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(54) **SPRAY RINSING METHOD INTENDED FOR WASHING MACHINES**

(57) The machine has a drum with a perforated wall capable of receiving a load of clothes, a motor for rotating the drum at variable speeds, and a spraying device capable of introducing liquid into the drum. The method comprises performing an impregnation (M) with an amount (A) of liquid by means of several spraying steps (A1, A2,...An) for spraying the liquid on the load of clothes while the drum rotates at a medium rotational speed (V2)

sufficient to keep the load of clothes stationary with respect to the rotating drum but insufficient to extract liquid out of the load of clothes by the centrifugal force generated, and performing, between every two of said spraying steps, a tumbling step for tumbling the load of clothes at a low rotational speed (V1) less than 1G. After the impregnation (M), a centrifugation (N) at a high rotational speed (V3) is performed.

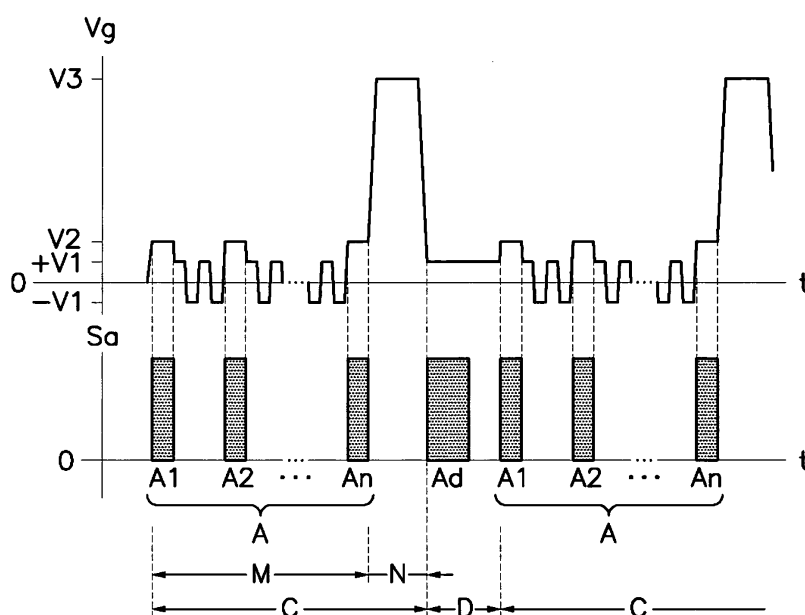


Fig. 1

Description

Technical Field

[0001] The present invention relates to a spray rinsing method applicable to a washing process in a washing machine having a rotating drum, preferably with a horizontal axis and an axial loading/unloading opening, although it is also applicable to washing machines with a vertical axis rotating drum. The rinsing method of the invention is aimed at providing a significant saving in water, power consumption and additives, preserving the lifetime of the motor.

[0002] In some cases throughout the present specification, the drum rotational speeds are expressed by means of G units, where 1G is equivalent to the acceleration of gravity, i.e., the rotational speed which, according to the radius of the drum, causes a centrifugal acceleration equivalent to the acceleration of gravity at the level of the cylindrical wall of the drum.

Background of the Invention

[0003] Washings machines of a type provided with a washing tub capable of containing an amount of liquid, inside which a rotating drum provided with a perforated wall is assembled, are well known. The drum is assembled such that it can rotate with respect to a horizontal or vertical axis and is provided with an axial loading/unloading opening. An electric motor is arranged to selectively rotate the drum in any of the two directions at variable speeds. The tub has a liquid inlet provided with controlled valve means for introducing an amount of liquid into the tub and a liquid outlet provided with controlled valve means for allowing a drainage of the tub.

[0004] Traditionally, in washing machines of this type, after one or more washing cycles several rinsing cycles are carried out, each one consisting of a tumbling stage for tumbling the load of clothes by means of rotations of the drum in alternate directions at a speed less than 1G with the tub partially full of a rinsing liquid followed by a drainage and centrifugation stage. This method has the drawback of causing a high consumption of rinsing liquid, which is basically clean water, optionally with additives. In fact, most of the total amount of water consumed in a washing process is used in the rinsing cycles. In relation to the additives, they can vary in each of the several rinsing cycles. For example, in a first rinsing cycle a bleaching agent could be added to the rinsing water, in one or more intermediate rinsing cycles, if any, only water could be used, and in a final rinsing cycle a softening agent could be added to the rinsing water.

[0005] Patent US-A-3811300, to Unimac, proposes reducing the number of rinsing cycles by means of a washing machine with a washing tub, a horizontal axis rotating drum with an axial loading/unloading opening, and spray nozzles installed in a door of the loading/unloading opening and directed for the purpose of spraying clean water

on the load of clothes located on the inner wall of the drum. The operation is as follows. After one or more washing cycles, a rinsing cycle is performed which consists of rotating the drum at a relatively high speed so that the load of clothes remains stationary with respect to the wall of the drum and continuously spraying clean water on the load of clothes rotating inside the drum. The centrifugal force generated by the rotation of the drum makes the rinsing water pass through the clothes and the perforated wall of the drum. This operation continues for a time considered to be sufficient for the load of clothes to be completely rinsed. However, the saving in water by using this single spray rinsing or "dynamic rinsing" cycle is not effective because when the drum rotates at a rotational speed sufficient to assure the extraction of the water by the centrifugal force generated, the load of clothes is so compacted against the inner wall of the drum that its capacity to absorb or let water pass therethrough is highly reduced and it is therefore necessary to spray a large amount of water to achieve an acceptable rinsing of the load of clothes.

[0006] Patent DE-A-4013450, to Licentia Patent-Verwaltungs-GmbH, discloses a rinsing process applied to a rotating drum washing machine, provided with a device for spraying water into the drum and controlled by a program. The process corresponds to the stages depicted in the graph of Figure 5, where "Vg" is the drum rotational speed in rpm, "Sa" is the rinsing liquid supply and "t" is the time. After a washing cycle I, the program proceeds to a rinsing phase II, during which the drum is rotated at a speed of approximately 80 rpm (slightly greater than 1G), such that the clothes contained in the drum adhere to the inner surface thereof, forming a ring, and the rinsing water is continuously sprayed on the clothes from the center of said ring. This spraying phase at the speed of 80 rpm is interrupted for periods in which the drum is rotated at a high speed, clearly greater than the washing rotational speed, to expel the water from the clothes by centrifugation. This high speed can alternate periods at a speed of 1000 to 1400 rpm with periods at a speed of 200 to 600 rpm. When, in correspondence with the drum rotational speed, the clothes are saturated due to having reached the limit in their capacity to absorb water, the excess water falls in the form of a bath into the tub. The water in the tub can be detected and used as a signal for a subsequent development of the program, for example, to interrupt the spraying of water and perform a tumbling of the clothes at 50 rpm to redistribute the clothes in the drum.

[0007] A drawback of this process of the cited patent DE-A-4013450 is that the tumbling of the clothes at 50 rpm is performed when it is considered that such clothes are already saturated with water. In other words, after tumbling the clothes at 50 rpm, no more water is added and the process passes directly to the centrifugation phase at speeds ranging from 200 to 1400 rpm. But the fact that the clothes adhered to the wall of the drum do not absorb more water and the water supplied by spray-

ing starts to fall to the bottom of the tub does not assure that all the clothes are uniformly and homogeneously impregnated, since in those places of the inner surface of the drum where the clothes are more accumulated the water will probably not have reached the deepest layers of fabric whereas in other places where there are not many clothes accumulated, the layers of fabric will already be saturated and the water sprayed thereon will fall to the bottom of the tub, leading the program to interpret that all the clothes are saturated. Consequently, the rinsing will be defective. Furthermore, the lack of uniformity and homogeneity in the impregnation of the clothes would involve a risk of causing negative effects on the clothes if the process were used to apply additives, such as bleaching agents and softening agents, with the rinsing water.

[0008] Patent DE-A-4115776, to Licentia Patent-Verwaltungs-GmbH, describes a rinsing and centrifugation method applicable to a washing machine with a washing tub, a horizontal axis rotating drum with an axial loading/unloading opening, and a spraying device for spraying rinsing liquid into the drum. The Licentia method comprises, as shown in the graph of Figure 6 (where "Vg" is the drum rotational speed in rpm, "Sa" is the rinsing liquid supply and "t" is the time), after the washing process I, performing an impregnation and centrifugation process II consisting, first of all, in draining the washing liquid from the tub and performing a centrifugation of the load of clothes at a speed of approximately 1000 rpm. The speed is then reduced to approximately 100 rpm (greater than 1G) and, when the drum has reached this speed, a certain amount of water is sprayed into the drum and on the load of clothes which remains stationary with respect to the wall of the drum. The drum is then taken to a centrifugation speed of approximately 800 to 1000 rpm to extract the water by the centrifugal force generated. After several of such impregnation and centrifugation operations, a redistribution operation III for redistributing the load of clothes is performed, reducing the speed of the drum to a tumbling speed and then spraying a larger amount of water to detach the load of clothes which has remained adhered to the inner wall of the drum due to the effect of the centrifugal force. After the redistribution operation, the speed of the drum is again increased to approximately 800 to 1000 rpm and then additional impregnation and centrifugation operations are performed in the same manner.

[0009] The method described in the cited patent DE-A-4115776 has some drawbacks. Firstly, the centrifugation at high speed performed before each spraying operation at medium speed causes an intense compression of the load of clothes against the inner wall of the drum and hinders the subsequent penetration of the water in the clothes, so a part of the sprayed water will be lost without having performed the rinsing function, and the absorbed water will impregnate the load of clothes in a non-uniform manner due to the existence, in the load of clothes applied against the inner wall of the drum, of ar-

reas with different degrees of accumulation and compression which will not vary substantially during the consecutive impregnation and centrifugation operations. Therefore, several consecutive spraying and centrifugation operations without an intermediate redistribution of the load of clothes mean a considerable loss of water. Secondly, the rinsing process according to this method does not allow an efficient application of additives with the rinsing water due to the fact that a complete and uniform absorption of the rinsing liquid in the load of clothes cannot be assured. Thirdly, the large number of centrifugation cycles required for a complete rinsing involves a high energy cost and, furthermore, it is detrimental to the lifetime of the driving motor of the drum.

[0010] Patent EP-A-1254283, to Dyson, describes a method for rinsing a load of clothes in a washing machine having a perforated drum rotating about an axis and capable of receiving the load of clothes therein, and a spraying device capable of spraying water into the rotating drum. The Dyson method, as shown in Figure 7 (where "Vg" is the drum rotational speed, "Sa" is the rinsing liquid supply and "t" is the time), comprises the following stages. Firstly, the drum is rotated at a first rotational speed V2 sufficient to keep the load of clothes stationary with respect to the rotating drum. Then, a volume A of rinsing water is introduced into the rotating drum through the spraying device, such that the rinsing water is sprayed on the load of clothes, and then the drum rotational speed is increased to a second rotational speed V3 sufficient to centrifuge a significant proportion of the rinsing water out of the load of clothes. The impregnation and centrifugation cycle C is preferably repeated several times.

[0011] The Dyson method has the drawback of not assuring a complete and homogeneous impregnation of the load of clothes during the first impregnation and centrifugation cycle C, because once the drum has reached the medium rotational speed V2 and the load of clothes has been stationarily applied to the inner wall of the drum, the distribution of the load of clothes will substantially not change, maintaining areas with a higher degree of accumulation and areas with a lower degree of accumulation on the inner wall of the drum until the speed of the drum reaches a value less than 1G again, which is not expected until the end of the entire rinsing process made up of the several repeated impregnation and centrifugation cycles C. The areas having different degrees of accumulation of the load of clothes on the inner wall of the drum generally cause a non-homogeneous absorption of the rinsing liquid. After the second impregnation and centrifugation cycle C, the Dyson method is very similar to the one discussed above in relation to the cited Licentia patent DE-A-4115776, and has the same drawback referring to the low water absorption capacity of the load of clothes after it has been subjected to an intense compression against the wall of the drum during the previous centrifugation operation at high speed, added to the non-homogeneous impregnation due to the irregular distribution of the load of clothes. Furthermore, the Dyson method

is also unsuitable for performing an application of additives with the rinsing water due to the incapacity to assure the complete and homogeneous impregnation of the load of clothes.

[0012] The cited Dyson patent also claims that the volume A of rinsing water introduced in the spraying stage is smaller than the volume required to saturate the load of clothes, such that substantially all the rinsing water is absorbed inside the load of clothes. However, it is obvious for any person having ordinary skill in the art that a load of clothes receiving an amount of water above the volume required to saturate it will drip, and the subsequent excess water will be lost water which is useless for the rinsing function. If, on the contrary, the amount of water sprayed on the load of clothes is much smaller than the volume required to saturate it, this will involve the need for a larger number of spraying and centrifugation cycles to perform the rinsing, with an increase in the time required, a higher energy consumption and a greater wear of the motor. The precise volume of water required to saturate a load of clothes will depend, among other factors, on the amount of clothes and on the type of fabric. Despite the difficulty involved in determining it with precision, this "precise" volume is well known to the persons skilled in washing and rinsing processes so most manufacturers offer in their washing machines for industrial use control devices which are pre-programmed to supply suitable amounts of water to a variety of fabrics and loading levels during the washing and rinsing cycles, or which can be programmed by the user to adjust the amounts of water supplied in each phase of the washing and rinsing operations to each type of fabric and loading level.

[0013] In view of the cited background documents, the problem to be solved is how to assure that this "precise" volume of water required to saturate a load of clothes and which is supplied by spraying on the load of clothes during an impregnation stage in a rinsing cycle is effectively absorbed completely and in a uniform and homogeneous manner by the load of clothes before proceeding to a centrifugation stage.

Disclosure of the Invention

[0014] The present invention contributes to solving the previous problem by providing a spray rinsing method applicable to a clothes washing machine provided with a drum having a perforated wall capable of receiving a load of clothes therein, a controlled motor for rotating said drum about an axis in any of the two directions at variable speeds, and a spraying device capable of introducing rinsing liquid into the drum. The method generally comprises, after a washing and drainage cycle, rotating the drum at a medium rotational speed (greater than 1G) sufficient to keep the load of clothes stationary with respect to the rotating drum but insufficient to cause an extraction of liquid out of the load of clothes by the centrifugal force generated, impregnating the load of clothes by spraying an amount of said liquid into the drum and

on the load of clothes by means of said spraying device while the drum rotates at said medium rotational speed, and then increasing the drum rotational speed to a high rotational speed sufficient to extract a significant proportion of the liquid out of the load of clothes by the centrifugal force generated. The method of the present invention is characterized in that it comprises performing said impregnation of the load of clothes with said amount of liquid by means of a plurality of spraying steps for spraying the liquid on the load of clothes while the drum rotates at said medium rotational speed, and carrying out, between every two of said spraying steps, a tumbling step for tumbling the load of clothes with the interruption of the spraying, wherein each tumbling step comprises reducing the drum rotational speed to a low rotational speed (less than 1G) suitable for performing a tumbling of the load of clothes inside the drum. Thus, by means of the mentioned combined spraying and tumbling steps, a substantially complete and homogeneous impregnation of the load of clothes with the amount of the liquid is obtained before increasing the drum rotational speed to said high rotational speed.

[0015] In a preferred embodiment, the amount of liquid sprayed is a predetermined amount which is established according to the amount and type of clothes to be treated, and said predetermined amount of liquid is supplied in successive fractions of liquid in the spraying steps alternated with tumbling steps until reaching a highly uniform and homogeneous impregnation. Although it is not essential, it is preferred to not reach the degree of saturation of the clothes before proceeding to the centrifugation stage for a better saving in rinsing liquid. Alternatively, the rinsing liquid can be supplied in successive doses in the spraying steps until it is considered that the total amount provided is sufficient for a rinsing stage, for example when the state of saturation of the clothes has been reached, which can be detected by the presence of spraying liquid at the bottom of the tub according to a procedure of the state of the art.

[0016] The method of the present invention further allows an efficient application of additives together with the rinsing liquid, which is generally water, as a result of the fact that it is assured that the rinsing liquid will completely and homogeneously impregnate the load of clothes. Preferably, after the application of one or more fractions of water with additive and before increasing the drum rotational speed to the high rotational speed for performing the centrifugation, the drum is maintained stopped or rotating at any rotational speed equal to or less than the medium rotational speed for a time period considered suitable for allowing the action of said additive. For example, during said time period for allowing the action of the additive, the drum can be rotated at a very low rotational speed, preferably comprised between zero and the low rotational speed, including one or more reversals in the rotational direction of the drum to tumble the load of clothes. These tumbling stages at the very low rotational speed can be alternated or combined with one or more

rotation stages at the medium rotational speed and/or with one or more stopping stages.

Brief Description of the Drawings

[0017] The previous and other features and advantages will be more fully understood from the following detailed description of exemplary embodiments with reference to the attached drawings, in which:

Figure 1 is a graph of drum rotational speeds and rinsing liquid supplies with respect to time in a clothes washing machine as per a spray rinsing method according to an embodiment of the present invention; Figure 2 is a schematic depiction of the arrangement of a load of clothes inside the drum when the latter rotates at a low speed less than 1G;

Figure 3 is a schematic depiction of the arrangement of a load of clothes inside the drum when the latter rotates at a medium speed greater than 1G;

Figure 4 is a graph of drum rotational speeds and rinsing liquid supplies with respect to time in a clothes washing machine as per a spray rinsing method according to another alternative embodiment of the present invention;

Figure 5 is a graph of drum rotational speeds and rinsing liquid supplies with respect to time as per a spray rinsing method according to a first comparative example of the state of the art described in the cited patent DE-A-4013450;

Figure 6 is a graph of drum rotational speeds and rinsing liquid supplies with respect to time as per a spray rinsing method according to a second comparative example of the state of the art described in the cited patent DE-A-4115776; and

Figure 7 is a graph of drum rotational speeds and rinsing liquid supplies with respect to time as per a spray rinsing method according to a third comparative example of the state of the art described in the cited patent EP-A-254283.

Detailed Description of Exemplary Embodiments

[0018] Referring first to Figure 1, the spray rinsing method according to an embodiment of the present invention is described below, which method is applicable to a clothes washing machine of a known type (not shown), having a drum 10 (Figures 2 and 3) with a perforated wall capable of receiving a load of clothes 12 therein, a controlled motor for rotating said drum 10 about an axis in any of the two directions at variable speeds, and a spraying device capable of introducing rinsing liquid into the drum. The drum 10 preferably has a substantially horizontal axis of rotation and an axial loading/unloading opening, and said spraying device includes one or more spraying nozzles installed, for example, in a door of the mentioned loading/unloading opening and directed towards the inner wall of the drum. The rotational

speeds and directions of the drum as well as the supplies of water or rinsing liquid through the spraying device are generally controlled with respect to time by a pre-programmed or programmable control device.

[0019] As shown in the graph of Figure 1 (where "Vg" is the drum rotational speed, "Sa" is the rinsing liquid supply and "t" is the time), the method of the present invention comprises, first of all and generally after a washing operation, impregnating a load of clothes 12 contained in the drum 10 by spraying a predetermined amount of said liquid A into the drum 10 and on the load of clothes 12 by means of the spraying device while the drum rotates at a medium rotational speed V2 (greater than 1G and generally less than 20G) (see also Figure 3) sufficient to keep the load of clothes 12 stationary with respect to the rotating drum 10 but insufficient to cause an extraction of liquid out of the load of clothes by the centrifugal force generated by the rotation, and then increasing the drum rotational speed to a high rotational speed V3 (generally greater than 50G and up to 300G or more) sufficient to extract a significant proportion of the liquid out of the load of clothes by the centrifugal force generated. The mentioned predetermined amount A of liquid will preferably be an amount of liquid equal to or slightly less than the amount of liquid which is considered hypothetically necessary to saturate the load of clothes. The impregnation stage M for impregnating the load of clothes 12 with the predetermined amount A of liquid and the subsequent centrifugation stage N together constitute an impregnation and centrifugation cycle C which can be repeated a number of times until achieving a satisfactory rinsing.

[0020] It will be observed that, according to the method of the present invention, the predetermined amount A of liquid for impregnating the load of clothes 12 is not provided all at once, but rather it is divided into fractions A1, A2,...An of liquid which are supplied by means of respective spraying steps for spraying on the load of clothes 12 while the drum rotates at said medium rotational speed V2, and between every two of said spraying steps a tumbling step for tumbling the load of clothes is carried out for a time period in which the spraying is interrupted. Each tumbling step comprises reducing the drum rotational speed to a low rotational speed V1 (less than 1G) (see also Figure 2) suitable for performing a tumbling of the load of clothes inside the drum and maintaining this low rotational speed V1 for a predetermined period. Each tumbling step at said low rotational speed V1 preferably includes one or more reversals in the rotational direction of the drum indicated in the graph of Figure 1 as +V1 and -V1. Optionally, an additional tumbling step can be performed after spraying the last fraction of liquid An and before the corresponding centrifugation stage N. It will be understood that although the medium rotational speed V2 and high rotational speed V3 have all been indicated in the graph in the positive direction, the rotations at these speeds can also be performed in the reverse direction or alternately in opposite

directions in the different steps or cycles without departing from the scope of the present invention.

[0021] As shown in Figure 3, during the spraying steps of the fractions A1, A2,...An of liquid, when the load of clothes 12 is arranged in a stationary manner with respect to the wall of the drum 10 due to the effect of the centrifugal force greater than 1G (and generally less than 20G) generated by the rotation of the drum 10 at the medium rotational speed V2, the load of clothes 12 is irregularly distributed, with areas with a higher degree of accumulation and areas with a lower degree of accumulation, on the inner wall of the drum 10, which can cause an irregular absorption of the liquid in the clothes. During the tumbling steps, as shown in Figure 2, given that the low rotational speed V1 causes a centrifugal force less than 1G, the clothes are detached due to the effect of gravity from the inner wall of the drum 10 at the upper part and fall on the clothes at the lower part of the drum 10, such that the tumbling of the load of clothes 12 causes a loosening and a change of position of the clothes and a mechanical work facilitating the absorption and homogenization of the fractions A1, A2,...An of liquid which are sprayed in the successive spraying steps. Thus, by means of the alternate combination of spraying steps and tumbling steps according to the present invention a substantially complete and homogeneous impregnation of the load of clothes 12 with the predetermined amount A of the liquid can be obtained before increasing the drum rotational speed to the high rotational speed V3 to perform the centrifugation and make the liquid pass through the clothes and through the perforated wall of the drum in order to perform the rinsing, according to the process disclosed by the cited patent US-A-3811300, to Unimac.

[0022] As has been stated above, the impregnation and centrifugation cycle C can be repeated a number of times until achieving a satisfactory rinsing. One embodiment contemplates performing from 2 to 6 complete spraying and centrifugation cycles C for a rinsing, depending on the amount and type of clothes in the load of clothes, the quality of the water, the detergent used in the previous washing operations, etc. Between every two of said impregnation and centrifugation cycles C the method comprises performing a detachment operation D consisting of a supply of liquid Ad into the drum 10 by means of the spraying device while the drum is rotated at the low rotational speed V1. This supply of liquid Ad increases the weight of the clothes and contributes to the latter being detached from the inner wall of the drum 10 after the centrifugation. Optionally, the amount of liquid Ad sprayed during the detachment operation D and which will be absorbed by the load of clothes can be considered as one of the fractions of liquid to be deducted from the fractions A1, A2,...An of the following impregnation stage M.

[0023] The sum of all the fractions A1, A2,...An of liquid used in the different spraying steps of an impregnation and centrifugation cycle C is equal to the predetermined amount A of liquid sprayed in the impregnation stage M.

The liquid used can be water alone or water with additives. The fact of supplying the predetermined amount A of liquid in fractions A1, A2,...An allows, for example, adding one or more additives to the water in one or more of the fractions A1, A2,...An of liquid selected. For example, in one or more of the spraying steps of the first impregnation stage M a bleaching agent could be added to the water of the corresponding fractions A1, A2,...An, and in one or more of the spraying steps of the last impregnation stage M a neutralizing or softening agent could be added to the water of the corresponding fractions A1, A2,...An. The complete and homogeneous impregnation of the load of clothes with the predetermined amount A of rinsing liquid including the additives, achieved by means of the alternate spraying and tumbling steps, allows a more precise metering and a better exploitation of the additives, which translates into a saving in additives and into clean clothes without excess additives.

[0024] Alternatively, the total amount of liquid to be sprayed in the impregnation stage M is not known beforehand and is determined during the cycle when it is detected that the load of clothes is saturated. The state of saturation of the load of clothes can be detected, for example, when after several spraying and tumbling steps a detector detects the presence of an amount of the liquid from the spraying at the bottom of a tub inside which the drum rotates, which indicates that the load of clothes is incapable of absorbing more liquid because it is saturated, and the excess liquid falls to the bottom of the tub.

[0025] The graph of Figure 4 (where "Vg" is the drum rotational speed, "Sa" is the rinsing liquid supply and "t" is the time) is a variant of the graph of Figure 1 including a first rinsing cycle C with an impregnation stage M including the application of additives, during which a predetermined amount A of liquid composed, for example, of water with one or more additives, is supplied. As in the example described above, in the first cycle C of Figure 4, the predetermined amount A of liquid is supplied by means of several spraying steps for spraying fractions A1, A2,...An of liquid while the drum rotates at the medium rotational speed V2. Between every two spraying steps for spraying the fractions A1, A2,...An of liquid, a tumbling step comprising alternate rotations of the drum in both directions at the low rotational speed +V1, -V1 is performed. Thus, at the end of the spraying step for spraying the last fraction An of liquid, the load of clothes will be completely and homogeneously impregnated with the predetermined amount A of water and additives. Then, this variant of the method comprises maintaining the drum stopped or rotating at one or more rotational speeds comprised between zero and the medium rotational speed V2 for a time period T considered sufficient or suitable for allowing the action of the additive or the additives impregnating the load of clothes together with the water. The cycle C ends with a centrifugation stage N in which the liquid is substantially extracted from the load of clothes by the centrifugal force generated by the rotation of the drum at the high rotational speed V3.

[0026] In the graph of Figure 4, the mentioned period T comprises first of all a tumbling of the impregnated load of clothes inside the drum at a very low rotational speed, less than the low rotational speed V1, including one or more reversals in the rotational direction of the drum to perform a light-duty mechanical work, followed by a rest period during which the rotation of the drum is stopped, and by a period of rotation at the medium rotational speed V2 during which the load of clothes remains stationary with respect to the wall of the drum, before the centrifugation stage N. However, the example of Figure 4 is merely illustrative, and variations with respect to the modes of rotation of the drum to be performed during the time period T for allowing the action of the additive or additives depending on the type of fabric and the class of additives will readily occur to a person skilled in the art. For example, during the entire time period T the drum could remain stopped or could remain rotating at a constant rotational speed less than the low rotational speed V1 or comprised between the low rotational speed V1 and the medium rotational speed V2, or alternatively it could remain rotating at a rotational speed less than the low rotational speed V1 including reversals in the rotational direction. Likewise, two or more of the modes of rotation shown in the period T of Figure 4 could be combined in a different order.

[0027] Generally, whichever the embodiment, the number of spraying steps for spraying fractions A1, A2,...An of liquid in each impregnation stage M will be determined by different factors, such as the type of fiber and/or fabric from which the load of clothes is formed, or the hardness of the water, and will generally be from 2 to 6, although it is not ruled out that it can be more than six. To adapt the predetermined amount A of liquid used in each impregnation stage M to the type and/or amount of clothes forming the load of clothes arranged inside the drum 10, the amount of liquid of the several fractions A1, A2,...An can be varied, or, alternatively, a fixed amount of liquid can be used for each of the fractions A1, A2,...An of liquid and varying the number of fractions A1, A2,...An of liquid sprayed in each impregnation stage M.

[0028] It must be taken into account that in Figures 1 and 4, for the sake of greater clarity of the drawing, the heights in the speed axes and the distances in the time axes are altered and disproportionate with respect to their respective actual scales and must not be interpreted literally.

[0029] A person skilled in the art will be capable of performing modifications and variations based on the embodiments shown and described without departing from the scope of the present invention.

[0030] Figures 5, 6 and 7 show comparative graphs corresponding to spray rinsing methods known in the state of the art. The graph of Figure 5 corresponds to the cited patent DE-A-4013450 to Licentia, the graph of Figure 6 corresponds to the cited patent DE -A-4115776 to Licentia, and the graph of Figure 7 corresponds to the cited patent EP-A-254283 to Dyson, as they have been

discussed above in relation to the background of the invention. It will be observed that, in the methods of the state of the art illustrated in Figures 5, 6 and 7, the amount of rinsing liquid necessary for each impregnation stage is supplied by continuously spraying while the drum rotates at a medium speed V2 (slightly greater than 1G) before each centrifugation stage at a high speed V3. On the contrary, in the method of the present invention illustrated in Figures 1 and 4, the amount of rinsing liquid A necessary for each impregnation stage is supplied distributed into different fractions A1, A2,...An while the drum rotates at a medium speed V2 (slightly greater than 1G), alternated with tumbling steps, in which the spraying is interrupted and the drum rotates at a low speed V1 (less than 1G), before each centrifugation stage at a high speed V3.

[0031] The scope of the present invention is defined in the attached claims.

Claims

1. A spray rinsing method applicable to a clothes washing machine having a drum with a perforated wall capable of receiving a load of clothes therein, a controlled motor for rotating said drum about an axis in any of the two directions at variable speeds, and a spraying device capable of introducing rinsing liquid into the drum, the method comprising the stages of

rotating the drum at a medium rotational speed (V2) greater than 1G sufficient to keep the load of clothes stationary with respect to the rotating drum but insufficient to cause an extraction of liquid out of the load of clothes by the centrifugal force generated;

impregnating the load of clothes by spraying an amount of said liquid into the drum and on the load of clothes by means of said spraying device while the drum rotates at said medium rotational speed (V2); and

increasing the drum rotational speed to a high rotational speed (V3) sufficient to extract a significant proportion of the liquid out of the load of clothes by the centrifugal force generated,

characterized in that it comprises:

performing said impregnation with said amount of liquid by means of a plurality of spraying steps for spraying the liquid on the load of clothes while the drum rotates at said medium rotational speed (V2); and

performing, between every two of said spraying steps, a tumbling step for tumbling the load of clothes with the interruption of the spraying, each tumbling step comprising reducing the drum rotational speed to a low rotational speed (V1) less than 1G suit-

- able for performing a tumbling of the load of clothes inside the drum, such that by means of said combined spraying and tumbling steps a substantially complete and homogeneous impregnation of the load of clothes with the amount of the liquid is obtained before increasing the drum rotational speed to said high rotational speed (V3).
2. The method according to claim 1, **characterized in that** it comprises performing each tumbling step at said low rotational speed (V1) including at least one reversal in the rotational direction of the drum.
 3. The method according to claim 1 or 2, **characterized in that** said amount of liquid is a predetermined amount (A), and **in that** a fraction (A1, A2,...An) of liquid is used in each spraying step, the sum of said fractions (A1, A2,...An) of liquid used in all the spraying steps being equal to said predetermined amount (A) of liquid sprayed in the impregnation stage.
 4. The method according to claim 3, **characterized in that** it comprises using water as said liquid and adding at least one additive to the water in at least one of the fractions (A1, A2,...An) of liquid.
 5. The method according to claim 4, **characterized in that** it comprises maintaining the drum stopped or rotating at one or more rotational speeds comprised between zero and said medium rotational speed (V2) for a time period (T) for allowing the action of said additive after the application of at least one of the fractions (A1, A2,...An) of water with additive and before increasing the drum rotational speed to said high rotational speed (V3).
 6. The method according to claim 5, **characterized in that** during said time period (T) for allowing the action of the additive the drum is rotated at one or more rotational speeds comprised between zero and the low rotational speed (V1) including at least one reversal in the rotational direction of the drum.
 7. The method according to any of claims 2 a 6, **characterized in that** it comprises spraying the predetermined amount (A) of liquid using from 2 to 6 spraying steps for spraying fractions (A1, A2,...An) of liquid in each impregnation stage (M).
 8. The method according to claim 7, **characterized in that** it comprises using a fixed amount of liquid for each of the fractions (A1, A2,...An) of liquid and adapting the predetermined amount (A) of liquid to the type and/or amount of clothes in the load of clothes by varying the number of fractions (A1, A2,...An) of liquid sprayed in each impregnation stage (M).

9. The method according to any of the previous claims, **characterized in that** it comprises performing a detachment operation (D) between every two spraying and centrifugation cycles (C) by rotating the drum at the low rotational speed (V1) in combination with a supply of liquid (Ad) into the drum by means of the spraying device.
10. The method according to claim 1 or 2, **characterized in that** it comprises repeating said spraying steps and tumbling steps in each impregnation stage (M) until a detector detects the presence of an amount of the liquid supplied by spraying at the bottom of a tub inside which the drum rotates.

Amended claims under Art. 19.1 PCT

1. A spray rinsing method applicable to a clothes washing machine having a drum with a perforated wall capable of receiving a load of clothes therein, a controlled motor for rotating said drum about a substantially horizontal axis in any of the two directions at variable speeds, and a spraying device capable of introducing rinsing liquid into the drum, the method comprising the stages of:

rotating the drum at a medium rotational speed (V2) greater than 1G sufficient to keep the load of clothes stationary with respect to the rotating drum but insufficient to cause an extraction of liquid out of the load of clothes by the centrifugal force generated;
 impregnating the load of clothes by spraying an amount of said liquid into the drum and on the load of clothes by means of said spraying device while the drum rotates at said medium rotational speed (V2); and
 increasing the drum rotational speed to a high rotational speed (V3) sufficient to extract a significant proportion of the liquid out of the load of clothes by the centrifugal force generated,
characterized in that it comprises:

performing said impregnation with said amount of liquid by means of a plurality of spraying steps for spraying the liquid on the load of clothes while the drum rotates at said medium rotational speed (V2); and
 performing, between every two of said spraying steps, a tumbling step for tumbling the load of clothes with the interruption of the spraying, each tumbling step comprising reducing the drum rotational speed to a low rotational speed (V1) less than 1G suitable for performing a tumbling of the load of clothes inside the drum, such that by means of said combined spraying and tum-

bling steps a substantially complete and homogeneous impregnation of the load of clothes with the amount of the liquid is obtained before increasing the drum rotational speed to said high rotational speed (V3).

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2. The method according to claim 1, **characterized in that** it comprises performing each tumbling step at said low rotational speed (V1) including at least one reversal in the rotational direction of the drum.

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3. The method according to claim 1 or 2, **characterized in that** said amount of liquid is a predetermined amount (A), and **in that** a fraction (A1, A2,...An) of liquid is used in each spraying step, the sum of said fractions (A1, A2,...An) of liquid used in all the spraying steps being equal to said predetermined amount (A) of liquid sprayed in the impregnation stage.

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4. The method according to claim 3, **characterized in that** it comprises using water as said liquid and adding at least one additive to the water in at least one of the fractions (A1, A2,...An) of liquid.

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5. The method according to claim 4, **characterized in that** it comprises maintaining the drum stopped or rotating at one or more rotational speeds comprised between zero and said medium rotational speed (V2) for a time period (T) for allowing the action of said additive after the application of at least one of the fractions (A1, A2,...An) of water with additive and before increasing the drum rotational speed to said high rotational speed (V3).

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6. The method according to claim 5, **characterized in that** during said time period (T) for allowing the action of the additive the drum is rotated at one or more rotational speeds comprised between zero and the low rotational speed (V1) including at least one reversal in the rotational direction of the drum.

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7. The method according to any of claims 2 a 6, **characterized in that** it comprises spraying the predetermined amount (A) of liquid using from 2 to 6 spraying steps for spraying fractions (A1, A2,...An) of liquid in each impregnation stage (M).

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8. The method according to claim 7, **characterized in that** it comprises using a fixed amount of liquid for each of the fractions (A1, A2,...An) of liquid and adapting the predetermined amount (A) of liquid to the type and/or amount of clothes in the load of clothes by varying the number of fractions (A1, A2,...An) of liquid sprayed in each impregnation stage (M).

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9. The method according to any of the previous claims, **characterized in that** it comprises perform-

ing a detachment operation (D) between every two spraying and centrifugation cycles (C) by rotating the drum at the low rotational speed (V1) in combination with a supply of liquid (Ad) into the drum by means of the spraying device.

10. The method according to claim 1 or 2, **characterized in that** it comprises repeating said spraying steps and tumbling steps in each impregnation stage (M) until a detector detects the presence of an amount of the liquid supplied by spraying at the bottom of a tub inside which the drum rotates.

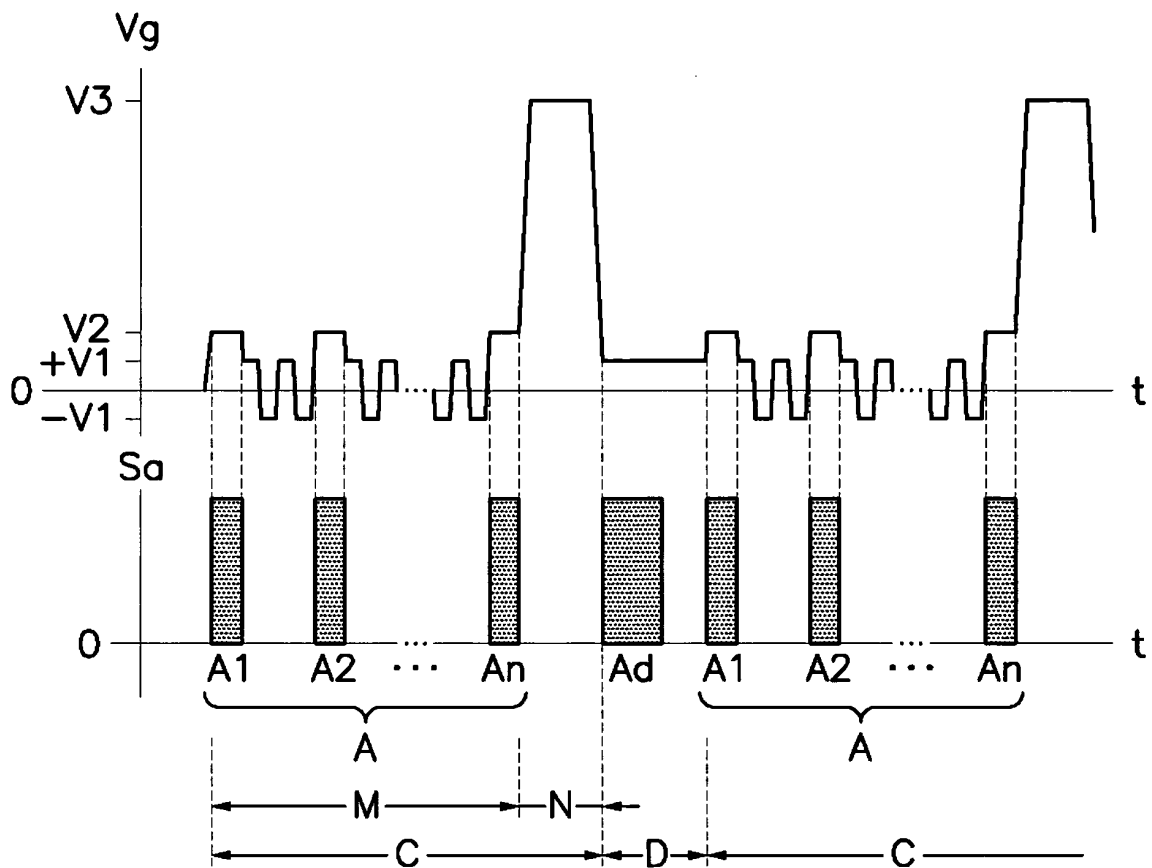


Fig. 1

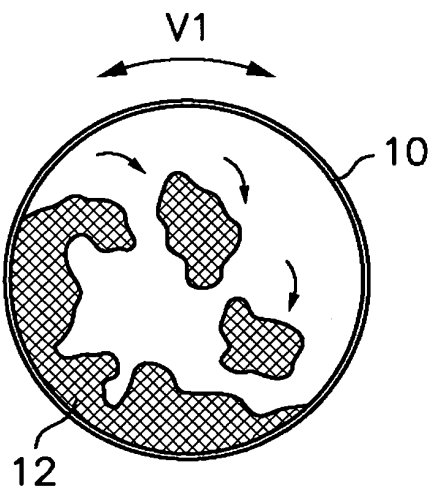


Fig. 2

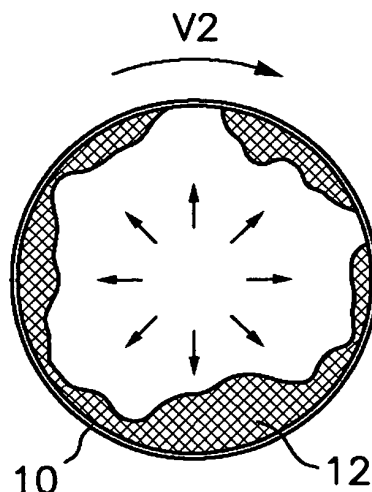


Fig. 3

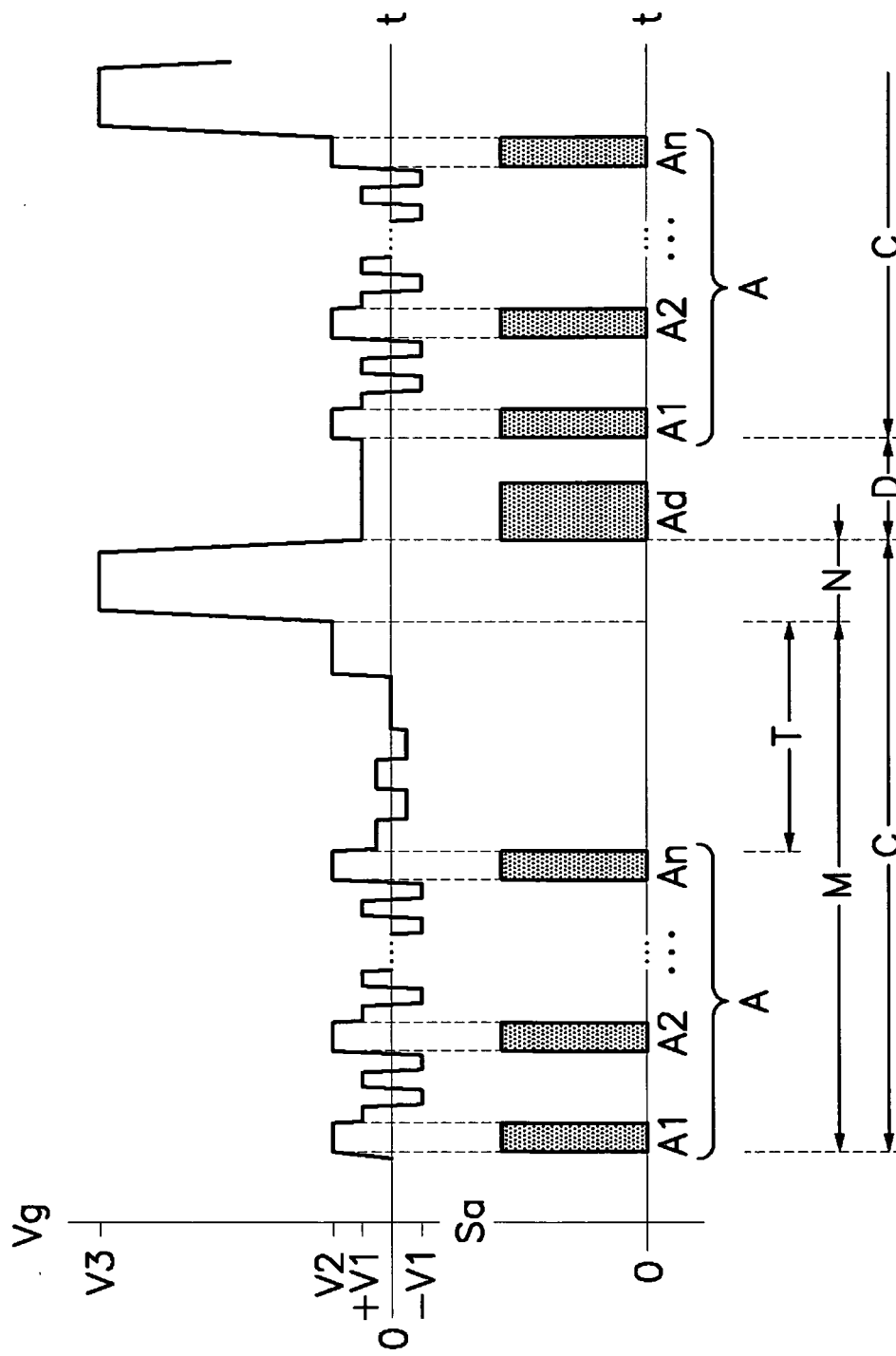


Fig. 4

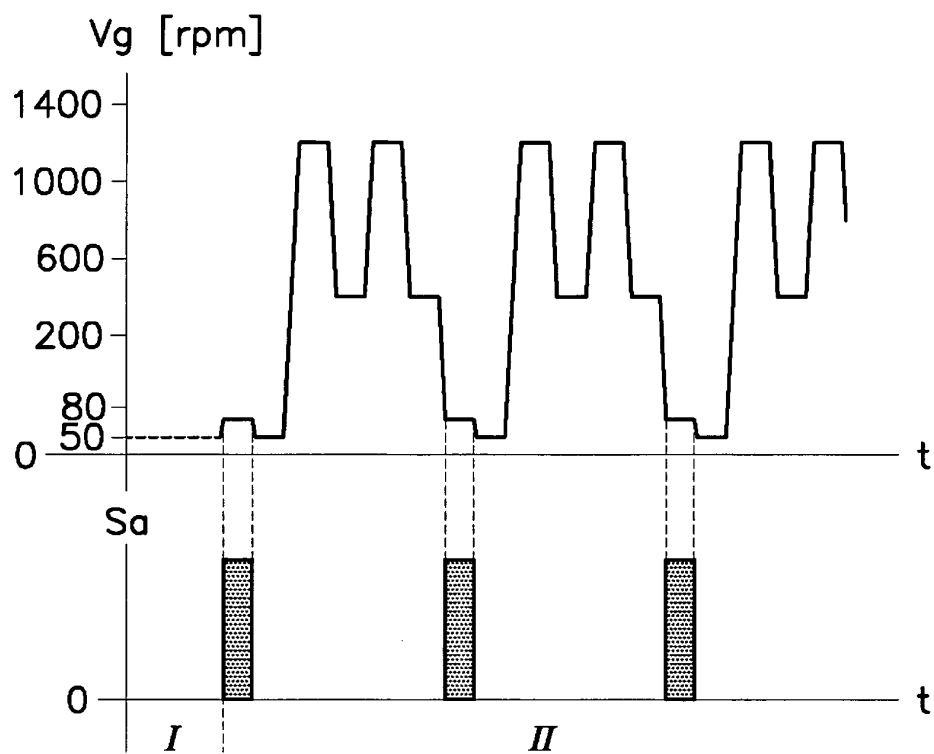


Fig. 5 State of the art

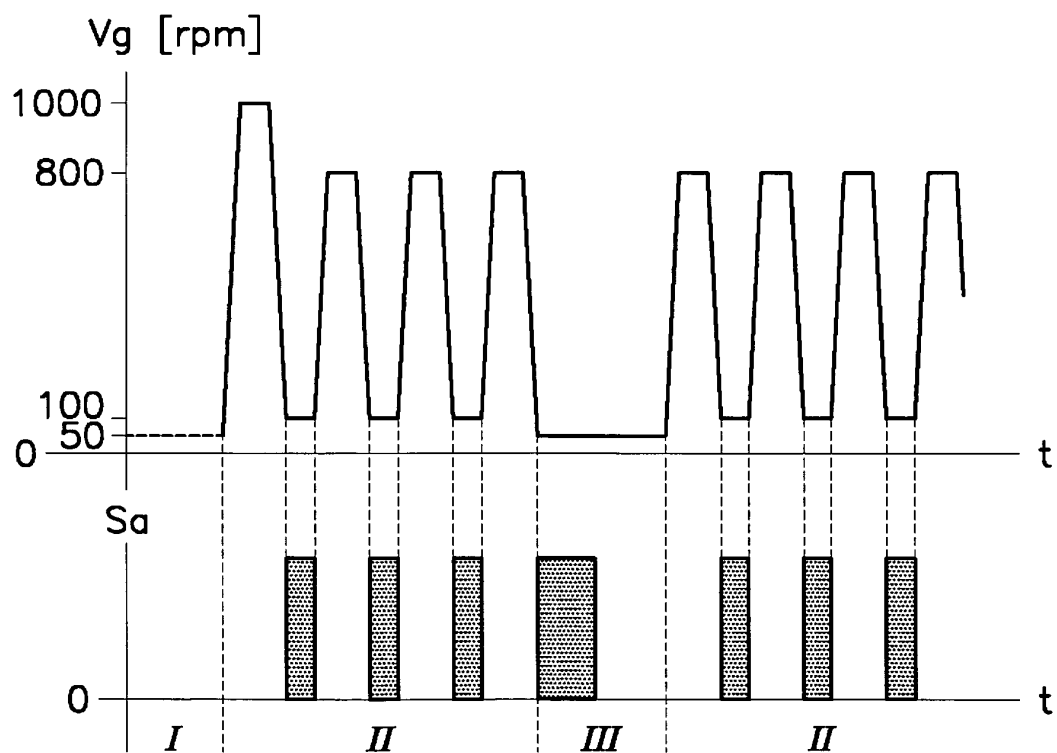


Fig. 6 State of the art

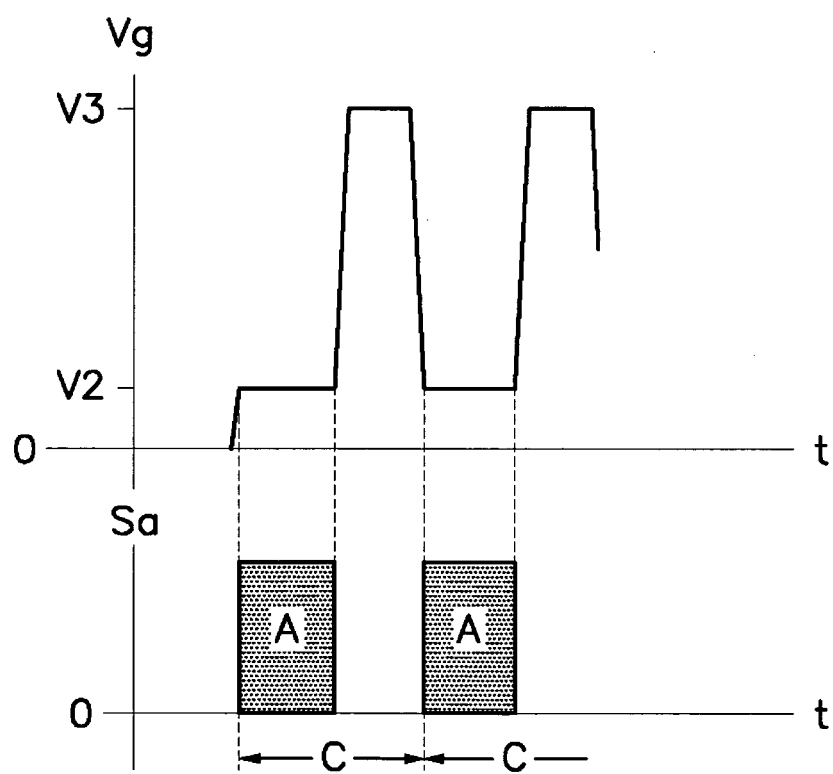


Fig. 7 State of the art

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ ES 2008/000745

A. CLASSIFICATION OF SUBJECT MATTER

D06F 33/02 (2006.01)

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

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

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

INVENES, EPODOC, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/0045097 A1 (KIM et alii) 11.03.2004, paragraphs 0185-0186, figures 8, 15, 18.	1-10
X	JP 11-47490 A (TOKYO SHIBAURA ELECTRIC CO. & TOSHIBA AVE KK) 23.02.1999, abstract, figure 10.	1-10
X	JP 8-66592 A (TOKYO SHIBAURA ELECTRIC CO.) 12.03.1996, abstract, figures 4 a 11.	1-10

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

* Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance.		
"E" earlier document 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)	"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
"O" document referring to an oral disclosure use, exhibition, or other means	"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 documents, such combination being obvious to a person skilled in the art
"P" document published prior to the international filing date but later than the priority date claimed		
	"&"	document member of the same patent family

Date of the actual completion of the international search

27.April.2009 (27.04.2009)

Date of mailing of the international search report

(30/04/2009)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/ ES 2008/000745

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Form PCT/ISA/210 (patent family annex) (July 2008)

REFERENCES CITED IN THE DESCRIPTION

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