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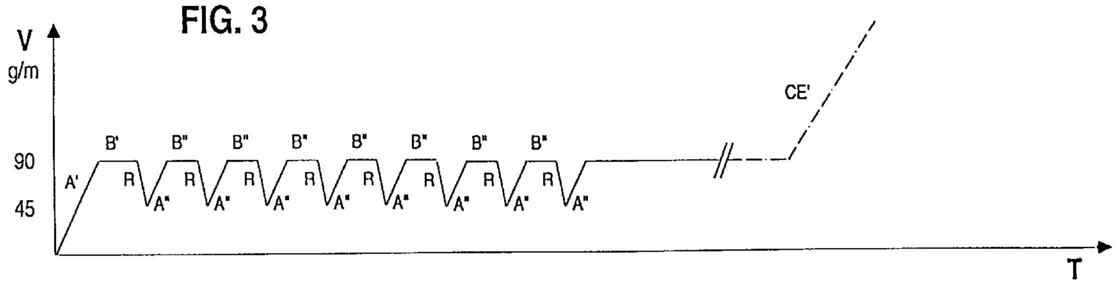
(54) Method for balancing the load in a laundry washing and/or drying machine, and machine implementing such a method

(57) A method is described for balancing the load of clothes in a laundry washing and/or drying machine of the type comprising a motor (MO) to generate a rotation of a drum containing the laundry, a control system (SC) for said motor (MO) and means (T) for detecting the balance conditions of the laundry load inside the drum, said method comprising an initial rotation phase (B') of the drum at a first speed capable of producing a substantial adhesion of the clothes to the drum walls, and a detection phase, during said initial phase (B'), of the load balance conditions, where one or more balance actions (R, A",B") of the load itself are provided should an unbalanced load condition be detected. According to the invention, said balance action or actions (R,A",B") are obtained maintaining the drum in continuous rotation, alternating phases (R) at a reduced rotation speed and phases (B") operating at said first speed.

FIG. 3



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Description

The present invention relates to a method for balancing the load in a laundry washing and/or drying machine.

It is known for the execution of an operating program of laundry washing and/or drying machines to have one or more spinning phases, i.e. drum rotation phases at a much higher speed than normally foreseen during the actual washing phases; for instance in some machine types the speed reached by the drum during the spinning phases may be much higher than 1000 revs per minute (rpm).

A critical element concerning said spinning phases is the risk of having an unbalanced laundry load with the clothes arranged unevenly inside the machine drum, i.e. either concentrated in some areas and not available in other areas, so that during high speed rotation of the drum this unbalanced load condition may in fact cause important machine oscillations or even the risk of a mechanical failure.

To this purpose modern washing machines are provided with special control systems and methods to check whether the laundry load is evenly distributed or balanced inside the drum, before execution of a spinning phase. In case of a balanced load, the control system enables execution of the spinning phase, whereas in case of an unbalanced load the control system will remove the unbalance condition and provide for a new distribution phase or at least bring its amount back to acceptable limits for the machine structure.

However, the systems known to obtain a balanced load condition have some problems.

More in detail and as it will result more clearly from the example described with reference to Fig. 1, the known systems are characterized by the fact that upon detection of a load unbalance, the machine drum stops to start a more or less long and complex new distribution phase for balancing the load. Typically, such a balance phase is carried out letting first the drum rotate in one direction at a given speed (eg. 45 rpm clockwise) and stop for a given time, then repeat drum rotation inversely (eg. 45 rpm anticlockwise) and stop rotation again, and so on, for a certain number of times.

After repeating these balance phases for a certain number of times, the control system of the machine makes a new attempt to spin and checks the load condition. In case of a persisting unbalance condition, said phases have to be repeated again.

Therefore, in the practice to remove a load unbalance according to the known state of the art a plurality of phases involving several stops and rotation intervals of the machine drum are required as long as the load unbalance has not been removed and the motor control system can release execution of the spinning phase.

However, the method of operation according to the known technology involves rather long operational times dictated by the need of executing a plurality of stops and rotation intervals of the machine drum. Such a problem is further sharpened considering that for some particular types of clothes (as for instance sponge textiles) a load balance is difficult to reach, so that repeated balance attempts are required.

It is the object of the present invention to solve the above problems and, in particular, provide an operational method to ensure balance of the laundry load in case of need in a much faster way than required by the known technology.

Therefore, it is the object of the present invention to provide a method for balancing the load in a laundry washing and/or drying machine as featured by the characteristics of the attached claims.

Further characteristics and advantages of the present invention will become apparent from the following description and annexed drawings, which are supplied by explanatory and not limiting way of example, where:

- Fig. 1 shows a simplified diagram of the distribution and balance phase flow for the laundry load according to the known technology;
- Fig. 2 shows a simplified block diagram of part of the machine control circuit implementing the method according to the present invention;
- Fig. 3 shows a simplified diagram of the distribution and balance phase flow of the laundry load according to the present invention;
- Fig. 4 shows a block diagram of part of the logical control circuit of a laundry washing and/or drying machine implementing the method according to the present invention.

The present invention and its comparison with the known technology will be further described with reference to a laundry washing-machine equipped with all elements for its operation, which elements well known to those skilled in the art will not be described in detail herein.

In Fig. 1 a simplified diagram shows the flow of the drum rotation speeds of a laundry washer operating according to the known state of the art in its phases of laundry load distribution, unbalance control and removal.

In said diagram, the axis of abscissas represents time, whereas the axis of ordinates represents the speed reached by the laundry washer drum during the various phases.

According to the known state of the art, a first phase indicated by A is foreseen before spin start, which brings the motor and then the drum of the laundry washer to such a speed allowing load satellization, i.e. such as to cause a substantial adhesion of the clothes to the drum walls. Said speed, called distribution speed, is typically about 90 revs per minute.

Once this speed has been reached, it is maintained for a certain period of time as it can be seen in the second phase indicated by B, during which the machine control system measures the load balance degree.

Such a balance measure may be carried out for example during phase B by measuring the frequency of the signal from a speedometer dynamo detecting the motor speed.

If the load is balanced, i.e. arranged evenly inside the drum, the motor control system will maintain a 90 rpm distribution speed for a pre-set time, which is longer than the one of phase B, after which the drum speed increase will be enabled till the spin speed is reached, as it is shown by the example in Fig. 1 through the hatched line CE.

If during phase B an unbalance is detected, the motor control system will cut off power to the motor causing the drum to stop. This action is graphically shown by phase C.

Once the drum has stopped (this condition is typically detected by the speedometer dynamo), a first interval of about 10 secs occurs as indicated by D. After interval D, the control system enables the motor and brings it to a speed of about 45 rpm in the phase indicated by E.

Then such a speed is maintained for about 10 secs (phase F), after which a new stop of the motor and of drum rotation (phase G) and a new interval (phase H) will take place.

Following the second interval (phase H) the control system starts the motor again (phase I) to rotate inversely to the direction of phases E-F, till the 45-rpm speed is reached and maintained for about 10 secs (phase L). Following this phase L a new stop (phase M) and a new interval (phase N) are provided, after which phases E-F-G can be repeated.

Said start, stop and drum motion reverse phases have the purpose of possibly obtaining a distribution of the clothes inside the drum different from the initial one, so as to remove a load unbalance. This occurs practically because said motion stops and reverses cause the clothes to fall down on the lower side of the drum as well as their "mixing", right with the purpose of eventually removing the initial unbalance condition.

Following the mentioned load distribution phases (A-B) and redistribution phases (C-N), the motor control system carries out a new distribution phase by repeating both phases A and B. If during the new phase B a new unbalance is detected, the control system will then repeat phases C-N.

The operational cycle described above will repeat till the load unbalance is removed through redistribution phases C-N and the motor control system enables distribution speed (90 rpm) to be maintained for a pre-set time, at the end of which the machine programmer will start the high speed spin phase (CE).

It is obvious, as already stated at the beginning of this description, that according to the known technology for balancing the load a certain number of complete drum stops and relevant intervals will be required, which determines rather long operational times.

According to the example of Fig. 1, it will be apparent how the attempts to redistribute the load (from the first phase C to the subsequent phase A) may require a time in the order of one minute and a half.

If we also consider that sometimes the various distribution phases (A-B) and redistribution phases (C-N) need to be repeated several times, it will be clear how the known state of the art does not appear particularly efficient.

In Fig. 2 a simplified block diagram shows part of the control circuit of the machine implementing the method according to the present invention. In this figure MO indicates the laundry washer motor, which generates rotation of a machine drum in a manner known for itself with the aid of belts and pulleys. SC indicates in its whole an electronic digital module or system for the control of motor MO. MP indicates an electronic microcontroller with an internal clock, indicated by CLOCK, with associated permanent memory means indicated by ROM. In the example, said microcontroller MP is actually the one available in the digital module SC to control the function of motor MO.

Memory ROM has some management programs of motor MO codified according to the various phases provided by the operational cycles of the machine, which can be selected by the user through proper control means (eg. an electro-mechanical timer and/or selection keys). Module SC, specifically through microcontroller MP and relevant memory ROM, manages the motor MO as a function of the signals received from said control organs and other machine components, such as a pressure switch, some push-buttons, a speedometer dynamo, etc.

T indicates a device suitable to generate a representative signal of the rotation speed reached by the drum and consequently by the motor MO during machine operation. In the example, the device T consists of a speedometer dynamo, but it is obvious that other similar devices can be used for the purpose of measuring rotation speed of both the drum and motor (eg. sensor of magnetic reed type).

According to the invention, the permanent memory ROM of the microcontroller MP has a proper program available, which will be described later with reference to Fig. 4, to perform the method according to the invention.

In Fig. 3 a simplified diagram shows the flow of drum rotation speeds of a laundry washer implementing the method according to the present invention, during the phases of laundry load distribution, its unbalance and its removal. Also in Fig. 3 time is represented on the axis of the abscissas, whereas the axis of the ordinates represents the speed reached by the washer drum during the various operational phases. According to the method provided by the present invention, a distribution or satellization phase for the laundry load is provided before starting a spinning phase.

Specifically, during said first phase indicated by A', the machine motor is controlled to bring the drum to a satellization speed of about 90 rpm. Upon reaching said speed, this is maintained for a certain time in the phase indicated by B'. During said phase B', the machine control system measures the load balance degree. Thus, said operations are substantially similar to the typical ones for the known state of the art, as previously described with reference to Fig. 1.

If the load is balanced, the motor control system will maintain distribution speed (90 rpm) for a pre-set time and subsequently enable an increase of the drum speed to reach the spin speed as it is shown by way of example in Fig. 3 by the line CE'.

Viceversa, should a load unbalance be detected, for instance analyzing the data from the speedometer dynamo T, the method according to the present invention provides for a decrease of the drum rotation speed from 90 rpm to a speed value allowing the clothes to disatellizite, i.e. to come off the drum walls and fall down to its centre so as not to slow down its rotation. This speed decrease phase is indicated in Fig. 3 by reference letter R. The speed value for disatellization of the load without decreasing the drum speed is substantially comprised between 45 and 55 rpm.

The drum speed decrease is simply obtained in the practice by stopping power feed to the motor MO of the laundry washer for a few seconds, till the speedometer dynamo T detects that the motor has reached the pre-set speed between 45 - 55 rpm, as stated above.

Once said decreased speed has been reached, control system SC of motor MO feeds the motor again determining a speed increase to 90 rpm during the phase indicated by A" in Fig. 3. This speed will be subsequently maintained for a pre-set time in the phase indicated by B".

According to the method of the present invention it should be noted that the phases of speed decrease (R), increase (phase A") and distribution (phase B") can be obtained in a total time of even less than 10 seconds.

Specifically, based on practical testing, it has resulted that such phases can be effectively performed in about 8 seconds.

As stated above, the decrease of speed rotation during phase R causes the clothes to come off the drum walls to the drum centre. However, a fast speed increase to 90 rpm (phase A") does not let the clothes collect to the drum lower side; in other words, therefore, before the clothes collect on the drum bottom the spinning force generated by the new speed increase to 90 rpm determines a new satellization of the load, so that drum rotation is not held back.

During phase B" the control system performs a new check of the load balance degree. If the load is now balanced, the control system will maintain a 90 rpm speed till the signal from the programmer or timer of the machine (not shown in the figure) indicates that the high speed spin phase has started, whereas in case of a still unbalanced load the control system SC of the machine will perform a new speed decrease phase down to 45 rpm (phase R), a new increase phase up to 90 rpm (phase A") and a new distribution phase (phase B") verifying the balance degree. Said operational cycle will be repeated as long as the load is not balanced so as to obtain a stable spin.

Therefore, it will be apparent how the method according to the present invention is substantially differing from the known state of the art as it has no stops during drum rotation, no rotation intervals and no reverse drum rotation.

From the above statement it is obviously clear that compared to the method according to the known state of the art, the same time taken by the method according to the present invention allows performance of a decidedly higher number of balance attempts for the load.

On the other hand, based on the same number of balance attempts, the method according to the present invention allows the performance of the operational cycle in a drastically shorter time compared to the known state of the art.

This will be quite apparent from a quick comparison between figures 1 and 3.

As stated above, according to the method of the present invention this is obtained using a digital micro-controller MP as a component of the duly programmed control system SC of the machine.

To this purpose, Fig. 4 shows by way of example a possible block diagram of a part of the logical circuit of the motor of a laundry washing and/or drying machine implementing the method according to the present invention.

In said Fig. 4 reference number 1 indicates the start block of the program, which releases control to block 2.

Said block 2 determines the start of a motor speed increase slope to 90 rpm (phase A' of Fig. 2), and then releases control to block 3.

Such a block 3 is a test block, testing load balance conditions during the distribution phase (phase B' of Fig. 3).

If the laundry load is balanced (output SI), the control goes on to block 4, which maintains drum rotation speed at 90 rpm. Then the control goes on to block 5, which is a test block verifying if the start signal of the spin phase has arrived from the machine programmer or timer through block 6. In the negative (output NO), the control goes back to block 4, whereas in the affirmative (output SI) the control goes on to block 7, which releases performance of the high speed spin phase (phase CE').

Then the control goes on to block 8, where the program will end.

Coming back to block 3, in case a load unbalance (output NO) is detected, the control will go on to block 9.

Said block controls motor feed, so as to decrease the drum rotation speed from 90 rpm (phase R in fig. 3). Then the control goes on to block 10.

Block 10 is a test block, verifying when the drum rotation speed reaches the pre-set disatellization value (comprised between 45 and 55 rpm), i.e. a speed allowing the clothes to come off the drum walls, however without stopping drum rotation. Upon reaching said decreased speed (output SI), the control goes back to block 2, which performs a new speed increase slope up to 90 rpm (block 2 or phase A" in Fig. 3) and a new test of the load balance (block 3 or phase B" in Fig. 3).

In case of a balanced load, the control will go on to block 4 while the program proceeds as described above, whereas in case of an unbalanced load the control will go on to block 9 and repeat a new disatellization phase (blocks 9 and 10) followed by a speed increase (block 2), which phases will repeat as long as the load is not balanced.

In the practice it has been ascertained that the method according to the present invention allows an extremely efficient balance of the clothes inside the drum of a laundry washer in drastically shorter times than according to the known technology described at the beginning of the present description.

Moreover, it should also be underlined that the method according to the invention is directly and easily applicable both to machines equipped with an alternating current commutation motor and machines equipped with an asynchronous motor, without any substantial programming difference for the digital control system.

The characteristics and advantages of the present invention will be apparent from the above description, mainly the fact that the proposed method - characterized by no stop or reverse phases of the motor rotation - performs a fast optimal distribution of the clothes to ensure a subsequent stable spin phase.

It is also obvious that many changes to the method described by way of example are possible for those skilled in the art.

To this purpose it should be underlined that the detection modes for a balance condition of the laundry load are prescinding from the present invention, i.e. they can be of any known type, without departing from the novelty spirit of the invention.

Claims

1. Method for balancing the load of clothes in a laundry washing and/or drying machine of the type comprising a motor (MO) to generate a rotation of a drum containing the laundry, a control system (SC) for said motor (MO) and means (T) for detecting the balance conditions of the laundry load inside the drum, said method comprising an initial rotation phase (B') of the drum at a first speed capable of producing a substantial adhesion of the clothes to the drum walls, and a detection phase, during said initial phase (B'), of the load balance conditions, where one or more balance actions (R, A",B") of the load itself are provided should an unbalanced load condition be detected, characterized in that said balance action or actions (R,A",B") are obtained maintaining the drum in continuous rotation, alternating phases (R) at a reduced rotation speed and phases (B") operating at said first speed.

2. Method for balancing the load of clothes in a laundry washing and/or drying machine of the type comprising a motor (MO) to generate a rotation of a drum containing the laundry, a control system (SC) for said motor (MO) and means (T) for detecting the balance conditions of the laundry load inside the drum, said method comprising an initial rotation phase (B') of the drum at a first speed capable of producing a substantial adhesion of the clothes to the drum walls, and a detection phase, during said initial phase (B'), of the load balance conditions, where one or more balance actions (R, A",B") of the load itself are provided should an unbalanced load condition be detected, characterized in that said balance action or actions (R,A",B") are obtained maintaining the drum in continuous rotation, without any interruptions of its rotation or reverse of its rotation sense.

3. Method according to Claim 1 or 2, characterized in that said balance action or actions (R,A",B") comprise a first phase (R) of reduction of the drum rotation speed from said first speed (90 rpm) to a second speed (45-55 rpm) suitable to cause the laundry to leave the drum walls and tend to fall towards the centre of the drum itself.

4. Method, according to Claim 3, characterized in that said balance action or actions (R,A",B") comprise a second phase (A") where the drum rotation speed is returned from said second speed (45-55 rpm) to said first speed (90 rpm).

5. Method, according to Claims 3 and 4, characterized in that said second phase (A") follows directly said first phase (R), so that the laundry leaving the drum walls and tending to fall towards the drum centre during said first phase (R), is pushed due to a centrifugal force to adhere again on said walls before collecting, so that the drum rotation is not slowed down.

6. Method, according to Claims 4 and 5, characterized in that said second phase (A") is followed by a third phase (B") to maintain said first speed (90 rpm).

7. Method, according to the previous Claim, characterized in that during said third phase (B") a new detection of the balance conditions of the laundry load is performed.

8. Method, according to the previous Claim, characterized by the fact that if a new load unbalance is detected during said third phase (B"), the first, second and third phases are repeated.

9. Method, according to the previous Claim, characterized in that said first, second and third phases are repeated in that sequence till the load inside the

drum is balanced, so as to subsequently perform a high speed spin phase (CE') of the laundry.

10. Method, according to at least one of the previous Claims, characterized in that said first speed is substantially about 90 revs per minute and/or said second speed is substantially comprised between 45 and 55 revs per minute.

11. Method, according to at least one of the previous Claims, characterized in that said first, second and third phases are performed in a total time of about 10 seconds.

12. Method, according to at least one of the previous Claims, characterized in that the detection of the balance conditions of the laundry load is obtained by analyzing the data supplied from a speedometer dynamo (T).

13. Laundry washing and/or drying machine implementing the method according to one or more of the previous Claims.

14. Laundry washing and/or drying machine, according to Claim 13, characterized in that it comprises an actuating motor (M) of the alternating current commutation type or of the asynchronous type, where in particular the control system (SC) of the motor (M) is of digital type with electronic microcontroller (MP).

FIG. 1

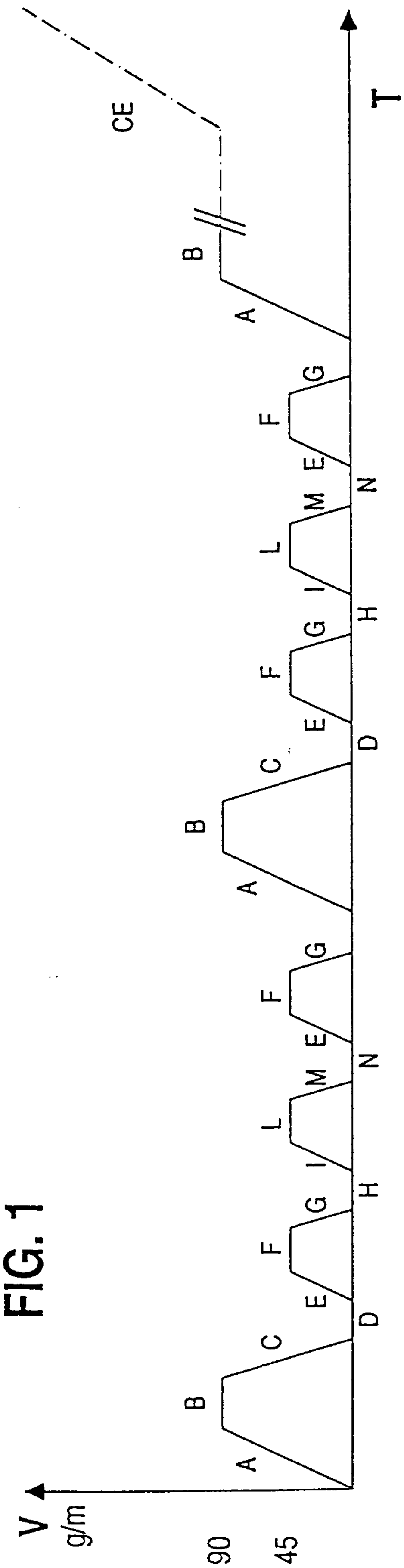
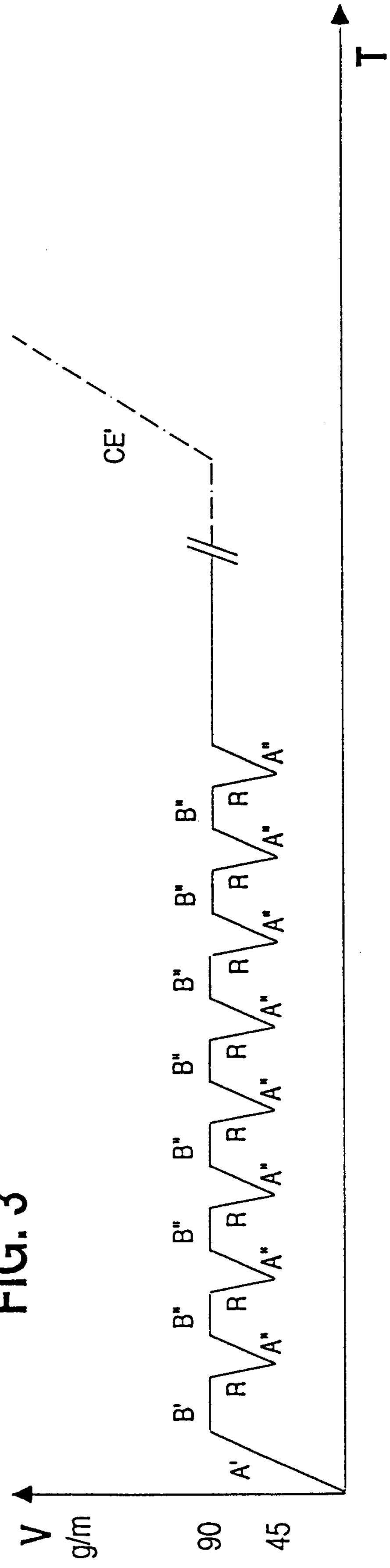


FIG. 3



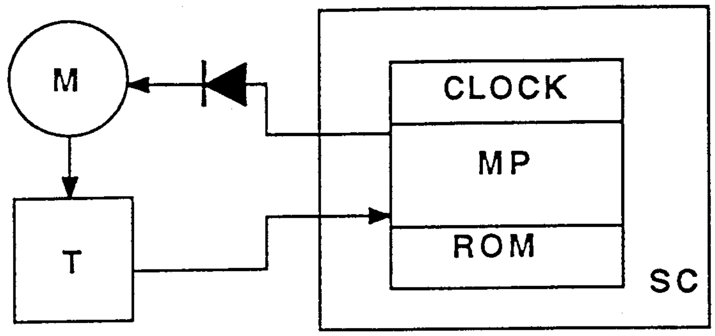


FIG. 2

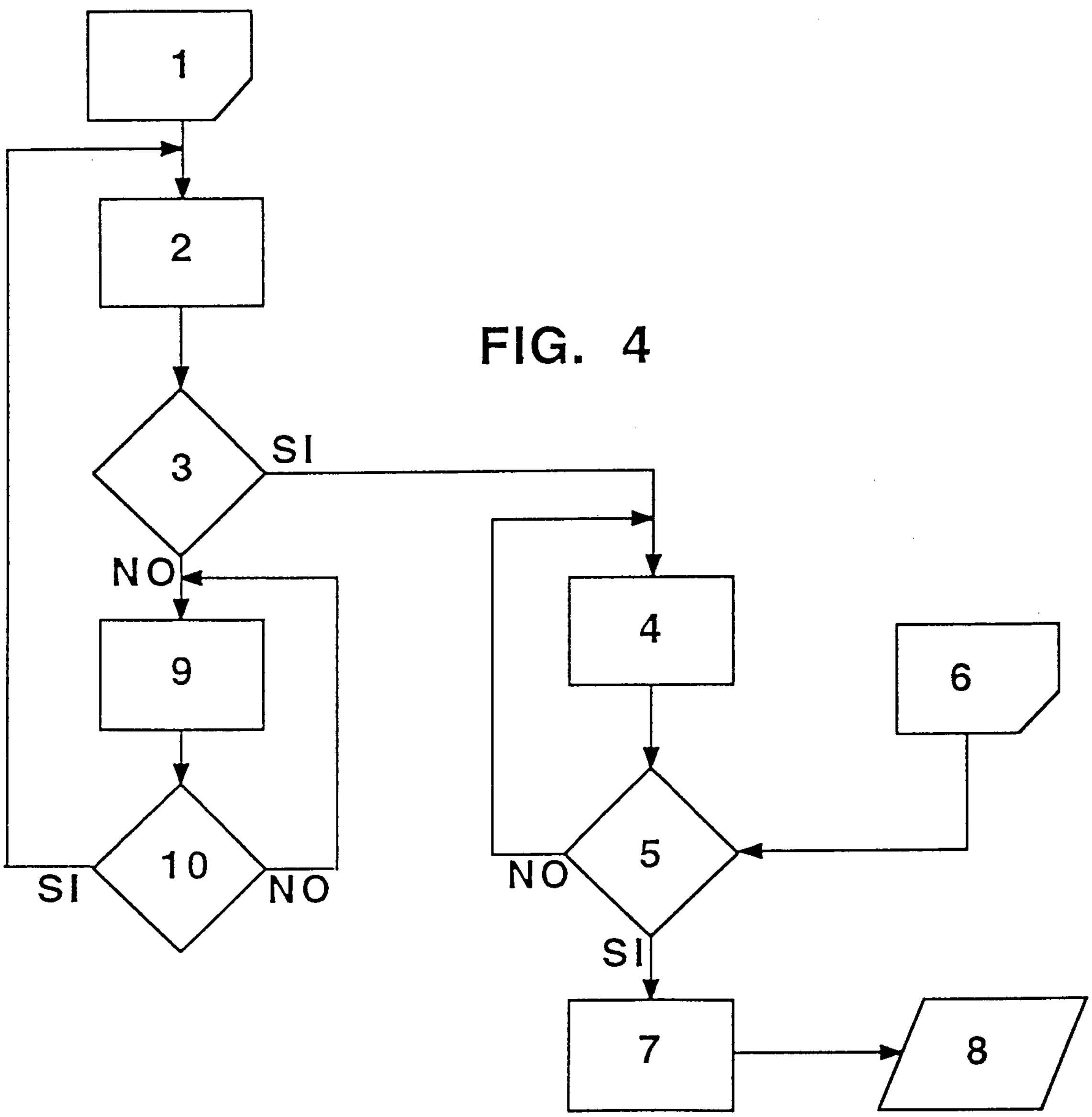


FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 96 10 4015

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X A	FR-A-2 645 553 (LICENTIA PATENT-VERWALTUNGS-GMBH) * the whole document * ---	1-9,12, 13 10,11,14	D06F35/00 D06F37/20
X	FR-A-2 311 883 (N.V. PHILIPS GLOEILAMPENFABRIEKEN) * the whole document * ---	1-10,13	
A	FR-A-2 157 867 (SIEMENS AG) * page 5, line 1 - line 20; claim 1; figure 1 * -----	1-6,9, 10,13	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	19 June 1996	Courrier, G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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