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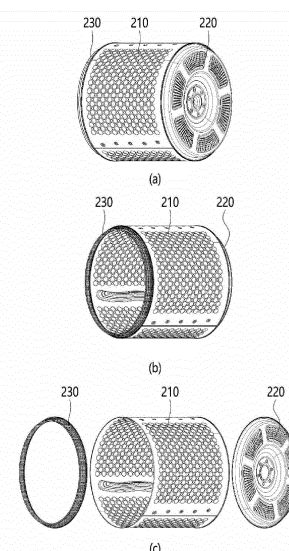
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(54) **METHOD FOR MANUFACTURING DRUM AND CLOTHING TREATMENT APPARATUS COMPRISING DRUM**

(57) The present disclosure relates to a method for manufacturing a drum in which a front part of the drum, which is coupled to the front of the drum and forms an inlet, is manufactured by producing a cylindrical metal plate and then expanding same, and a clothing treatment apparatus comprising the drum.

【FIG. 13】



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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a method of manufacturing a drum configured to receive laundry and a laundry treatment apparatus including the drum.

BACKGROUND ART

[0002] Generally, a drum configured to receive laundry is formed in a cylindrical shape and is applied to a laundry treatment apparatus, such as a washing machine for washing laundry using water and detergent or a dryer for removing moisture from laundry.

[0003] The drum is rotated in the laundry treatment apparatus to evenly apply physical force to the entirety of laundry or to evenly supply hot air to the entirety of the laundry. The drum may be made of a metal material so as to have a predetermined level of durability and to maintain the shape thereof at high speeds of rotation.

[0004] FIG. 1 shows a drum used in a conventional laundry treatment apparatus.

[0005] The drum includes a cylindrical drum body 1 that provides a space for receiving laundry.

[0006] The drum may further include a front drum portion 2 configured to rotatably support the front of the drum body 1 such that the drum body 1 can be rotated about the same axis.

[0007] The front drum portion 2 may be coupled to the front of the drum body 1 to support the load of the drum body 1. The front drum portion 2 may be configured in a ring shape having an introduction port through which laundry is introduced into the drum body 1, and may have a smaller diameter than the drum body 1.

[0008] Consequently, in the conventional laundry treatment apparatus, the front drum portion 2 may be rotatably supported or fixed, whereby the drum body 1 may be rotated in a coaxial state.

[0009] FIG. 2 shows a conventional method of manufacturing the front drum portion 2.

[0010] The front drum portion 2 may have a smaller diameter than the drum body 1, and may be manufactured separately from the drum body 1 because higher rigidity than the drum body 1 may be required.

[0011] Referring to FIG. 2(a), the front drum portion 2 may be manufactured using a metal plate M1.

[0012] The metal plate M1 may be a metal sheet obtained from a thin plate roll.

[0013] Conventionally, a region including the area of the front drum portion 2 is cut from the metal sheet. The cut metal plate M1 may be formed in a polygonal shape, such as a rectangular shape or a square shape, and the minimum width of the metal plate may be set to be greater than the diameter of an outer circumferential surface of the front drum portion 2.

[0014] Referring to FIG. 2(b), in order to form a ring-shaped material member D corresponding to the front

drum portion 2 from the cut metal plate M1, an inner region I and an outer region E of the material member D are removed.

[0015] The material member D may be separated from the cut metal plate M1 by cutting or scrapping at least a part of each of an outer circumferential surface and an inner circumferential surface of the material member D from the cut metal plate M1 and then pressing the outer circumferential surface and inner circumferential surface regions using a press machine

[0016] Referring to FIG. 2(c), an inner circumference close to the inner circumferential surface of the material member D is protruded to form a support of the front drum portion 2. This may be accomplished by using a drawing method or a spinning method in which the inner circumferential surface of the material member D is pressed using a roller or the like to protrude the support.

[0017] Referring to FIG. 2(d), a separation process is performed in which a part of the inner circumferential surface of the material member D is separated from the material member D to secure the area of an introduction port. The separation process may be performed using a forming or piercing method.

[0018] Referring to FIG. 2(e), a curling method may be performed in which the outer circumferential surface of the material member D is folded to form a coupling portion that can be seated on and coupled to the outer circumferential surface of the drum body 1 and the inner circumferential surface of the material member D is folded to form a ring-shaped protective portion having a predetermined thickness and a dull surface.

[0019] At this time, the part of the material member D between the inner circumferential surface and the outer circumferential surface may be pressed to further form a bent reinforcing portion configured to enhance rigidity. This process may be performed using a burring or trimming method.

[0020] As a result, the material member D may be formed into a front drum portion 2, which may be subsequently welded to the drum body 1 or may be coupled to the drum body 1 via a separate fastening member.

[0021] The conventional method of manufacturing the drum or the front drum portion 2 has the problem that the majority of the cut metal plate M is not utilized. In other words, in order to secure the ring-shaped material member D from the cut metal plate M1, it is necessary to cut an inner region I and an outer region E each having a larger area than the material member D. As a result, the material utilization rate of the metal plate M is less than 40%, resulting in waste, which is the largest factor that increases the material cost for manufacturing the drum.

[0022] FIG. 3 is a conceptual view showing a process of manufacturing a front drum portion of a conventional drum.

[0023] In the method of manufacturing the conventional drum, the inner circumferential surface of the material member D is shaped using a drawing or spinning method in order to form a protruding support having an

introduction port from the material member D. That is, a support having a small diameter and protruding outward from the drum is manufactured through plastic deformation of the material member D.

[0024] Referring to FIG. 3(a), the material member D for the conventional front drum portion may be disposed in the shape of a ring shielding a part of the front of the drum body 2. The material member D may be a thin metal plate formed in a toroidal shape. The material member D may be provided as a ring-shaped plate disposed in a diametric direction of the drum body 210.

[0025] In addition, the material member D may be divided into an inner portion B forming a support and an outer portion A forming a coupling portion based on the diameter thereof. The diameter of the outer portion A of the material member D may be equal to or slightly greater than the diameter of the drum body 2.

[0026] As the inner portion B of the material member D is pushed forward by a roller or the like, the support is formed.

[0027] In this process, the entirety of the inner portion B is difficult to be physically perfectly uniformly shaped, and is plastically deformed from the original nature of the material member D.

[0028] As a result, the conventional laundry treatment apparatus has the problem that the rigidity of the entirety of the support is not uniform, whereby a specific part of the support is intensively stressed by external force, and therefore durability of the support is not ensured.

[0029] In addition, the reliability of the front drum portion 2 is not ensured because the morphological features of the entirety of the support, such as surface texture and curvature, are not uniformly secured.

[0030] Furthermore, since the diameter of the material member D must be equal to the diameter of the drum body 1, it is necessary to provide a metal plate M whose width is greater than the diameter of the drum body 2, resulting in an increase in the material cost and a greater number of wasted metal plates M.

[0031] Moreover, the outer portion A of the front drum portion 2 that is coupled to the drum body 1 is not plastically deformed from the metal plate M. Consequently, the outer portion A may not have higher rigidity than the inner portion B, and the conventional laundry treatment apparatus may not ensure the force of coupling between the front drum portion 2 and the drum body 1 or the durability of the front drum portion 2.

[0032] As a result, the conventional laundry treatment apparatus has the fundamental limitation that, in order to prevent an excessive load from being applied to the part where the front drum portion 2 and the drum body 1 are coupled to each other, it is not possible to rotate the drum body 1 at higher than a predetermined RPM or to change the rotational direction of the drum body 1.

DISCLOSURE

TECHNICAL TASK

[0033] It is an object of the present disclosure to provide a drum manufacturing method capable of reducing the material cost of a front drum portion forming the front of a drum.

[0034] It is another object of the present disclosure to provide a drum manufacturing method capable of uniformly ensuring the properties of a support that supports a load at the front of a drum.

[0035] It is another object of the present disclosure to provide a drum manufacturing method capable of manufacturing a front drum portion coupled to the front of a drum using a method such as welding.

[0036] It is another object of the present disclosure to provide a drum manufacturing method capable of ensuring the shapeability of a front drum portion coupled to the front of a drum even when using a method such as welding.

[0037] It is a further object of the present disclosure to provide a laundry treatment apparatus including a drum manufactured by the above manufacturing method.

TECHNICAL SOLUTIONS

[0038] In order to accomplish the above objects, the present disclosure provides a laundry treatment apparatus configured such that a front drum portion coupled to the front of a drum and having an introduction port configured to allow laundry being introduced or withdrawn therethrough is provided with a weld line formed by welding a metal plate.

[0039] The weld line may be disposed in a thickness direction or a forward-rearward direction of the front drum portion.

[0040] The front drum portion may include a support supported by a support wheel, the support having the introduction port, and a body coupling portion extending from the support so as to have a larger diameter, the body coupling portion being coupled to the drum body. The weld line may extend from the support toward the body coupling portion.

[0041] The laundry treatment apparatus according to the present disclosure may further include a support plate disposed farther rearward than the drum and a drive unit coupled to the support plate, the drive unit being configured to rotate the drum, wherein the drive unit may be coupled to a rear surface of the drum to rotate the drum. The support may be configured to transmit a load of the drum to the support wheel.

[0042] The rigidity of the weld line provided on the support may be set to be higher than the rigidity of other regions.

[0043] The rigidity of the body coupling portion may be set to be higher than the rigidity of the support.

[0044] In order to accomplish the above objects of the

present disclosure, scratches may be formed on the front drum portion coupled to the front of the drum and having the introduction port in the forward-rearward direction or the thickness direction.

[0045] The front drum portion may have no scratches formed in a diametric direction or a circumferential direction, or the number of scratches formed on the front drum portion in the forward-rearward direction or the thickness direction may be greater than the number of scratches formed on the front drum portion in the diametric direction.

[0046] The scratches may be formed on the body coupling portion in the forward-rearward direction or the thickness direction. The number of scratches provided on the body coupling portion may be greater than the number of scratches provided on the support.

[0047] The front drum portion may further include a shaping portion bent and extending from the support toward the body coupling portion, wherein the scratches may be formed on the shaping portion in the forward-rearward direction or the thickness direction.

[0048] The front drum portion may be formed such that the number of scratches provided on the shaping portion is greater than the number of scratches provided on the support.

[0049] The front drum portion may be provided with a weld line formed by welding a metal plate.

[0050] The weld line may extend from the support to the body coupling portion.

ADVANTAGEOUS EFFECTS

[0051] The present disclosure has the effect of reducing the material cost of a front drum portion forming the front of a drum.

[0052] The present disclosure has the effect of uniformly ensuring the properties of a support that supports a load at the front of the drum.

[0053] The present disclosure has the effect of manufacturing the front drum portion that is coupled to the front of the drum using a method such as welding.

[0054] The present disclosure has the effect of ensuring the shapeability of the front drum portion coupled to the front of the drum even when using a method such as welding.

DESCRIPTION OF DRAWINGS

[0055]

FIG. 1 shows a drum of a conventional laundry treatment apparatus.

FIG. 2 shows a conventional drum manufacturing method.

FIG. 3 is a conceptual view of the conventional drum manufacturing method.

FIG. 4 shows the appearance of a laundry treatment apparatus according to the present disclosure.

FIG. 5 shows the internal structure of the laundry treatment apparatus according to the present disclosure.

FIG. 6 shows the detailed configuration of the laundry treatment apparatus according to the present disclosure.

FIG. 7 shows a reducer of the laundry treatment apparatus according to the present disclosure.

FIG. 8 shows the internal structure of the reducer.

FIG. 9 shows a rear plate and a base configured to support the reducer.

FIG. 10 shows the configuration in which the reducer is coupled to the rear plate.

FIG. 11 shows the structure in which the reducer and a motor are coupled to each other.

FIG. 12 shows the structure in which the rotation axes of the reducer and the motor are coincident.

FIG. 13 shows the configuration of a drum of the laundry treatment apparatus according to the present disclosure.

FIG. 14 shows a structure configured to support the drum.

FIG. 15 is a conceptual view showing a method of manufacturing the drum of the laundry treatment apparatus according to the present disclosure.

FIG. 16 shows the structure to which the method of manufacturing the drum according to the present disclosure is applied.

FIG. 17 shows a drum manufacturing method.

FIG. 18 shows a method of manufacturing a front drum portion.

FIG. 19 shows a process of securing a material for the front drum portion.

FIG. 20 shows a welding process at the front drum portion.

FIG. 21 shows the structure in which the front drum portion is shaped.

FIG. 22 shows the features of the drum according to the present disclosure manufactured by the above manufacturing method.

FIG. 23 shows a welding process of the drum according to the present disclosure.

FIG. 24 shows another embodiment of the welding process of the drum according to the present disclosure.

FIG. 25 shows that the grain structure of the drum according to the present disclosure is changed during a shaping process.

FIG. 26 shows the aspect in which the rigidity of the drum according to the present disclosure is increased.

BEST MODE FOR DISCLOSURE

[0056] Hereinafter, embodiments disclosed herein will be described in detail with reference to the accompanying drawings. In this specification, the same and similar configurations are denoted by the same and similar

reference numerals even in different embodiments, and the descriptions thereof refer to the first description. As used herein, singular expressions include plural expressions unless the context clearly indicates otherwise. In addition, in describing the embodiments disclosed herein, a detailed description of related prior art are omitted upon determining that the detailed description would obscure the gist of the embodiments disclosed herein. It should also be noted that the accompanying drawings are intended only to facilitate understanding of the embodiments disclosed herein, and should not be construed as limiting the technical ideas disclosed herein by the accompanying drawings.

[0057] FIG. 4 shows the appearance of a laundry treatment apparatus according to the present disclosure.

[0058] Hereinafter, the laundry treatment apparatus according to the present disclosure will be described based on the assumption that the apparatus is configured as a dryer capable of drying laundry using hot air, steam, and the like.

[0059] However, this is only an embodiment, and it is not excluded that the laundry treatment apparatus according to the present disclosure is configured as a washing machine for washing laundry using water and detergent.

[0060] That is, a drum of the laundry treatment apparatus according to the present disclosure, a description of which will follow, may be applied to a dryer and may be applied to a washing machine.

[0061] A laundry treatment apparatus according to an embodiment of the present disclosure may include a cabinet 100 that forms the appearance of the laundry treatment apparatus.

[0062] The cabinet 100 may include a front panel 110 that forms a front surface of the laundry treatment apparatus, an upper panel 150 that forms an upper surface of the laundry treatment apparatus, and a side panel 140 that forms a side surface of the laundry treatment apparatus. The side panel 140 may include a left panel 141 that forms a left side surface of the laundry treatment apparatus. The front panel 110 may be provided with an opening 111 configured to communicate with the interior of the cabinet 100 and a door 130 rotatably coupled to the cabinet 100 to open and close the opening 111.

[0063] A manipulation panel 117 may be installed on the front panel 110. The manipulation panel 117 may be provided with an input unit 118 configured to receive a control command from a user and a display unit 119 configured to output information, such as the control command, selectable by the user. The control command may include a drying course or a drying option for performing a series of drying cycles. A control panel configured to control internal components in order to perform the control command input through the input unit 118 may be installed in the cabinet 100. The control panel may be connected to the internal components of the laundry treatment apparatus and may control the components to perform the input command.

[0064] The input unit 118 may include a power supply request portion configured to request the supply of power to the laundry treatment apparatus, a course input portion configured to allow a user to select a desired one from among a plurality of courses, and an execution request portion configured to request initiation of the course selected by the user.

[0065] The display unit 119 may include at least one of a display panel capable of outputting text and figures and a speaker capable of outputting a voice signal and sound.

[0066] Meanwhile, the laundry treatment apparatus according to the present disclosure may include a water storage tank 120 configured to separately store moisture generated in a process of drying the laundry. The water storage tank 120 may include a handle provided on one side of the front panel 110 so as to be withdrawn outward. The water storage tank 120 may be configured to collect condensate generated during a drying cycle. Consequently, a user may withdraw the water storage tank 120 from the cabinet 100, may remove the condensate, and may reinstall the water storage tank in the cabinet 100. Consequently, the laundry treatment apparatus according to the present disclosure may be disposed in a place where a sewer or the like is not installed.

[0067] Meanwhile, the water storage tank 120 may be disposed above the door 130. Consequently, when the user withdraws the water storage tank 120 from the front panel 110, the user may bend his/her waist relatively less, thereby increasing the convenience of the user.

[0068] FIG. 5 schematically shows the interior of the laundry treatment apparatus according to the present disclosure.

[0069] FIG. 6A shows a drum and components disposed in front the drum in detail, and FIG. 6B shows components disposed at the rear of the drum in detail.

[0070] The laundry treatment apparatus according to the present disclosure may include a drum 200 received in the cabinet 100 to receive laundry, a drive unit configured to rotate the drum 200, a heat exchange unit 900 configured to supply hot air to the drum 200, and a base 800 having a circulating flow path unit 820. The circulating flow path unit 820 is configured to be in communication with the drum 200. Air discharged from the drum 200 may be supplied to the circulating flow path unit 820. In addition, air discharged from the circulating flow path unit 820 may be supplied back to the drum 200.

[0071] The drive unit may include a motor unit 500 configured to provide power necessary to rotate the drum 200. The drive unit may be directly connected to the drum 200 to rotate the drum 200.

[0072] For example, the drive unit may be configured as a DD (direct drive) type. Consequently, the drive unit may control the rotational direction of the drum 200 or the rotational speed of the drum 200 by directly rotating the drum 200 without components, such as a belt and a pulley.

[0073] Of course, the drive unit may include a motor disposed lower than the drum 200 and a belt configured

to connect the motor and an outer circumferential surface of the drum to each other.

[0074] It is only an embodiment that the laundry treatment apparatus according to the present disclosure is configured as a DD type, and it is not excluded that the laundry treatment apparatus is configured as a belt/pulley type.

[0075] Meanwhile, the motor unit 500 may be configured to rotate at a high RPM. For example, the motor unit may rotate at an RPM that is significantly greater than the RPM at which the laundry in the drum 200 can be rotated in a state of being attached to an inner wall of the drum 200.

[0076] However, if the laundry in the drum 200 is rotated in a state of being continuously attached to the inner wall of the drum 200, the part of the laundry attached to the inner wall of the drum is not exposed to hot air, whereby drying efficiency is reduced.

[0077] If a rotor 520 is rotated at a low RPM in order to roll or agitate the laundry in the drum 200 without attachment thereof to the inner wall of the drum 200, power or torque that can be generated by the drive unit may not properly used.

[0078] Consequently, the drive unit of the laundry treatment apparatus according to the present disclosure may further include a reducer 600 configured to reduce the RPM to increase torque while utilizing the maximum power of the motor unit 500.

[0079] In addition, the drive unit may include a drum rotating shaft 6341 connected to the drum 200 to rotate the drum 200.

[0080] The drum 200 may be cylindrical in shape and configured to receive laundry. In addition, unlike a drum used for washing, water need not be introduced in the drum 200 used only for drying, and water in a liquid state condensed in the drum 200 need not be discharged from the drum 200. Consequently, through-holes provided along the circumferential surface of the drum 200 may be omitted from the drum. That is, the drum 200 used only for drying may be different from the drum 200 used for washing.

[0081] The drum 200 may be configured in an integrated cylindrical shape, or may be manufactured in a configuration in which a drum body 210 including a circumferential surface and a rear drum surface 220 that forms a rear surface are coupled to each other.

[0082] An introduction port 211, through which laundry is introduced or withdrawn, may be provided in front of the drum body 210. The drive unit, which rotates the drum, may be connected to the rear of the rear drum surface 220. The drum body 210 and the rear drum surface 220 may be coupled to each other via a fastening member, such as a bolt; however, the present disclosure is not limited thereto, and a variety of methods may be used as long as the drum body 210 and the rear drum surface 220 can be coupled to each other so as to rotate together.

[0083] The drum body 210 may be provided with a lifter 213 configured to upwardly tow the laundry received

therein such that the laundry can be mixed as the drum rotates. As the drum 200 rotates, the laundry received therein may be repeatedly raised and lowered by the lifter 213. The laundry received in the drum 200 may evenly contact hot air as the laundry is repeatedly raised and lowered. Consequently, the drying efficiency is increased and the drying time is shortened.

[0084] A reinforcing bead 212 may be formed on the circumferential surface of the drum body 210. The reinforcing bead 212 may be inwardly depressed or may outwardly protrude along the circumferential surface of the drum 200. The reinforcing bead 212 may be provided in plural, and the plurality of reinforcing beads may be spaced apart from each other. The reinforcing beads may be provided inwardly or outwardly of the circumferential surface in a regular pattern.

[0085] The rigidity of the drum body 210 may be increased by the reinforcing bead 212. Consequently, twisting of the drum body 210 may be prevented even when a large amount of laundry is received in the drum body 210 or when the drum body 210 is subjected to sudden rotational force transmitted through the drive unit. In addition, when the reinforcing bead 212 is provided, the distance between the laundry and the inner circumferential surface may be increased compared to when the circumferential surface of the drum body 210 is flat, whereby the hot air supplied to the drum 200 may more effectively flow between the laundry and the drum 200. The durability of the drum is increased by the reinforcing bead, and the drying efficiency of the laundry treatment apparatus is increased.

[0086] In a DD-type washing machine, the drive unit is coupled and fixed to a tub configured to receive the drum 200, and the drum 200 may be coupled to the drive unit so as to be supported by the tub. However, since the laundry treatment apparatus according to the present disclosure is configured to intensively perform a drying cycle, the tub fixed to the cabinet 100 to receive the drum 200 is omitted.

[0087] Consequently, the laundry treatment apparatus according to the present disclosure may further include a support unit 400 configured to fix or support the drum 200 or the drive unit in the cabinet 100.

[0088] The support unit 400 may include a front plate 410 disposed in front of the drum 200, and a rear plate 420 disposed at the rear of the drum 200. The front plate 410 and the rear plate 420 may be configured in a plate shape and may be disposed to face the front and rear of the drum 200. The distance between the front plate 410 and the rear plate 420 may be equal to the length of the drum 200, or may greater than the length of the drum 200. The front plate 410 and the rear plate 420 may be fixed to and supported by a bottom surface of the cabinet 100 or the base 800.

[0089] The front plate 410 may be disposed between the front panel, which forms the front surface of the cabinet, and the drum 200. In addition, the front plate 410 may be provided with an introduction port commu-

nication hole 412 in communication with the introduction port 211. Since the introduction port communication hole 412 is provided in the front plate 410, laundry may be introduced into or withdrawn from the drum 200.

[0090] The front plate 410 may include a duct connection portion 416 provided under the introduction port communication hole 412. The duct connection portion 416 may form a lower surface of the front plate 410.

[0091] The front plate 410 may include a duct communication hole 417 formed through the duct connection portion 416. The duct communication hole 417 may be hollow to guide air discharged through the introduction port 211 of the drum downwardly of the drum 200. In addition, the duct communication hole may guide air discharged through the drum 211 to the circulating flow path unit 820 located under the drum 200.

[0092] A filter portion (not shown) configured to filter out lint or large particle debris generated from laundry may be installed in the duct communication hole 417. The filter portion may filter the air discharged from the drum 200 to prevent the accumulation of debris in the laundry treatment apparatus and to prevent the circulation of air from being disrupted due to the accumulation of the debris.

[0093] Since the introduction port 211 is disposed in the front, the drive unit is preferably installed on the rear plate 420 rather than on the front plate 410. The drive unit may be mounted to and supported by the rear plate 420. Consequently, the drive unit may rotate the drum 200 while being stably fixed in position through the rear plate 420.

[0094] At least one of the front plate 410 and the rear plate 420 may rotatably support the drum 200. At least one of the front plate 410 and the rear plate 420 may rotatably receive a front end or a rear end of the drum 200.

[0095] For example, the front of the drum 200 may be rotatably supported by the front plate 410, and the rear of the drum 200 may be connected to the motor unit 500 mounted to the rear plate 420 while being spaced apart from the rear plate 420 so as to be indirectly supported by the rear plate 420. Consequently, the area where the drum 200 contacts or rubs against the support unit 400 may be minimized and unnecessary noise or vibration may be prevented.

[0096] Of course, the drum 200 may also be configured to be rotatably supported by both the front plate 410 and the rear plate 420.

[0097] At least one support wheel 415 configured to support the front of the drum 200 may be provided under the front plate 410. The support wheel 415 may be rotatably provided on a rear surface of the front plate 410. The support wheel 415 may be rotated in contact with a lower part of the drum 200.

[0098] When the drum 200 is rotated by the drive unit, the drum 200 may be supported by a drum rotating shaft 6341 connected to the rear thereof. When laundry is received in the drum 200, the load applied to the drum rotating shaft 6341 by the laundry may be increased.

Consequently, the drum rotating shaft 6341 may be bent by the load.

[0099] If the support wheel 415 supports a lower part of the front of the drum 200, the load applied to the drum rotating shaft 6341 may be reduced. Consequently, bending of the drum rotating shaft 6341 may be prevented and noise due to vibration may be prevented.

[0100] The support wheels 415 may be provided at positions symmetrical to each other with respect to the center of rotation of the drum 200 to support the load of the drum 200. Preferably, the support wheels 415 are provided at left and right lower parts of the drum 200, respectively, to support the drum 200. However, the present disclosure is not limited thereto, and a greater number of support wheels 415 may be provided depending on the operating environment of the drum 200.

[0101] The circulating flow path unit 820 provided in the base 800 may form a flow path for circulating air in the drum 200 and introducing the air back into the drum 200.

[0102] The circulating flow path unit 820 may include an introduction duct 821 into which air discharged from the drum 200 is introduced, a discharge duct 823 configured to supply air to the drum 200, and a movement duct 822 configured to connect the introduction duct 821 and the discharge duct 823 to each other.

[0103] If air is discharged from the front of the drum 200, the movement duct 822 may be located on a front side of the circulating flow path unit 820. The discharge duct 823 may be located on a rear side of the circulating flow path unit 820.

[0104] The discharge duct 823 may further include a blowing portion 8231 configured to discharge air to the outside of the circulating flow path unit 820. The blowing portion 8231 may be provided at a rear side of the discharge duct 823. Air discharged through the blowing portion 8231 may move to the drum 200.

[0105] A duct cover portion 830 may be coupled to an upper side of the circulating flow path unit 820 to shield a part of an open upper surface of the circulating flow path unit 820. The duct cover portion 830 may prevent air from escaping the circulating flow path unit 820. In other words, the duct cover portion 830 may form one surface of the air circulating flow path.

[0106] In addition, the heat exchange unit 900 provided at the base 800 may include a first heat exchanger 910 provided in the circulating flow path unit 820 to cool air and a second heat exchanger 920 provided in the circulating flow path unit 820 to heat the air cooled by the first heat exchanger 910.

[0107] The first heat exchanger 910 may dehumidify air discharged from the drum 200, and the second heat exchanger 920 may heat the dehumidified air. The heated air may be supplied back to the drum 200 to dry the laundry received in the drum 200.

[0108] Each of the first heat exchanger 910 and the second heat exchanger 920 may be configured as a heat exchanger in which refrigerant flows. When configured as a heat exchanger in which refrigerant flows, the first

heat exchanger 910 may be configured as an evaporator, and the second heat exchanger 920 may be configured as a condenser. The refrigerant moving along the first heat exchanger 910 and the second heat exchanger 920 may exchange heat with the air discharged from the drum 200.

[0109] The heat exchange unit 900 may include a circulating flow path fan 950 installed in the circulating flow path unit 820 to generate air flow in the circulating flow path unit 820. In addition, the heat exchange unit 900 may further include a circulating flow path fan motor 951 configured to rotate the circulating flow path fan 950. The circulating flow path fan 950 may be rotated by rotational force from the circulating flow path fan motor 951. When the circulating flow path fan 950 is operated, air dehumidified by the first heat exchanger 910 and heated by the second heat exchanger 920 may be moved to the rear of the drum 200.

[0110] The circulating flow path fan 950 may be installed in any one of the introduction duct 821, the movement duct 822, and the discharge duct 823. Since the circulating flow path fan 950 is configured to rotate, the circulating flow path fan 950 may generate noise when operated. Consequently, it is preferable for the circulating flow path fan 950 to be disposed at the rear of the circulating flow path unit 820.

[0111] The circulating flow path fan 950 may be installed in the blowing portion 8231. In addition, the circulating flow path fan motor 951 may be disposed at the rear of the blowing portion 8231. When the circulating flow path fan 950 is rotated by the circulating flow path fan motor 951, air in the circulating flow path unit 820 may be discharged to the outside of the circulating flow path unit 820 via the blowing portion 8231.

[0112] Since it is preferable for the introduction port 211 of the drum 200 to be disposed at a relatively high position such that a user can easily withdraw the laundry from the drum 200, the circulating flow path unit 820 and the heat exchange unit 900 are preferably disposed under the drum 200.

[0113] The rear plate 420, which is configured to guide air discharged from the circulating flow path unit 820 to the drum 200, may be provided at the rear of the drum 200. The rear plate 420 may be spaced apart from the rear drum surface 220. The circulating flow path unit 820 may receive air from the drum 200 via the front plate 410 and may supply air to the drum 200 via the rear plate 420. Air discharged from the circulating flow path unit 820 may be guided to the drum 200 via the rear plate 420.

[0114] The base 800 may further include a connector 850 configured to guide air discharged from the circulating flow path unit 820 to the rear plate 420. The connector 850 may guide the discharged air so as to be evenly spread throughout the rear plate 420.

[0115] The connector 850 may be installed at the blowing portion 823. That is, the connector 850 may guide air discharged from the blowing portion 8231 to the rear plate 420. The hot air supplied to the rear plate 420 may be

introduced into the drum 200 through the rear drum surface 220.

[0116] The drum 200 of the laundry treatment apparatus according to the present disclosure may not be indirectly rotated in a state of being coupled to a belt or the like but may be rotated in a state of being directly connected to the drive unit located at the rear of the drum 200. Consequently, unlike a drum of a conventional dryer which is provided in a cylindrical shape open at the front and the rear, the rear of the drum of the laundry treatment apparatus according to the present disclosure may be shielded and directly coupled to the drive unit.

[0117] As previously described, the drum 200 may include a drum body 210 configured in a cylindrical shape to receive laundry and a rear drum surface 220 coupled to the rear of the drum body 210 to form a rear surface of the drum.

[0118] The rear drum surface 220 may be configured to shield the rear of the drum body 210 to provide a coupling surface for direct coupling to the drive unit. That is, the rear drum surface 220 may be connected to the drive unit to rotate the entire drum 200 using rotational force therefrom. As a result, the introduction port 211, through which laundry is introduced, is formed in the front of the drum body 210, and the rear of the drum body may be shielded by the rear drum surface 220.

[0119] The rear drum surface 220 may be provided with a bushing portion 300 configured to connect the drive unit and the rear drum surface 220 to each other. The bushing portion 300 may be provided on the rear drum surface 220 to form the center of rotation of the drum 200. The bushing portion 300 may be integrally formed at the rear drum surface 220, or may be made of a material having greater rigidity or durability than the rear drum surface 220 so as to be firmly coupled to a rotating shaft configured to transmit power. The bushing portion 300 may be seated on and coupled to the rear drum surface 220 so as to be coaxial with the center of rotation of the rear drum surface 220.

[0120] The rear drum surface 220 may include a circumferential portion 221 coupled to an outer circumferential surface of the drum body 210 and a mounting plate 222 provided inside the circumferential portion 221 so as to be coupled to the drive unit. The bushing portion 300 may be seated on and coupled to the mounting plate 222. The rotating shaft that rotates the drum may be coupled to the mounting plate 222 via the bushing portion 300, which provides a firmer coupling effect. In addition, deformation of the rear drum surface 220 may be prevented.

[0121] The rear drum surface 220 may include a suction hole 224 formed through the circumferential portion 221 and the mounting plate 222 therebetween such that the front and rear of the rear drum surface 220 communicate with each other. Hot air supplied through the circulating flow path unit 820 may be introduced into the drum body 210 via the suction hole 224. The suction hole 224 may include a plurality of holes formed through the rear drum surface 220, or may be configured as a

mesh.

[0122] The drive unit, which rotates the drum 200, may be located at the rear of the rear plate 420. The drive unit may include a motor unit 500 configured to generate rotational force and a reducer 600 configured to reduce the rotational force of the motor unit 500 and to transmit the same to the drum 200.

[0123] The motor unit 500 may be disposed at the rear of the rear plate 420. The motor unit 500 may be coupled to the rear of the rear plate 420 via the reducer 600.

[0124] The reducer 600 may be fixed to a rear surface of the rear plate 420, and the motor unit 500 may be coupled to a rear surface of the reducer 600. That is, the rear plate 420 may provide a support surface configured to support the reducer 600 or the motor unit 500. However, the present disclosure is not limited thereto, and the motor unit 500 may be coupled to the rear plate 420.

[0125] FIG. 6 is an exploded perspective view of internal components constituting the laundry treatment apparatus in a state of being separated from each other.

[0126] The laundry treatment apparatus according to the embodiment of the present disclosure may include a drum 200 configured to receive laundry, a front plate 410 configured to support a front surface of the drum, a rear plate 420 located at the rear of the drum, a base 800 provided under the drum to provide space for air in the drum to circulate or for moisture contained in the air to condense, a motor unit 510, 520, and 540 located at the rear of the drum to provide rotational force to the drum, a reducer 600 configured to slow down the rotation of the motor units and to transmit the same to the drum, and a rear cover 430 coupled to the rear plate 420 to prevent the motor unit from being exposed to the outside.

[0127] The base 800 may include a circulating flow path unit 820 in communication with the drum 200 to allow air to flow into or out of the drum therethrough.

[0128] The front plate 410 may include a front panel 411 that forms a front surface, and an introduction port communication hole 412 formed through the front panel 411 so as to be in communication with the drum 200. The front plate 410 may have a front gasket 413 provided on a rear surface of the front panel 411 so as to surround the outside of the introduction port communication hole 412 in a radial direction and to receive a part of the drum body 210.

[0129] The front gasket 413 may rotatably support the drum body 210, and may be in contact with an outer circumferential surface or an inner circumferential surface of the introduction port 211. The front gasket 413 may prevent hot air in the drum 200 from leaking between the drum body 210 and the front plate 410. The front gasket 413 may be made of a plastic resin material or an elastic body, and a separate sealing member may be further coupled to the front gasket 413 to prevent laundry or hot air from moving from the drum body 210 to the front plate 410.

[0130] Meanwhile, the front plate 410 may include a duct communication hole 417 formed through an inner

circumferential surface of the introduction port communication hole 412. In addition, the front plate 410 may include a duct connection portion 416 extending downwardly of the duct communication hole 417 to form a flow path configured to allow the drum body 210 and the circulating flow path unit 820 to communicate with each other therethrough.

[0131] The duct connection portion 416 may communicate with the drum body 210 via the duct communication hole 417, and air discharged from the drum body 210 may be introduced into the duct connection portion 416 via the duct communication hole 417 and be guided to the circulating flow path unit 820. The air discharged from the drum body 210 is guided to the circulating flow path unit 820 by the duct connection portion 416, thereby preventing air from escaping the drum.

[0132] A filter portion (not shown) configured to filter out debris or lint from the air discharged from the drum 200, thereby preventing debris from being introduced into the circulating flow path unit 820, may be installed in the duct connection portion 416.

[0133] The front plate 410 may be provided with a support wheel 415 rotatably installed on the rear surface of the front panel 411 to support a lower part of the drum 200. The support wheel 415 supports the front of the drum 200, thereby preventing bending of a rotating shaft connected to the drum.

[0134] The front plate 410 may be provided with a water storage tank support hole 414 formed through the front panel 411 to withdraw or support a water storage tank 120 (see FIG. 1), in which condensate generated in a drying process is stored. If the water storage tank support hole 414 is provided on an upper side, a user does not have to bend down to withdraw the water storage tank, thereby increasing the convenience of the user.

[0135] The drum 200 that receives laundry may include a drum body 210 having an introduction port 211, through which laundry is introduced and withdrawn, in the front thereof and a rear drum surface 220 that forms a rear surface.

[0136] The rear drum surface 220 may include a circumferential portion 221 connected to the drum body 210, a suction hole 224 formed through the rear drum surface 220 inside the circumferential portion 221, and a mounting plate 222 provided at the center of rotation of the rear drum surface 220 so as to be coupled to the rotating shaft. Air may be introduced into the rear of the drum through the suction hole 224.

[0137] The rear drum surface 220 may further include a reinforcing rib 225 extending from the circumferential portion 221 toward the center of rotation. The reinforcing rib 225 may extend so as to avoid the suction hole 224. The reinforcing rib 225 may prevent the rigidity of the rear drum surface 220 from being reduced by the suction hole 224. The reinforcing rib 225 may extend radially from an outer circumferential surface of the mounting plate 222 toward an inner circumferential surface of the circumferential portion 221.

[0138] In addition, the rear drum surface 220 may further include a circumferential rib 227 extending in a circumferential direction of the rear drum surface 220 so as to connect the reinforcing ribs 225 to each other. The suction hole 224 may be disposed between each reinforcing rib 225 and the circumferential rib 227 and the circumferential portion 221. The reinforcing rib 225 and the circumferential rib 227 may prevent deformation of the rear drum surface 220 even when the rear drum surface 220 receives rotational force from the motor unit 500.

[0139] The introduction duct 821 may be in communication with the duct communication hole 417 of the front plate 410 so as to communicate with a flow path installed in the front plate 410. The movement duct 822 may extend from an end of the introduction duct 821 toward the rear of the drum 200, and the discharge duct 823 may be provided at an end of the movement duct 822 to guide the air to the drum 200.

[0140] The blowing portion 8231 may be located downstream of the discharge duct 823, and the blowing portion 8231 may provide a space in which a circulating flow path fan is installed. When the circulating flow path fan is operated, air introduced into the introduction duct 821 may be discharged upwardly of the blowing portion 8231.

[0141] Meanwhile, a heat exchange unit 900 configured to cool and heat air circulating in the drum 200 may be installed on the base 800. The heat exchange unit 900 may include a compressor 930 connected to a first heat exchanger and a second heat exchanger to supply compressed refrigerant. The compressor 930 may be provided so as not to directly exchange heat with circulating air, and thus may be located outside the circulating flow path unit 820.

[0142] In addition, the heat exchange unit may include a circulating flow path fan motor 951 supported at the rear of the blowing portion 8231 to rotate the circulating flow path fan. The circulating flow path fan motor 951 may be coupled to the rear of the blowing portion 8231.

[0143] Meanwhile, the laundry treatment apparatus according to the embodiment of the present disclosure may further include a connector 850 coupled to the circulating flow path unit 820 to direct hot air discharged from the circulating flow path unit 820 to the rear of the drum 200 or to the rear plate 420.

[0144] The connector 850 may be disposed above the discharge duct 823 to guide hot air heated by passing through the second heat exchanger 920 upward farther than the discharge duct 823. In addition, the connector 850 may be coupled to an opening provided above the blowing portion 8231.

[0145] The connector 850 may be configured to form a flow path therein. The connector 850 may be configured to evenly guide air flow generated by the circulating flow path fan to the rear plate 420. That is, the connector 850 may be configured such that the area of the flow path increases with increasing distance from the blowing portion 8231.

[0146] The rear plate 420 may be coupled to the base 800 or supported by the base 800 and located at the rear of the drum 200. The rear plate 420 may include a rear panel 421 located so as to face the front plate 410 and a duct portion 423 depressed in the rear panel 421 to form a flow channel through which air flows and to guide air discharged from the circulating flow path unit 820 to the drum.

[0147] The rear plate 420 may include a mounting portion 425 to which the drive unit is coupled or by which the drive unit is supported. The mounting portion 425 may be formed through the rear panel 421 and may be disposed at an inner circumferential surface of the duct portion 423. The mounting portion 425 may be spaced radially inward from the inner circumferential surface of the duct portion 423.

[0148] Here, the drive unit may refer to a combination of the reducer 600 and the motor unit 500, as described above. The drive unit may mean only the motor unit 500. That is, the configuration that generates power and transmits rotational force to the drum may be referred to as the drive unit.

[0149] The drive unit may be mounted in the mounting part 425. The mounting portion 425 may support the load of the drive unit. The drive unit may be connected to the drum 200 while being supported by the mounting portion 425.

[0150] The duct portion 423 may be configured to receive a part of the rear drum surface 220. The duct portion 423 may form a flow path for movement of air together with the rear drum surface 220.

[0151] The drive unit may be installed in the mounting portion 425 so as to be prevented from interfering with the duct portion 423. That is, the drive unit may be spaced radially inward from the inner circumferential surface of the duct portion 423. The drive unit may be installed in the mounting portion 425 such that the rear thereof is exposed to the outside so as to be cooled by outside air.

[0152] The drive unit may include a motor unit 500 configured to provide power necessary to rotate the drum 200. The motor unit 500 may include a stator 510 configured to generate a rotating magnetic field and a rotor 520 configured to be rotated by the stator 510.

[0153] The rotor 520 may be configured as an outer rotor type that receives the stator 510 and is configured to rotate along the circumference of the stator 510. In this case, a drive shaft may be coupled to the rotor 520, and the drive shaft may be directly connected to the drum 200 through the stator 510 and the mounting portion 425. In this case, the rotor 520 may directly transmit power necessary to rotate the drum 200.

[0154] The rotor 520 may be coupled to the drive shaft via a washer portion 540. The washer portion 540 may function to connect the drive shaft and the rotor 520 to each other. The contact area between the rotor 520 and the drive shaft may be increased by the washer portion 540, whereby rotation of the rotor 520 is more effectively transmitted.

[0155] The reducer 600 may be configured to connect the motor unit 500 and the drum 200 to each other. The reducer 600 may convert the power of the motor unit 500 to rotate the drum 200. The reducer 600 may be disposed between the motor unit 500 and the drum 200 to receive power from the motor unit 500, to convert the same, and to transmit the same to the drum 200. The reducer 600 may be configured to convert the RPM of the rotor to a lower RPM while increasing the torque value and to transmit the same to the drum 200.

[0156] Specifically, the reducer 600 may be coupled to the drive shaft 530 that is coupled to the rotor 520 and rotated with the rotor 520. The reducer 600 may include a gear assembly configured to rotate in engagement with the drive shaft 530 and to change the RPM of the drive shaft 530 while increasing torque, and the gear assembly may be coupled to a drum rotating shaft 6341 that is coupled to the drum 200 to rotate the drum. Consequently, when the drive shaft 530 rotates, the drum rotating shaft 6341 may rotate at a slower RPM than the drive shaft 530 while having greater torque.

[0157] The performance of the reducer 600 may be dependent on whether the drive shaft 530 and the drum rotating shaft 6341 are coaxial with each other. That is, if the drive shaft 530 and the drum rotating shaft 6341 are misaligned from each other, the parts constituting the gear assembly in the reducer 600 may become loose or disengaged from at least one of the drive shaft 530 and the drum rotating shaft 6341. As a result, power of the drive shaft 530 may not be properly transmitted to the drum rotating shaft 6341, or the drive shaft 530 may spin with no traction.

[0158] In addition, if the drive shaft 530 and the drum rotating shaft 6341 are temporarily misaligned from each other, gears in the reducer 600 may be misaligned and may collide with each other, causing unnecessary vibration or noise.

[0159] In addition, if the angle by which the drive shaft 530 and the drum rotating shaft 6341 are temporarily misaligned from each other is increased, the reducer 600 may break or be completely out of position.

[0160] In order to prevent this, for laundry processing apparatuses each having a reducer 600, it is generally preferable to fix the reducer 600 and the motor unit 500 to a support configured to remain in the original state thereof without deformation even when external force is generated.

[0161] For example, in the case of a washing machine, it is possible to primarily fix a tub configured to receive the drum to a cabinet and to secondly fix the motor unit and the reducer to a bearing housing made of a rigid body embedded in the tub by injection molding. Consequently, even if significant vibration is generated from the tub, the reducer and the motor unit may be tilted or may vibrate together with the bearing housing or the steel fixing plate. As a result, the reducer and the drive unit may remain coupled to each other, and the drive shaft and the rotating shaft remain coaxial with each other.

[0162] However, since the laundry treatment apparatus according to the present disclosure is configured as a dryer, the construction of the tub fixed in the cabinet 100 is omitted. In addition, a rear panel of the cabinet 100 may be made of a relatively thin plate, whereby, even if the stator 510 is fixed, the rear panel may easily vibrate or may be easily bent due to the repulsive force when the rotor 520 rotates. If the rear panel vibrates or is bent even temporarily, the centers of the rotation of the reducer 600 and the motor unit 500 coupled to the drum 200 may be misaligned from each other.

[0163] In addition, since the rear panel is made of a thin steel plate, it may be difficult to support both the reducer 600 and the motor unit 500. For example, if the reducer 600 and the motor unit 500 are coupled to the rear panel side by side, rotational moment may be generated due to the overall length and weight of the reducer 600 and the motor unit 500, causing the reducer 600 to sag downward. As a result, the drum rotating shaft coupled to the drum may be misaligned with the reducer 600, whereby the drum rotating shaft 6341 may not remain coaxial with the drive shaft 530.

[0164] Meanwhile, it may be considered that the stator 510 is coupled to the rear plate 420 to support the motor unit 500. If a large amount of laundry is received in the drum 200 or if eccentricity occurs, the drum rotating shaft may be misaligned depending on disposition of the laundry whenever the drum 200 rotates. At this time, since the stator 510 is separated from the drum 200 and fixed to the rear plate 420, the drum rotating shaft 6341 may vibrate at a different width from the stator 510 or may be tilted at a different angle therefrom. Consequently, the drum rotating shaft 6341 and the drive shaft 530 may not remain coaxial with each other.

[0165] From another perspective, the drum 200 may be supported by the front plate 410 and the rear plate 420 such that the installation position thereof may be fixed to a certain extent. Consequently, the position of the drum rotating shaft 6341 coupled to the drum 200 may also be fixed to a certain extent. Consequently, even if vibration occurs from the drum 200, the vibration may be absorbed by at least one of the front plate 410 and the rear plate 420.

[0166] However, if the vibration generated from the drum 200 is transmitted to the motor unit 500, the vibration amplitude of the motor unit 500 and the rear plate 420 may be greater than the vibration amplitude of the drum rotating shaft even though the reducer 600 and the motor unit 500 are fixed to the rear plate 420. Even in this case, the drive shaft and the drum rotating shaft 6341 may not remain coaxial with each other.

[0167] In order to solve this problem, in the laundry treatment apparatus according to the present disclosure, the motor unit 500 may be coupled and fixed to the reducer 600. In other words, the reducer 600 may serve as a reference point for the entire drive unit. That is, the reducer 600 may serve as a reference for vibration and the tilting angle of the entire drive unit.

[0168] Since the motor unit 500 is not fixed to any other component of the laundry treatment apparatus but only to the reducer 600, the motor unit 500 may be tilted or may vibrate simultaneously with the reducer 600 if the reducer 600 is tilted or vibrates when vibration is transmitted to the drive unit or external force is transmitted to the drive unit.

[0169] As a result, the reducer 600 and the motor unit 500 may form a single vibration system, and the reducer 600 and the motor unit 500 may remain stationary without moving relative to each other.

[0170] The stator 510 of the motor unit 500 may be directly coupled and fixed to the reducer 600. As a result, the installation position of the drive shaft 530 relative to the reducer 600 may not be changed. The center of the drive shaft 530 and the center of the reducer 600 may be disposed in a state of coincidence with each other, and the drive shaft 530 may be rotated in a state of remaining coaxial with the center of the reducer 600.

[0171] A first axis M1 may mean an imaginary line extending along the center of rotation of the drum 200 in a forward-rearward direction. That is, the first axis M1 may be in parallel with an X axis.

[0172] A second axis M2 and a third axis M3 may mean imaginary lines extending upward from the front to the rear of the laundry treatment apparatus. That is, the second axis M2 and the third axis M3 may be provided parallel with an XZ plane or perpendicular to a Y axis.

[0173] The first axis M1 and the second axis M2 may intersect each other at the reducer 600. In addition, the first axis M1 and the third axis M3 may intersect each other at the mounting portion 425.

[0174] The reducer 600 and the motor unit 500 may be designed to be disposed along the first axis M1 parallel to the ground when there is no load on the drum 200 or when the motor unit 500 is not in operation.

[0175] However, if vibration is generated from the drum 200 or the motor unit 500, the vibration may be transmitted to the reducer 600, causing the reducer 600 to tilt, thereby temporarily causing the reducer 600 to be tilted along the second axis M2.

[0176] At this time, since the motor unit 500 is coupled to the reducer 600, the motor unit may vibrate or may be tilted along with the reducer 600. Consequently, the motor unit 500 may be disposed parallel with the reducer 600 on the second axis M2. Consequently, the drive shaft 530 and the drum rotating shaft 6341 may also be disposed in parallel with each other along the second axis M2.

[0177] As a result, even if the reducer 600 is tilted, the motor unit 500 may move in unison with the reducer 600, and the drive shaft 530 and the drum rotating shaft 6341 may remain coaxial with each other.

[0178] The reducer 600 may be coupled and fixed to the rear plate 420. In this case, the reducer 600 may be tilted or may vibrate in a state of being coupled to the rear plate 420, whereby the rear plate 420 may serve as the center of a vibration system including the reducer 600, the motor unit 500, and the drum 200. Even in this case,

the motor unit 500 may not be directly coupled to the rear plate 420, but may be coupled and fixed to only the reducer 600.

[0179] In the state in which the reducer 600, the motor unit 500 and the drum 200 are disposed parallel with each other along the first axis M1, the reducer 600 may be tilted parallel with the third axis M3 by vibration of the drum 200 or the motor unit 500. The third axis M3 may extend through the reducer 600 coupled to the rear plate 420. At this time, since the reducer 600 and the motor unit 500 are coupled to each other, the motor unit 500 may also be tilted parallel with the third axis M3 in the same manner as the reducer 600.

[0180] Eventually, since the motor unit 500 and the drum 200 are coupled to the reducer 600, the motor unit 500 and the drum 200 may be tilted parallel with each other with respect to the reducer 600 or may vibrate simultaneously.

[0181] The meaning of coaxiality and alignment is not intended to imply physically perfect coaxiality and alignment, but rather is a concept that allows for a mechanically acceptable margin of error or a range of levels that can be recognized as coaxiality or alignment by those skilled in the art. For example, a range in which the drive shaft 530 and the drum rotating shaft 6341 are misaligned from each other by less than 5 degrees may be defined as a coaxial state or an aligned state. However, the angular value is just one example, and the tolerance allowed by design may change.

[0182] Since the drive shaft 530 is fixed and thus prevented from being tilted while rotating relative to the reducer 600 and the stator 510 is also fixed to the reducer 600, the distance between the stator 510 and the rotor 520 may be maintained at all times. As a result, collision between the stator 510 and the rotor 520 may be prevented, and noise or vibration that may be generated due to a change in the center of rotation 520 as the rotor 520 rotates the stator 510 may be fundamentally prevented.

[0183] The drum rotating shaft 6341 may be provided in the reducer 600 so as to extend toward the drum 200, may vibrate with the reducer 600, and may be tilt with the reducer 600. That is, the drum rotating shaft 6341 is configured to rotate in the reducer 600, but may be fixed in installation position. As a result, the drum rotating shaft 6341 and the drive shaft 530 may always be disposed parallel with each other, and may be coaxial with each other. In other words, the center of the drum rotating shaft 6341 and the center of the drive shaft 530 may remain aligned with each other.

[0184] Meanwhile, a sealing unit 450 may be provided between the rear drum surface 220 and the rear plate 420. The sealing unit 450 may form a seal between the rear drum surface 220 and the rear plate 420 such that air introduced into the duct portion 423 of the rear plate 420 is introduced into the suction hole 224 without leakage to the outside.

[0185] The sealing unit 450 may be disposed on each of an outer surface and an inner surface of the duct

portion 423. A first sealing portion 451 may be provided on a radially outer side of the duct portion 423, and a second sealing portion 452 may be provided on a radially inner side of the duct portion. The first sealing portion 451 may prevent hot air from leaking radially outward between the rear drum surface 220 and the duct portion 423, and the second sealing portion 452 may prevent hot air from leaking radially inward between the rear drum surface 220 and the duct portion 423.

[0186] In other words, the sealing unit 450 may be disposed on each of the radially outer side and the radially inner side of the suction hole 224. The first sealing portion 451 may be provided on the radially outer side of the suction hole 224, and the second sealing portion 452 may be provided on the radially inner side of the suction hole 224.

[0187] Preferably, the sealing unit 450 is in contact with both the rear drum surface 220 and the rear plate 420 to prevent leakage of hot air. Since the drum 200 rotates in a course of operation of the laundry treatment apparatus, the sealing unit 450 is subjected to continuous friction by the rear drum surface 220. Consequently, it is preferable for the sealing unit 450 to be made of a material capable of forming a seal between the rear drum surface 220 and the duct portion 423 without deterioration in performance despite the frictional force and frictional heat generated by rotation.

[0188] Meanwhile, the motor unit 500 or the reducer 600 may be coupled to the rear of the rear plate 420, wherein the rear plate 420 may be made of a thin iron plate material, whereby the rear plate may be bent or deformed by the reducer 600 and the load transmitted to the reducer 600 from the drum 200. That is, it is necessary to ensure rigidity of the rear plate 420 in order to install the reducer 600, the motor unit 500, and the like.

[0189] To this end, the rear plate 420 may further include a bracket 700 configured to reinforce coupling rigidity. The bracket 700 may be further coupled to the rear plate 420, and the reducer 600 and the motor unit 500 may be coupled to the rear plate 420 by the bracket 700.

[0190] The reducer 600 may be simultaneously coupled to the bracket 700 and the rear plate 420. A fastening member may extend through the reducer 600, the rear plate 420, and the bracket 700 for coupling therebetween. The bracket 700 may be coupled to the rear plate 420, whereby rigidity of the rear plate may be secured. The reducer 600, the motor unit 500, and the like may be coupled to the rigid rear plate 420.

[0191] The reducer 600 may be first coupled to the bracket 700, and then the bracket 700 may be coupled to the rear plate 420. That is, the reducer may not be directly coupled to the rear plate 420 but may be fixed to the rear plate 420 via the bracket 700.

[0192] Meanwhile, when the motor unit 500 or the reducer 600 is coupled to the rear of the rear plate 420, the motor unit 500 and the reducer 600 may be exposed to the outside. Consequently, it is necessary to

prevent exposure of the motor unit 500 coupled to the rear of the rear plate 420. In addition, the duct portion 423 may be heated by hot air. Consequently, it may be necessary to insulate the rear surface of the duct portion 423.

[0193] The rear cover 430 may be coupled to the rear of the rear plate 420 to prevent the duct portion 423 and the motor unit 500 or the reducer 600 from being exposed to the outside. The rear cover 430 may be disposed spaced apart from the duct portion 423 and the drive unit.

[0194] The rear cover 430 prevents damage to the motor unit 500 due to external interference or a decrease in drying efficiency due to heat loss through the duct part 423.

[0195] FIG. 7 shows the appearance of a reducer 600 according to an embodiment of the present disclosure.

[0196] The reducer 600 may include a reducer housing 610 and 620 that forms the appearance thereof. The reducer housing may include a first housing 610 configured to face the drum and a second housing 620 configured to face the motor unit.

[0197] The reducer 600 may include a gearbox. The gearbox may be configured to receive power from the motor unit 500, to convert the RPM of the motor unit 500 to a lower RPM while increasing a torque value, and to transmit the same to the drum 200. Most of the gearbox may be received in the second housing 620, and the first housing 610 may shield the interior of the reducer 600. Consequently, the overall thickness of the reducer 600 may be reduced. The detailed construction of the gearbox will be described later.

[0198] The first housing 610 may include a first housing blocking body 611 configured to shield the second housing 620 and a first housing bearing portion 612 extending from the first housing blocking body 611 in a direction away from the second housing 620. The first housing bearing portion 612 may receive the drum rotating shaft 6341 and may rotatably support the drum rotating shaft 6341.

[0199] The first housing 610 may include a stator coupling portion 613 configured to support the motor unit 500. The stator coupling portion 613 may extend from a circumferential surface of the first housing blocking body 611 in a direction away from the first housing bearing portion 612.

[0200] The stator coupling portion 613 may include a stator fastening hole 615 to which the motor unit 500 may be fastened. The stator fastening hole 615 may be depressed in the stator coupling portion 613. A separate fastening member may be inserted into the stator fastening hole 615. The stator coupling portion 613 and the motor unit 500 may be coupled to each other using the reducer fastening member.

[0201] The first housing 610 may further include a coupling guide 614 configured to guide the coupling of the motor unit 500. The coupling guide 614 may extend from the circumferential surface of the first housing blocking body 611 in a direction away from the first housing

bearing portion 612. The coupling guide 614 may extend from the first housing blocking body 611 so as to be connected to the stator coupling portion 613. The coupling guide 614 may guide the position of the stator 510 when the stator 510 is coupled to the stator coupling portion 613. As a result, assembly efficiency may be improved.

[0202] Referring to FIG. 8, the second housing 620 may receive a gear assembly therein. Generally, the gearbox coupled to the reducer 600 may include a sun gear, a planetary gear configured to orbit the sun gear, and a ring gear configured to receive the planetary gear and to guide rotation of the planetary gear. The second housing 620 may include a second housing coupling body 621 coupled to the first housing 610, a second housing blocking body 622 extending from the second housing coupling body 621 in a direction away from the first housing 610 to form a space in which the gearbox is received, and a second housing bearing portion extending from an inner circumferential surface of the second housing blocking body 622 so as to be away from the first housing 610 to support the drive shaft 530.

[0203] The center of the first housing 610 and the center of the second housing 620 may be designed to be coaxially disposed. It is advantageous for power transmission that the drive shaft 540 and the drum rotating shaft 6341 are coaxially located. Consequently, it is preferable for the first housing bearing portion 612, which rotatably supports the drum rotating shaft 6341, and the second housing bearing portion 623, which rotatably supports the drive shaft 540, to be coaxially coupled to each other.

[0204] The drive shaft 530 may be inserted into the second housing 620 and rotatably supported in the second housing 620. A washer portion 540 configured to rotatably support the rotor 520 may be coupled to the drive shaft 530. The washer portion 540 may include a receiving body 542 having an axial support hole 543, in which the drive shaft 530 is received, formed in the center thereof and a washer coupling body 541 extending from an outer circumferential face of the receiving body 542 in the radial direction to form a surface to which the rotor 520 is coupled. The shaft support hole 543 may be formed in the shape of a recess corresponding to a protrusion formed on the outer circumferential surface of the drive shaft 530 such that the protrusion can be coupled to the shaft support hole.

[0205] The washer portion 540 may include at least one washer coupling protrusion 5411 protruding from the washer coupling body 541 in a direction away from the reducer. In addition, the washer portion 540 may include at least one washer coupling hole 5412 formed through the washer coupling body 541.

[0206] The washer coupling protrusion 5411 may be coupled to a receiving recess formed in the rotor 520. A fastening member extending through the rotor may be inserted into the washer coupling hole 5412 to couple the rotor 520 to the washer portion 540.

[0207] The washer coupling protrusion 5411 and the washer coupling hole 5412 may be provided in plural so as to be alternately located at the surface of the washer coupling body 541 in a circumferential direction.

[0208] FIG. 8 is an enlarged sectional view showing the drive unit in detail.

[0209] The drive unit may include a motor unit 500 configured to generate rotational force and a reducer 600 configured to reduce the rotational speed of the motor unit 500 and to transmit the same to the drum 200. The reducer 600 may include a drum rotating shaft 6341 configured to rotate the drum.

[0210] The motor unit 500 may include a stator 510 configured to generate a rotating magnetic field upon receiving external power and a rotor 520 configured to surround an outer circumferential surface of the stator 510. A permanent magnet may be disposed on an inner circumferential surface of the rotor 520.

[0211] The permanent magnet disposed on the inner circumferential surface of the rotor 520 may be moved in a specific direction by the rotating magnetic field generated by the stator 510, and the permanent magnet may be fixed to the inner circumferential surface of the rotor 520. Consequently, the rotor 520 may be rotated by the rotating magnetic field of the stator 510.

[0212] A drive shaft 530 configured to rotate with the rotor 520 and to transmit rotational force of the rotor 520 may be coupled to the center of rotation of the rotor 520. The drive shaft 530 may be configured to rotate with the rotor 540. The drive shaft 530 may be coupled to the rotor 540 via the washer portion.

[0213] While the drive shaft 530 may be directly coupled to the rotor 520, the drive shaft may be more firmly coupled to the rotor 520 when connected via the washer portion 540, thereby more effectively transmitting the rotational force of the rotor 520. In addition, intensive application of load to the drive shaft 530 may be prevented, which may increase the durability of the drive shaft 530.

[0214] Although the drive shaft 530 may be directly connected to the drum 200, deceleration of the drive shaft may be required since the drive shaft 530 rotates at the same speed as the rotational speed of the rotor 520. Consequently, the drive shaft 530 may be connected to the reducer 600, and the reducer may be connected to the drum. That is, the reducer 600 may decelerate the rotation of the drive shaft 530 and rotate the drum 200.

[0215] The reducer 600 may include a first housing 610 and a second housing 620 that form the appearance thereof and a gearbox 630 configured to reduce the power of the drive shaft 530. The second housing 620 may provide a space for receiving the gearbox 630, and the first housing 610 may shield the receiving space provided by the second housing 620.

[0216] The second housing 620 may include a second housing coupling body 621 coupled to the first housing 610, a second housing blocking body 622 extending rearward from an inner circumferential surface of the

second housing coupling body 621 to form a receiving space for receiving the gearbox 630, and a second housing bearing portion 623 extending rearward from the second housing blocking body 622 to receive the drive shaft 530.

[0217] The gearbox 630 may include a ring gear 633 installed along an inner circumferential surface of the second housing blocking body 622. At least one planetary gear 632 engaged with the ring gear 633 may be provided on an inner circumferential surface of the ring gear 633, and a sun gear 631 engaged with the planetary gears 632 and configured to rotate with the drive shaft 530 may be provided inside the ring gear 633.

[0218] The sun gear 631 may be coupled to the drive shaft 530 so as to rotate. The sun gear 631 may be provided as a member separate from the drive shaft 530; however, the present disclosure is not limited thereto, and the sun gear 631 may be integrally formed with the drive shaft 530.

[0219] Each of the sun gear 631, the planetary gear 632, and the ring gear 633 may be configured as a helical gear. When each gear is configured as a helical gear, noise may be reduced and power transmission efficiency may be increased. However, the present disclosure is not limited thereto, and each of the sun gear 631, the planetary gear 632, and the ring gear 633 may be configured as a spur gear.

[0220] In an example of operation of the gearbox 630, when the drive shaft 530 and the sun gear 631 connected to the drive shaft 530 rotate as the rotor rotates, the planetary gear 632, which is engaged with the outer circumferential surface of the sun gear 631, may rotate between the ring gear 633 and the sun gear 631 in engagement therewith.

[0221] The planetary gear 632 may include a planetary gear shaft 6323 inserted into the center of rotation. The planetary gear shaft 6323 may rotatably support the planetary gear 632.

[0222] The reducer 600 may further include a first carrier 6342 and a second carrier 6343 configured to support the planetary gear shaft 6323. The planetary gear shaft 6323 may be supported by the second carrier 6343 at the front and by the first carrier 6342 at the rear.

[0223] The drum rotating shaft 6341 may extend from the center of rotation of the second carrier 6343 in a direction away from the motor unit. The drum rotating shaft 6341 may be separate from the second carrier 6343 and coupled thereto for rotation. Alternatively, the drum rotating shaft 6341 may extend from the second carrier 6343 and be integrally formed with the second carrier 6343.

[0224] The drum rotating shaft 6341 may be coupled to the drum 200 to rotate the drum 200. As described above, the drum rotating shaft 6341 may be coupled to the drum 200 via a connection member such as the bushing portion, or may be directly coupled to the drum 200 without a separate connection member.

[0225] The drum rotating shaft 6341 may be supported

by the first housing 610. The first housing 610 may include a first housing blocking body 611 configured to shield the receiving space of the second housing 620 and a first housing bearing portion 612 extending from the first housing blocking body 611 in a direction away from the second housing 620 to receive the drum rotating shaft 6341. A first bearing 660 and a second bearing 670 may be pressed into an inner circumferential surface of the first housing bearing portion 612 to rotatably support the drum rotating shaft 6341.

[0226] The first housing 610 and the second housing 620 may be coupled to each other via a reducer fastening member 681. In addition, the reducer fastening member 681 may simultaneously extend through the first housing 610 and the second housing 620 to couple the same to each other. In addition, the reducer fastening member 681 may simultaneously extend through the first housing 610, the second housing 620, and the rear plate 420 to couple the first housing 610 and the second housing 620 to each other and to fix the reducer 600 to the rear plate 420.

[0227] The rear plate 420 may be made of a thin steel plate. Therefore, it may be difficult to secure rigidity to support the reducer 600, the motor unit 500 coupled to the reducer 600, and the drum 200 coupled to the reducer 600. Therefore, when coupling the reducer 600 to the rear plate 420, a bracket 700 may be used to secure rigidity of the rear plate 420. The bracket 700 may be made of a material having higher rigidity than the rear plate 420 and may be coupled to the front surface or the rear surface of the rear plate 420.

[0228] The bracket 700 may be coupled to the front surface of the rear plate 420 to provide rigidity for coupling of the reducer 600, and the reducer 600 may be simultaneously coupled to the rear plate 420 and the bracket 700. A fastening member, such as a bolt, may be used to couple the rear plate 420, the bracket 700, and the reducer to each other.

[0229] In addition, the reducer fastening member 681 that was used to couple the first housing 610 and the second housing 620 to each other may be used to secure the reducer 600 to the rear plate 420. That is, the reducer fastening member 681 may simultaneously extend through the second housing 620, the first housing, the rear plate 420, and the bracket 700 for coupling. When so coupled, the rear plate 420 may be supported by the bracket 700 at the front and by the first housing 610 at the rear, thereby securing rigidity despite coupling of the reducer 600. However, the present disclosure is not limited thereto, and the first housing 610 and the second housing 620 may be coupled to each other using the reducer fastening member 681, and then the reducer 600 may be coupled to the rear plate 420 using a separate fastening member.

[0230] In addition, a stator coupling portion 613, to which the motor unit 500 may be coupled, may be formed outside the first housing 610 in the radial direction. The stator coupling portion 613 may include a coupling recess

depressed in the stator coupling portion 613.

[0231] The stator 510 may be directly coupled to the rear plate 420, or may be coupled to the stator coupling portion 613. The stator 510 may include a fixing rib 512 provided on an inner circumferential surface thereof to support the stator. The fixing rib 512 may be coupled to the stator coupling portion 613. The fixing rib 512 and the stator coupling portion 613 may be coupled to each other by a stator coupling pin 617.

[0232] As the motor unit 500 is coupled to the reducer 600 while being spaced apart from the rear plate 420, the motor unit 500 and the reducer 600 may form a single vibrating body. Consequently, the drive shaft 530 coupled to the rotor 520 and the drum rotating shaft 6341 connected to the reducer 600 may easily remain coaxial with each other even when vibration is applied from the outside.

[0233] The axial direction of the drum rotating shaft 6341 may be distorted by vibration of the drum 200. However, since the motor unit 500 is coupled to the first housing 610 that supports the drum rotating shaft 6341, when the axial direction of the drum rotating shaft 6341 is distorted, the axial direction of the drive shaft 530 is also similarly distorted by the first housing 610. That is, the motor unit 500 is moved integrally with the reducer 600, whereby the drum rotating shaft 6341 and the drive shaft 530 may remain coaxial with each other even if force is applied from the outside.

[0234] In the above coupling structure, efficiency and reliability with which power generated by the motor unit 500 is transmitted to the drum 200 may be improved, and wear of the gearbox 630 caused by axial distortion of the drum rotating shaft 6341 and the drive shaft 530, a decrease in efficiency of power transmission, a decrease in durability, a decrease in reliability, and the like may be prevented.

[0235] FIG. 9 shows a base and a rear plate according to an embodiment of the present disclosure.

[0236] Referring to FIG. 9, the rear plate 420 may be located at the rear of the drum. The rear plate 420 may guide hot air discharged from the circulating flow path unit 820 to the drum. That is, the rear plate 420 may be located at the rear of the drum 200 to form a flow path such that hot air is evenly supplied throughout the drum 200.

[0237] The rear plate 420 may include a rear panel 421 facing the rear surface of the drum and a duct portion 423 depressed rearward in the rear panel 421 to form a flow path. The duct portion 423 may be formed by pressing the rear panel 421 rearward. The duct portion 423 may be configured to receive a part of the rear surface of the drum.

[0238] The duct portion 423 may include an inlet portion 4233 located at the rear of the circulating flow path unit 820 and a flow portion 4231 located at the rear of the drum 200. The flow portion 4231 may be configured to receive a part of the drum. The flow portion 4231 may receive a part of the drum 200 to form a flow path provided at the rear of the drum 200.

[0239] The flow portion 4231 may be formed in a ring shape so as to face the suction hole formed in the rear surface of the drum. The flow portion 4231 may be depressed in the rear panel 421. That is, the flow portion 4231 may be open at the front and may form a flow path with the rear surface of the drum 200.

[0240] When the flow portion 4231 is open at the front, hot air that has moved to the flow portion 4231 may be moved directly to the drum 200 without passing through a separate configuration. Consequently, it is possible to prevent heat loss of the hot air while passing through the separate configuration. That is, it is possible to reduce the heat loss of the hot air, thereby increasing drying efficiency.

[0241] The rear plate 420 may include a mounting portion 425 provided inside the flow portion 4231 in the radial direction. The mounting portion 425 may provide a space in which the reducer 600 or the motor unit 500 is coupled. That is, the rear plate 420 may include a mounting portion 425 provided inside and a flow portion 4231 annularly provided outside the mounting portion 425 in the radial direction.

[0242] Specifically, the flow portion 4231 may include an outer circumferential flow portion 4231a configured to externally surround an inner space in which hot air flows. In addition, the flow portion 4231 may include an inner circumferential flow portion 4231b configured to internally surround the inner space in which the hot air flows. That is, the outer circumferential flow portion 4231a may form an outer circumference of the flow portion 4231, and the inner circumferential flow portion 4231b may form an inner circumference of the flow portion 4231.

[0243] In addition, the flow portion 4231 may include a depressed flow surface 4232 that forms a rear surface of the flow path through which the hot air flows. The depressed flow surface 4232 may be configured to connect the outer circumferential flow portion 4231a and the inner circumferential flow portion 4231b to each other. That is, the inner circumferential flow portion 4231b, the outer circumferential flow portion 4231a, and the depressed flow surface 4232 may form a space in which hot air discharged from the circulating flow path unit 820 flows.

[0244] In addition, the depressed flow surface 4232 may guide hot air toward the drum 200, thereby preventing rearward leakage of the hot air. That is, the depressed flow surface 4232 may refer to a depressed surface of the flow portion 4231.

[0245] The inlet portion 4233 may be located so as to face the circulating flow path unit 820. The inlet portion 4233 may be located so as to face the blowing portion 8231. The inlet portion 4233 may be depressed rearward in the rear panel 421 to prevent interference with the blowing portion 8231. An upper side of the inlet portion 4233 may be connected to the flow portion 4231.

[0246] The laundry treatment apparatus according to the embodiment of the present disclosure may include a connector 850 connected to the blowing portion 8231. The connector 850 may guide hot air discharged from the

blowing portion 8231 to the flow portion 4231. The connector 850 may have a flow path formed therein to guide hot air discharged from the blowing portion 4231 to the flow portion 4231. That is, the connector 850 may form a flow path connecting the blowing portion 8231 and the flow portion 4231 to each other. The sectional area of the flow path provided in the connector 850 may be increased with increasing distance from the blowing portion 8231.

[0247] The connector 850 may be located to face the inlet portion 4233. The inlet portion 4233 may be formed so as to be depressed rearward to prevent interference with the connector 850. In addition, an upper end of the connector 850 may be configured to separate the flow portion 4231 and the inlet portion 4233 from each other. That is, hot air discharged from the connector 850 may be introduced into the flow portion 4231, but may be prevented from being introduced into the inlet portion 4233.

[0248] The connector 850 may be configured to evenly supply hot air to the flow portion 4231. The connector 850 may be configured to have a width gradually increasing with increasing distance from the blowing portion 8231. The upper end of the connector 850 may be located along an extension line of the outer circumferential flow portion 4231a in the circumferential direction.

[0249] Consequently, hot air discharged from the connector 850 may be entirely supplied to the flow portion 4231 without moving to the inlet portion 4233. The connector 850 may prevent hot air from being concentrated on one side of the flow portion 4231, thereby evenly supplying the hot air into the drum 200. As a result, laundry drying efficiency is improved.

[0250] The connector 850 may be configured to have a width gradually increasing toward the upstream side, whereby the speed of hot air moving along the connector 850 may be decreased in the flow direction. That is, the connector 850 may perform the function of a diffuser that regulates the speed of the hot air. The connector 850 may prevent hot air from being concentrated in a specific part of the drum 200 by reducing the speed of the hot air.

[0251] The inlet portion 4233, which is configured to face the connector 850 and to prevent interference with the connector 850 due to the shape of the connector 850, may also be configured to have a width gradually increasing with increasing distance from the blowing portion 8231. When viewed from the front, the duct portion 423 may have an overall shape like "9" due to the shape of the inlet portion 4233.

[0252] Since the drum 200 is configured to rotate during a drying cycle, the drum 200 may be spaced apart from the flow portion 4231 by a predetermined distance. Hot air may flow out through the space.

[0253] Consequently, the laundry treatment apparatus may further include a sealing unit 450 configured to prevent leakage of hot air into the space between the drum 200 and the flow portion 4231. The sealing unit 450 may be located along the circumference of the flow portion 4231.

[0254] The sealing unit 450 may include a first sealing

portion 451 provided along an outer circumference of the flow portion 4231. The first sealing portion 451 may be provided between the drum 200 and the outer circumference of the flow portion 4231. In addition, the first sealing portion 451 may be in contact with both the rear drum surface 220 and the rear plate 420, thereby more effectively preventing leakage.

[0255] Meanwhile, the first sealing portion 451 may be in contact with the front surface of the connector 850. In addition, the first sealing portion 451 may be in contact with the upper end of the connector 850. The connector 850 may form a flow path in which hot air flows together with the flow portion 4231. Consequently, the first sealing portion 451 may be in contact with the connector 850 to prevent leakage of hot air between the drum 200 and the connector 850.

[0256] The sealing unit 450 may include a second sealing portion 452 provided along an inner circumference of the flow portion 4231. The second sealing portion 452 may be provided between the drum 200 and the inner circumference of the flow portion 4231. In addition, the second sealing portion 452 may be in contact with both the rear drum surface 220 and the rear plate 420. The second sealing portion 452 may prevent hot air moving along the flow portion 4231 from leaking in a direction toward the mounting portion 425.

[0257] Since the drum 200 rotates in the course of operation of the laundry treatment apparatus, the sealing unit 450 is subjected to continuous friction by the rear drum surface 220. Consequently, it is preferable for the sealing unit 450 to be made of a material capable of forming a seal between the rear drum surface 220 and the flow portion 4231 without deterioration in performance despite the frictional force and frictional heat generated by rotation.

[0258] FIG. 10 shows a coupling structure of a rear plate, a reducer, and a motor unit according to an embodiment of the present disclosure.

[0259] Referring to FIG. 10, the reducer 600 may be supported by the rear plate 420, and the motor unit 500 may be coupled to the reducer 600. That is, the rear plate 420 may be configured to support both the reducer 600 and the motor unit 500.

[0260] The motor unit 500, which provides rotational force, and the reducer 600, which reduces power of the motor unit 500 and transmits the same to the drum, may be located at the rear of the rear plate 420.

[0261] The reducer 600 may be installed on the rear plate 420 so as to be located in the duct portion 423. The reducer 600 may be located radially inwardly of the flow portion 4231 such that interference with the flow portion 4231 is prevented.

[0262] A gear device in the reducer 600 may be damaged by the heat of hot air moving along the flow portion 4231. Consequently, the flow portion 4231 and the reducer 600 may be spaced apart from each other by a predetermined distance.

[0263] The reducer 600 may be coupled through the

rear plate 420. Consequently, the reducer 600 may be connected to the drum 200 located in front of the rear plate 420.

[0264] A stator 510 may be coupled to the reducer 600. The stator 510 may be coupled to the reducer 600 and may be installed so as to be spaced apart from the rear plate 420. In this case, the reducer 600 may be located between the drum 200 and the motor unit 500 to support the drum 200 and the motor unit 500 so as to be spaced apart from the rear plate 420. That is, the reducer 600 may be the center of support for the drum 200 and the motor unit 500.

[0265] Meanwhile, the stator 510 includes a main body 511 formed in a ring shape, a fixing rib 512 extending from an inner circumferential surface of the main body 511 and coupled to the stator coupling portion 613 of the reducer 600, teeth 514 extending from an outer circumferential surface of the main body 511 along the circumference thereof and configured to allow a coil to be wound thereon, and a pole shoe 515 provided at a free end of the teeth 514 to prevent dislodgement of the coil.

[0266] A rotor 520 may include a rotor body 521 having a cylindrical hollow shape. In addition, the rotor 520 may include an installation body 522 depressed forward in a rear surface of the rotor body 521. A permanent magnet may be disposed along an inner circumferential surface of the rotor body 521 of the rotor 520.

[0267] The rotor 520 may be coupled to a drive shaft 530 to transmit rotational force of the rotor 520 to the outside via the drive shaft 530. The drive shaft 530 may be connected to the rotor 520 via a washer portion 540.

[0268] In addition, the motor unit 500 may include a washer portion 540 configured to support the drive shaft 530. The washer portion 540 may include a washer coupling body 541 coupled to the rotor. The washer coupling body 541 may have a disc shape.

[0269] The washer portion 540 may include a receiving body 542 received in the rotor. The receiving body 542 may be configured to protrude rearward from the washer coupling body 541. The washer portion 540 may include a shaft support hole 543 formed through the center of the receiving body 542. The drive shaft 530 may be inserted into the shaft support hole 543 and supported by the washer portion 540.

[0270] In addition, the washer portion 540 may include a washer coupling hole 5412 formed through the washer coupling body 541. In addition, the installation body 522 may include a rotor coupling hole 526 provided at the position corresponding to the washer coupling hole 5412. That is, the washer portion 540 and the rotor 520 may be coupled to each other by a coupling member simultaneously extending through the washer coupling hole 5412 and the rotor coupling hole 526. That is, the washer portion 540 and the rotor 520 may be coupled to rotate together.

[0271] In addition, the washer portion 540 may include a washer coupling protrusion 5411 protruding rearward from the washer coupling body 541. In addition, the

installation body 522 may include a washer protrusion receiving hole 525 provided so as to correspond to the washer coupling protrusion 5411. The washer coupling protrusion 5411 may be inserted into the washer protrusion receiving hole 525 to support coupling between the washer portion 540 and the rotor 520.

[0272] In addition, the rotor 520 may include a rotor installation hole 524 formed through the center of the installation body 522. The rotor installation hole 524 may receive the receiving body 542. Consequently, the washer portion 540 may be rotated with the drive shaft 530 by the rotor 520 and may firmly support coupling between the drive shaft 530 and the rotor 520. Consequently, durability and reliability of the entirety of the motor unit 500 may be secured.

[0273] FIG. 11 is a rear view showing a coupling structure of a reducer and a stator according to an embodiment of the present disclosure.

[0274] The stator 510 may include a main body 511 fixed to the reducer 600 and formed in a ring shape, a fixing rib 512 extending from an inner circumferential surface of the main body 511 and coupled to the stator fastening hole 615 of the reducer, teeth 514 extending from an outer circumferential surface of the main body 511 along the circumference thereof and configured to allow a coil to be wound thereon, a pole shoe 515 provided at a free end of the teeth 514 to prevent dislodgement of the coil, and a terminal (not shown) configured to control the supply of current to the coil.

[0275] The stator 510 may include a receiving space 513 formed through the main body 511 and provided in the main body 511. The fixing rib 512 may be provided in plural so as to be spaced apart from each other by a predetermined angle relative to the receiving space 513 in the main body 511, and a fixing rib hole 5121, in which a fixing member is installed, may be provided inside the fixing rib 512, whereby the fixing rib hole 5121 and the stator fastening hole 615 of the reducer may be coupled to each other using the fixing member, such as a pin.

[0276] When the stator 510 is directly coupled to the reducer 600, a part of the reducer 600 may be received in the stator 510. In particular, when the reducer 600 is received in the stator 510, the thickness of the entire drive unit including both the reducer 600 and the motor unit 500 may be reduced to further increase the volume of the drum 200.

[0277] To this end, the diameter of the reducer 600 may be less than the diameter of the main body 511. That is, the first housing 610 and the second housing 620 may be configured such that the largest diameter thereof is less than the diameter of the main body 511. Consequently, at least a part of the reducer 600 may be received and disposed in the main body 511. However, the stator coupling portion 613 may extend from the housing of the reducer so as to overlap the fixing rib 512. Consequently, the stator coupling portion 613 may be coupled to the fixing rib 512, and a part of each of the first housing 610 and the second housing 620 may be located in the

main body 511.

[0278] FIG. 12 shows coupling between a reducer and a motor unit according to an embodiment of the present disclosure.

[0279] The stator 510 may be coupled to the reducer 600. As a result of being coupled to the stator coupling portion 613 protruding outward from the housing of the reducer 600, at least a part of the reducer may be received in the main body 511. Consequently, the center of the main body 511 and the centers of the drive shaft 530 and the reducer 600 may remain coaxial with each other.

[0280] Meanwhile, the rotor 520 may be disposed so as to receive the stator 510 in a state of being spaced apart from the pole shoe 515 by a predetermined distance. Since the drive shaft 530 is fixed to the reducer received in the main body 511, the gap G1 between the rotor 520 and the stator 510 may be maintained.

[0281] Consequently, collision between the rotor 520 and the stator 510 may be prevented or rotation of the stator 510 while being temporarily twisted may be prevented, thereby preventing noise or unnecessary vibration.

[0282] Meanwhile, an imaginary first diameter line K1 passing through the center of the reducer 600 and the center of the drive shaft 530, an imaginary second diameter line K2 passing through the center of the main body 511, and an imaginary third diameter line K3 passing through the center of the rotor 520 may be disposed on the center of rotation of the reducer 600.

[0283] Consequently, the reducer 600 may become the center of rotation of the drive shaft 530, and since the stator 510 is directly fixed to the reducer 600, the drive shaft 530 may be prevented from being twisted relative to the reducer 600. As a result, the reliability of the reducer 600 may be ensured.

[0284] FIG. 13 shows the structure of the drum of the laundry treatment apparatus according to the present disclosure in detail.

[0285] Referring to FIG. 13(a), the drum 200 may include a drum body 210 configured to receive laundry, and a rear drum surface 220 coupled to the rear of the drum body 210 to prevent dislodgement of laundry received in the drum body 210.

[0286] The front of the drum body 210 may be configured as an introduction port through which the laundry is introduced.

[0287] However, the thickness of the drum body 210 is a thickness corresponding to the thickness of a metal plate, which is relatively small. As a result, when the drum body 210 is rotated, the drum body 210 may be temporarily deformed due to inertial force or the concentration of load of laundry, and the introduction port of the drum body 210 may be distorted, whereby it may be difficult to maintain the shape of the introduction port.

[0288] In order to prevent this, it may be considered to use a steel plate having a great thickness to inhibit deformation of the drum body 210. However, in this case, the overall weight of the drum 200 may become heavy,

which may increase the load of the motor unit, and the difficulty in shaping and manufacturing the drum body 210 may unnecessarily increase.

[0289] In order to remedy this, the drum 200 of the present disclosure may further include a front drum portion 230 coupled to the front of the drum body 210 to maintain the durability and shape of the drum body 210.

[0290] Referring to FIGs. 13(b) and 13(c), the front drum portion 230 may be coupled to the front of the drum body 210 to form a front surface of the drum 200.

[0291] The front drum portion 230 may be ring-shaped to form a drum introduction port 211 therein. The front drum portion 230 may be coupled and disposed along a front circumference of the drum body 210.

[0292] The front drum portion 230 may be made of the same material as the drum body 210. However, the front drum portion 230 may be made of a different material than the drum body 210.

[0293] For example, the front drum portion 230 may be made of a metal material having higher rigidity and durability than the drum body 210.

[0294] In addition, the front drum portion 230 may be made of a metal plate having a thickness greater than the thickness of the drum body 210.

[0295] The front drum portion 230 may include a body coupling portion 232 coupled to the front of the drum body 210 and a support 231 extending from the body coupling portion 232 to form the introduction port 211 of the drum 200.

[0296] The body coupling portion 232 may be coupled along the front circumference of the drum body 210 to maintain the sectional shape of the drum body 210.

[0297] The body coupling portion 232 may be coupled to an outer circumferential surface of the drum body 210 or to an outer surface of the drum body 210. Consequently, even when excessive load is applied to a lower part of the front drum portion 230 or even when temporary impact and external force are applied thereto, the front drum portion 230 may be prevented from being bent or separated inwardly of the drum body 210. In addition, damage to or deformation of the outer circumferential surface of the drum body 210 may be prevented.

[0298] The support 231 may extend farther forward than the body coupling portion 232. The support 231 may be provided in the shape of a ring forming the introduction port 211 in an inner circumferential surface thereof, and may be disposed farther forward than the drum body 210 to secure an area supported by a support wheel 415 provided on the front plate 410.

[0299] The diameter of the support 231 may be less than the diameter of the body coupling portion 232. In addition, the diameter of the support 231 may be less than the diameter of the drum body 210. Consequently, when laundry received in the drum body 210 arbitrarily moves to the front of the drum body 210, the laundry may be blocked by the support 231 and prevented from escaping to the outside.

[0300] FIG. 14 shows the detailed structure of the front

drum portion 230 of the present disclosure.

[0301] The front drum portion 230 of the present disclosure may be coupled to the front of the drum body 210 and may extend farther forward than the drum body 210 so as to be supported by the support wheel 415.

[0302] The support wheel 415 may be rotatably disposed lower than the drum body 210 in a state of being fixed to the drum body 210.

[0303] The support wheel 415 may be configured to support a lower part of the front drum portion 230, and may be provided in plural so as to be spaced apart from each other by a predetermined distance.

[0304] Of course, the support wheel 415 may be made of a material, such as felt, as long as it is possible to rotatably support the front drum portion 230 without applying excessive frictional force to the front drum portion 230.

[0305] The support 231 may be rotatably supported by the support wheel 415 to transmit a part of the load of the drum body 210 to the support wheel 415.

[0306] The support 231 may be supported by the support wheel 415 to rotate with the drum body 210. Consequently, the entirety of the drum 200 may rotate while the installed height of the drum is maintained.

[0307] Meanwhile, the body coupling portion 232 may extend from the support 231 while expanding, and a circumferential surface or an exposed surface of the body coupling portion 232 may be coupled to a front surface of the drum body 210.

[0308] The front drum portion 230 may further include a shaping portion 233 between the support 231 and the body coupling portion 232.

[0309] The shaping portion 233 may be formed in a depressed or convex shape from the support 231 toward the body coupling portion 232, and may serve to distribute the load transmitted to the front drum portion 230 and to strengthen the rigidity and durability of the front drum portion 230.

[0310] Meanwhile, the support 231 may be shaped to allow the support wheel 415 to roll stably when supported by the support wheel 415. That is, since the support wheel 415 moves relative to the support 231 along an outer circumferential surface of the support 231, it is necessary for the support 231 to have a rail-like structure configured to guide the movement of the support wheel 415.

[0311] However, when the support 231 is shaped such that the support wheel 415 is seated thereon, the surface of the support 231 may be uneven along the circumference thereof and may not have a constant curvature.

[0312] In addition, while the support 231 is shaped, a part of the support may be excessively plastically deformed, resulting in non-uniform strength and durability.

[0313] In addition, one surface or a front surface (exposed surface) of the support 231 is exposed by the thickness of the metal plate M, which forms an inner circumferential surface of the introduction port. Therefore, it is necessary to make one surface or the exposed

surface of the support 231 blunt in order to prevent laundry from being damaged by one surface of the support 231 or the user's body from being injured.

[0314] In order to solve this, the front drum portion 230 of the present disclosure may further include a curling portion 234 configured to allow the exposed surface of the support 231 to be curled outward in a diametric direction, thereby preventing the exposed surface of the support 231 from being sharply exposed in a state as the metal plate M.

[0315] As a result, the support 231 is provided at the front or the exposed surface thereof with the curling part 234 having a larger diameter than the support 231, and is provided at the rear or the other surface thereof with the shaping portion part 233 or the body coupling portion 232 having a larger diameter than the support 231. Consequently, the support 231 may guide the movement of the support wheel 415 without a depressed or concave guide rail provided along the circumference thereof.

[0316] A change in position of the support wheel 415 may be restricted by the curling portion 234 and the shaping portion 233 or the body coupling portion 232 even when vibration occurs from the drum 200. Consequently, the drum 200 may be stably supported by the support wheel 415.

[0317] As a result, the support 231 may not be separately shaped or plastically deformed, and the inherent properties of the metal plate of which the support is made may be maintained throughout the entire area thereof.

[0318] FIG. 15 is a conceptual view showing a process in which the front drum portion 230 of the laundry treatment apparatus according to the present disclosure is installed on the drum body 210.

[0319] Referring to FIG. 15(a), the front drum portion 230 of the present disclosure may be made of a cylindrical material member 230a (hereinafter referred to as a cylindrical member), like the drum body 210.

[0320] The cylindrical member 230a may have a cylindrical shape with a smaller diameter than the drum body 210.

[0321] The cylindrical member 230a may not be configured as a ring or donutshaped plate capable of shielding the front surface of the drum body 210, but may be configured as a cylindrical shape capable of forming a predetermined receiving space or volume therein.

[0322] The cylindrical member 230a may be made of a metal material, and may be manufactured by coupling both ends of a rectangular metal plate to each other, like the drum body 210.

[0323] The cylindrical member 230a may be divided into a first end A, which forms the introduction port of the drum 200, and a second end B, which is coupled to the front of the drum body 210.

[0324] The first end A and the second end B may be divided in a height direction of the cylindrical member 230a, and the second end B may be defined as the part of the cylindrical member 230a that is closer to the drum body 210 than the first end A.

[0325] Referring to FIG. 15(b), the front drum portion 230 may be manufactured by expanding the second end B of the cylindrical member 230a.

[0326] Specifically, the diameter of the second end B may be equal to or greater than the diameter of the drum body 210.

[0327] For example, the second end B of the cylindrical member 230a may be pressed by a die using a pressing method such that the diameter of the second end B is greater than the diameter of the first end A. As a result, the second end B may be manufactured as a body coupling portion 232 which is coupled to the drum body 210.

[0328] Meanwhile, if the cylindrical member 230a is manufactured from the beginning such that the diameter of the cylindrical member corresponds to the diameter of the support 231, the first end A may be disposed with a diameter that does not need to be further increased or decreased. In other words, the first end A may maintain the initial state of the cylindrical member 230a without being separately shaped or plastically deformed, except that the forwardly exposed one surface or the circumferential surface is shaped.

[0329] As a result, the support 231 of the present disclosure may be prevented from developing production tolerances such as a specific area having a different surface texture, different curvature, different shape, or more plastic deformation than other areas. Therefore, the support 231 of the front drum portion 230 of the present disclosure may be uniformly maintained in physical values and physical properties, whereby the reliability of the support 231 may be ensured, and the support force of the support wheel 451 may be stably maintained.

[0330] In addition, the second end A of the cylindrical member 230a made of the metal plate M is plastically deformed to form the body coupling portion 232.

[0331] When the metal plate M is plastically deformed, the metal plate generally has higher rigidity or strength. Therefore, in a method of manufacturing the drum of the present disclosure, the body coupling portion 232 of the front drum portion 230 is plastically deformed and expanded, whereby the rigidity or the strength of the body coupling portion 232 may be higher than that of the initial metal material.

[0332] Since the rigidity or the strength of the body coupling portion 232 coupled to the drum body 210 is increased, the force of coupling between the front drum portion 230 and the drum body 210 may be increased, and the ability of the front drum portion 230 to maintain the shape of the drum body 210 may be increased.

[0333] Consequently, in the laundry treatment apparatus according to the present disclosure, the drum body 210 may be rotated at a high enough RPM to generate an acceleration of 1 G or more at which laundry is rotated in a state of sticking to the inner wall of the drum.

[0334] In addition, in the laundry treatment apparatus according to the present disclosure, the direction of rotation of the drum body 210 may be changed to generate significant inertial force.

[0335] As a result, the method of manufacturing the drum of the present disclosure may be applied to manufacture a laundry treatment apparatus capable of changing the rotational direction of the drum 200 or rotating the drum at a high speed.

[0336] FIG. 16 shows an embodiment in which the method of manufacturing the drum of the present disclosure is applied to a laundry treatment apparatus.

[0337] Hereinafter, the method of manufacturing the drum of the present disclosure will be described based on application to a laundry treatment apparatus in which the drum 200 is rotated directly by a reducer and a motor, but the method of manufacturing the drum of the present disclosure is not excluded from being applied to a laundry treatment apparatus in which the drum body 210 is rotated by a belt, a pulley, and a motor.

[0338] Referring to FIG. 16(a), the drum 200 may be disposed farther forward than the rear plate 400, and the drive unit that rotates the drum 200 may be disposed farther rearward than the rear plate 420 at a height facing the rear surface of the drum 200.

[0339] The reducer 600 may be coupled to the rear of the rear plate 400 and coupled to the rear drum surface 220 coupled to the drum body 210.

[0340] The stator 510 of the motor 500 may be coupled to the position farther rearward than the reducer 600 and disposed at the position farther rearward than the rear plate 420 to rotate the rotor 520.

[0341] The drum 200 is coupled to the reducer 600 and supported at the position farther forward than the support plate 400. As a result, the drum 200 may be disposed like a cantilever with a fixed rear end and a freely moving front end. Consequently, in the laundry treatment apparatus according to the present disclosure, it may become more important for the front of the drum 200 to be pivotably supported while maintaining the installation height thereof than the rear of the drum 200.

[0342] Referring to FIG. 16(b), in the laundry treatment apparatus according to the present disclosure, a front lower part of the drum 200 may be rotatably supported by the support wheel 415.

[0343] The support wheel 415 may be fixed to the front plate 410 so as to be rotatable, and may be disposed lower than the drum body 210.

[0344] As the front drum portion 230 is seated on the support wheel 415, the installation height of the entire front of the drum 200 may be maintained.

[0345] The support 231 of the front drum portion 230 may be rested on the support wheel 415, and when the drum body 210 is rotated, the outer circumferential surface of the support 231 may be rotated in a state of being supported by the support wheel 415.

[0346] Since the region of the support 231 supported by the support wheel 415 is not plastically deformed, the shape thereof may be maintained. Consequently, the support 231 may be supported by the support wheel 415 with minimal vibration or positional change when the drum body 210 is rotated.

[0347] The body coupling portion 232 extending from the support 231 and coupled to the front of the drum body 210 is plastically deformed and thus has higher rigidity and strength than the support 231. Consequently, the body coupling portion 232 may be more firmly coupled to the drum body 210. In addition, even when laundry is received in the drum body 210 and rotated, the body coupling portion 232 may remain stably coupled to the drum body 210.

[0348] In addition, in the laundry treatment apparatus according to the present disclosure, the rigidity and strength of the body coupling portion 232 are increased, whereby it is possible to rotate the drum body 210 while changing the rotational direction of the drum body 210 and to rotate the drum body 210 at a high speed.

[0349] Even when considerable load, external force, or vibration is transmitted to the body coupling portion 232 in this process, the shape and installation position of the body coupling portion 232 may be maintained to the greatest extent.

[0350] As a result, the support 231 extending from the body coupling portion 232 may be rotated in a state of being stably supported by the support wheel 415 even if the support does not have higher rigidity or strength than the body coupling portion 232.

[0351] FIGs. 17 to 21 show a process of manufacturing the front drum portion 230.

[0352] Referring to FIG. 17, the method (S) of manufacturing the drum of the present disclosure may include a body manufacturing step (S1) of manufacturing a drum body 210, a front manufacturing step (S2) of manufacturing a front drum portion 230, a rear surface manufacturing step (S3) of manufacturing a rear drum surface 220, and a coupling step (S4) of coupling the front drum portion 230 and the rear drum surface 220 to the drum body 210.

[0353] The body manufacturing step (S1) may include cutting a metal plate whose width corresponds to the length of the drum body 210 in the forward-rearward direction into a rectangular shape and coupling both ends of the metal plate to each other to manufacture the drum body 210.

[0354] Referring to FIG. 18, the front manufacturing step (S2) may include a blanking step (S21) of cutting a metal plate M, which is a material for the front drum portion 230, into a rectangular shape, a manufacturing step (S22) including a welding process of welding the cut metal plate M into a cylindrical shape, and an expanding step (S23) of expanding one surface of the welded cylindrical member 230a so as to be coupled to the drum body 210.

[0355] FIG. 19 shows an embodiment of the blanking step.

[0356] The front manufacturing step (S2) may include a blanking step (S21) of cutting a metal plate M having a much smaller width than a metal plate from which the drum body 210 is manufactured into a rectangular shape.

[0357] The blanking step (S21) may include securing the length of the metal plate M corresponding to a front

circumference of the drum body 210 and cutting the metal plate M.

[0358] The width of the metal plate M used in the blanking step (S21) may be much less than the front diameter of the drum body 210. Consequently, a small metal plate M may be used to manufacture the front drum portion 230, thereby reducing material costs.

[0359] The blanking step (S21) may include a process of mounting a metal plate M rolled into a roll shape on a rotating machine 81 and inserting a free end of the metal plate M into a guiding machine or an extrusion machine 82.

[0360] When the rotating machine 81 rotates the metal plate M, the free end of the metal plate M may pass through the guiding machine 82 and may be inserted into a die machine 83 for performing a blanking process or a cutting process.

[0361] The die machine 83 may be configured to cut the metal plate M whenever the length of the metal plate M reaches a length required for manufacture of the front drum portion 230.

[0362] The length to which the metal plate M is cut may be a length corresponding to the circumference of the drum body 210.

[0363] The cut metal plate M may be loaded in plural and moved to a step of manufacturing a plurality of front drum portions 230.

[0364] FIG. 20 shows an embodiment of the manufacturing step.

[0365] The front manufacturing step (S2) may further include a manufacturing step (S22) of connecting or coupling both ends of the metal plate M to shape the metal plate into a cylindrical shape, thereby forming a cylindrical member 230a, which is a matrix of the front drum portion 230.

[0366] In the manufacturing step (S22), a metal plate M formed in a plate shape may be manufactured into a cylindrical member 230a.

[0367] In the manufacturing step (S22), the metal plate M may be manufactured into a cylindrical member 230a having a diameter less than the diameter of the drum body 210.

[0368] The manufacturing step (SS2) may be performed in a welding room 85 equipped with a rolling machine 84 for bending the metal plate M into a cylindrical shape, a welding machine 85a for welding both ends of the bent metal plate M, a welding inspection apparatus 85b for checking whether the welding has been normally performed, and the like.

[0369] The manufacturing step (S22) may include a rolling step (S221) of bending the metal plate M cut in the blanking process so that both ends thereof face each other.

[0370] The rolling step (S221) may be a step of shaping the metal plate M into a cylindrical member 230a corresponding to the diameter of the support 221 through a rolling process using the rolling machine 84.

[0371] The diameter of the cylindrical member 230a

manufactured in the rolling step (S221) may be set to the diameter corresponding to the introduction port 211 of the drum 200.

[0372] Meanwhile, the manufacturing step (S22) may further include a welding step (S222) of welding both ends of the metal plate M bent into a cylindrical shape.

[0373] In the welding step (S222), both ends of the metal plate M may be firmly fixed and coupled to each other by the welding machine 85a and a metal member for welding.

[0374] Both ends of the metal plate M may be welded while facing each other. Consequently, the front drum portion 230 may be manufactured such that the overall thickness thereof is uniform.

[0375] In addition, both ends of the metal plate M may be welded in a state of partially overlapping each other. Consequently, the fixing force for the welded portion may be secured.

[0376] As a result, the metal plate M may be manufactured into a cylindrical member 230a through the welding step (S222), and a weld line L of the cylindrical member 230a may correspond to a disposition direction of both ends of the metal plate M that face each other.

[0377] The weld line L may be set to be parallel with a height direction of the cylindrical shape or a thickness direction of the front drum portion 230 so as not to be damaged or broken in a subsequent shaping process.

[0378] That is, the cylindrical member 230a may be manufactured by coupling both ends of a rectangular metal plate by welding or the like, and the weld line L of the cylindrical member 230a may be formed in a width direction of the metal plate.

[0379] The weld line L may be formed in the height direction rather than a diametric direction with respect to the cylindrical member 230a, and when coupled to the drum body 210, the weld line L may be formed in a forward-rearward direction of the drum 200.

[0380] Of course, the weld line L may be formed so as to be inclined upward and downward relative to the forward-rearward direction of the drum 200.

[0381] Meanwhile, the cylindrical member 230a may be expanded or the circumference thereof may be shaped through the blanking step (S21) and the manufacturing step (S22) to immediately form the front drum portion 230. During this process, a process in which the metal plate M is scrapped and discarded may be omitted or minimized.

[0382] In other words, to form the cylindrical member 230a, it is not necessary to remove the areas corresponding to the inside and the outside of the cylindrical member 230a, but only to connect both ends of the metal plate to each other, which may greatly increase the material utilization rate of the metal plate M.

[0383] For example, the material utilization rate of the metal plate M in the front manufacturing step (S2) of the present disclosure may be secured to 80% or more.

[0384] In addition, since the cylindrical member 230a is manufactured using a metal plate M having a width much

less than the diameter of the drum body 210, a small metal plate M may be used a lot.

[0385] That is, the weight and size of the metal plate M may be minimized, and therefore the manufacturing cost of the front drum portion 230 may be greatly reduced.

[0386] FIG. 21 shows an embodiment of the expanding step (S23).

[0387] The front manufacturing step (S2) of the present disclosure may include an expanding step (S23) of expanding a part of the cylindrical member 230a by the diameter of the drum body 210.

[0388] The expanding step (S23) may include increasing the diameter of one surface of the cylindrical member 230a while pressing the cylindrical member 230a using a press die or the like.

[0389] One surface of the cylindrical member 230a may correspond to an edge surface of one end of the cylindrical member 230a, not a side surface of the cylindrical member, and the other surface of the cylindrical member 230a may correspond to an edge surface of the other end of the cylindrical member 230a facing one surface.

[0390] The side surface of the cylindrical member 230a may be disposed between one surface and the other surface.

[0391] The expanding step (S23) may include a pressing step (S232) of pressing one surface of the cylindrical member 230a using a press die to increase the diameter thereof relative to the other surface.

[0392] In the pressing step (S232), the area of a free end of the press die may be slightly less than the diameter of the cylindrical member 230a, and the area of a fixed end of the press die may be greater than the diameter of the cylindrical member 230a.

[0393] Consequently, when one surface of the cylindrical member 230a is pressed using the press die, one surface of the cylindrical member 230a may be expanded while being bent outward.

[0394] The pressing step (S232) may be finished by pressing one surface of the cylindrical member 230a once. For example, in the pressing step (S232), the cylindrical member 230a may be pressed once using the press die such that one surface of the cylindrical member is expanded while being inclined at least 90 degrees relative to the other side. However, if one surface of the cylindrical member 230a is pressed once and is plastically deformed to a strain rate equal to or greater than a reference value, the weld line L may burst or be damaged.

[0395] Therefore, the pressing step (S232) may include pressing one surface of the cylindrical member 230a once and then further pressing the same twice, i.e. pressing one surface of the cylindrical member a plurality of times.

[0396] For example, the pressing step (S232) may include a first pressing step (S232a) of primarily pressing one surface of the cylindrical member 230a and a second pressing step (S232b) of secondarily pressing the one

surface of the cylindrical member.

[0397] In order for one surface of the cylindrical member 230a to be evenly expanded along the circumference thereof in the expanding step (S23), the expanding step (S23) may further include a centering step (S231) of zeroing the die member and the cylindrical member 230a.

[0398] Consequently, the expanding step (S23) may include a centering step (S231) and a pressing step (S232) of pressing one surface of the cylindrical member 230a.

[0399] Meanwhile, the pressing step (S232) may include pressing and shaping one surface of each of a plurality of cylindrical members 230a using the press die at one time.

[0400] In addition, the pressing step (S232) may include pressing and shaping one surface of one cylindrical member 230a using the press die stepwise.

[0401] When pressing one surface of each of a plurality of cylindrical members 230a in the pressing step (S232), the pressing pressure of the press die may be set to be higher than when pressing one cylindrical member 230a.

[0402] For example, when the plurality of cylindrical members 230a is pressed and shaped simultaneously, the cylindrical members may be pressed with a load of 1200 tons, and when one cylindrical member 230a is pressed and shaped, the cylindrical member may be pressed with a subdivided load of 500 tons, 300 tons, or 250 tons.

[0403] Hereinafter, the pressing step (S232) will be described on the basis that one cylindrical member 230a is pressed and shaped using the press die stepwise. However, a plurality of cylindrical members 230a may be pressed and shaped using one press die stepwise.

[0404] The pressing step (S232) may include a first pressing step (S232a) of disposing the cylindrical member 230a on a first press die I and pressing the cylindrical member.

[0405] In the first pressing step (S232a), one surface of the cylindrical member 230a may be bent outward less than 90 degrees relative to the other surface. For example, the one surface may be bent 60 degrees relative to the other surface.

[0406] The pressing step (S232) may include a second pressing step (S232b) of disposing the cylindrical member 230a on a second press die II and pressing the cylindrical member.

[0407] In the second pressing step (S232), one surface of the cylindrical member 230a may be bent outward 90 degrees or more relative to the other surface. For example, the one surface may be bent 90 degrees relative to the other surface.

[0408] The load or pressure with which the cylindrical member 230a is pressed in the second pressing step (S232b) may be set differently from the load or pressure with which the cylindrical member 230a is pressed in the first pressing step (S232a).

[0409] For example, in the first pressing step (S232a), the cylindrical member 230a may be pressed with a load of 500 tons, and in the second pressing step (S232b), the cylindrical member 230a may be pressed with a load of 300 tons.

[0410] The first pressing die (I) may be set to press the cylindrical member 230a more strongly than the second pressing die (II).

[0411] Consequently, the cylindrical member 230 may be prevented from being rapidly plastically deformed, thereby preventing breakage of the weld line L or the like.

[0412] The first pressing step (S232a) and the second pressing step (S232b) may be steps of shaping the region of the cylindrical member 230a corresponding to the body coupling portion 231.

[0413] One surface of the cylindrical member 230a may be expanded to shape the body coupling portion 232, and a support 231 may be provided from the other surface of the cylindrical member 230a to the region where the expansion begins.

[0414] The pressing step (S232) may include a forming step (S232c) of forming a reinforcing portion 233 between the support 231 and the body coupling portion 232.

[0415] The reinforcing portion 233 may protrude toward the region where the drum body 210 is disposed between the support 231 and the body coupling portion 232, or may be depressed toward the outside of the front drum portion 230.

[0416] The reinforcing portion 233 may be formed along the circumference of the front drum portion 230 between the support 231 and the body coupling portion 232 to distribute the load applied to the front drum portion 230 in multiple directions, thereby improving the durability of the front drum portion 230.

[0417] The forming step may also be performed through pressing using the press die.

[0418] That is, the forming step (S232c) may include pressing the inner surface of the cylindrical member 230a using a third press die III. The forming step (S232c) may be performed by pressing the region of the cylindrical member 230a between the support 231 and the body coupling portion 232 using the press die.

[0419] The third press die III may be used in the forming step, and the pressing force may be 250 tons.

[0420] The reinforcing portion 233 may include a protrusion 233a convexly protruding farther outward than the body coupling portion 232 and a depression 233b extending from the protrusion 233a and formed by depressing the inner surface corresponding to the space between the body coupling portion 232 and the support 231.

[0421] Meanwhile, the pressing step S232 may include a trimming step (S232d) of cutting a free end or the outermost circumferential surface of the body coupling portion 232. The trimming step may be a process of cutting the part of the outermost circumferential surface of the body coupling portion 232 that is unnecessary for coupling to the drum body 210.

[0422] The trimming step may be performed using a

separate cutting tool. However, in the manufacturing step (S) of the present disclosure, the trimming step may also be performed by pressing and cutting the outermost circumferential surface or the free end of the cylindrical member 230a using the press die.

[0423] A fourth press die IV may be used in the trimming step, and the pressing force may be 250 tons.

[0424] The trimming step may be a step in which a part is completely separated from the cylindrical member 230a and scrapped.

[0425] The pressing step (S232) may include a curling step (S232e) of curling the circumference of each of one surface and the other surface of the cylindrical member 230a.

[0426] The curling step (S232e) may include a first curling step (E1) of outwardly curling the other surface of the cylindrical member 230a or the free end of the support 231 and a second curling step (E2) of outwardly curling one surface of the cylindrical member 230a or the free end of the body coupling portion 232.

[0427] The first curling step (E1) may have a greater degree of shaping the cylindrical member 230a than the second curling step (E2). That is, the first curling step (E1) may have a greater amount of winding of the metal plate than the second curling step (E2).

[0428] For example, the first curling step (E1) may be a step of winding the free end or the exposed circumferential surface of the support 231 into a ring shape having a circular section, and the second curling step (E2) may be a step of winding the free end or the exposed circumferential surface of the body coupling portion 232 only to the extent of facing the outer circumferential surface of the drum body 210.

[0429] The first curling step (E1) may be a step of shaping a curling portion 2311 configured to strengthen the durability of the support 231 while preventing dislodgement of the support wheel 451, and the second curling step (E2) may be a step of shaping a bent portion 2321 configured to allow the body coupling portion 232 to be coupled to the drum body 210 therethrough.

[0430] The curling step (S232e) may be performed by a rolling process.

[0431] However, the curling step (S232e) may also be performed by pressing both surfaces of the cylindrical member 230a using the press die.

[0432] A fifth press die V may be used in the curling step (S232e), and the pressing force may be 250 tons.

[0433] Consequently, the pressing step (S232) is a step of shaping the cylindrical member 230a into the front drum portion 230, and may be performed mostly using the press die.

[0434] Of course, the pressing step (S232) may also be performed by repeatedly using one press die.

[0435] In the pressing step (S232), the pressing step of increasing the diameter of the cylindrical member may be performed with a heavy load, while other steps of changing the shape of the cylindrical member 230a may be performed with a light load.

[0436] FIG. 22 shows the features of the drum according to the present disclosure manufactured by the above manufacturing method.

[0437] Referring to FIG. 22(a), a front drum portion 2 of a conventional laundry treatment apparatus is manufactured by drawing or spinning.

[0438] In the conventional laundry treatment apparatus, a support 21 of the front drum portion 2 is formed by outwardly pressing the inside of a metal plate using a roller or the like. At this time, not only the support 21 but also the body coupling portion 23 and the shaping portion 22 may be shaped by spinning or drawing using a roller or the like.

[0439] Consequently, in the conventional laundry treatment apparatus, since the roller moves along the inner circumferential surface of the front drum portion 2 to shape the support 21, the shaping portion 22 and the body coupling portion 23, a scratch T is formed along the circumference of the front drum portion 2 of the conventional laundry treatment apparatus.

[0440] The scratch T is formed as the roller presses the surface of the front drum portion 2.

[0441] The scratch T may be formed along the circumference of the front drum portion 2, and may be formed in plural along the circumference of the front drum portion 2.

[0442] In addition, since a method of manufacturing a drum of the conventional laundry treatment apparatus forms the support 21 and the shaping portion 22 by outwardly pushing the inside of the metal plate using a roller or the like, the number, depth, and density of scratches T formed on the support 21 and the shaping portion 22 may be greater than the number, depth, and density of scratches T formed on the body coupling portion 23.

[0443] Referring to FIG. 22(b), in the laundry treatment apparatus according to the present disclosure, at least one of the shaping portion 233 and the body coupling portion 232 is shaped by pressing one surface of the cylindrical member 230a using the press die or the like.

[0444] In other words, the shaping portion 233 or the body coupling portion 232 is shaped by pressing one surface of the cylindrical member 230a using the press die in the thickness direction of the cylindrical member 230a or in the forward-rearward direction of the front drum portion 230.

[0445] Consequently, in the laundry treatment apparatus according to the present disclosure, a scratch G may be formed in the thickness direction of the front drum portion 230 or in the forward-rearward direction based on the front drum portion 230 being coupled to the drum body 210.

[0446] The scratch G is formed by friction when the die that presses the cylindrical member 230a presses one surface of the cylindrical member 230a.

[0447] The scratch G may be formed in the thickness direction of the front drum portion 230, and may be formed in plural along the circumference of the front drum portion 230 in the thickness direction.

[0448] Since the support 231 maintains the original shape of the cylindrical member 230a, the scratch G that is formed by the press die may not be formed on the support 231.

[0449] In addition, even if the scratches G are formed on the support 231, the number, depth, and density of scratches G formed on the body coupling portion 232 or the shaping portion 233 may be greater than the number, depth, and density of scratches G formed on the support 231, since the method of manufacturing the drum of the present disclosure presses one surface of the cylindrical member 230a using the press die to shape the body coupling portion 232 or the shaping portion 233.

[0450] In addition, even though the scratches T are provided along the circumference of the front drum portion 230 manufactured by the manufacturing method according to the present disclosure, the scratches G formed in the thickness direction or in the forward-rearward direction of the front drum portion may necessarily be present.

[0451] The number, depth, and density of scratches T formed in the thickness direction or in the forward-rearward direction of the front drum portion may be greater than the number, depth, and density of scratches T formed along the circumference of the front drum portion 230 manufactured by the manufacturing method according to the present disclosure.

[0452] FIG. 23 shows an embodiment of the welding step of the present disclosure.

[0453] The welding step (S222), which is performed in the front manufacturing step (S2) of the present disclosure, may be performed in the state in which both ends of the metal plate M are disposed so as to overlap or face each other.

[0454] In the welding step (S222), welding is performed using a welding machine 85a capable of heating a separate metal member at the part where both ends of the metal plate M face each other. The welding machine 85a performs welding by temporarily melting the metal member using a laser method or a high-voltage method and then allowing the same to solidify.

[0455] At this time, both ends of the molten metal member shrink inward as the molten metal member is thermally shrunk in the process of cooling in the metal plate M. As a result, when welding is completed, a depressed weld defect portion is generated on at least one of both ends of the metal plate M, as shown in the figure.

[0456] Since stress is concentrated on the weld defect portion, the weld defect portion may be easily broken when pressing force or the like is applied when manufacturing the front drum portion 230.

[0457] FIG. 24 shows another embodiment of the welding step of the present disclosure.

[0458] The welding step (S222) may be performed by further disposing a metal block C on at least one of both sides of the part where both ends of the metal plate M face each other.

[0459] The metal block C may be disposed at each of a

weld start part and a weld end part of the metal plate M, and may be disposed on both sides of the part where both ends of the metal plate M face each other.

[0460] The metal block C may absorb heat of the molten metal member. Consequently, the part of the molten metal member that faces the metal block C may be rapidly cooled and may solidify while maintaining the shape thereof in contact with the metal block C.

[0461] As a result, even if the entirety of the metal member is cooled and solidify, a welding defect such as a depression may not be formed at both ends of the metal plate M.

[0462] The metal block C may be made of a metal material having high thermal conductivity, such as copper.

[0463] Since the part of the metal plate M where both ends thereof are welded is provided in a uniform shape like the other parts, the part may be prevented from being damaged or breaking even if the part is pressed by a press die or the like.

[0464] Meanwhile, when performing welding, the welding machine 85a, which is disposed perpendicular to the surface of the metal plate M, may be disposed inclined in the welding direction.

[0465] That is, the welding machine 85a may weld the metal plate M while being disposed inclined by an angle E in the direction in which the welding machine moves from the metal plate M. For example, the angle E may be set to 5 degrees to 10 degrees.

[0466] Consequently, the amount of movement of the molten metal member may be limited, and the metal member may solidify while flowing in the direction of movement of the welding machine 85a, whereby both ends of the metal plate M may be uniformly welded.

[0467] FIG. 25 shows the process of the pressing step in detail.

[0468] A body coupling portion 232 of the front drum portion 230 is manufactured while being bent outward 90 degrees or more than 90 degrees from the support 231.

[0469] At this time, if the support 231 is pressed so as to be bent by 90 degrees or more at once to shape the body coupling portion 232, damage to the cylindrical member 230a, such as tear, may occur.

[0470] In particular, since the weld line L of the cylindrical member 230a may be most vulnerable to external force or stress may be concentrated thereon, damage to the weld line L or a part adjacent thereto, such as breakage or tear, may occur.

[0471] Therefore, in the method of manufacturing the drum of the present disclosure, the expanding step (S23) may be performed by expanding one surface of the cylindrical member 230a while being divided by a predetermined angle when manufacturing the body coupling portion 232.

[0472] For example, the expanding step (S23) of the present disclosure may include a first pressing step (S232a) of pressing one surface of the cylindrical member 230a so as to be expanded and a second pressing

step (S232b) of further pressing the one surface so as to be expanded.

[0473] Consequently, damage to or breakage of the weld line L may be prevented.

[0474] FIG. 25(a) is an enlarged view showing the state of metal particles near the weld line L when the first pressing step (S232a) is performed.

[0475] When one surface of the cylindrical member 230a is bent outward and expanded in the first pressing step (S232a), the weld line L may maintain the state in which both ends of the metal plate M are coupled to each other.

[0476] Of course, the weld line L may be formed thicker than particles of the metal plate M because recrystallization or the like occurs in the process in which the metal is melted and then cooled. However, even when the first pressing step (S232a) is performed, the coupling state may be maintained.

[0477] FIG. 25(b) is an enlarged view showing the state of metal particles near the weld line L when the second pressing step (S232b) is performed.

[0478] When one surface of the cylindrical member 230a is further bent outward and expanded in the second pressing step (S232b) and expanded, the weld line L may still maintain the state in which both ends of the metal plate M are coupled to each other.

[0479] Furthermore, it can be seen that the metal member corresponding to the weld line L is completely plastically deformed and the particles become denser. Consequently, the metal member corresponding to the weld line L may become more similar to the size of the particles of the metal plate M adjacent thereto. As a result, the cylindrical member 230a forming the front drum portion 230 may be overall more uniform, and breakage or damage in a subsequent shaping process may be significantly reduced.

[0480] FIG. 26 shows a structure whose rigidity is enhanced by the pressing step.

[0481] Since, in the method of manufacturing the drum of the present disclosure, the front drum portion 230 is manufactured through a welding process, it is necessary to ensure the rigidity, the strength, or the durability of the weld line L.

[0482] In addition, when the drive unit is coupled to and supported by the rear of the drum 200 of the present disclosure, it is necessary for the front drum portion 230 to support a significant part of the drum load.

[0483] Therefore, it is necessary to ensure rigidity or durability of the entirety of the front drum portion 230 of the present disclosure including the weld line L, and it is necessary to prevent the weld line L from being damaged or broken even when being pressed by the die or the like.

[0484] FIG. 26(a) shows a change in the hardness of the front drum portion 230 at the weld line L and a region adjacent thereto when the first pressing step (S232a) is performed. The units of hardness in the graph are based on Vickers Hardness, wherein HV0.5 means pressing with a force of 0.5 kg.

[0485] It may be understood that hardness is proportional to strength and rigidity.

[0486] When the front drum portion 230 is disposed in the form of a cylindrical member 230a, the front drum portion 230 has uniform hardness in the thickness direction or the forward-rearward direction, not in the circumferential direction.

[0487] However, when the first pressing step (S232a) is performed to press the cylindrical member 230a, external force may be transmitted to the entirety of the cylindrical member 230a. At this time, the cylindrical member 230a may be subjected to a higher degree of plastic deformation in the order close to the press die, whereby hardness may be increased.

[0488] In other words, hardness may be increased in the order of the metal plate M, which has basic hardness, the body coupling portion 232, the shaping portion 233, and the support 231. For example, the basic hardness of the metal plate M may be set to 150 to 155 HV0.5. In addition, as the metal plate M undergoes the first pressure step (S232a), the hardness of the body coupling portion 232 may be measured as about 180 HV0.5, the hardness of the shaping portion 233 may be measured as 160 HV0.5, and the hardness of the support 231 may be measured as 155 HV0.5.

[0489] Meanwhile, in the cylindrical member 230a, the hardness of the weld line L is set to be higher because the weld line has been thermally deformed in the process of coupling the metal plate M adjacent thereto. Specifically, it can be seen that the hardness of the weld line L exceeds 200 HV0.5 while the hardness of the metal plate M adjacent thereto is less than 200 HV0.5. This indicates that, when the weld line L is pressed by the press die or the like and is plastically deformed, the particles become denser, whereby hardness and strength increase.

[0490] The hardness of the entirety of the weld line L in the thickness direction is set to be higher than that of the metal plate M. In addition, the hardness of the weld line L may be increased in the order of the body coupling portion 232, the shaping portion 233, and the support 231. For example, in the weld line L, the hardness of the body coupling portion 232 may be measured as about 210 HV0.5, the hardness of the shaping portion 233 may be measured as 175 HV0.5, and the hardness of the support 231 may be measured as 170 HV0.5.

[0491] As a result, the hardness of the front drum portion 230 may be increased enough to actively support the load of the drum body 210. Therefore, it is possible to stably support not only the front load but also the overall load of the drum body 210 only through the front drum portion 230 even if the rear surface of the drum body 210 is not supported by the rear plate 420.

[0492] In addition, since the hardness of the weld line L becomes higher than that of other parts, the durability of the weld line L may be ensured even though the front drum portion 230 is excessively shaped in the manufacturing process or is rotated with a high load in a state of being coupled to the drum body 210.

[0493] FIG. 26(b) shows a change in the hardness of the front drum portion 230 at the weld line L and a region adjacent thereto when the second pressing step (S232b) is performed. It can be seen that, when the second pressing step (S232b) is performed, the hardness or the rigidity of the weld line L of the front drum portion 230 becomes higher than that of a region M adjacent thereto.

[0494] Specifically, when the second pressing step (S232b) is performed to press the cylindrical member 230a, external force may be additionally transmitted to the entirety of the cylindrical member 230a. At this time, the cylindrical member 230a may be subjected to a higher degree of plastic deformation in the order close to the press die, whereby hardness may be further increased.

[0495] However, a hardness increasing phenomenon of the metal plate M may not be pronounced because the metal plate M has already been sufficiently plastically deformed in the first pressing step (S232a). However, the hardness of the body coupling portion 232, the shaping portion 233, and the support 231 may become uniform through the second pressing step (S232b).

[0496] That is, as the difference in hardness between the body coupling portion 232, the shaping portion 233, and the support 231 is reduced, the overall hardness difference of the front drum portion 230 may not be great. Consequently, the load applied to the front drum portion 230 may be evenly distributed, and any one of the body coupling portion 232, the shaping portion 233, and the support 231 may be prevented from being more excessively deformed or more intensively stressed than the others.

[0497] As a result, even if the drum 200 receives drive force through the rear surface thereof and transmits a load to the front drum portion 230, the front drum portion 230 may stably support the load of the drum 200.

[0498] Meanwhile, as the weld line L undergoes the second pressing step (S232b), the particles may become denser while having a smaller size. Consequently, the hardness of the weld line L may be overall further increased.

[0499] For example, in the weld line L, the hardness of the body coupling portion 232 may be measured as about 220 HV0.5, the average hardness of the shaping portion 233 may be measured as 190 HV0.5, and the hardness of the support 231 may be measured as 170 HVO.5.

[0500] Since the hardness of the weld line L becomes higher than that of other parts, the durability of the weld line L may be further improved even though the front drum portion 230 is excessively shaped in the manufacturing process or is rotated with a high load in a state of being coupled to the drum body 210.

[0501] Consequently, even if stress is concentrated on the weld line L, the weld line L may be fundamentally prevented from bursting or being damaged. Consequently, it may be possible to rotate the drum 200 at a high speed or to frequently change the direction of rotation of the drum.

[0502] Consequently, the laundry treatment apparatus according to the present disclosure may be used to directly rotate the drum 200 at the rear surface thereof through the drive unit.

[0503] The present disclosure may be practiced in various modifications, and the scope of the present disclosure is not limited to the embodiments described above. Therefore, if the modifications include elements constituting the claims of the present disclosure, it should be considered that the modifications fall within the scope of the present disclosure.

Claims

1. A laundry treatment apparatus comprising:

a cabinet;
a drum disposed in the cabinet, the drum being configured to receive laundry;
a front plate disposed between the cabinet and a front of the drum; and
a support wheel coupled to the front plate, the support wheel being configured to support the drum, wherein
the drum comprises:

a drum body configured to receive the laundry; and
a front drum portion coupled to a front of the drum body, the front drum portion having an introduction port configured to allow the laundry being introduced or withdrawn therethrough, and
the front drum portion is provided with a weld line formed by welding a metal plate.

2. The laundry treatment apparatus of claim 1, wherein the weld line is disposed in a thickness direction or a forward-rearward direction of the front drum portion.

3. The laundry treatment apparatus of claim 1, wherein the front drum portion comprises:

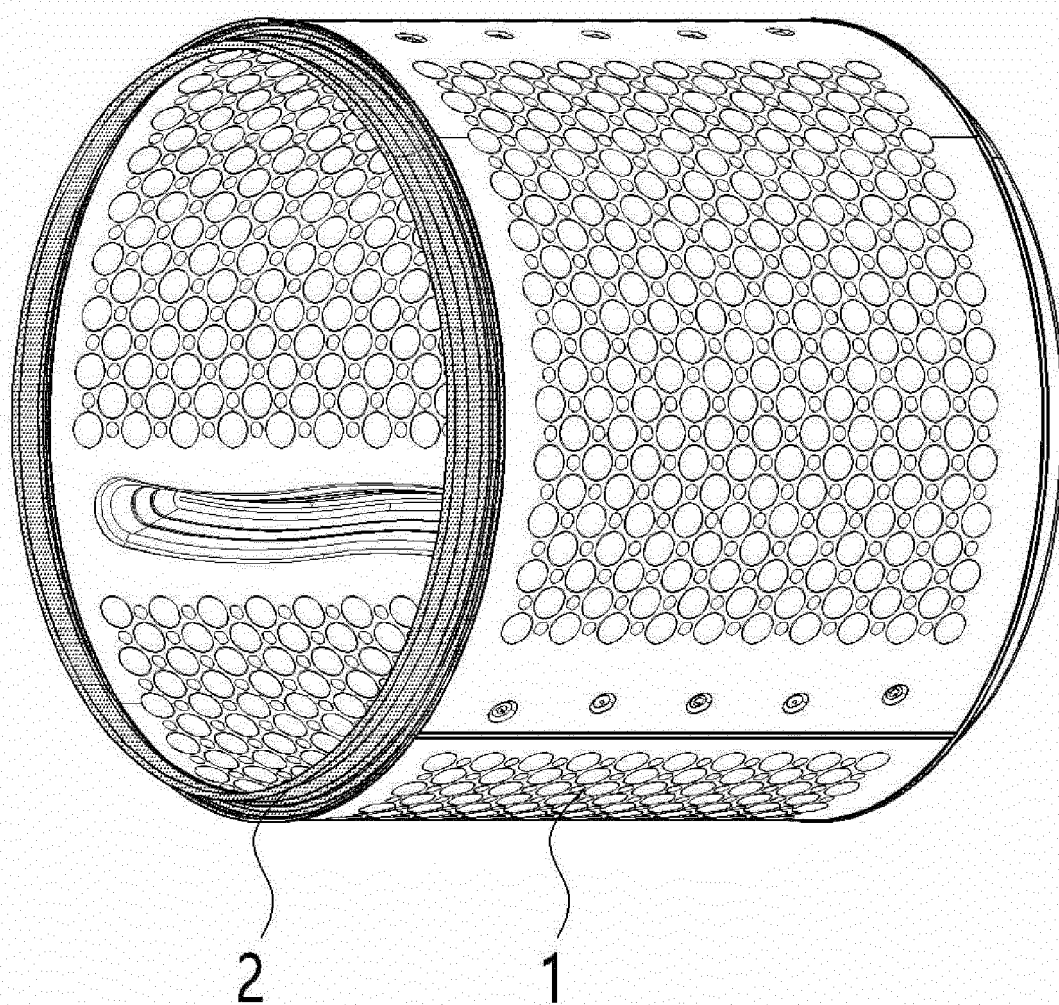
a support supported by the support wheel, the support having the introduction port; and
a body coupling portion extending from the support so as to have a larger diameter, the body coupling portion being coupled to the drum body, and
the weld line extends from the support toward the body coupling portion.

4. The laundry treatment apparatus of claim 3, further comprising:

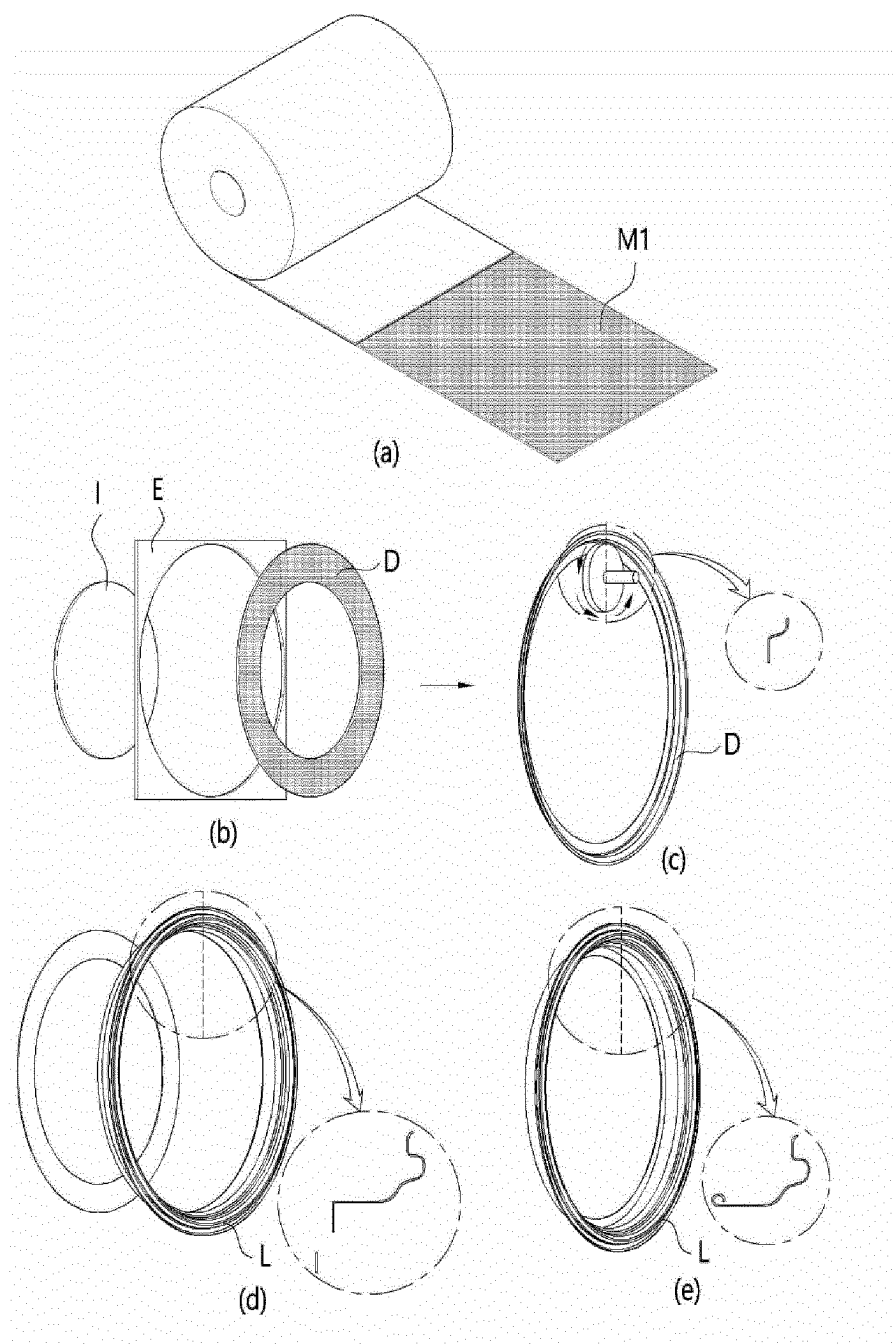
a support plate disposed farther rearward than the drum; and

- a drive unit coupled to the support plate, the drive unit being configured to rotate the drum, wherein the drive unit is coupled to a rear surface of the drum to rotate the drum, and the support is configured to transmit a load of the drum to the support wheel.
- 5
5. The laundry treatment apparatus of claim 4, wherein rigidity of the weld line provided on the support is set to be higher than rigidity of other regions. 10
6. The laundry treatment apparatus of claim 4, wherein rigidity of the body coupling portion is set to be higher than rigidity of the support. 15
7. A laundry treatment apparatus comprising:
- a cabinet;
- a drum disposed in the cabinet, the drum being configured to receive laundry; 20
- a front plate disposed between the cabinet and a front of the drum; and
- a support wheel coupled to the front plate, the support wheel being configured to support the drum, wherein 25
- the drum comprises:
- a drum body configured to receive the laundry; and 30
- a front drum portion coupled to a front of the drum body, the front drum portion having an introduction port configured to allow the laundry being introduced or withdrawn therethrough, and 35
- scratches are formed on the front drum portion in a forward-rearward direction or a thickness direction.
8. The laundry treatment apparatus of claim 7, wherein 40
- the front drum portion has no scratches formed in a diametric direction or a circumferential direction, or
- the number of scratches formed on the front drum portion in the forward-rearward direction or the thickness direction is greater than the number of scratches formed on the front drum portion in the diametric direction. 45
9. The laundry treatment apparatus of claim 7, wherein the front drum portion comprises: 50
- a support supported by the support wheel, the support having the introduction port; and 55
- a body coupling portion extending from the support so as to have a larger diameter, the body coupling portion being coupled to the drum body,
- and
- the scratches are formed on the body coupling portion in the forward-rearward direction or the thickness direction.
10. The laundry treatment apparatus of claim 9, wherein the front drum portion is formed such that the number of scratches provided on the body coupling portion is greater than the number of scratches provided on the support.
11. The laundry treatment apparatus of claim 9, wherein
- the front drum portion further comprises a shaping portion bent and extending from the support toward the body coupling portion, and the scratches are formed on the shaping portion in the forward-rearward direction or the thickness direction.
12. The laundry treatment apparatus of claim 11, wherein the front drum portion is formed such that the number of scratches provided on the shaping portion is greater than the number of scratches provided on the support.
13. The laundry treatment apparatus of claim 7, wherein the front drum portion is provided with a weld line formed by welding a metal plate.
14. The laundry treatment apparatus of claim 13, wherein the front drum portion comprises:
- a support supported by the support wheel, the support having the introduction port; and
- a body coupling portion extending from the support so as to have a larger diameter, the body coupling portion being coupled to the drum body, and
- the weld line extends from the support to the body coupling portion.

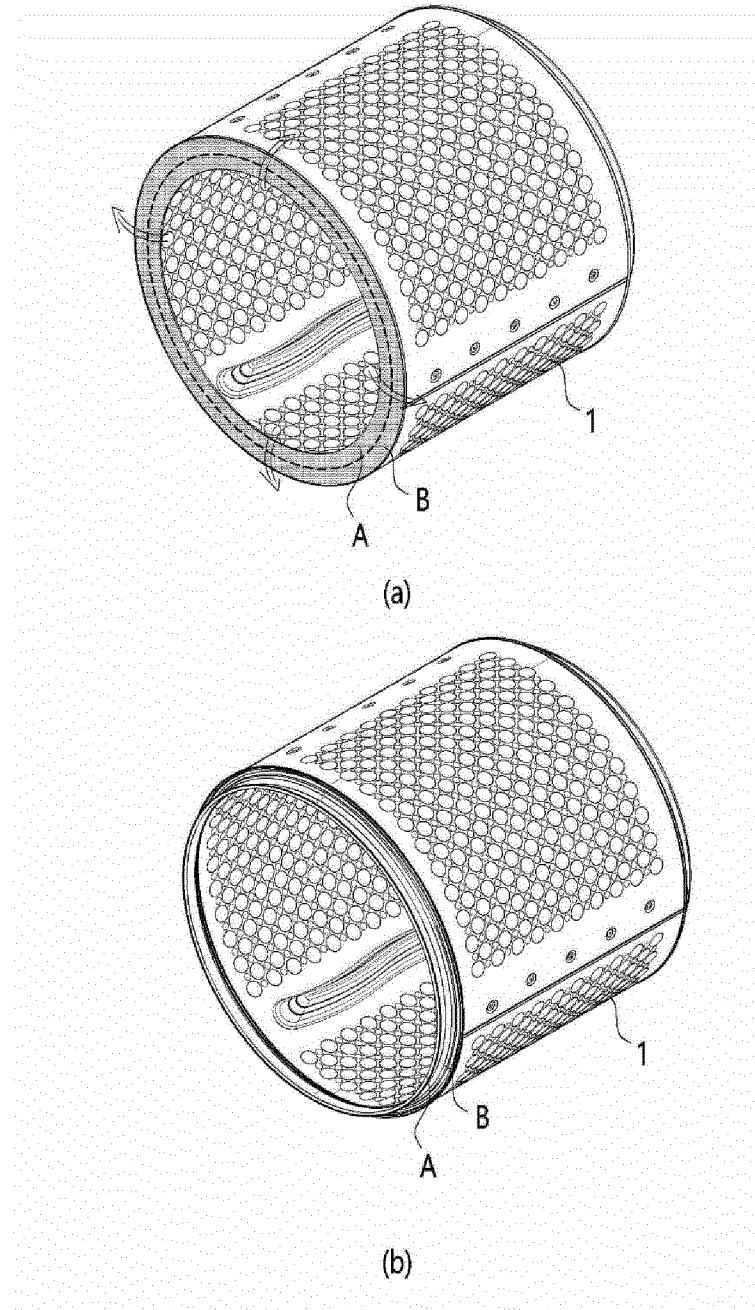
【FIG. 1】



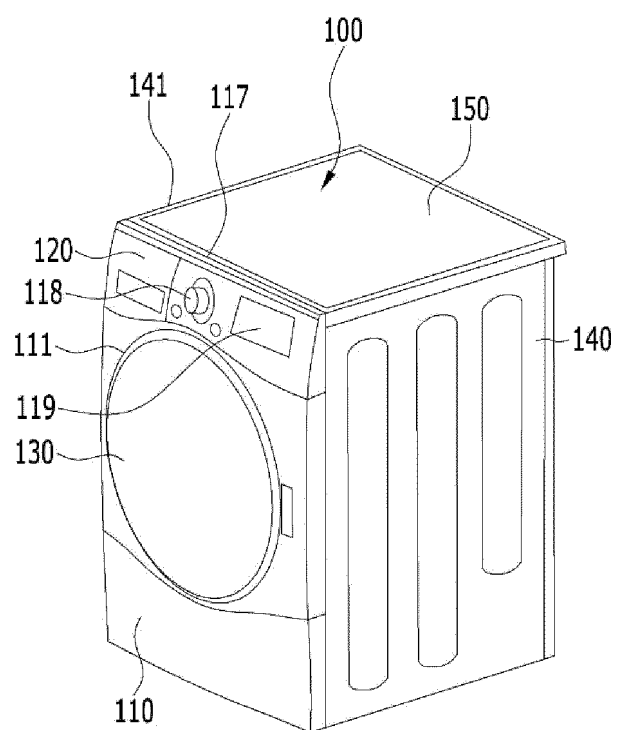
【FIG. 2】



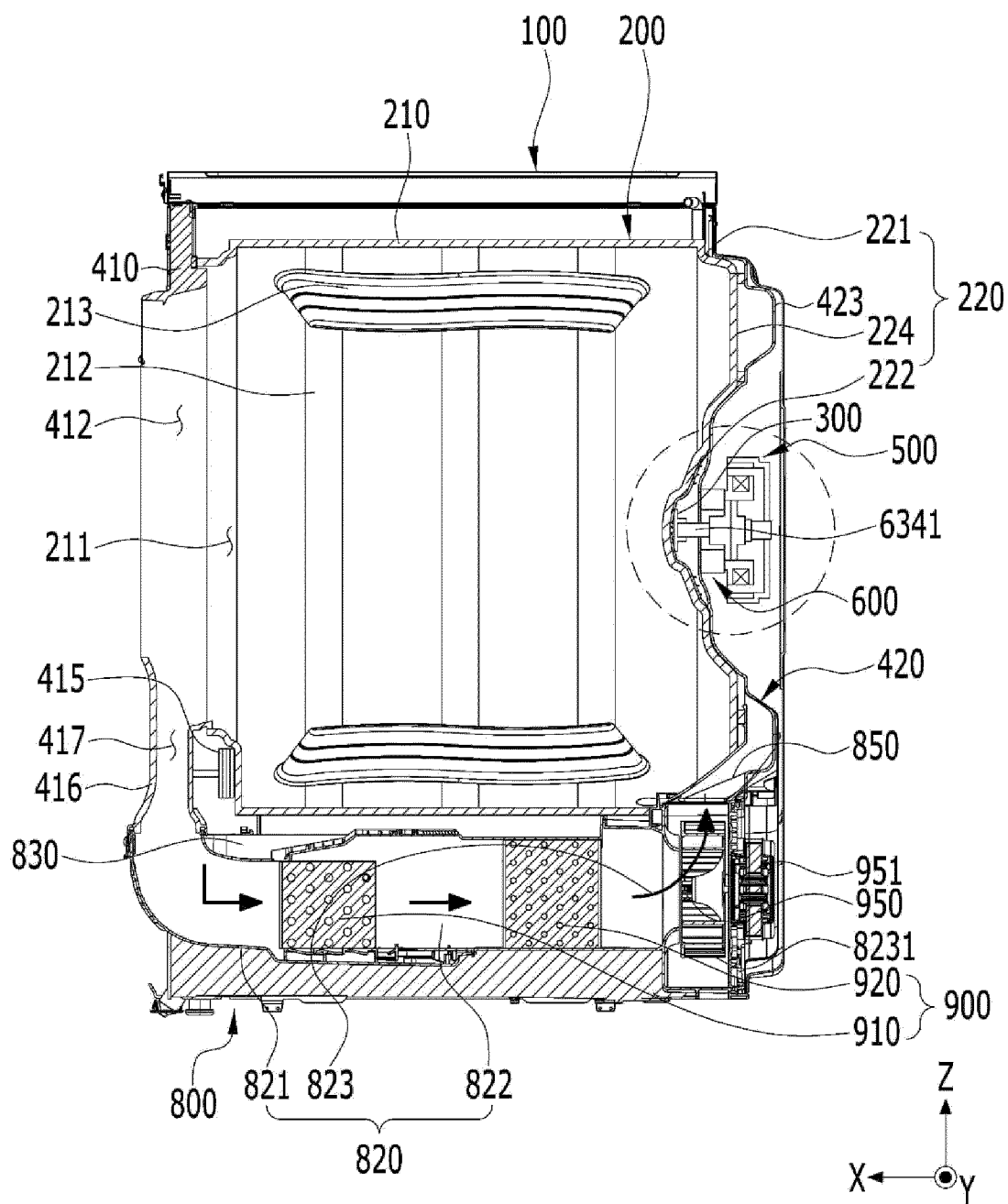
【FIG. 3】



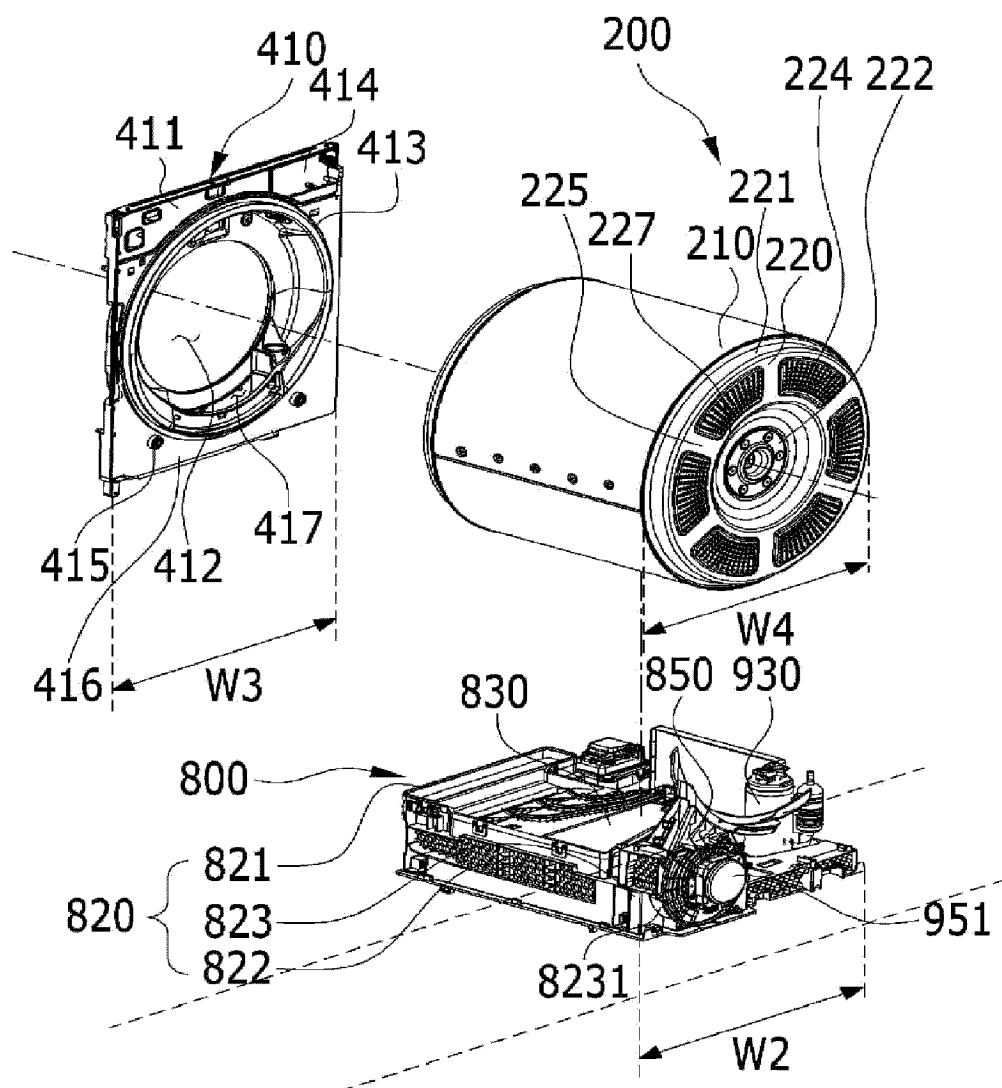
【FIG. 4】



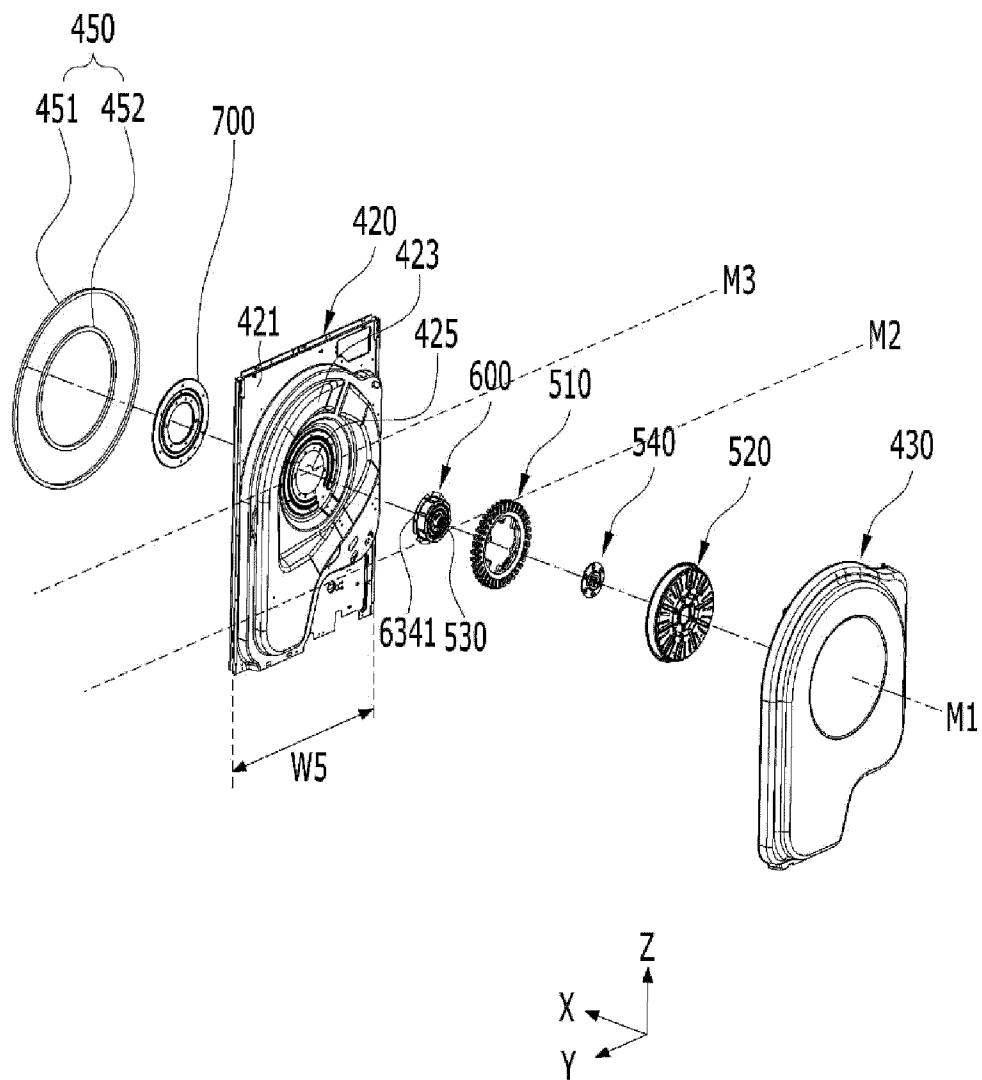
【FIG. 5】



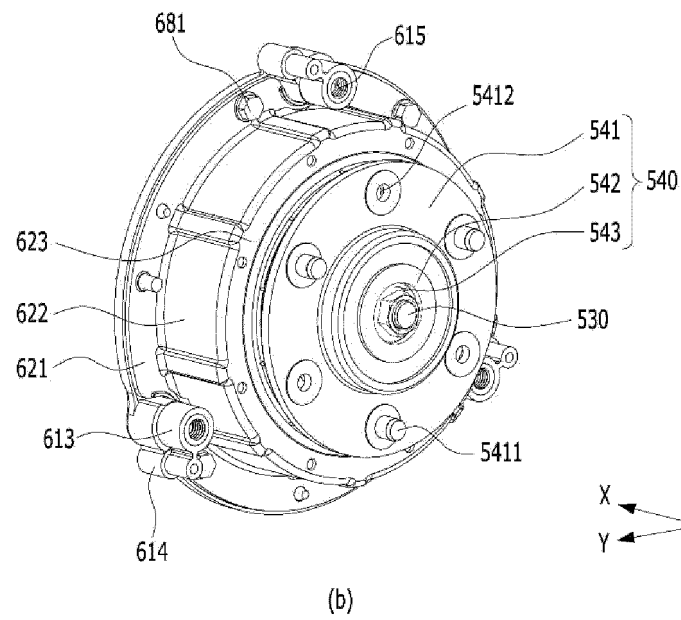
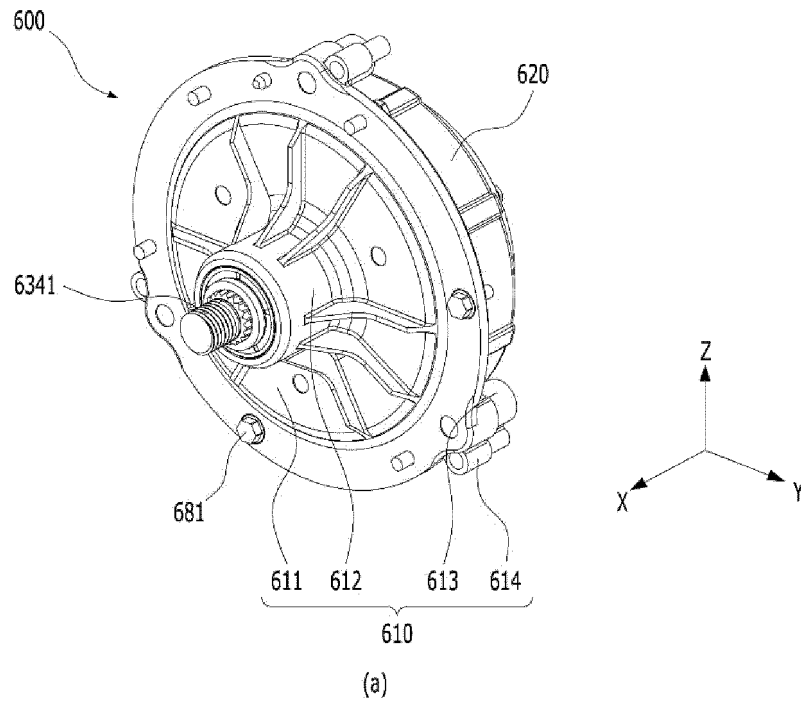
【FIG. 6a】



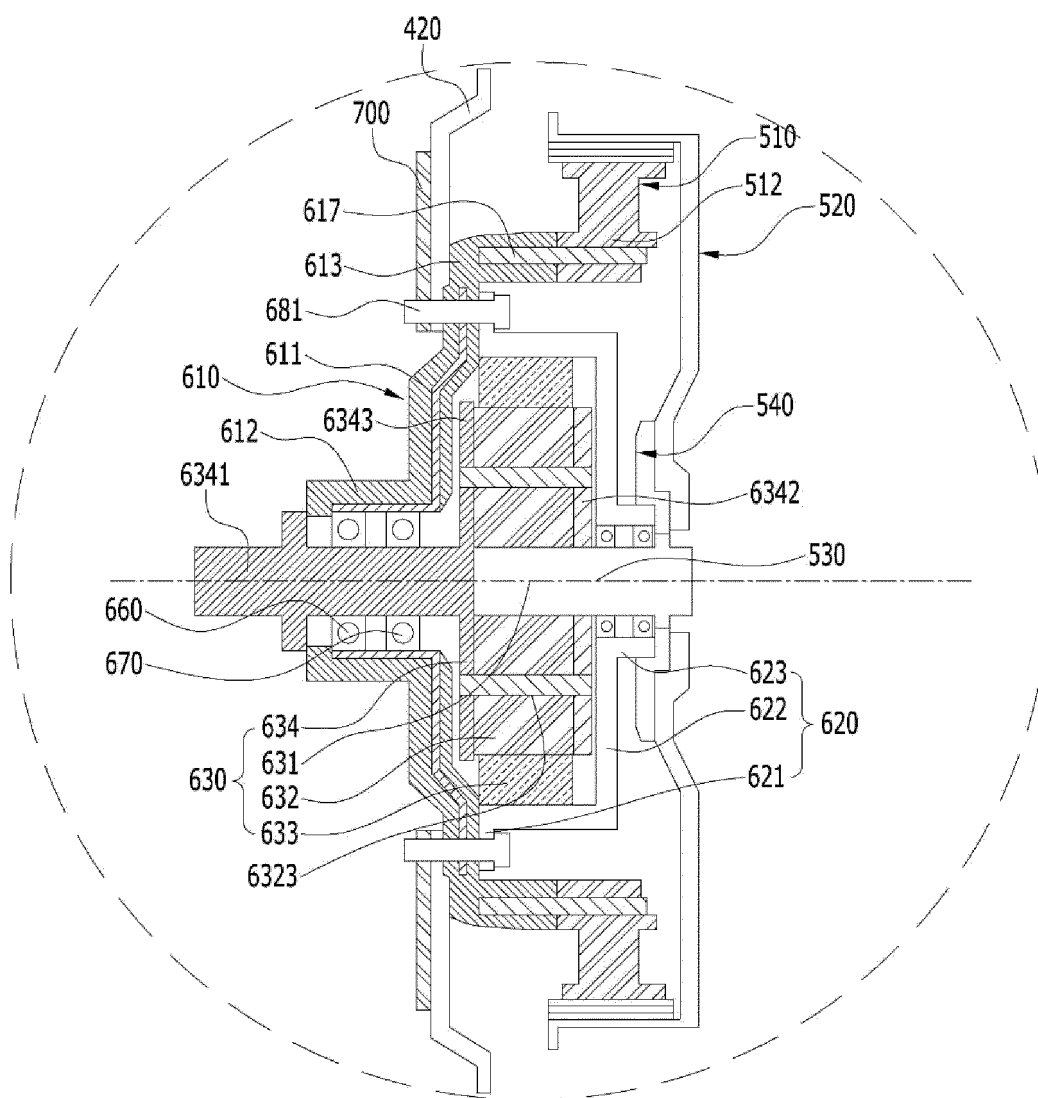
【FIG. 6b】



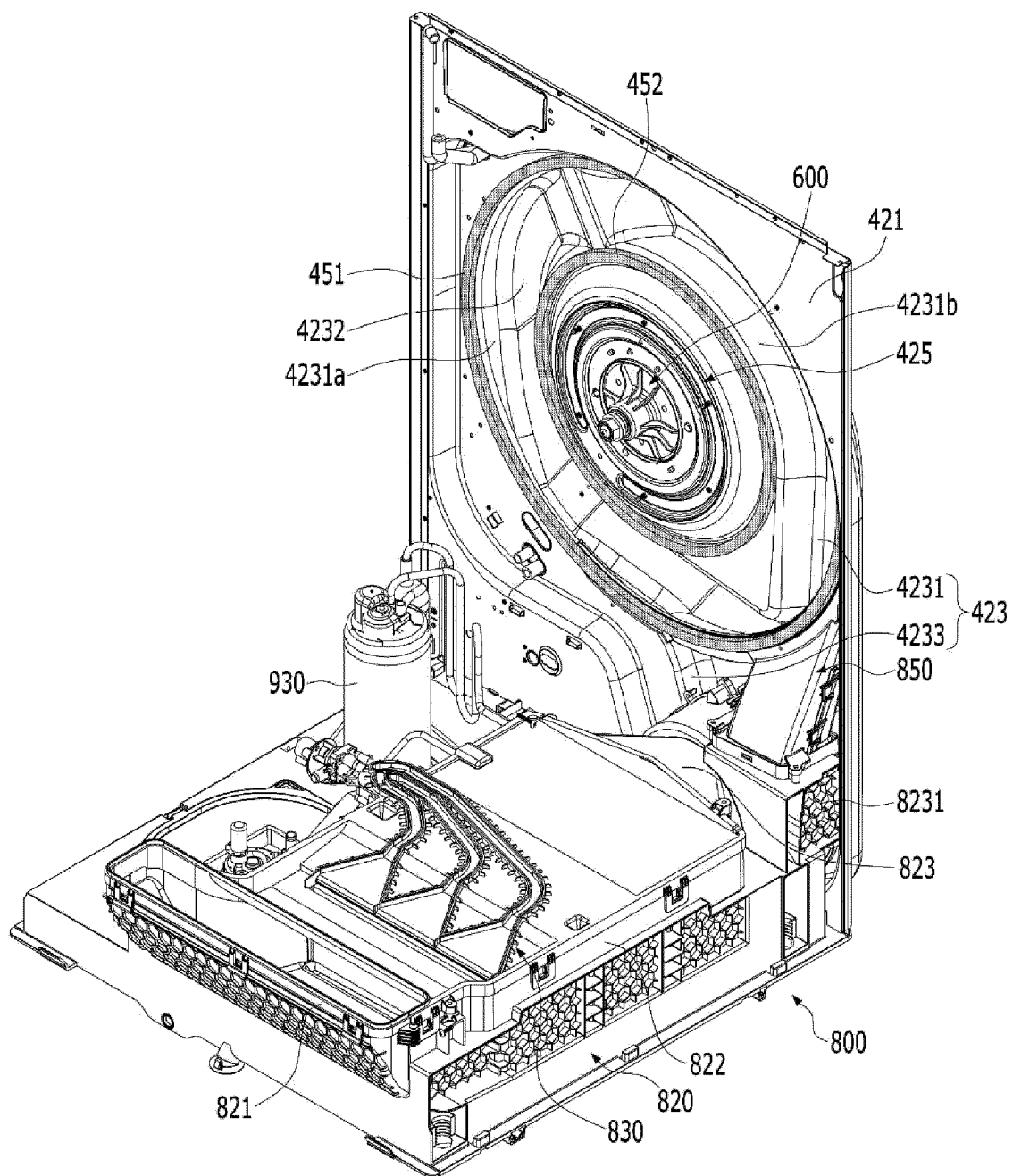
【FIG. 7】



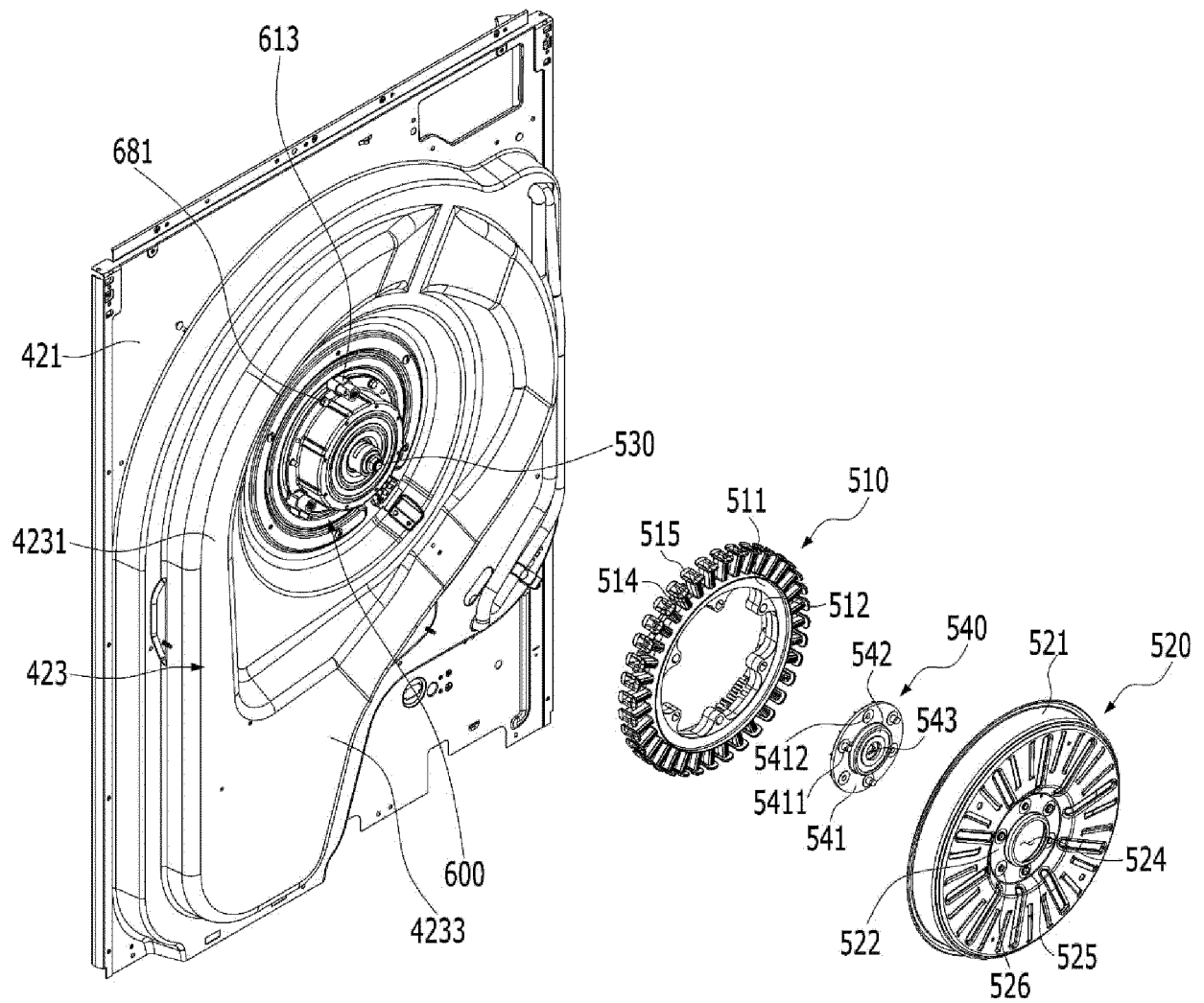
【FIG. 8】



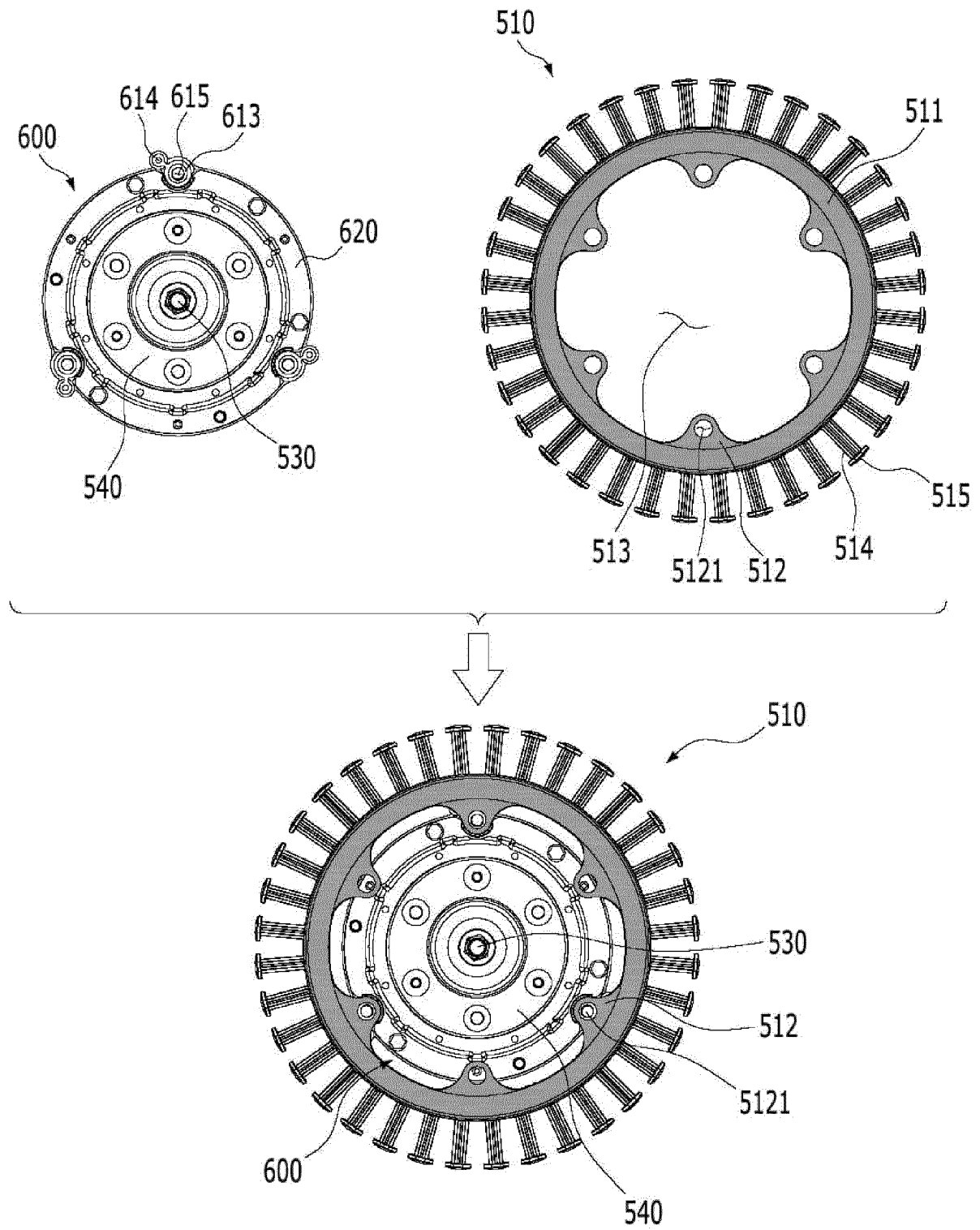
【FIG. 9】



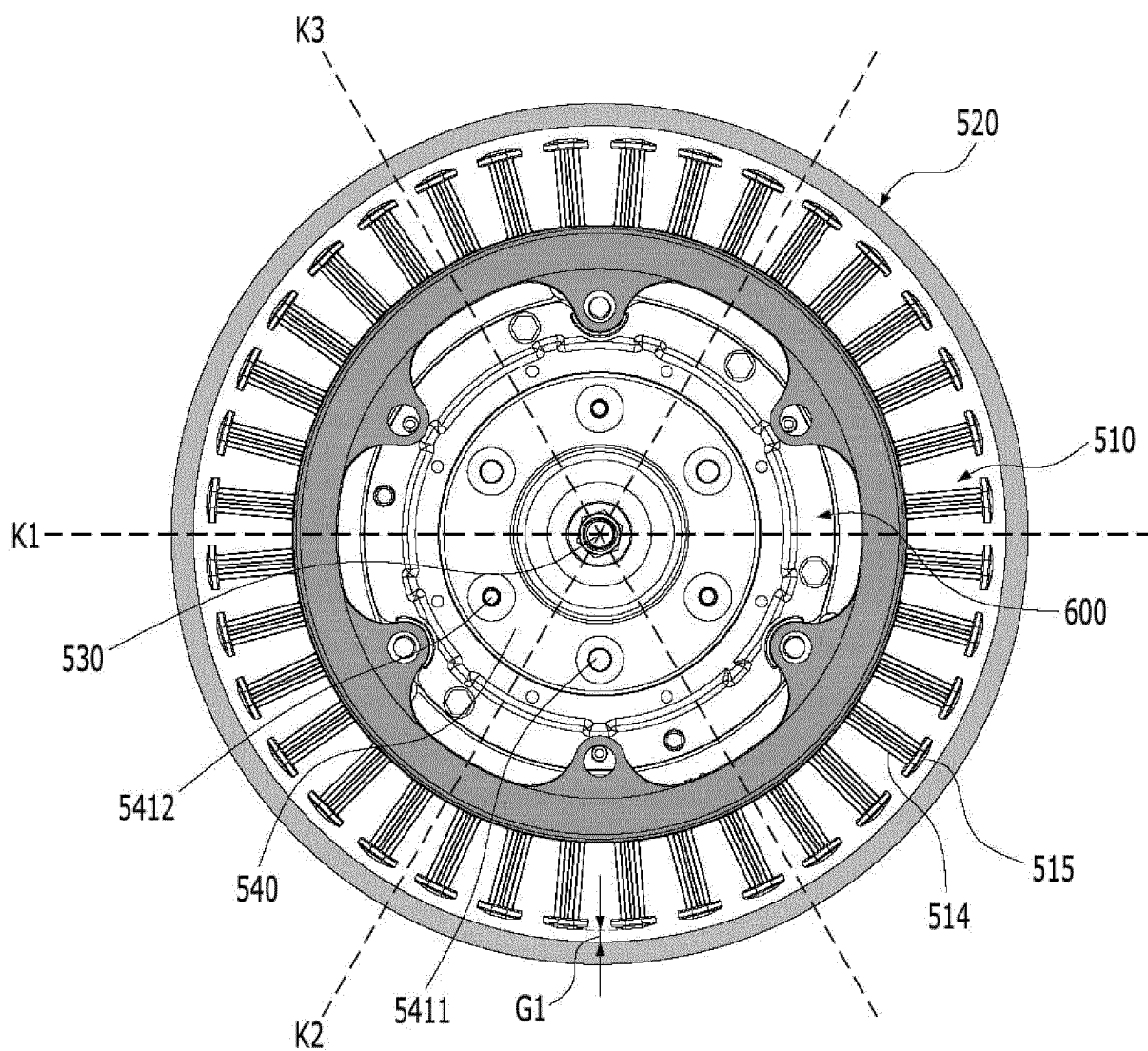
【FIG. 10】



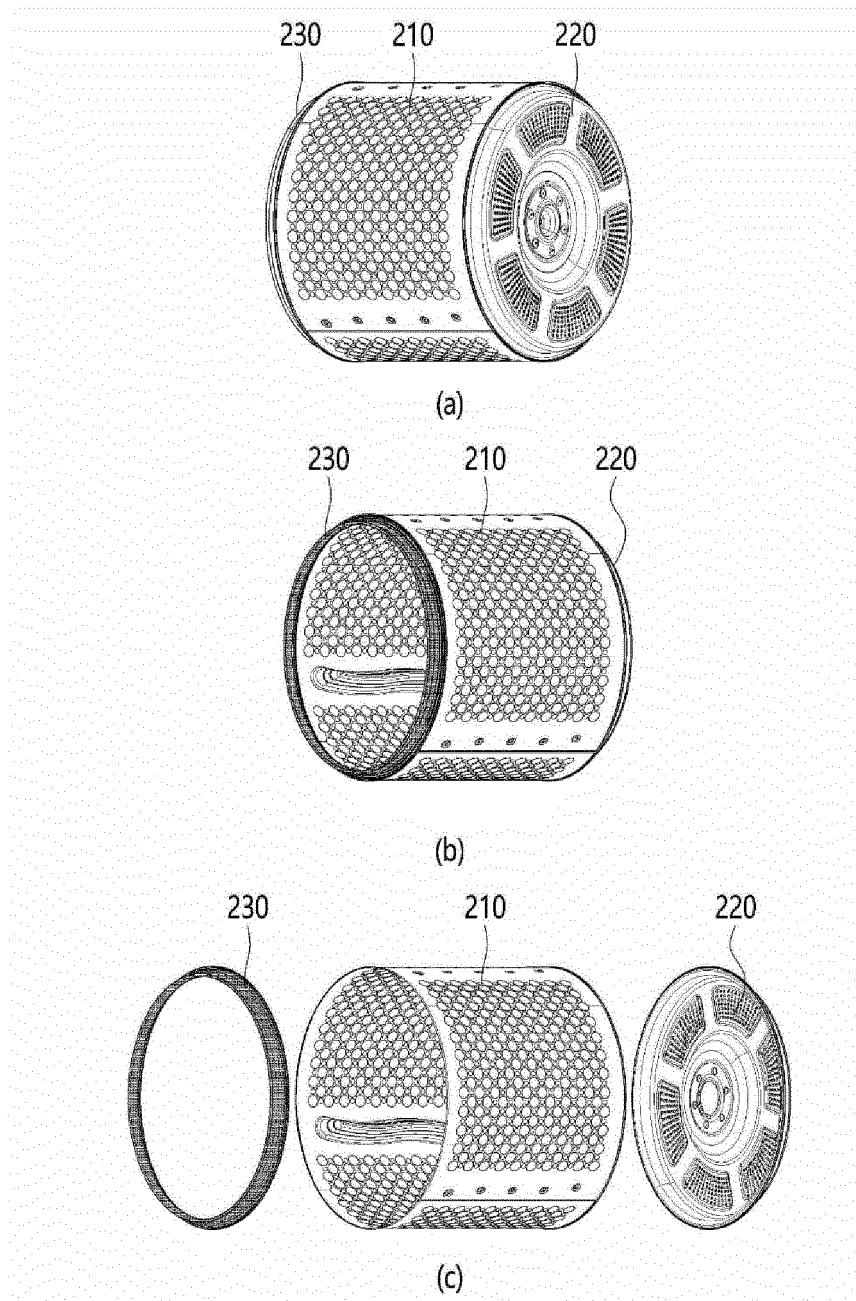
【FIG. 11】



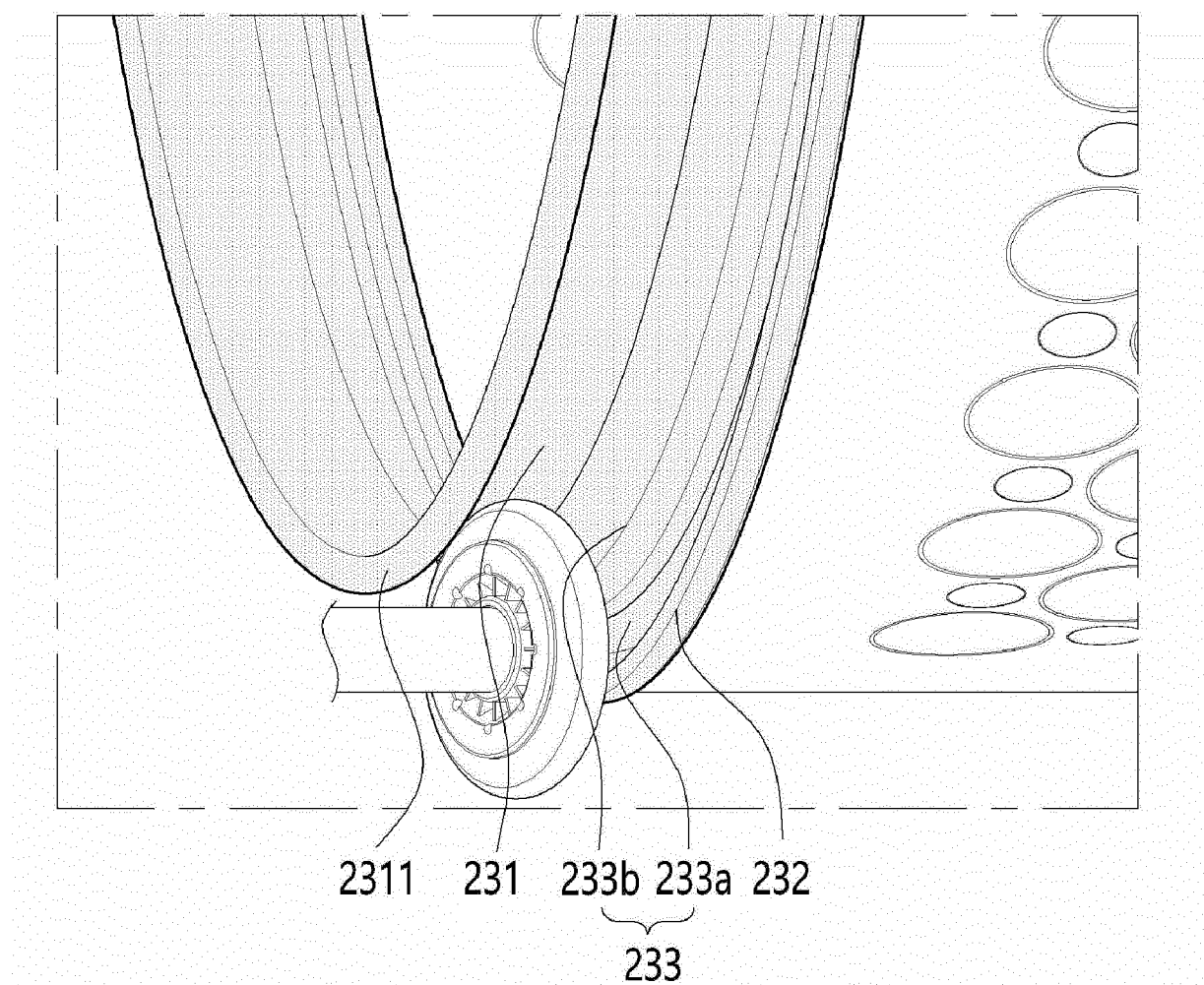
【FIG. 12】



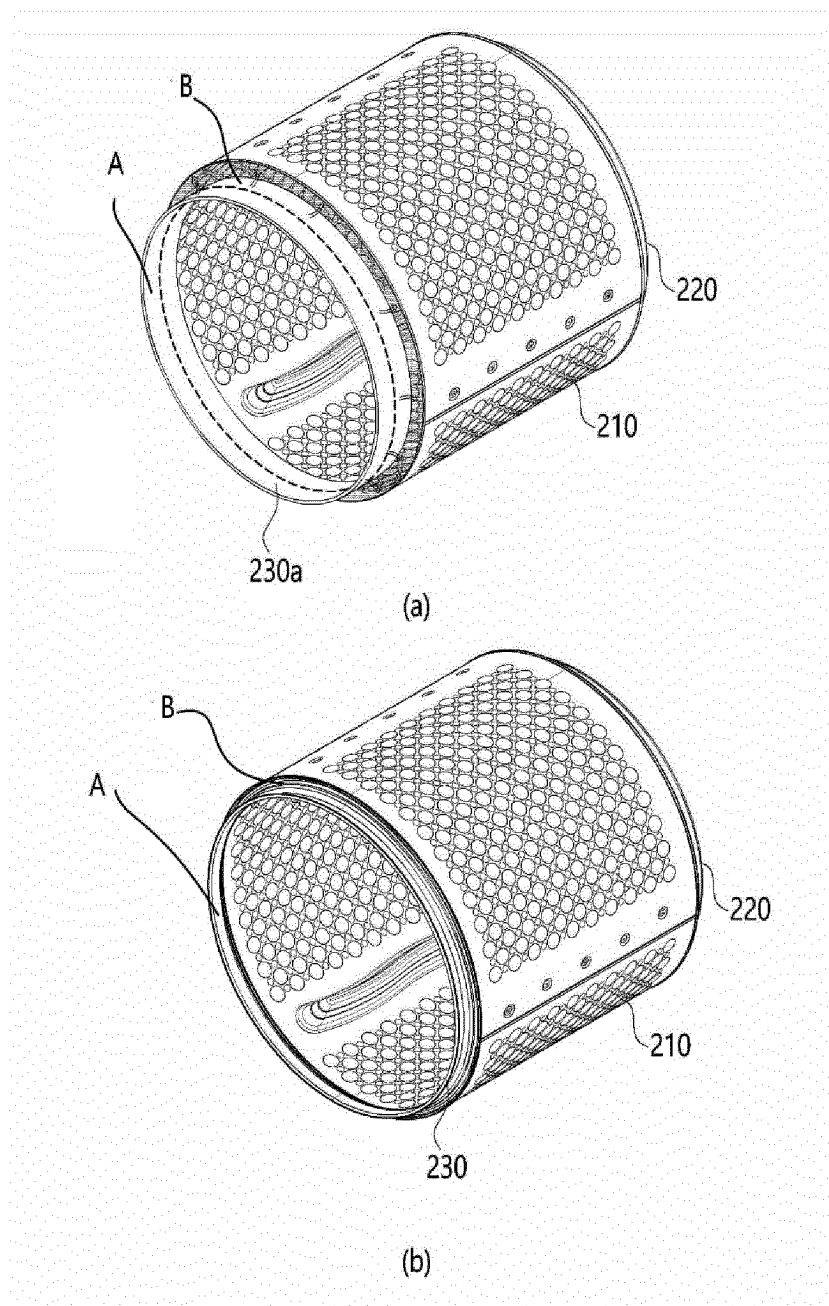
【FIG. 13】



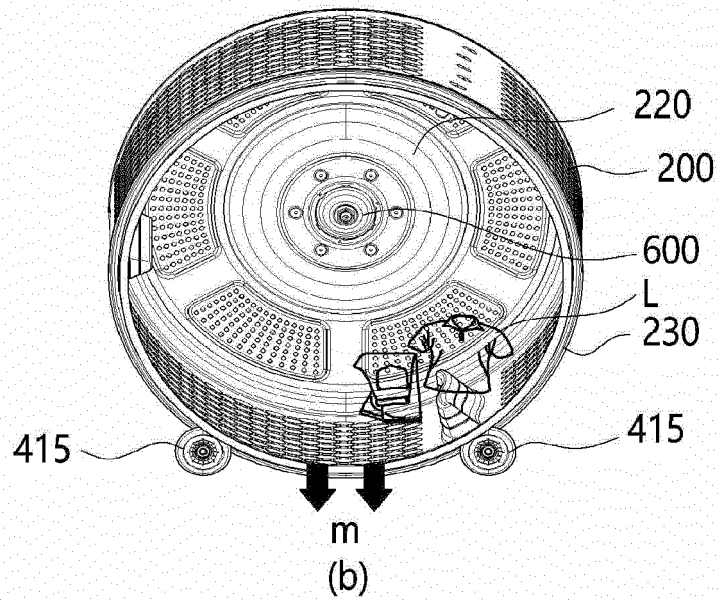
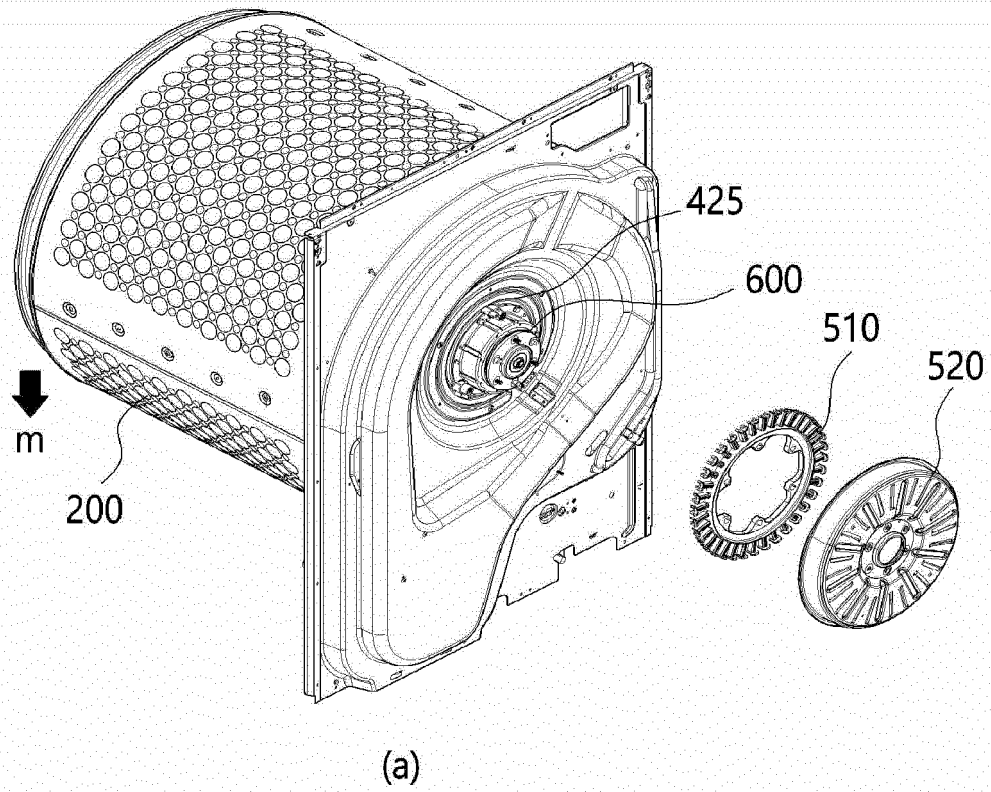
【FIG. 14】



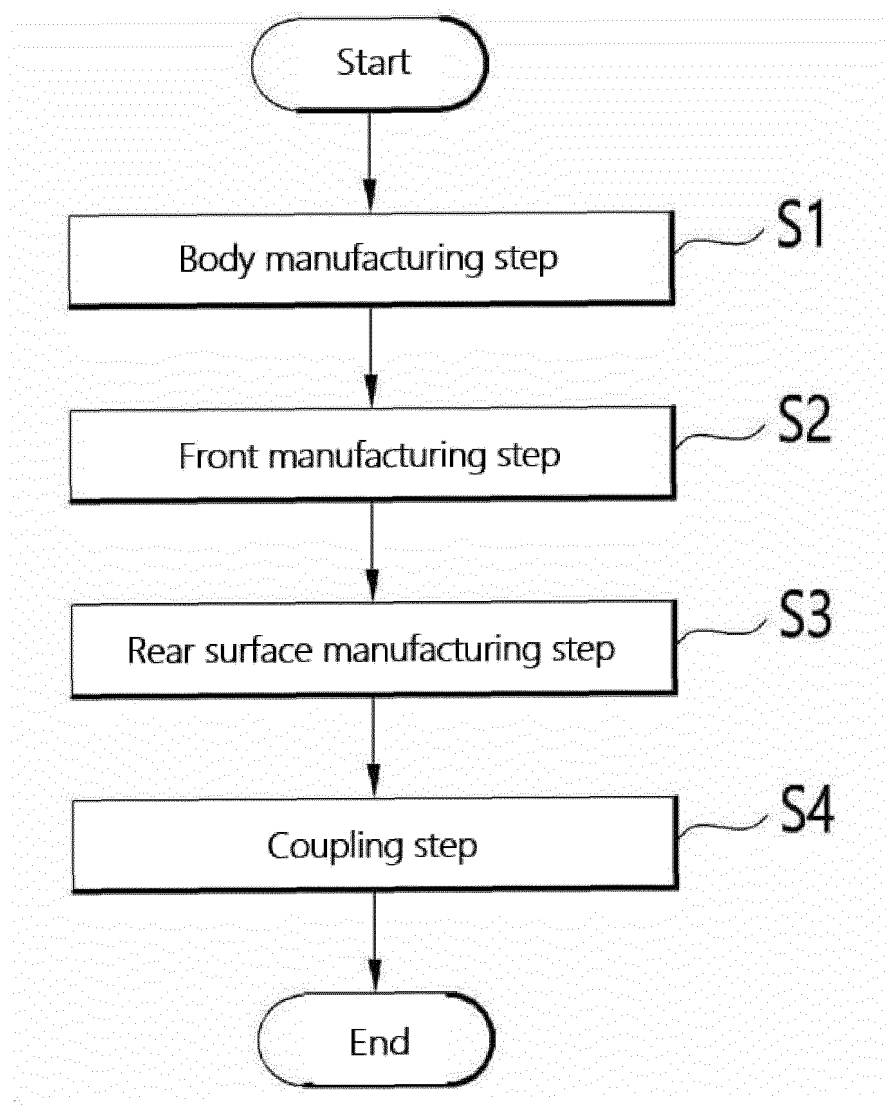
【FIG. 15】



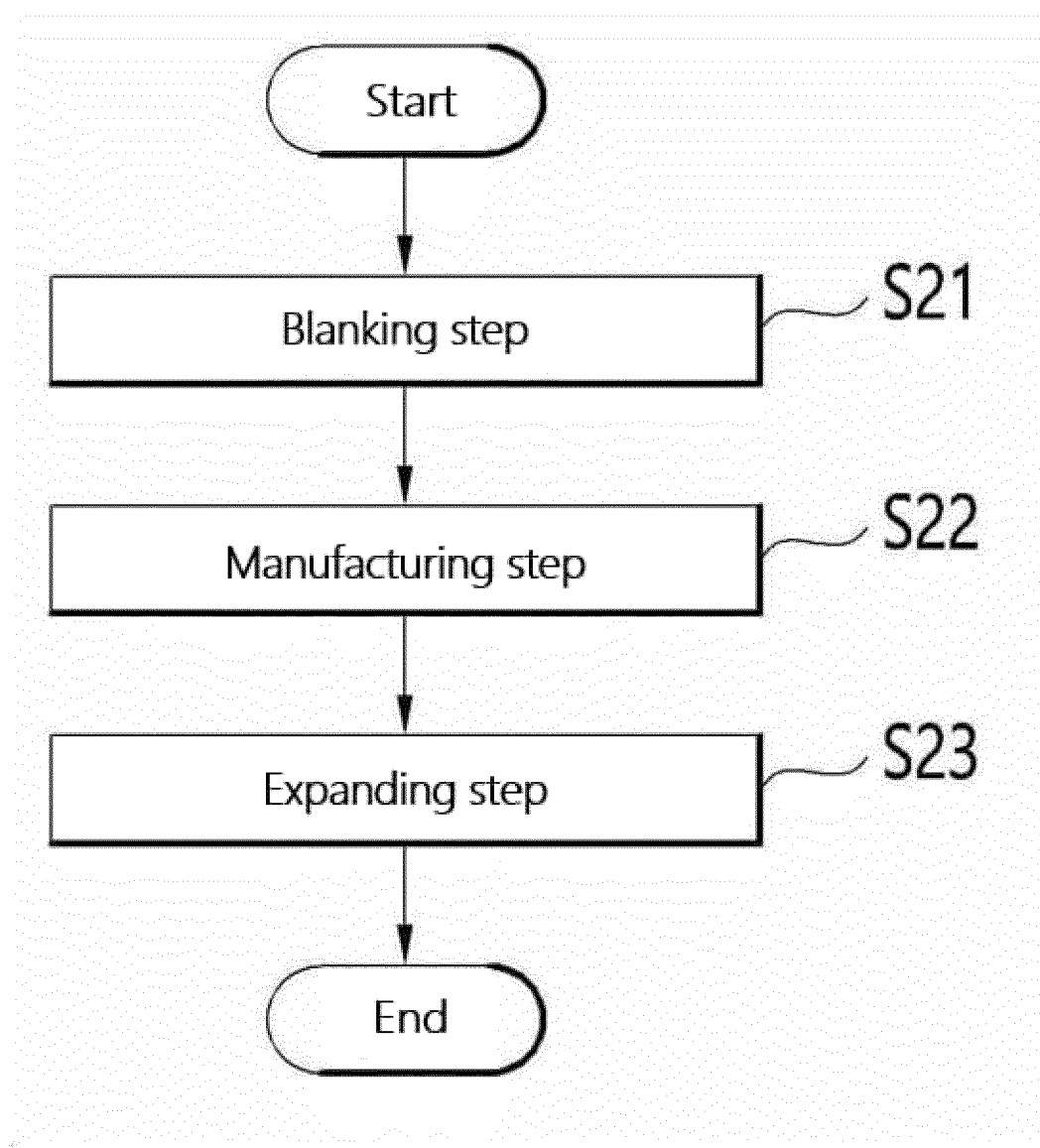
【FIG. 16】



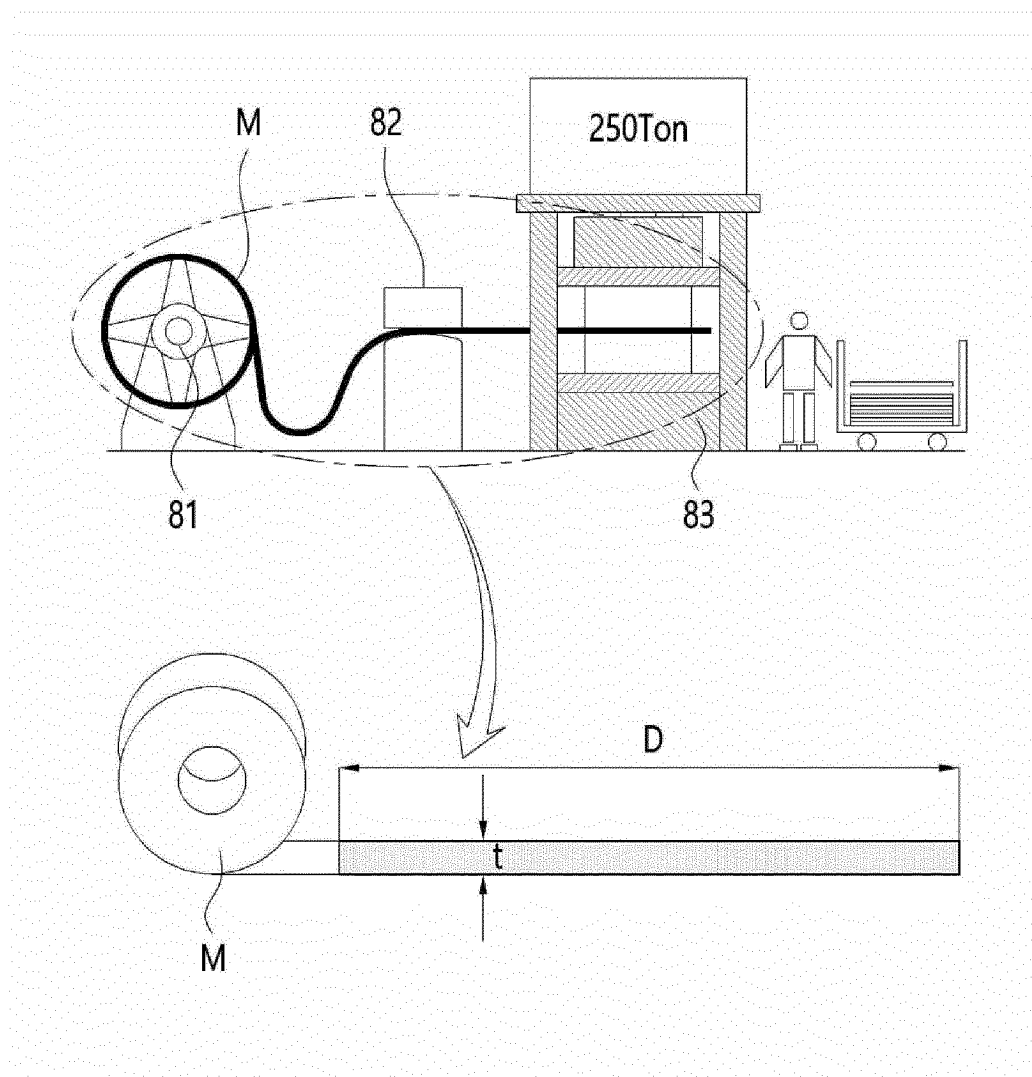
【FIG. 17】



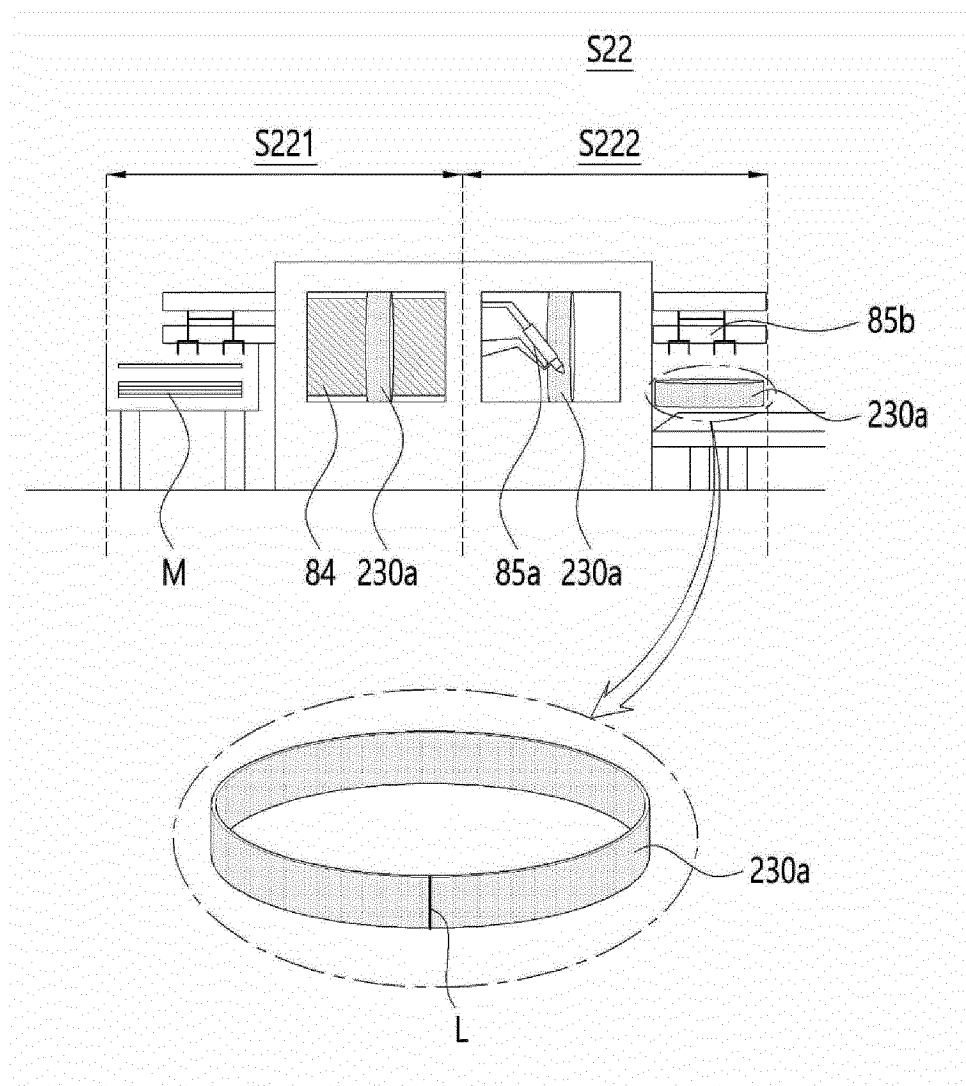
【FIG. 18】



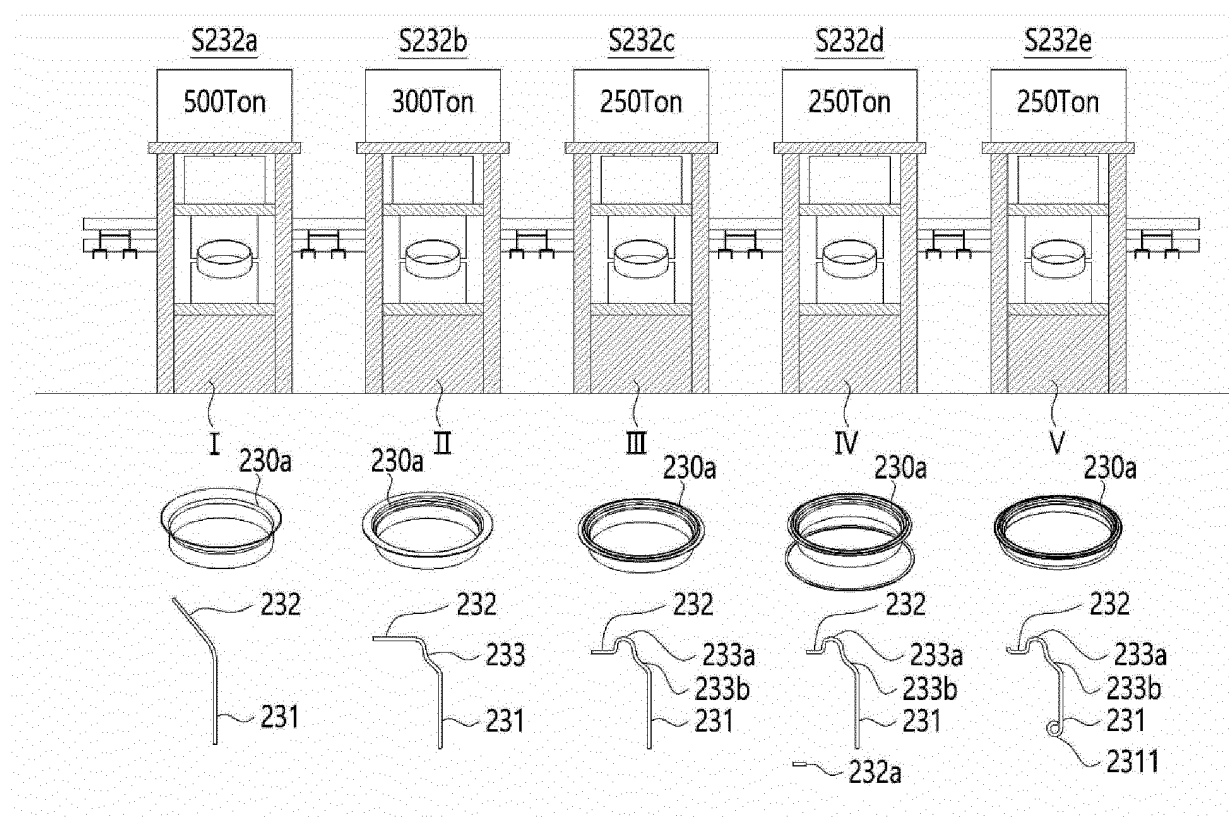
【FIG. 19】



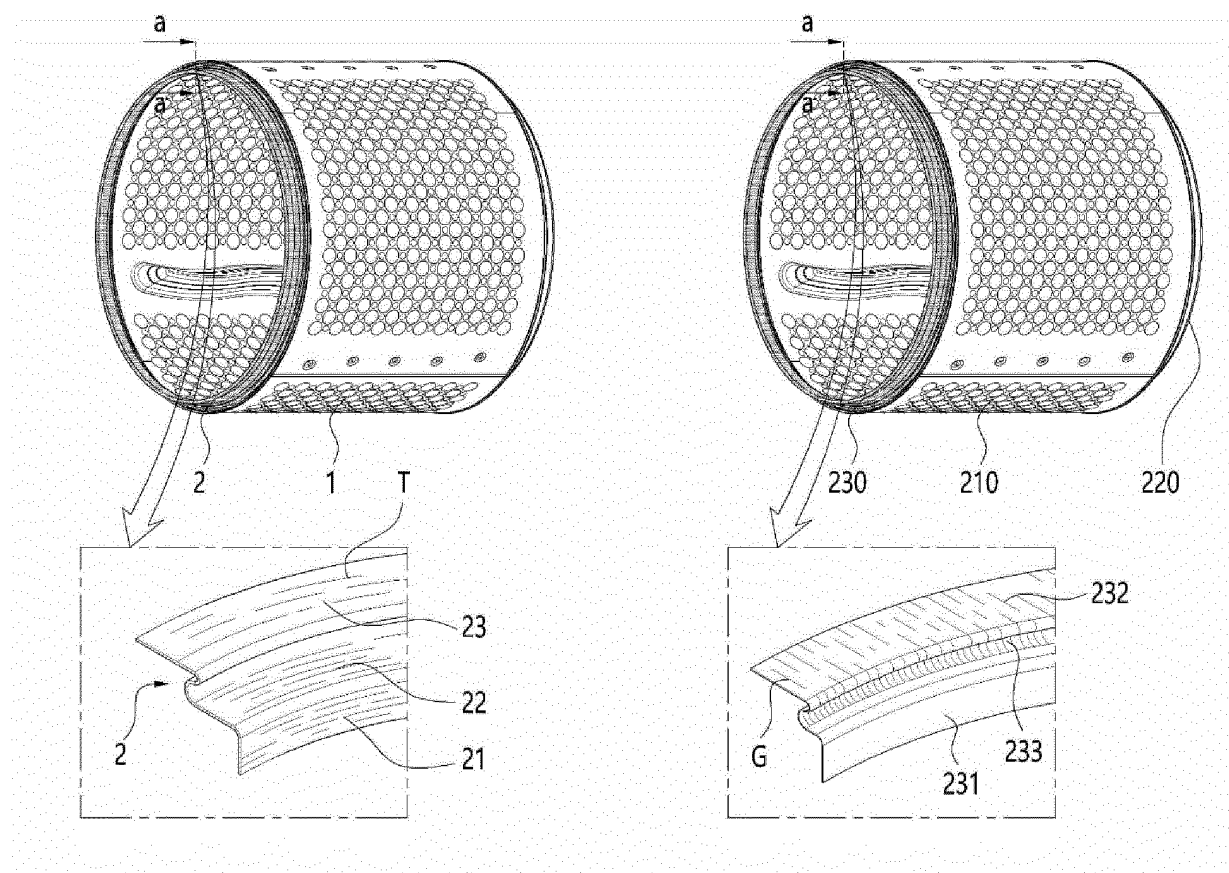
【FIG. 20】



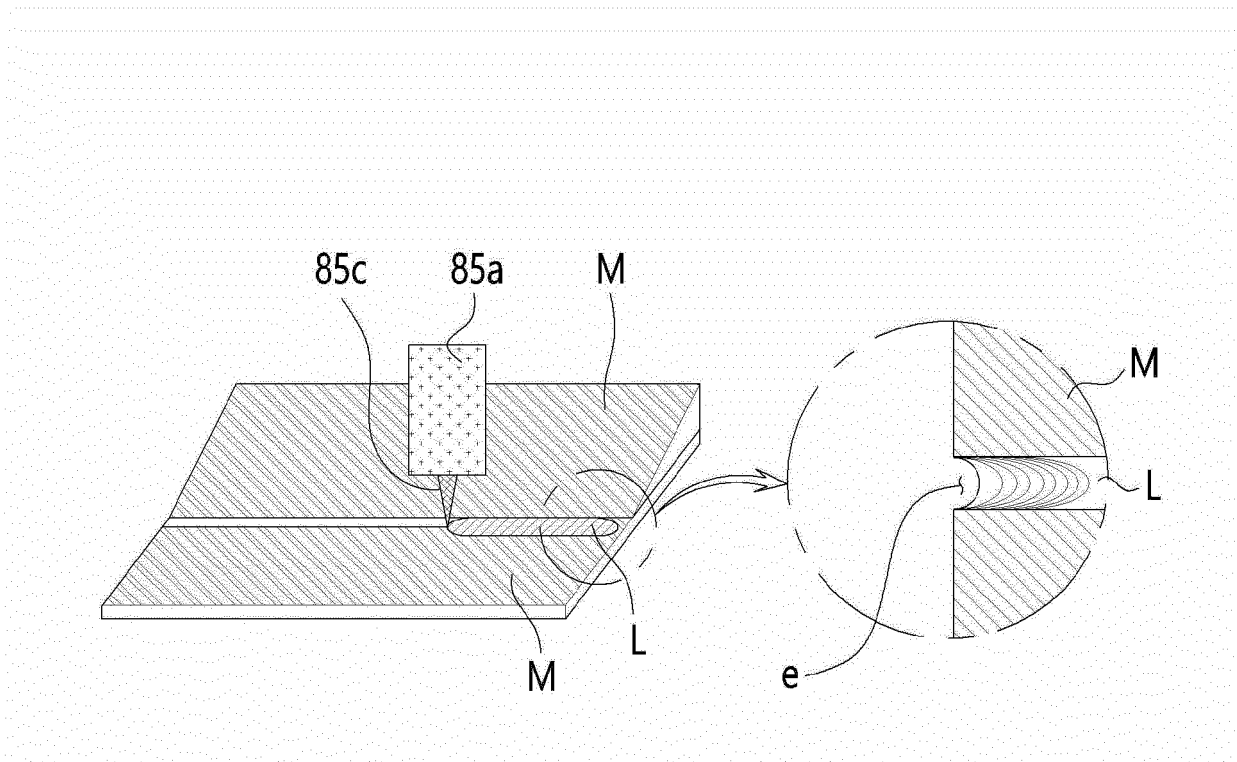
【FIG. 21】



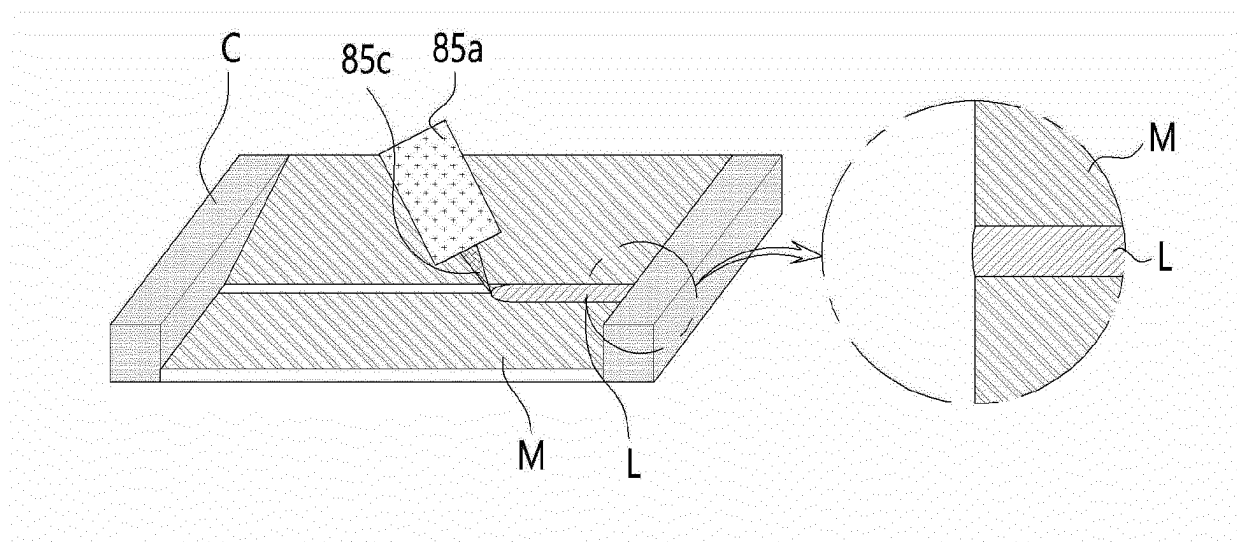
【FIG. 22】



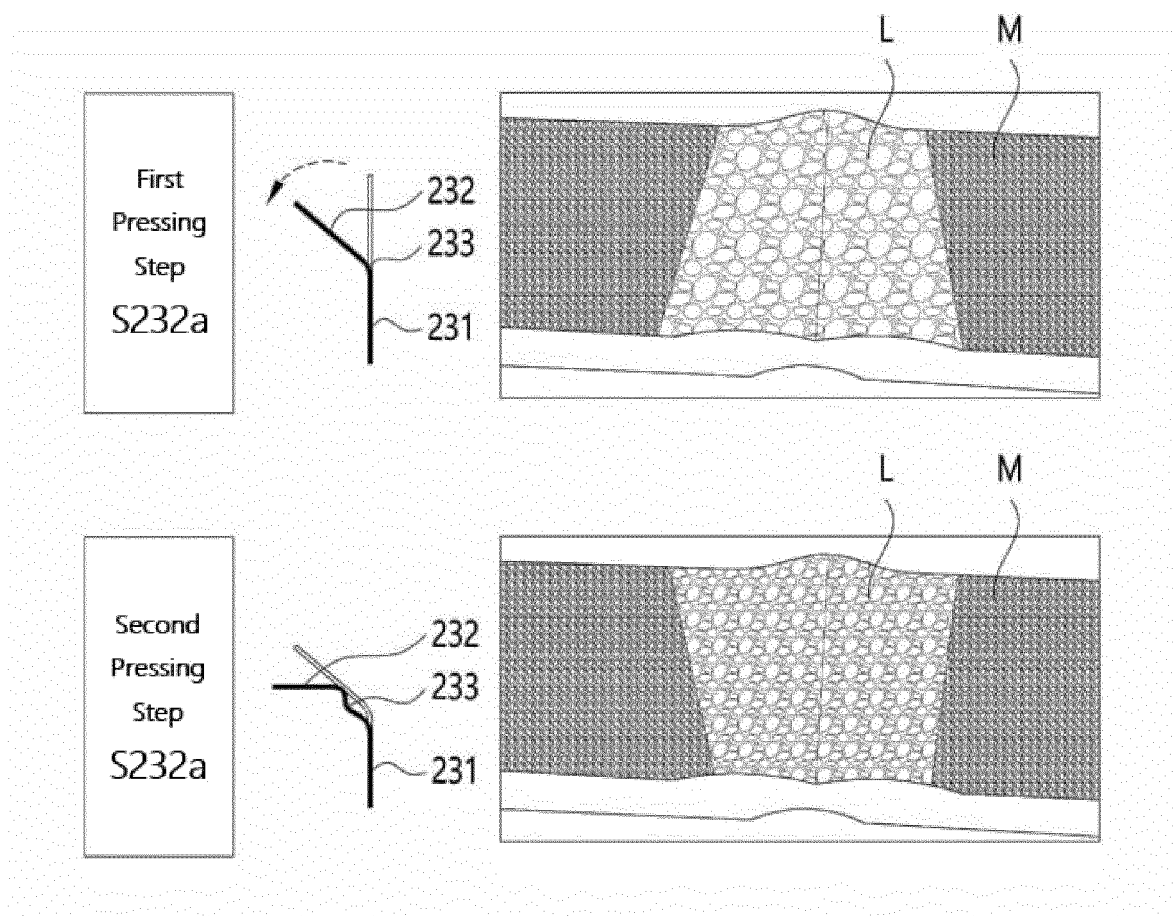
【FIG. 23】



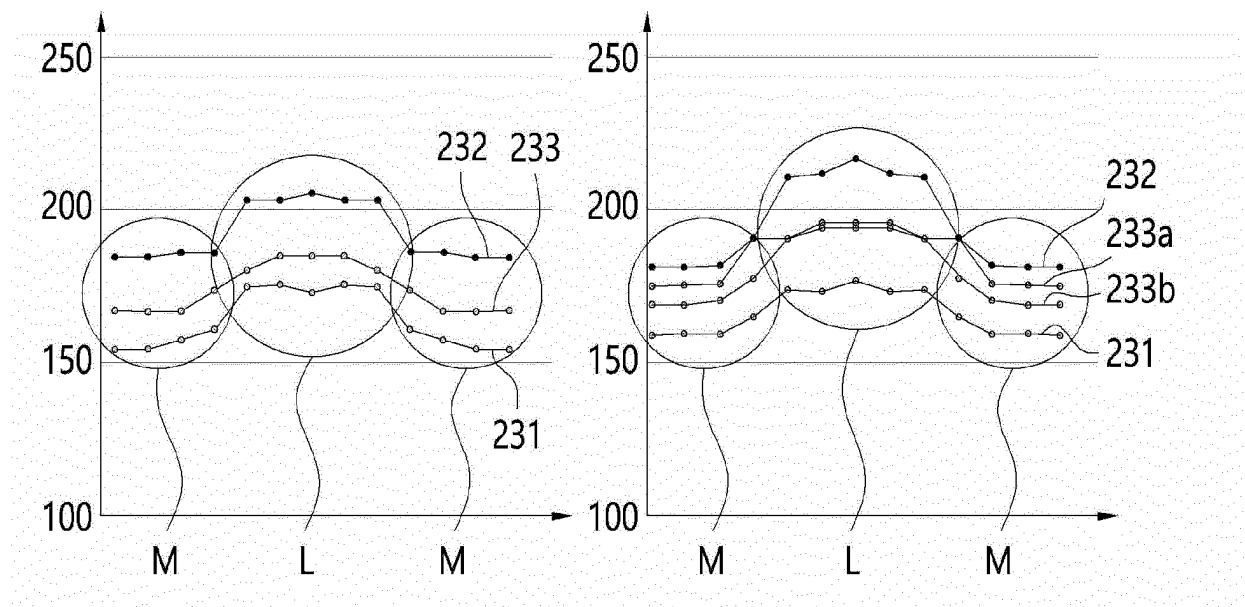
【FIG. 24】



【FIG. 25】



【FIG. 26】



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2023/006502

A. CLASSIFICATION OF SUBJECT MATTER

D06F 37/26(2006.01)i; **D06F 39/12**(2006.01)i; **D06F 58/06**(2006.01)i; **D06F 58/04**(2006.01)i; **D06F 58/20**(2006.01)i;
B21D 51/18(2006.01)i; **B23K 26/02**(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D06F 37/26(2006.01); B21D 19/08(2006.01); B21D 51/00(2006.01); B21D 51/16(2006.01); D06F 37/04(2006.01);
D06F 58/04(2006.01); D06F 58/06(2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models: IPC as above
Japanese utility models and applications for utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS (KIPO internal) & keywords: 세탁기(washing machine), 드럼(drum), 용접(welding), 프레스(press), 스크래치
(scratch)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-2019-0128490 A (LG ELECTRONICS INC.) 18 November 2019 (2019-11-18) See paragraphs [0025]-[0031], [0114], [0129], [0153]-[0157] and [0184] and figures 1-5.	1-14
Y	WO 2019-096484 A1 (ARCELIK ANONIM SIRKETI) 23 May 2019 (2019-05-23) See paragraph [0023] and figures 1-4.	1-6,14
Y	JP 11-147147 A (RINNAI CORP.) 02 June 1999 (1999-06-02) See paragraphs [0017]-[0018] and [0025] and figures 1-4.	7-14
A	KR 10-0686061 B1 (LG ELECTRONICS INC.) 22 February 2007 (2007-02-22) See figures 1-2.	1-14
A	WO 2015-155008 A1 (BSH HAUSGERÄTE GMBH) 15 October 2015 (2015-10-15) See figures 4-6.	1-14

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"D" document cited by the applicant in the international application	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"E" earlier application or patent but published on or after the international filing date	"&" document member of the same patent family
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 07 September 2023	Date of mailing of the international search report 07 September 2023
Name and mailing address of the ISA/KR Korean Intellectual Property Office Government Complex-Daejeon Building 4, 189 Cheongsaro, Seo-gu, Daejeon 35208	Authorized officer
Facsimile No. +82-42-481-8578	Telephone No.

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2023/006502

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Claims 1-6 pertain to a clothes treatment device comprising: a cabinet; a drum having a drum body and a drum front part; a front plate; and a support wheel, wherein a metal plate is welded to the drum front part such that a welding line is provided,

Claims 7-14 pertain to a clothes treatment device comprising: a cabinet; a drum having a drum body and a drum front part; a front plate; and a support wheel, wherein a scratch is formed on the drum front part in the front-back direction or in the thickness direction.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

- Remark on Protest**
- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
 - ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
 - ☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2023/006502

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
KR 10-2019-0128490 A	18 November 2019	None	
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		EP 3710241 B1	12 July 2023
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KR 10-0686061 B1	22 February 2007	US 2007-0214630 A1	20 September 2007
WO 2015-155008 A1	15 October 2015	CN 106460289 A	22 February 2017
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		DE 102014206637 A1	08 October 2015
		EP 3129171 A1	15 February 2017
		EP 3129171 B1	28 February 2018
		ES 2665352 T3	25 April 2018
		PL 3129171 T3	31 July 2018

Form PCT/ISA/210 (patent family annex) (July 2022)