(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 889 340 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
06.10.2021 Bulletin 2021/40

(21) Application number: **19890726.3**

(22) Date of filing: **28.11.2019**

(51) Int Cl.:
D06F 58/04 *(2006.01)* ***D06F 58/20*** *(2006.01)*

(86) International application number:
PCT/KR2019/016580

(87) International publication number:
WO 2020/111817 (04.06.2020 Gazette 2020/23)

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

(30) Priority: **30.11.2018 KR 20180152885**
30.10.2019 KR 20190136803

(71) Applicant: **LG Electronics Inc.**
Seoul 07336 (KR)

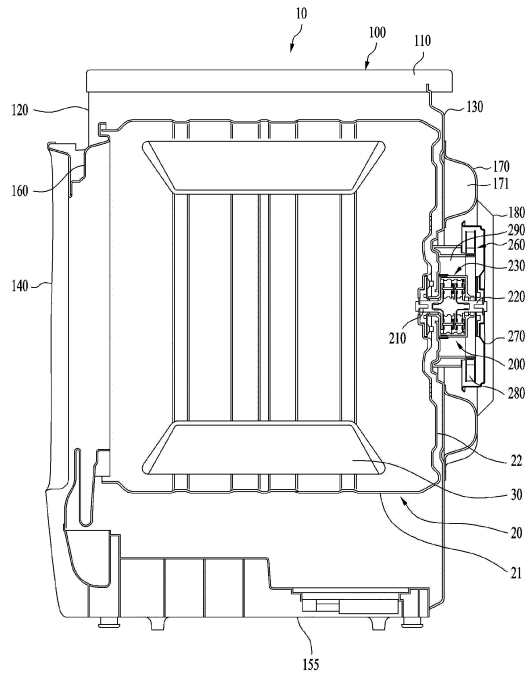
(72) Inventors:
- **BAE, Sanghun**
  Seoul 08592 (KR)
- **CHO, Hongjun**
  Seoul 08592 (KR)
- **KIM, Hyeonjoong**
  Seoul 08592 (KR)

(74) Representative: **Vossius & Partner**
Patentanwälte Rechtsanwälte mbB
Siebertstraße 3
81675 München (DE)

(54) DRYER

(57) The present application relates to a dryer comprising: a case forming the exterior thereof; a drum which is provided inside the case and which accommodates an object to be dried; and a driving part which is provided so as to drive the drum and which includes a motor having a stator and a rotor, wherein the case includes a rear case forming the exterior of the rear part of the dryer, the rotor is supported to be coaxially rotatable with a rotational axis of the drum with respect to the rear case on the outer side of the rear case, and the stator is fixed to the rear case on the outer side of the rear case.

[Fig. 1]



EP 3 889 340 A1

Description

TECHNICAL FIELD

[0001] The present disclosure relates to a dryer, and more particularly, to a dryer to a dryer for drying an object inside a rotating drum.

BACKGROUND ART

[0002] A dryer is a device for drying an object, and may be referred to as a device for drying an object by supplying hot air to the inside of an object receiving unit.

[0003] A drum dryer having an object receiving unit formed in a cylindrical drum shape so as to supply hot air into a drum by rotating the drum is popularly used. Particularly, a home dryer popularly includes a drum dryer that rotates with reference to a horizontal axis approximately.

[0004] A motor for rotating a drum is used for such a drum dryer, and a driving force of the motor is transferred to the drum through a power transfer part such as a belt and the like so as to rotate the drum. A rotation axis of the motor is generally different from that of the drum, which may be called a belt type.

[0005] Therefore, power loss may occur due to the power transfer part such as the belt and the like, and a separate space needs to be provided within a case to install the motor and the power transfer part such as the belt.

[0006] Most of drum washers produced recently include drum type washers of a direct-connection (or direct-drive) type that is not a belt type. The direct connection type means a type that a rotation axis of a motor and a rotation axis of a drum are coaxially configured, and a stator of the motor is generally mounted on a rear (or bottom) wall of a tub. A motor generally used for a washer is referred to as a Direct Drive (DD) motor, and such a washer is called a DD washer.

[0007] Compared to a belt type, a direct drive has various advantages. For example, a drum drive RPM and a drum torque can be controlled in a manner of being variously changed in various environments. In addition, a drum rotation direction control, a drum rotation angle control and the like can be further facilitated. In addition, as power loss is reduced to save energy advantageously.

[0008] Of course, in case of a washer & dryer (referred to as 'combo'), as a tub is provided, a direct drive type is applicable. Yet, in case of a dryer having a dryer function only, as there is no configuration corresponding to a tub, implementation of a direct-drive type dryer is not facilitated. Namely, it is not easy to apply a direct drive type to a dryer despite that the direct drive type has various advantages in comparison to a belt type.

[0009] Meanwhile, disclosed in JP1982-124674 or KR291966 is a dryer having a rotor directly connected to a rotation shaft for driving a drum. However, those prior patents disclose that a motor provided within a fan casing is supported by the fan casing or that a motor provided within a fan casing is supported through a separate configuration. Therefore, the structure of a drive unit is complex and it is not easy to support a motor stably.

DISCLOSURE

TECHNICAL TASKS

[0010] An object of the present disclosure is to provide a Direct Drive (DD) dryer.

[0011] An object of one embodiment of the present disclosure is to provide a dryer capable of stably supporting a motor in a manner of installing a motor in a rear case forming and supporting a rear exterior of the dryer. Namely, it is intended to provide a stable dryer that minimizes an additional configuration in a manner of installing a motor in a rear case that is one of structural frames forming and supporting an exterior of the dryer.

[0012] An object of one embodiment of the present disclosure is to provide a DD dryer capable of applying a circulation flow path of air for drying.

[0013] An object of one embodiment of the present disclosure is to provide a dryer having a fan motor for circulating air and a motor separated from the fan motor so as to drive a drum, thereby providing a large airflow amount by individually controlling an RPM of a drum and an RPM of a fan and also effectively broadening a variable airflow amount region.

[0014] An object of one embodiment of the present disclosure is to provide a dryer capable of reducing air flow resistance in a manner of preventing flow resistance from being generated by a motor isolated from a circulation flow path of air for drying.

[0015] An object of one embodiment of the present disclosure is to provide a DD dryer capable of employing a flow path structure that dry air flows in through a rear side of a drum and that air is discharged from a front side of the drum.

[0016] An object of one embodiment of the present disclosure is to provide a DD dryer capable of securing a space within a case and increasing degree of freedom in flow path design by disposing a motor in a space outside a case instead of an inner space of the case in which a drum is installed.

[0017] An object of one embodiment of the present disclosure is to provide a DD dryer capable of driving a motor with optimal motor efficiency on an optimal motor efficiency band despite a difference between a drum rotation band of the dryer and an optimal efficiency band of the motor.

[0018] An object of one embodiment of the present disclosure is to provide a DD dryer capable of improving drying efficiency by increasing an area for enabling air to flow into a drum.

[0019] An object of one embodiment of the present disclosure is to provide a dryer for enabling hot air to flow into a drum in three dimensions in a manner that the hot

air is led to flow into the drum through a donut-shape area except central and outer portions of a drum rear wall. Namely, it is intended to provide a dryer capable of increasing hot air and a heat transfer area of a drying object in a manner of supplying hot air in a cylindrical shape having a vacant center.

[0020] An object of one embodiment of the present disclosure is to provide a DD dryer capable of preventing enlargement of a front-rear width of a dryer or reduction of a drum volume in a manner of forming a compact size of a power transfer part between a drum and a motor.

[0021] An object of one embodiment of the present disclosure is to provide a DD dryer capable of minimizing the front-rear length increase of a drive part and stably fixing a stator and a decelerator to a rear case through a connector having one side coupled to the stator so as to overlap in a front-rear direction of the dryer and the other side coupled to the decelerator so as to overlap in the front-rear direction of the dryer.

[0022] An object of one embodiment of the present disclosure is to provide a DD dryer capable of protecting a rear case in a manner that a repulsive force generated from a stator and decelerator is transferred to a connector instead of being directly transferred to the rear case. Particularly, it is intended to provide a DD dryer capable of facilitating the stamping coupling of the stator and decelerator by forming a connector by injection molding and also cancelling out the repulsive force transferred from the stator and decelerator autonomously.

[0023] An object of one embodiment of the present disclosure is to provide a DD dryer that can be manufactured with ease. Particularly, it is intended to provide a DD dryer of which manufacturing is facilitated by skipping a step of coupling a decelerator and a stator to a rear case in a manner of coupling a connector to the rear case.

[0024] An object of one embodiment of the present disclosure is to provide a DD dryer capable of facilitating the accurate location and rotation speed controls of a drum by directly driving the drum through a motor, enabling the implementation of various drum motions by reducing the inaccuracy and abrasivity due to the slip of a belt, and reducing power loss by implementing an optimal drum RPM.

[0025] An object of one embodiment of the present disclosure is to provide a DD dryer capable of preventing volume reduction of a drum due to the thickness increase of a decelerator by applying an outer diameter increase instead of a thickness increase for the gear strength reinforcement of the decelerator.

[0026] An object of one embodiment of the present disclosure is to provide a dryer capable of reducing a power loss due to the rotation support of a drum by excluding a rear supporter rotatably supporting a rear side of the drum in a manner of contacting with the rear side of the drum despite having a front supporter rotatably supporting a front side of the drum in a manner of contacting with the front side of the drum.

TECHNICAL SOLUTIONS

[0027] In one technical aspect of the present disclosure, provided is a dryer including a case forming an appearance, a drum provided within the case to receive a drying object therein, and a drive unit configured to drive the drum and including a motor having a stator and a rotor, wherein the case may include a rear case forming to support a rear appearance of the dryer, wherein the rotor may be supported on an outside of the rear case in a manner of being coaxially rotatable to the rear case on a rotation axis of the drum, and wherein the stator may be fixed to the rear case on the outside of the rear case.

[0028] The drive unit may include a power transfer unit transferring a rotation force of the rotor to the drum and the power transfer unit may be provided between the rotor and the drum. The power transfer unit may preferably transfer power so that the rotor and the drum can have the same axis.

[0029] Preferably, the motor may include an outer rotor type motor having the rotor provided to be rotatable on a radial outside of the stator. The outer rotor type motor may use a motor used for a conventional washer.

[0030] Preferably, the stator having a hollow part provided to a radial inside may be fixed to an outside of the rear case. At least one portion of the power transfer unit may be inserted in the hollow part, thereby preventing a front-rear distance of the power transfer unit or the drive unit from being increased.

[0031] The dryer may include a connector provided between the stator and the rear case to fix the stator to the rear case and form a front-rear space between the stator and the rear case. Through the connector, the stator may be solidly fixed to the rear case and the rotor may rotate without interfering with the rear case.

[0032] A portion of the connector may be inserted in the hollow part of the stator. Therefore, the stator may be fixed to the connector more solidly by stamping.

[0033] Preferably, the connector may have a hollow part provided to a radial inside. A prescribed configuration of the power transfer unit is inserted in the hollow part, thereby preventing a front-rear length of the power transfer unit and the drive unit from being increased.

[0034] The power transfer unit may include a decelerator transforming high-RPM low-torque of the rotor into low-RPM high-torque of the drum and at least one portion of the decelerator may be preferably located by being inserted in the hollow part of the connector.

[0035] The power transfer unit may include a drum shaft connected to a rear side of the drum, a rotor shaft connected to the rotor, and a decelerator provided between the drum shaft and the rotor shaft.

[0036] A shaft perforated hole perforated by the drum shaft may be formed in the rear case.

[0037] The decelerator may include a housing and a transforming device provided within the housing to transform high-RPM low-torque of the rotor into low-RPM high-torque of the drum. The transforming device may include

a plurality of gears.

[0038] The housing of the decelerator may be fixed to an outside of the rear case. The decelerator housing may be directly fixed to the rear case.

[0039] The decelerator housing may be first fixed to the connector. Thereafter, the connector may be directly fixed to the rear case. The connector may be configured to enclose the decelerator housing. In this case, at a point having a greater radius in the shaft perforated hole, the connector may be fixed to the rear case. Hence, it is more preferable that the decelerator housing may be fixed to the rear case through the connector instead of being directly coupled to the rear case.

[0040] The housing of the decelerator may include a drum shaft perforated hole projected in prescribed length in front direction to be perforated by the drum shaft and having a bearing installed inside to support the drum shaft rotatably and a rotor shaft perforated hole projected in prescribed length in rear direction to be perforated by the rotor shaft and having a bearing installed inside to support the rotor shaft rotatably.

[0041] Preferably, the drum shaft perforated hole may be located by being inserted in the shaft perforated hole of the rear case and the rotor shaft perforated hole may be located in a hollow part formed in a radial inside of the stator.

[0042] Through the above perforated holes, sufficient support can be performed as well as bearing support points of the rotating shafts are secured. Moreover, positions of the perforated holes may substantially include a space between the drum rear wall and the rear case and an inner space of the stator. Therefore, the front-rear length of the power transfer unit or the drive unit may be prevented from increasing. Namely, a compact power transfer unit or a compact drive unit may be implemented.

[0043] The decelerator may include a first sun gear rotating with the rotor shaft as an integral part, a ring gear, a plurality of first planet gears provided between the ring gear and the first sun gear, and a first carrier rotatably supporting a plurality of the first planet gears.

[0044] Power of the rotor shaft may be transformed into a first stage on the first carrier.

[0045] The first sun gear is located in front of the rotor shaft and may be formed with the rotor shaft as an integral part.

[0046] The decelerator may include a second sun gear rotating with the first carrier as an integral part, a ring gear, a plurality of second planet gears provided between the ring gear and the second sun gear, and a second carrier rotatably supporting a plurality of the second planet gears and rotating with the drum shaft as an integral part.

[0047] Power of the rotor shaft may be transformed into a second state on the second carrier.

[0048] The second carrier may be located in rear of the drum shat and be formed with the drum shaft as an integral part.

[0049] The first carrier may be formed with the second sun gear as an integral part.

[0050] The decelerator may include a middle shaft extended from the first carrier in rear direction, extended from the second sun gear in the front direction, and forming a co-axis between the drum shaft and the rotor shaft.

[0051] The first carrier, the second sun gear and the middle shaft may be formed as an integral part.

[0052] Preferably, one end of the middle shaft may be supported to enable independent rotation on a co-axis with the rotor shaft within the rotor shaft through a bearing, and the other end of the middle shaft may be supported to enable independent rotation on a co-axis with the drum shaft within the drum shaft through a bearing.

[0053] Preferably, a ring gear for the first stage transform and a ring gear for the second stage transform may include a single ring gear.

[0054] Preferably, the first stage transform ratio and the second stage transform ratio may be set equal to each other. Hence, implementation of a very compact decelerator is possible. A 2-stage planet gear decelerator may be implemented.

[0055] A plurality of the gears may include a single ring gear, a first sun gear rotating with the rotor shaft as an integral part on an inner rear side of the ring gear, a plurality of first planet gears provided between the ring gear and the first sun gear, a first carrier rotatably supporting a plurality of the first planet gears, a second sun gear rotating with the first carrier as an integral part, a plurality of second planet gears provided between the ring gear and the second sun gear, and a second carrier rotating with the drum shaft as an integral part on an inner front side of the ring gear, and a plurality of the gears may preferably include a helical gear.

[0056] Preferably, the first planet gear and the second planet gear may have the same radius and a height (or thickness) of the second planet gear may be greater than that of the first planet gear.

[0057] Preferably, a front-rear width of the gears for the second stage transform is greater than that of the gears for the first stage transform.

[0058] A shaft perforated hole perforated by a drum shaft connected to the drum to transfer power of the rotor to the drum may be formed in the rear case and an installation area for installation of the drive unit may be formed on a radial outside centering on the shaft perforated hole in the rear case.

[0059] An air supply area for supplying air into the drum may be formed in the rear case and the air supply area may be formed on a radial outside of the installation area centering on the installation area.

[0060] An air intake area for sucking air from the drum may be formed in the rear case and the air intake area may be formed on a radial outside of the air supply area.

[0061] The air intake area may be formed in a manner of excluding a radial central portion and a most outer portion from the rear wall of the drum. Hence, hot air may be evenly supplied to the whole drum. Particularly, as the air supply area can be increased, deviation for an air

flow speed can be significantly reduced toward a front side from the drum rear wall. Therefore, uniform drying can be performed.

[0062] Preferably, the dryer may include a flow path duct coupled to the rear case on an outside of the rear case so as to form an air flow space with the rear case in between by covering the air intake area and the air supply area. Namely, a prescribed section for supplying air into the drum may be preferably provided to a rear case outside, i.e., a case outside through the flow path duct.

[0063] Preferably, the flow path duct may include an inner coupling part coupled to the rear case between the installation area and the air supply area of the rear case, an outer coupling part coupled to the rear case by enclosing both of the air supply area and the air intake area of the rear case, and an extension part forming an air flow space by being extended in rear direction of the rear case between the inner coupling part and the outer coupling part.

[0064] Therefore, the air flowing into the flow path duct from a bottom of one side of the rear case may flow into the drum through the flow path duct with a very wide area except center and rim portions of the drum.

[0065] To cover the drive unit exposed to an outside of the dryer from a radial inside of the inner coupling part, a drive unit cover coupled to the flow path duct in rear of the flow path duct to cover the inner coupling part may be included.

[0066] Preferably, a plurality of openings for letting air to flow in or out of a space for receiving the power transfer unit may be formed in the drive unit cover. The power transfer unit may be cooled down by letting air at low temperature to enter the power transfer unit, and air at the relatively high temperature may be discharged. Namely, cooling can be performed through natural convection generated from temperature difference. Particularly, if a rotor is provided to the power transfer unit, air can be forced to flow by rotation of the rotor. Such air flow may include air inflow through the opening in the drive unit cover and air discharge through another opening in the drive unit cover.

[0067] A wire draw-out hole for drawing out a wire from an inside of the dryer case to an outside may be formed in a top portion of the rear case, and the wire may be connected to the stator by being extended to the installation area of the rear case through an outside of the flow path duct.

[0068] A wire cover covering the wire may be provided to an outside of the rear case.

[0069] A seat part having the wire cover seated thereon may be formed on the flow path duct in a manner of being recessed in front direction, and both ends of the wire cover may be coupled to the rear case.

[0070] A wire cover coupling area for coupling one end of the wire cover may be formed between the installation area and the air supply area of the rear case.

[0071] Preferably, an installation area confronting the installation area of the rear case and an air intake area confronting the air supply area of the rear case may be formed in a rear wall of the drum.

[0072] The dryer may include a gasket provided between the rear case and the rear wall of the drum to enable air supplied from the air supply area of the rear case to flow into the air intake area of the drum.

[0073] The gasket may include an inner gasket provided between the rear case and the rear wall of the drum to prevent air from leaking through a radial inside of the drum rather than the air intake area of the drum and an outer gasket provided between the rear case and the rea wall of the drum to prevent air from leaking through a radial outside of the drum rather than the air intake area of the drum.

[0074] The inner gasket may include an extension part slantly extending toward the radial inside and the rear wall of the drum, and the outer gasket may include an extension part slantly extending toward the radial outside and the rear wall of the drum.

[0075] The gasket may be preferably provided to be fixed to an inside of the rear case and then extended toward the drum. Namely, the gasket may be preferably mounted on the fixed rear case instead of the rotating drum.

[0076] Preferably, a blower fan for enabling air to flow into the flow path duct and a heating part for heating the air flowing into the flow path duct may be provided to an inner space of the case. The heating part may be implemented using a heat pump. Through the heat pump, air may be heated and moisture in the air may be condensed.

[0077] The heated air is guided into the flow path duct, which is a drying outside, by the blower fan. The heated air enters the drum from the rear side of the drum through the flow path duct. The air heat-exchanged in the drum is discharged through the front side of the drum. The discharged humid air is changed into dry air in a manner of being cooled in an evaporator of the heat pump to condense moisture, and the dry air is headed in a condenser of the heat pump. The heated air enters the drum again. Thus, an air circulation structure may be configured.

[0078] In another technical aspect of the present disclosure, provided is a dryer including a rear case forming a rear appearance of the dryer, a drum provided in front of the rear case to receive a drying object therein, a motor including a stator fixed to the rear case on a rear outside of the rear case and a rotor rotatably supported to the rear case on the rear outside of the rear case and configured to rotate on a radial outside of the stator, and a flow path duct fixed to the rear case by being located on a circumference of the motor on the rear outside of the rear case and configured to guide hot air flowing from a front side of the rear case to an inside of the drum.

[0079] In another technical aspect of the present disclosure, provided is a dryer including a rear case forming a rear appearance of the dryer, a drum provided in front of the rear case to receive a drying object therein, a power

transfer unit configured to drive the drum and fixed rotatably to the rear case on a rear outside of the rear case, and a flow path duct fixed to the rear case by being located on a circumference of the drive unit on a rear outside of the rear case and configured to guide hot air flowing from a front side of the rear case to an inside of the drum.

[0080] The power transfer unit is located to correspond to a rotation center part of the drum, whereby hot air may be supplied to a radial outside of the rotation center part of the drum via the flow path duct. Namely, hot air may be supplied into the drum in form of donut. Through this, a three-dimensional and large air volume may be supplied into the drum.

[0081] The rear case and the flow path duct are coupled to each other, thereby forming an air flow space inside. Therefore, one portion of the rear case may form one portion of the duct. Namely, the flow path duct may form the air flow space with the rear case in between. Hence, a flow path duct having an open front side is closely coupled to the rear case, thereby forming a duct with ease.

[0082] The flow path duct may include an inner coupling part coupled to the rear case, an outer coupling part coupled to the rear case on an outside of the inner coupling part, and an extension part extended in rear direction of the rear case between the inner coupling part and the outer coupling part to form an air flow space.

[0083] In rear of the rear case, a space having the motor provided therein and the air flow space may be preferably partitioned by the flow path duct. Namely, the space having the motor provided therein is isolated from an inner space of the flow path duct by the flow path duct and the rear case. Therefore, air flow resistance by the motor is not generated.

[0084] The inner coupling part may be coupled to the rear case on a radial outside of the stator or the rotor.

[0085] Therefore, the flow path duct may have a donut shape enclosing an installation space of the motor. Of course, a prescribed portion of the donut shape may be modified.

[0086] To cover the drive unit exposed to an outside of the dryer on a radial inside of the inner coupling part, a drive unit cover coupled to the flow path duct in rear of the flow path duct may be preferably included. Namely, a center portion in a donut shape is preferably covered through the drive unit cover. Hence, it is able to prevent the rotating rotor and the wire connected stator from being exposed to a n outside of the dryer.

[0087] In the rear case, an air supply area for supplying air to the drum inside and an air intake area for sucking air from the drum inside are preferably formed. Namely, air passes through the above areas from a front side of the rear case to a rear side of the rear case, *and vice versa.* Here, the front side of the rear case may mean an inner space of the dryer enclosed by the case.

[0088] The air intake area may be formed on a radial outside of the air supply area. When the air supply area substantially corresponds to top, bottom, right, left and center portions of the rear case, the air intake area may be formed at a left bottom portion of the rear case.

[0089] Namely, the air discharged from the dryer inside through the left bottom portion of the rear case may flow in right top direction along an inside of the flow path duct and be then supplied into the drum.

[0090] The flow path duct may be configured to cover both of the air intake area and the air supply area. Hence, the donut-shaped flow path duct may have a shape having one portion extended to the left bottom portion of the rear case.

[0091] A blower fan for generating an air flow and a heating part for heating air may be included. The blower fan and the heating part may be located on a front side of the rear case, i.e., within the case. Hence, configurations for air heating and flow generation are not provided to the rear side of the rear case. Thus, the increase of the degree of flow path design freedom and the simple structure may be implemented.

[0092] Air may pass through from the front side to the rear side of the air intake area of the rear case and then enter the flow path duct. Air may pass through from the rear side to the front side of the air supply area of the rear case and then enter the drum.

[0093] Preferably, in the rear case, a shaft perforated hole perforated by the drum shaft for transferring power of the rotor to the drum be being connected to the drum may be formed and an installation area for installation of the motor may be formed on a radial outside centering on the shaft perforated hole.

[0094] Preferably, the flow path duct is coupled to the rear case on a radial outside of the installation rea, whereby an air flow space within the flow path duct is partitioned into the installation area and the motor.

[0095] An air supply area for supplying air into the drum may be formed in the rear case by being covered with the flow path duct, and an air intake area confronting the air supply area of the rear case may be formed in the rear wall of the drum.

[0096] The air supply area of the rear case may have a donut shape, and the air intake area of the drum confronting the air supply area may have a donut shape as well.

[0097] The air intake area in donut shape may supply 3-dimensional hot air into the drum. Namely, hollow cylindrical hot air may be supplied into the drum. Preferably, the air intake area is not formed in an outer part of the drum rear wall. Through the 3-dimensional cylindrical hot air, a size of heat exchange with a drying object within the drum may be increased effectively.

[0098] Preferably, to enable the air, which is supplied from the air supply area of the rear case, to flow into the air intake area of the drum, a gasket provided between the rear case and the rear wall of the drum is included.

[0099] The gasket may include an inner gasket provided to prevent air from leaking toward a radial inside rather than the air intake area of the drum between the rear

case and the rear wall of the drum and an outer gasket provided to prevent air from leaking toward a radial outside rather than the air intake area of the drum between the rear case and the rear wall of the drum.

[0100] Therefore, it is able to prevent hot air from leaking externally between the drum and the rear case and also flowing into the decelerator or motor.

[0101] Preferably, the inner gasket includes an extension part extended slantly toward a radial inside and the rear wall of the drum and the outer gasket includes an extension part extended slantly toward a radial outside and the rear wall of the drum.

[0102] Through such extension parts, sealing efficiency can be raised and friction and damage of the gasket can be minimized.

[0103] A wire draw-out hole for drawing a wire from a front side to a rear side is formed in a top portion of the rear case, and the wire is preferably connected to the motor by being extended to the installation area of the rear case through an outside of the flow path duct.

[0104] After the motor and the flow path duct have been installed on the rear case, wire connection can be performed easily and the wire can be protected through a wire cover. After the wire cover has been installed, a drive unit cover may be coupled to the flow path duct or the rear case.

[0105] In another technical aspect of the present disclosure, provided is a dryer a including a case forming an appearance of the dryer, a drum provided within the case to receive a drying object therein, a drive unit including a motor having a stator and a rotor to drive the drum, and a flow path duct enabling air sucked from an inside of the drum to flow in the inside of the drum, wherein the case may include a rear case forming a rear appearance of the dryer and having an installation area of a power transfer unit transferring a drive force to the drum, an air intake area and an air supply area, wherein the power transfer unit may be installed in the installation area in rear of the rear case, and wherein the flow path duct may be coupled to the rear case by covering the air intake area and the air supply area except the installation area so as to form an air flow space between the flow path duct and the rear case.

[0106] In another technical aspect of the present disclosure, provided is a dryer a including a case forming an appearance, a drum provided within the case to receive a drying object therein, and a drive unit including a motor having a stator and a rotor to drive the drum, wherein the case may include a rear case forming a rear appearance of the dryer, wherein the rotor may be supported on an outside of the rear case to be coaxially rotatable to the rear case on an axis of the drum, and wherein the stator may be fixed to the rear case on the outside of the rear case.

[0107] In another technical aspect of the present disclosure, provided is a dryer including a rear case forming a rear appearance of the dryer, a drum provided in front of the rear case to receive a drying object therein, a motor including a stator fixed to the rear case on a rear outside of the rear case and a rotor rotatably supported to the rear case on the rear outside of the rear case and configured to rotate on a radial outside of the stator, a rotor shaft rotating with the rotor as an integral part and extended from a rear wall of the drum in rear direction of the rear case by perforating the rear case, a drum shaft rotating with the drum as an integral part, and a decelerator performing power transform between the rotor shaft and the drum shaft and including a middle shaft coaxially connected to the rotor shaft and the drum shaft.

[0108] As the middle shaft is inserted in a hollow part of the drum shaft and a hollow part of the rotor shaft, the three shafts may be configured coaxially. As the three shafts are connected by simple insertion, a manufacturing process may be significantly facilitated.

[0109] The drum shaft, the decelerator and the rotor shaft may be manufactured and handled as a single assembly. The drum shaft and the drum may be coupled within the rotor, and the rotor shaft and the rotor may be coupled on the rear outside of the rotor. Therefore, the coupling of the drum, drum shaft, decelerator, rotor shaft and rotor can be performed very easily.

[0110] The rotor shaft, the drum shaft and the middle shaft may be formed individually and connected sequentially for power transfer. Preferably, such coupling positions are located within the housing of the decelerator. Therefore, through the housing of the decelerator, disconnection between shafts may be prevented.

[0111] The rotor shaft and the middle shaft may be connected to be independently rotated through a bearing, and the drum shaft and the middle shaft may be connected to be independently rotated through a bearing.

[0112] The stator may have a hollow part in a radial inside and be fixed to a rear outside of the rear case.

[0113] Preferably, the dryer includes a connector provided between the stator and the rear case to fix the stator to the rear case and forming a front-rear space between the stator and the rear case.

[0114] A portion of the connector may be inserted in the hollow part of the stator. Namely, the stator and the connector may be coupled together so as to overlap each other in front-rear direction of the dryer. Through this, the increase of the front-rear length of the drive unit may be minimized. And, coupling strength may be further raised through the stamping coupling of the stator and the connector.

[0115] The connector may have a hollow part in a radial inside.

[0116] The decelerator may include the housing and the middle shaft, and also include a transforming device provided within the housing to transform high-RPM low-torque of the rotor into low-RPM high-torque of the drum.

[0117] At least one portion of the decelerator may be located by being inserted in the hollow part of the connector. Namely, at least one portion of the decelerator housing may be inserted in the hollow part of the connector. Hence, the decelerator and the connector may

be coupled together to overlap each other in front-rear direction of the dryer. Through this, the front-rear length increase of the drive unit can be minimized. In addition, through the stamping coupling of the decelerator and connector, coupling strength can be further raised.

[0118] The housing of the decelerator may be provided to be fixed to an outside of the rear case.

[0119] The connector may be coupled and fixed to the rear side of the rear case. The decelerator housing and the stator may be coupled and fixed to the connector. Hence, the decelerator housing and the stator may be indirectly fixed to the rear case through the connector. Namely, after the decelerator housing and the stator have been coupled and fixed to the connector, the connector may be coupled and fixed to the rear housing. Thus, it is able to skip a process and coupling components (e.g., studs, bolts or screws) for coupling and fixing the decelerator housing and the stator to the rear case.

[0120] Therefore, a repulsive force generated from the decelerator and the stator may be transferred to the connector without being transferred to the rear case directly. Through this, the rear case can be protected.

[0121] The connector may be formed by injection molding. The connector may be formed with plastics, and more particularly, with engineering plastics. The repulsive force may be self-cancelled owing to material properties. As shape forming is facilitated, the stamping structure of the stator and decelerator can be formed very precisely.

[0122] The transforming device may include a first sun gear rotating with the rotor shaft as an integral part, a ring gear, a plurality of planet gears provided between the ring gear and the first sun gear, and a first carrier rotatably supporting a plurality of the first planet gears, and power of the rotor shaft may be transformed into a first stage on the first carrier.

[0123] Preferably, the first sun gear is located in front of the rotor shaft and formed with the rotor shaft as an integral part.

[0124] The transforming device may include a second sun gear rotating with the first carrier as an integral part, a ring gear, a plurality of second planet gears provided between the ring gear and the second sun gear, and a second carrier rotatably supporting a plurality of the second planet gears and rotating with the drum shaft as an integral part, and power of the rotor shaft may be transformed into a second stage on the second carrier.

[0125] Preferably, the second carrier is located in rear of the drum shaft and formed with the drum shaft as an integral part.

[0126] Preferably, the first carrier is formed with the second sun gear as an integral part.

[0127] The middle shaft may be formed in a manner of being extended from the first carrier in rear direction and extended from the second sun gear in front direction.

[0128] Preferably, the first carrier, the second sun gear and the middle shaft are formed as an integral part.

[0129] One end of the middle shaft may be supported within the rotor shaft to enable independent rotation on a same axis of the rotor shaft through a bearing, and the other end of the middle shaft may be supported within the drum shaft to enable independent rotation on a same axis of the drum shaft through a bearing.

[0130] The decelerator may include a 2-stage gear decelerator, and a first stage transform ratio and a second stage transform ratio may be set equal to each other.

[0131] The decelerator may include a single ring gear, a first sun gear rotating with the rotor shaft as an integral part on an inner rear side of the ring gear, a plurality of first planet gears provided between the ring gear and the first sun gear, a first carrier rotatably supporting a plurality of the first planet gears, a second sun gear rotating with the first carrier as an integral part, a plurality of second planet gears provided between the ring gear and the second sun gear, and a second carrier rotating with the drum shaft as an integral part on an inner front side of the ring gear

[0132] Preferably, the first planet gear and the second planet gear may have the same radius and a height (or thickness) of the second planet gear may be greater than that of the first planet gear.

[0133] In another technical aspect of the present disclosure, provided is a dryer including a rear case forming and supporting a rear appearance of the dryer, a rum provided in front of the rear case to receive a drying object therein, a motor provided to drive the drum and including a stator having a hollow part and a rotor provided to rotate on a radial outside of the stator, a connector having one side coupled to the stator by being inserted in the hollow part of the stator and the other side coupled to the rear case in rear direction of the rear case and having a hollow part, and a decelerator coupled to the connector by being inserted in the hollow part of the connector and configured to transform and transfer power of the rotor to the drum.

[0134] In further technical aspect of the present disclosure, provided is a dryer including a case forming an appearance, a drum provided within the case to receive a drying object therein, and a drive unit configured to drive the drum and including a motor having a stator and a rotor, wherein the case may include a rear case forming to support a rear appearance of the dryer, wherein the rotor may be supported on an outside of the rear case in a manner of being coaxially rotatable to the rear case on a rotation axis of the drum, and wherein the stator may be fixed to the rear case on the outside of the rear case.

[0135] The drive unit may include a power transfer unit transferring a rotation force of the rotor to the drum and the power transfer unit may be provided between the rotor and the drum. The power transfer unit may preferably transfer power so that the rotor and the drum can have the same axis.

[0136] The drive unit may include a power transfer unit transferring a rotation force of the rotor to the drum and the power transfer unit may be provided between the rotor and the drum. The power transfer unit may preferably transfer power so that the rotor and the drum can

have the same axis.

[0137] Preferably, the stator having a hollow part provided to a radial inside may be fixed to an outside of the rear case. At least one portion of the power transfer unit may be inserted in the hollow part, thereby preventing a front-rear distance of the power transfer unit or the drive unit from being increased.

[0138] Preferably, the stator having a hollow part provided to a radial inside may be fixed to an outside of the rear case. At least one portion of the power transfer unit may be inserted in the hollow part, thereby preventing a front-rear distance of the power transfer unit or the drive unit from being increased.

[0139] A portion of the connector may be inserted in the hollow part of the stator. Therefore, the stator may be fixed to the connector more solidly by stamping.

[0140] Preferably, the connector may have a hollow part provided to a radial inside. A prescribed configuration of the power transfer unit is inserted in the hollow part, thereby preventing a front-rear length of the power transfer unit and the drive unit from being increased.

[0141] The power transfer unit may include a decelerator transforming high-RPM low-torque of the rotor into low-RPM high-torque of the drum and at least one portion of the decelerator may be preferably located by being inserted in the hollow part of the connector.

[0142] The power transfer unit may include a drum shaft connected to a rear side of the drum, a rotor shaft connected to the rotor, and a decelerator provided between the drum shaft and the rotor shaft.

[0143] A shaft perforated hole perforated by the drum shaft may be formed in the rear case.

[0144] The decelerator may include a housing and a transforming device provided within the housing to transform high-RPM low-torque of the rotor into low-RPM high-torque of the drum. The transforming device may include a plurality of gears.

[0145] The housing of the decelerator may be fixed to an outside of the rear case. The decelerator housing may be directly fixed to the rear case.

[0146] The decelerator housing may be first fixed to the connector. Thereafter, the connector may be directly fixed to the rear case. The connector may be configured to enclose the decelerator housing. In this case, at a point having a greater radius in the shaft perforated hole, the connector may be fixed to the rear case. Hence, it is more preferable that the decelerator housing may be fixed to the rear case through the connector instead of being directly coupled to the rear case.

[0147] The housing of the decelerator may include a drum shaft perforated hole projected in prescribed length in front direction to be perforated by the drum shaft and having a bearing installed inside to support the drum shaft rotatably and a rotor shaft perforated hole projected in prescribed length in rear direction to be perforated by the rotor shaft and having a bearing installed inside to support the rotor shaft rotatably.

[0148] Preferably, the drum shaft perforated hole may be located by being inserted in the shaft perforated hole of the rear case and the rotor shaft perforated hole may be located in a hollow part formed in a radial inside of the stator.

[0149] Through the above perforated holes, sufficient support can be performed as well as bearing support points of the rotating shafts are secured. Moreover, positions of the perforated holes may substantially include a space between the drum rear wall and the rear case and an inner space of the stator. Therefore, the front-rear length of the power transfer unit or the drive unit may be prevented from increasing. Namely, a compact power transfer unit or a compact drive unit may be implemented.

[0150] The decelerator may include a first sun gear rotating with the rotor shaft as an integral part, a ring gear, a plurality of first planet gears provided between the ring gear and the first sun gear, and a first carrier rotatably supporting a plurality of the first planet gears.

[0151] Power of the rotor shaft may be transformed into a first stage on the first carrier.

[0152] The first sun gear is located in front of the rotor shaft and may be formed with the rotor shaft as an integral part.

[0153] The decelerator may include a second sun gear rotating with the first carrier as an integral part, a ring gear, a plurality of second planet gears provided between the ring gear and the second sun gear, and a second carrier rotatably supporting a plurality of the second planet gears and rotating with the drum shaft as an integral part.

[0154] Power of the rotor shaft may be transformed into a second state on the second carrier.

[0155] The second carrier may be located in rear of the drum shat and be formed with the drum shaft as an integral part.

[0156] The first carrier may be formed with the second sun gear as an integral part.

[0157] The decelerator may include a middle shaft extended from the first carrier in rear direction, extended from the second sun gear in the front direction, and forming a co-axis between the drum shaft and the rotor shaft.

[0158] The first carrier, the second sun gear and the middle shaft may be formed as an integral part.

[0159] Preferably, one end of the middle shaft may be supported to enable independent rotation on a co-axis with the rotor shaft within the rotor shaft through a bearing, and the other end of the middle shaft may be supported to enable independent rotation on a co-axis with the drum shaft within the drum shaft through a bearing.

[0160] Preferably, a ring gear for the first stage transform and a ring gear for the second stage transform may include a single ring gear.

[0161] Preferably, the first stage transform ratio and the second stage transform ratio may be set equal to each other. Hence, implementation of a very compact decelerator is possible. A 2-stage planet gear decelerator may be implemented.

[0162] A plurality of the gears may include a single ring

gear, a first sun gear rotating with the rotor shaft as an integral part on an inner rear side of the ring gear, a plurality of first planet gears provided between the ring gear and the first sun gear, a first carrier rotatably supporting a plurality of the first planet gears, a second sun gear rotating with the first carrier as an integral part, a plurality of second planet gears provided between the ring gear and the second sun gear, and a second carrier rotating with the drum shaft as an integral part on an inner front side of the ring gear, and a plurality of the gears may preferably include a helical gear.

[0163] Preferably, the first planet gear and the second planet gear may have the same radius and a height (or thickness) of the second planet gear may be greater than that of the first planet gear.

[0164] Preferably, a front-rear width of the gears for the second stage transform is greater than that of the gears for the first stage transform.

[0165] A shaft perforated hole perforated by a drum shaft connected to the drum to transfer power of the rotor to the drum may be formed in the rear case and an installation area for installation of the drive unit may be formed on a radial outside centering on the shaft perforated hole in the rear case.

[0166] An air supply area for supplying air into the drum may be formed in the rear case and the air supply area may be formed on a radial outside of the installation area centering on the installation area.

[0167] An air intake area for sucking air from the drum may be formed in the rear case and the air intake area may be formed on a radial outside of the air supply area.

[0168] The air intake area may be formed in a manner of excluding a radial central portion and a most outer portion from the rear wall of the drum. Hence, hot air may be evenly supplied to the whole drum. Particularly, as the air supply area can be increased, deviation for an air flow speed can be significantly reduced toward a front side from the drum rear wall. Therefore, uniform drying can be performed.

[0169] Preferably, the dryer may include a flow path duct coupled to the rear case on an outside of the rear case so as to form an air flow space with the rear case in between by covering the air intake area and the air supply area. Namely, a prescribed section for supplying air into the drum may be preferably provided to a rear case outside, i.e., a case outside through the flow path duct.

[0170] Preferably, the flow path duct may include an inner coupling part coupled to the rear case between the installation area and the air supply area of the rear case, an outer coupling part coupled to the rear case by enclosing both of the air supply area and the air intake area of the rear case, and an extension part forming an air flow space by being extended in rear direction of the rear case between the inner coupling part and the outer coupling part.

[0171] Therefore, the air flowing into the flow path duct from a bottom of one side of the rear case may flow into the drum through the flow path duct with a very wide area except center and rim portions of the drum.

[0172] To cover the drive unit exposed to an outside of the dryer from a radial inside of the inner coupling part, a drive unit cover coupled to the flow path duct in rear of the flow path duct to cover the inner coupling part may be included.

[0173] A wire draw-out hole for drawing out a wire from an inside of the dryer case to an outside may be formed in a top portion of the rear case, and the wire may be connected to the stator by being extended to the installation area of the rear case through an outside of the flow path duct.

[0174] A wire cover covering the wire may be provided to an outside of the rear case.

[0175] A seat part having the wire cover seated thereon may be formed on the flow path duct in a manner of being recessed in front direction, and both ends of the wire cover may be coupled to the rear case.

[0176] A wire cover coupling area for coupling one end of the wire cover may be formed between the installation area and the air supply area of the rear case.

[0177] Preferably, an installation area confronting the installation area of the rear case and an air intake area confronting the air supply area of the rear case may be formed in a rear wall of the drum.

[0178] The dryer may include a gasket provided between the rear case and the rear wall of the drum to enable air supplied from the air supply area of the rear case to flow into the air intake area of the drum.

[0179] The gasket may include an inner gasket provided between the rear case and the rear wall of the drum to prevent air from leaking through a radial inside of the drum rather than the air intake area of the drum and an outer gasket provided between the rear case and the rea wall of the drum to prevent air from leaking through a radial outside of the drum rather than the air intake area of the drum.

[0180] The inner gasket may include an extension part slantly extending toward the radial inside and the rear wall of the drum, and the outer gasket may include an extension part slantly extending toward the radial outside and the rear wall of the drum.

[0181] The gasket may be preferably provided to be fixed to an inside of the rear case and then extended toward the drum. Namely, the gasket may be preferably mounted on the fixed rear case instead of the rotating drum.

[0182] Preferably, a blower fan for enabling air to flow into the flow path duct and a heating part for heating the air flowing into the flow path duct may be provided to an inner space of the case. The heating part may be implemented using a heat pump. Through the heat pump, air may be heated and moisture in the air may be condensed.

[0183] The heated air is guided into the flow path duct, which is a drying outside, by the blower fan. The heated air enters the drum from the rear side of the drum through the flow path duct. The air heat-exchanged in the drum

is discharged through the front side of the drum. The discharged humid air is changed into dry air in a manner of being cooled in an evaporator of the heat pump to condense moisture, and the dry air is headed in a condenser of the heat pump. The heated air enters the drum again. Thus, an air circulation structure may be configured.

ADVANTAGEOUS EFFECTS

[0184] According to the present disclosure, a DD dryer may be provided. Particularly, a DD dryer capable of using a DD motor used for a related art washer may be provided.

[0185] According to one embodiment of the present disclosure, it may provide a dryer capable of stably supporting a motor in a manner of installing a motor in a rear case forming and supporting a rear exterior of the dryer.

[0186] The present disclosure may provide a stable dryer that minimizes an additional configuration in a manner of installing a motor in a rear case that is one of structural frames forming and supporting an exterior of the dryer.

[0187] According to one embodiment of the present disclosure, it may provide a DD dryer capable of applying a circulation flow path of air for drying.

[0188] According to one embodiment of the present disclosure, it may provide a dryer having a fan motor for circulating air and a motor separated from the fan motor so as to drive a drum, thereby providing a large airflow amount by individually controlling an RPM of a drum and an RPM of a fan and also effectively broadening a variable airflow amount region.

[0189] According to one embodiment of the present disclosure, it may provide a dryer capable of reducing air flow resistance in a manner of preventing flow resistance from being generated by a motor isolated from a circulation flow path of air for drying.

[0190] According to one embodiment of the present disclosure, it may provide a DD dryer capable of employing a flow path structure that dry air flows in through a rear side of a drum and that air is discharged from a front side of the drum.

[0191] According to one embodiment of the present disclosure, it may provide a DD dryer capable of securing a space within a case and increasing degree of freedom in flow path design by disposing a motor in a space outside a case instead of an inner space of the case in which a drum is installed.

[0192] According to one embodiment of the present disclosure, it may provide a DD dryer capable of driving a motor with optimal motor efficiency on an optimal motor efficiency band despite a difference between a drum rotation band of the dryer and an optimal efficiency band of the motor.

[0193] According to one embodiment of the present disclosure, it may provide a DD dryer capable of improving drying efficiency by increasing an area for enabling air to flow into a drum.

[0194] According to one embodiment of the present disclosure, it is intended to provide a dryer for enabling hot air to flow into a drum in three dimensions in a manner that the hot air is led to flow into the drum through a donut-shape area except central and outer portions of a drum rear wall. Namely, it may provide a dryer capable of increasing hot air and a heat transfer area of a drying object in a manner of supplying hot air in a cylindrical shape having a vacant center.

[0195] According to one embodiment of the present disclosure, it may provide a DD dryer capable of preventing enlargement of a front-rear width of a dryer or reduction of a drum volume in a manner of forming a compact size of a power transfer part between a drum and a motor.

[0196] According to one embodiment of the present disclosure, it may provide a DD dryer capable of minimizing the front-rear length increase of a drive part and stably fixing a stator and a decelerator to a rear case through a connector having one side coupled to the stator so as to overlap in a front-rear direction of the dryer and the other side coupled to the decelerator so as to overlap in the front-rear direction of the dryer.

[0197] According to one embodiment of the present disclosure, it may provide a DD dryer capable of protecting a rear case in a manner that a repulsive force generated from a stator and decelerator is transferred to a connector instead of being directly transferred to the rear case. Particularly, it is intended to provide a DD dryer capable of facilitating the stamping coupling of the stator and decelerator by forming a connector by injection molding and also cancelling out the repulsive force transferred from the stator and decelerator autonomously.

[0198] According to one embodiment of the present disclosure, it is intended to provide a DD dryer that can be manufactured with ease. Particularly, it may provide a DD dryer of which manufacturing is facilitated by skipping a step of coupling a decelerator and a stator to a rear case in a manner of coupling a connector to the rear case.

[0199] According to one embodiment of the present disclosure, it may provide a DD dryer capable of facilitating the accurate location and rotation speed controls of a drum by directly driving the drum through a motor, enabling the implementation of various drum motions by reducing the inaccuracy and abrasivity due to the slip of a belt, and reducing power loss by implementing an optimal drum RPM.

[0200] According to one embodiment of the present disclosure, it may provide a DD dryer capable of preventing volume reduction of a drum due to the thickness increase of a decelerator by applying an outer diameter increase instead of a thickness increase for the gear strength reinforcement of the decelerator.

[0201] According to one embodiment of the present disclosure, it may provide a dryer capable of reducing a power loss due to the rotation support of a drum by excluding a rear supporter rotatably supporting a rear side

of the drum in a manner of contacting with the rear side of the drum despite having a front supporter rotatably supporting a front side of the drum in a manner of contacting with the front side of the drum.

DESCRIPTION OF DRAWINGS

[0202]

FIG. 1 is a cross-sectional diagram of a dryer according to one embodiment of the present disclosure.

FIG. 2 is a diagram showing a rear view of a dryer according to one embodiment of the present disclosure.

FIG. 3 is an enlarged diagram of a drive unit of a dryer according to one embodiment of the present disclosure.

FIG. 4 is an exploded diagram showing components of a drum, rear case and drive unit of a dryer according to one embodiment of the present disclosure.

FIG. 5 is a diagram showing a front view of a drum according to one embodiment of the present disclosure.

FIG. 6 is a diagram showing a rear view of a drum according to one embodiment of the present disclosure.

FIG. 7 is a diagram showing an air inflow structure in a drive unit of a dryer according to one embodiment of the present disclosure.

FIG. 8 is a diagram showing an external view of a rear case of a dryer according to one embodiment of the present disclosure.

FIG. 9 is a diagram showing an internal view of a rear case of a dryer according to one embodiment of the present disclosure.

FIG. 10 is a graph showing the necessity and deceleration rate of a decelerator in a dryer according to an embodiment of the present disclosure.

FIG. 11 is an exploded diagram of components of a decelerator of a dryer according to one embodiment of the present disclosure.

FIG. 12 is a diagram showing the components engaged for a first-stage shift of a decelerator.

FIG. 13 is a diagram showing the components engaged for a second-stage shift of a decelerator.

FIG. 14 is a graph of comparison of speed standard deviation depending on a position of a cross section of a drum between a dryer according to one embodiment of the present disclosure and a related art dryer.

BEST MODE FOR DISCLOSURE

[0203] Reference will now be made in detail to the preferred embodiments of the present disclosure, examples of which are illustrated in the accompanying drawings.

[0204] First of all, major components of a dryer will be described with reference to FIG. 1 and FIG. 2. In the present specification, for clarity of description, a direction of a door 140 of a dryer shown in FIG. 1 may be defined as a front direction and a direction of a drive unit 200 may be defined as a rear direction.

[0205] A dryer 10 includes a case 100, 120, 130 and 150 and a drum 20 provided within the case. Drying objects may be placed within the drum 20. In case of a laundry dryer, laundry may be put in the drum 20 and then dried.

[0206] The case may include a top case 100 forming a top surface of the dryer, a front case 120 forming a front surface a rear case 130 forming a rear surface and a lateral case 150 forming a lateral surface. In addition, the case may include a dryer base 155 forming a bottom part of the dryer. The cabinet forms an inner surface, and various components including the drum 20 are received in the inner space.

[0207] The top case 100, the front case 120, the rear case 130, the lateral case 150 and the base 155 are structurally coupled together. Hence, each of the cases and the base forms a support structure supportive of an outer shape of the dryer as well as an exterior in a prescribed direction of the dryer.

[0208] A door 140 is provided to the front case. After the door 140 has been open, laundry may be put into the drum.

[0209] The drum 20 may be rotatably provided with reference to a horizontal axis parallel to a ground surface.

[0210] The drum 20 is formed in a cylindrical shape, and a front side of the drum 20 is open to put laundry in the drum.

[0211] A plurality of lifters 30 may be provided on an inner wall of the drum 20. The lifter 30 may be provided in a manner of extending in front-rear direction. The lifter 30 may be configured to be rotated together with the drum as an integral part. As the drum 20 is rotated, the lifter 30 lifts laundry. If the drum is further rotated, the laundry leaves the lifter 30 and then falls down by gravity. Owing to the rotation of the drum 20, the shaking of the laundry may be further smoothened and activated within the drum 20 by the lifter 30. Therefore, the laundry may be evenly exposed to hot air.

[0212] According to the present embodiment, a drive unit 200 configured to drive the drum 20 is located in rear of the drum 20. The drive unit 200 includes a motor 260 including a rotor 270 and a stator 280. A rotation axis of the rotor 270 and a rotation axis of the drum may be formed coaxially. Namely, the drum 20 and the rotor 270 are rotated with the same center of rotation. Hence, the dryer according to the present embodiment may be referred to as a Direct Drive (DD) dryer.

[0213] To transfer the power of the rotor 270 to the drum 20, a drum shaft 210 is provided to the drum 20. The drum shaft 210 is connected to the center of a rear wall 22 of the drum 20. Hence, as the drum shaft 210 is rotated, the drum 20 is rotated with the drum shaft 210 as an integral part.

[0214] To support a front side of the drum 20, a front supporter 160 may be provided. The front supporter 160 may be coupled to a rear side of the front case 120 or formed as a portion of the front case 120.

[0215] In the belt type dryer of the related art, an opening is formed in the rear side of a drum as well as in the front side of the drum and the drum substantially includes a cylindrical sidewall having open front and rear sides only. And, a rear supporter is provided to the rear opening of the drum. Namely, the drum is supported by the rear supporter while the rear opening of the drum is closed. As the rear supporter is a fixed component, the sidewall of the drum is rotated only by a belt.

[0216] Yet, according to the present embodiment, the drum 20 includes the rear wall 22 as well as the sidewall 21 of the cylindrical type, and the sidewall 21 and the rear wall 22 are rotated as an integral part. Therefore, the drum rear support structure of the present embodiment is different from the belt type dryer of the related art.

[0217] Regarding the drum of the present embodiment, unlike the drum of the related art dryer, the sidewall 21 and the rear wall 22 of the drum 20 are rotated as an integral part. The drum of the present embodiment may be similar to a drum of a washer. Yet, since the drum of the present embodiment is not provided for washing, through-holes for air or water entrance are not formed on the sidewall of the drum. Instead, a plurality of perforated holes or a perforated portion for allowing air communication but excluding entrance of laundry may be formed in the rear wall 22. This will be described later.

[0218] The rear side of the drum 20 may be rotatably supported by the drum shaft 210. Particularly, as the drum shaft 210 is rotatably supported to the rear case 130, the rear side of the drum may be eventually regarded as rotatably supported to the rear case 130. The rear case 130 is configured to form a support structure of the whole dryer. Hence, the rear side of the drum 20 may be supported rotatably and solidly through the rear case 130 that is the support structure of the dryer.

[0219] As shown in FIG. 3, the drum shaft 210 is extended in the rear direction from the center of the rear wall 22 of the drum 20. And, the drive unit 200 and the power transfer unit 210, 220 and 230 are provided in rear of the drum rear wall 22. The power transfer unit 210, 220 and 230 includes the drum shaft 210, and the drive unit 200 includes the motor 260 and the power transfer unit 210, 220 and 230.

[0220] The power transfer unit 210, 220 and 230 is provided between the drum 20 and a rotor 270 of the motor 260, thereby transferring a drive force of the rotor to the drum. Hence, the drive unit 200 including the power transfer unit 210, 220 and 230 may be located in rear of the rear side of the drum 200.

[0221] The motor 260 may include a stator 280 and the rotor 270 rotatably provided outside in a radial direction of the stator 280. Thus, the motor 260 may be referred to as an outer rotor type motor. Such an outer motor type motor is popularly used for a Direct Drive (DD) washer. Yet, as described above, since the related art dryer has difficulty in implementing a DD dryer, it is difficult to apply an outer rotor type motor to the related art dryer.

[0222] According to the present embodiment, the stator 280 is preferably provided to an outside of the rear case 130. Particularly, the stator 280 is preferably provided as fixed to the outside of the rear case 130. The rear case 130 is configured to form an appearance of the dryer on the rear side of the dryer 10 and also form an inner space of the dryer. Hence, the rear case 130 is configured to be fixed. Thus, as the stator 280 is fixed to the outside of the rear case 130, it can be fixed solidly.

[0223] As the motor 260 is provided to the outside of the rear case 130, a space between an inner side of the rear case 130 and the drum rear wall 22 may be provided enough to avoid a rotation interference of the drum. In addition, as the motor 260 is provided outside the rear case 130, the manufacturing is considerably facilitated.

[0224] The stator 280 may be provided so as to be spaced apart from a rear surface of the rear case 130. Namely, it is preferable that the stator 280 is not coupled to contact with the rear case 130 in direct. A connector 250 is provided between the rear case 130 and the stator 280. The stator 280 may be coupled to the rear case 130 through the connector 250.

[0225] A decelerator 230 may be provided to an inside of the connector 250, and more particularly, to a hollow part 250a located at a radial inside of the connector. Namely, the decelerator 230 may be inserted in the connector 250. Hence, it is able to minimize that a front-rear space of the drive unit 200 or the power transfer unit 210, 220 and 230 is increased by the decelerator 230.

[0226] The decelerator 230 may be located between the rotor 270 and the drum 20. The decelerator 230 may be configured to transform and transfer the drive force of the rotor 270 to the drum 20. Particularly, the decelerator 240 may be configured to transform high RPM and low torque of the rotor 270 into low RPM and high torque of the drum 20.

[0227] The drum shaft 210 coupled to the drum 20 is located in front of the decelerator 230, and a rotor shaft 220 coupled to the rotor 270 is located in rear of the decelerator 230. The rotor shaft 220 is rotated with the rotor as an integral part, and the drum shaft 210 is rotated with the drum 20 as an integral part. Hence, the decelerator 230 may configure the power transfer unit that transforms and transfers the power of the rotor shaft to the drum shaft. To secure efficiency and facilitation of such power transfer, it is preferable that the drum shaft 210 and the rotor shaft 220 are formed coaxially.

[0228] The decelerator 230 may be installed in the rear case 130. The decelerator 230 may be installed in a manner of directly contacting with the rear surface of the rear case 130. The connector 250 is provided to a radial outside of the decelerator 230, and the stator 280 may be installed in the rear case 130 through the connector 250.

[0229] The rotor 270 rotates on the radial outside of the stator 280, and is substantially configured in a manner

of being further extended in a front direction from the radial outside of the stator toward the rear case. Hence, securing a front-rear spaced distance between the rear case 130 and the stator 280 through the connector 250 may be necessary to secure a rotation space of the rotor 270.

[0230] In addition, the decelerator 230 is located in a manner of being inserted in the connector 250. Therefore, a front-rear with of the drive unit 200 by the decelerator 230 and the motor 260 may be formed to be very compact, whereby the external width extension of the rear case 130 can be minimized.

[0231] In some implementations, the drive unit 200 including the power transfer unit 210, 220 and 230 may be regarded as supported by the rear case that forms the exterior of the rear side of the dryer and the support structure of the dryer.

[0232] According to the present embodiment, since the motor 260 and the decelerator 230 are located in rear of the rear case 130, such components may be externally exposed and need protection. To this end, as shown in FIG. 4, a drive unit cover 180 may be provided to cover the drive unit in rear of the dryer 10.

[0233] Among the components configuring the drive unit 200, the largest component in a radial direction may be the rotor 270. Hence, except the rotor 270, all the components configuring the drive unit 200 are located within a radial inside of the rotor 270. Hence, it is necessary for the drive unit cover 180 to fully cover the rotor 270 only. Namely, the drive unit cover 180 may be formed in a circular dish having an outer diameter slightly greater than that of the rotor 270.

[0234] The drive unit cover 180 may be coupled to the rear case 130 in the rear direction of the rear case. Alternatively, the drive unit cover 180 may be coupled to a flow path duct 170 described later. The drive unit cover 180 and the flow path duct 170 are just located in rear of the rear case 130 but may not be the components that configure the support structure of the dryer. Therefore, although the drive unit cover 180 and the flow path duct 170 are removed, the support structure of the dryer may not change. Yet, according to the present embodiment, in a manner that the drive unit 200 and the air flow path are partially extended to a rear outside of the rear case 130 instead of an inside of the case 10, the drive unit cover 180 and the flow path duct 170 may be provided.

[0235] According to the present embodiment, a rear air inflow structure for providing air to the drum 20 from an outside of the rear case 130 may be provided. Particularly, as the flow path duct 170 is installed in the rear case 130, air may be supplied into the drum 20 through the flow path duct 170.

[0236] The flow path duct 170 is mounted on the rear surface of the rear case 130, thereby forming a space 171 inside to enable air to flow therein. The flow path duct 170 may be formed on a radial outside of the drive unit 200. Namely, the flow path duct 170 may be configured to enclose the drive unit 200.

[0237] Therefore, the air flow space 171 in the flow path duct 170, the motor 260 and the decelerator 230 may be structurally divided or separated outside the rear case 130. Thus, air flow may be performed smoothly, and hot or humid air may be prevented from entering the motor 260 or the decelerator 230.

[0238] An air communication structure among the flow path duct 170, the rear case 130 and the drum 20 will be described in detail later.

[0239] The motor 260 is located on a rear outside of the rear case 130. And, the motor 260 is enclosed by the flow path duct 170 on the rear outside of the rear case 130. Hence, a wire or signal line extended from an inside of the case 100 has difficulty in being connected to the motor 260.

[0240] According to the present embodiment, a wire or signal line passing through the rear case 130 may be extended to a radial inside from a radial outside of the flow path duct 170 and then connected to the motor 260. In this case, the wire or signal line may be exposed externally. To prevent such exposure, a wire cover 190 may be provided.

[0241] The connection and position relation among the drum rear wall 22, the rear case 130 and the drive unit 200 will be described in detail with reference to FIG. 3 and FIG. 4 as follows. FIG. 3 is an enlarged cross-sectional diagram of the rear part of the dryer shown in FIG. 1, and FIG. 4 is an exploded perspective diagram of the drum, rear case and drive unit.

[0242] The rear case 130 is located in rear of the drum rear wall 22. As the drum rear wall 22 is rotatably configured, it is located in a manner of being spaced apart from the rear case 130.

[0243] The motor 260 is provided to an outside of the rear case 130. The stator 280 of the motor is located in a manner of being spaced apart from the rear surface of the rear case toward a rear direction by the connector 250 and fixed to the rear case 130.

[0244] To transfer a drive force of the rotor 270 of the motor to the drum 20, the power transfer unit 210, 220 and 230 are provided. The power transfer unit 210, 220 and 230 includes the drum shaft 210, the decelerator 230 and the rotor shaft 220.

[0245] To transfer a drive force of the rotor 270, the rotor 270 is coupled to the rotor shaft 220. The rotor shaft 220 forms the same axis with a rotation axis of a rotor and rotates with the rotor as an integral part. Hence, to secure the coupling rigidity and the power transfer reliability, a coupler 296 may be provided. The coupler 296 may be referred to as a rotor coupler 296.

[0246] The rotor coupler 296 may be coupled to an inner surface of the rotor through a plurality of bolts. The rotor shaft 220 may pass through the rotor coupler 296 and be coupled to the rotor 270 by a stud 294. To rigidify the coupling by the stud, a washer 295 may be inserted between the stud 294 and the rotor 270.

[0247] Regarding the stud 294, a female screw may be formed at the center of the rotor shaft 220 so as to be

coupled with the stud.

[0248] In addition, the rotor shaft 220 may be coupled to the rotor coupler 296 by serration. A serration may be formed on an outer circumference of the rotor shaft 220 and a serration may be formed on the rotor coupler through which the rotor shaft passes. Hence, a drive force of the rotor may be solidly transferred to the rotor shaft 220.

[0249] A drive force of the rotor shaft 220 is transformed through the decelerator 230 and then transferred to the drum shaft 210. The drum shaft 210 may have the coupling structure identical or similar to that of the rotor shaft 220 and be coupled to the drum rear wall 22.

[0250] Namely, a stud 291, a washer 292 and a drum coupler 293 may be provided. Shapes and structures of them may be identical or similar to those of the stud 294, washer 295 and rotor coupler 296 for the coupling of the rotor shaft 220.

[0251] The stud 291 may pass through a stud perforated hole 29a from an inside of the drum to an outside (i.e., from a front side to a rear side) and be then coupled to the drum shaft 210. On the other hand, the stud 294 may pass through a stud perforated hole from an inside of the rotor to an outside of the rotor (i.e., from a rear side to a front side) and be then coupled to the rotor shaft 220.

[0252] The rotor shaft 220 rotates with the rotor 270 as an integral part, and the drum shaft 210 rotates with the drum 20 as an integral part. Hence, the decelerator 230 may be referred to as a device for performing power transform between the rotor shaft 220 and the drum shaft 210.

[0253] The decelerator 230 includes a transforming device 240 provided within the housing. The transforming device may include various gears. The rotor shaft 220 and the drum shaft 210 may be extended into the housing 231 and then connected to the transforming device. The rotor shaft 220 and the drum shaft 210 may be parts of the decelerator 230 or partial configuration of the transforming device.

[0254] A drum shaft perforated hole 232 is provided to a front side of the housing 231 so that the drum shaft 210 can pass through the drum shaft perforated hole 232. The drum shaft perforated hole 232 may be configured in a manner of being extended in the front direction. Namely, it may be configured to form a prescribed front straight-line distance. The drum shaft perforated hole 232 may pass through a shaft perforated hole 130a formed in the rear case 130.

[0255] The shaft perforated hole 130a is formed to enable the drum shaft 210 to be extended from the rear wall 22 of the drum 20 to the decelerator 230 in a manner of passing through the rear case q130. Here, it is not preferable that the drum shaft 210 is rotatably supported through the shaft perforated hole 130a. Namely, since the rear case 130 is formed using a plate such as a thin steel sheet, if a bearing support structure is formed in a perforated hole formed in a plate, it is not easy and preferable.

[0256] Therefore, it is preferable that the shaft perforated hole 130a is formed to have a diameter so that the drum shaft perforated hole 232 of the decelerator housing 231 as well as the drum shaft 210 can pass through the shaft perforated hole 130a.

[0257] The decelerator housing 231 may be fixed and coupled to the rear side of the rear case 130. The drum shaft perforated hole 232 of the decelerator housing 231 may be further extended in the front direction by passing through the shaft perforated hole 130a.

[0258] A bearing 234 may be provided within the drum shaft perforated hole 232. The drum shaft 210 may be inserted into the bearing 234. Therefore, the drum shaft 210 may be rotatably supported to the housing through the bearing 234. As the housing 231 is fixed to the rear case 130, the drum shaft 210 may be rotatably provided to the rear case 130 through the housing.

[0259] In addition, the decelerator housing 231 may be fixed and coupled to the connector 250. The decelerator housing 231 may be coupled in a manner of being fixed to an inside of the connector 250 by stamping. The connector 250 may be fixed to the rear case in the rear direction of the rear case in a manner of enclosing the decelerator housing 231.

[0260] Therefore, the decelerator 230 may be solidly fixed to the rear case 30 through the connector 250. This is because a radius of a part (e.g., a coupling part through a bolt or stud) for coupling the connector 250 to the rear case 130 is greater than that of the decelerator housing 231.

[0261] As described above, the motor 260 may include an outer rotor type motor. Therefore, the rotor 260 rotates on a radial outside of the stator 280. Based on such a structure, a hollow part 280a may be formed in a radial inside of the stator 280.

[0262] A portion of the connector 250 may be inserted in the hollow part 280a. Through this, the front-rear length increase of the drive unit 200 may be prevented and the stator 280 may be solidly coupled to the connector 250.

[0263] By the decelerator 230, a front-rear length for the connection of a rotation axis (i.e., a rotation axis including a drum shaft, a middle shaft described later, and a rotor shaft) between the rotor 270 and the drum 20 may be increased. Therefore, it is important to secure a rotatable support point of the rotation axis. However, it is not preferable that an overall length of a rotation axis is increased for the support point securing.

[0264] A portion of the rear side of the decelerator housing 231 is preferably inserted in the hollow part 280a of the stator 280.

[0265] A rotor shaft perforated hole 233, through which the rotor shaft 220 passes, is formed in the rear side of the decelerator housing. The rotor shaft perforated hole 233 may be formed in a manner of extending in a rear direction. Namely, it may be provided to form a prescribed rear straight-line distance. The rotor shaft perforated hole 233 is preferably inserted in the hollow part 280a of the stator 280.

[0266] A bearing 236 may be provided within the rotor shaft perforated hole 233. The rotor shaft 220 may be inserted in the bearing 236. Hence, the rotor shaft 220 may be rotatably supported to the housing 231 through the bearing 236. As the housing 231 is fixed to the rear case 130, and more particularly, may be fixed through the connector, the rotor shaft 220 may be regarded as provided rotatably to the rear case 130 as well.

[0267] As described above, the bearing support point of the drum shaft 210 is substantially located in a space between the drum rear wall 22 and the front side of the rear case 130. In addition, the bearing support point of the rotor shaft 220 is substantially located within the stator 280, i.e., the hollow part 280a. Therefore, the bearing support point of the overall rotation axis can be secured smoothly, thereby preventing an overall length of the rotation axis from being increased.

[0268] In addition, since the bearings 234 and 236 can be installed in the decelerator housing 231 in advance, the manufacturing is further facilitated.

[0269] The decelerator 230 may include a middle shaft 241. The transforming device 240 of the decelerator may include the middle shaft 241. The middle shaft 241 is the shaft 241 for connecting the rotor shaft 220 and the drum shaft 210 coaxially and is configured to be rotated independently from the drum shaft 210 or the rotor shaft 220.

[0270] The middle shaft 241 is inserted in the center of each of the rotor shaft 220 and the drum shaft 210, whereby those shafts are configured coaxially. A bearing is 235 provided to an outside of the middle shaft 241 and an inside of the drum shaft 210. Through the bearing 235, the middle shaft and the drum shaft may be rotated independently. A bearing 237 is provided to an outside of the middle shaft 241 and an inside of the rotor shaft 220. Through the bearing 237, the middle shaft and the rotor shaft may be rotated independently.

[0271] By the aforementioned structures of the drum 20, the rear case 130, the power transfer unit and the drive unit, the assembly may be further facilitated.

[0272] First of all, the decelerator 230 and the connector 250 are coupled together. The connector 250 is coupled to the rear case 130. After the stator 280 has been coupled to the connector 250, the connector 250 may be coupled to the rear case 130. Thereafter, the stator is coupled to the connector 250. As the rotor shaft 220 is semi-coupled by being inserted in the center of the rotor 260. Likewise, the drum shaft 210 may be semi-coupled by being inserted in the center of the drum rear wall 22.

[0273] Inside the drum, through the stud 291, the drum rear wall and the drum shaft 210 are coupled together. On the outer rear side of the rotor 270, through the stud 294, the rotor 270 and the rotor shaft 220 are coupled together.

[0274] Through such a sequence, the coupling of the drum 20, the rear case 130, the power transfer unit 210, 220 and 230 and the motor 260 may be facilitated. Thereafter, the flow path duct 170 may be coupled to the rear case 130 in the rear direction of the rear case, and the drive unit cover 180 may be coupled to the flow path duct 270 so as to protect the drive unit 200. Wires or signal lines exposed after having been connected to the motor 260 may be protected by the wire cover 190. One end of the wire cover 190 may be coupled to the rear case 130 on the radial outside of the flow path duct, and the other end may be coupled to the flow path duct or the rear case 130 on the radial inside of the flow path 170. Alternatively, after the wire cover 190 has been coupled, the drive unit cover 180 may be coupled.

[0275] In the following, with reference to FIG. 5 and FIG. 6, the drum 20 applicable to the present embodiment will be described in detail.

[0276] FIG. 5 is a perspective diagram of a front side of a drum, and FIG. 6 is a front diagram of a rear side of the drum.

[0277] The drum 20 may include the sidewall 21 and the rea wall 22 in a manner that a front side is open. The drum may be configured in a cylindrical shape of which rear side is blocked by the rear wall 22. Here, the 'blocked' means that entrance of laundry is impossible and that air communication is possible.

[0278] An installation area 23 is formed at a central portion of the rear wall 22. The installation area 23 may include an area in which the drum shaft 210 is installed and indicate an area that confronts the decelerator 230. An air intake area 24 may be formed on a radial outside of the installation area 23. A rear wall rim area 25 is formed on a radial outside of the air intake area 24 and may be connected to the sidewall 21.

[0279] Assuming that the rear wall 22 has a circular shape, the installation area 23 may be formed to exclude the air communication for the installation of the drum shaft at the central portion, and the air intake area 24 may be formed on a radial outside of the installation area 23 to enable air to pass therethrough.

[0280] To enable air to communicate, a plurality of holes 26 are formed in the air intake area 24. Particularly, the air intake area 24 of a mesh type is formed. If the air intake area 24 becomes wider, air may be supplied with the drum more evenly, whereby drying efficiency can be raised. A diameter of the hole 26 is very small. This is to prevent laundry from entering the hole 26 and being damaged. Therefore, the number of the holes 26 will be very high to enable air to be supplied into the drum smoothly.

[0281] However, the rigidity of the rea wall 22 may become vulnerable by the holes 26. To reinforce the rigidity of the rear wall 22 from the air intake area 24, a plurality of radial bridges 27 and a circumferential bridge 28 may be included. The radial bridges 27 may be provided to divide the air intake area 24 along a circumferential direction, and the circumferential bridge 28 may be provided to divide the air intake area 24 into a radial inside and a radial outside.

[0282] The radial bridge 27 may be extended from the installation are 23 to the rear wall rim area 25 via the air intake area 24. The radial bridge 27 may be connected to the circumferential bridge 28.

[0283] It is preferable that the holes 26 are not formed in the radial bridges 27 and the circumferential bridge 28. Therefore, as a support structure supportive of the air intake area 24 of the mesh type attributed to a plurality of the holes 26, the radial bridges 27 and the circumferential bridge 28 may be formed. Preferably, to reinforce self-rigidity, the radial bridges 27 and the circumferential bridge 28 may be formed convex in front or rear direction.

[0284] Preferably, the holes 26 are not formed in the rear wall rim area 25 as well. As the rear wall rim area 25 is connected to the sidewall 21, it is necessary to prevent the rigidity of the rear wall rim area 25 from being weakened. Moreover, in case that air flows in the rear wall rim area 25, the air may be supplied to laundry closely attached to an inner wall of the drum or a place in which laundry does not exist. Therefore, to raise the drying efficiency, it is preferable that air supply is focused not on the rear wall rim area 25 but on the air intake area 24.

[0285] A stud hole 29a may be formed at the center of the installation area 29 of the central portion of the drum rear wall 22. A washer seat part 29c may be formed on a radial outside that encloses the stud hole 29. A plurality of bolt fastening parts 29b may be formed in a radial outside of the washer seat part 29. Here, a stud, bolt or screw in the present embodiment may be named for convenience according to a relative size of a fastening means. Therefore, the fastening means may be non-limited by the specific names.

[0286] The installation area 29 may be the area that is fastened with the drum shaft 210. To fasten the drum shaft 210 to the drum 20 rigidly and secure reliability of power transfer, a coupler is provided. This may be referred to as a drum coupler 293 (see FIG. 3).

[0287] It is not preferable that hot air substantially flows into the drum through the central portion of the drum rear wall. Therefore, it is preferable that the installation area 29 is more extended to a further radial outside of the drum coupler.

[0288] FIG. 6 shows that a gasket 40 and 50 is projected on the drum rear wall 22. The gasket 40 and 50 may be provided for air sealing between the drum rear wall 22 and the rear case 130. Namely, air flowing in from an outside of the rear case 130 flows into the drum through the air intake area 24 by the sealing provided by the gasket between the drum rear wall 22 and the rear case 130.

[0289] The position, structure and function of the gasket 40 and 50 are described in detail with reference to FIG. 7. FIG. 7 is a cross-sectional diagram of the drum, drive unit and flow path duct in a gasket part.

[0290] The gasket 40 and 50 may include an inner gasket 40 of a radial inside and an outer gasket 50 of a radial outside. The inner gasket 40 partitions the installation area 29 and the air intake area 24 of the drum. Therefore, it is able to prevent hot air from leaking in an installation area direction (toward a radial inside) of the drum from an outside of the drum. The outer gasket 50 partitions the air intake area 24 and the rear wall rim area 25 of the drum. Therefore, it is able to prevent hot air from leaking into the rear wall rim area 25 of the drum from an outside of the drum.

[0291] The inner gasket 40 includes a fixing part 41 and an extension part 42, and a fastening part 43 may be formed in the fixing part 41. The inner gasket 40 may be mounted on an inner surface of the rear case through the fixing part 41 and the fastening part 43, and the extension part 42 may be formed in a manner of being extended from the fixing part 41 in a direction of the drum rear wall 22. The extension part 42 is configured to contact with the drum rear wall, whereby sealing can be performed. The extension part 42 may be slantly extended toward an inside from a radial outside. Namely, the extension part 42 may be located on a radial inside of the fixing part 41.

[0292] Likewise, the outer gasket 50 includes a fixing part 51 and an extension part 52, and a fastening part 53 may be formed in the fixing part 51. The outer gasket 50 may be mounted on an inner surface of the rear case through the fixing part 51 and the fastening part 53, and the extension part 52 may be formed in a manner of being extended from the fixing part 51 in a direction of the drum rear wall 22. The extension part 52 is configured to contact with the drum rear wall, whereby sealing can be performed. The extension part 52 may be slantly extended toward an outside from a radial inside. Namely, the extension part 52 may be located on a radial outside of the fixing part 51.

[0293] The extension part 42/52 of the inner/outer gasket 40/50 may be slantly extended from the fixing part 41/51 toward the drum rear wall. Through this, air sealing may be performed while the frictional force between the rotating drum and the end of the extension part 42/52.

[0294] Of course, unlike the above description, the gasket 40 and 50 may be installed not in the rear case 130 but in the drum 20. Yet, it will be preferable that the gasket is installed not in the rotatably-configured drum 20 but in the fixed rear case 130. Through this, as the sealing point may be formed not in the upstream of an air flow path but in the downstream thereof, it becomes more advantageous in aspect of sealing as well as manufacturing facilitation.

[0295] Meanwhile, as shown in FIG. 7, the power transfer unit may be placed in a hermetically sealed space. For example, the motor including the stator 280 and the rotor 260 and the decelerator may be located within a space enclosed by the rear case 130, the flow path duct 170 and the drive unit cover 180.

[0296] As the drum is driven, heat is generated from the decelerator and the motor, and more particularly, from the stator. If such a heat problem is resolved, it is very advantageous in securing performance. Therefore, it is preferable that a component for heat radiation or cooling is added.

[0297] Instead of adding such a component as a separate cooling fan, cooling performance may be secured using natural convection or convection through rotation

of a rotor.

[0298] A plurality of openings 260a may be formed in the rotor 260. As the rotor rotates, air may flow into the rotor from an outside of the rotor. The inflow air may flow toward the stator 280.

[0299] Meanwhile, the air flowing into the rotor 260 preferably includes external air. To this end, an opening 180a may be provided to the drive unit cover 180. A plurality of the openings 180a may be provided.

[0300] The air flowing in through the opening 180a of the drive unit cover 180 cools down the stator within the rotor through the opening 260a of the rotor. Here, if the air having cooled down the rotor is discharged externally, effective air circulation or flow can be generated. Therefore, a discharge part 180b for discharging air externally is preferably formed in the drive unit cover 180.

[0301] By such a structure, as shown in FIG. 7, an air flow is generated, whereby effective cooling can be performed.

[0302] Here, it is preferable that the opening 260a of the rotor and the opening 180a of the drive unit cover 180 are located to confront each other. Through this, air flow resistance can be minimized. Meanwhile, in case that air flows in from an outside, it is not preferable that an inflow pressure becomes excessively high. Therefore, the number and total size of the openings 180a may be preferably greater than those of the rotor, respectively.

[0303] In addition, to perform the inflow and discharge of air smoothly, a position of an inflow part of air is preferably different from that of a discharge part of air. Namely, the position of the discharge part is located at a radial outside of the position of the inflow part.

[0304] Accordingly, by forming the openings for the air inflow and discharge in the drive unit cover 180 with ease, effective cooling of the motor and decelerator can be performed.

[0305] With reference to FIG. 8 and FIG. 9, an air flow path of a dryer according to one embodiment of the present disclosure is described in detail.

[0306] An outlet 131 for discharging air from a dryer inside externally may be formed in the rear case 130. An inlet 135 for the air discharged through the outlet 131 to flow into the dryer may be formed in the rear case 130. The outlet 131 is a single outlet but a plurality of the inlets 135 may be formed.

[0307] The inlet may be formed in an air supply area 134 of the rear case 130, and the air supply area 134 may be formed on a radial outside of an installation area 136. The air supply area 134 may be configured to enclose the installation area 136.

[0308] The outlet 131 may be formed in the air intake area of the rear case 130. The air intake area may be provided to a radial outside of the air supply area 134. As the outlet 131 may be configured as a single outlet, the outlet may be regarded as the air intake area.

[0309] The air having flown into the flow path duct 170 via the outlet 135 flows into the dryer through the inlet 135. Particularly, a flow path passing through the inlet 135 may enter the drum in a manner of passing through a space between the drum rear wall 22 sealed by the gasket 40 and 50 and a front side of the rear case.

[0310] To reduce resistance of a flow of air that flows in via the inlet 135, it is preferable that a size of the inlet 135 is greater than that of a hole 26 through which air flows into the drum. As shown in the drawing, the number of the holes 26 of the drum projected onto the single inlet 135 may be equal to or greater than 10.

[0311] The area in which the holes 26 of the drum are formed is formed continuously along a circumferential direction except a radial rib 27. On the other hand, the inlet 135 and the inlet 135 may be configured in a manner of being spaced apart from each other along the circumferential direction. A size of a portion of the air inflow area 134, in which the inlet 135 is formed, may be similar to that of a portion in which the inlet is not formed.

[0312] Moreover, it is preferable that a radial direction width of the inlet 135 is preferably smaller than a radial width of the air intake area 24 of the drum. Namely, it is preferable that a size for sucking air from the drum is greater than a size for supplying air to the drum from the rear case. Through this, air inflow may be performed more smoothly and air can be evenly flow into the drum.

[0313] The flow path duct 170 may be configured to cover both of the air intake area 131 and the air supply area 134 of the rear case except the installation area of the rear case. Therefore, the air having flown into the flow path duct 170 via the air intake are 131 may diverge into both sides of the installation area and then flow along an installation area circumference, thereby being discharged from the flow path duct through the inlet 134.

[0314] The air discharged through the inlet 134 flows into the drum through a plurality of holes 29 formed in the air intake area 24 formed in the drum rear wall 22. The air having flown into the drum is discharged to a drum front side, passes through a heat pump 300 and a fan 179, and is then discharged out of the dryer rear case 130 through the outlet 131 of the rear case.

[0315] In some implementations, the heat pump 300 may be substituted with a heating part (not shown). Namely, a configuration for condensing moisture in air may be omitted. So to speak, air outside the dryer is made to flow into the dryer and then heated,

[0316] Through such a structure, air can be dried in a manner of circulating in the dryer according to the present embodiment. A fan 179 for generating circulation flow of air, a heat pump 300 as an exemplary configuration for heating and condensing air, a flow path duct 170 forming a flow path of air, a connecting duct 179 forming the flow path of the air and the like may be included.

[0317] Meanwhile, a fan mount part 132 projected in rear direction may be provided to the rear case 130. The outlet 131 may be formed in the fan mount part 132. A wire draw-out hole 133 may be formed in a top portion of the rear case 130.

[0318] The flow path duct 170 may include an inner coupling part 172 and an outer coupling part 171. The

inner coupling part 172 may be coupled to the rear case between the mount area of the rear case and the air supply area. The outer coupling part 171 may be coupled to the rear case in a manner of enclosing both of the air supply area and the air intake area of the rear case. An extension part 173 is formed between the outer coupling part 171 and the inner coupling part 172 so as to form an air flow space 171.

[0319] The extension part 173 may be configured in a manner of being convex in rear of the rear case 130. Hence, a wire extended to a rear case outside through the wire draw-out hole 133 needs to be connected to the motor located at a radial inside of the inner coupling part 172 of the flow path duct 170 by crossing the extension part 173. Hence, a wire cover 133 for protecting the crossing wire crosses the extension part 173 as well. The front-rear width of the dryer may be increased by the wire cover 133. Therefore, a seat part 173 recessed in front direction is preferably formed at a prescribed portion of the extension part 173 so that the wire cover is seated on the seat part 173.

[0320] A wire coupling area or a wire cover coupling area 137 may be formed between the air supply area 134 and the installation area 136 of the rear case 130. The wire coupling area 137 may include an area formed in a manner that a prescribed portion of the installation area 136 is extended to a radial outside. Hence, a radial width of the inlet 135 formed in the radial outside of the wire coupling area may be decreased by the wire coupling area 137.

[0321] A wire coupling area may be formed in the flow path duct to correspond to the wire coupling area of the rear case. Through the wire coupling area, one end of the wire cover 190 may be fixed and coupled thereto.

[0322] As described above, the decelerator 230 is preferably included in the dryer according to one embodiment of the present disclosure. In the following, why the decelerator is required for one embodiment of the present disclosure and what is an optimal deceleration ratio will be described with reference to FIG. 10.

[0323] To facilitate the torque and RPM control of a motor, an outer rotor type motor having a permanent magnet provided to a rotor is popularly used for a Direct Drive type device. In order to apply such an outer rotor type motor to the present embodiment, it is necessary to consider efficiency of a motor. FIG. 10 shows efficiency of a motor according to a current phase angle in case of using a motor of 269-W power consumption.

[0324] As shown in the drawing, it is observed that efficiency of an outer rotor type motor is high in a high-speed drive range, e.g., 600 ~ 750 RPM range. Yet, in a low sped drive at about 50 RPM that is a general drive RPM of a dryer drum, efficiency is noticeably decreased or a drum is not rotated due to the insufficient torque. Namely, there may occur a case that it is impossible to drive a drum. Thus, there may be a demand for a decelerator capable of driving a drum at about 50 RPM while driving a motor at the RPM having optimal efficiency. Therefore, according to the present embodiment, a decelerator having a deceleration ratio of 15:1 may be provided. Although an optimal deceleration ratio may be changed due to the difference of a motor and the difference of a drum drive RPM, it may be similar to 15:1 approximately.

[0325] Generally, a decelerator that uses a planet gear is manufactured for the purpose of deceleration of a servo motor and the like and fastened to a front side of a motor. Hence, due the outer diameter limit of a decelerator by a motor, a safety rate is generally secured in a manner of increasing a thickness of a planet gear (e.g., an axial length of a gear).

[0326] However, a decelerator of a dryer according to one embodiment of the present disclosure may require a compact design for a height (i.e., an axial length) of the decelerator rather than an outer diameter thereof. Namely, since a motor of the present embodiment is a motor of an outer rotor type, an outer diameter of a decelerator may be set to approach an outer diameter of a rotor as close as possible.

[0327] To implement a high deceleration ratio (e.g., 15:1), a decelerator of a 2-stage planet gear type may be applicable. A decelerator of a 1-stage planet gear type is normally used at a deceleration ratio of about 9:1. If a deceleration ratio of about 15:1 is implemented in a decelerator of a 1-stage planetary type, the number of planet gears becomes two according to the geometrical feature of implementing the deceleration mechanism. Therefore, stability becomes very low. According to the present embodiment, to implement a high deceleration ratio and secure stability, it is able to apply a decelerator of a 2-stage planet gear type that eventually performs 2-stage deceleration by performing deceleration through four planet gears in 1-stage deceleration.

[0328] Meanwhile, in case of using a 2-stage gear, as thickness (i.e., axial length of decelerator) due to gears is increased, the demand for the compact and lightweight design is considerably rising. According to the present embodiment, a decelerator capable of 2-stage changing high-RPM low-torque into low RPM high-torque between a rotor and a drum can be provided. And, a decelerator capable of implementing compactness and lightweight in consideration of power transform features in a dryer can be provided.

[0329] In 1-stage power transform, a thickness of a gear may be decreased in consideration of a feature that a torque of an input shaft (e.g., a rotor shaft in the present embodiment) is low. And, it is able to form a gear not through steel series materials but through engineering plastics such as Poly Oxy Methylene (POM) series materials. Therefore, by decreasing thickness and weight of a gear in proportion to strength of a gear, the compact and lightweight design will be possible.

[0330] Yet, in 2-stage power transform, since a torque of an output shaft (e.g., a drum shaft in the present embodiment) is raised through 1-stage power transform, higher gear strength may be required. Therefore, in the

2-stage power transform, it will be preferable that a height of a gear is relatively increased and that a gear of steel materials is formed.

[0331] In this respect, it may be difficult to implement a compact decelerator due to a thickness of a gear for power transform, and particularly, in 2-stage power transform,

[0332] One embodiment of the present disclosure pays attention to gear strength improvement through an outer diameter increase of a gear instead of a thickness increase of a gear.

[0333] By increasing a total outer diameter of a planet gear using the same deceleration ratio and the same-rated configurations, gear strength can be improved. Namely, if an outer diameter is increased in a gear having the same number of gear teeth, a size of a support part of the gear tooth is increased. So to speak, it is able to increase a size of a support part of a gear tooth in a manner of increasing a size of the gear tooth instead of increasing a thickness of a gear.

[0334] Such gear strength securing is identically applicable to 2-stage power transform as well as 1-stage power transform. Hence, it is able to implement a decelerator that is very compact in front-rear direction in all of 1-stage gears and 2-stage gears having the same outer diameter. Particularly, since a decelerator of the present embodiment transforms power of an outer rotor type motor, an outer diameter increase of the decelerator can be allowed sufficiently. Specifically, it is possible to increase an outer diameter of a decelerator to correspond to an inner diameter of the hollow part 250a of the connector that fixes the stator to the rear case.

[0335] In the following, a decelerator and deceleration principle according to one embodiment of the present disclosure will be described in detail with reference to FIGs. 11 to 13. FIG. 11 is an exploded perspective diagram of a decelerator, FIG. 12 shows a connection structure of decelerator components for 1-stage transform of power, and FIG. 13 shows a connection structure of decelerator components for 2-stage transform of power.

[0336] A decelerator 230 includes a housing 231, and the housing may include a front housing 231a and a rear housing 231b. Various components for a transforming device may be received in the housing 231. A fastening part 231c may be provided to the housing 231. The rear housing 231b may substantially receive the components for the transforming device therein, the front housing 231a may perform a cover function of covering the rear housing, *and vice versa.*

[0337] When the rear housing 231b substantially receives the components for the transforming device, the fastening part 231c may be provided to the rear housing 231b. The rear housing 231b is inserted in the hollow part 250a of the connector and then coupled and fixed to the connector 250 through the fastening part 231c.

[0338] A perforated hole 233 of a rotor shaft 220 is formed in a central portion of the rear housing 231b, and a bearing 236 is provided within the perforated hole 233, whereby the rotor shaft 220 is rotatably supported.

[0339] A perforated hole 232 of a drum shaft 210 is formed in a central portion of the front housing 231a, and a bearing 234 is provided within the perforated hole 232, whereby the drum shaft 210 is rotatably supported.

[0340] An input RPM in 1-stage power transform may be regarded as a high RPM. Hence, the bearing 236 supporting the rotor shaft 220 preferably includes a ball bearing. In addition, two ball bearings are preferably provided along the rotor shaft 220. An output RPM in 2-stage power transform may be regarded as a low RPM. Hence, a bearing supporting the drum shaft 210 preferably uses an oilless bearing. This is to secure reliability and save manufacturing costs.

[0341] Power of the rotor 260 is directly transferred to the rotor shaft 220. The rotor shaft 220 is solidly coupled to the rotor 260 through the rotor coupler 296, the washer 295 and the stud 194. One side of the rotor shaft 220 is coupled to the rotor, and the other side may configure a first sun ear 221. Hence, the rotor shaft 220 and the first sun gear 221 may be regarded as a single part or component, and may be the component formed of a single material.

[0342] The same first planet gear 223 is located on a radial outside of the first sun gear 221, and the first sun gear and the first planet gear are engaged. If the first planet gear is provided to leave the same space in between along a circumferential direction of the first sun gear, four first planet gears may be provided for example.

[0343] The first planet gear 223 is provided rotatably centering on a roller shaft 222, and the roller shaft 222 may be fixed to a first carrier 243. For the front-rear position fixing of the first planet gear and the fixing of the roller shaft, a first carrier supporter 224 may be provided. Hence, the first planet gear 223 may be rotatably provided to the first carrier 243. As the first planet gear 223 revolves around the first sun gear 221, the first carrier 243 rotates.

[0344] All the first planet gears 223 may be engaged in a manner of being inscribed in a ring gear 244.

[0345] When a deceleration ratio in each step is set to 'a', if the ring gear 244 is provided to be fixed within the decelerator housing 231, 'a' has the value resulting from adding 1 to a value obtained from dividing the number of gear teeth of the ring gear 244 by the number of teeth of the sun gear.

[0346] If a motor power of N RPM and T torque is inputted to the rotor shaft 220, the first sun gear 221 has the same N RPM and the same T torque.

[0347] As the rotor shaft 220 rotates, the first planet gear 223 and the first carrier 243 rotate. In doing so, the first carrier 243 has a deceleration ratio 'a', N/a RPM, and T*a torque. Hence, the power of the rotor shaft 220 is 1-stage transformed through the first carrier 243.

[0348] The first planet gear 223 is rotatably provided to one side (e.g., a rotor shaft side) of the first carrier 243. And, a second sun gear 242 may be provided to the other side (e.g., a drum shaft side) of the second carrier 243.

The second carrier 243 and the second sun gear 242 may be configured as an integral part. Thus, the second carrier 243 and the second sun gear 242 rotate as an integral part. Therefore, the second sun gear 242 has a deceleration ratio 'a', N/a RPM, and T*a torque.

[0349] As the second sun gear rotates, the second planet gear 213 and the second carrier 211 rotate. The second planet gear 213 may be rotatably provided to the second carrier 211 through a roller shaft 212. For the front-rear position fixing of the second planet gear 213 and the fixing of the roller shaft 212, a second carrier supporter 214 may be provided.

[0350] As the second planet gear 213 revolves around the second sun gear 242, the second carrier 211 rotates.

[0351] In this case, the second carrier 211 has a deceleration ratio 'a', N/a/a RPM, and T*a*a torque.

[0352] The second carrier 211 may be coupled to the drum shaft 210. Preferably, the second carrier 211 and the drum shaft 210 may be provided as a single part or component. Hence, the drum shaft 210 has N/a/a RPM and T*a*a torque.

[0353] As described above, a deceleration ratio of a decelerator in the present embodiment is 15:1. Hence, if each of a first-stage deceleration ratio and a second-stage deceleration ratio has the same value 'a', the value of 'a' may have the square root of 15, i.e., 3.871.

[0354] Here, it is very effective to have a final deceleration ratio of the square root of 'a' by setting the second stage deceleration ratio to 'a' with the first stage deceleration ratio 'a'. This is because a ring gear used for the first stage deceleration and the second stage deceleration may be implemented as a single ring gear. Namely, a rear side of a fixed single ring gear may be engaged with the first planet gears and a front side of the single ring gear may be engaged with the second planet gears. Therefore, implementation of a decelerator can be very facilitated.

[0355] In addition, there is an effect that radius sizes of planet gears and carriers can be set equally. Hence, it is able to implement a decelerator having a cylindrical shape and the same front-rear diameter. Of course, a fastening part structure for the fixed coupling of a decelerator is out of the question.

[0356] The drum shaft 210 may be solidly fixed to the drum rear wall through a drum shaft coupler 293, a washer 292 and a stud 291.

[0357] Eventually, according to the present embodiment, there decelerator 230 is provided between the drum rear wall and the rotor inner wall, thereby transforming high-RPM and low-torque of the rotor into low-RPM and high-torque of the drum.

[0358] Meanwhile, the rotor shaft 220 and the drum shaft 210 are spaced apart from each other in front-rear direction. The rotor shaft 220 and the drum shaft 210 are configured to form a co-axis, and the co-axis needs to be maintained solidly.

[0359] To this end, a middle shaft 241 may be provided. One side of the middle shaft may form a co-axis by being connected to the rotor shaft 220, and the other side may form the co-axis by being connected to the drum shaft 210.

[0360] The middle shaft 241 may configure an integral part with the first carrier 243 and the second sun gear 242. Namely, they may include a single component or part. Hence, the middle shaft 241 and the first carrier 243 may rotate as an integral part. This means that a rotation speed of the first carrier is different from a rotation speed of each of the rotor shaft and the drum shaft.

[0361] Therefore, a structure for supporting that the middle shift 241, the drum shaft 210 and the rotor shaft 220 may rotate at different rotation speeds, respectively or rotate independently is necessary. Of course, such a support structure may include a structure for forming and maintaining a co-axis.

[0362] The middle shaft 241 is positioned in a manner of being inserted in the center of the drum shaft 210 and the center of the rotor shaft 220. The middle shaft may be inserted in a hollow formed at prescribed portions of the drum and rotor shafts. A bearing 235 is provided between the drum shaft and the middle shaft. Likewise, a bearing 237 may be provided between the rotor shaft and the middle shaft.

[0363] A thrust generated between the rotor 260 and the drum rear wall 22 may be supported the aforementioned bearings 236 and 234. For example, it may be supported in a manner that a short sill formed on a lateral side of the oilless bearing 234 comes in contact with a circumference of the drum shaft and a lateral side of the ball bearing 236 comes in contact with an annular ring (no reference number in FIG. 10) coupled to the shafts. Therefore, a frictional force due to the thrust in the drive unit or the power transfer unit can be minimized.

[0364] Meanwhile, a decelerator different from the above-described planet gear decelerator of one embodiment of the present disclosure may be applicable to a dryer according to one embodiment of the present disclosure. For example, a cyclo-decelerator is applicable.

[0365] A cyclo-decelerator is a decelerator that uses a decelerating device having a cyclo-tooth shape. The cyclo-decelerator is a decelerator of which gear tooth shape forms a continuous curve of a cyclo-tooth shape to enable rolling contact. As an input shaft and an output shaft may form a co-axis, it is applicable to the present embodiment.

[0366] In a dryer according to one embodiment of the present disclosure, uniform drying can be performed. As shown in FIG. 14, it can be observed that an air flow speed is uniform irrespective of a front-rear position of a drum in a dryer according to one embodiment of the present disclosure.

[0367] The speed standard deviation means a deviation of an air flow speed in a whole cross section at a drum cross section position. If a speed standard deviation is small, it means that a speed difference in a whole area of a specific cross section is insignificant.

[0368] Therefore, according to the present embodiment, it can be observed that a speed standard deviation

at seven cross section positions between front and rear sides of a drum is about 0.7 or below, and more particularly, about 0.6 or below except the rear side of the drum. Since air inflow is performed in a predetermined area of the drum rear side only, such a result is predictable.

[0369] On the contrary, in a related art dryer having a structure that air flows in through a drum rear side, it is observed that a speed standard deviation increases significantly depending on a drum cross section position. Particularly, it can be observed that the speed standard deviation is greater than that of the present disclosure at all positions. In addition, it can be observed that the speed standard deviation is significantly high near the rear side of the drum. This paradoxically shows that the speed standard deviation is significantly low at the rear side of the drum in one embodiment of the present disclosure.

[0370] It can be assumed that the speed standard deviation characteristics of a dryer according to one embodiment of the present disclosure are attributed to the annular air supply area of the rear case and the annular air intake area of the rear wall of the drum. That is, since the position of air entering the drum is the same regardless of whether the drum is rotated or a rotation speed of the drum, it can be assumed that such characteristics are provided. In addition, it can be assumed that the area where air enters the drum and the area where air is supplied to the drum are increased in comparison to conventional dryers.

[0371] In particular, according to the present embodiment, air can flow into a drum throughout 360 degrees inside. Therefore, a larger volume of air can be supplied into the drum, and air can be supplied evenly. In addition, in a dryer according to the present embodiment, drying efficiency can be increased and uniform drying can be performed.

Claims

1. A dryer, comprising:

a case forming to support an appearance of the dryer;
a drum provided within the case to receive a drying object therein; and
a drive unit configured to drive the drum and including a motor having a stator and a rotor,
wherein the case includes a rear case forming to support a rear appearance of the dryer,
wherein the rotor is supported on an outside of the rear case in a manner of being coaxially rotatable to the rear case on a rotation axis of the drum, and
wherein the stator is fixed to the rear case on the outside of the rear case.

2. The dryer of claim 1, wherein the drive unit comprises a power transfer unit transferring a rotation force of the rotor to the drum and wherein the power transfer unit is provided between the rotor and the drum.

3. The dryer of claim 2, wherein the motor comprises an outer rotor type motor having the rotor provided to be rotatable on a radial outside of the stator.

4. The dryer of claim 2, wherein the stator having a hollow part provided to a radial inside is fixed to an outside of the rear case.

5. The dryer of claim 4, comprising a connector provided between the stator and the rear case to fix the stator to the rear case and form a front-rear space between the stator and the rear case.

6. The dryer of claim 5, wherein a portion of the connector is inserted in the hollow part of the stator.

7. The dryer of claim 5, wherein the connector has a hollow part provided to a radial inside.

8. The dryer of claim 7, wherein the power transfer unit includes a decelerator transforming high-RPM low-torque of the rotor into low-RPM high-torque of the drum and wherein at least one portion of the decelerator is located by being inserted in the hollow part of the connector.

9. The dryer of claim 2, the power transfer unit comprising:

a drum shaft connected to a rear side of the drum;
a rotor shaft connected to the rotor; and
a decelerator provided between the drum shaft and the rotor shaft.

10. The dryer of claim 9, wherein a shaft perforated hole perforated by the drum shaft is formed in the rear case.

11. The dryer of claim 10, the decelerator comprising:

a housing; and
a transforming device provided within the housing to transform high-RPM low-torque of the rotor into low-RPM high-torque of the drum.

12. The dryer of claim 11, wherein the housing of the decelerator is fixed to an outside of the rear case.

13. The dryer of claim 12, the housing of the decelerator, comprising:

a drum shaft perforated hole projected in prescribed length in front direction to be perforated by the drum shaft and having a bearing installed

inside to support the drum shaft rotatably; and a rotor shaft perforated hole projected in prescribed length in rear direction to be perforated by the rotor shaft and having a bearing installed inside to support the rotor shaft rotatably.

14. The dryer of claim 13, wherein the drum shaft perforated hole is located by being inserted in the shaft perforated hole of the rear case and wherein the rotor shaft perforated hole is located in a hollow part formed in a radial inside of the stator.

15. The dryer of one of claims 1 to 14, wherein a shaft perforated hole perforated by a drum shaft connected to the drum to transfer power of the rotor to the drum is formed in the rear case and wherein an installation area for installation of the drive unit is formed on a radial outside centering on the shaft perforated hole in the rear case.

16. The dryer of claim 15, wherein an air supply area for supplying air into the drum is formed in the rear case and wherein the air supply area is formed on a radial outside of the installation area centering on the installation area.

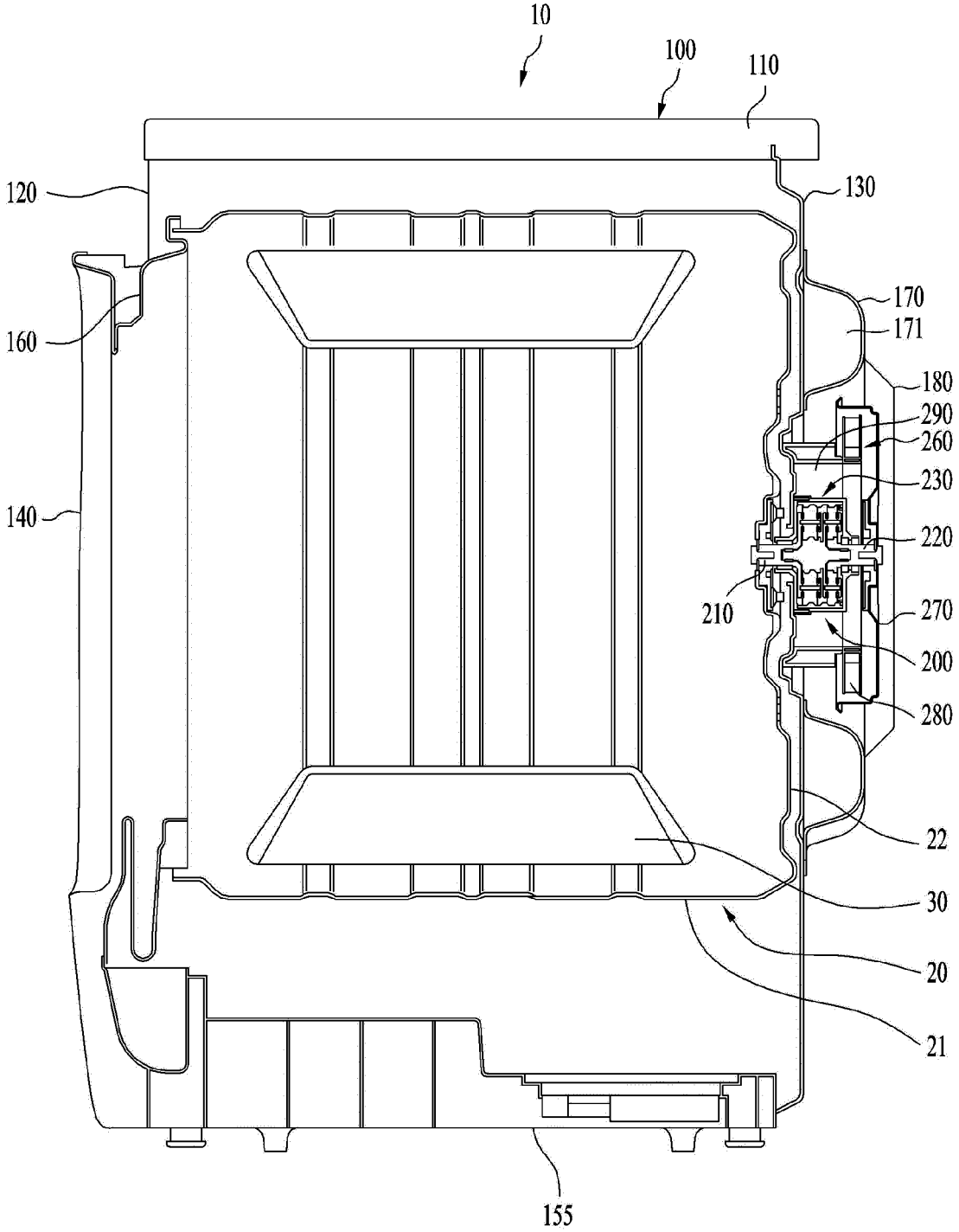
17. The dryer of claim 16, wherein an air intake area for sucking air from the drum is formed in the rear case and wherein the air intake area is formed on a radial outside of the air supply area.

18. The dryer of claim 17, comprising a flow path duct coupled to the rear case on an outside of the rear case so as to form an air flow space with the rear case in between by covering the air intake area and the air supply area.

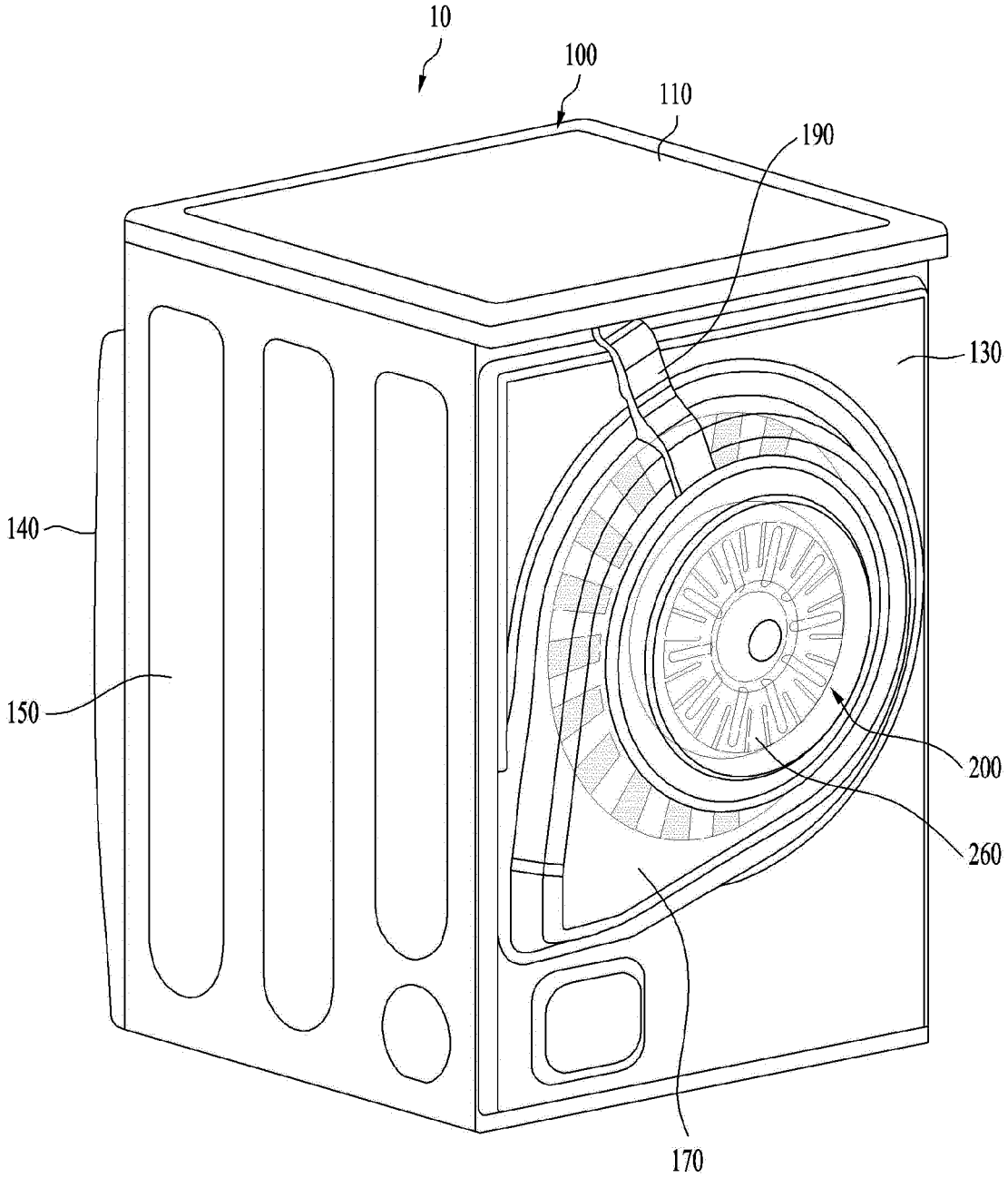
19. The dryer of claim 15, wherein a donut-shaped air intake area confronting the air supply area of the rear case is formed in a rear wall of the drum.

20. The dryer of claim 19, comprising a gasket provided between the rear case and the rear wall of the drum to enable air supplied from the air supply area of the rear case to flow into the air intake area of the drum.

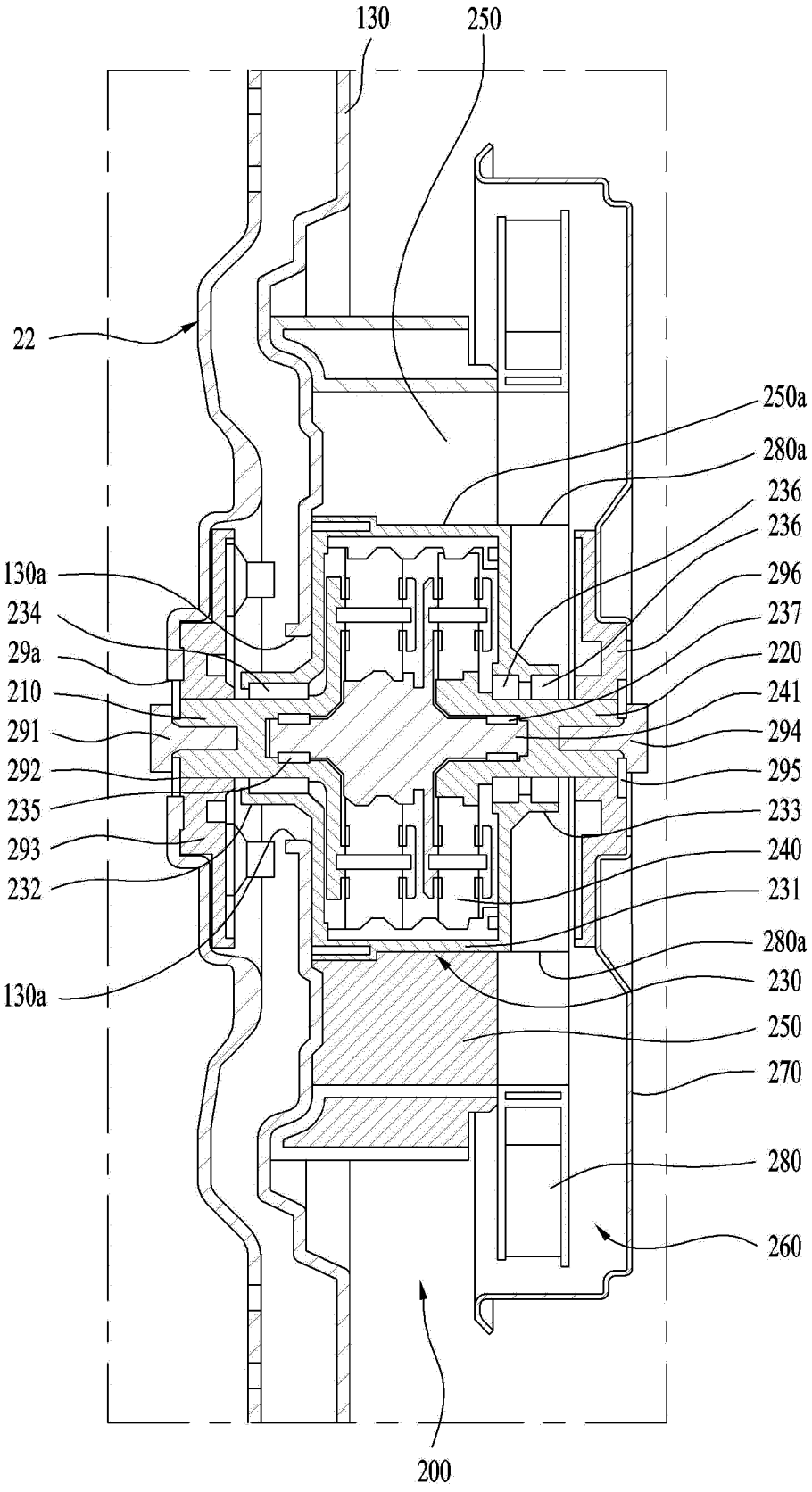
[Fig. 1]


10
100
110
120
130
160
170
171
180
290
260
230
140
220
210
270
200
280
22
30
20
21
155

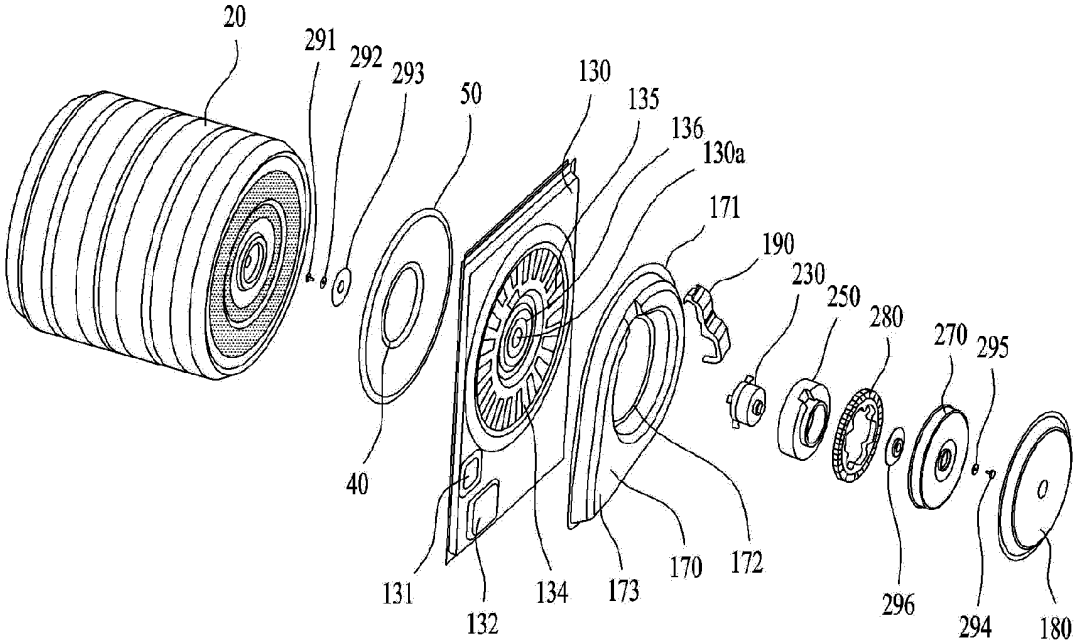
[Fig. 2]



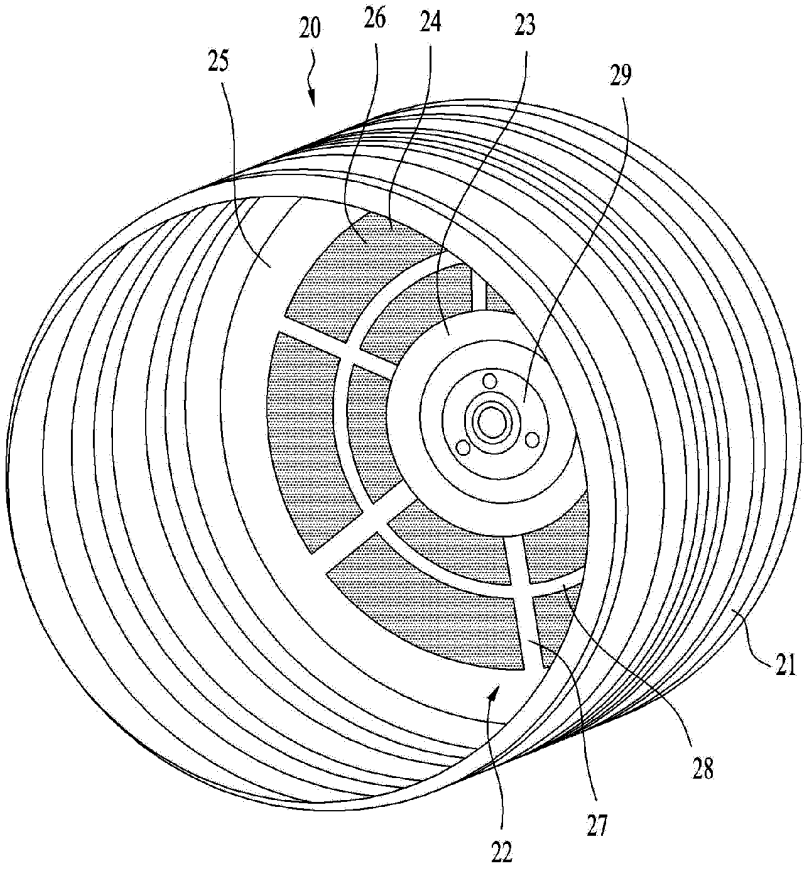
[Fig. 3]


130
250
22
250a
280a
236
236
130a
296
234
237
29a
220
210
241
291
294
292
295
235
233
293
240
232
231
280a
130a
230
250
270
280
260
200

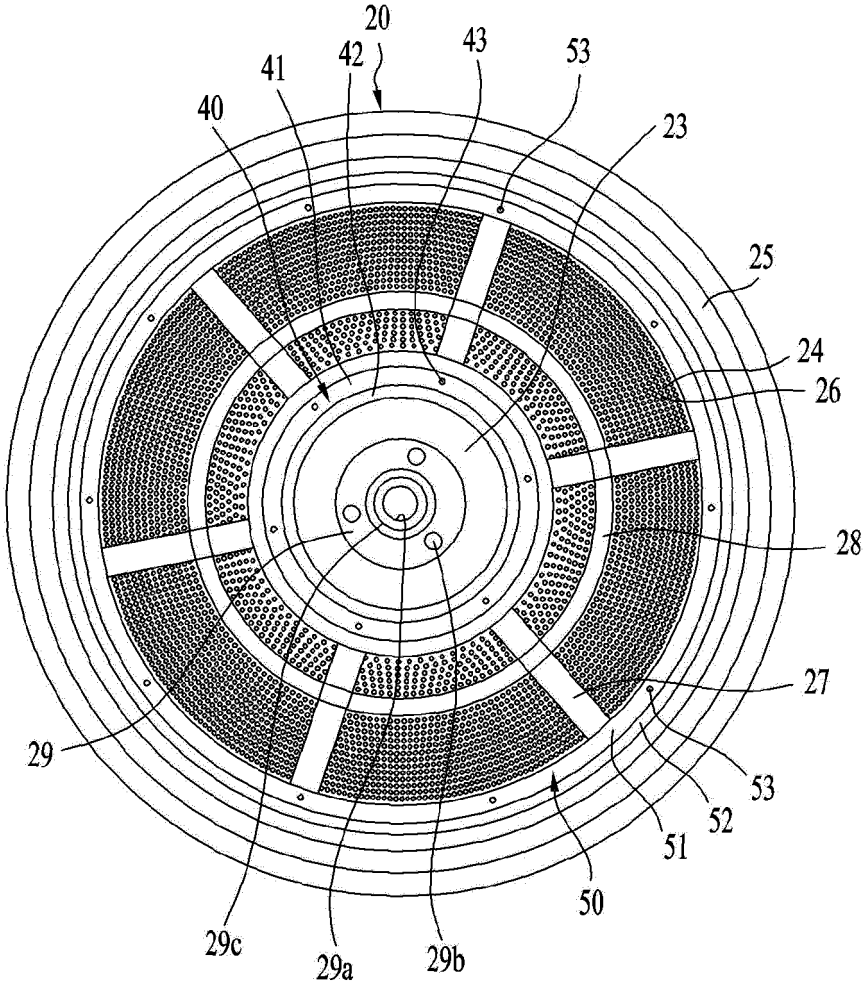
[Fig. 4]


20
291
292
293
50
130
135
136
130a
171
190
230
250
280
270
295
40
131
132
134
173
170
172
296
294
180

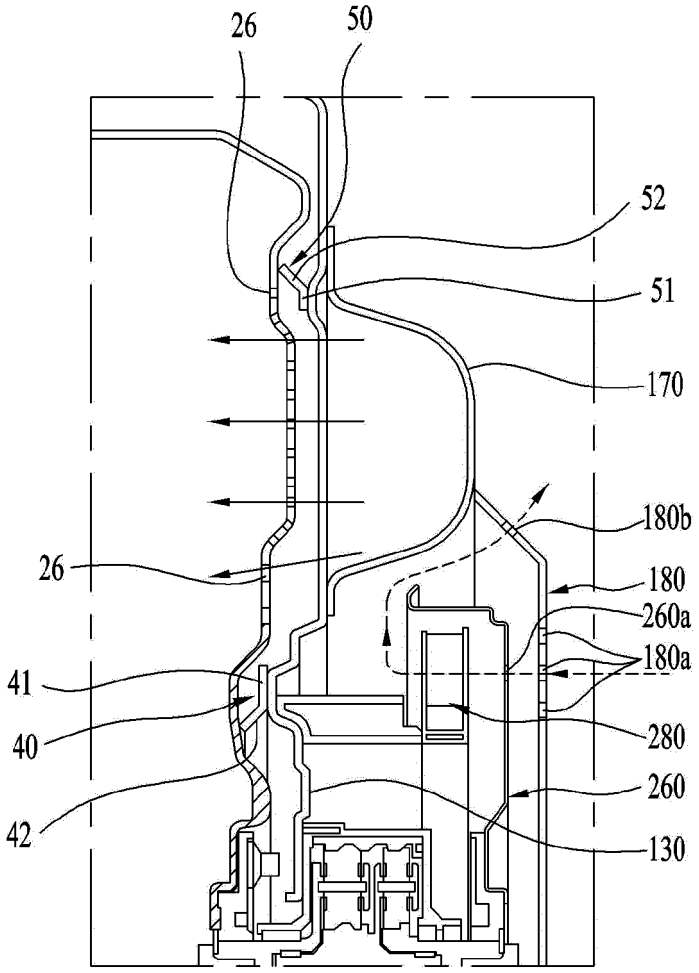
[Fig. 5]


20
26
24
23
25
29
21
28
27
22

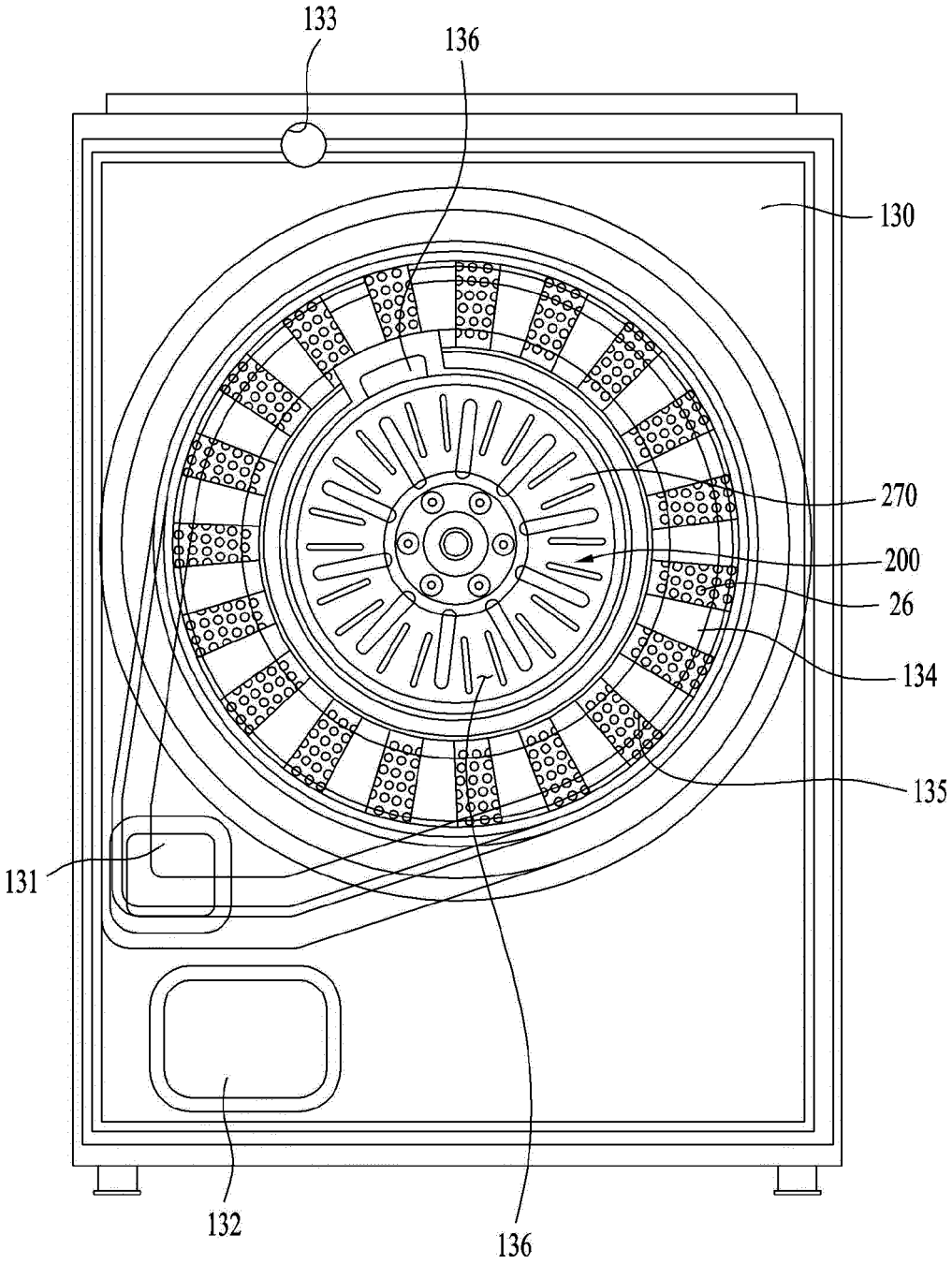
[Fig. 6]



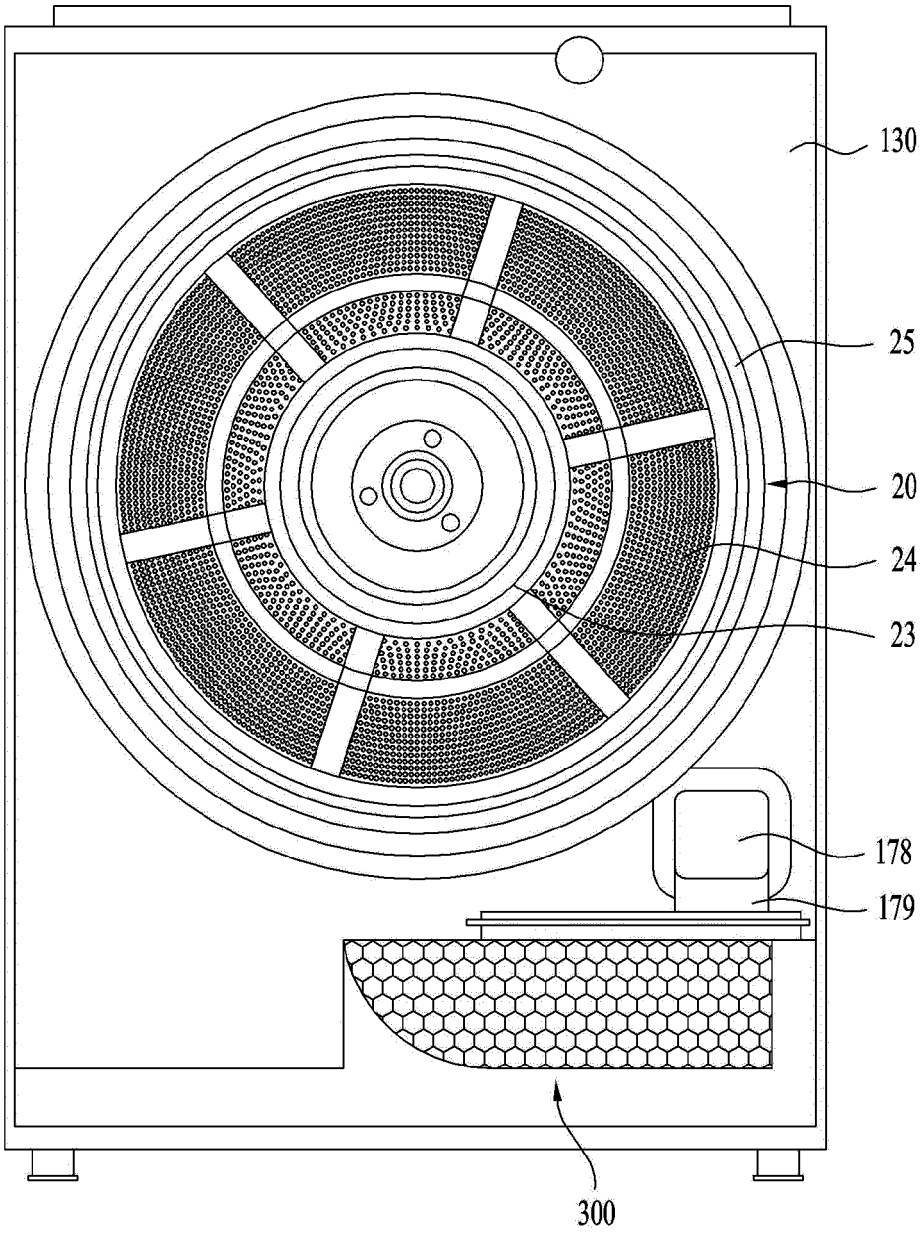
[Fig. 7]



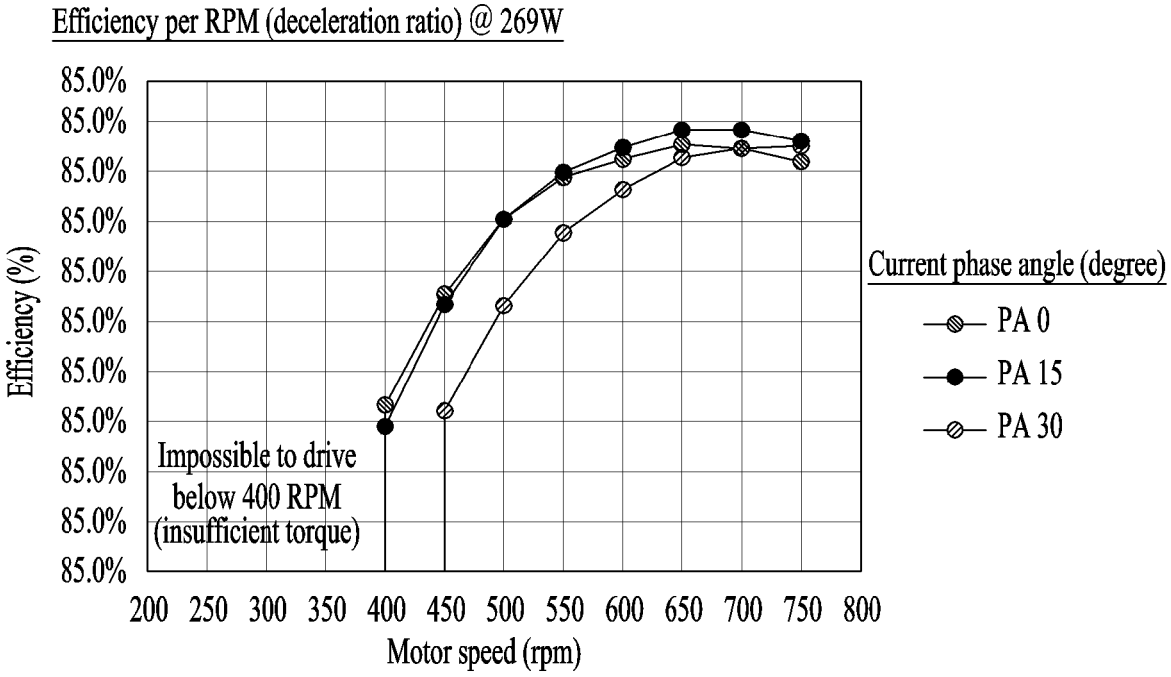
[Fig. 8]



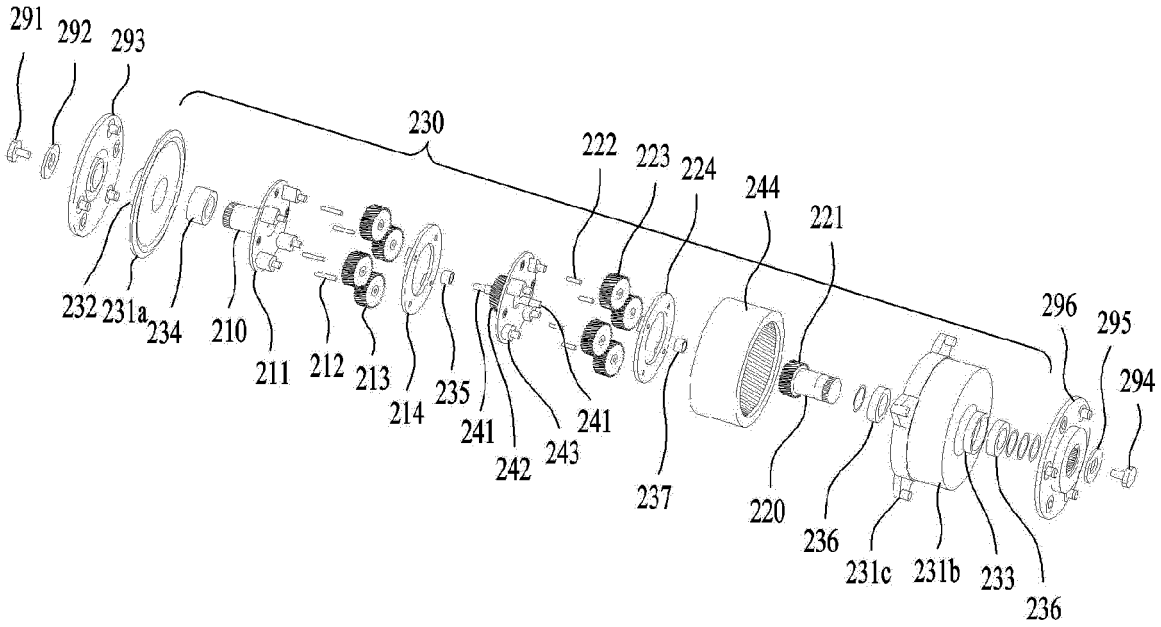
[Fig. 9]



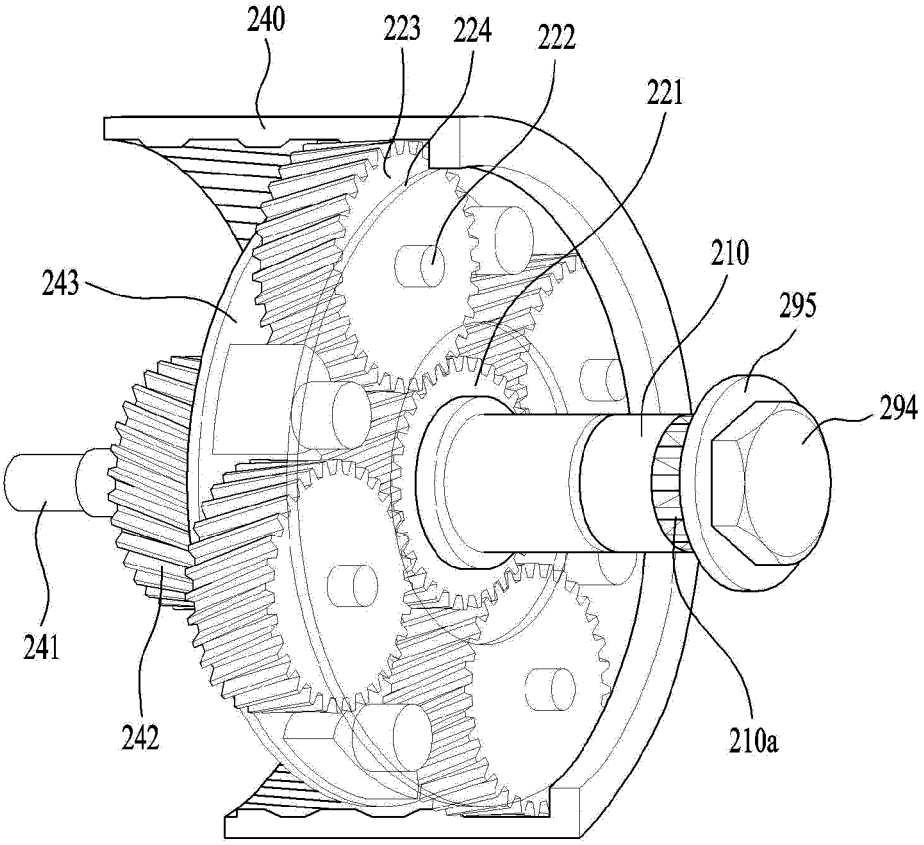
[Fig. 10]


Efficiency per RPM (deceleration ratio) @ 269W
Efficiency (%)
85.0%
85.0%
85.0%
85.0%
85.0%
85.0%
85.0%
85.0%
85.0%
85.0%
85.0%
Impossible to drive
below 400 RPM
(insufficient torque)
200 250 300 350 400 450 500 550 600 650 700 750 800
Motor speed (rpm)
Current phase angle (degree)
PA 0
PA 15
PA 30

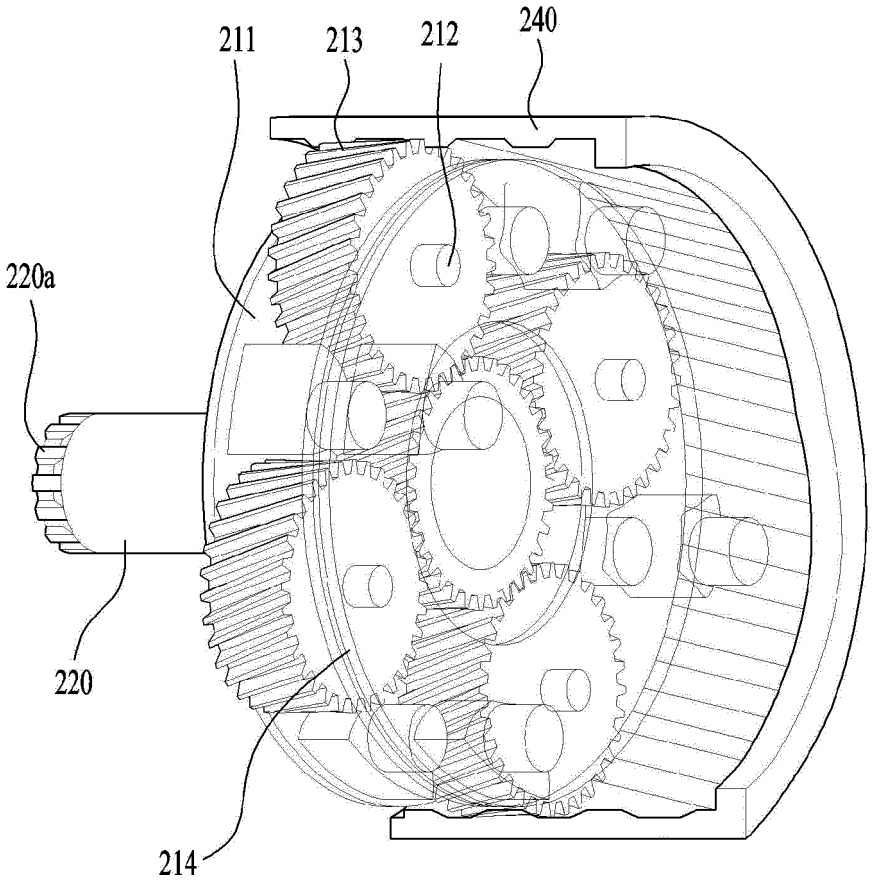
[Fig. 11]


291
292
293
230
222
223
224
244
221
232
231a
234
210
211
212
213
214
235
241
242
243
241
237
220
236
231c
231b
233
236
296
295
294

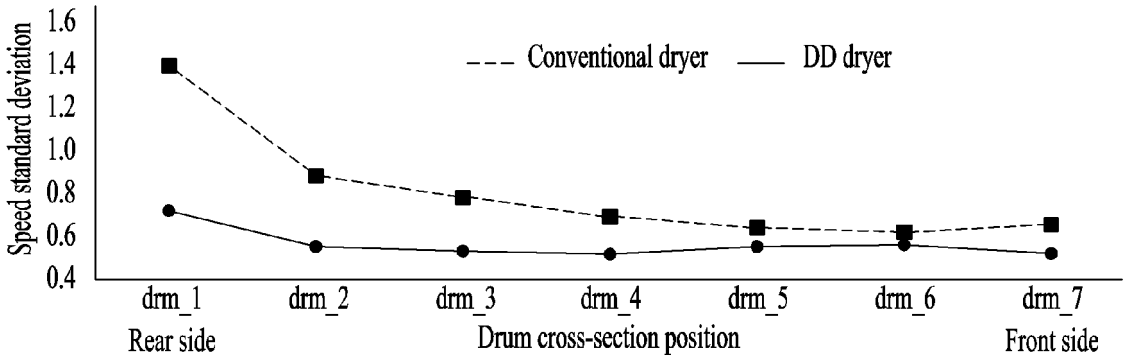
[Fig. 12]


240
223
224
222
221
243
210
295
294
241
242
210a

[Fig. 13]



[Fig. 14]


Speed standard deviation
1.6
1.4
1.2
1.0
0.8
0.6
0.4
Conventional dryer
DD dryer
drm_1
drm_2
drm_3
drm_4
drm_5
drm_6
drm_7
Rear side
Drum cross-section position
Front side

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2019/016580

A. CLASSIFICATION OF SUBJECT MATTER

D06F 58/04(2006.01)i, D06F 58/20(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 58/04; D06F 25/00; D06F 35/00; D06F 37/12; D06F 37/24; D06F 58/02; D06F 58/22; H02K 15/00; H02K 7/18; D06F 58/20

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: dryer, motor, stator, case, connector, reducer

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-0823328 B1 (DAEIL COOLER CO., LTD. et al.) 17 April 2008 See paragraphs [2]-[4], [30], claim 1, and figure 3.	1-20
Y	KR 10-2013-0013060 A (SAMSUNG ELECTRONICS CO., LTD.) 06 February 2013 See paragraphs [54]-[59], and figures 1-3.	1-20
Y	KR 10-2015-0016175 A (NEW MOTECH CO., LTD.) 11 February 2015 See paragraphs [24]-[25], and figure 1.	5-8
Y	KR 10-1644561 B1 (DONG-A UNIVERSITY RESEARCH FOUNDATION FOR INDUSTRY-ACADEMY COOPERATION) 01 August 2016 See paragraphs [17]-[20], and figures 2-4b.	8-14
Y	JP 2014-014584 A (PANASONIC CORP.) 30 January 2014 See paragraphs [31]-[32], and figures 1-2, 5.	19-20

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"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
"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
"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
"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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 MARCH 2020 (30.03.2020)	**30 MARCH 2020 (30.03.2020)**
Name and mailing address of the ISA/KR Korean Intellectual Property Office Government Complex Daejeon Building 4, 189, Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea Facsimile No. +82-42-481-8578	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2019/016580

Patent document cited in search report	Publication date	Patent family member	Publication date
KR 10-0823328 B1	17/04/2008	None	
KR 10-2013-0013060 A	06/02/2013	AU 2012-287653 A1	20/02/2014
		AU 2012-287653 A8	06/03/2014
		AU 2012-287653 B2	17/09/2015
		BR 112014001990 A2	21/02/2017
		CA 2842915 A1	31/01/2013
		CA 2842915 C	29/12/2015
		CN 102899847 A	30/01/2013
		CN 102899847 B	18/05/2016
		EP 2551398 A1	30/01/2013
		KR 10-1555897 B1	07/10/2015
		MX 2014000961 A	26/08/2014
		MX 343821 B	24/11/2016
		RU 2555656 C1	10/07/2015
		US 2013-0025330 A1	31/01/2013
		US 9260813 B2	16/02/2016
		WO 2013-015593 A1	31/01/2013
KR 10-2015-0016175 A	11/02/2015	KR 10-1987204 B1	11/06/2019
		KR 10-2015-0017430 A	17/02/2015
		US 10003224 B2	19/06/2018
		US 2016-0149447 A1	26/05/2016
		WO 2015-016478 A1	05/02/2015
KR 10-1644561 B1	01/08/2016	KR 10-2016-0035877 A	01/04/2016
JP 2014-014584 A	30/01/2014	None	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 57124674 A **[0009]**
- KR 291966 **[0009]**