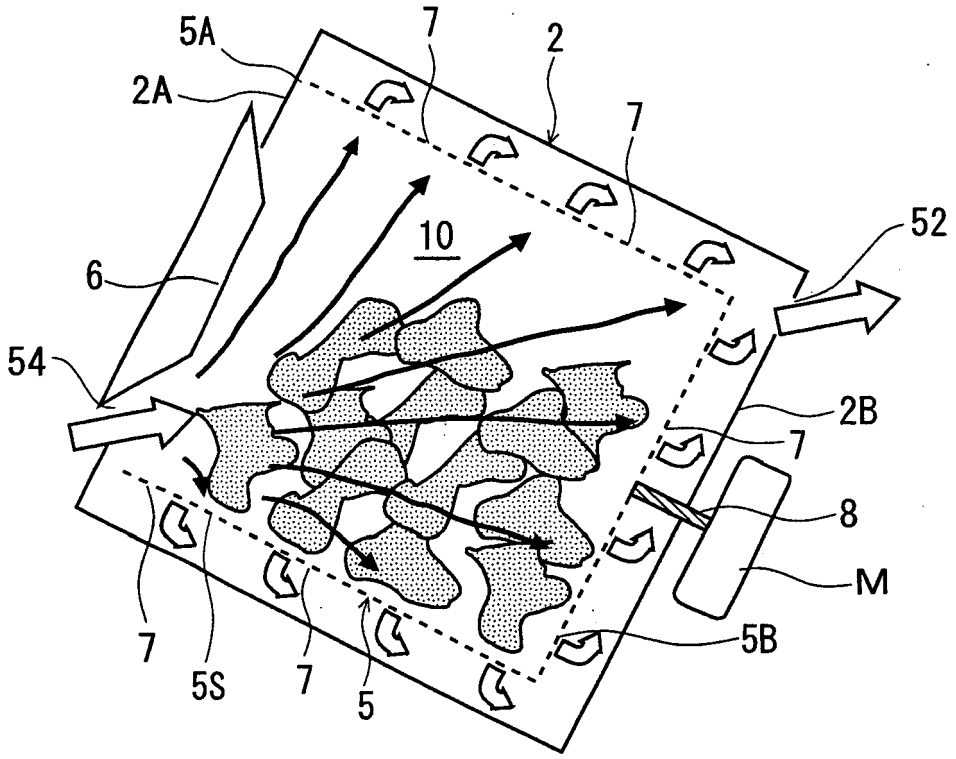


FIG. 11



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 08 00 4387

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	EP 1 559 829 A (CANDY SPA [IT]) 3 August 2005 (2005-08-03) * paragraph [0022] - paragraph [0025]; figures 1,2 *	1-4	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	10 June 2008	Hannam, Martin

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