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

(11) EP 1 526 209 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
27.04.2005 Bulletin 2005/17

(51) Int Cl.[7]: **D06F 23/06**, D06F 35/00

(21) Application number: **04025184.5**

(22) Date of filing: **22.10.2004**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL HR LT LV MK

(30) Priority: **23.10.2003 JP 2003362660**

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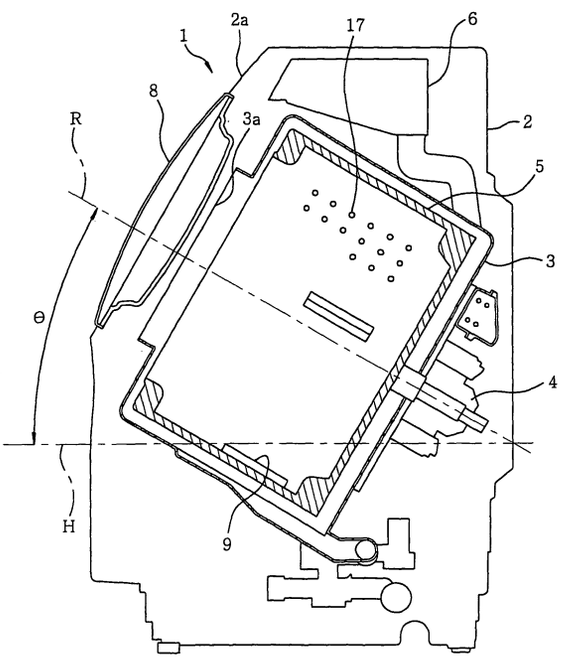
(54) Drum type washing machine

(57) A drum type washing machine (1) includes a rotary drum (5) installed in a water tub (3) such that a rotational axis thereof is declined toward a rear portion of the washing machine with respect to a horizontal direction. An agitation control is executed for a predetermined time in at least one of a washing process and a rinsing process. The agitation control repeatedly performs a control process of rotating the rotary drum at a rotational speed for a first preset period of time and then stopping the rotary drum for a second preset period of time, and a rotational force due to the first rotational speed allows laundry articles to be lifted up in the rotational direction of the rotary drum and dropped when reaching a height where the weight of the laundry articles is greater than a centrifugal force of the rotary drum exerted on the laundry articles.

FIG. 1



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Description

[0001] The present invention relates to a drum type washing machine for washing laundry articles accommodated in a rotary drum by rotating the rotary drum installed in a water tub.

[0002] Referring to Fig. 7, there is shown a conventional drum type washing machine. As shown therein, housing 57 of the washing machine includes water tub 53 installed via a suspension structure. Incorporated in water tub 53 is rotary drum 51 which is provided with a number of drum perforations 52 on its peripheral surface. Rotary drum 51 is driven to rotate by drum driving motor 55. Further, by opening door 54, which is installed at the front portion of housing 57, laundry articles can be loaded into or unloaded from rotary drum 51 via respective openings formed at the front portions of water tub 53 and rotary drum 51.

[0003] After opening door 54, the laundry articles and detergent are added into rotary drum 51, and the operation of the washing machine is initiated. Water is fed into water tub 53 and the amount of water required for rotary drum 51 is supplied into rotary drum 51 through drum perforations 52. Then, when rotary drum 51 is driven to rotate at a predetermined rotational speed by drum driving motor 55, the laundry articles accommodated in rotary drum 51 are lifted up in the rotational direction by being caught on agitation blades 56 provided on the inner peripheral surface of rotary drum 51 and are dropped upon reaching a specific height, thereby undergoing pounding motions. After completion of the washing process, soiled washing water is drained, and a rinsing process is carried out in fresh water. Then, when the rinsing process is finished, a water-extracting process is carried out by way of spinning rotary drum 51 at a high rotational speed. The series of processes described are automatically performed according to a preset control sequence.

[0004] The above-described washing machine has a general configuration of a drum type washing machine. In addition to the washing machine with such a basic configuration, there is suggested, for example, a drum type washing machine employing a structure for supplying the water stored in the water tub into the rotary drum in order to allow laundry articles to be sufficiently soaked in water, to provide more thorough washing (see Japanese Patent Laid-Open Application No. 1997-215893, pp. 3 to 5, Fig. 1). Besides, there is also developed a washing machine having a laundry drying function for drying laundry articles by way of blowing warm air into the rotary drum.

[0005] A drum type washing machine is the most popular type in the Western countries because it is advantageous in that laundry articles are subject to less damages and that a small amount of water can be used for washing, compared to a conventional vertical washing machine for washing laundry articles by rotating a pulsator. Since, however, the conventional drum type washing machine employs the structure of carrying the laundry articles into and out of the rotary drum through an opening provided at about the central portion of the front surface of the washing machine, the user has to bend down to load and unload laundry articles; this is not only inconvenient but also unsuitable for a small place without sufficient clearance space in front of the washing machine. To solve the problems, it has been suggested to have the rotary drum slanted, while raising the opening of the rotary drum so that loading and unloading of laundry articles would become easier. However, if the slanted rotary drum is rotated at the same rotational speed as that of the conventional drum type washing machine having a horizontal rotary drum, the laundry articles tend to slide toward the rear portion of the rotary drum. Consequently, a satisfactory effect of pounding motions; i.e., lift and dropping of laundry articles, do not occur, thereby failing to achieve a desired cleaning efficiency.

[0006] That is, although the loading and unloading of laundry articles can be facilitated by slanting the rotary drum, there still exists a problem in that laundry articles tend to remain in the bottom portion of the slanted rotary drum while such tendency of laundry articles is further caused by the rotation of the rotary drum, failing to achieve a sufficient cleaning efficiency. The problem gets worse as the angle of inclination of the rotary drum is increased. Accordingly, if the rotary drum is slanted at a greater angle of inclination to maximize the function of facilitating loading and unloading of laundry articles, the effect of pounding motions, which is a characteristic feature of the drum type washing machine, is deteriorated, so that a sufficient cleaning efficiency cannot be achieved.

[0007] It is, therefore, an object of the present invention to provide a drum type washing machine capable of facilitating loading/unloading of laundry articles by slanting a cylindrical rotary drum; and capable of solving the problem of laundry articles gathering at the lower position of the rear portion of the rotary drum by way of performing an agitation control for agitating laundry articles so that all of the laundry articles are subject to the same level of detergency.

[0008] In accordance with a preferred embodiment of the present invention, there is provided a drum type washing machine including: a cylindrical rotary drum having a bottom surface, installed in a water tub such that a rotational axis thereof is declined toward a rear portion of the washing machine at an angle of about 30 $\pm$ 5 degrees with respect to a horizontal direction, the rear portion referring to a portion opposite to a front portion where an opening of the rotary drum is provided, wherein a first agitation control is executed for a first specific period of time in at least one of a washing process and a rinsing process, the first agitation control repeatedly performing a control process of rotating the rotary drum at a first rotational speed for a first preset period of time and then stopping the rotary drum for a sec-

ond preset period of time, and a rotational force due to the first rotational speed allowing laundry articles to be lifted up in the rotational direction of the rotary drum and dropped when reaching a height where the weight of the laundry articles is greater than a centrifugal force of the rotary drum exerted on the laundry articles.

[0009] Since the cylindrical rotary drum having the bottom surface is slanted, the front opening of the rotary drum is raised, so that the loading and unloading of laundry articles into and out of the rotary drum is facilitated. The angle of about 30 ± 5 degrees at which the rotary drum is slanted enables any users, whether they are children (not infants), adults or people using a wheelchair, to load and unload laundry articles conveniently regardless of their height. Accordingly, loading and unloading of the laundry articles can be performed without a user having to bend down while an installation of a drum type washing machine in a small space is also possible. Therefore, the drum type washing machine can be designed to be suitable for even small houses with limited space. On the other hand, if the rotary drum is slanted, there occurs a problem in that laundry articles tend to gather at the lower position of the rear portion of the rotary drum, where they cannot be fully agitated. The problem, however, can be solved by performing an agitation control in the washing and/or the rinsing process. That is, since the agitation control allows the laundry articles, which tend to gather at the lower position of the slanted rotary drum, to be sufficiently agitated while changing positions in the rotary drum, the laundry articles can be subject to substantially the same level of detergency.

[0010] With the above configuration, the rotary drum is driven to rotate in forward and reverse directions alternately to prevent laundry articles from being entangled. As a result, the position changes of the laundry articles in the rotary drum can be facilitated, which guarantees efficient cleaning of laundry articles.

[0011] Further, if the rotary drum rotates at a first rotational speed, e.g., 30 ± 5 rpm when the diameter of the rotary drum is about 500 ± 50 mm, the laundry articles are lifted up in the rotational direction of the rotary drum and then dropped when they reach a position where their weight becomes greater than the centrifugal force e the rotary drum. As a result, the laundry articles go through pounding motions while their positions are being changed. If the rotational speed of the rotary drum is lower than about 30 ± 5 rpm, the laundry articles may not be lifted up, and, if the rotational speed is greater than the above value, on the other hand, the articles may not drop because the centrifugal force is greater than their weight.

[0012] The rotational speed for changing the positions of laundry articles is varied depending on the amount of laundry articles. Therefore, the amount of laundry articles is detected by a laundry amount detector. When the detected amount of the laundry articles is greater than a preset amount, the first rotational speed is reduced down to, e.g., 25 to 30 rpm. On the other hand, if the detected amount is smaller than the preset amount, the first rotational speed is raised to, e.g., 30 to 35 rpm. As a result, the pounding motions depending on the amount of the laundry articles can occur and therefore the laundry articles can be efficiently agitated while changing their positions in the rotary drum.

[0013] Furthermore, a second agitation control is performed for a second specific period of time in at least one of the washing process and the rinsing process. The second agitation control repeatedly performs a control process of rotating the rotary drum at a second rotational speed for a third preset period of time and then stopping the rotary drum for a fourth preset period of time. If the rotary drum rotates at the second rotational speed increasing the influence of centrifugal force on the laundry articles, the laundry articles get separated from each other and spread out to cling to the inner peripheral surface of the rotary drum, and, when the rotary drum is stopped, the laundry articles would drop. Therefore, in addition to the position changes, the laundry articles go through changes in their forms as well, so that the laundry articles, which tend to entangle in the lower position of the rotary drum, can be dispersed in the rotary drum.

[0014] Moreover, by performing the first agitation control and the second agitation control alternately for a predetermined period of time, the laundry articles are fully agitated while changing their forms and positions. Therefore, all the laundry articles are subject to substantially the same degree of detergency, and the problem caused by slanting the rotary drum can be solved.

[0015] In addition, one or more agitation blades, each having a ridge elongated at a specific angle of inclination with respect to the direction of the rotational axis of the rotary drum, are provided at one or more locations on the inner peripheral surface of the rotary drum. When the rotary drum rotates, the agitation blades serve to move laundry articles from a lower position of the rotary drum to a higher position thereof in a direction different from the rotational direction of the rotary drum by using the ridges thereof. Thus, if ridges are formed at an angle of inclination capable of creating an effect of lifting the laundry articles from a lower position to the higher position of the rotary drum, the laundry articles, which tend to gather at the lower position of the rotary drum, can be dispersed in the rotary drum more efficiently.

[0016] In accordance with another preferred embodiment of the present invention, there is provided a drum type washing machine including: a rotary drum having a substantially horizontal or slanted rotational axis and a controller, wherein the controller performs a first agitation control for rotating the rotary drum at a first rotational speed and a second agitation control for rotating the rotary drum at a second rotational speed higher than the first rotational speed in at least one of a washing process and a rinsing process.

[0017] The above and other objects and features of the present invention will become apparent from the fol-

lowing description of a preferred embodiment given in conjunction with the accompanying drawings, in which:

Fig. 1 shows a configuration of main components of a drum type washing machine in accordance with a preferred embodiment of the present invention;
Fig. 2 illustrates the arrangement of a control unit for use in the drum type washing machine in accordance with the preferred embodiment of the present invention;
Fig. 3 shows a timing chart that describes a control sequence of a rotary drum by using the control unit as shown in Fig. 2;
Figs. 4A to 4C provide a plan view, a front view and a side view of a first example of an agitation blade, respectively;
Figs. 5A to 5C present a plan view, a front view and a side view of a second example of an agitation blade, respectively;
Figs. 6A to 6C set forth a plan view, a front view, and a side view of a third example of an agitation blade, respectively; and
Fig. 7 shows a configuration of a conventional drum type washing machine.

[0018] Referring to Fig. 1, there is shown a configuration of main components of drum type washing machine 1 in accordance with a preferred embodiment of the present invention. Housing 2 incorporates therein water tub 3 installed via a suspension structure (not shown), and cylindrical rotary drum 5 having a bottom surface is disposed in water tub 3 such that the direction R of its rotational axis is slanted at an angle θ of 30 ± 5 degrees with respect to the horizontal direction H.

[0019] Specifically, rotary drum 5 is installed in water tub 3 such that its opening is positioned at the front portion of housing 2 while the bottom surface of rotary drum 5 is disposed at the rear portion of housing 2. Further, rotary drum 5 is slanted such that the direction R of the rotational axis thereof is declined toward the rear portion of housing 2 at a specific angle θ. Rotary drum 5 is driven to rotate by drum driving motor 4. Formed at the front portion of water tub 3 is opening 3a through which laundry articles are loaded into and unloaded from rotary drum 5. Further, door 8 is installed through inclined surface 2a formed at the front surface portion of housing 2, facing opening 3a. Laundry articles can be loaded into or unloaded from rotary drum 5 after door 8 is opened. Further, by forming door 8 partially or entirely with a transparent material, the inside of rotary drum 5 can be viewed from the outside.

[0020] As described, by having rotary drum 5 slanted and installing door 8 on housing 2 to face the opening of rotary drum 5, loading and unloading of laundry articles can be performed without a user having to bend down, and installation of drum type washing machine 1 in a small space, e.g., a bathroom, where a conventional vertical washing machine is typically installed, is facilitated because having clearance space in front of washing machine 1 is no longer required. Therefore, drum type washing machine 1 can be configured to be suitable for even small houses with limited space.

[0021] Inventors of the present invention conducted extensive researches to find an optimum angle θ of inclination of rotary drum 5, and it was found that it is preferable to be about 30 ± 5 degrees. By slanting rotary drum 5 at the angle θ of about 30 ± 5 degrees, any users, whether they are children (not infants), adults or people using a wheelchair, can load and unload laundry articles conveniently regardless of their height.

[0022] In addition, the angle of inclination may be unimportant if rotary drum 5 is located at an extremely high or low level even if it is slanted at the optimum angle θ of about 30 ± 5 degrees. However, there is a preferable height level for a washing machine to be usually placed on the floor, and there is also a height level for rotary drum 5 determined in order to install components such as a water feed/drain structure and/or a control unit in housing 2. Therefore, the height of rotary drum 5 is not varied greatly, and the height of door 8, which is configured to correspond to the opening provided in front of rotary drum 5 to allow loading and unloading of laundry articles, is not raised or lowered considerably. Drum type washing machine 1 in accordance with the preferred embodiment has a height of about 930 mm and the height of a central portion of door 8 is about 693 mm.

[0023] Although slanted rotary drum 5 described above is advantageous in that it facilitates loading and unloading of laundry articles and allows water supplied in rotary drum 5 to build up in the rear portion thereof so that a higher water depth level can be obtained even with a small quantity of water, it also has a disadvantage in that laundry articles accommodated in rotary drum 5 gather at the lower position of the rear portion of rotary drum 5. In addition, the tendency of the laundry articles to gather in the rear bottom portion is caused by the rotation of rotary drum 5, in which condition it is not possible to provide a satisfactory degree of detergency to all laundry articles being washed by changing their positions in rotary drum 5. For this reason, in addition to simply having inclined installation of rotary drum 5, other attempts have been made to solve the above problem. As a solution to such problem, the preferred embodiment of the present invention includes a process of changing the positions of the laundry articles in rotary drum 5 by way of controlling the rotations of rotary drum 5 driven by drum driving motor 4.

[0024] As shown in Fig. 2, control unit 10 for controlling the operation of drum type washing machine 1 includes controller 11 made up of a microcomputer. Controller 11 controls operations of drum driving motor 4, water supply valve 26 and water drain pump 27. Further, setting unit 13 and display unit 14 are installed in a console disposed on the surface of housing 2. When an operation course is selected through setting unit 13, a selected setup state to be conducted and an operational

state are displayed on display unit 14, and controller 11 transmits control commands to power switching unit 12 according to a control sequence stored in storage unit 15, so that drum driving motor 4, water supply valve 26 and water drain pump 27 are turned on and off according to an operational sequence. Hereinafter, operation of drum type washing machine 1 using control unit 10 will be described with reference to Figs. 1 to 3.

[0025] After opening door 8, laundry articles are loaded into rotary drum 5 and detergent is also added into rotary drum 5 from a detergent dispenser disposed in water supply unit 6. Then, power switch 18 is turned on and an operation course is selected from setting unit 13 depending on the types of laundry articles being washed. Then, an operation start input is generated, and an operation control is initiated by control unit 10. Drum type washing machine 1 basically performs a washing process, a rinsing process and a water-extracting process in that order. When drum type washing machine 1 has a drying function, a drying process can be executed without a particular process sequence.

[0026] First, in order to detect the amount of laundry articles accommodated in rotary drum 5, controller 11 transmits a control command to power switching unit 12 to prompt drum driving motor 4 to rotate rotary drum 5 at a predetermined rotational speed. Then, drum driving motor 4 which is switched on by power switching unit 12 is driven to rotate rotary drum 5, and laundry amount detector 16 detects the amount of the laundry articles based on a load exerted on drum driving motor 4 from the laundry articles. The amount of the laundry articles detected by laundry amount detector 16 is stored in storage unit 15 for use in a control operation to be described below.

[0027] Controller 11 transmits a control command to power switching unit 12 to open water supply valve 26, and water supply valve 26 is opened by power switching unit 12. Then, fresh water is fed into water tub 3 from a water supply hose connected to water supply unit 6. At this time, the detergent supplied in water supply unit 6 is also added into water tub 3 while being dissolved in the water. The water level in water tub 3 is detected by the sensor of water level detector 19 installed in water tub. When the water level reaches a specific level, a water level detection signal is transmitted to controller 11 from water level detector 19, and controller 11 transmits a control command for closing water supply valve 26 to power switching unit 12 to thereby stop the supply of water. Since the water supplied in water tub 3 is absorbed by the laundry articles in rotary drum 5 through drum perforations 17 formed on rotary drum 5, the water level in water tub 3 becomes lower. Thus, water tub 3 is replenished with water through the same process as described above. Although a control operation for heating water in water tub 3 by a heater up to a certain temperature to improve detergency may be done, explanation thereof will be omitted because such feature is not directly related to the present invention.

[0028] Washing of laundry articles can be initiated through the above-described control operations. Controller 11 transmits a control command to power switching unit 12 to prompt drum driving motor 4 to rotate rotary drum 5. An operational sequence for rotating rotary drum 5 is stored in storage unit 15. Hereinafter, the operational sequence for rotating rotary drum 5 will be described in accordance with the preferred embodiment of the present invention in conjunction with Fig. 3. Further, though drum driving motor 4 is configured so that its rotational speed and rotational direction can be changed, explanation of the configuration and a controlling method thereof will be omitted herein. In addition, the influence of, e.g., centrifugal force applied on the laundry articles due to the rotation of rotary drum 5 is varied depending on the diameter of rotary drum 5. Specific values of rotational speeds to be explained hereinafter are examples for the case where the diameter of rotary drum 5 in drum type washing machine 1 is about 500 mm in accordance with the preferred embodiment of the present invention.

[0029] As shown in Fig. 3, a first agitation control operation is conducted at first. Repeatedly executed in the first agitation control operation is a first agitation cycle, which includes a series of stages of forwardly rotating rotary drum 5 at a first rotational speed (e.g., 30 ± 5 rpm) for a first preset period of time (e.g., 13 seconds); stopping rotary drum 5 for a second preset period of time (e.g., 2 seconds); reversibly rotating rotary drum 5 at the first rotational speed for the first preset period of time; and then stopping rotary drum 5 for the second preset period of time. The first agitation control operation is conducted for a first predetermined period of time (e.g., 4 minutes).

[0030] The first rotational speed is a rotational speed allowing laundry articles accommodated in rotary drum 5 to be lifted up in the rotational direction of rotary drum 5 and dropped upon reaching a position where the weight of the laundry articles becomes greater than the centrifugal force exerted on them by the rotary drum. Since the laundry articles are lifted up and dropped, an effect of pounding motions is produced, and repeated pounding motions facilitate a cleaning action for removing soils from laundry articles soaked in wash water containing detergent dissolved therein. With a rotational speed smaller than the first rotational speed, the laundry articles cannot be lifted up by agitation blades 9, whereas no drop motion of the laundry articles would take place with a rotational speed greater than the first rotational speed because the influence of centrifugal force would become greater than the weight of the laundry articles. Furthermore, by reversing the rotational direction of rotary drum 5 alternately, the laundry articles can be prevented from being entangled so that position changes of the laundry articles in rotary drum 5 become facilitated.

[0031] The effect of pounding motions, i.e., lifting up and then dropping laundry articles, is affected by the

amount of laundry articles accommodated in rotary drum 5. Therefore, it is recommended to vary the first rotational speed depending on the amount of the laundry articles. As described earlier, the amount of laundry articles can be detected by laundry amount detector 16 and the detected laundry amount is stored in storage unit 15. When the amount of the laundry articles stored in storage unit 15 is greater than a preset amount, controller 11 sets the first rotational speed to be reduced to, e.g., 25 to 30 rpm. On the other hand, if the amount of the laundry articles stored in storage unit 15 is smaller than the preset amount, controller 11 increases the first rotational speed up to, e.g., 30 to 35 rpm.

[0032] Though it is possible to obtain a cleaning effect of laundry articles while changing their positions by way of repeating only the first agitation control operation for a specific washing time (e.g., about 15 minutes), it is more preferable to execute a second agitation control operation after the first agitation control operation, as shown in Fig. 3.

[0033] Repeatedly performed in the second agitation control operation is a second agitation cycle including a series of stages of forwardly rotating rotary drum 5 at a second rotational speed (e.g., 45 to 90 rpm) for a third preset period of time (e.g., 7 seconds); stopping rotary drum 5 for a fourth preset period of time; reversibly rotating rotary drum 5 at the second rotational speed for the third preset time period; and then stopping rotary drum 5 for the fourth preset time period. The second agitation cycle is repeated for a second predetermined period of time (e.g., 1 minute).

[0034] The second rotational speed represents a rotational speed allowing the laundry articles not to drop but to cling to the inner peripheral surface of rotary drum 5 by the centrifugal force produced by the rotation of rotary drum 5. The laundry articles' tendency to cling to the inner peripheral surface of rotary drum 5 separates and spreads out the entangled articles. Furthermore, when rotary drum 5 is stopped for the fourth preset time period, the laundry articles lifted up to the upper portion of rotary drum 5 are detached from the inner peripheral surface and dropped by the influence of gravity. By the spreading-out and dropping movements of the laundry articles, positions of the articles are changed while their shapes are changed as well.

[0035] By performing the first and the second agitation control operations alternately for a third predetermined period of time (e.g., 15 minutes), changing of the positions of laundry articles in rotary drum 5 can be sufficiently performed and different pounding motions in the two agitation control operations can be obtained so that it is possible to provide substantially the same degree of detergency to all of the laundry articles even in slanted rotary drum 5 without reducing the cleaning efficiency.

[0036] Upon completion of the washing process described, controller 11 opens a water drain valve and, at the same time, transmits a control command to power switching unit 12 to operate water drain pump 27, so that a water drain control operation for discharging soiled water from water tub 3 is executed. Moreover, controller 11 transmits a control command to power switching unit 12 to extract water from the laundry articles by rotating drum driving motor 4, whereby a water-extraction of the laundry articles is performed after the washing process.

[0037] After a predetermined time period for the water extraction of laundry articles, controller 11 closes the water drain valve but opens water supply valve 26, so that fresh water is fed into water tub 3 and a rinsing process is started. In the rinsing process, the laundry articles in rotary drum 5 are subject to agitating motions by alternately rotating rotary drum 5 forwardly and reversibly. For instance, if the first and/or the second agitation control operation as in the washing process are executed in the rinsing process, the positions of the laundry articles in rotary drum 5 are changed and the effect of the pounding motions can be applied to all over laundry articles, so that a substantially uniform rinsing result can be obtained.

[0038] After a predetermined time period for the rinsing operation, a water-extraction process is performed, after which the whole process is terminated. Then, controller 11 reports the termination of the whole process and, at the same time, triggers to turn off power switch 18 to thereby terminate the operation of washing machine 1. When drum type washing machine 1 additionally has a drying function, a drying process can be performed after the water extraction process.

[0039] Referring to Figs. 4 to 6, there are shown examples of agitation blade 9 provided on the inner peripheral surface of rotary drum 5 in drum type washing machine 1 described above. As shown therein, each of agitation blades 9a to 9c has ridge 4a elongated at a specific angle of inclination with respect to the direction of the rotational axis of rotary drum 5.

[0040] Figs. 4A to 4C show a first example of agitation blade 9. Agitation blade 9a includes base 23 of a substantially rectangular shape abutted against the inner peripheral surface of rotary drum 5 and has a cross section of a mountain shape having ridge 22 of a predetermined height formed in a generally diagonal direction with respect to base 23. Formed between ridge 22 and base 23 is inclined surface of a substantially arc shape having different radii depending on the cross sectional position. Agitation blade 9a is placed on the inner peripheral surface of rotary drum 5 such that the longitudinal direction of base 23 coincides with the direction of the rotational axis of rotary drum 5, so that ridge 22 forms the angle of inclination with respect to the direction of the rotational axis of rotary drum 5.

[0041] If rotary drum 5 having agitation blades 9a configured as above at a plurality of locations on the inner peripheral surface is rotated in the washing or the rinsing process, laundry articles, which tend to gather at the lower position of slanted rotary drum 5, are lifted up from the rear portion to a higher position of the front portion

of rotary drum 5. Therefore, the laundry articles can be sufficiently agitated in such slanted rotary drum 5 without sliding toward the lower position of the rear portion of rotary drum 5. As a result, the laundry articles are agitated, while changing positions in rotary drum 5, to thereby prevent a reduction in the washing efficiency. In case of washing a small amount of laundry articles, the amount of wash water is also small, so that the laundry articles may not be completely soaked in wash water. In such case, the agitating motions for changing positions of the laundry articles in rotary drum 5 should be sufficiently performed in order to make the laundry articles fully soaked in wash water. However, in rotary drum 5 having agitation blades 9a, changing of the positions of the laundry articles are sufficiently performed, which in turn prevents non-uniform cleaning and enhances the cleaning efficiency.

[0042] Figs. 5A to 5C show agitation blade 9b as a second example of agitation blade 9, wherein the height of ridge 22 becomes greater toward the rear portion of rotary drum 5. By heightening ridge 22 toward the rear portion of rotary drum 5, i.e., the lower position of rotary drum 5, the motion of lifting up the laundry articles from the lower position to the higher position of the front portion of rotary drum 5 increases. As a result, the laundry articles are sufficiently agitated by changing the positions in rotary drum 5 to increase the agitating efficiency.

[0043] Figs. 6A to 6C show agitation blade 9c as a third example of agitation blade 9, wherein two ridge sections 24 of a substantially triangular shape are formed on base 25, and they are inclined at same angles but in reverse directions with respect to the direction of the rotational axis of rotary drum 5, respectively. Agitation blade 9c configured as above allows for the laundry lift-up motions for lifting up the laundry articles to the higher position of the front portion of rotary drum 5 to be uniformly performed regardless of the rotational direction of rotary drum 5, which is driven to rotate forwardly and backwardly alternately.

[0044] When rotary drum 5 is slantingly disposed, the agitating efficiency can be improved by installing agitation blades 9a to 9c near to the rear portion of rotary drum. Further, it is preferred to configure the length of agitation blades 9a to 9c to be approximately 1/2 of that of rotary drum 5. By configuring agitation blades 9a to 9c as such, there can be obtained an effect of raising laundry articles in the lower position of rotary drum 5 to the higher position thereof.

[0045] The conventional drum type washing machine is advantageous in that the laundry articles are subject to less damage and that a small quantity of water is used, but is disadvantageous with respect to effective utilization of space. That is, the structure of carrying the laundry articles into and out of the rotary drum through the front portion of the washing machine is not only inconvenient but also unsuitable for small houses having limited space. However, by slantingly disposing the rotary drum at an angle of about 30 ± 5 degrees, the loading and unloading processes of the laundry articles can be performed conveniently without a user having to bend down, and it is possible to install the drum type washing machine in a small space. Accordingly, the ergonomics of the drum type washing machine is equal to that of the conventional washing machine having a vertical water tub in which the loading and unloading of the laundry articles is performed through an opening prepared at its top portion. Moreover, the problem of the laundry article gathering in the lower position of the slanted rotary drum can be solved by using the agitation blades that serve to move the laundry articles in the lower position up to the higher position. As a result, a drum type washing machine having an excellent cleaning efficiency and ergonomics can be fabricated.

[0046] While the invention has been shown and described with respect to the preferred embodiments, it will be understood by those skilled in the art that various changes and modifications may be made without departing from the scope of the invention as defined in the following claims.

Claims

1. A drum type washing machine comprising:

a cylindrical rotary drum having a bottom surface, installed in a water tub such that a rotational axis thereof is declined toward a rear portion of the washing machine at an angle of about 30 ± 5 degrees with respect to a horizontal direction, the rear portion referring to a portion opposite to a front portion where an opening of the rotary drum is provided,

wherein a first agitation control is executed for a first specific period of time in at least one of a washing process and a rinsing process, the first agitation control repeatedly performing a control process of rotating the rotary drum at a first rotational speed for a first preset period of time and then stopping the rotary drum for a second preset period of time, and a rotational force due to the first rotational speed allowing laundry articles to be lifted up in the rotational direction of the rotary drum and dropped when reaching a height where the weight of the laundry articles is greater than a centrifugal force of the rotary drum exerted on the laundry articles.

2. The washing machine of claim 1, wherein the rotary drum is driven to rotate in forward and reverse directions alternately.

3. The washing machine of claim 1 or 2, wherein the first rotational speed is about 30 ± 5 rpm when the diameter of the rotary drum is about 500 ± 50 mm.

4. The washing machine of claim 3, wherein the amount of the laundry articles accommodated in the rotary drum is detected by a laundry amount detector, and the first rotational speed of the rotary drum is controlled to be about 25 to 30 rpm when the amount of the laundry articles is found to be greater than a preset amount.

5. The washing machine of claim 3, wherein the amount of the laundry articles accommodated in the rotary drum is detected by a laundry amount detector, and the first rotational speed is controlled to be about 30 to 35 rpm when the amount of the laundry articles is found to be smaller than a preset amount.

6. The washing machine of claim 1 or 2, wherein a second agitation control is executed for a second specific period of time in at least one of the washing process and the rinsing process, the second agitation control repeatedly performing a control process of rotating the rotary drum at a second rotational speed for a third preset period of time and then stopping the rotary drum for a fourth preset period of time, and the second rotational speed being a rotational speed allowing the laundry articles to cling to the inner peripheral surface of the rotary drum without dropping.

7. The washing machine of claim 6, wherein the first and the second agitation control are executed alternately for a third specific period of time.

8. The washing machine of any one of claims 1 to 7, further comprising one or more agitation blades provided at one or more locations on the inner peripheral surface of the rotary drum, wherein each of the agitation blades has a ridge elongated at a specific angle of inclination with respect to the direction of the rotational axis of the rotary drum.

9. A drum type washing machine comprising:

a rotary drum having a substantially horizontal or slanted rotational axis; and
a controller,

wherein the controller performs a first agitation control for rotating the rotary drum at a first rotational speed and a second agitation control for rotating the rotary drum at a second rotational speed higher than the first rotational speed in at least one of a washing process and a rinsing process.

10. The washing machine of claim 9, wherein the slanted rotational axis is inclined at an angle of about 30 ± 5 degrees with respect to the horizontal direction.

11. The washing machine of claim 9, wherein the first agitation control repeatedly performs a control process of rotating the rotary drum at the first rotational speed allowing laundry articles to be lifted up in the rotational direction of the rotary drum and dropped when reaching a height where the weight of the laundry articles is greater than a centrifugal force of the rotary drum exerted on the laundry articles; and then stopping the rotary drum.

12. The washing machine of claim 11, wherein the rotary drum is driven to rotate in forward and reverse directions alternately in the first agitation control.

13. The washing machine of claim 12, wherein the second agitation control repeatedly performs a control process of rotating the rotary drum at the second rotational speed allowing the laundry articles to cling to the inner peripheral surface of the rotary drum without dropping; and then stopping the rotary drum.

14. The washing machine of claim 13, wherein the first and the second agitation controls are executed alternately.

15. The washing machine of claim 13, wherein a time period for the first agitation control is longer than a time period for the second agitation control.

16. The washing machine of claim 13, wherein a duration of forward or reverse rotation prior to alternating the rotational direction of the rotary drum during the first agitation control is longer than a duration of forward or reverse rotations prior to alternating the rotational direction of the rotary drum during the second agitation control.

17. The washing machine of claim 13, wherein the rotary drum is driven to rotate in forward and reverse directions alternately in the second agitation control.

18. The washing machine of claim 17, wherein a duration of a forward rotation prior to alternating the rotational direction of the rotary drum is identical to a duration of a reverse rotation prior to alternating the rotational direction of the rotary drum in each of the first and second agitation controls.

FIG. 1

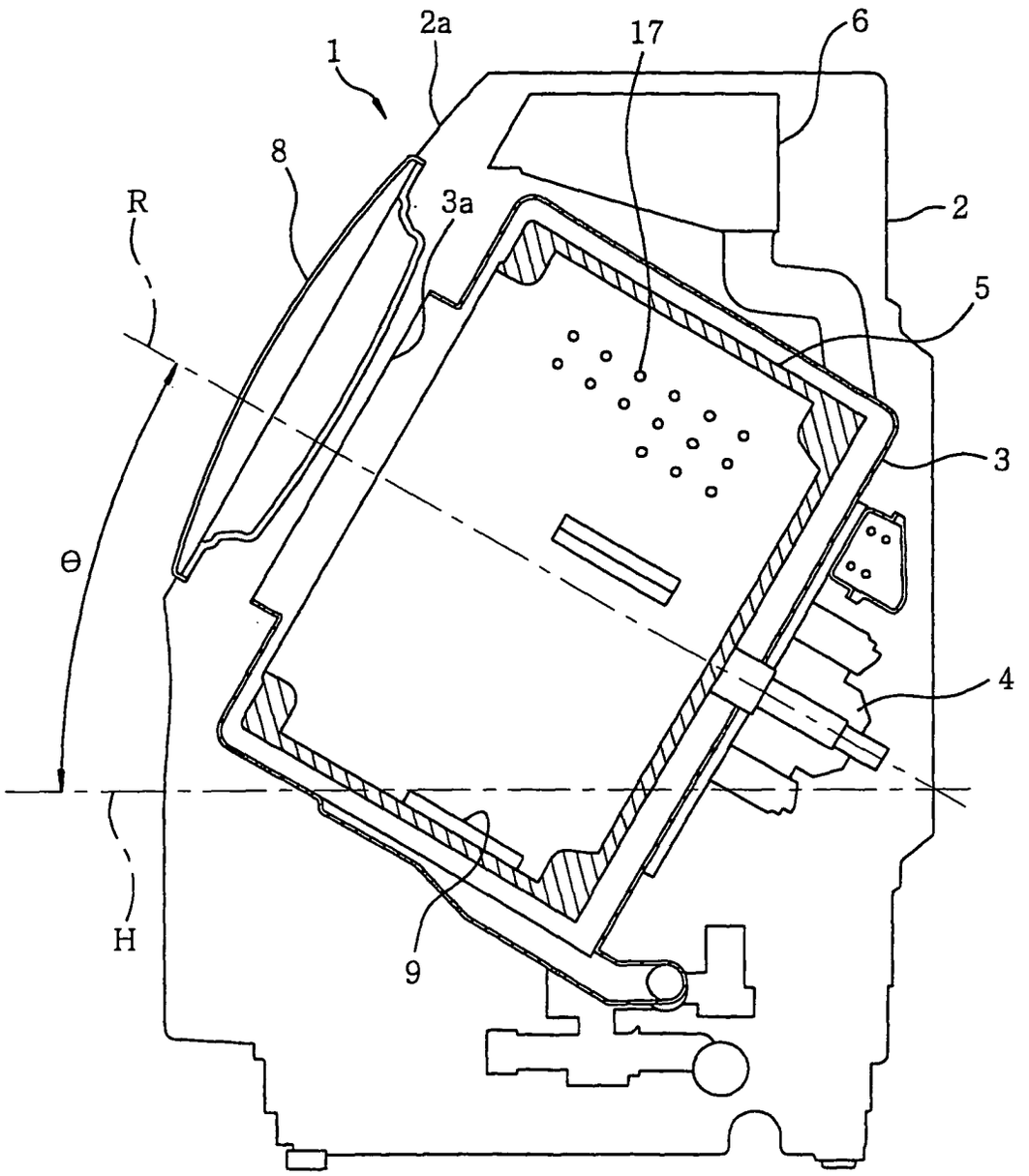

FIG.2

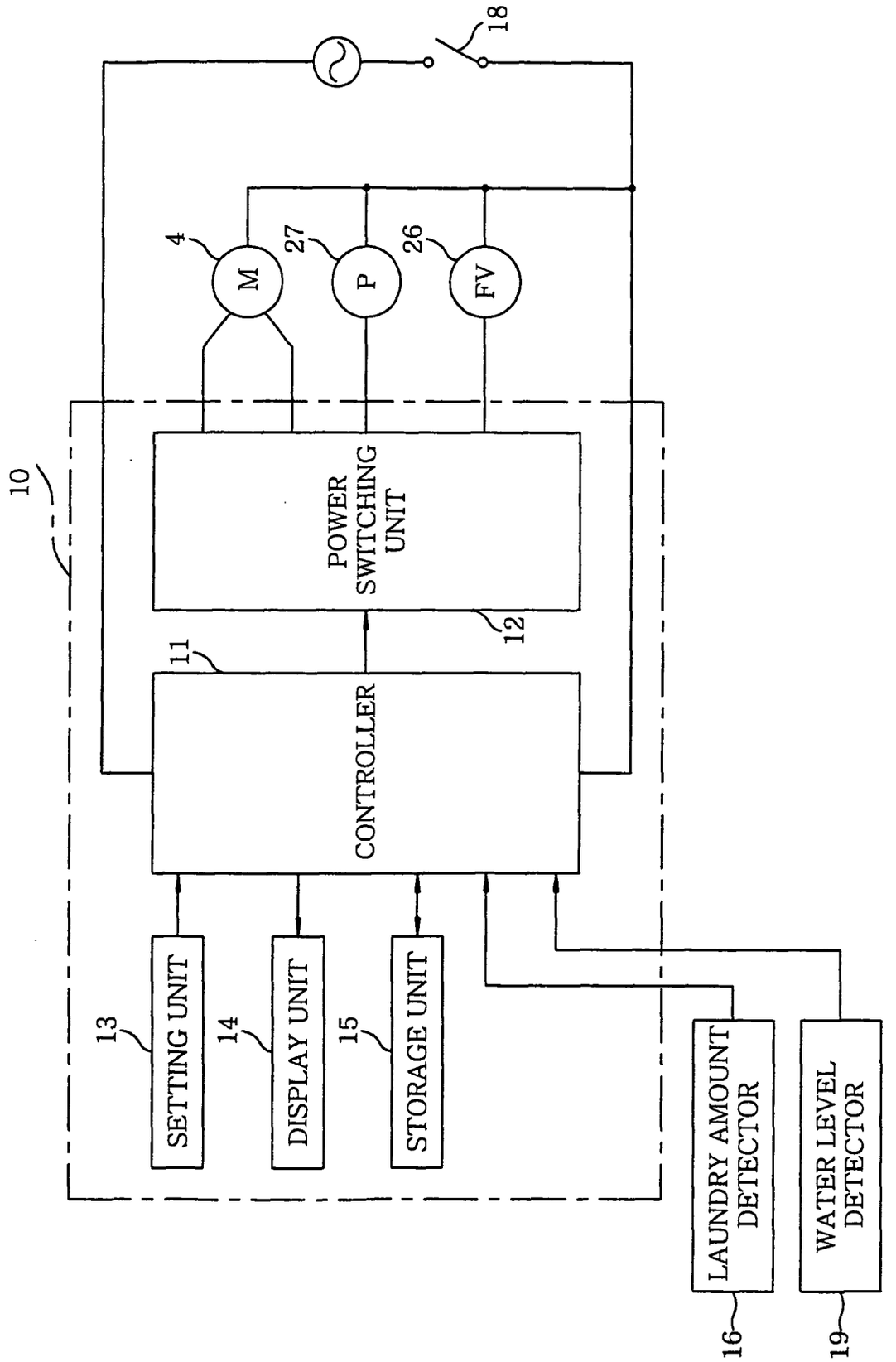
18
4
M
27
P
26
FV
10
POWER SWITCHING UNIT
12
11
CONTROLLER
13
SETTING UNIT
14
DISPLAY UNIT
15
STORAGE UNIT
LAUNDRY AMOUNT DETECTOR
16
WATER LEVEL DETECTOR
19

FIG.3

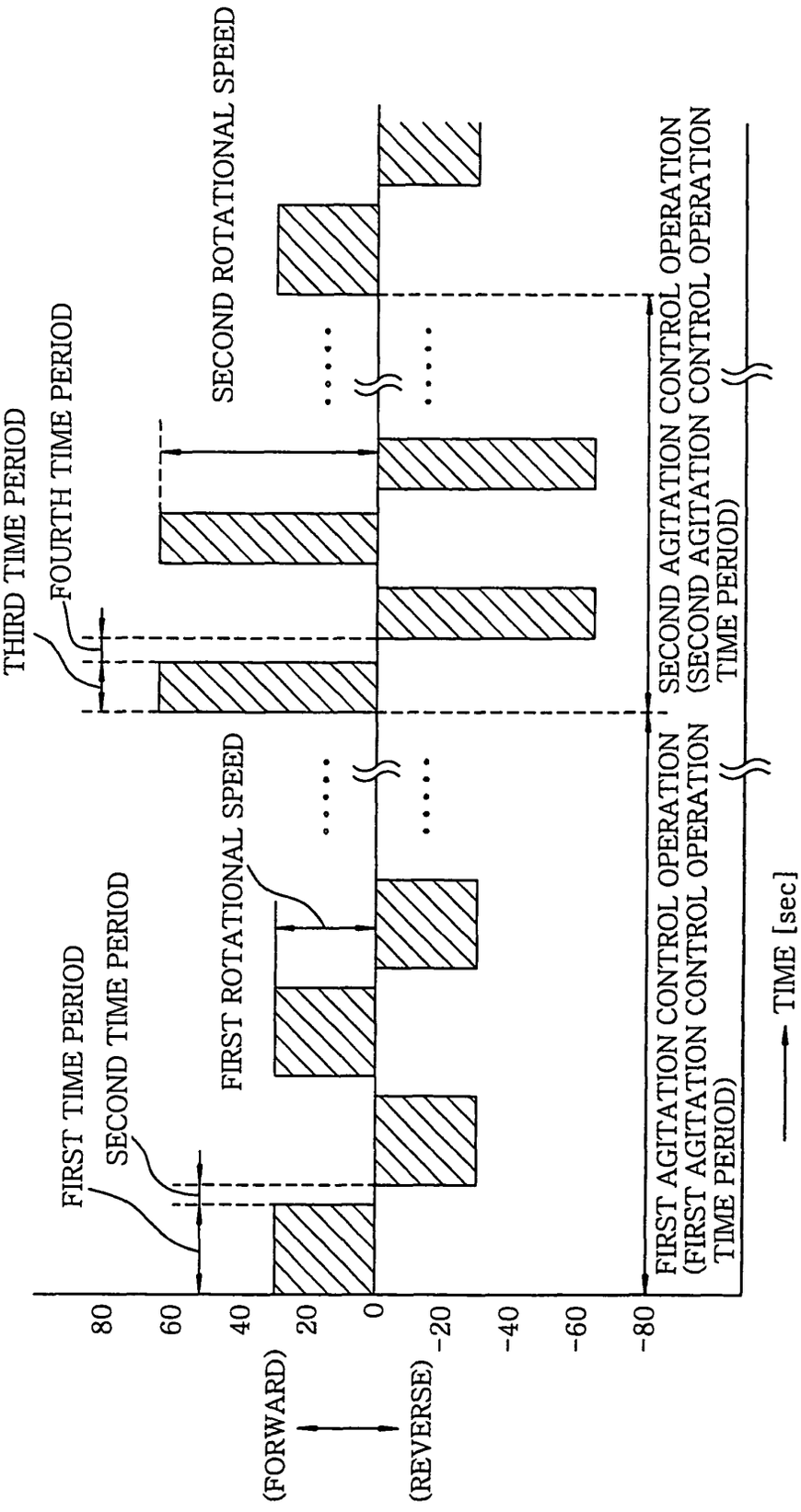
REVOLUTION NUMBER OF ROTARY DRUM [r/min]
80
60
40
20
0
-20
-40
-60
-80
(FORWARD)
(REVERSE)
FIRST TIME PERIOD
SECOND TIME PERIOD
THIRD TIME PERIOD
FOURTH TIME PERIOD
FIRST ROTATIONAL SPEED
SECOND ROTATIONAL SPEED
FIRST AGITATION CONTROL OPERATION (FIRST AGITATION CONTROL OPERATION TIME PERIOD)
SECOND AGITATION CONTROL OPERATION (SECOND AGITATION CONTROL OPERATION TIME PERIOD)
TIME [sec]

FIG.4

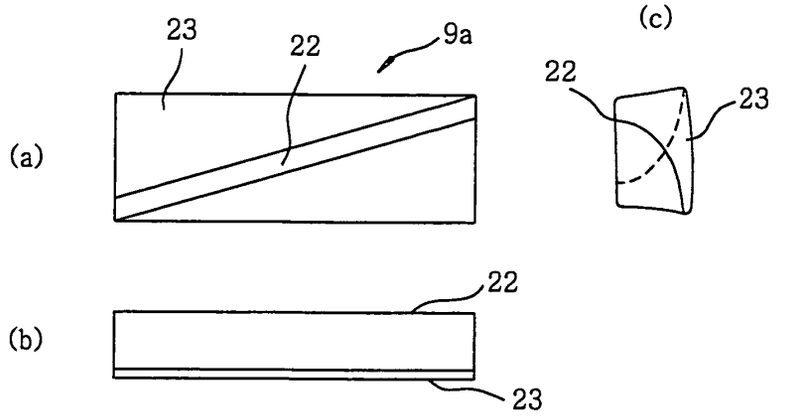

FIG.5

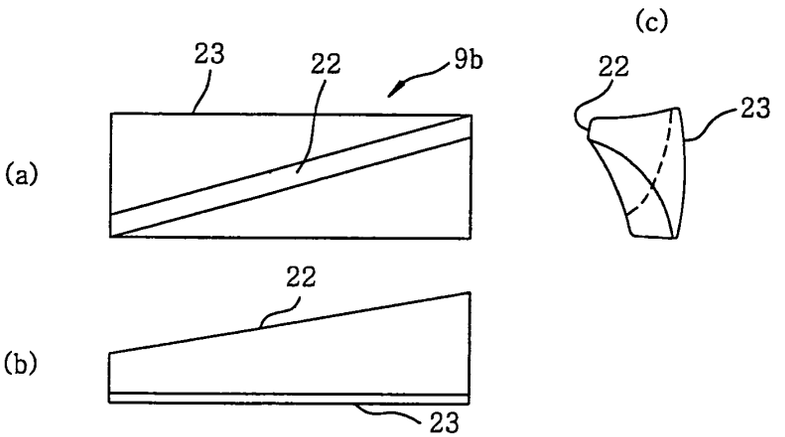

FIG.6

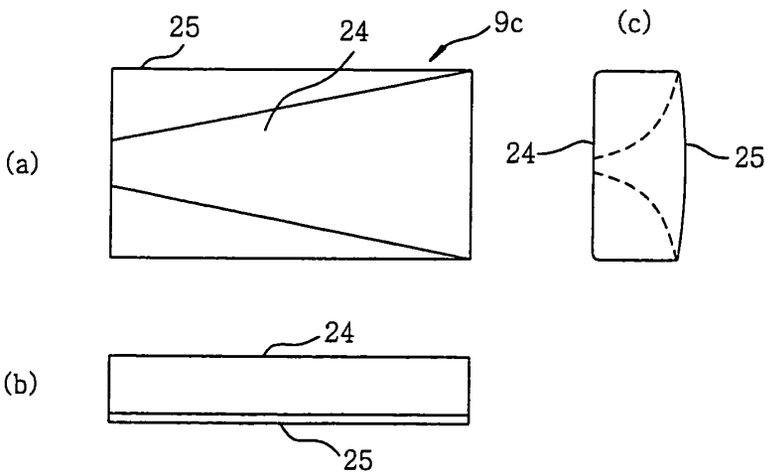

FIG. 7
(PRIOR ART)