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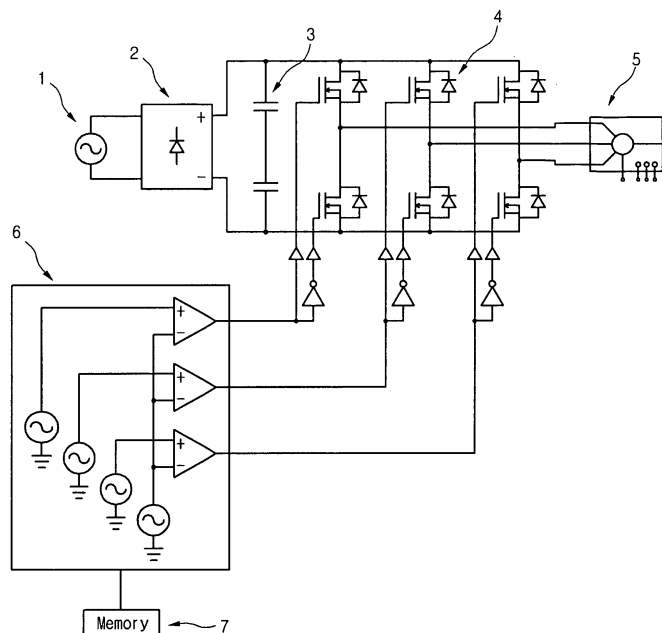
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(54) **Operating apparatus and method of a washing machine**

(57) The operating apparatuses of a washing machine and the methods on that are renovated. The aforementioned washing machine is including: a memory (7) that the reference signals are saved in order to operate a motor (5) in a best condition according to each of the condition of the torque and noise; a control unit (6) which generates the switching signals as calling the reference

signals which are different each other according to the strokes of a washing machine, and comparing with the carrier signals; an inverter (4) which generates a motor operating signal as an external power is switched by a switching signal; a motor which is rotated by a motor operating signal; and a revolving screen of a washing machine which is operated by a motor.

FIG.1



## Description

**[0001]** The present invention relates to an operating apparatus and method of a washing machine, more particularly, to an operating apparatus and method of a washing machine which make a revolving screen to be rotated in a optimal condition with the movement condition of a washing machine and a user's taste.

### 2. Description of the related art

**[0002]** A washing machine is, as an apparatus that launders clothes and etc., recently popularized in every household. This sort of washing machine includes: a drum washing machine that clothes are fell by the rotation of a drum, and washed by the shock power between the laundry and the washing water; pulsator washing machine that a pulsator is rotated on the bottom of a washing machine, and the clothes are washed by the shock power between the laundry and the washing water; an agitator washing machine that a compelled water current which is generated by an agitator protruded toward the inside of a laundry tray, and the clothes are washed by the shock power between the laundry and the washing water. However, it is certain for all of the afore-mentioned washing machines that the washing is achieved by a process that a revolving screen which is applied to a drum, pulsator, or an agitator is rotated by a rotary power delivered by a motor.

**[0003]** Moreover, in case that the functions of a washing machine and a hydroextractor are adopted in a single washing machine, the function that the moisture content of a laundry is drained by a centrifugal force is more progressed as a drum rotated with a high speed during the dehydration process is progressed. In recent years, being progressed of the functions of a washing machine and a hydroextractor in single equipment is general.

**[0004]** Under this sort of background, on the afore-mentioned various kinds of washing machine, when a washing stroke is progressed, a movement that a drum, pulsator, or an agitator are rotating towards the right and the opposite direction with a low speed so as to rotate a washing water or agitate clothes is accomplished. And, when a dehydration stroke is progressed, a drum filled with the entire clothes is rotated in one direction with a high speed, so the centrifugal force is added to the clothes, and the water is drained by the centrifugal force. As the above-mentioned, a washing machine is equipment that a high speed rotation is progressed as well as a low speed rotation is progressed at the same time.

**[0005]** On the other hand, it is general that an operating method of a motor of a washing machine is PWM(Pulse Width Modulation) control method. On the PWM(Pulse Width Modulation) control method, the carrier signal of the chopping waves and the reference signal of the sine waves are input into a comparator, compared together, and a specific form of the PWM signal output. And the output PWM signal controls a switching of an inverter,

and motor operating signals which are output from an inverter induce a turning effect of a motor as input into each of the coils of a motor. And, a PWM control method changes the rotation speed of a motor according to the methods that change the frequency of the above-mentioned chopping waves and the sine waves.

**[0006]** However, as the conventional PWM signal which is output according to the comparison of the carrier signal of the chopping waves and the reference signal of the sine waves has a low practical use rate of DC-link, can't cope adaptively with washing processes which needs a high torque. That is, because a lot of electric power in input DC power isn't used as an electromotive force, the torque of a motor gets low. For this, make DC input voltage to be amplified or make the reverse torque to be higher during the motor design, but as these sorts of structural changes aren't advisable, because they enlarge the motor size or raise the manufacturing costs.

**[0007]** The present invention is proposed as to improve the above-mentioned problems, therefore an object of the present invention is to propose an operating apparatus and method of washing machine which changes the operating method according to the movement condition of a washing machine.

**[0008]** Also, another objects of the present invention is to propos an operating apparatus and method of washing machine that the movement of a washing machine is controlled in the optimal condition according to the proper rotation speed of a rotating body like a drum of a washing machine, particularly, according to the rotate condition of a high speed rotation and low speed rotation.

**[0009]** Also, another objects of the present invention is to propose an operating apparatus and method of a washing machine which make(s) a motor of a washing machine operate in the optimal condition according to the required torque and the required noise condition among the various strokes of a washing machine.

**[0010]** An operating apparatus of washing machine of the present invention according to an aspect to achieve the above-mentioned purposes is comprising: a memory which saves the reference signals; a control part which forms the switching signals as calling out the reference signals different each other and comparing with the carrier signals according to the stroke of a washing machine; an inverter forms the motor operating signals as the external power is switched according to the switching signals; a motor rotates according to the motor operating signals; and a revolving screen of a washing machine operates by a motor.

**[0011]** The operating method of a washing machine in accordance with another aspect is characterized by: a single revolving screen that at least, a high speed rotation and a low speed rotation processes are progressed in a condition having laundry; a step that the rotation required condition of a washing machine can be judged on a washing machine including a single motor rotates a revolving screen; and in case, that the rotation required condition of a washing machine is a high speed rotation, a motor

is three phase operated for a specified period to get a lower noise, and in case, that the rotation required condition of a washing machine is a low speed rotation, a motor is two phase operated at least for a specified period to get a higher torque.

**[0012]** The operating method of a washing machine in accordance with another aspect is characterized by: in case that a revolving screen of a washing machine contains the laundry is rotated with a high speed to dehydrate from the laundry in a condition that the laundry is contained, at least for a specified period, a motor which operates a revolving screen operates in SPWM method; and in case that a revolving screen is rotated with a low speed to remove the dirt on the laundry in a condition that the laundry and water are contained, at least for a specified period, a motor is operated in DPWM method.

**[0013]** The operating method of a washing machine in accordance with another aspect is characterized by: a step that a stroke which is progressed on a washing machine is judged; a step that a rotation condition of a drum suitable with a judged stroke is judged; a step that the reference signals which generates PWM signals are called; a step that reference signals and carrier signals are compared, so PWM signals are generated and input into an inverter; a step that a motor operating signals are generated by an inverter; and a step that a motor is rotated by a motor operating signal is progressed, and the called reference signals are different according to a rotation condition of a drum.

**[0014]** According to the present invention which is proposed, a motor can be operated in a best suitable condition according to a stroke of a washing machine, the movement capacity can be improved, and a user's taste can be promoted.

**[0015]** The abstraction of the present invention can be understood more clearly by the appended drawings.

Fig. 1 is a plane diagram of an operating apparatus of a washing machine in accordance with the present invention.

Fig. 2 is a flow diagram explaining an operating method of a washing machine in accordance with the present invention.

Fig. 3 is a drawing showing an example of a three phase operating method of a motor in accordance with the present invention.

Fig. 4 is a drawing showing an example of a two-phase operating method of a motor in accordance with the present invention.

**[0016]** Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

**[0017]** Fig. 1 is a plane diagram of an operating apparatus of a washing machine in accordance with the present invention.

**[0018]** As shown in Fig. 1, an operating apparatus of a washing machine in accordance with the present in-

vention includes: a power section(1) that the AC power is input; a communication section(2) which communicates the AC power input through the power section into a direct current; a smoothing unit(3) which smooth a direct current communicated on a communication section (2); an inverter(4) which generates motor operating signals as switching a power to be smooth into a direct current; a motor(5) which is operated by a n input power of an inverter.

**[0019]** Also, includes: a control section(6) which generates switching signals controls a power of an inverter (4), and input into an inverter(4); a memory(7) that the information which is needed for the operations of a control section(6) are saved.

**[0020]** As a distinctive feature of the present invention, at least two kinds of reference signals are gathered as a form of look up table so as a proper reference signals to be called by the operation condition of a motor. For instance, one of the reference signals is the No.1 look-up table which is needed for a two-phase operating of a motor, and another is the No.2 look-up table which is needed for a three-phase of a motor. The reference signals form switching signals which are needed for the operations of an inverter(4) as compared with carrier signals is already mentioned.

**[0021]** And, PWM signals formed by an inverter is input into a motor(5), and used as operation signals of a motor.

**[0022]** The operating method of a washing machine in accordance with the present invention as based on the operating apparatus of a washing machine as the same with the proposal is briefly explained.

**[0023]** First, the various strokes which are progressed on a washing machine includes: a stroke which needs a rotation of a motor; and a stroke which doesn't need a rotation of a motor. For instance, a stroke which needs a rotation of a motor are a stroke that a drum, pulsator, and an agitator are rotated during the laundering, rinsing out, dehydrating stokes; and a stroke which doesn't need a rotation of a motor are the water supplying, and the draining strokes. It is judge if the stroke which is about to be progressed is a high speed rotation, or a low speed rotation if the stroke is a stroke which needs a rotation of a motor among the afore-mentioned strokes. A high speed stroke and A low speed stroke can be previously decided by the operating condition, for instance, laundering and rinsing can be a low speed stroke, and a dehydrate stroke can be a high speed stroke.

**[0024]** If a high speed rotation stroke is progressed, a motor is operated as three phase. On the three-phase operating of a motor on a high speed rotation stroke, generally as comparatively a lot of noise is generated if a motor is rotated in a high speed, even if the torque is low, a motor is operated as a three-phase operating method that little noise is generated. Differently with this, in case that a low speed rotation stroke is progressed, a motor is operating as two-phase. On a low speed stroke, a motor is operating as two-phase, because generally, in case that a motor is rotated with a low speed, as a

condition that clothes and water are contained in the inner side of a drum like the laundering stroke, the conversion of the rotation direction of a motor is frequent and a lot of resistance is inflicted to the rotation of a motor. Therefore, a motor is operated as two-phase that the torque is strong on a low speed rotation stroke. Even though a little noise is generated when a motor is two-phase operated, it doesn't give any unpleasant feeling to a user as being absorbed into the noise generated during the agitating of clothes.

**[0025]** The above-explained two-phase operating method and three phase operating method of a motor will be explained more particularly on the followings.

**[0026]** Continually, after an end of a stroke of a washing machine, the next stroke is decided; an two-phase operating method is applied if it is a low speed rotation stroke, three-phase operating method is applied if it is a high speed rotation stroke, and the next operation stroke of a washing machine is progressed.

**[0027]** On the other hand, a data which is necessary for two-phase operating method and three-phase operating method of a motor is used as the information are called which is saved on a memory(7); when two-phase operating method is applied, the No. 1 look-up table is called and used as a reference signal; when three-phase operating method is applied, the No. 2 look-up table is called and used as a reference signal. Also, the information of the called look-up table compared with the carrier signal by a control section(6), and the signals out put after the comparison is used as a switching signal as being input into an inverter(4).

**[0028]** The operating method of a washing machine like the above-explained can be understand according to a flow diagram explains the operating method of a washing machine presented on the drawing 2.

**[0029]** As explain the operating method of a washing machine particularly as referring to the drawing 2: first, the motor operating if it will be operated is decided(St 1). The motor operating steps are divided, as a step that a laundering stroke, rinsing stroke, and a dehydrating stroke are progressed directly, and as a step that a drum, a pulsator, and an agitator are rotated for laundering, into a stroke that a motor is rotated with a low speed for laundering stroke and rinsing stroke, and a stroke that a motor is rotated with a high speed for dehydrating stroke.

**[0030]** Next, a step if a motor is rotated with a high speed is decided(St 2), in case which decided as a high speed rotation mode, a motor is progressed as a three-phase operating step(St 3), in case which decided as a low speed rotation mode, a motor is progressed as a two-phase operating step(St 4).

**[0031]** Whether it's a step that a motor rotates with a high speed can be previously decided according to the series of a stroke condition which is previously saved on a memory according to the progress condition of a washing machine.

**[0032]** Being changed an operating method of a motor according to the strokes of a washing machine is a work

that a washing machine to be operated with a best torque and noise condition according to a stroke of a washing machine. Particularly, a high torque is generated, because the DC-link application rate of a motor is high near 100% in a two-phase operating condition of a motor so a high torque is generated, but a lot of harmonics is generated, so a lot of noise is generated during the operating. And in the condition that a motor is three-phase operating method, compared with two-phase operating method, application rate of a DC-link is low as about 87%, the torque is low, but the little harmonics are generated, so it can be suitably applied when a low noise operating is required.

**[0033]** Fig. 3 is a drawing showing an example of a three phase operating method of a motor, and Fig. 4 is a drawing showing an example of a two-phase operating method of a motor. Three phase operating method is embodied by SPWM: Sinusoidal Pulse Width Modulation, a two-phase operating method is embodied by DPWM: Dead-band sinusoidal Pulse Width Modulation.

**[0034]** As refer to Fig. 3 to 4, the (a) of Fig. 3 and the (a) of Fig.4 are as drawings illustrated an alteration condition of carrier signals(11)(21) and reference signals(21)(22), illustrating at least one part of the carrier signals of the chopping waves and reference signals of sine waves are compared each other. The line-to-neutral switching pattern which is output after the two signals are compared by a comparator is illustrated as the (b) of Fig. 3 and the (b) of Fig. 4. And, the (c) of Fig. 3 and the (c) of Fig. 4 are drawings that the signals of the (b) of Fig. 3 and the (b) of Fig. 4 are on the condition frequency analyzed as a frequency domain as fourier converted.

**[0035]** As referring to the (b) of Fig. 3 and the (b) of Fig. 4, the carrier signals(11)(21) are the same, on the comparison of the reference signals(12)(22); reference signals(12) are continued chopping waves, but on SPWM, the reference signals(22) are discontinued chopping waves, and No signals exist in the period of 120 in between 0 degree and 360 degree. Therefore, PWM altered operating signals are continually input into the entire of the three phase of a motor(5) on SPWM, but (ON) signal which isn't altered according to the carrier signals (21) are input through a phase which is altered with the intervals of 120° on DPWM. For DPWM, because the reference signals(22) aren't able to be input on 120°, this section is called as Dead-band. According to these method, the altered motor operating signals are input only into the two phases on DPWM, and because of this, DPWM is always operated with two phase operating method.

**[0036]** Also, as referring to the (c) of Fig. 3 and the (c) of Fig. 4, the two-phase operating method, compared with the three-phase operating method, generates more harmonics, and a lot of noise is generated during the operating of a motor by the harmonics.

**[0037]** Each of the (d) of Fig. 3 and the (d) of Fig. 4 are illustrating the output wavy pattern between a line and a line on the SPWM method and the DPWM method, and the (e) of Fig. 3 and the (e) of Fig. 4 are drawings of a

condition that the (d) of Fig. 3 and the (d) of Fig. 4 signals are Fourier altered frequency analyzed as a frequency domain.

**[0038]** As referring to the (d) of Fig. 3 and the (d) of Fig. 4, DC-link application rate of the DPWM method is higher, compared with SPWM method, as the Duty-on section is enlarged, hereby, a high torque is generated on the two-phase operating that the DPWM method is applied is noticed easily.

**[0039]** As referring to the (e) of Fig. 3 and the (e) of Fig. 4, the DPWM method, compared with SPWM method, generates more harmonics, hereby, it is easily noticed that more noise is generated on the two-phase operating method that DPWM method is applied.

**[0040]** Explained motor operating method can be applied differently each other according to the strokes of a washing machine. As explain particularly, applying two-phase operating method of a motor which is operated as DPWM method is suitable on a washing stroke or a rinsing stroke that a high torque is required among the operating strokes of a washing machine. It is suitable because, though the noise in a measure is generated, a high torque is obtained. Also, it is suitable because, though the noise is generated on a motor, giving a user an unpleasant feeling is very rare, because it is mixed with the noise during the agitating of the laundry like clothes. Also, even though a laundry stroke and a rinsing stroke rotate with a low speed, because a sudden change of the rotate direction is frequent, a two-phase operating method which operates with DPWM method that a high torque is generated is more suitable.

**[0041]** Also, on the dehydrate stroke which is rotated with a high speed among the operating strokes, the three-phase operating method which is operated as SPWM method is suitable, because a low noise operating condition can be obtained even though a torque is low. Also, on the dehydrate stroke, the rotate direction isn't changed continually though it is rotated with a high speed, as a high torque isn't required on the rotating condition, and able to obtain the enough power with a low torque, so three-phase operating method of SPWM method of a motor is more suitable.

**[0042]** As referring Fig. 2 again: if the two-phase operating of a motor is progressed(St 5) as decided to a low speed rotation mode(St 2); first, the No. 1 look-up table is called on the memory(7) (St 6); on a control section(6), the switching signals are generated after comparing the reference signals of the No. 1 look-up table and carrier signals(St 7). And, the switching signals are used as switching signals of inverter (4); and direct motor operating signals are generated on the inverter(4); supplied to a motor(5) and a motor is rotated(St 8).

**[0043]** Also, on a high speed rotation mode decision step(St 2); if the three-phase operating is progressed as decided it isn't a high speed rotation mode(St 3); first, the No. 2 look-up table is called(St 6); on a control section (6), the switching signals are generated after comparing

the reference signals of the No. 2 look-up table and carrier signals(St 7). And, the switching signals are used as switching signals of inverter(4); motor operating signals are generated on the inverter(4); supplied to a motor(5) and a motor is rotated(St 8).

**[0044]** According to the proposed present invention, especially, when a stroke like a dehydrate stroke which is required of a low noise-conditioned driving is progressed; as a motor is three-phase operated with a SPWM method, a washing machine is able to be operated in a required low noise condition though the torque is low.

**[0045]** And, especially when a laundering stroke or a rinsing stroke that a high torque driving is required is progressed; as a motor to be two-phase operated with DPWM method, a washing machine is able to be operated in a required high torque condition though the noise in a measure is generated.

**[0046]** As explained, according to an operating method of a washing machine in accordance with the present invention: without an addition of a complex hardware-like composing, only saving the two kinds of look-up tables on a memory(7), two-phase operating method according to the DPWM method; an embodiment of the three-phase operating method of a motor according to the SPWM method are possible.

**[0047]** Therefore, without additional circuits or a additional consumption of the costs, the operating method of a washing machine can be adaptable by the strokes of a washing machine.

**[0048]** The preferred embodiment as proposed of the present invention is able to have more different embodiments to be changed in the extent of the original abstraction, the changeable embodiments are explained on the following.

**[0049]** First, the main abstraction of the present invention is making a motor of a washing machine to be rotated by the operating condition, -that is, a laundering and a rinsing strokes which is required a high torque and the require condition of the noise is low, and a dehydrate stroke which is required a low noise and the require condition of the torque- and different methods. As the operation of a washing machine is progressed like this, the satisfaction of a user by a low noise classified by the operations of a washing machine is raised, operation stability is obtained of a washing machine according to the high torque, laundering efficiency is improved. Also, without hardware-like additional composing, as only adding a small number of information-for instance, several number of look-up table-applied differently to the number and kinds of a phase capable of operating of a motor on a memory, the effect can be achieved, the manufacturing costs are decreased.

**[0050]** Also, the reference signals and carrier signals which is used on the DPWM method aren't limited by the above-mentioned, the various forms of the associated signals are able to be used. However, a motor is operated as two-phase as the dead regions are formed with certain internals on the DPWM method. As well as on the three-

phase operating method of a motor, the various kinds of reference signals and carrier signals are able to be used. Furthermore, according to an operation method, the operation method of a motor which is able to be proposed as various forms, compare with a case that the high torque is required, in case that a low noise is required, being added an operating method has more phases is desirable.

**[0051]** Also, as another example, when a certain stroke is progressed according to the strokes of a washing machine, for a motor being operated as two-phase of a certain section and being operated as three-phase of a certain section possible, and this is included on the extent of the present invention. However, desirably, entirely only the two-phase is operated when the two-phase operating, and entirely only the three-phase is operated when the three-phase operating are desirable.

**[0052]** Also, in the equipment aspect, it is possible that the two of look-up tables are saved and called when it is needed according to a motor operating method, but several numbers of look-up tables on a washing machine are saved according to the progress condition of the continued strokes, it is possible that more suitable look-up tables are called and used according to the needs. Also, it is possible that a reference signal is able to be formed at every moment when it is needed by an arithmetical method not by the method that the tables are saved on the memory. it is more desirable that a reference signal is able to be formed at every moment when it is needed.

**[0053]** Also, the present invention, on the various forms of a washing machine, is able to be applied to the various revolving screen like a drum, pulsator, and an agitator, more desirably, because it isn't influenced by the amount, so the fullness of revolving screen is applied comparatively to be identified.

**[0054]** According to the proposed present invention, because the operating method of an inverter and a motor is different, the operating of a washing machine appropriated by the special quality of the strokes can be operated.

**[0055]** Also, because the two-phase and three-phase of a motor is selectively applied according to the noise condition and the proper rotation speed of a revolving screen like a drum of a washing machine, especially, a low noise driving is possible during the dehydrating and a high torque driving is possible during the laundering and rinsing.

**[0056]** Also, several reference signals of only being saved on the memory installed conventionally for the individual movement of an inverter, the operating condition of a washing machine is able to be operated as a user's desire, so the additional composition isn't needed as well as the costs for that isn't consumed.

## Claims

1. An operating apparatus of a washing machine com-

prising;

a memory storing reference signals;  
 a control unit generating switching signals by calling out the reference signals based on a stroke of a washing machine and comparing the reference signals with the carrier signals;  
 an inverter generating motor driving signals by switching external power source according to the switching signals;  
 a motor being rotated according to the motor driving signals; and  
 a rotating body being rotated by the motor.

2. The operating apparatus of claim 1, wherein the reference signals comprise at least reference signals for driving the motor in a two-phase mode and reference signals for driving the motor in a three-phase mode.
3. The operating apparatus claim 2, wherein the reference signals for driving the motor in the three-phase mode have a sinusoidal waveform, and the reference signals for driving the motor in the two-phase mode have a chopped sinusoidal waveform.
4. The operating apparatus of any of claims 1 to 3, wherein the rotating body is a drum for a washing machine.
5. The operating apparatus of any of claims 1 to 4, wherein the laundering, rinsing and dehydrate strokes are progressed by the rotating body.
6. The operating apparatus of any of claims 1 to 5, wherein the motor driving signals are two-phase or three-phase driving signals being determined according to the reference signals.
7. The operating apparatus of any of claims 1 to 6, wherein the reference signals are previously stored as the forms of several look-up tables.
8. The operating apparatus of any of claims 1 to 7, wherein the reference signals are called as different signals each other according to the strokes of the washing machine.
9. The operating apparatus of claim 8, wherein the reference signals are called that the motor is operated as the three-phase driving mode in case that a stroke of a washing machine is a dehydrate stroke.
10. The operating apparatus of claim 8, wherein the reference signals are called for driving the motor the three-phase mode in case that the stroke of a washing machine is a laundering and/or rinsing stroke.

11. A operating method of a washing machine comprising a single rotating body being able to rotate in high speed and low speed on a condition that the laundry is contained, and a single motor rotating the single rotating body, comprising; 5
- deciding a rotation request of the washing machine ;  
driving the single motor in a three-phase mode for a certain time period in case of the rotation request in high speed , in order to get a low noise; and 10  
driving the single motor in a two-phase mode for a certain time period in case of the rotation request in low speed , in order to get a high torque. 15
12. The method of claim 11, wherein the washing machine is a drum washing machine.
13. The method of claim 11 or 12, wherein a stroke of the washing machine is a dehydrate stroke in case that the rotating body is in a high speed rotation. 20
14. The method of claim 11 or 12, wherein a stroke of the washing machine is a laundering stroke and/or a rinsing stroke in case that the rotating body is in a low speed rotation. 25
15. The method of any of claims 11 to 14, wherein the single motor is driven by an inverter. 30
16. The method of claim 15, wherein a switching signal of the inverter is generated by the SPWM method in case that the rotating body is rotated in high speed. 35
17. The method of claim 15, wherein a switching signal of the inverter is generated by the DPWM method in case that the rotating body is rotated in low speed.
18. A operating method of a washing machine according a driving method of a motor, comprising; 40
- driving a motor for a certain time period as a SPWM method to operate a rotating body in case that the rotating body which contains a laundry is rotated in high speed to drain the moisture of a laundry; and 45  
driving a motor for a certain time period as a DPWM method to operate a rotating body in case that the rotating body which contains a laundry and water is rotated in low speed to remove the dirt on the laundry. 50
19. A operating method of a washing machine according a rotating state of a drum, comprising; 55
- deciding a stroke being progressed on a washing machine;
- deciding a rotating state of the drum based on the decision of the stroke;  
calling a reference signal generating a PWM signal;  
comparing the reference signal with a carrier signal;  
generating the PWM signal based on a result of the comparison and inputting the PWM signal into the inverter;  
generating a motor driving signal using the inverter; and  
rotating a motor based on the motor driving signal,
- wherein the reference signals are different each other according to the rotating state of the drum.
20. The operating method of claim 19, wherein the reference signal being called is suitable for a two-phase driving of a motor when a drum is rotated in high speed, and the reference signal being called is suitable for a three-phase driving of a motor when a drum is rotated in low speed.

FIG.1

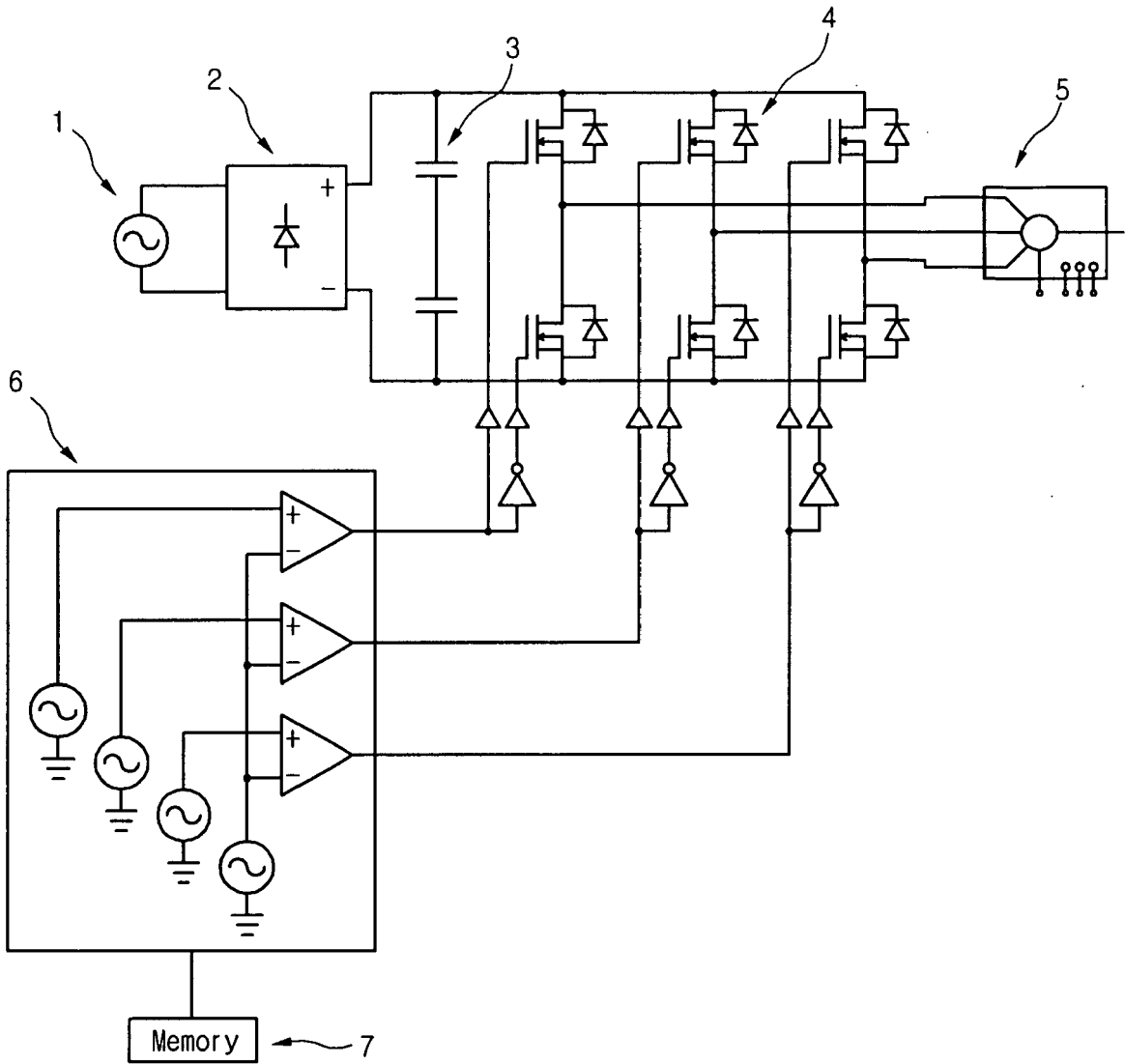


FIG.2

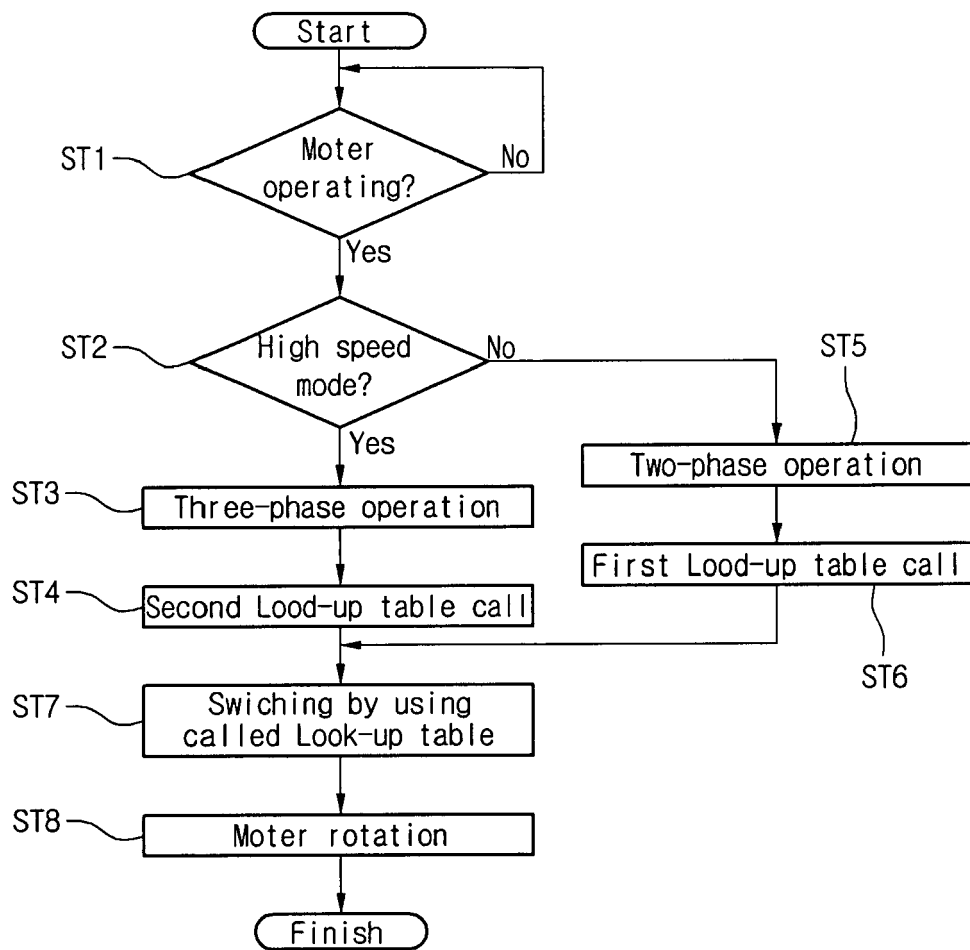


FIG.3

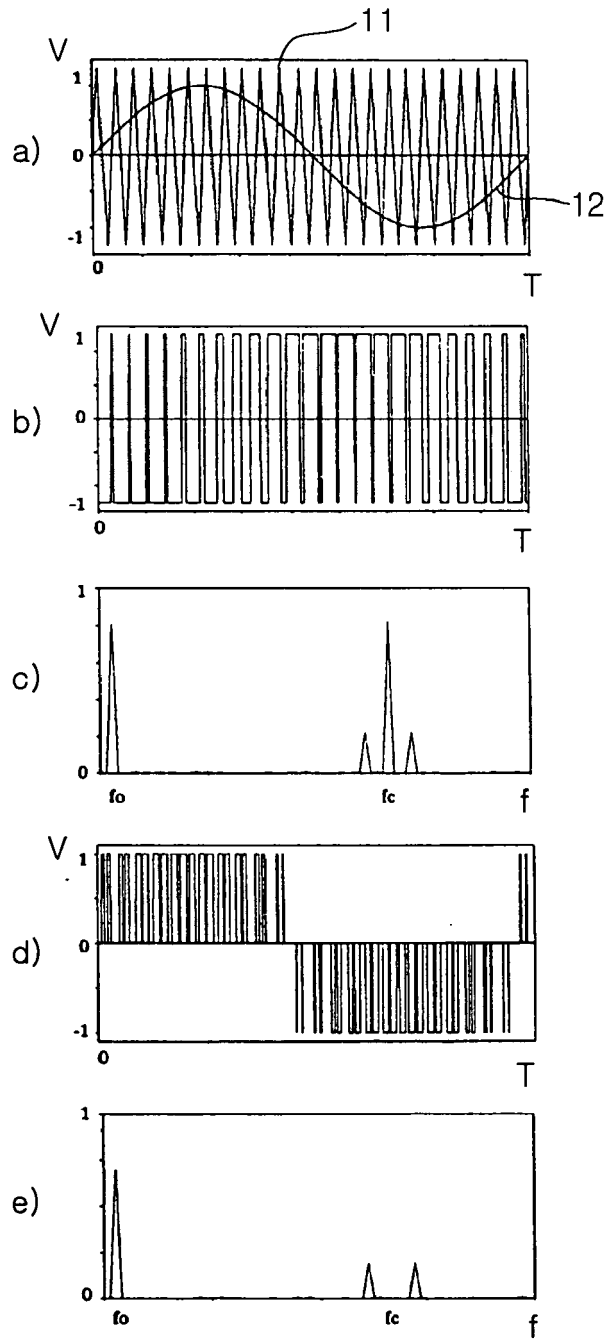


FIG.4

