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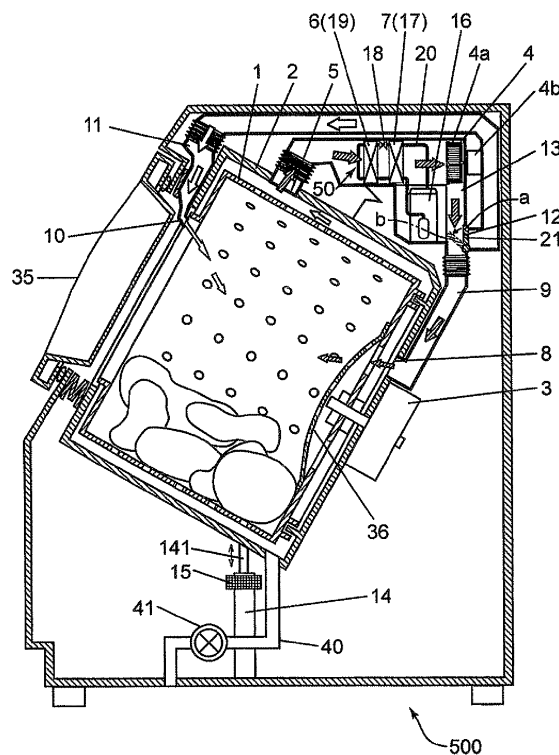
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(54) **Switching mechanism for switching blowing path, laundry dryer and washing dryer**

(57) Provided is a switching mechanism including a first blowing path (9) through which a blown fluid passes, a second blowing path (11) branching from the first blowing path (9) to allow the fluid to pass through, a pivotal blocking member (21c) mounted in a branch between the first and second blowing paths (9, 11), a drive motor (23) configured to drive the blocking member (21c), and a deceleration gear (22) configured to transmit driving force of the drive motor (23) to the blocking member (21c), wherein the blocking member (21c) selectively blocks one of the first and second blowing paths (9, 11).

FIG.1



Description**BACKGROUND OF THE INTENTION**5 **Field of the Invention**

[0001] The present invention is related to a switching mechanism for selectively switching a blowing path, and a laundry dryer and a washing dryer provided with the switching mechanism.

10 **Description of the Related Art**

[0002] Conventional drum-typed laundry dryers and washing dryers supply dry air into a drum through an air duct to dry laundry. The dry air hits the laundry in the drum to remove moisture from the laundry. As a result, laundry is suitably dried.

15 **[0003]** Since the dry air hits the laundry and removes the moisture from the laundry as described above, the air becomes highly humid. The highly humid air is then discharged into an air duct outside the drum. Since the processes for drying laundry are carried out particularly in a narrow space in the drum, various methods have been proposed to efficiently and uniformly dry laundry in a short period of time (see, for example, Japanese Patent Application Laid-open No. 2008-259549).

20 **[0004]** FIG. 16 is a schematic view showing main portions of a conventional drum-typed washing dryer described in Japanese Patent Application Laid-open No. 2008-259549. As shown in FIG. 16, the conventional drum-typed washing dryer is provided with a switching valve 102. The switching valve 102 switches blowing path of dry air suctioned into a blower 101. The conventional drum-typed washing dryer controls the switching valve 102 during the drying processes to blow the dry air into the drum from a front blowout port near the opening of the drum in a period of a constant drying rate. In addition, the washing dryer also blows the dry air into the drum from a rear blowout port provided in the rear of the drum during a period of a decreasing drying rate. As a result, laundry is shortly and uniformly dried.

25 **[0005]** The drum-typed washing dryer described above is provided with a switching mechanism including a member configured to closes the air duct (such as a valve). The switching mechanism suitably switches the blowing path of the dry air. For example, the switching mechanism uses a valve to open one of the blowing paths and simultaneously close the other blowing path. As a result, the desired blowing path is selected.

30 **[0006]** However, the aforementioned switching mechanism has drawbacks in terms of control for stably switching the blowing paths. For example, if debris becomes entrapped in the valve of the switching mechanism, the valve becomes locked, so that valve position may be no longer suitably controlled.

35 **[0007]** In case of improper switching control of the blowing path, the desired blowing path may not be selected or air leakage from the blowing paths may occur. As a result, the drying performance considerably becomes worse. Thus, the drying time becomes longer and power consumption increases. In addition, the laundry may be unevenly dried or wrinkled.

[0008] In particular, a lot of lint and other debris are present in laundry dryers and washing dryers used to dry laundry after washing. Thus, it is likely that the debris causes valve lockup and air leakage.

40 **SUMMARY OF THE INVENTION**

[0009] An object of the present invention is to provide a highly reliable switching mechanism, which is likely to prevent the debris from causing lockup and air leakage, and a laundry dryer and a washing dryer provided with the switching mechanism.

45 **[0010]** A switching mechanism according to one aspect of the present invention is provided with a first blowing path through which blown fluid passes; a second blowing path branching from the first blowing path to allow the fluid to pass through; a pivotal blocking member mounted in a branch between the first blowing path and the second blowing path; a drive motor configured to drive the blocking member; and a deceleration gear configured to transmit driving force of the drive motor to the blocking member, wherein the blocking member selectively blocks one of the first blowing path and the second blowing path.

50 **[0011]** A laundry dryer according to another aspect of the present invention is provided with the aforementioned switching mechanism, a container configured to contain laundry; a blower configured to send dry air as the fluid to dry the laundry into the container through one of the first blowing path and the second blowing path; and a controller configured to control the switching mechanism so that the switching mechanism selectively switches flow path of the dry air between the first blowing path and the second blowing path.

55 **[0012]** A washing dryer according to another aspect of the present invention is provided with the aforementioned laundry dryer and a water tub which includes the container and retains wash water.

BRIEF DESCRIPTION OF THE DRAWINGS**[0013]**

5 FIG. 1 is a cross-sectional side view of a drum-typed washing dryer according to one embodiment;
 Fig. 2 is a schematic block diagram of the washing dryer shown in FIG. 1;
 FIG. 3 is a schematic perspective view of a duct switcher of the washing dryer shown in FIG 1;
 FIG. 4 is a schematic perspective view of the duct switcher of the washing dryer shown in FIG. 1;
 FIG. 5 is a schematic view of a louver of the duct switcher shown in FIGS. 3 and 4;
 10 FIG. 6 is a schematic plane view of a guiding duct of the washing dryer shown in FIG 1;
 FIG. 7 is a schematic plane view of the guiding duct of the washing dryer shown in FIG 1;
 FIG. 8 is a schematic cross-sectional view along line A-A of FIG. 4;
 FIG. 9 is a schematic perspective view of the guiding duct shown in FIGS. 6 and 7;
 FIG. 10 is a schematic enlarged perspective view around a branch between first and second blowing paths;
 15 FIG. 11 is a timing chart exemplifying switching timings for a dry air path;
 FIG. 12 is a schematic perspective view showing an internal structure of a guiding duct;
 FIG. 13 is an enlarged perspective view around a rib of the guiding duct shown in FIG 12;
 FIG. 14 is a schematic perspective view showing an internal structure of a guiding duct;
 FIG. 15 is an enlarged perspective view around a rib of the guiding duct shown in FIG 14; and
 20 FIG. 16 is a schematic drawing of main portions of a conventional drum-typed washing dryer.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

25 **[0014]** A drum-type washing dryer according to one embodiment is described hereinafter with reference to the accompanying drawings. It should be noted that detailed structures shown in the drawings or described hereinafter are merely exemplary, and are not intended to limit the methodologies of the switching mechanism, laundry dryer and washing dryer in any way.

(Structure of Washing Dryer)

30 **[0015]** FIG 1 is a cross-sectional side view of a drum-typed washing dryer according to one embodiment. The washing dryer described below is also exemplified as a laundry dryer.

35 **[0016]** A washing dryer 500 shown in FIG. 1 is provided with a cylindrical drum 1 configured to contain laundry. The drum 1 has an opening in the front. In addition, the drum 1 has a bottom in opposition to the opening. In the present embodiment, the drum 1 is exemplified as the container.

[0017] The washing dryer 500 is further provided with the cylindrical water tub 2 configured to retain wash water. The drum 1 is supported in the water tub 2. The washing dryer 500 is further provided with a drive motor 3 attached to the back of the water tub 2. The drive motor 3 rotates the drum 1. The rotation axis of the drum 1 is upward inclined toward the front.

40 **[0018]** The washing dryer 500 is further provided with a door 35, which is opened and closed by a user. The door 35 faces the opening of the drum 1. The user may open the door 35 to put and take out laundry (clothes) into and from the drum 1.

45 **[0019]** The washing dryer 500 is further provided with a water supply pipe (not shown) attached to the water tub 2 and a water supply valve (not shown) attached to the water supply pipe. When the water supply valve is opened, water is supplied to the water tub 2 through the water supply pipe. The washing dryer 500 is further provided with a drain pipe 40 connected to the water tub 2 and a drain valve 41 attached to the drain pipe 40. When the drain valve 41 is opened, water is drained from the water tub 2.

50 **[0020]** The washing dryer 500 is further provided with a blower 4 configured to circulate dry air for drying the laundry. Dry air sent into the drum 1 by the blower 4 removes moisture from the laundry and becomes more humid. The dry air is exemplified as the fluid in the present embodiment.

[0021] An exhaust port 5 is formed on the water tub 2. Dry air is discharged outside the water tub 2 through the exhaust port 5 near the peripheral surface of the drum 1.

55 **[0022]** The washing dryer 500 is further provided with a dehumidifier 6 which dehumidifies the dry air, and a heater 7 which heats the dry air. The dry air passed through the exhaust port 5, then, flows into the dehumidified 6 to be dehumidified. The dry air dehumidified by the dehumidifier 6 is then heated by the heater 7.

[0023] The washing dryer 500 is further provided with a first duct 9 which guides dry air and a second duct 11 branching from the first duct 9. The heated dry air is guided to one of the first and second ducts 9,11. Subsequently, the dry air again flows into the drum 1. In the present embodiment, the first duct 9 is exemplified as a first blowing path. In addition,

the second duct 11 is exemplified as a second blowing path.

[0024] The first duct 9 includes a first blowout port 8 opened in the rear of the drum 1. The second duct 11 includes a second blowout port 10 in fluid communication with the opening of the drum 1. The first blowout port 8 of the first duct 9 has a larger cross-sectional area than the second blowout port 10. Thus, pressure loss of dry air flowing along the first duct 9 is less than that of dry air flowing along the second duct 11. Thus, a larger volume of the dry air flows into the drum 1 from the first blowout port 8. The dry air blown out from the second blowout port 10 flows into the drum under higher pressure at higher speed than the dry air blown out from the first blowout port 8 due to the smaller cross-sectional area of the second blowout port 10 than that of the first blowout port 8.

[0025] In a front portion of the washing dryer 500, a gap between the drum 1 and the water tub 2 is preferably designed to be as small as possible. As a result, it is less likely that the laundry enters the gap between the drum 1 and the water tub 2. It is difficult to provide a comparatively large blowout port (blowout port with low pressure loss) such as the first blowout port 8 described above in the narrow gap between the drum 1 and the water tub 2. However, since the second blowout port 10 has a smaller cross-sectional area than the first blowout port 8, the narrow gap between the drum 1 and the water tub 2 is preferably exploited to install the second blowout port 10 from which dry air is blown out under high pressure at high speed.

[0026] In a rear portion of the washing dryer 500, the first blowout port 8 with a comparatively large opening area is formed in the bottom of the comparatively wide water tub 2. The washing dryer 500 is further provided with a cover 36 configured to cover the first blowout port 8. A large number of small holes through which the dry air flows are formed in the cover 36. Thus, the cover 36 as a whole has a large aperture ratio. The cover 36 prevents the laundry from entering into the first blowout port 8. The first blowout port 8 formed in the bottom of the water tub 2 achieves inflow of the dry air with a comparatively low pressure loss.

[0027] In the present embodiment, the rotation axis of the drum 1 is upward inclined towards the front. It is likely that small laundry such as socks, handkerchiefs or underpants accumulates in the bottom of the drum 1 during rotation of the drum 1. On the other hand, it is likely that long laundry such as long-sleeved undershirts, undershorts, long-sleeved dress shirts or long-sleeved pajamas accumulates in the front of the drum 1.

[0028] If a user puts a mixture of small laundry and long laundry in the drum 1, a large amount of the dry air blown out from the first blowout port 8 near the bottom of the drum 1 first hits the small laundry intensively distributed in the bottom of the drum 1. Subsequently, the dry air passes through the small laundry and hits the long laundry intensively distributed in the front side of the drum 1. Thus, both small laundry and long laundry are efficiently dried. In addition, it is likely that the aforementioned drying methodologies cause comparatively few wrinkles in the small laundry.

[0029] Since it is likely that the long laundry become twisted due to agitation during the drying process, more wrinkles are likely to be formed in the long laundry than in the small laundry. Since it is likely that the long laundry becomes intensively distributed towards the front of the drum 1 as described above, the dry air blown out from the second blowout port 10 may more quickly dry the long laundry than the dry air blown out from the first blowout port 8. In addition, since dry air blown out from the second blowout port 10 flows under high pressure at high speed as described above, the dry air blown out from the second blowout port 10 may preferably spread and considerably move considerably the long laundry in the drum 1. As a result, the dry air blown out from the second blowout port 10 may decrease wrinkles formed in the long laundry.

[0030] A branch between the first and second ducts 9, 11 is formed at a downstream position of the blower 4. The washing dryer 500 is further provided with a duct switcher 12 arranged in the branch between the first and second ducts 9, 11. The duct switcher 12 switches a path of dry air to one of the first and second ducts 9, 11. As a result, the dry air sent from the blower 4 is supplied to the drum 1 after passing through one of the first and second ducts 9, 11. In the present embodiment, the duct switcher 12 is exemplified as a switching mechanism,

[0031] The duct switcher 12 is provided with a pivotal louver 21 supported in the branch between the first and second ducts 9, 11, and a drive unit which pivots the louver 21. When the louver 21 pivots to be upright and closes the second duct 11 (the louver 21 indicated by the reference symbol "a" in FIG. 1), the first duct 9 is opened, so that dry air sent from the blower 4 passes through the first duct 9. When the first duct 9 is closed by the inclined louver 21, which traverses the flow of dry air sent from the blower 4 (the louver 21 indicated by the reference symbol "b" in FIG. 1), the second duct 11 is opened, so that the dry air sent from the blower 4 passes through the second duct 11. The duct switcher 12 is described hereinafter.

[0032] The washing dryer 500 is further provided with a circulation duct 13, which defines a circulation path of the dry air. The blower 4, the duct switcher 12, the dehumidifier 6 and the heater 7 are arranged in the circulation duct 13. One end of the circulation duct 13 is connected to the water tub 2 and becomes the exhaust port 5. Dry air in the drum 1 is discharged from the exhaust port 5, and then passes through the dehumidifier 6 and the heater 7. The blower 4 resends the dry air passed through the heater 7 to the drum 1. The duct switcher 12 determines the path of the dry air after the blower 4. If the duct switcher 12 allows the dry air to flow along the first duct 9, the dry air flows into the drum 1 through the first blowout port 8. If the duct switcher 12 allows the dry air to flow along the second duct 11, the dry air passes flows into the drum 1 through the second blowout port 10. Thus, the dry air is circulated in the washing dryer 500.

[0033] The blower 4 situated between the heater 7 and the duct switcher 12 sends dry air heated by the heater 7 downstream along the circulation duct 13. The blower 4 is provided with a fan 4a and a fan motor 4b configured to rotate the fan 4a. If the duct switcher 12 switches the path of the dry air to the first duct 9, the fan motor 4b of the blower 4 rotates to achieve a given flow rate predetermined so that dry air flow along the first duct 9 becomes more than that along the second duct 11. If the duct switcher 12 switches the path of dry air to the second duct 11, the fan motor 4b of the blower 4 rotates the fan 4a to achieve a given flow rate predetermined so that dry air speed along the second duct 11 is higher than that along the first duct 9. For example, if the flow rate of dry air passing through the first blowout port 8 is about 10 m/s, then the flow rate of dry air passing through the second blowout port 10 may be set to about 50 m/s or more. It should be noted that as long as the flow rate of dry air at the second blowout port 10 is higher than that of dry air at the first blowout port 8, the flow rates of the dry air passing through the first and second blowout ports 8, 10 may be set to other values, respectively.

[0034] The drum-typed washing dryer 500 according to the present embodiment makes the flow volume of dry air passing through the first duct 9 greater than that of dry air passing through the second duct 11. In addition, the washing dryer 500 makes the flow rate of dry air passing through the second blowout port 10 of the second duct 11 higher than that of dry air passing through the first blowout port 8. It should be also noted that the washing dryer 500 operates the duct switcher 12 in the drying process to switch the circulation path of dry air between the first and second ducts 9, 11.

[0035] The exhaust port 5 is formed farther away from the first blowout port 8 than the second blowout port 10 (namely, the exhaust port 5 is formed closer to the second blowout port 10 than the first blowout port 8). Thus, the exhaust port 5 becomes closer to the front of the drum 1 rather than the rear of the drum 1. The exhaust port 5 may be also formed near the second blowout port 10 in front of the drum 1. As a result, the distance between the exhaust port 5 and the first blowout port 8 becomes comparatively long.

[0036] The exhaust port 5 is formed near the top of the drum 1. As a result, dry air hit to laundry is efficiently discharged upward. It should be noted if methodologies according to the present embodiment are applied to a drum-typed washing dryer without a washing function, it is not necessary to form the exhaust port for discharging dry air from the drum 1 near the top of the drum. In the present embodiment, the washing dryer 500 washes laundry with wash water. Therefore, the exhaust port 5 is formed at a higher position than the wash water level, so that it is less likely that the wash water flows into the exhaust port 5.

[0037] The second blowout port 10 in front of the drum 1 opens in an upper portion of the drum 1. Thus, highly pressurized and high-speed dry air is effectively blown onto laundry, which bounces upward as the rotation of the drum 1. Consequently, the dry air from the second blowout port 10 effectively decreases wrinkle formation in the laundry.

[0038] The washing dryer 500 is further provided with a damper 14 below the water tub 2. The damper 14 supports the water tub 2. During dewatering laundry, for example, the laundry is unevenly distributed in the drum 1, so that weight distribution of the drum 1 becomes unbalanced. The unbalanced weight distribution of the drum 1 causes vibration of the water tub 2 during the rotation of the drum 1. The damper 14 suitably attenuates the vibration of the water tub 2.

[0039] The damper 14 is provided with a shaft 141 which vertically reciprocates in response to weight of laundry in the water tub 2. The washing dryer 500 is further provided with a sensor 15 configured to detect the weight of laundry in the water tub 2 based on the displacement amount of the shaft 141. The sensor 15 is attached to the damper 14.

[0040] The drum-typed washing dryer 500 according to the present embodiment uses a heat pump system to dehumidify and heat dry air. The washing dryer 500 is provided with a heat pump device 50. The heat pump device 50 is provided with a compressor 16 which compresses coolant, a radiator 17 which dissipates heat of the coolant that has become high temperature and high pressure due to the compression, a restrictor 18 which reduces pressure of the highly pressurized coolant, a heat sink 19 which absorbs surrounding heat with the coolant after the reduction in pressure by the restrictor 18, and a pipeline 20 connected to the compressor 16, the radiator 17, the restrictor 18 and the heat sink 19. The coolant is circulated through the pipeline 20. The heat sink 19 is used as the aforementioned dehumidifier 6. In addition, the radiator 17 is used as the aforementioned heater 7.

[0041] In the present embodiment, the drum-typed washing dryer 500 washes laundry using the heat pump device 50. Alternatively, the methodologies according to the present embodiment may be also applied to any device provided with another structure for drying laundry. For example dry air may be dehumidified using a water cooling device which sprays water directly into dry air. In addition, dry air may be heated by an electrical heater.

[0042] FIG. 2 is a schematic block diagram of the drum-typed washing dryer 500. The washing dryer 500 is further described with reference to FIGS. 1 and 2.

[0043] The washing dryer 500 is provided with a controller 70 and an input setting portion 32. A user may input setting information relating to operation of the washing dryer 500 to the input setting portion 32. The controller 70 controls a series of operations such as washing, dewatering and drying on the basis of the setting information with monitoring various elements of the washing dryer 500, which operates on the basis of the setting information. For example, in the drying process, the controller 70 controls rotation speed of the drive motor 3 with a motor drive circuit 42. In addition, the controller 70 controls operations of the blower 4 and the heat pump device 50 to adjust various parameters such as flow rate, temperature and humidity of dry air. In addition, the controller 70 controls the duct switcher 12 to selectively

switch the flow path of the dry air between the first and second ducts 9, 11. The controller 70 may include, for example, a central processing unit (CPU) (not shown), a read only memory (ROM) which stores a program, a random access memory (RAM) which stores programs and data during execution of various processes, an input/output interlace and a bus which connects them.

[0044] The controller 70 is provided with a timer 71. The timer 71 sets a first set time and a second set time, which are described hereinafter. The timer 71 may be, for example, an internal timer incorporated as a part of the internal operational functions carried out by the controller 70. Alternatively, the timer may be also a timer device provided separately from the controller.

[0045] The washing dryer 500 according to the present embodiment is provided with a single first blowout port 8. Alternatively, the washing dryer may be also provided with several first blowout ports.

[0046] Similarly, the washing dryer 500 is provided with a single second blowout port 10. Alternatively, the washing dryer may be also provided with several second blowout ports.

[0047] FIGS. 3 and 4 are schematic perspective views of the duct switcher 12. FIG. 5 is a schematic view of the louver 21. The duct switcher 12 is described with reference to FIGS. 1 to 5.

[0048] As described above, the duct switcher 12 is mounted in the branch between the first and second ducts 9, 11. In the present embodiment, the first duct 9 extends linearly from the blower 4 as shown in FIGS. 1, 3 and 4. The second duct 11 branches from the first duct 9. In the present embodiment, the second duct 11 branches substantially at a right angle (approximately 90 degrees) with respect to the first duct 9. Alternatively, the branching angle of the second duct with respect to the first duct may be also another value.

[0049] As described above, the first duct 9 configured to guide a comparatively large flow volume of dry air extends linearly from the blower 4, so that pressure loss of the dry air flowing along the first duct 9 becomes very small. Thus, the large flow volume of the dry air is efficiently sent into the drum 1 through the first duct 9.

[0050] As shown in FIGS. 3 and 4, the first duct 9 configured to guide a comparatively large flow volume of dry air has a larger cross-sectional area (area of a cross-sectional region through which dry air flow) than the second duct 11 configured to guide dry air flowing at high speed.

[0051] In the present embodiment, the cross-sectional shape of the first duct 9 around the branch between the first and second ducts 9, 11 is not circular, but rectangular as shown in FIGS. 3 and 4. Since the cross-sectional shape of the first duct 9 around the branch is substantially rectangular, the peripheral walls of the first duct 9 are flat. Thus, other components are easily attached to the flat peripheral walls of the first duct 9.

[0052] In the present embodiment, the cross-sectional shape of the first duct 9 around the branch between the first and second ducts 9, 11 is substantially rectangular. Alternatively, the cross-sectional of the first duct 9 around the branch between the first and second ducts 9, 11 may also have a different shape. For example, the first duct 9 around the branch between the first and second ducts 9, 11 may be also formed to have a substantially circular cross-section.

[0053] FIGS. 6 and 7 are schematic plane views of a guiding duct which guides dry air from the blower 4 to the branch between the first and second ducts 9, 11. The guiding duct is described with reference to FIG 1 and FIGS. 3 to 7.

[0054] The washing dryer 500 is further provided with a guiding duct 24 configured to guide dry air from the blower 4 to the branch between the first and second ducts 9, 11. The guiding duct 24 is provided with a casing portion 25 which defines a room in which the fan 4a of the blower 4 is situated. The casing portion 25 includes a first casing wall 25a shown in Fig. 6 and a second casing wall 25b shown in FIG. 7. The first and second casing walls 25a, 25b include fastening portions 25c, respectively, which protrude to the outside. The first casing wall 25a is superimposed on the second casing wall 25b, and then their fastening portions 25c are fixed together using suitable fastening members such as bolts. The fan 4a of the blower 4 is placed in the internal space formed by the superimposed first and second casing walls 25a, 25b.

[0055] A first guiding duct 26 used as a part of the first duct 9 is arranged at a downstream position of the casing portion 25. The aforementioned branch is formed immediately before the first guiding duct 26. As shown in FIG. 6, the guiding duct 24 is further provided with a duct piece 26a integrally formed with the first casing wall 25a, and a duct piece 26b integrally formed with the second casing wall 25b. The duct piece 26a is superimposed on the duct piece 26b and forms an interval from the casing portion 25 to the branch immediately before the first guiding duct 26.

[0056] In the present embodiment, the first casing wall 25a and the duct piece 26a are integrally molded from a material such as synthetic resin as shown in FIG 6. In addition, the second casing wall 25b and the duct piece 26b are integrally molded from a material such as synthetic resin as shown in FIG. 7. The duct pieces 26a and 26b are provided with the fastening portions 25c, respectively, similarly to the first and second casing walls 25a, 25b. When the duct piece 26a is superimposed on the duct piece 26b and then their fastening portions 25c are fixed together using suitable fastening members such as bolts, an interval from the casing portion 25 to the branch immediately before the first guiding duct 26 is formed. It should be noted that the upper portion of the branch shown in FIG. 3 corresponds to the duct piece 26a described in the context of FIG. 6. In addition, the lower portion of the branch shown in FIG. 3 corresponds to the duct piece 26b described in the context of FIG 7.

[0057] As shown in FIGS. 6 and 7, the guiding duct 24 is provided with ribs 28 protruding from the inner surface of

the duct pieces 26a and 26b, respectively. When the duct pieces 26a and 26b are superimposed, the ribs 28 on the duct pieces 26a, 26b form a substantially C-shaped protruding contour.

[0058] The first duct 9 further extends downstream from the first guiding duct 26 to the first blowout port 8 formed in the water tub 2. As shown in FIG 6, a second guiding duct 27 used as a part of the second duct 11 is formed in the duct piece 26a.

[0059] As shown in FIG 3, the duct switcher 12 in the branch between the first and second ducts 9, 11 is provided with the louver 21, a deceleration gear 22, a drive motor 23 which drives the louver 21, and the rib 28.

[0060] The louver 21 selectively blocks one of the first and second ducts 9, 11. FIG. 3 shows the louver 21 blocking the second duct 11, which causes dry air circulation through the first duct 9. FIG. 4 shows the louver 21 blocking the first duct 9, which causes dry air circulation through the second duct 11.

[0061] As shown in FIG. 5, the louver 21 is provided with a pivot shaft 21a mounted in the branch between the first and second ducts 9, 11, a gear mounting portion 21b situated on the upper end of the pivot shaft 21a, and a blocking portion 21c fixed to the pivot shaft 21a. The blocking portion 21c selectively blocks one of the first and second ducts 9, 11. In the present embodiment, the blocking portion 21c is exemplified as the blocking member.

[0062] The louver 21 is formed from a material such as synthetic resin. The blocking portion 21c of the louver 21 includes an upper edge 21x, a lower edge 21y and a distal edge 21z. The dimensions and contours of the upper edge 21x, the lower edge 21y and the distal edge 21z are determined in accordance with the cross-sectional shape of the guiding duct 24 in the branch.

[0063] The blocking portion 21c of the louver 21 has a larger surface area than the cross-sectional area of the second duct 11 connected to the branch. As shown in FIG. 3, the blocking portion 21c arranged at a position perpendicular to the second duct 11 completely blocks the second duct 11.

[0064] The blocking portion 21c of the louver 21 slightly smaller than the cross-section of the first duct 9 is pivoted in the branch formed in the guiding duct 24. A gap is formed between the upper or lower edge 21x, 21y of the blocking portion 21c and the inner surface of the first duct 9. Designing an excessively narrow gap between the upper or lower edge 21x, 21y and the inner surface of the first duct 9 not only requires excessively high mounting accuracy, but also is likely to cause debris entrapped in the gap. Thus, the gap between the upper or lower edge 21x of the blocking portion 21c and the inner surface of the first duct 9 may be set to about 1.5 mm.

[0065] As shown in FIGS. 3, 6 and 7, the rib 28 is formed on the inner surface of the first duct 9. The rib 28 contacts the edges (upper edge 21x, lower edge 21y and distal edge 21z) of the blocking portion 21c of the louver 21. The rib 28 is formed at a downstream position of the blocking portion 21c of the louver 21 in the flow direction of dry air. As shown in FIG. 4, when the louver 21 pivots and blocks the first duct 9, the edges (upper edge 21x, lower edge 21y and distal edge 21z) of the blocking portion 21c contact the rib 28. As a result, the first duct 9 is completely sealed by the blocking portion 21c and the rib 28.

[0066] FIG 8 schematically shows contact between the louver 21 and the rib 28. It should be noted that FIG. 8 schematically shows a cross-section along line A-A shown in FIG 4. The contact between the louver 21 and the rib 28 is described with reference to FIGS. 4 and 8.

[0067] If the rib 28 is excessively largely protrudes (too large protruding amount from the inner surface of the first duct 9), the rib 28 causes large air resistance. Therefore, the protruding amount of the rib 28 is preferably set to, for example, about 2 mm. If the gap between the edges (upper edge 21x, lower edge 21y and distal edge 21z) of the blocking portion 21c of the louver 21 and the inner surface of the first duct 9 is set to about 1.5 mm, an overlapping amount between the rib 28 protruding by about 2 mm and the blocking portion 21c becomes about 0.5 mm. The overlapping amount of about 0.5 mm is large enough to seal the first duct 9. It should be noted that the aforementioned values for the protruding amount of the rib 28, the gap between the louver 21 and the inner surface of the first duct 9 and the overlapping amount are merely intended to be examples thereof, so that other values may be also set for these dimensional parameters.

[0068] An angle θ shown in FIG. 4 refers to a pivot angle of the louver 21 from the blocking position for the second duct 11 to the blocking position for the first duct 9 (or, the angle formed by the blocking portion 21c of the louver 21 which contacts the rib 28 to the extending direction of the first duct 9). In the present embodiment, the angle θ is set to about 50 degrees. If the angle θ is set to an angle less than 90 degrees (about 50 degrees in the present embodiment), pressure loss attributable to collision of dry air flowing into the second duct 11 branching from the first duct 9 with the blocking portion 21c of the louver 21 becomes very small (in comparison with the angle θ being set to 90 degrees). Thus, the flow path of dry air becomes gently curved towards the second duct 11. Thus, dry air efficiently flows into the second duct 11.

[0069] In the present embodiment, the angle θ is set to an angle larger than 45 degrees (about 50 degrees in the present embodiment). Since the angle θ is set to the angle larger than 45 degrees, the cross-sectional area of the flow path of dry air which curves towards the second duct 11 becomes larger in comparison with the set angle θ to 45 degrees. In the present embodiment, the angle θ is preferably set within a range from 50 degrees to 55 degrees in consideration of pressure loss at the corner in the branch between the first and second ducts 9, 11 and the cross-sectional area of the flow path of dry air.

[0070] The rib 28 arranged at the downstream position of the louver 21 which blocks the first duct 9 becomes substantially parallel to the blocking portion 21c of the louver 21. The edges (upper edge 21x, lower edge 21y and distal edge 21z) of the blocking portion 21c of the louver 21 tightly contact the rib 28 at the blocking position for the first duct 9. A sealing member such as an O-ring is preferably provided where the blocking portion 21c of the louver 21 and the rib 28 make contact. The sealing member reduces air leakage from between the blocking portion 21c of the louver 21 and the rib 28. The sealing member such as an O-ring may be also attached to one of the blocking portion 21c of the louver 21 and the rib 28.

[0071] FIG 9 is a schematic perspective view of the guiding duct 24. Attachment of the louver 21 is described with reference to FIGS. 3 to 6 and FIG 9.

[0072] One end of the pivot shaft 21a of the louver 21 arranged in the first duct 9 is pivotally supported by the guiding duct 24. The other end of the pivot shaft 21a slots through a mounting hole 24a provided in the guiding duct 24 (see FIGS. 6 and 9) to be pivotally supported. A gear mounting portion 21b is provided on the end of the pivot shaft 21a, which slots through the mounting hole 24a to protrude outside the first duct 9 (see FIG 5). A second gear 22b of the deceleration gear 22 is attached to the gear mounting portion 21b as shown in FIGS. 3 and 4.

[0073] The deceleration gear 22 transmits driving force of the drive motor 23 to the blocking portion 21c, and is provided with a first gear 22a (cylindrical spur gear) and the second gear 22b (fan-shaped spur gear) configured to engages with the first gear 22a. The first gear 22a is smaller in diameter than the second gear 22b. The first gear 22a is used as a pinion gear (small diameter gear). The first gear 22a is attached to the rotating shaft 23a of the drive motor 23. Driving force of the drive motor 23 is directly transmitted to the first gear 22a. It should be noted that drive transmission from the drive motor 23 to the first gear 22a may be also achieved by another drive transmission system instead of the direct transmission system described above.

[0074] The second gear 22b engaging with the first gear 22a rotates as the rotation of the first gear 22a. Thus, the first gear 22a is used as a driving gear while the second gear 22b is used as a driven gear.

[0075] The reference symbol "Z1" is assigned to the number of teeth of the first gear 22a (driving gear) hereinafter. In addition, the reference symbol "Z2" is assigned to the number of teeth of the second gear 22b (driven gear). The deceleration ratio of the deceleration gear 22 is represented as $Z2/Z1$.

[0076] The reference symbol "N1" is assigned to the rotating speed of the first gear 22a (driving gear) hereinafter. In addition, the reference symbol "N2" is assigned to the rotating speed of the second gear 22b (driven gear). The deceleration ratio of the deceleration gear 22 is represented as $N1/N2$. The driving torque of the louver 21 attached to the second gear 22b is adjusted in accordance with the deceleration ratio of the deceleration gear 22.

[0077] As described above, a sufficiently large driving torque of the louver 21 is obtained from the combination of the drive motor 23 and the deceleration gear 22. For example, the driving torque of the louver 21 is preferably set so that it becomes less likely that debris is entrapped between the louver 21 and the first duct 9 to lock the louver 21.

[0078] FIG. 10 is a schematic enlarged perspective view around the branch between the first and second ducts 9, 11. The drive for the louver 21 is described with reference to FIGS. 2 to 4 and FIG. 10.

[0079] As shown in FIG 10, the first and second gears 22a, 22b are covered by a cover 29. It is likely that the cover 29 prevents external debris from entering into the engagement portion between the first and second gears 22a, 22b as well as the first duct 9.

[0080] In the present embodiment, a stepping motor which bi-directionally rotates is used for the drive motor 23. The controller 70 described in the context of FIG. 2 applies drive pulses to the drive motor 23 to adjust the amount of rotation (rotation angle) of the drive motor 23, which results in suitably controlled operation of the louver 21.

[0081] As shown in FIG. 3, if the louver 21 is driven towards the blocking position for the second duct 11, the controller 70 applies an excess number of drive pulses to the drive motor 23 so as to cause a slight overrun. As a result, when the louver 21 contacts the wall surface around the second duct 11, a prescribed pressure is applied to the louver 21. Thus, the louver 21 may suitably block the second duct 11.

[0082] As shown in FIG 3, a restrictive rib 30 is formed on the outer surface of the guiding duct 24. The restrictive rib 30 restricts rotation of the second gear 22b to the left if the restrictive rib 30 contacts the right end 22c of the fan-shaped second gear 22b. Thus, it is less likely that the louver 21 excessively pivots to the left.

[0083] Similarly, as shown in FIG. 4, if the louver 21 is driven towards the blocking position for the first duct 9, the controller 70 applies an excess number of drive pulses to the drive motor 23 so as to cause a slight overrun. As a result, when the louver 21 contacts the rib 28, a prescribed pressure is applied to the louver 21. Thus, the louver 21 may suitably block the first duct 9.

[0084] As shown in FIG. 4, a restrictive rib 31 is formed on the outer surface of the guiding duct 24. The restrictive rib 31 restricts rotation of the second gear 22b to the right if the restrictive rib 31 contacts the left end 22d of the fan-shaped second gear 22b. Thus, it is less likely that the louver 21 excessively pivots to the right. An upper portion of the corner of the branch between the first and second ducts 9, 11 is recessed to form the restrictive ribs 30, 31.

(Operation of Washing Dryer)

[0085] Operation and advantageous effects of the aforementioned drum-typed washing dryer 500 is described.

[0086] It is less likely that the aforementioned washing dryer 500 wrinkles laundry during the drying process.

[0087] It is likely that laundry is dried without stretching enough in a small drum, which causes numerous wrinkles in the laundry dried in the small drum. This makes users disappointed. In particular, there may be numerous wrinkles if laundry largely contains cotton. Thus, it is likely that an increase in cotton in the laundry makes condition of dried laundry worse.

[0088] While moisture intervenes among cotton fibers, the cotton fibers may move comparatively freely. Thus, even if laundry agitated as rotation of the drum are folded up by mechanical force, the folded portions are stretched out to remove the wrinkles by a force subsequently applied in a direction so that the force stretches out the laundry.

[0089] When the moisture in the cotton fibers decreases as the drying process progresses, cohesive force among the cotton fibers becomes stronger. Therefore it becomes harder that the cotton fibers move. If mechanical strength acts on cotton fibers which contain less moisture to bend them, it is likely that the cotton fibers maintain the bent shapes.

[0090] As the drying process further progresses, the moisture in the cotton fibers further decreases. Even if force is subsequently applied in a direction to stretch out the cotton fibers, the cotton fibers are kept bent and are hardly stretched out. This condition is referred to as "wrinkle fixation".

[0091] Therefore the drying process for drying laundry facilitates evaporation of moisture from the laundry whereas the drying process also forms wrinkles in the laundry because of a reduction in moisture. Larger wrinkle fixation means worse finishing condition of dried laundry.

[0092] If the drum is small, cotton fibers are usually bent. Thus, in order to reduce wrinkles, it is necessary to reduce the number of laundry wrinkles in the drum as well as sharp bending of fibers (at sharp bending angles) which is likely to cause strong wrinkle fixation. If bending portions of fibers are subsequently stretched out whereas fibers in other areas are bent, laundry wrinkles are reduced even in case of the small drum. It is preferable that the bending portions frequently move during the drying process. If the moisture in fibers decreases as the drying process progresses, it becomes likely that the strong cohesive force among the fibers prevents new wrinkles from being caused by bending force acting on the stretched fibers.

[0093] According to the aforementioned consideration, it depends on laundry dryness whether laundry is subject to wrinkles. A drying rate under which it is likely that laundry wrinkles are fixed is described on the basis of laundry made from cotton fibers (laundry which is the most likely to cause wrinkles).

[0094] It is the most likely that wrinkles are fixed under a drying rate ranged from about 85% to about 100%. If the drying rate for the laundry made from cotton fibers in particular is in a range from about 90% to about 100%, it is the most likely that the laundry fixedly wrinkles. It should be noted that the drying rate (%) is represented by the following equation.

[Equation 1]

Drying rate (%) = (standard laundry weight/weight of laundry containing moisture) × 100,

where the "standard laundry weight" refers to the weight of laundry measured under a temperature of 20°C and humidity of 65%.

[0095] Landry wrinkles are described in relation to uneven dryness on a single piece of cloth.

[0096] Even a single piece of cloth may be unevenly dried. If the cloth is not uniformly dried, there are some areas which are slowly dried. For example, the underarm areas of long-sleeved shirts become the most slowly dried area.

[0097] In general, in consideration of the aforementioned uneven dryness, a target value for the drying rate at the end of the drying process is set to a value over 100% (for example, to a drying rate from 102% to 105%). Laundry is over-dried if the laundry is uniformly dried at such a target value.

[0098] A range from a drying rate immediately after dewatering to a drying rate of about 90% is referred to as the "initial drying stage". In the initial drying stage, it is less likely that laundry fixedly wrinkles as described above. A range of a drying rate from about 90% to about 100% is referred to as the "intermediate drying stage". In the intermediate drying stage, it is likely that the laundry fixedly wrinkles. A range of drying rate over 100% is referred to as the "final drying stage". In the final drying stage, it is less likely that laundry fixedly wrinkles as described above.

[0099] In the present embodiment, dry air at high pressure and high speed is sent out from the second blowout port 10 of the second duct 11 during the intermediate drying stage. The high-pressure and high-speed dry air sent out from

the second blowout port 10 of the second duct 11 serves to effectively stretch out the laundry and reduce its wrinkles. Dry air at a comparatively high flow volume is supplied from the first blowout port 8 of the first duct 9 during at least one of the initial and final drying stages. It contributes to electrical power saving to switch the supply path of dry air between the first and second ducts 9, 11 during the drying process.

[0100] As described above, the "initial drying stage", "intermediate drying stage" and "final drying stage" determined for the time period of the drying process may be estimated on the basis of elapsed time from a start of the drying process. In the present embodiment, the controller 70 determines whether the drying process is in the "initial drying stage", "intermediate drying stage" or "zeal drying stage" based on the elapsed time from the starting time of the drying process. The controller 70 controls the duct switcher 12 based on the results of the aforementioned determination to switch the path of dry air between the first and second ducts 9, 11.

[0101] For example, the controller 70 stores a first set time period determined for execution time of the drying process in advance. Unless the elapsed time from the start of the drying process exceeds the first set time, the controller 70 determines that the drying process is in the initial drying stage. The controller 70 also preliminarily stores a second set time period determined for execution time of the drying process. It should be noted that the second set time period is set to a larger value than the first set time period. If the elapsed time of the drying process is in a range from the first set time to the second set time, the controller 70 determines that the drying process is in the intermediate drying stage. If the elapsed time of the drying process exceeds the second set time, the controller 70 determines that the drying process is in the final drying stage.

[0102] The controller 70 suitably switches the path of dry air between the first and second ducts 9, 11 based on the results of the aforementioned determination during the drying process. Consequently, wrinkles on laundry are effectively reduced using a single blower 4.

[0103] As described above, a comparatively large flow volume of dry air is supplied from the first blowout port 8 of the first duct 9 during at least one of the initial and final drying stages. Supply of a comparatively large flow volume of dry air consumes less electrical power than supplying high-speed dry air from the second blowout port 10. Thus, the washing dryer 500 according to the present embodiment may achieve a lower level of total electrical power consumption than a device which supplies dry air at high pressure and high speed or a device including several fans to additionally increase air volume and supplying dry air at high pressure and high speed. Thus, the drum-typed washing dryer 500 according to the present embodiment may consume less electrical power to achieve better finishing of dried laundry with fewer wrinkles.

[0104] FIG 11 is a timing chart exemplifying switching timings for the dry air path. The switch of the dry air path is described with reference to FIGS. 1 to 5 and FIG. 11.

[0105] In the initial drying stage from the start of the drying process until the first set time is elapsed, dry air is supplied to the drum 1 from the first duct 9. Since the cross-sectional area of the flow path of the first duct 9 through which dry air flows is large, pressure loss of the dry air is lower. A large flow volume of dry air supplied through the first duct 9 is blown from the first blowout port 8 formed in the bottom of the water tub 2, and then hits the laundry. The controller 70 controls the drive motor 23 of the duct switcher 12 to close the second duct 11 with the blocking portion 21c of the louver 21 as shown in FIG. 3, so that the first duct 9 is opened. Subsequently, the drying process starts. Once the drying process starts, the controller 70 uses the timer 71 to measure elapsed time from the starting time of the drying process. The controller 70 continues to keep the first duct 9 opened until the elapsed time from the starting time of the drying process exceeds the first set time. Since the pressure loss of dry air passing through the first duct 9 is very small, the controller 70 determines comparatively low rotating speed of the fan motor 4b. The blower 4 may consume less electrical power to supply a large flow volume of dry air into the drum 1. Since the large flow volume of dry air is supplied to the drum 1, drying time is shortened in the initial drying stage. In addition, the initial drying stage requires less electrical power consumption.

[0106] Once the elapsed time from the starting time of the drying process exceeds the first set time, the controller 70 determines that the drying process moves to the intermediate drying stage. The controller 70 controls the drive motor 23 of the duct switcher 12 to switch the path of dry air to the second duct 11. In addition, the controller 70 increases the rotating speed of the fan motor 4b. As a result, dry air flows into the drum 1 from the second blowout port 10 during the intermediate drying stage. Since the cross-sectional area of the flow path of the second blowout port 10 through which dry air flows is smaller than that of the first blowout port 8, dry air blown from the second blowout port 10 becomes high pressure and high speed.

[0107] When the elapsed time from the starting time of the drying process exceeds the first set time, the controller 70 controls the drive motor 23 of the duct switcher 12 so that the blocking portion 21 c of the louver 23 contacts the rib 28 as shown in FIG 4. As a result, the first duct 9 is closed whereas the second duct 11 is opened. Subsequently, the controller 70 controls the blower 4 to increase the rotating speed of the fan motor 4b. The controller 70 continues to keep the second duct 11 opened until the elapsed time from the starting time of the drying process exceeds the second set time. During the intermediate drying stage, the dry air at high pressure and high speed spreads laundry to reduce wrinkles of the laundry.

[0108] Once the elapsed time from the starting time of the drying process exceeds the second set time, the controller 70 determines that the drying process moves to the final drying stage. The controller 70 controls the drive motor 23 of the duct switcher 12 to again switch the path of dry air to the first duct 9.

[0109] As described above, laundry contains a very small amount of moisture in the final drying stage. The dry air hits the low level of moisture in the laundry, so that it takes a comparative long period of time to evaporate the moisture from the laundry. Therefore it is preferable that a large flow volume of dry air is supplied into the drum 1 to increase opportunities for hitting the dry air to the moisture in the laundry. Since the dry air is supplied to the drum 1 through the first duct 9, a comparatively high flow volume of the dry air is achieved with a comparatively low level of power consumption.

[0110] During the final drying stage, the first duct 9 is used for the circulation path of dry air. Since cross-sectional area of the flow path of the first duct 9 through which dry air flows is large, pressure loss of dry air is very small. A large flow volume of dry air is blown from the first blowout port 8 formed in the bottom of the water tub 2, and then hits the laundry.

[0111] When the elapsed time from the starting time of the drying process exceeds the second set time, the controller 70 controls the drive motor 23 of the duct switcher 12 to open the first duct 9 as shown in FIG. 3. In addition, the controller 70 controls the blower 4 to decrease the rotating speed of the fan motor 4b. Subsequently, the controller 70 continues to keep the first duct 9 opened until the drying process completes. Since pressure loss of dry air passing through the first duct 9 is small, the controller 70 may determine a comparatively low rotating speed of the fan motor 4b, so that it consumes less electrical power to drive the blower 4. In addition, the blower 4 may achieve a comparatively high flow volume of dry air. Thus, the drying time is shortened in the final drying stage, so that the final drying stage requires less electrical power consumption.

[0112] In the present embodiment, the controller 70 determines whether the drying process is in the "initial drying stage", the "intermediate drying stage" or the "final drying stage" on the basis of the elapsed time from the starting time of the drying process (first and second set times). Alternatively, the duration of the entire drying process as well as the durations of the "initial drying stage", the "intermediate drying stage" and the "final drying stage", respectively, may be dependent on an amount of laundry placed in the drum 1. Therefore, the controller 70 preferably adjusts the first and second set times to determine the "initial drying stage", the "intermediate drying stage" or the "final drying stage" on the basis of the detected result of a sensor configured to detect the amount of laundry in the drum 1.

[0113] The sensor 15 may also detect the amount (weight) of laundry placed into the drum 1 before the drying process starts. For example, the sensor 15 detects a difference in a position of the shaft of damper 14 which supports the water tub 2 between when the water tub 2 is empty (water has not been supplied to the water tub 2 and there are no laundry put into the drum 1) and when laundry is placed in the drum 1 before the start of the drying process (before water is supplied to the water tub 2). Information on the positional difference of the shaft 141 is output to the controller 70 as information on the amount of laundry put into the drum 1. Thus the controller 70 may determine the amount of laundry in the drum 1 based on the positional difference of the shaft 141.

[0114] If an amount of laundry placed into the drum 1 goes up, the controller 70 makes the first and second set times longer based on the detection result of the sensor 15. As a result, the durations of the "initial drying stage", the "intermediate drying stage" and the "final drying stage" are suitably set in response to the amount of laundry in the drum 1. The controller may switch the circulation path of dry air between the first and second ducts 9, 11 based on the first and second set times which are suitably set in response to the laundry amount in the drum 1.

[0115] The duct switcher 12 is described.

[0116] The controller 70 applies drive pulses to the drive motor 23. The drive motor 23 rotates in the direction in response to the applied drive pulses. Driving force of the drive motor 23 is transmitted to the first gear 22a attached to the motor rotating shaft 23a. Subsequently, driving force of the drive motor 23 is transmitted to the second gear 22b which engages with the first gear 22a.

[0117] The deceleration gear 22 including the first and second gears 22a, 22b decreases the rotating speed of the drive motor at a prescribed deceleration ratio. As a result, torque for driving the louver 21 increases. The louver 21 attached to the second gear 22b rotates bi-directionally with adequate torque. Thus, it is likely that the comparatively large torque in response to the deceleration ratio of the deceleration gear 22 prevents debris entrapped between the louver 21 and the inner surface of the first duct 9 from locking the louver 21, which results in suitable angular movement of the louver 21. Under a suitable deceleration ratio of the deceleration gear 22, positional control of the louver 21 is less likely to fail.

[0118] The control for switching the circulation path of dry air by a conventional washing dryer encounters problems attributable to debris. For example, the desired circulation path may not be selected or air leakage may occur. The washing dryer 500 according to the present embodiment is less sensitive to debris due to high torque acting on the louver 21 as described above. Consequently it is less likely that the aforementioned problems associated with conventional washing dryers occur.

[0119] The washing dryer 500 according to the present embodiment is less sensitive to debris and less likely to cause the problems such as locking of the louver 21 and leakage of air. Thus, the washing dryer 500 according to the present embodiment may highly reliably switch the circulation path of dry air. Since the washing dryer 500 according to the

present embodiment has highly reliable structure for switching the circulation path of dry air, the washing dryer 500 may maintain quality drying performances over a long period of time.

[0120] As shown in FIG 4, since the peripheral edges (upper edge 21 x, lower edge 21y and distal edge 21z) of the blocking portion 21c of the louver 21 pivoted to the blocking position for the first duct 9 contact the rib 28, the first duct 9 is suitably blocked, so that it is less likely that air leaks from the first duct 9. Thus, the dry air circulation becomes highly reliable and efficient.

[0121] The rib 28 is arranged at a downstream position of the louver 21 in the circulation direction of dry air. Therefore, the louver 21 is urged to the rib 28 by a pressure of dry air hitting the louver 21. Thus, the louver 21 is facilitated to contact the rib 28. As a result, it becomes less likely that the air leaks from between the louver 21 and the rib 28. Thus, the rib 28 is provided with both a stopper function for immobilizing the louver 21 at a prescribed position and a sealing function for sealing the first duct 9 in coordination with the louver 21.

[0122] As shown in FIG. 4, the angle θ between the louver 21 which blocks the first duct 9 and the extension direction of the first duct 9 is set in a range from 50 degrees to 55 degrees. As a result, pressure loss of dry air passing through the curved portion of the branch between the first and second ducts 9 suitably goes down. In addition, the cross-sectional area of the flow path of dry air in the curved portion of the branch is maintained at a suitable size. Thus, dry air may flow into the second duct 11 branching from the first duct 9 along a gently curved circulation path.

[0123] FIG. 12 is a schematic perspective view showing an internal structure of the guiding duct 24. FIG. 13 is an enlarged perspective view around the rib 28 of the guiding duct 24 shown in FIG. 12. The rib 28 is described with reference to FIGS. 3, 4, 8, 12 and 13.

[0124] The rib 28 shown in FIGS. 3, 4, 8 forms a substantially C-shaped protruding contour. As a result, the rib 28 contacts the upper edge 21 x, lower edge 21y and distal edge 21 z of the blocking portion 21c of the louver 21. Alternatively, as shown in FIGS. 12 and 13, a portion of the rib 28 which the distal edge 21z contacts may be omitted. For example, if the louver 21 is at the blocking position for the first duct 9, the distal edge 21z, which is the farthest away from the pivot shaft of the louver 21, may contact a sidewall of the guiding duct 24. As a result, the first duct 9 is suitably blocked even without the portion of the rib 28 corresponding to the distal edge 21z.

[0125] As shown in FIGS. 12 and 13, the guiding duct 24 is preferably provided with a protruding wall 61, which protrudes inward from a sidewall of the guiding duct 24. The protruding wall 61 is situated in an upstream position of the louver 21, which blocks the first duct 9 in the circulation direction of dry air. It is likely that the protruding wall 61 formed on the sidewall of the guiding duct 24 to abut or be adjacent to the distal edge 21 z of the louver 21 prevents dry air from passing in between the distal edge 21z of the louver 21 and the guiding duct 24. In the present embodiment, the protruding wall 61 is exemplified as the protrusion. In addition, the sidewall surface where the protruding wall 61 is formed is exemplified as the inner surface.

[0126] If the protruding wall 61 is formed, it is unnecessary that a sealing member such as a packing is adhered to the distal edge 21 z of the louver 21. Even if there is a slight gap between the distal edge 21z of the louver 21 and the sidewall of the guiding duct 24, it is less likely that the dry air enters the slight gap between the distal edge 21 z of the louver 21 and the sidewall of the guiding duct 24 since the protruding wall 61 formed at the upstream position of the louver 21 in the circulation path of dry air hits the flowing dry air. Thus, the protruding wall 61 suitably reduces air leakage through the slight gap between the distal edge 21z of the louver 21 and the sidewall of the guiding duct 24.

[0127] The protruding wall 61 does not interfere with the angular movement of the louver 21.

[0128] Since there is a small gap between the distal edge 21z and the protruding wall 61, the distal edge 21 z of the angularly moving louver 21 does not contact the protruding wall 61.

[0129] FIG. 14 is a schematic perspective view showing the internal structure of the guiding duct 24. FIG. 15 is an enlarged perspective view around the rib 28 of the guiding duct 24 shown in FIG 14. The rib 28 is described with reference to FIGS. 14 and 15.

[0130] The guiding duct 24 may be provided with a ramp 62 inwardly protruding from a sidewall to which the second duct 11 is connected. The ramp 62 is formed at an upstream position (in the circular direction of dry air) of the distal edge 21 z of the louver 21 which blocks the second duct 11. The ramp 62 contacts the distal edge 21z of the louver 21 which blocks second duct 11. Circulated dry air is guided over the inclined surface of the ramp 62 and jumps over the distal edge 21z of the louver 21. In the present embodiment, the ramp 62 is exemplified as the protrusion. The sidewall surface where the ramp 62 is formed is exemplified as the inner surface.

[0131] A protruding amount of the ramp 62 from the inner surface of the guiding duct 24 may be larger than a thickness of the distal edge 21 z of the blocking portion 21c of the louver 21. For example, if the distal edge 21 z of the blocking portion 21 c is about 2 mm in thickness, then the protruding amount of the ramp 62 may be, for example, about 2.5 mm to about 3 mm. It is likely that the ramp 62 prevents dry air from entering in between the distal edge 21 z of the louver 21 and the sidewall of the guiding duct 24.

[0132] The surface of the blocking portion 21c of the louver 21 which blocks the second duct 11 is substantially parallel to the flow direction of dry air. Although the second duct 11 is blocked by the blocking portion 21c of the louver 21, it is likely that the circulated dry air also flows in between the distal edge 21 z of the louver 21 and the sidewall of the guiding

duct 24 without the ramp 62. The dry air entering in between the distal edge 21z of the louver 21 and the sidewall of the guiding duct 24 may cause the louver 21 to move away from the sidewall of the guiding duct 24. As a result, it is likely that the circulated dry air flows into the second duct 11 without the ramp 62.

[0133] With the ramp 62, dry air may jump over the distal edge 21z of the louver 21 since the dry air passes over the ramp 62 formed at the upstream position of the louver 21 in the circulation direction of dry air. Thus, it is less likely that the dry air directly hits with the distal edge 21z of the louver 21. As a result, it becomes less likely that the circulated dry air enters in between the distal edge 21z of the louver 21 and the sidewall of the guiding duct 24. Therefore it is less likely that the dry air flows into the second duct 11.

[0134] The ramp 62 is formed in the upstream position of the distal edge 21z of the louver 21 in the circulation direction of dry air. Since the ramp 62 does not interfere with the angular motion of the louver 21, the gap between the distal edge 21z of the louver 21 closing the second duct 11 and the ramp 62 may be narrower than the gap between the distal edge 21z of the louver 21 and the protruding wall 61.

[0135] As shown in FIG. 3, in the present embodiment, the cross-sectional area of the first duct 9 in the branch (cross-sectional area of the flow path of dry air) is larger than the cross-sectional area of the second duct 11. Alternatively, the cross-sectional area of the first duct in the branch (cross-sectional area of the flow path of dry air) may be substantially equal to the cross-sectional area of the second duct. In addition, a rib may be formed on the inner surface of the second duct which contacts the louver. A rib which protrudes from the inner surface of the second duct and a louver may be also used to block the second duct.

[0136] The methodologies according to the present embodiment are described with the drum-typed washing dryer 500 having both washing functions and laundry drying functions. Alternatively, the methodologies according to the present embodiment may be also applied to a laundry dryer without washing functions.

[0137] A laundry dryer without washing functions may be, for example, realized by removing various elements for washing functions from the drum-typed washing dryer 500 shown in FIG. 1. For example, the water supply pipe and drain pipe 40 connected to a water tub shown in FIG. 1 may be removed from the drum-typed washing dryer 500 to realize the laundry dryer. The water tub 2 may be also used as an outer tub for protecting the drum 1. Various other elements of the laundry dryer may be the same as those of the washing dryer 500 described in the context of FIG. 1.

[0138] The methodologies according to the present embodiment are described with the drum-typed washing dryer 500 having both washing functions and laundry drying functions. Alternatively, the methodologies according to the present embodiment may be also applied to other types of devices. The methodologies according to the present embodiment are preferably applied to devices such as laundry dryers and washing dryers having a structure for switching the circulation path of dry air. For example, the methodologies according to the present embodiment may be also applied to a device in which laundry is suspended in baskets or a device in which laundry is agitated with a pulsator (such as a top-loading washing dryer).

[0139] The aforementioned embodiment mainly includes a laundry processing device having configurations described below. A switching mechanism with the following structure as well as a laundry dryer and washing dryer provided with the switching mechanism includes a structure which makes them less sensitive to debris, and so is less likely to cause failures in switching control.

[0140] A switching mechanism according to one aspect of the aforementioned embodiment includes a first blowing path through which blown fluid passes; a second blowing path branching from the first blowing path to allow the fluid to pass through; a pivotal blocking member mounted in a branch between the first blowing path and the second blowing path; a drive motor configured to drive the blocking member; and a deceleration gear configured to transmit driving force of the drive motor to the blocking member, wherein the blocking member selectively blocks one of the first blowing path and the second blowing path.

[0141] According to the aforementioned configuration, the blown fluid passes through the first blowing path or the second blowing path branching from the first blowing path. The driving force of the drive motor is transmitted by the deceleration gear to the blocking member mounted in the branch between the first and second blowing paths to pivot the blocking member. As a result, the blocking member selectively blocks one of the first and second blowing paths. Driving torque is adjusted corresponding to the deceleration ratio of the deceleration gear because the driving force is transmitted via the deceleration gear. Thus, the blocking member continuously pivots against debris, which impairs the pivoting of the blocking member, under an appropriate setting of the deceleration ratio of the deceleration gear. Since it is likely that the structure of the switching mechanism causes the blocking member from locking, the blocking member may continue to appropriately operate so that the fluid is suitably guided to the first or second blowing path, which results in the reliable switching mechanism.

[0142] In the aforementioned configuration, the switching mechanism further includes a contact portion which protrudes inside the branch, wherein the blocking member includes an edge configured to contact the contact portion while the blocking member blocks at least one of the first blowing path and the second blowing path.

[0143] According to the aforementioned configuration, since the edge of the blocking member contacts the contact portion which protrudes inward in the branch when at least one of the first and second blowing paths is blocked, the at

least one of the first and second blowing paths is suitably blocked. Thus, the fluid is suitably guided to the first or second blowing path, which results in the reliable switching mechanism.

[0144] In the aforementioned configuration, the contact portion is arranged at a downstream position of the blocking member in a flow direction of the fluid.

[0145] According to the aforementioned configuration, since the contact portion is arranged at a downstream position of the blocking member in the flow direction of the fluid, the blocking member is suitably pressed to the contact portion by pressure from the fluid which hits the blocking member. Thus, the fluid is appropriately guided to the first or second blowing path, which results in the reliable switching mechanism.

[0146] In the aforementioned configuration, the one of the first blowing path and the second blowing path, which is blocked by the blocking member, includes an inner surface adjacent to the blocking member, and a protrusion protruding from the inner surface, and the protrusion is arranged at an upstream position of the blocking member in the flow direction.

[0147] According to the aforementioned configuration, the one of the first blowing path and the second blowing path, which is blocked by the blocking member, includes the inner surface adjacent to the blocking member and the protrusion protruding from the inner surface. Since the protrusion is arranged at the upstream position of the blocking member in the flow direction, it is less likely that the fluid enters in between the inner surface and the blocking member. Thus, the fluid is suitably guided to the first or second blowing path, which results in the reliable switching mechanism.

[0148] A laundry dryer according to another aspect of the aforementioned embodiment is provided with the aforementioned switching mechanism, a container configured to contain laundry; a blower configured to send dry air as the fluid to dry the laundry into the container through one of the first blowing path and the second blowing path; and a controller configured to control the switching mechanism so that the switching mechanism selectively switches flow path of the dry air between the first blowing path and the second blowing path.

[0149] According to the aforementioned configuration, the blower sends the dry air to dry laundry to the container, which contains laundry, through one of the first and second blowing paths. The controller controls the switching mechanism to selectively switch the flow path of the dry air between the first and second blowing paths. As described above, due to the reliable switching mechanism, the laundry dryer may maintain its drying performance over a long period of time.

[0150] A washing dryer according to yet another aspect of the aforementioned embodiment is provided with the aforementioned laundry dryer and a water tub which includes the container and retains wash water.

[0151] According to the aforementioned configuration, the water tub contains the container and retains wash water. Since the washing dryer is provided with the aforementioned laundry dryer, the drying performance may be maintained over a long period of time.

Industrial Applicability

[0152] The methodologies according to the present embodiment are preferably used in various types of laundry dryers and washing dryers such as those of the drum type, suspending type or pulsator type.

Claims

1. A switching mechanism, comprising:

a first blowing path (9) through which blown fluid passes;
a second blowing path (11) branching from the first blowing path (9) to allow the fluid to pass through;
a pivotal blocking member (21c) mounted in a branch between the first blowing path (9) and the second blowing path (11);
a drive motor (23) configured to drive the blocking member (21c); and
a deceleration gear (22) configured to transmit driving force of the drive motor (23) to the blocking member (21c), wherein
the blocking member (21c) selectively blocks one of the first blowing path (9) and the second blowing path (11).

2. The switching mechanism according to claim 1, further comprising a contact portion (28) which protrudes inside the branch,
wherein the blocking member (21c) includes an edge (21x, 21y, 21z) configured to contact the contact portion (28) while the blocking member (21c) blocks at least one of the first blowing path (9) and the second blowing path (11).

3. The switching mechanism according to claim 2, wherein the contact portion (28) is arranged at a downstream position of the blocking member (21c) in a flow direction of the fluid.

4. The switching mechanism according to claim 3, wherein the one of the first blowing path (9) and the second blowing path (11), which is blocked by the blocking member (21c), includes an inner surface adjacent to the blocking member (21c), and a protrusion (61,62) protruding from the inner surface, and the protrusion (61,62) is arranged at an upstream position of the blocking member (21c) in the flow direction.

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5. A laundry dryer, comprising:
- the switching mechanism according to any of claims 1 to 4;
- 10 a container (1) configured to contain laundry;
- a blower (4) configured to send dry air as the fluid to dry the laundry into the container (1) through one of the first blowing path (9) and the second blowing path (11); and
- a controller (70) configured to control the switching mechanism so that the switching mechanism selectively switches flow path of the dry air between the first blowing path (9) and the second blowing path (11).

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6. A washing dryer, comprising:
- the laundry dryer according to claim 5; and
- a water tub (2) which includes the container (1) and retains wash water.

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FIG.1

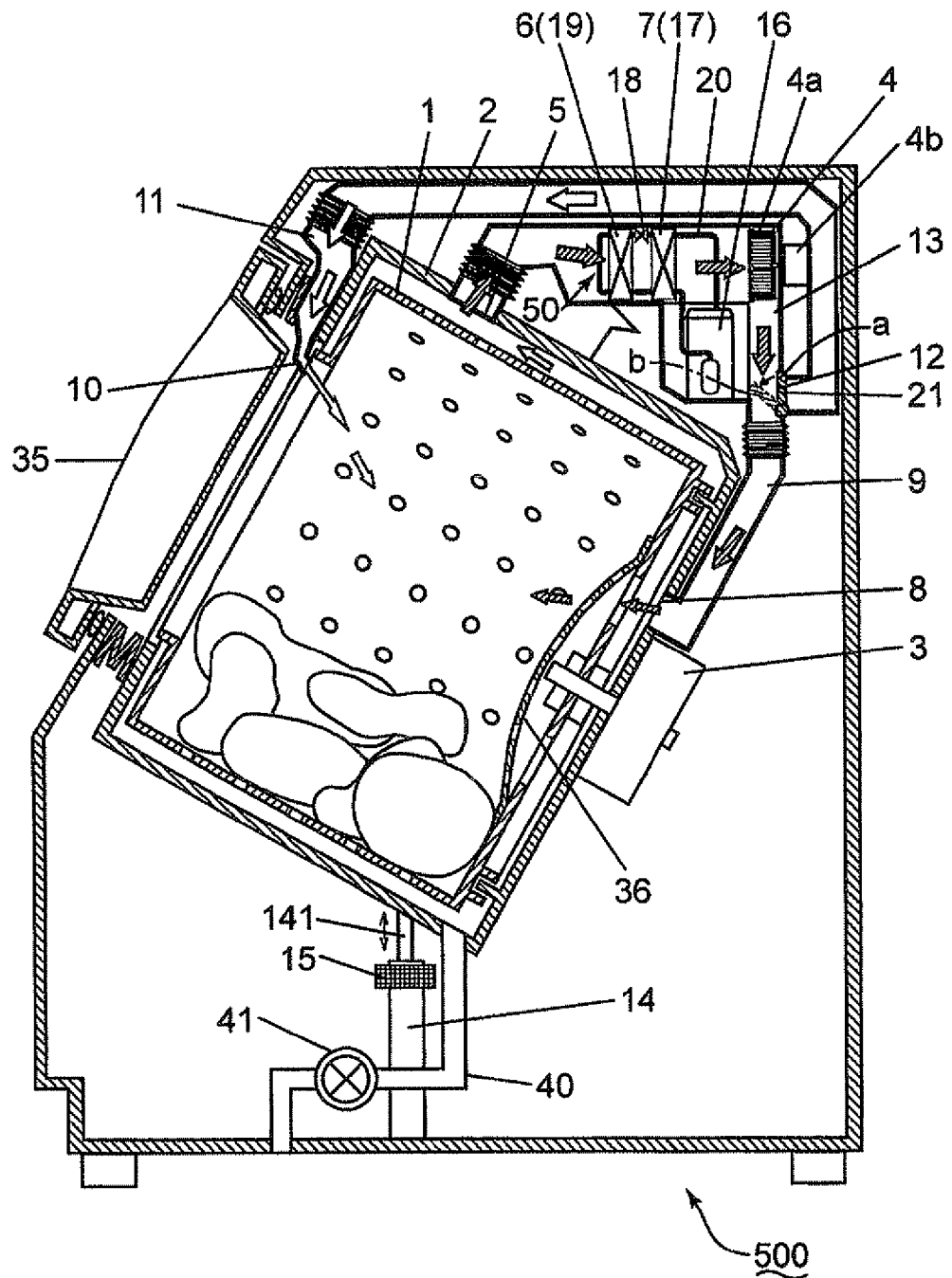
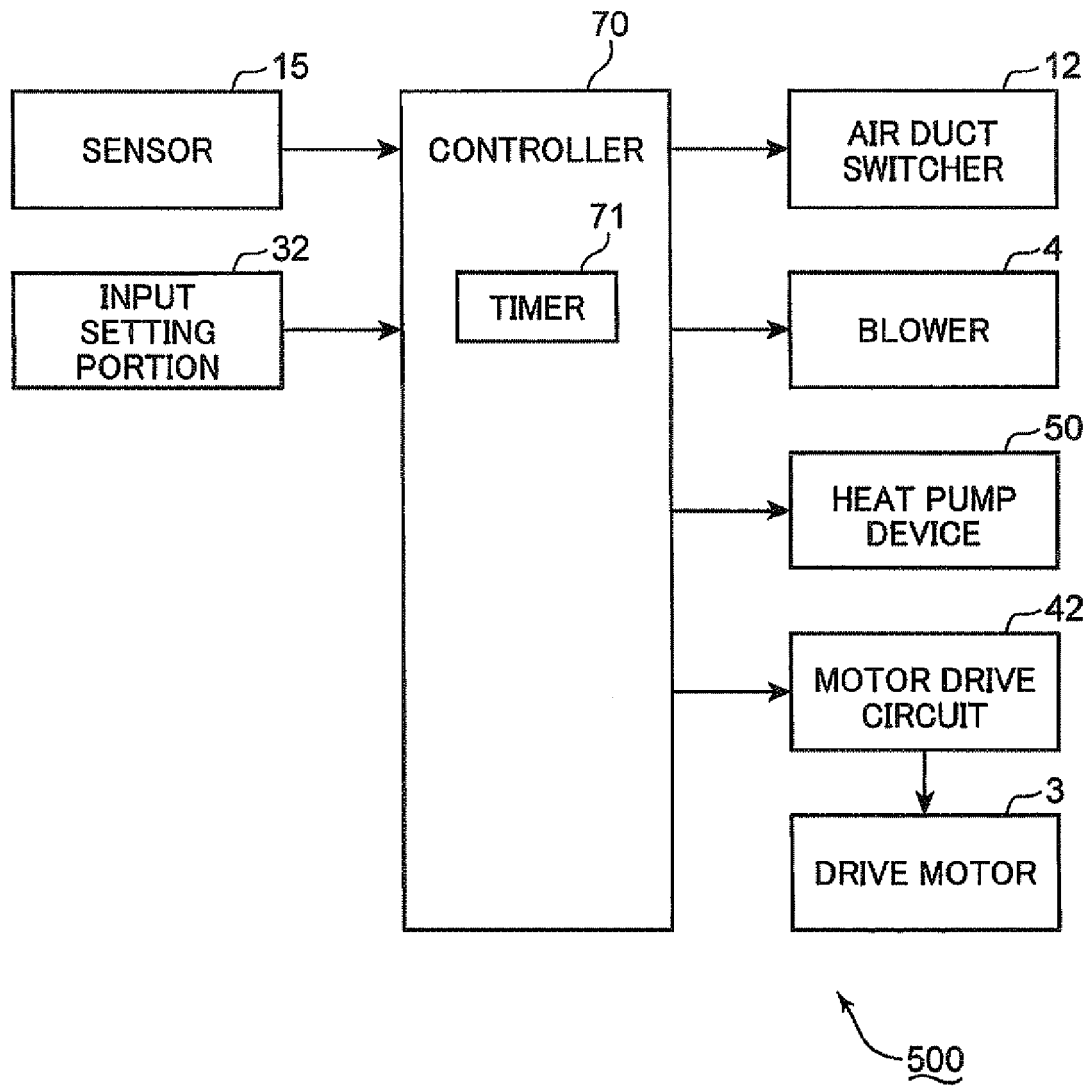


FIG.2



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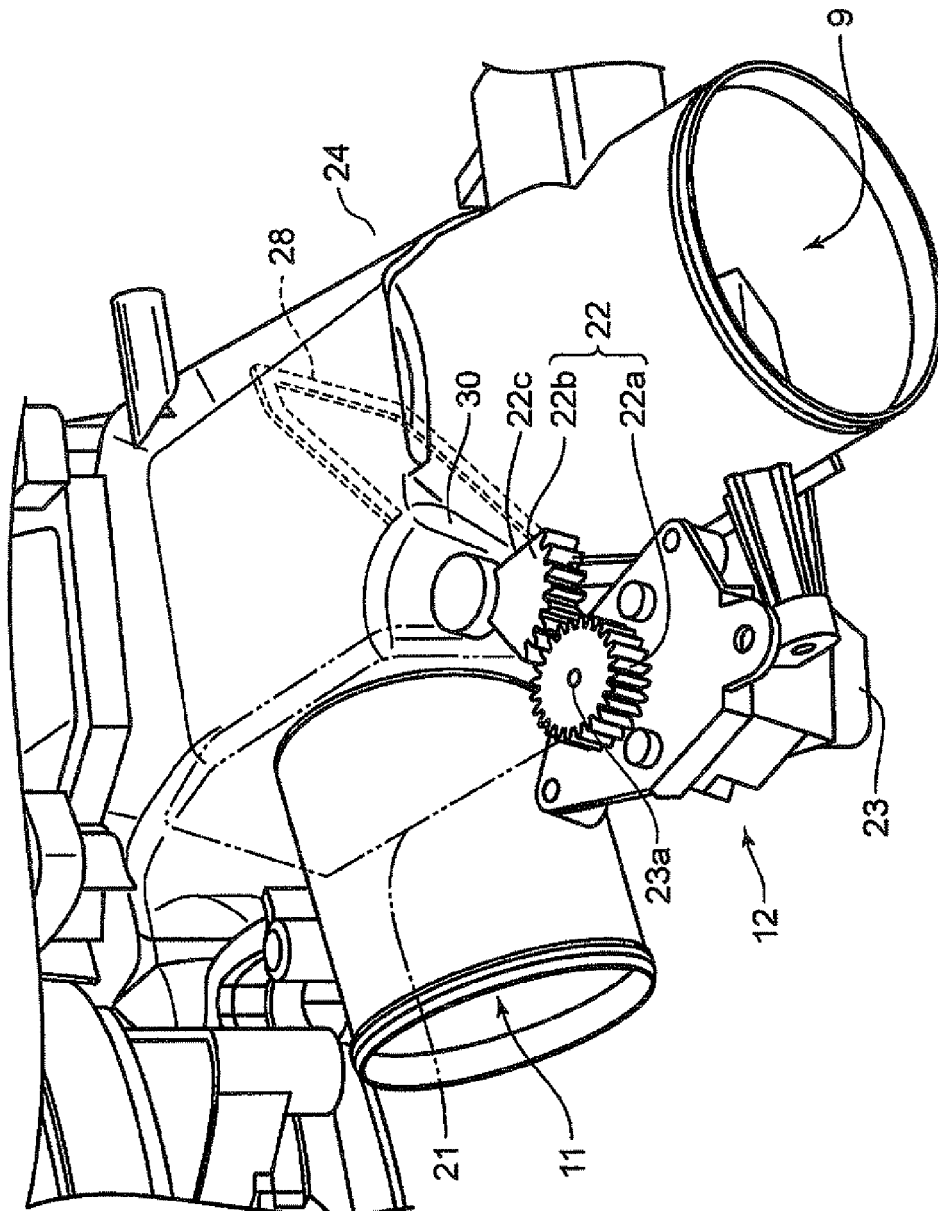


FIG.4

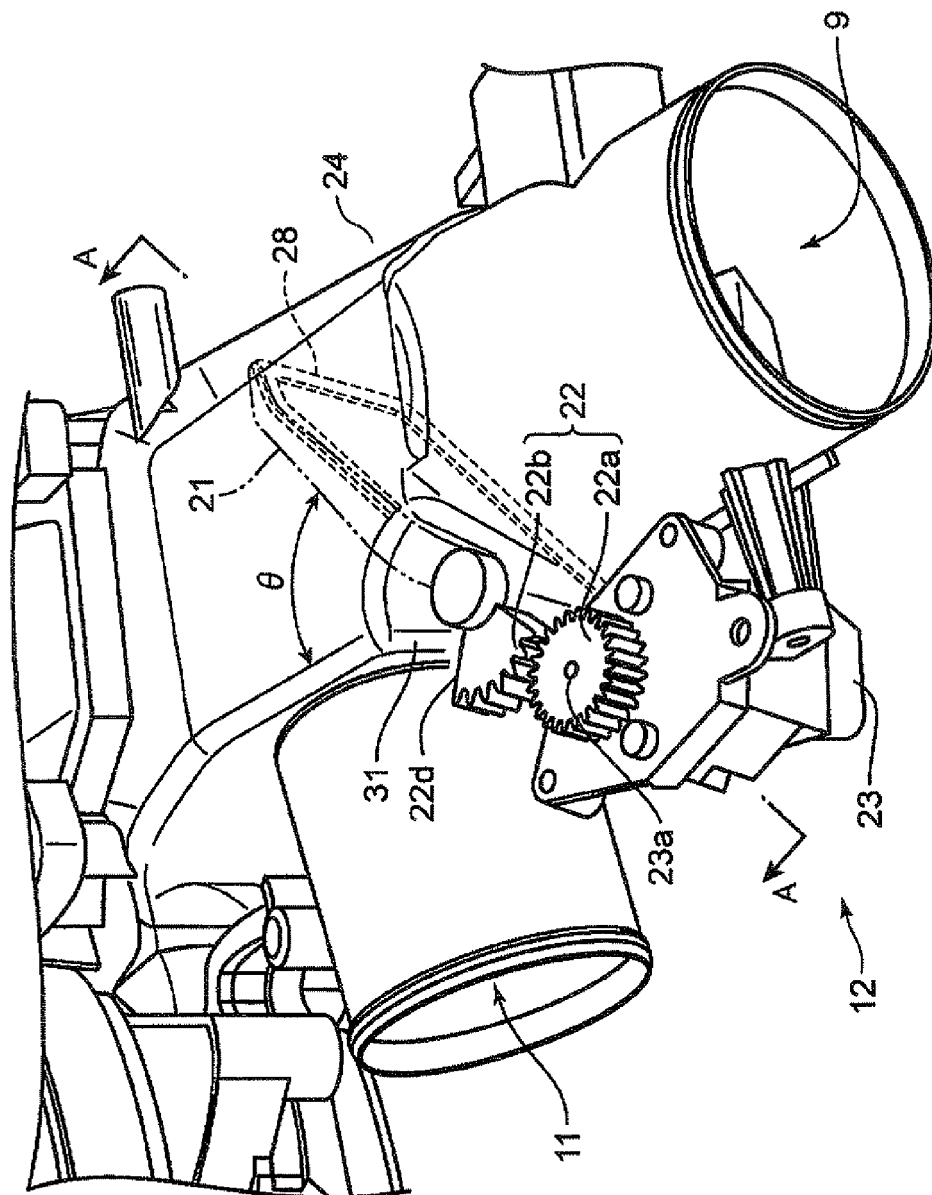


FIG.5

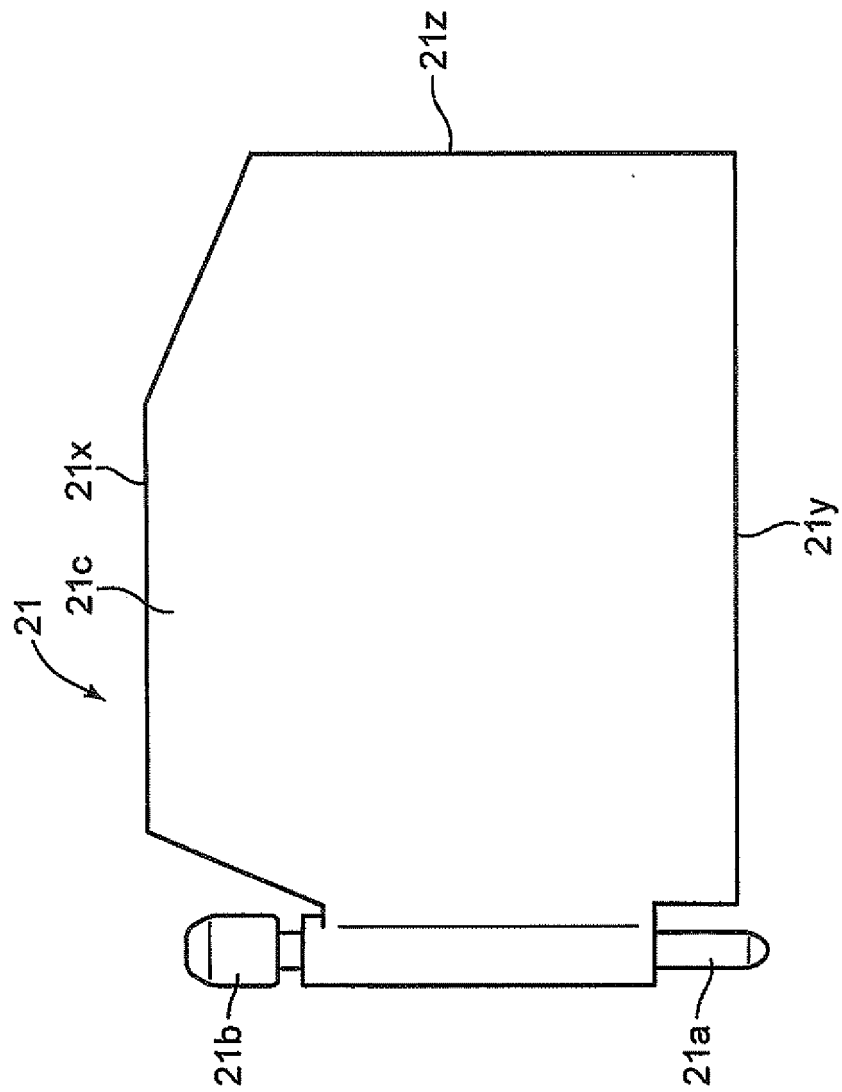


FIG.6

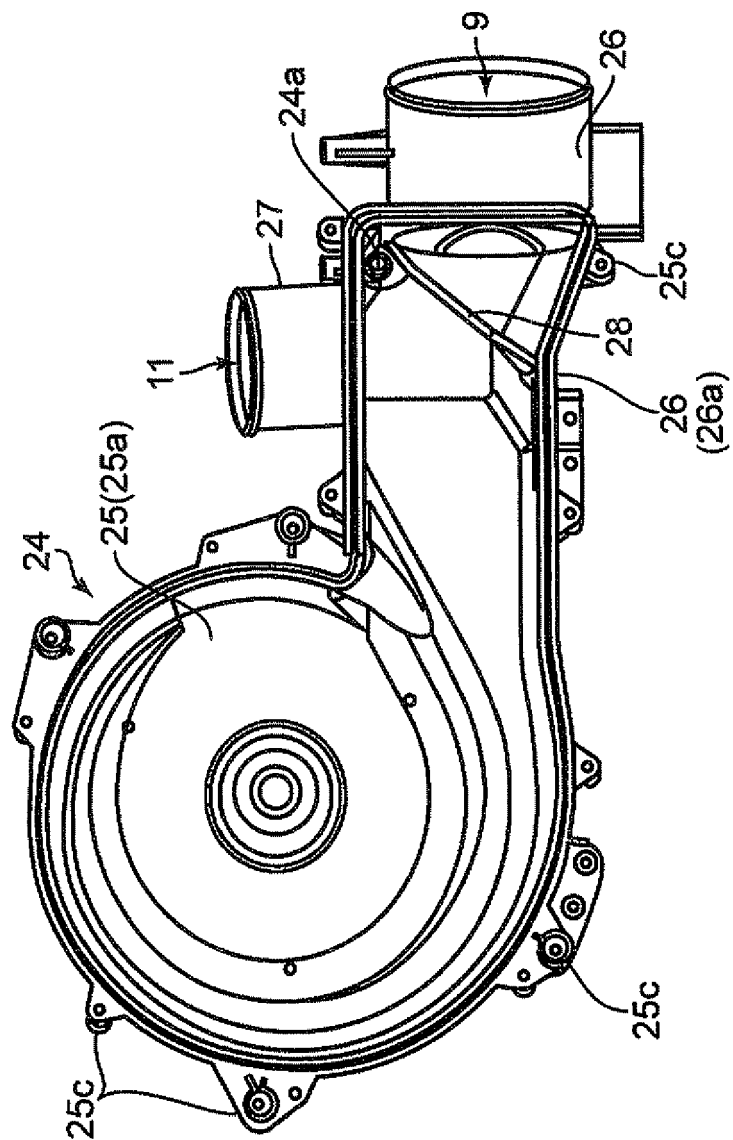


FIG.7

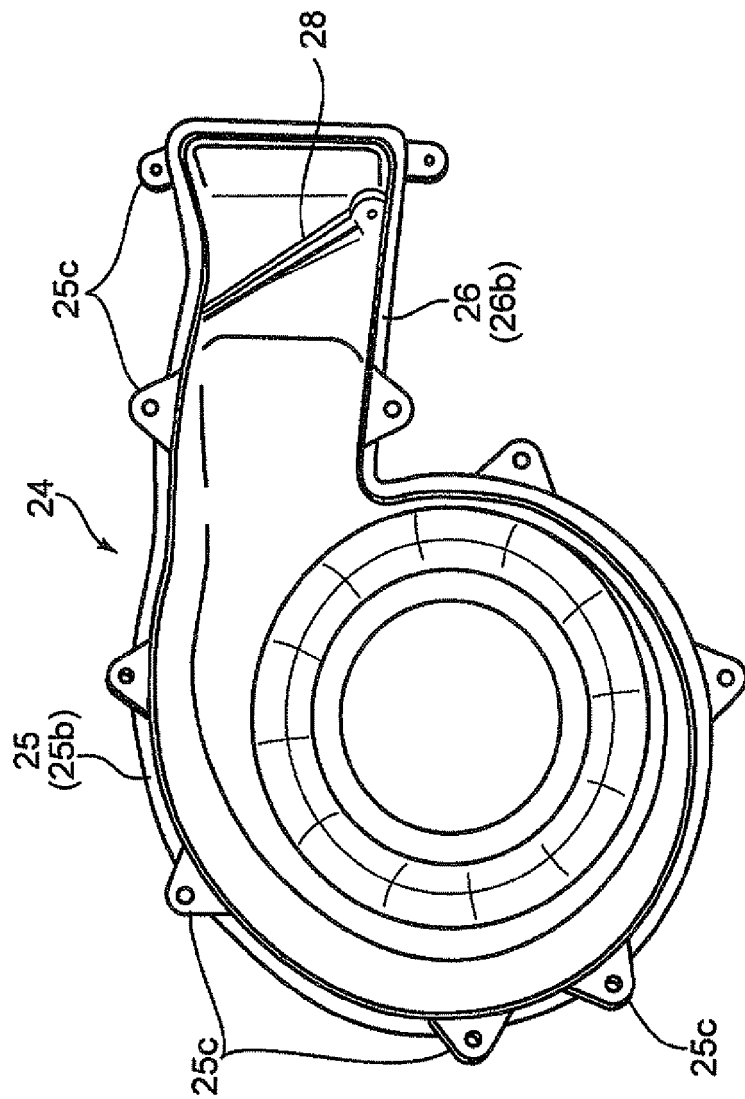


FIG.8

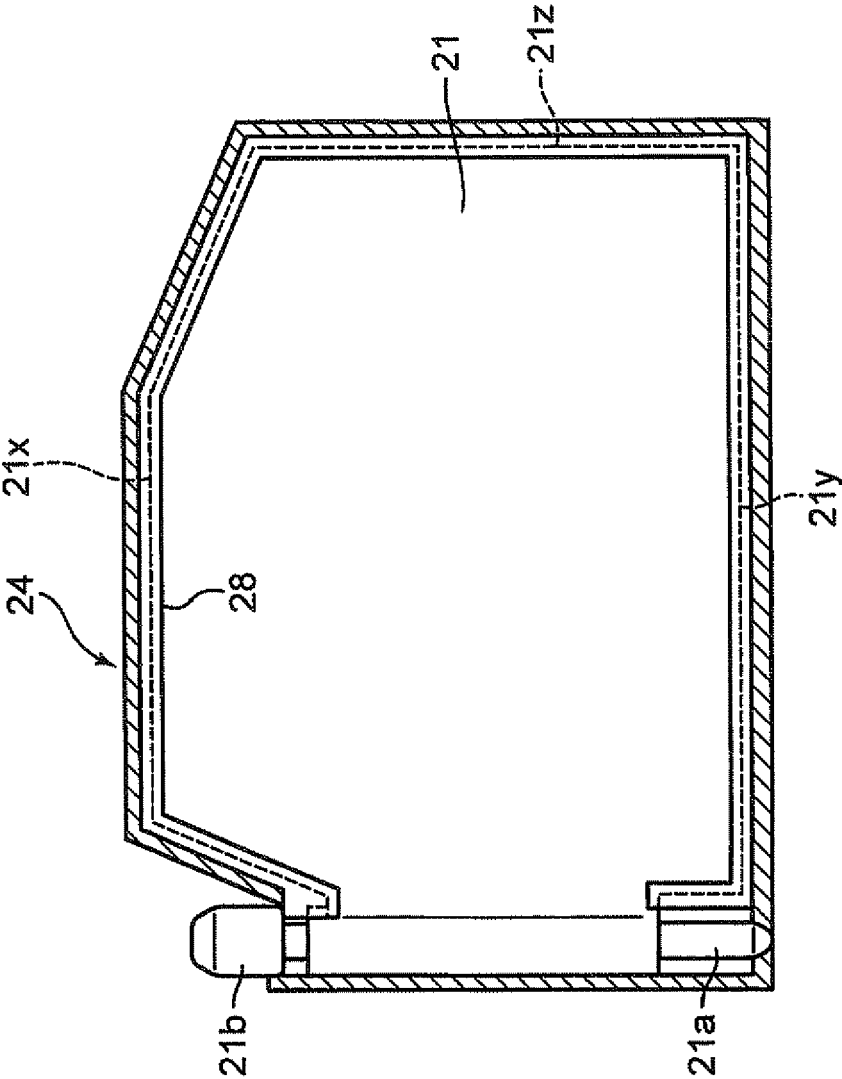


FIG.9

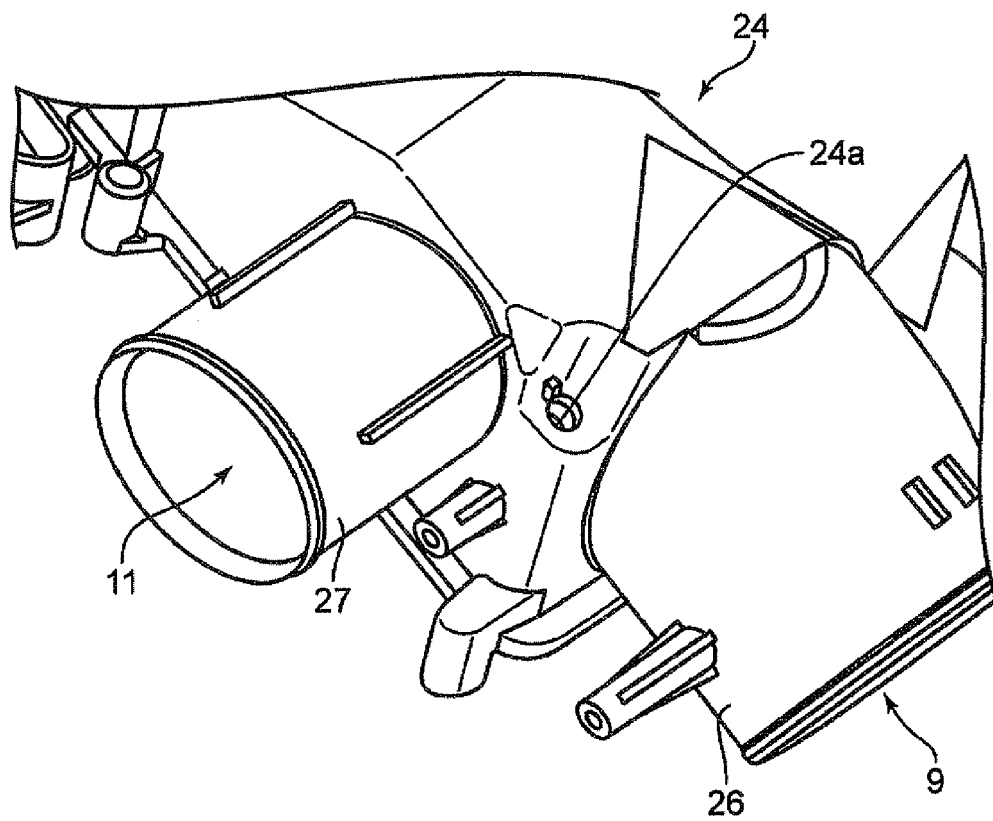


FIG.10

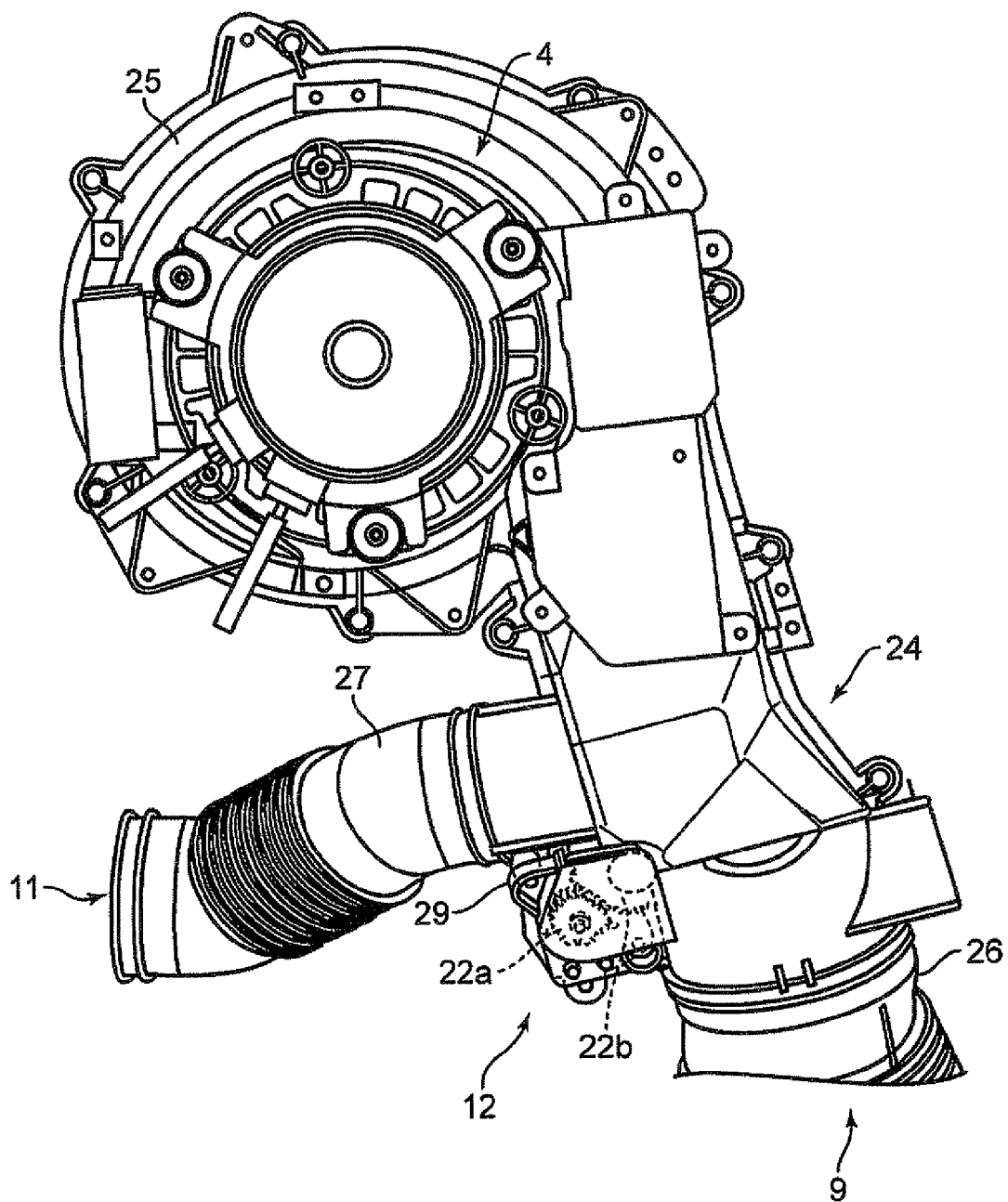


FIG.11

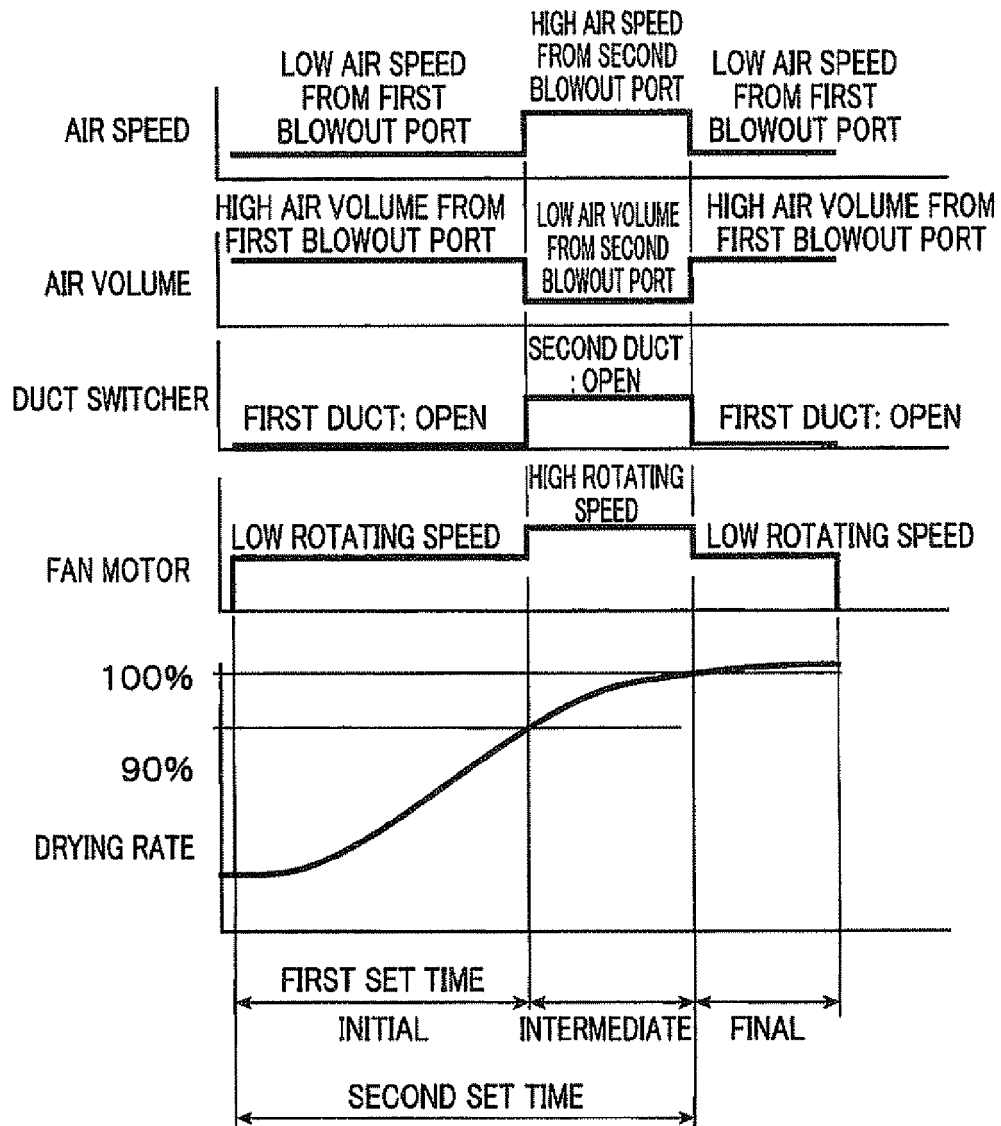


FIG.12

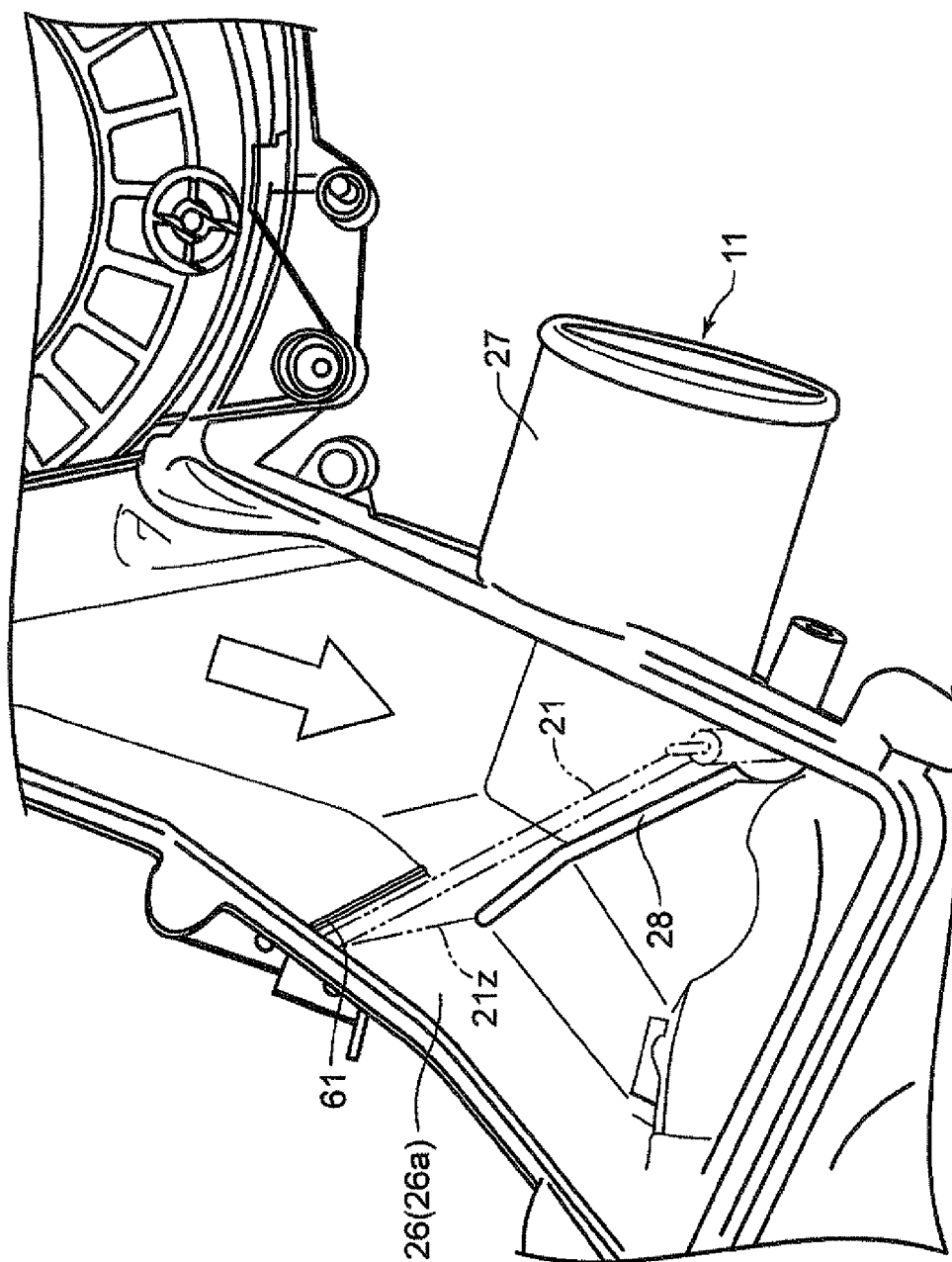
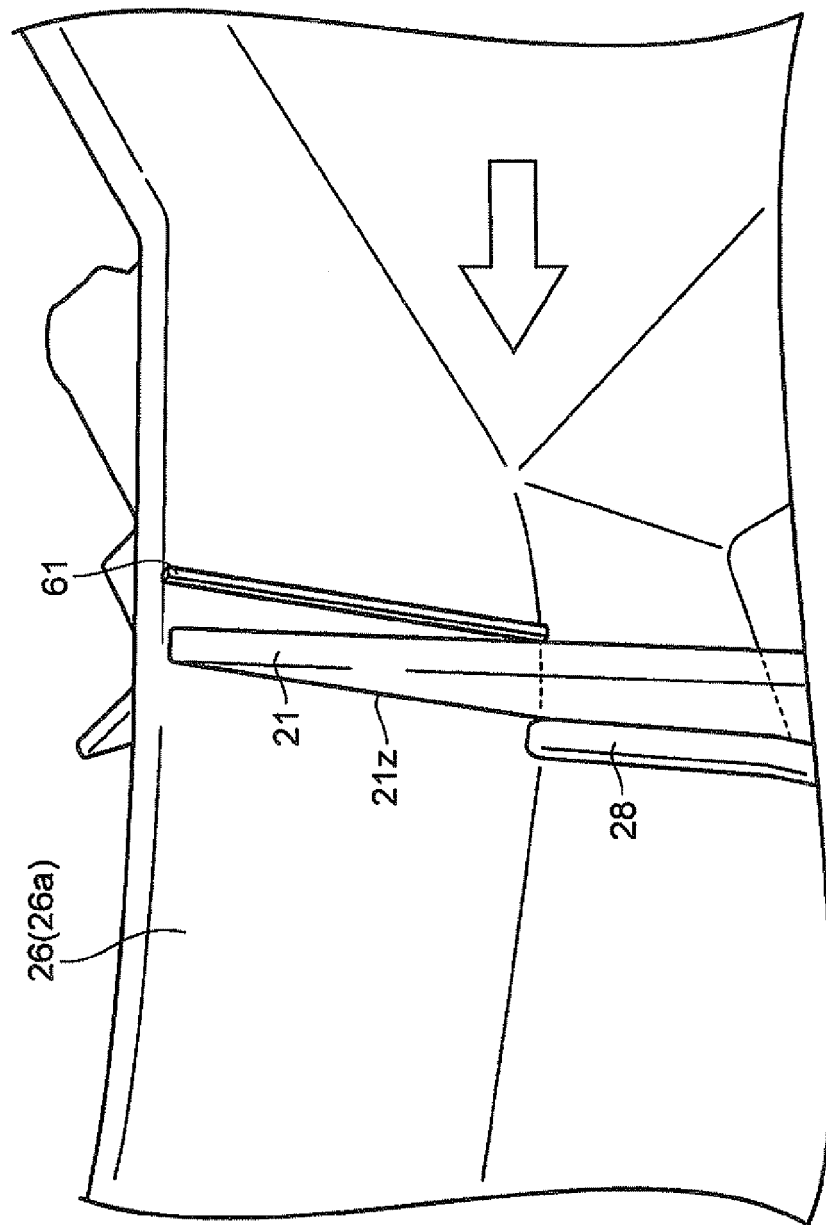


FIG.13



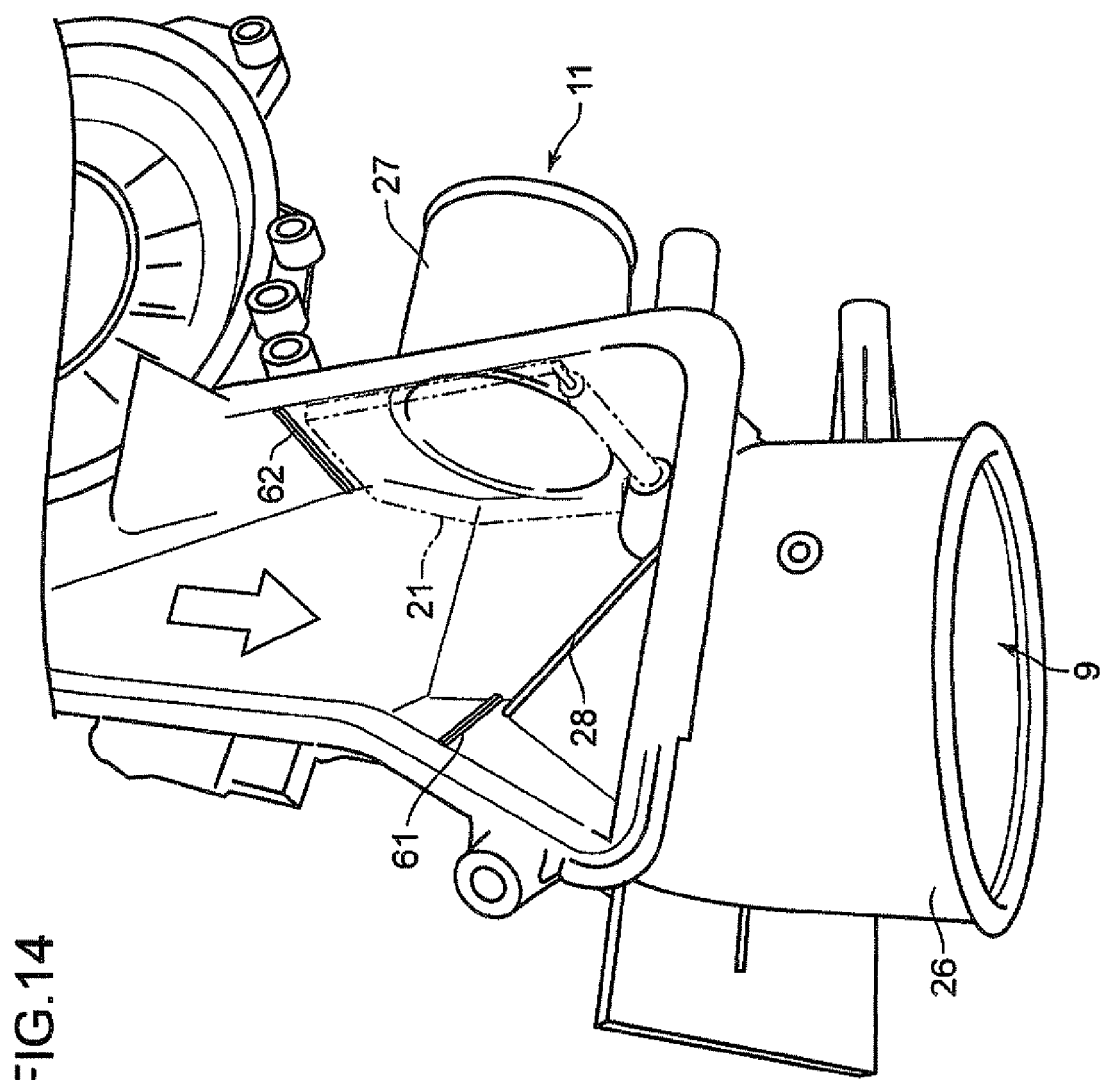


FIG.15

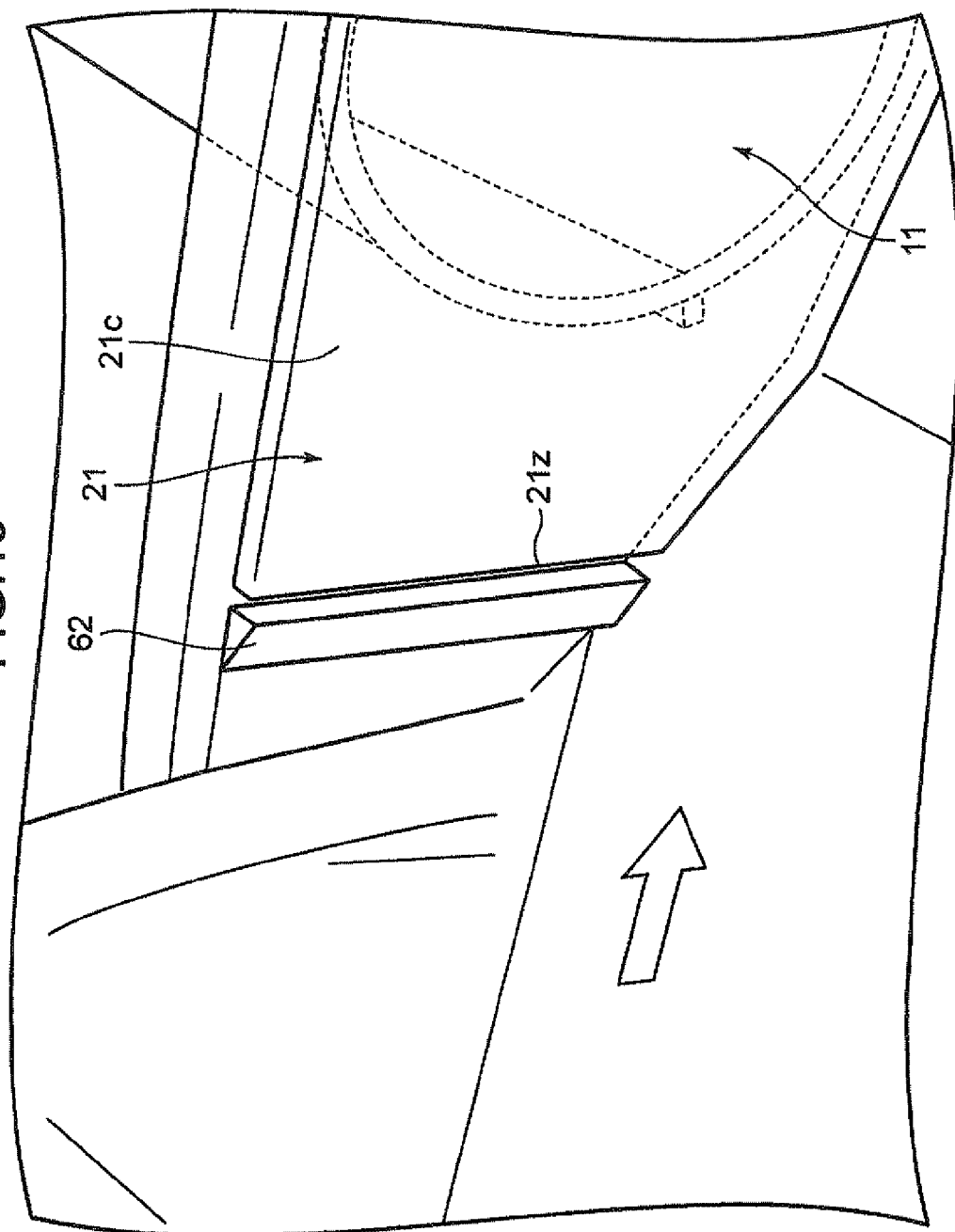
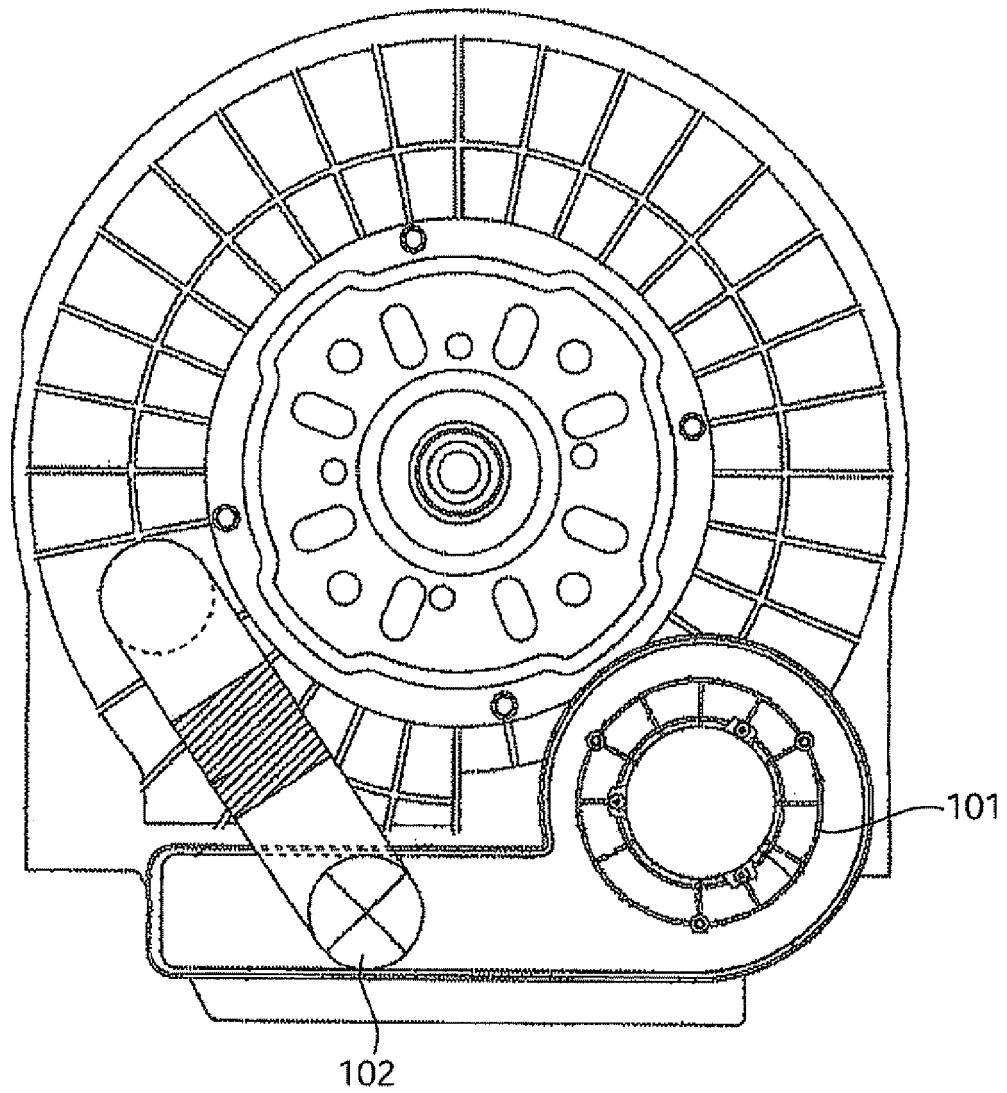


FIG.16





EUROPEAN SEARCH REPORT

Application Number
EP 11 17 2044

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 22 20 425 A1 (LICENTIA GMBH) 15 November 1973 (1973-11-15) * the whole document *	1-6	INV. D06F58/02
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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		19 December 2011	Diaz y Diaz-Caneja
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EPO FORM 1503 03/82 (P04/C01)

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EP 11 17 2044

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The members are as contained in the European Patent Office EDP file on
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19-12-2011

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