



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

(43) Date of publication:
07.07.2021 Bulletin 2021/27

(51) Int Cl.:
D06F 37/06 ^(2006.01) **D06F 37/22** ^(2006.01)
D06F 37/26 ^(2006.01) **D06F 37/30** ^(2020.01)

(21) Application number: **19853494.3**

(86) International application number:
PCT/KR2019/010621

(22) Date of filing: **21.08.2019**

(87) International publication number:
WO 2020/045888 (05.03.2020 Gazette 2020/10)

(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 KH MA MD TN

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(30) Priority: **30.08.2018 KR 20180103079**
07.01.2019 KR 20190001970

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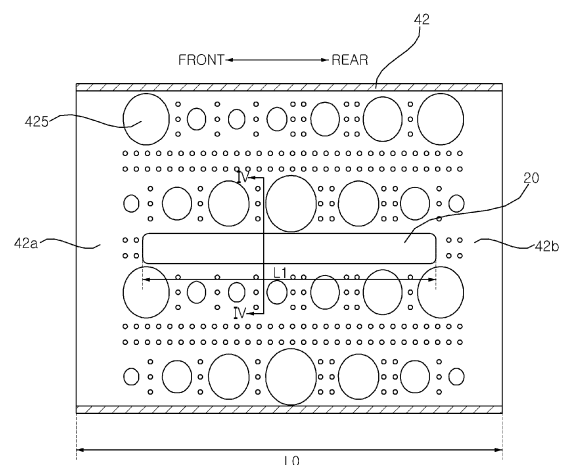
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(54) **WASHING MACHINE AND METHOD FOR CONTROLLING WASHING MACHINE**

(57) The present invention relates to a washing machine configured to have a drum, into which cloth is loaded, that is rotated around a horizontal axis. The washing machine includes a plurality of protrusions which are extended in a front and rear direction on an inner circumferential surface of the drum, and are spaced along a circumferential direction, and the protrusion has a height protruding inwardly into the drum is 2.0 to 6.0% of a diameter of the drum.

FIG. 3



Description

BACKGROUND OF THE INVENTION

1. Field of the invention

[0001] The present disclosure relates to a washing machine having a drum rotated about a horizontal axis, and more particularly, to a washing machine having a height of protrusion structure, which is formed on an inner circumferential surface of the drum, that is less than 40 mm.

2. Description of the Related Art

[0002] A washing machine configured to have a drum, into which laundry is loaded, that is rotated about a horizontal axis is widely known. For example, in a washing machine disclosed in Korean Patent Publication No. 10-2011-0022359, a lifter disposed in an inner circumferential surface of a drum lifts laundry when the drum rotates.

[0003] In such a washing machine provided with the lifter installed in the drum, laundry is lifted up to a certain height by the physical force exerted by the lifter and then falls, or a friction between the lifter and the laundry is induced. Therefore, it is possible to secure a certain level of washing force, which is less affected by the amount of water filled in the drum, the amount of laundry (cloth amount), and the rotational speed (RPM) of the drum, in comparison with a structure having no lifter.

[0004] Meanwhile, in the case of a drum having no lifter, the centrifugal force caused by the rotation of the drum becomes the driving force for lifting the laundry. In this case, when the rotational speed of the drum is equal to or higher than a cloth adhering speed at which the centrifugal force exerted on the laundry equals gravity, the laundry is rotated while being adhered to the inner circumferential surface of the drum. Although there is a variation depending on the diameter of the drum, the cloth adhering speed is 90 to 110 rpm.

[0005] Meanwhile, when the lifter is installed in the drum, the force of lifting the laundry by the lifter is more applied as well as the centrifugal force. Therefore, even if the rotational speed of the drum is lower than 90rpm, laundry can be rotated while being adhered to the drum. In the conventional washing machine, a lifter having a height of about 40 mm is applied. In this case, when the rotation speed of the drum reaches about 55 rpm, the laundry is rotated while being adhered to the drum.

[0006] That is, such a conventional washing machine has to limit the rotational speed of the drum to about 55 rpm or less so that the laundry is lifted up by the lifter and dropped. However, there are various factors that affect the washing force. For example, various factors include the friction between the drum and the laundry, the impact force exerted on the laundry by the lifter, and the bending and stretching of the laundry as well as the drop of laundry by the lifter. In particular, since these factors are closely

related to the rotational speed of the drum, there is a need to devise a method that can rotate the drum at a higher speed than the conventional one while causing a drop of laundry.

SUMMARY OF THE INVENTION

[0007] The present disclosure has been made in view of the above problems, and provides a washing machine which enhances an upper limit of drum rotation speed that can induce a drop of laundry due to the rotation of drum, and induce the flow of laundry in comparison with the prior art.

[0008] The present disclosure further provides a washing machine which forms a protrusion for lifting laundry on an inner circumferential surface of drum, appropriately designs the height of the protrusions, so that the laundry can flow in the drum while not adhering to the drum even if the rotation speed of the drum is 60 rpm or more.

[0009] The present disclosure relates to a washing machine configured to have a drum, into which cloth is loaded, that is rotated around a horizontal axis. A plurality of protrusions are provided on an inner circumferential surface of the drum. The protrusion is extended in a front and rear direction, and a plurality of protrusions are spaced along a circumferential direction.

[0010] The protrusion has a height protruding inwardly into the drum is 2.0 to 6.0% of a diameter of the drum. Alternatively, the protrusion protrudes inwardly into the drum at a height of 10 to 30 mm.

[0011] A protrusion structure higher than any one of the plurality of protrusions does not exist, between a pair of adjacent protrusions arbitrarily selected from among the plurality of protrusions, on the inner circumferential surface of the drum.

[0012] The drum further includes a plurality of embossing, on the inner circumferential surface, formed to be lower than any of the plurality of protrusions, and a protrusion structure does not exist excluding at least one of the plurality of embossings, between the pair of adjacent protrusions arbitrarily selected from among the plurality of protrusions, on the inner circumferential surface of the drum. A height of the embossing is 5mm or less.

[0013] Between a pair of adjacent protrusions arbitrarily selected from the plurality of protrusions, there is no protrusion structure on the inner circumferential surface of the drum, or only at least one of the plurality of embossings exists.

[0014] The protrusion includes: a first side surface portion that forms a positive first angle with respect to the inner circumferential surface at a first point on the inner circumferential surface of the drum, when viewed from a front; and a second side surface portion that forms a negative second angle with respect to the inner circumferential surface at a second point circumferentially spaced from the first point on the inner circumferential surface, when viewed from the front. At least one of the first angle and the second angle is 17.5 degrees or less.

[0015] A length from a front end to a rear end of the protrusion is 50 to 100% of a length of the drum. The drum has a front end band portion and a rear end band portion that are flat and formed in a front end and a rear end, respectively, and the protrusion is disposed between the front end band portion and the rear end band portion.

[0016] The protrusion is formed integrally with the drum. The drum is manufactured by processing a metal sheet of stainless steel, and has a thickness of 0.4 to 0.6mm.

[0017] Alternatively, the protrusion is made of synthetic resin and coupled with the drum.

[0018] A diameter of the drum may be 484mm, and the height at which the protrusion protrudes toward the inside of the drum may be 10.0 to 30.0mm.

[0019] A diameter of the drum may be 515mm, and the height at which the protrusion protrudes toward the inside of the drum may be 10.6 to 30.9mm.

[0020] A diameter of the drum may be 575mm, and the height at which the protrusion protrudes toward the inside of the drum may be 11.8 to 34.5mm.

[0021] A diameter of the drum may be 590mm, and the height at which the protrusion protrudes toward the inside of the drum may be 12.1 to 35.4mm.

[0022] A method of controlling a washing machine of the present disclosure controls the drum to be continuously rotated one or more revolutions in one direction at a set speed between 60 to 90 rpm such that the cloth is lifted to a certain height by the protrusion and then dropped at least once.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The above and other objects, features and advantages of the present disclosure will be more apparent from the following detailed description in conjunction with the accompanying drawings, in which:

FIG. 1 is a side cross-sectional view of a washing machine according to an embodiment of the present disclosure;

FIG. 2 schematically illustrates a cross section of a washing tub shown in FIG. 1;

FIG. 3 schematically illustrates a longitudinal section of the washing tub shown in FIG. 1;

FIG. 4 is a cross-sectional view taken along a line IV-IV of FIG. 3;

FIG. 5 is a graph showing a cloth adhering speed according to a height of protrusion;

FIG. 6 is a diagram referred to explain the correlation between a height of protrusion and a side surface angle; and

FIG. 7 illustrates a flow of cloth according to a rotational speed of drum.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0024] Advantages and features of the present disclosure and methods for achieving them will be made clear from the embodiments described below in detail with reference to the accompanying drawings. The present disclosure may, however, be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. The present disclosure is defined only by the scope of the claims. Like reference numerals refer to like elements throughout the specification.

[0025] Referring to FIG. 1, a washing machine according to an embodiment of the present disclosure may include a casing 1 forming an outer shape, a water storage tank 3 which is disposed in the casing 1 and stores washing water, a washing tub 4 which is rotatably installed in the water storage tank 3 and into which laundry is loaded, and a motor 9 which rotates the washing tub 4.

[0026] The washing tub 4 includes a front cover 41 having an opening for entering and exiting laundry, a cylindrical drum 42 disposed substantially horizontally so that a front end is coupled to the front cover 41, and a rear cover 43 coupled to a rear end of the drum 42. The rotating shaft of the motor 9 may be connected to the rear cover 43 by passing through the rear wall of the water storage tank 3. A through hole 42h may be formed in the drum 42 so that water may exchange between the washing tub 4 and the water storage tank 3.

[0027] The washing tub 4 is rotated about a horizontal axis. Here, "horizontal" does not mean a geometric horizontal in a strict sense, and even when the washing tub 4 is inclined at a certain angle with respect to the horizontal as shown in FIG. 1, it is closer to horizontal than vertical. Thus, it can be said that the washing tub 4 is rotated about a horizontal axis.

[0028] In addition, the washing tub 4 includes a plurality of protrusions 20 provided on an inner circumferential surface of the drum 42. A plurality of protrusions 20 are extended long in the front-rear direction on the inner circumferential surface of the drum 42, and these protrusions 20 are spaced apart along the circumferential direction, and preferably, disposed at a constant angle (equal angle) with respect to the center O of the drum 42.

[0029] A protrusion structure higher than any one of the plurality of protrusions 20 does not exist between a pair of adjacent protrusions 20 selected arbitrarily (or randomly) from among the plurality of protrusions 20.

[0030] In other words, no matter how the pair of adjacent protrusions 20 are taken, a protrusion structure protruding higher than the protrusion 20 does not exist between them.

[0031] A plurality of embossings 425 may be provided on the inner circumferential surface of the drum 42. The

embossing 425 has a protruding structure formed on the inner circumferential surface, and the height protruding into the drum 42 is lower than any of the plurality of the protrusions 20.

[0032] On the inner circumferential surface of the drum 42, a protrusion structure except at least one of the plurality of embossings 425 does not exist between a pair of adjacent protrusions arbitrarily selected from among the plurality of protrusions 20.

[0033] Embossing 425 may be formed integrally with drum 42, and the plurality of embossings 425 need not to be constant in size and or height, and as shown in FIG. 3, a plurality of embossings 425 having a size that gradually increases or decreases in the longitudinal direction of the drum 42 may be formed.

[0034] The height of the embossing 425 is 5 mm or less.

[0035] Meanwhile, the drum 42 is manufactured by processing a metal sheet of stainless steel, and the thickness may be 0.4 to 0.6mm. A cylindrical drum 42 can be formed by rounding a rectangular metal sheet and joining (e.g. welding) both ends to each other. The metal sheet is preferably an STS430 series, but is not necessarily limited thereto.

[0036] A laundry loading port is formed in the front surface of the casing 1, and a door 2 for opening and closing the laundry loading port is rotatably provided in the casing 1. Inside the casing 1, a water supply valve 5, a water supply pipe 6, and a water supply hose 8 may be installed. When the water supply valve 5 is opened to supply water, the washing water passing through the water supply pipe 6 may be mixed with the detergent in a dispenser 14, and then supplied to the water storage tank 3 through the water supply hose 8.

[0037] An input port of a pump 11 is connected to the water storage tank 3 by a discharge hose 10, and a discharge port of the pump 11 is connected to a drain pipe 12. Water discharged from the water storage tank 3 through the discharge hose 10 is pumped by the pump 11 and flows along the drain pipe 12, and then discharged outside the washing machine.

[0038] FIG. 7 shows the flow of cloth according to the rotational speed of the drum. Referring to FIG. 7, in a process where the drum 42 is rotated, the forces acting on the cloth introduced into the drum 42 may be centrifugal force F_c caused by the rotation of the drum 42, gravity F_g , and lifting force F_n applied from the protrusion 20.

[0039] As shown in FIG. 7A, since the centrifugal force F_c is relatively small when the drum 42 is rotated at a low speed, the cloth is raised to a certain height by the protrusion 20, and then the cloth is separated from the protrusion 20 and falls when the sum of the centrifugal force F_c and the lifting force F_n is unable to bear the gravity F_g . Such a flow of cloth is defined as a rolling motion.

[0040] FIG. 7B shows a state in which the rotational speed of the drum 42 is higher than that of FIG. 7A, and shows that the cloth falls after rising to a higher position.

In particular, the position where the cloth falls is equal to or greater than 90 degrees of rotation angle from the lowest point of the drum, and such a flow of cloth is defined as a tumbling motion.

[0041] If the rotational speed of the drum 42 further increases, as shown in FIG. 7C, the cloth does not fall even at the highest point of the drum 42 but is rotated while being adhered to the drum 42. The lowest value of the rotational speed of the drum 42, which can cause the cloth adhering in a form like FIG. 7C, is defined as a cloth adhering speed V_f .

[0042] When the drum 42 does not have the protrusion 20, the lifting force F_n is eliminated, and thus, only the centrifugal force F_c and the gravity F_g remain as the force acting on the cloth. In this case, the cloth adhering speed v_f can be obtained from an equilibrium equation where centrifugal force equals gravity. Since the mass of the cloth is canceled in both sides of the equilibrium equation, the cloth adhering speed V_f becomes a value which is dependent on the diameter of the drum irrespective of the mass of the cloth, and is a preset value that can be obtained by knowing the diameter of the drum.

[0043] Meanwhile, when the protrusion 20 is formed in the drum 42, the lifting force F_n acts further, and thus, the cloth adhering speed V_f becomes low in comparison with the case where the protrusion 20 is not applied. At this time, the cloth adhering speed V_f will vary depending on the structure of the protrusions 20. However, the cloth adhering speed V_f is about 55 rpm or less, in a conventional washing machine where the drum 42 has a diameter of 24 to 27 inches and the height of the lifter (protrusion) 40mm or more.

[0044] The washing force is determined by several factors such as flexing, friction, and drop of the cloth. These factors are closely related to the rotational speed of the drum 42, and in particular, the drop of the cloth or the relative movement (or flow in the drum) with respect to the drum such as rolling or tumbling motion is induced, but at this time the higher rotational speed of the drum 42 is advantageous to enhance the washing force.

[0045] In this aspect, it is necessary to devise a method to increase the cloth adhering speed V_f while rotating the drum 42 at a higher speed than in the related art, and the present disclosure lowers the height h (i.e. the height protruded into the drum 42) of the protrusion 20 in comparison with the related art to reduce the lifting force F_n . The height h of the protrusion 20 at this time is 2.0 to 6.0% of the diameter D in comparison with the diameter D of the drum 42, and is approximately 10 to 30 mm in absolute value.

[0046] The control method of the washing machine according to an embodiment of the present disclosure can implement a rolling or tumbling motion while rotating the drum 42 at a higher speed than in the related art.

[0047] Specifically, when the protrusion height of the protrusion 20 is 2.0 to 6.0% of the diameter of the drum 42, the drum 42 is continuously rotated one or more revolutions in one direction at a speed set between 60 and

90 rpm. Thus, it is possible to perform an operation that the cloth inside the drum 42 is lifted to a certain height by the protrusion 20 and then falls at least once.

[0048] The set speed may be a speed at which a rolling motion is induced, and in this case, the cloth in the drum 42 is lifted to an angle of 90 degrees or less in the rotational direction of the drum 42 from the lowest point of the drum 42 and then falls.

[0049] Alternatively, the set speed may be a speed that induces tumbling motion. At this time, the cloth in the drum 42 is lifted to an angle of 90 degrees or more and 180 degrees or less in the rotational direction of the drum 42 from the lowest point of the drum 42, and then falls.

[0050] A controller (not shown) for controlling the rotation of the motor 9 may be provided, and the drum 42 may be rotated by the speed control of the motor 9 by the controller.

[0051] FIG. 2 schematically illustrates a cross section of a washing tub shown in FIG. 1, FIG. 3 schematically illustrates a longitudinal section of the washing tub shown in FIG. 1, and FIG. 4 is a cross-sectional view taken along a line IV-IV of FIG. 3. Hereinafter, it will be described with reference to FIGS. 2 to 4.

[0052] When viewed from the front of the drum 42, the protrusion 20 is longer in the longitudinal direction (or the front and rear direction) of the drum 42 than the width of the drum 42 in the circumferential direction. These protrusions 20 are disposed symmetrically with respect to the center of the drum 42, and in the embodiment, three protrusions 20 are disposed at an isometric angle of 120 degrees with respect to the center of the drum 42, but is not necessarily limited thereto.

[0053] The protrusion 20 may be integrally formed with the drum 42. For example, the protrusion 20 can be formed by plastic working of the metal sheet. However, the present disclosure is not limited thereto, and in some embodiments, the protrusion 20 may be formed separately from the drum 42, and then coupled to the drum 42. In particular, in the latter case, the protrusion 20 may be made of synthetic resin.

[0054] Meanwhile, in order to smoothly lift up the cloth by expanding the contact area (or the area on which the protrusion 20 exerts a lifting force F_n) between the protrusion 20 and the cloth, the length of the protrusion 20 should be appropriate, and in this aspect, the present disclosure suggests that the length L_1 from the front end to the rear end of the protrusion 20 is 50 to 100% of the length L_0 of drum L . In particular, even when the length L_1 of the protrusion 20 is close to 50% of the length L_0 of the drum 42, it is preferable that the protrusion 20 is provided in such a manner that the front end of the protrusion 20 is located in a position spaced rearward from the front end of the drum 42, so that the protrusion 20 can be disposed to encompass the front and rear of the drum 42.

[0055] Specifically, the drum 42 has a front end band portion 42a and a rear end band portion 42b which are flat and formed at the front end and the rear end respec-

tively, and the protrusion 20 may be disposed between the front end band 42a and the rear end band 42b.

[0056] Meanwhile, referring to FIG. 4, when viewed from the front, the protrusion 20 may include a first side surface portion 21 that forms a positive first angle $+\theta$ with respect to the inner circumferential surface at a first point P1 on an inner circumferential surface of the drum 42, and a second side surface portion 22 that forms a negative second angle $-\theta$ with respect to the inner circumferential surface at a second point P2 circumferentially spaced from the first point P1 on the inner circumferential surface. Here, at least one of the first angle and the second angle is 17.5 degrees or less. Hereinafter, angle θ is defined as a side surface angle.

[0057] In the embodiment, the first side surface portion 21 and the second side portion 22 are symmetrical, and the first angle and the second angle have the same size, but are not necessarily limited thereto.

[0058] FIG. 5 is a graph showing a cloth adhering speed V_f according to a height of protrusion. FIG. 6 is a diagram referred to explain the correlation between a height of protrusion and a side surface angle. First, as described above, FIG. 5 shows that as the height h of the protrusion 20 becomes higher, the cloth adhering speed V_f becomes lower. Meanwhile, when the height h of the protrusion 20 is 5mm or less, the washing performance seems to be good as the cloth adhering speed V_f is high, but actually it is not.

[0059] When the height h of the protrusion 20 is 5 mm or less, in a state of not reaching the cloth adhering speed V_f of the drum 42 as the lifting force F_n of the protrusion 20 is too small, when the cloth rolls almost in place, or moves only up and down within a very small angle of rotation section, and then suddenly starts to adhere to the drum 42 when reaching the cloth adhering speed V_f . Such a type of flow of cloth is intensified as the cloth amount becomes small, and the drop or flexion of the cloth is not smoothly induced, such that the washing power is not good. For this reason, the height h of the protrusion 20 should be greater than at least 5 mm, preferably at least 10 mm or more.

[0060] The height h of the protrusion 20 is preferably 30 mm or less, and in this case, the cloth adhering speed V_f becomes about 65 rpm or more, so that an increase in the cloth adhering speed of about 18% can be expected in comparison with 55 rpm when the conventional height is 40 mm.

[0061] For each diameter D of the drum 42, preferred values of the lower limit LSL and the upper limit USL of the height h of the protrusion 20 are as follows. Here, the diameter of the drum 42 may be any of an inner diameter, an outer diameter, or an intermediate value between the inner diameter and the outer diameter of the drum 42.

[TABLE 1]

Drum Diameter(D (mm))	LSL(mm)	USL(mm)
484	10.0	30.0

(continued)

Drum Diameter(D(mm))	LSL(mm)	USL(mm)
515	10.6	30.9
575	11.8	34.5
590	12.1	35.4

[0062] Meanwhile, referring to FIG. 6, it can be known that the rolling or tumbling of the cloth is not induced in the area A where the height h of the protrusion 20 is smaller than 5 mm and the side surface angle θ is smaller than 17.5 degrees. Accordingly, even when the height h of the protrusion 20 is 5 mm, the side surface angle θ is preferably at least 17.5 mm so as to induce rolling or tumbling.

[0063] The area B shown in FIG. 6 indicates an area in which the height h of the protrusion 20 is 5 mm or more and the side surface angle θ is 17.5 or more, and it is possible to induce rolling or tumbling motion of the cloth in this area. However, the height of the protrusion 20 which can further enhance a washing performance due to such a motion is preferably 10mm or more.

[0064] Meanwhile, the curve shown by the dotted line in FIG. 6 connects the threshold values of the side surface angle θ that can induce rolling or tumbling.

[0065] As described above, according to the washing machine of the present disclosure, even if the drum is rotated at a higher speed than in the related art, the cloth is not adhered to the drum, but can flow in the drum, thereby improving the washing force.

[0066] In particular, even if the rotational speed of the drum is 60rpm or more, the laundry does not adhere to the drum but flows in the drum, thereby increasing the cloth adhering speed by approximately 18% in comparison with the related art.

[0067] Further, since the cloth flows inside the drum even while the drum is being rotated at a higher speed than in the related art, the friction force between the cloth and the drum is increased, thereby enhancing the rubbing effect.

[0068] Meanwhile, a control method of a washing machine according to an embodiment of the present disclosure can also be embodied as processor readable code on a processor-readable recording medium. The processor-readable recording medium includes all kinds of recording apparatuses storing data that can be read by a processor. Examples of the processor-readable recording medium is ROM, RAM, CD-ROM, magnetic tapes, floppy disks, optical data storage apparatuses, and, including those that are implemented in the form of carrier waves such as data transmission through the Internet. In addition, the processor-readable recording medium is dispersed in computer systems connected through a network, the code that is read by the processor can be stored and executed in a distributed fashion.

[0069] Although embodiments have been described

with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the scope of the principles of this disclosure. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

Claims

1. A washing machine configured to have a drum, into which cloth is loaded, that is rotated around a horizontal axis, the washing machine comprising:

a plurality of protrusions which are extended in a front and rear direction on an inner circumferential surface of the drum, and are spaced along a circumferential direction,

wherein the protrusion has a height protruding inwardly into the drum is 2.0 to 6.0% of a diameter of the drum, and a protrusion structure higher than any one of the plurality of protrusions does not exist, between a pair of adjacent protrusions arbitrarily selected from among the plurality of protrusions, on the inner circumferential surface of the drum.

2. The washing machine of claim 1, wherein the drum further comprises a plurality of embossing, on the inner circumferential surface, formed to be lower than any of the plurality of protrusions, and wherein a protrusion structure does not exist excluding at least one of the plurality of embossings, between the pair of adjacent protrusions arbitrarily selected from among the plurality of protrusions, on the inner circumferential surface of the drum.

3. The washing machine of claim 2, wherein a height of the embossing is 5mm or less.

4. The washing machine of claim 1, wherein the protrusion comprises:

a first side surface portion that forms a positive first angle with respect to the inner circumferential surface at a first point on the inner circumferential surface of the drum, when viewed from a front; and

a second side surface portion that forms a negative second angle with respect to the inner circumferential surface at a second point circumferentially spaced from the first point on the inner

circumferential surface, when viewed from the front,
wherein at least one of the first angle and the second angle is 17.5 degrees or less.

5

5. The washing machine of claim 1, wherein a length from a front end to a rear end of the protrusion is 50 to 100% of a length of the drum.
6. The washing machine of claim 5, wherein the drum has a front end band portion and a rear end band portion that are flat and formed in a front end and a rear end, respectively,
wherein the protrusion is disposed between the front end band portion and the rear end band portion.
7. The washing machine of claim 1, wherein the protrusion is formed integrally with the drum.
8. The washing machine of claim 7, wherein the drum is manufactured by processing a metal sheet of stainless steel, and has a thickness of 0.4 to 0.6mm.
9. The washing machine of claim 1, wherein the drum is formed of stainless steel, and
the protrusion is made of synthetic resin and coupled with the drum.
10. The washing machine of claim 1, wherein the protrusion has a height of 10 to 30mm protruding inwardly into the drum.
11. A method of controlling a washing machine configured to have a drum, into which cloth is loaded, that is rotated around a horizontal axis, to have a plurality of protrusions which are extended in a front and rear direction on an inner circumferential surface of the drum, and are spaced along a circumferential direction, and the protrusion has a height protruding inwardly into the drum is 2.0 to 6.0% of a diameter of the drum, the method comprising controlling the drum to be continuously rotated one or more revolutions in one direction at a set speed between 60 to 90 rpm such that the cloth is lifted to a certain height by the protrusion and then dropped at least once.
12. The control method of claim 11, wherein the set speed is set such that the cloth in the drum is lifted to an angle of 90 degrees or less in a rotational direction of the drum from a lowest point of the drum and then dropped.
13. The control method of claim 11, wherein the set speed is set such that the cloth in the drum is lifted to an angle of 90 degrees or more and 180 degrees or less in a rotational direction of the drum from a lowest point of the drum and then dropped.

FIG. 1

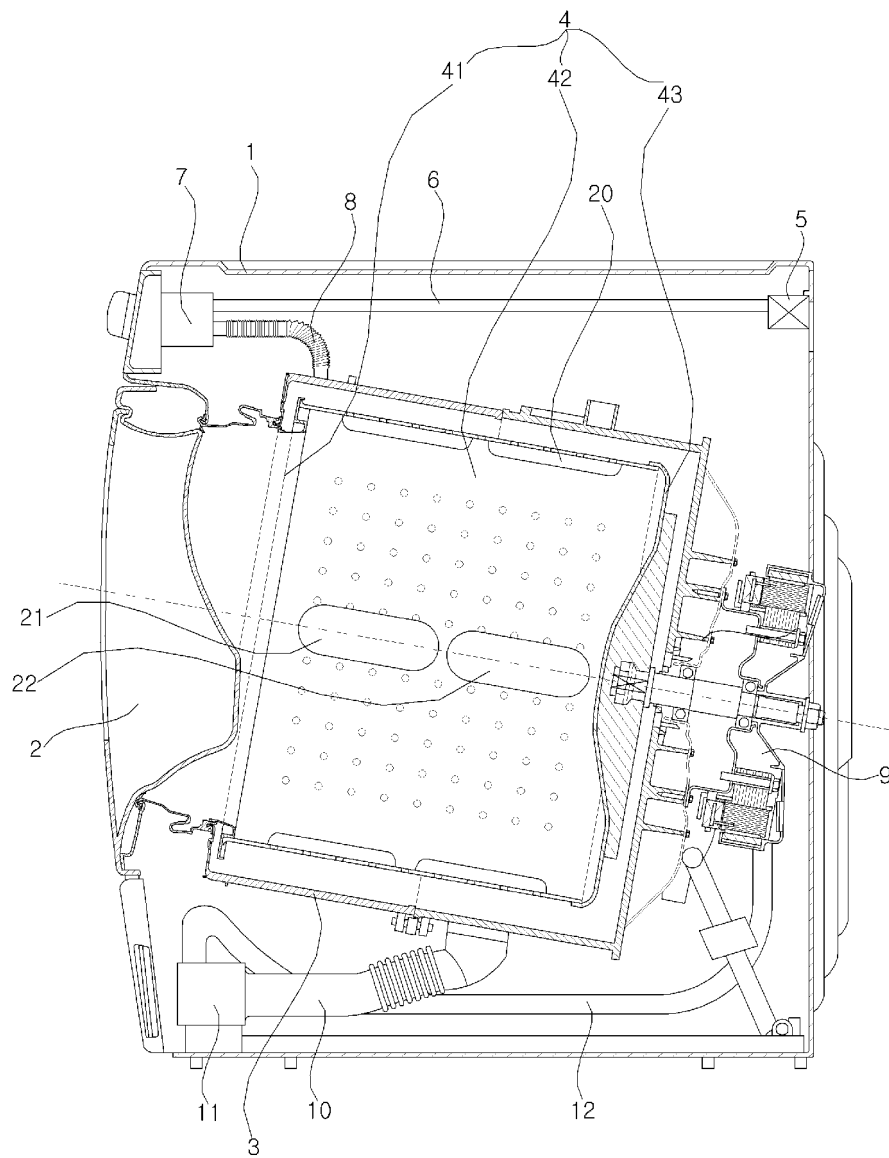


FIG. 2

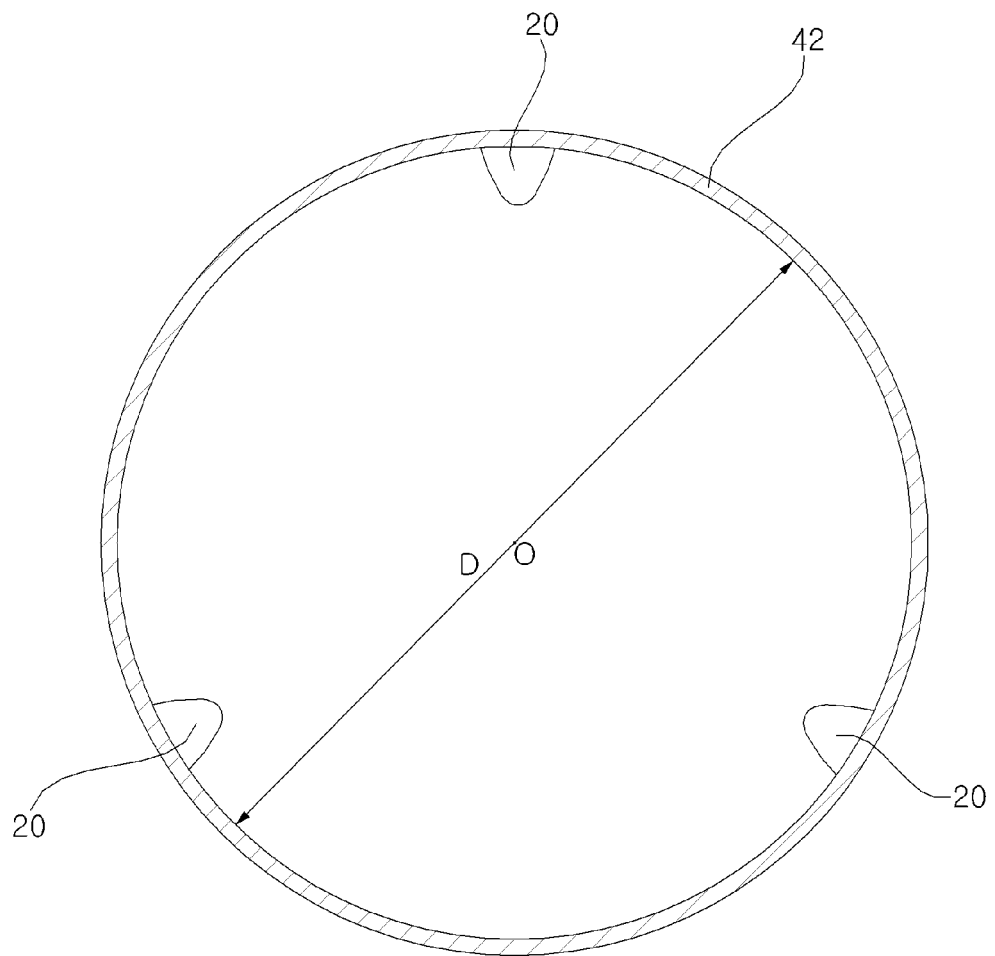


FIG. 3

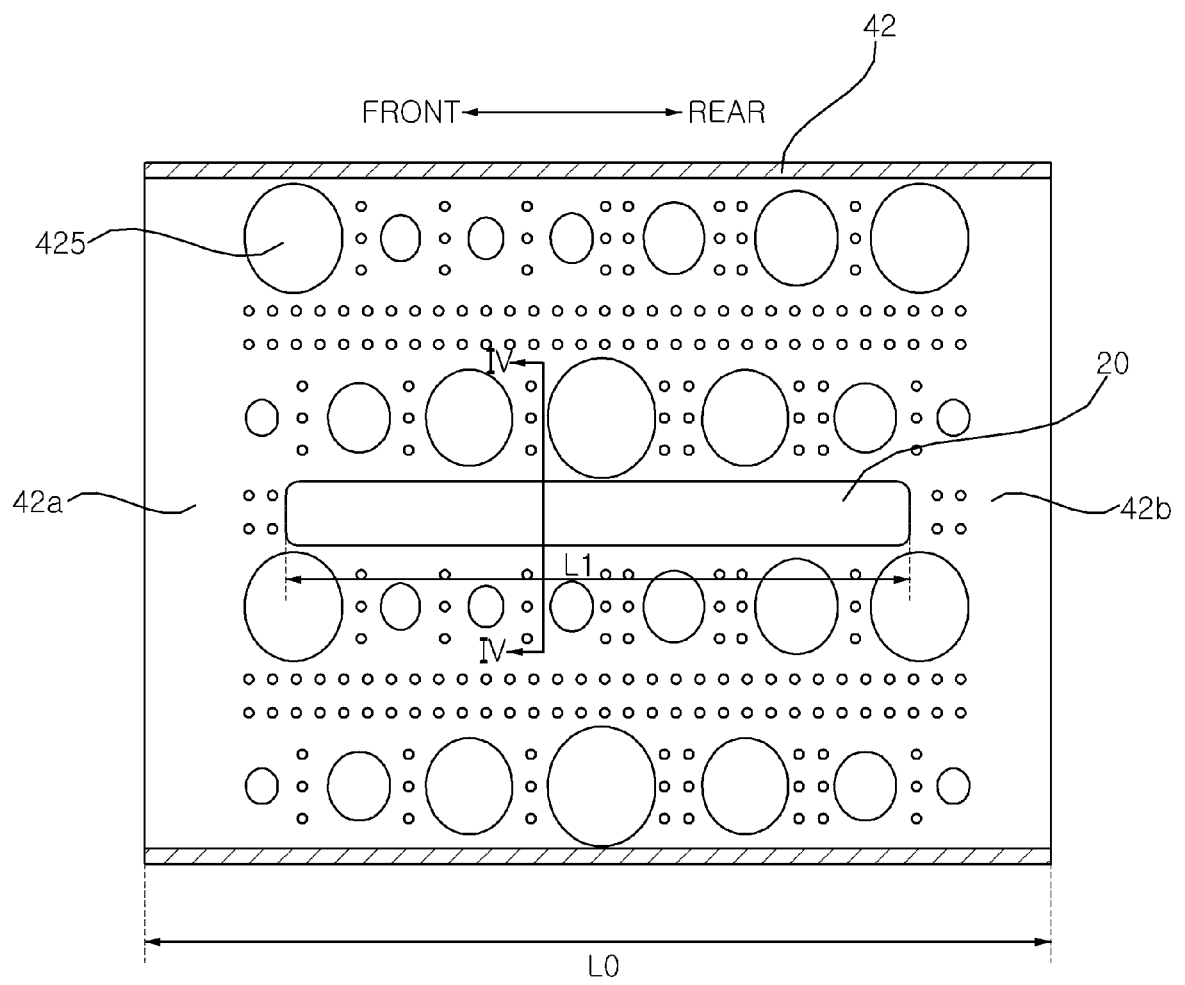


FIG. 4

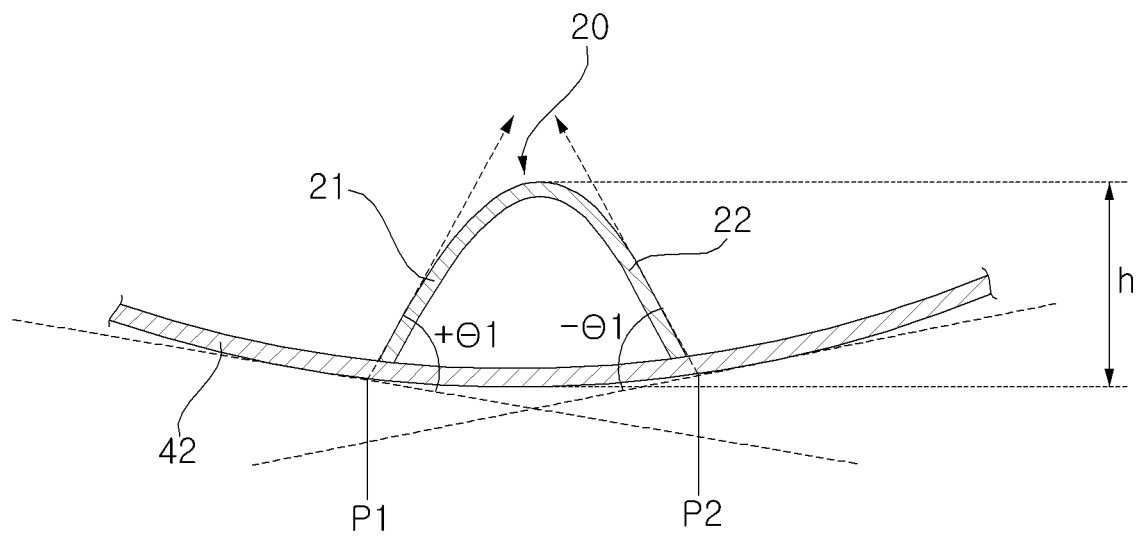


FIG. 5

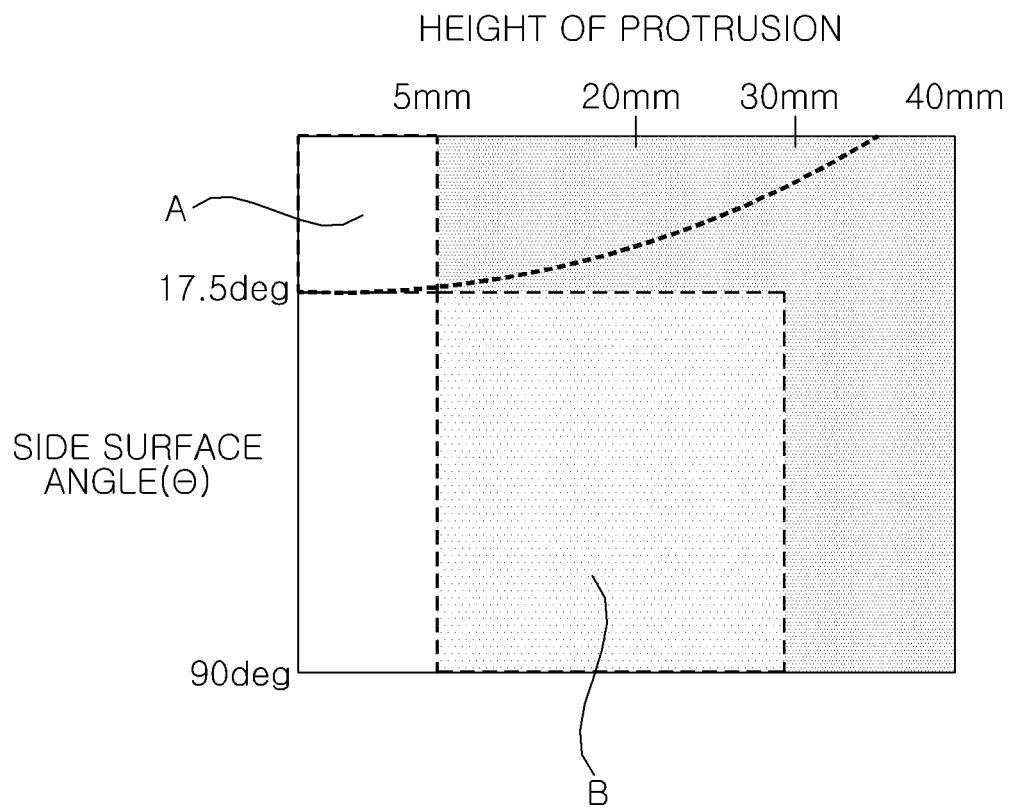


FIG. 6

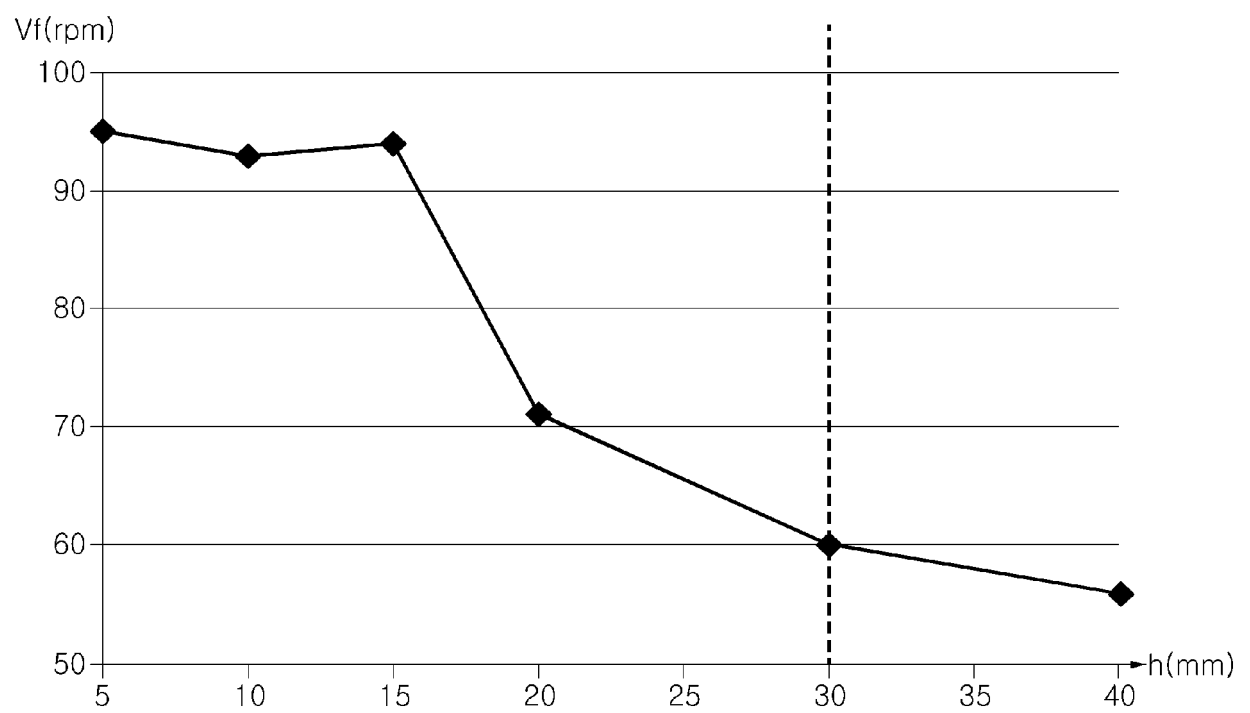
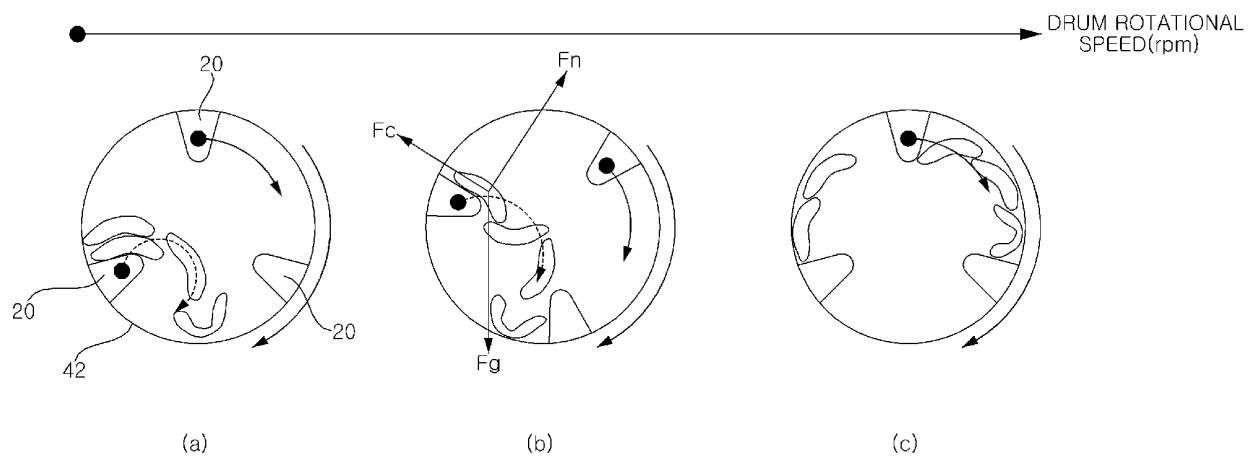


FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2019/010621

5	A. CLASSIFICATION OF SUBJECT MATTER <i>D06F 37/06(2006.01)i, D06F 37/22(2006.01)i, D06F 37/26(2006.01)i, D06F 33/02(2006.01)i, D06F 37/30(2006.01)i</i> According to International Patent Classification (IPC) or to both national classification and IPC		
10	B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) D06F 37/06; D06F 21/02; D06F 21/04; D06F 23/06; D06F 37/40; D06F 37/22; D06F 37/26; D06F 33/02; D06F 37/30 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		
15	Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) eKOMPASS (KIPO internal) & Keywords: washing machine, drum, protruding portion, embossing, height, fall		
20	C. DOCUMENTS CONSIDERED TO BE RELEVANT		
25	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	X	KR 10-2018-0009285 A (SAMSUNG ELECTRONICS CO., LTD.) 26 January 2018 See paragraphs [0037], [0077]-[0079] and figure 7.	1-2,5,7,10-11
	Y		3-4,6,8-9,12-13
30	Y	CN 204690366 U (WUXI LITTLE SWAN CO., LTD.) 07 October 2015 See claims 1, 4, 7-9 and figures 1-4.	3-4,6,8-9
	Y	JP 2015-006283 A (SHARP CORP.) 15 January 2015 See claims 1, 5 and figures 2-4, 8, 11.	12-13
35	A	KR 10-2002-0093274 A (LG ELECTRONICS INVESTMENT LTD.) 16 December 2002 See claims 1-4 and figures 3-6.	1-13
	A	US 5782111 A (SIGHTS et al.) 21 July 1998 See column 3, lines 31-57 and figures 1-3.	1-13
40	☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
45	* 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		
50	Date of the actual completion of the international search 19 DECEMBER 2019 (19.12.2019)		Date of mailing of the international search report 20 DECEMBER 2019 (20.12.2019)
55	Name and mailing address of the ISA/KR  Korean Intellectual Property Office Government Complex Daejeon Building 4, 189, Cheongsu-ro, Seo-gu, Daejeon, 35208, Republic of Korea Facsimile No. +82-42-481-8578		Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

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KR 10-2002-0093274 A	16/12/2002	None	
US 5782111 A	21/07/1998	None	

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- KR 1020110022359 [0002]