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(54) Automatic change dispenser

(57) An automatic change dispenser comprising at least one magazine for each coin denomination able to be connected to a counter or a cash-register to receive information relative to the amount of the change to be dispensed and to select the correct number of coins, characterized in that the coins (M) of each denomination are stacked in the magazines which are slightly inclined with respect to the vertical to reduce the weight of the stack resting on the lowest coin, and that the stacks of coins are placed side by side in pairs so that it is possible to dispense alternately coins (M) of two different denominations by the same actuator ($3^{I} \div 3^{IV}$), the inclination of the magazines reducing the force necessary to dispense the lowest coin (M). Each actuator includes a small anchor ($3^{I} \div 3^{IV}$) rotating in a plane which is parallel to the plane of the stacked coins, i.e. orthogonal to the axis of the magazines. Under rest conditions, each small anchor ($3^{I} \div 3^{IV}$) is located between two stacks of coins (M) placed side by side so that the side rotation of the small anchor ($3^{I} \div 3^{IV}$) toward one stack exerts a force to the lowest coin of the stack that pushes it outside the stack and then the magazine to a lower opening (4) in the resting plane of the coin so that the latter falls from such opening into the lower tray (2).

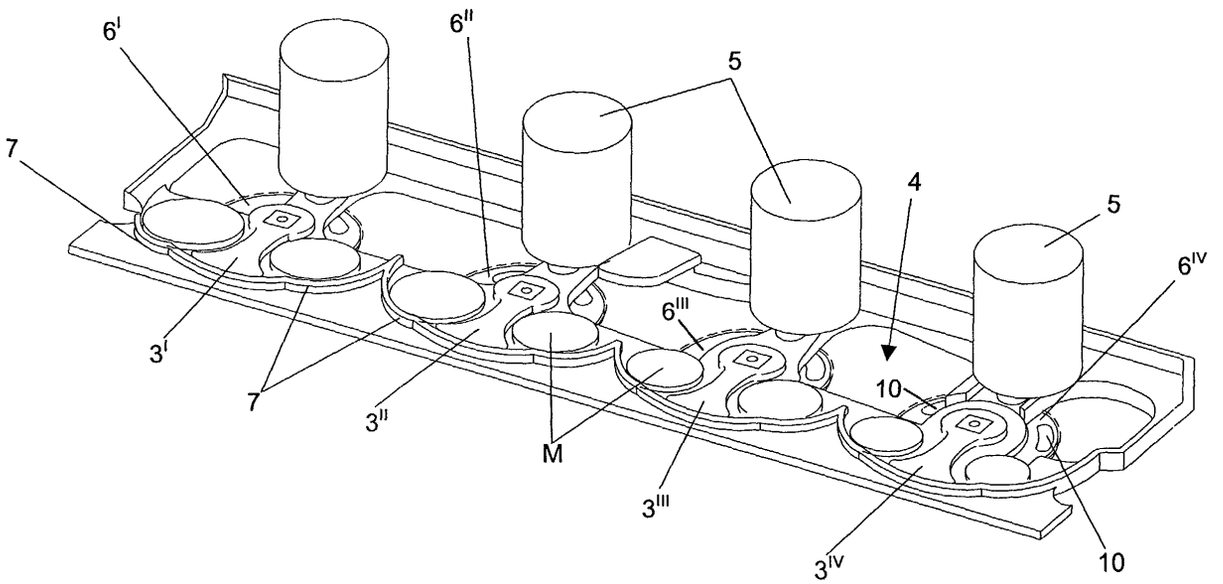

FIG. 3

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Description

[0001] The present invention relates essentially to the trade and particularly an automatic device able to be connected to a corresponding counter of a post office, travel agency, supermarket, as well as a cash-register of a shop, bar, pharmacy, etc., in order to deliver a correct change in coins, leaving only the duty to the cash clerk to give the change in notes.

[0002] As known, Euro (∈) will be the new money of the countries of the United Europe from January 1, 2002 and, after two months of double circulation of Euro/national currency, from March 1, 2002 the national currency won't be able to be used for trades any longer.

[0003] To this purpose, it should be noted that there are as much as eight metal coins, 1, 2, 5, 10, 20, 50 cents and 1 and 2 Euro. Instead the bills will be seven, 5, 10, 20, 50, 100, 200 and 500 Euro.

[0004] It is evident that the high number of metal coins will greatly complicate the work of the cash clerks of shops, bank tellers, etc. In particular, an increase in the complexity of taking the right combination of change coins is to be expected by the cash clerk, for example, to give the change to customers which have made purchases in a shop. This will bring to an increase in the waiting time at the counters and a discomfort in the customers.

[0005] A number of the present cash-registers shall be replaced while others shall only be brought up to date as for their software.

[0006] In any case, however, the problem of limiting the waiting time at the counters for payments and cash operations will be heavy as the use of coins will be much more frequent than today because of the value of Euro.

[0007] Coin dispensers connected to cash-registers are nowadays known (for example in the United States). They have essentially the following characteristics:

dimensions [cm] : 16x33x40
weight [kg]: 5.5÷10 (up to 22)
capacity :1000÷1200 coins
velocity : about 6 coins per second

It should be noted that the technology used today is generally characterized by a high mechanical complexity and heavy weight.

[0008] Therefore, the main object of the present invention is to overcome the above-mentioned drawbacks by reducing the waiting time at the counters, avoiding the mistakes by the cash clerk in taking coins, and facilitating the check of the change.

[0009] A second object of the invention is to provide a device which can be connected to all of the counters and cash-registers brought up to date for Euro or other currency.

[0010] A third object of the invention is to provide a coin dispenser which has a small size and is easy to use and reliable both in its operation and giving back the change coins.

[0011] These and other objects are accomplished by providing a coin dispenser according to claim 1 which is able to select automatically the change that should be given back (if necessary, together with notes) according to information directly from the counter or cash-register.

[0012] A better understanding of the invention will result from the following detailed description with reference to the accompanying drawings that show some preferred embodiments thereof only by way of a not limiting example.

In the drawings:

Figure 1 shows a schematic perspective view of the invention;

Figure 2 is a perspective bottom view showing schematically the inside of the invention;

Figure 3 is a general top view showing the arrangement of the mechanisms for selecting the coins;

Figure 4 is a bottom view similar to the preceding figure;

Figures 5A÷5D show the shape of the crown qears of the device of Figure 1, each of them having a different shape of the missing portion;

Figures 6A÷6C are longitudinal sections showing the operation of a flat spring able to support the lower coin of each stack during the extraction of a coin;

Figures 7A and 7B show a top plan view of the position of the device in rest condition and upon extracting a coin corresponding to Figures 6A and 6C, respectively;

Figure 8 shows an embodiment of the several coin dispensing means arranged to provide a support to the corresponding stacks of coins even when a coin is dispensed;

Figure 9, 10 and 11 are flow diagrams relative to the motor control logic, the operations which are necessary for dispensing coins from one of the odd stacks, and the control of the rest position of the dispensing means, respectively.

[0013] With reference to the above figures, the disclosed automatic change dispenser, particularly for Euro, consists essentially of a device provided with at least one magazine 1 for each coin denomination, which device is connected to a counter or cash-register to receive information relative to the change to be dispensed and is able to select the correct number of coins among the available denominations to reach the necessary change.

In fact, according to the invention, once the information about the change to be given back is obtained, the automatic dispenser calculates how many coins M of the denominations available in the magazines are necessary and immediately causes those coins to fall into a suitable lower collecting tray 2.

[0014] A first peculiar feature of the invention shown in Figure 1 is that the coins of each denomination are stacked into magazines 1 that are slightly inclined with respect to the vertical to reduce the weight of the stack resting on the lowest coin.

[0015] A second peculiar feature of the invention is that the stacks of coins M are placed side by side in pairs so that it is possible to dispense alternately coins M of two different denominations by the same actuator $3^{I} \div 3^{IV}$, thus reducing advantageously the overall dimensions and the number of components and simplifying considerably the construction of the whole apparatus (Figures 2 and 3). It should be appreciated that the inclination of the magazines 1 also reduces the force necessary to dispense the lowest coin M.

[0016] In the illustrated embodiment, each actuator includes a small anchor $3^{I} \div 3^{IV}$ rotating in a plane which is parallel to the plane of the stacked coins, i.e. orthogonal to the axis of magazines 1. Under rest conditions, each small anchor $3^{I} \div 3^{IV}$ is located between two stacks of coins M placed side by side (Figs. 3 and 7A) so that the side rotation of the small anchor $3^{I} \div 3^{IV}$ toward one stack exerts a force to the lowest coin that pushes it outside the stack and then the magazine 1 to a lower opening 4 in the resting plane of the coin. Thus the coin falls from such opening into the lower tray 2.

[0017] In the disclosed embodiment, each small anchor is preferably driven by an electric motor 5 capable of rotating in both directions. In particular, the motion is transmitted by a pinion P keyed on the axis of motor 5 and meshed with an arc of a circular crown gear $6^{I} \div 6^{IV}$ which is integral with the corresponding small anchor $3^{I} \div 3^{IV}$ which of course rotates about the centre of rotation of such crown gear. The amplitude of each arc of crown gear $6^{I} \div 6^{IV}$ is such as to cause the small anchor $3^{I} \div 3^{IV}$ to rotate enough to dispense coins M from the two relative stacks.

[0018] According to a further peculiar feature of the invention, the shape and the dimension of the small anchors $3^{I} \div 3^{IV}$ are such that, when a small anchor is at its maximum angle of rotation (limit stop), i.e. when the lowest coin M of a stack has been extracted and caused to fall into the lower tray 2, the stack of overlaying coins has at least three resting points on the same small anchor so as to prevent the coin resting directly on the small anchor $3^{I} \div 3^{IV}$ from tilting and preventing in turn such small anchor from returning to its rest position between the two magazines 1 (Fig. 8).

[0019] It should be appreciated that, under rest conditions, the stacks of coins M rest on a plane surface which is orthogonal to the axis of the magazines and then parallel to the laying plane of the corresponding small anchors $3^{I} \div 3^{IV}$.

[0020] The preferred disclosed embodiment provides that the extraction of coins M causes the same to shift along an arc of circumference and to slide on said resting plane surface. Therefore, it is preferable to arrange a projecting peripheral edge 7 able to keep the coin on the correct curved path.

[0021] In order to check the presence of coins in each magazine 1, the invention provides the use of optical sensors 8 which perform their functions through suitable holes 9 in the resting surface of each coin stack. The detection of (metal) coins M is based on that the sensor receives a reflection signal if magazine 1 contains one or more coins, while the sensor does not receive any reflection signal if the magazine is empty.

[0022] Advantageously, such optical sensors are also used to check that the limit stop is reached by each small anchor $3^{I} \div 3^{IV}$. To do so, as described hereafter, the crown gears $6^{I} \div 6^{IV}$ integral with small anchors $3^{I} \div 3^{IV}$ are used.

[0023] Under resting conditions, if the magazines contain coins, the sensors receive reflection signals of intermediate amplitude between a zero reflection value (no coin in the magazines) and a maximum reflection value in case of perfectly reflecting surface (mirror).

In order to check the angle of rotation of a small anchor $3^{I} \div 3^{IV}$, a mobile mirror surface is arranged integral with the relative small anchor so that, as soon as the latter begins to rotate toward one of the two associated magazines, the mirror surface rotates toward the optical sensor of the other magazine which receives under such conditions a maximum reflection signal. The limit stop of the small anchor $3^{I} \div 3^{IV}$ can easily be adjusted by stopping the motion as soon as the reflection signal detected by the sensor decreases because of the interruption of the mirror surface. The return motion of the small anchor is controlled in the same way by reversing motor 5. In other words, the travel is proportional to the amplitude of the corresponding mirror surface.

[0024] In the disclosed embodiment, the arc of the crown gears $6^{I} \div 6^{IV}$ are chromium plated so as to provide a generally reflecting surface such as to give the maximum reflection to optical sensors 8. In order to determine the limit stops, (preferably through) grooves 10 are provided causing the amplitude of the reflection signal which is received by optical sensors 8 to be reduced significantly.

Now, it is necessary to draw the attention to the software control to manage the motions of small anchors $3^{I} \div 3^{IV}$ and the selection of coins M that should fall into the lower tray 2.

In order to explain the operation of the software, also referring to the flow diagrams of Figures 9, 10 and 11, we shall imagine to have to dispense a coin from the left magazine 1 (odd position) of one of the pairs of illustrated magazines. In fact, each pair has a magazine in "odd" position (1, 3, 5, 7) and a magazine in "even" position (2, 4, 6, 8). In this case, the small anchor $3^{I} \div 3^{IV}$ is rotated

to the left by driving motor 5 which causes crown gear $6^{I} \div 6^{IV}$ to rotate. This initial motion causes the right optical sensor 8 (corresponding to the magazine in even position) to receive a maximum reflection signal as the generally specular surface of the arc of crown gear $6^{I} \div 6^{IV}$ shifts and enters the "visual" field of optical sensor 8. As a consequence, the signal of the left sensor is detected to check that at least one coin is present in the relative magazine. In fact, in this case the reflection signal has an intermediate value between a maximum value (specular surface) and a minimum or zero value corresponding to the total lack of coins in the magazine (the interior of which is dark).

Therefore, if the left sensor receives a minimum or zero reflection signal, the motor is stopped as there are no coins to be dispensed, otherwise the small anchor $3^{I} \div 3^{IV}$ continues rotating until the other (right) sensor receives a reflection signal whose value is lower than the maximum. In this way, as already described above, the coin is dispensed and the motor reverses its rotation direction to bring the small anchor $3^{I} \div 3^{IV}$, which at that moment is still underneath the stack of coins, back to its resting position.

The flow diagram of Figure 9 shows the operations carried out by the control software. In particular, the dispensation of coins from each stack is carried out according to the modes listed in the diagram of Figure 10, at the end of which the small anchor is brought back to its rest position by the cycle "STAY HOME" shown in the diagram of Figure 11.

In case a magazine is empty, the number of coins of each still available denomination which is necessary to reach the required amount is calculated again.

It should be appreciated that such type of control of the limit stops and the presence of coins in the magazines requires advantageously only the presence of one optical sensor 8 for each stack of coins M.

Still another advantage of the invention consists in that it is not necessary to check the precision with which the small anchor $3^{I} \div 3^{IV}$ is brought to its resting position, as the small anchor is moved until the optical sensor of the adjoining magazine receives the maximum reflection signal before checking that the coin to be dispensed is really present in the magazine.

It has been already mentioned that the crown gears $6^{I} \div 6^{IV}$ are not complete discs. In particular, they have a missing portion directed to the small anchor $3^{I} \div 3^{IV}$ so that the optical sensors 8 are not covered at the resting position. Moreover, such missing portion (Figures 5A÷5D and 7A÷7D) also allows the already described lower opening 4 to be free so that coin M can fall into the lower tray 2. Finally, the edge of the crown gears $6^{I} \div 6^{IV}$ determines the limit stop for the rotation of the small anchor and forms the end/beginning of the highly reflecting surfaces that interact with the optical sensors and are limited at the other end by grooves or slots 10.

[0025] The size of slots 10 and the shape of the missing portion of each crown gear 6 vary as a function of the size of coins M, the positioning of optical sensors 8, as well as the shape of the small anchors $3^{I} \div 3^{IV}$ that have different shapes. Thus the crown gears $6^{I} \div 6^{IV}$ are different from one another even if they have the same pitch diameter and the same toothing.

Since magazines 1 are slightly inclined to reduce the weight resting on the lowest coin to be dispensed, the coins lie on parallel, non-horizontal planes. Therefore, when one or only a few coins M remain in magazine 1, the coin in the lowest position could slide away into the lower tray 2, thus causing a mistake in the amount of coins to be dispensed and then troubles in the accounting of the cash.

In order to overcome such problem, the invention provides an elastic tongue or flat spring T for each magazine 1 able to prevent coins from falling accidentally. In particular, such semi-rigid flat spring is disposed perpendicular to the plane of the coin and is able to provide an elastic force which is sufficient to oppose to the small weight of the coin which is parallel to its resting plane. When the coin is pushed by the small anchor $3^{I} \div 3^{IV}$, spring T bends and generates a light downward thrust helping the coin to fall down (Figs. 6A÷6C).

It should he noted that each small anchor $3^{I} \div 3^{IV}$ has a thickness which is equal to or lower than coins M in the relative magazines 1 so as to allow only one coin at a time to be dispensed.

[0026] It is evident from the foregoing that the invention can advantageously be used without functional modifications for all currencies.

It would further be possible to provide several magazines for each coin denomination and, in case they are coupled together, each small anchor could extract coins with the same denomination from both parts.

The present invention has been described and illustrated according to a preferred embodiment thereof, however, it should be understood that those skilled in the art can make technical/functional equivalent modifications and/or replacements without departing from the scope of the present industrial invention. A variation of the invention, for example, can provide the use of crown gears of opaque material, for example plastics, which do not have slots but are provided with strips or inserts of high reflecting material which are suitable positioned on the surface of the crown gears $6^{I} \div 6^{IV}$ facing optical sensors 8.

Claims

1. An automatic change dispenser comprising at least one magazine (1) for each coin denomination able to be connected to a counter or a cash-register to receive information relative to the amount of the change to be dispensed and to select the correct number of coins, **characterized in that** the coins (M) of each denomination are stacked in the magazines (1) which are slightly inclined with respect to

the vertical to reduce the weight of the stack resting on the lowest coin, and that the stacks of coins are placed side by side in pairs so that it is possible to dispense alternately coins (M) of two different denominations by the same actuator ($3^{I} \div 3^{IV}$), the inclination of the magazines (1) reducing the force necessary to dispense the lowest coin (M).

2. The automatic dispenser according to claim 1, **characterized in that** each actuator includes a small anchor ($3^{I} \div 3^{IV}$) rotating in a plane which is parallel to the plane of the stacked coins, i.e. orthogonal to the axis of magazines (1).

3. The automatic dispenser according to the preceding claim, **characterized in that** under rest conditions, each small anchor ($3^{I} \div 3^{IV}$) is located between two stacks of coins (M) placed side by side so that the side rotation of the small anchor ($3^{I} \div 3^{IV}$) toward one stack exerts a force to the lowest coin of the stack that pushes it outside the stack and then the magazine (1) to a lower opening (4) in the resting plane of the coin so that the latter falls from such opening into the lower tray (2).

4. The automatic dispenser according to the preceding claim, **characterized in that** each small anchor ($3^{I} \div 3^{IV}$) is driven by an electric motor (5) capable of rotating in both directions, the motion being transmitted by a pinion (P) keyed on the axis of motor (5) and meshed with an arc of a circular crown gear ($6^{I} \div 6^{IV}$) which is integral with the corresponding small anchor ($3^{I} \div 3^{IV}$) which of course rotates about the centre of rotation of said crown gear, said motor (5) being driven by a control electronics.

5. The automatic dispenser according to the preceding claim, **characterized in that** the amplitude of each arc of crown gear ($6^{I} \div 6^{IV}$) is such as to cause a small anchor ($3^{I} \div 3^{IV}$) to rotate enough to dispense coins (M) from the two relative stacks.

6. The automatic dispenser according to any claim from 2 on, **characterized in that** the shape and the dimension of the small anchors ($3^{I} \div 3^{IV}$) are such that, when a small anchor is at its maximum angle of rotation (limit stop), i.e. when the lowest coin (M) of a stack has been extracted, the stack of overlaying coins has at least three resting points on the same small anchor so as to prevent the coin resting directly on the small anchor ($3^{I} \div 3^{IV}$) from tilting and preventing in turn said small anchor from returning to its rest position between the two magazines (1).

7. The automatic dispenser according to any claim from 2 on, **characterized in that** under rest conditions, the stacks of coins (M) rest on a plane surface which is orthogonal to the axis of the magazines and then parallel to the laying plane of the corresponding small anchors ($3^{I} \div 3^{IV}$).

8. The automatic dispenser according to any preceding claim, **characterized in that** the extraction of coins (M) causes the same to shift along an arc of circumference and to slide on said resting plane surface, and to this purpose there is provided a projecting peripheral edge (7) able to keep the coin on the correct curved path.

9. The automatic dispenser according to any preceding claim, **characterized in that** in order to check the presence of coins in each magazine (1), there are provided respective optical sensors (8) which are fixed with respect to the magazines and perform their functions through suitable holes (9) in the resting surface of each coin stack, the detection of coins (M) being based on that the relative optical sensor receives a reflection signal if a magazine (1) contains one or more coins, while the sensor does not receive any reflection signal if the magazine is empty.

10. The automatic dispenser according to the preceding claim, **characterized in that** said optical sensors (8) are also used to check that the limit stop is reached by each small anchor ($3^{I} \div 3^{IV}$) by detecting the change of the reflection signal amplitude received by the sensors as the rotation of the crown gears ($6^{I} \div 6^{IV}$) integral with small anchors ($3^{I} \div 3^{IV}$) changes.

11. The automatic dispenser according to the preceding claim, **characterized in that** in order to check the angle of rotation of a small anchor ($3^{I} \div 3^{IV}$), a mobile mirror surface is arranged integral with the relative small anchor so that, as soon as the latter begins to rotate toward one of the two associated magazines (1), the mirror surface rotates toward the optical sensor (8) of the other magazine which receives under such conditions a maximum reflection signal, the limit stop of the small anchor ($3^{I} \div 3^{IV}$) being adjusted by stopping the motion as soon as the reflection signal detected by the optical sensor (8) decreases because of the interruption of the mirror surface.

12. The automatic dispenser according to the preceding claim, **characterized in that** the return motion of the small anchor ($3^{I} \div 3^{IV}$) is controlled in the same way as the coin extraction motion, i.e. by reversing motor (5).

13. The automatic dispenser according to claim 11 or 12, **characterized in that** said mirror surface is obtained by providing a chromium plating or a reflecting material for the arc of the crown gears ($6^{I} \div 6^{IV}$)

so as to obtain a generally reflecting surface which is able to give the maximum reflection to optical sensors (8), and that in order to determine the limit stops, grooves (10) are provided causing the amplitude of the reflection signal which is received by optical sensors (8) to be reduced significantly.

14. The automatic dispenser according to any claim from 2 on, **characterized in that** under resting conditions the optical sensors (8) receive reflection signals of intermediate amplitude between a zero reflection value (no coin in the magazines) and a maximum reflection value in case of perfectly reflecting surface (mirror).

15. The automatic dispenser according to any preceding claim, **characterized in that** in order to extract a coin from left magazine (1) of one of the pairs of magazines, the sensor and motor control software performs the following operations:

- driving the motor (5) that rotates the crown gear ($6^{I} \div 6^{IV}$) to rotate the relative small anchor ($3^{I} \div 3^{IV}$) to the left;
- detecting the signal received by the right optical sensor (8) to check that such reflection signal has the maximum amplitude as such initial motion causes the generally specular surface of the arc of crown gear $6^{I} \div 6^{IV}$ to shift and enter the "visual" field of optical sensor (8);
- detecting the signal of the left sensor to check that at least one coin is present in the relative magazine, the reflection signal having in this case an intermediate value between a maximum value (specular surface) and a minimum or zero value corresponding to the total lack of coins in the magazine (the interior of which is dark) ;
- if the left sensor receives a minimum or zero reflection signal, the motor is stopped as there are no coins to be dispensed, otherwise the small anchor ($3^{I} \div 3^{IV}$) continues rotating until the other (right) sensor receives a reflection signal whose value is lower than the maximum.

16. The automatic dispenser according to any preceding claim, **characterized in that** the crown gears ($6^{I} \div 6^{IV}$) are not complete discs but have a missing portion directed to the small anchor ($3^{I} \div 3^{IV}$) so that, when the small anchor ($3^{I} \div 3^{IV}$) is in the resting position, the optical sensors (8) are not completely or partially covered by the same crown gears.

17. The automatic dispenser according to any preceding claim, **characterized in that** in order to avoid undesired escape of coins (M) from inclined magazines (1), each magazine is provided with an elastic tongue or flat spring (T) located near the lowest coin, said flat spring being disposed perpendicular to the plane of the coin and being able to provide an elastic force which is sufficient to oppose to the small weight of the coin which is parallel to its resting plane.

18. The automatic dispenser according to the preceding claim, **characterized in that** the flat spring is positioned such that, when the coin is pushed by the small anchor ($3^{I} \div 3^{IV}$), the spring bends and generates a light downward thrust helping the coin to fall down.

19. The automatic dispenser according to any claim from 2 on, **characterized in that** each small anchor ($3^{I} \div 3^{IV}$) has a thickness which is equal to or lower than coins (M) in the relative magazines (1) so as to allow only one coin at a time to be dispensed.

20. The automatic dispenser according to claim 13, **characterized in that** instead of chromium plated arcs of crown gears ($6^{I} \div 6^{IV}$) there are provided arcs of crown gears of opaque material which do not have slots but are provided with strips or inserts of high reflecting material which are suitable positioned on the surface of the crown gears ($6^{I} \div 6^{IV}$) facing optical sensors (8).

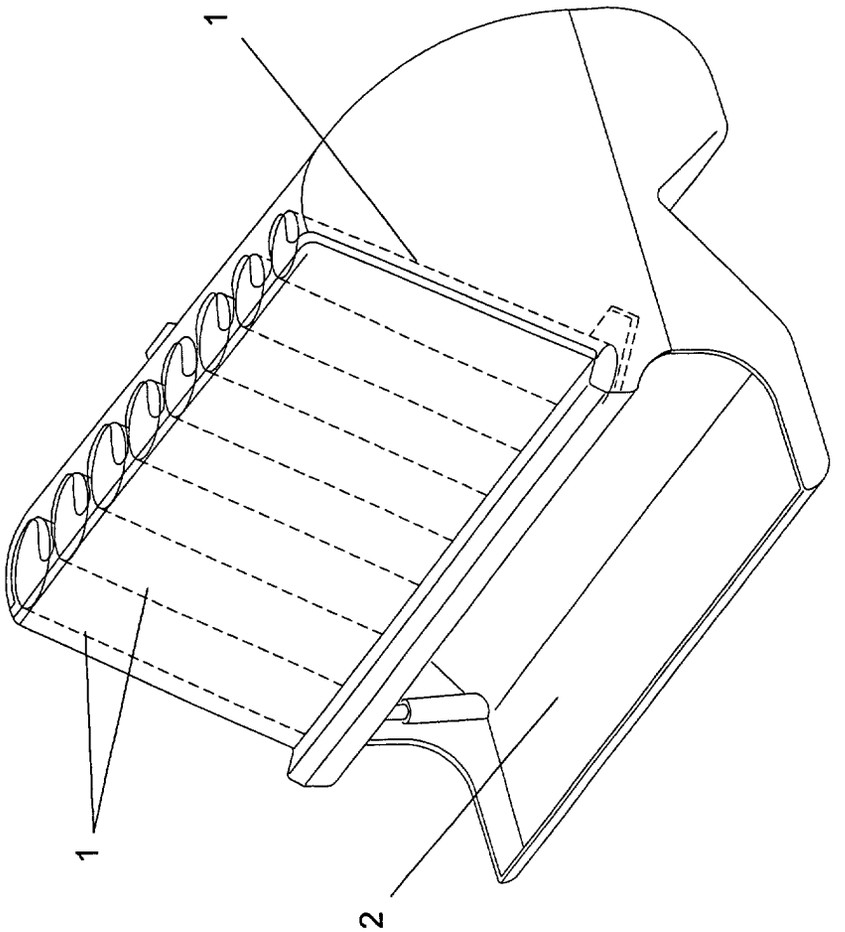

FIG. 1

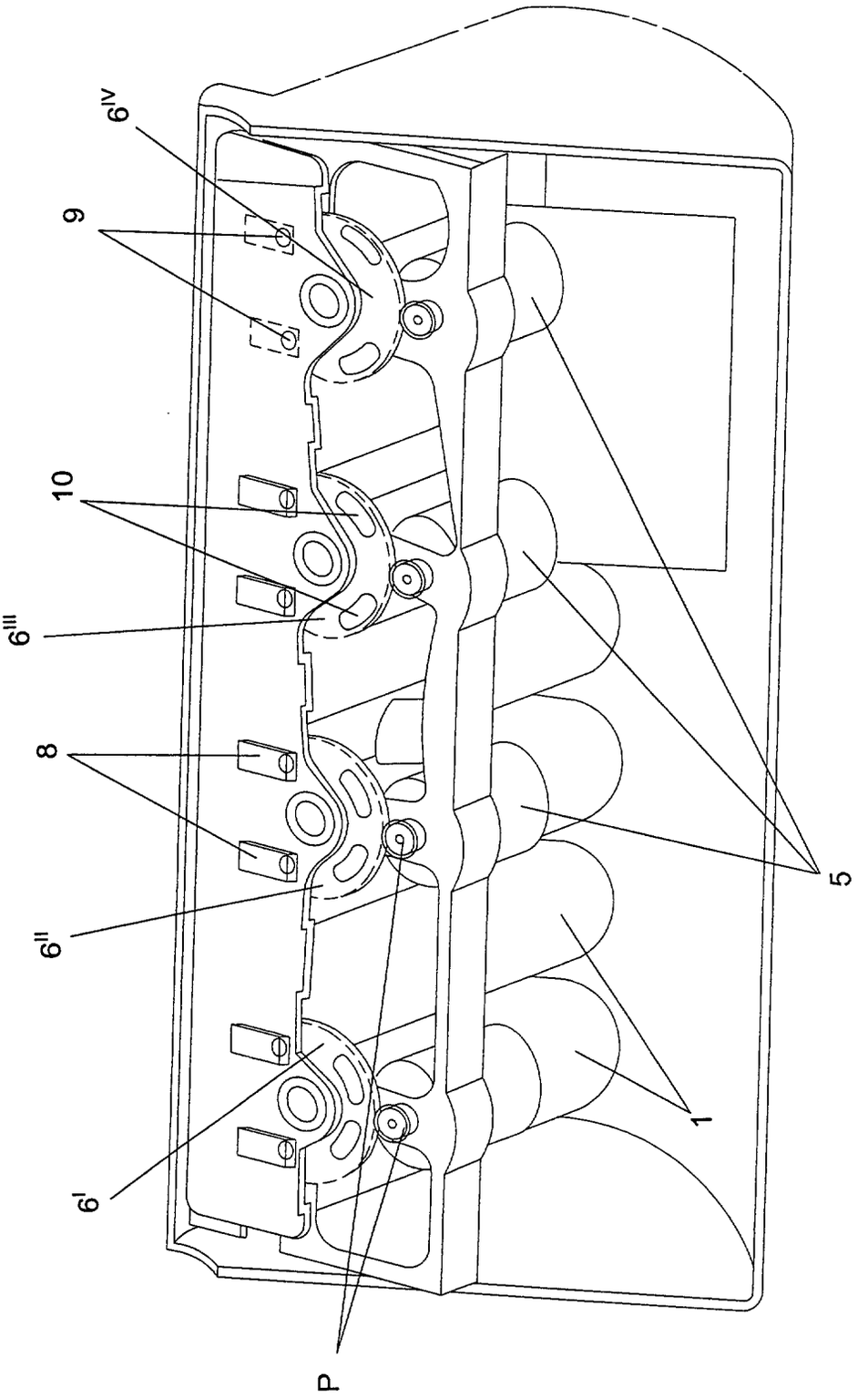

FIG. 2

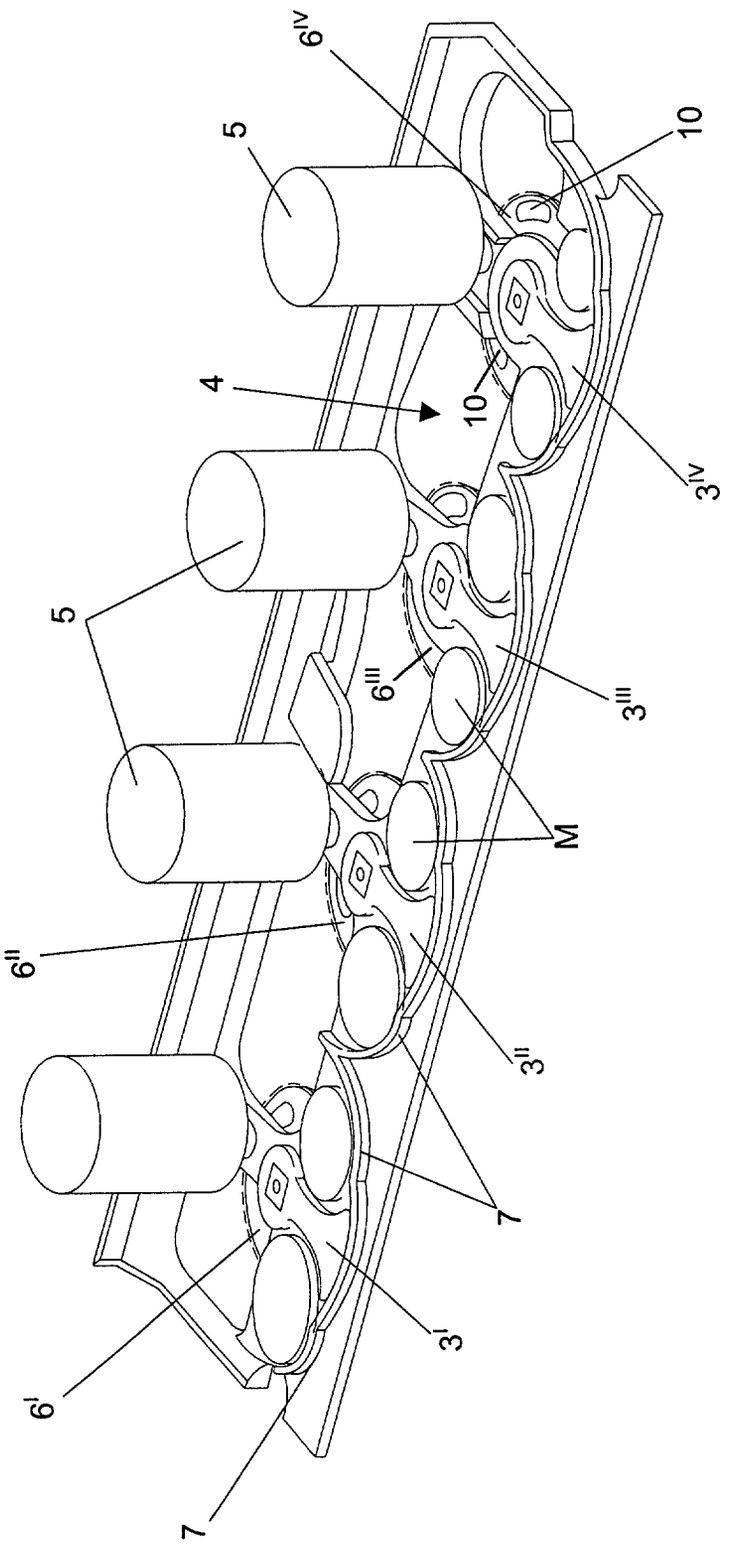

FIG. 3

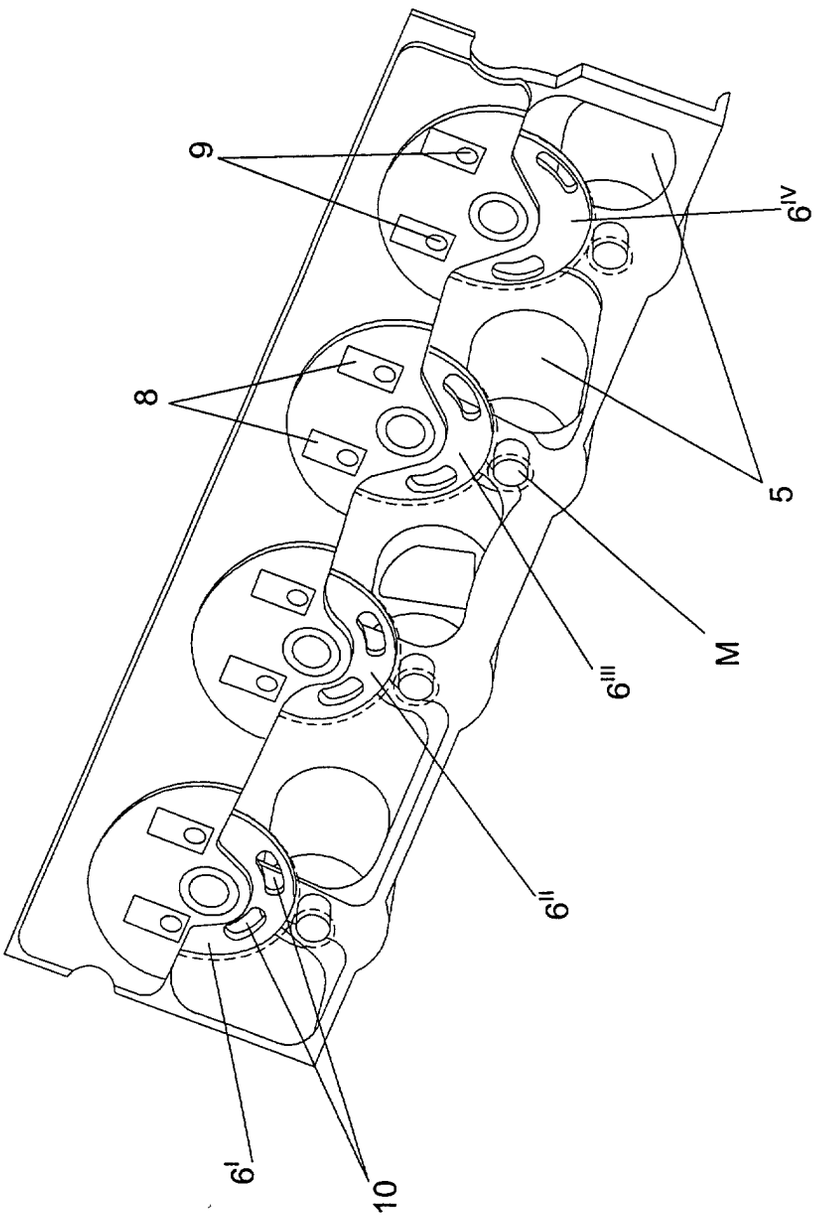

FIG. 4

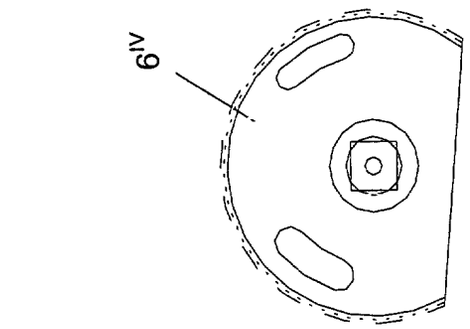

FIG. 5D

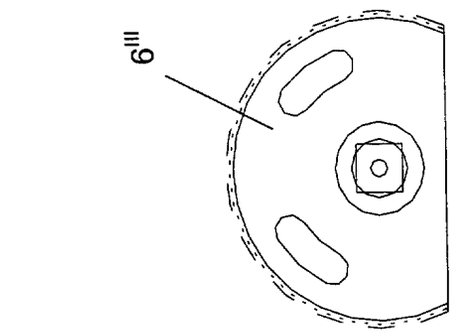

FIG. 5C

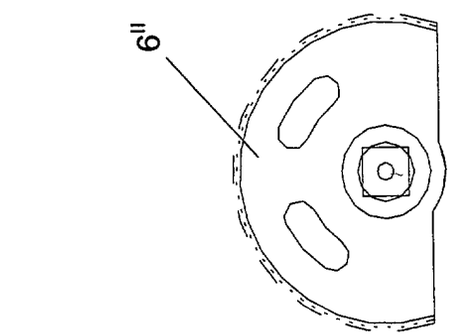

FIG. 5B

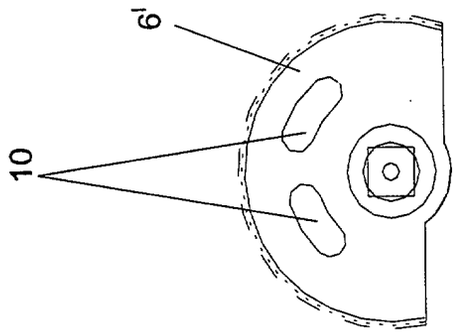

FIG. 5A

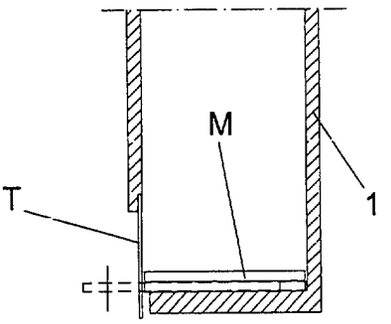

FIG. 6A

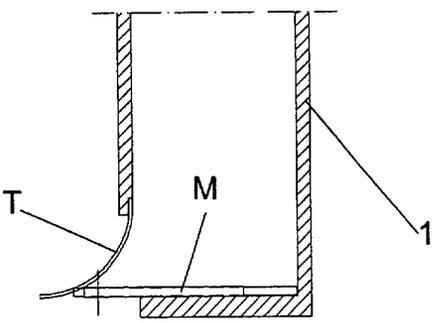

FIG. 6B

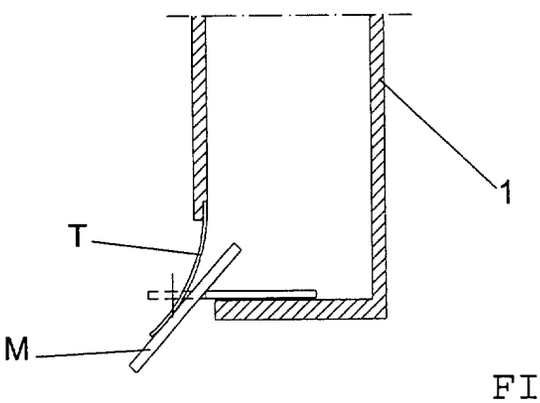

FIG. 6C

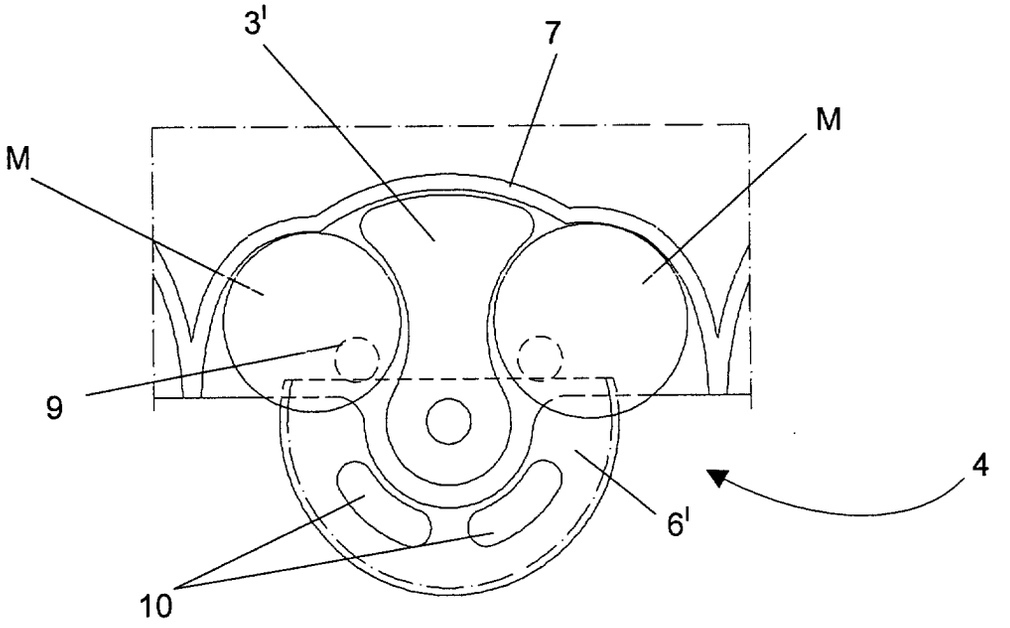

FIG. 7A

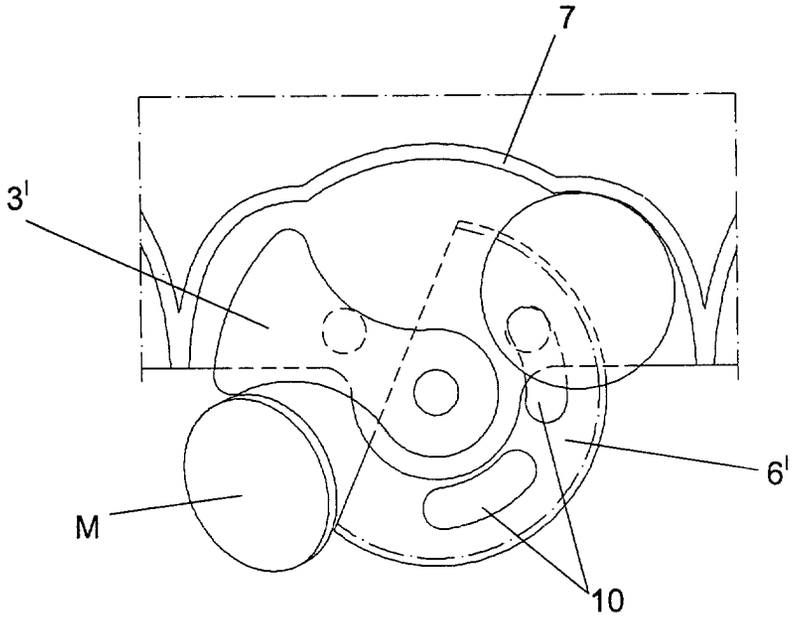

FIG. 7B

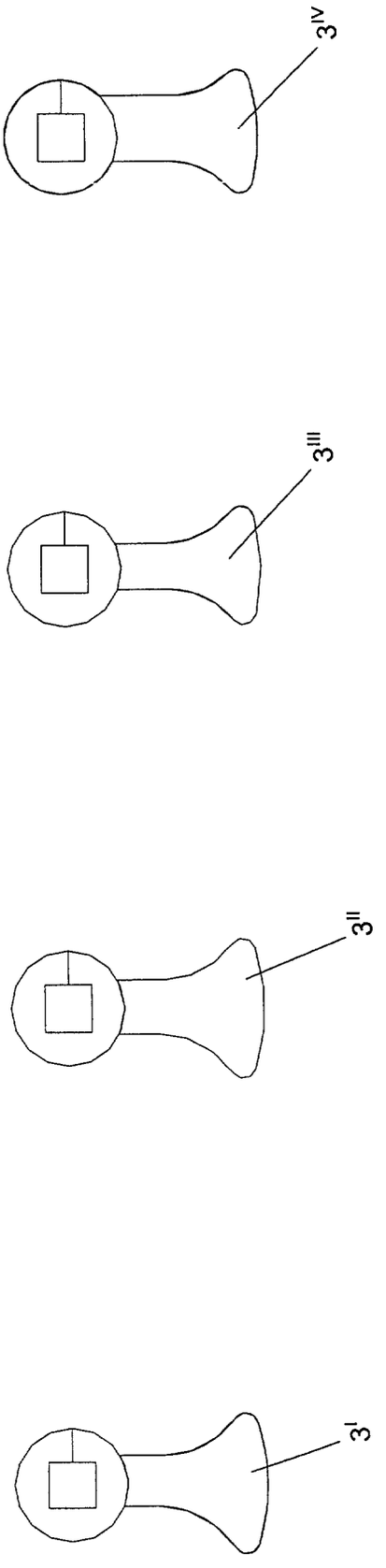

FIG. 8

MOTOR CONTROL LOGIC

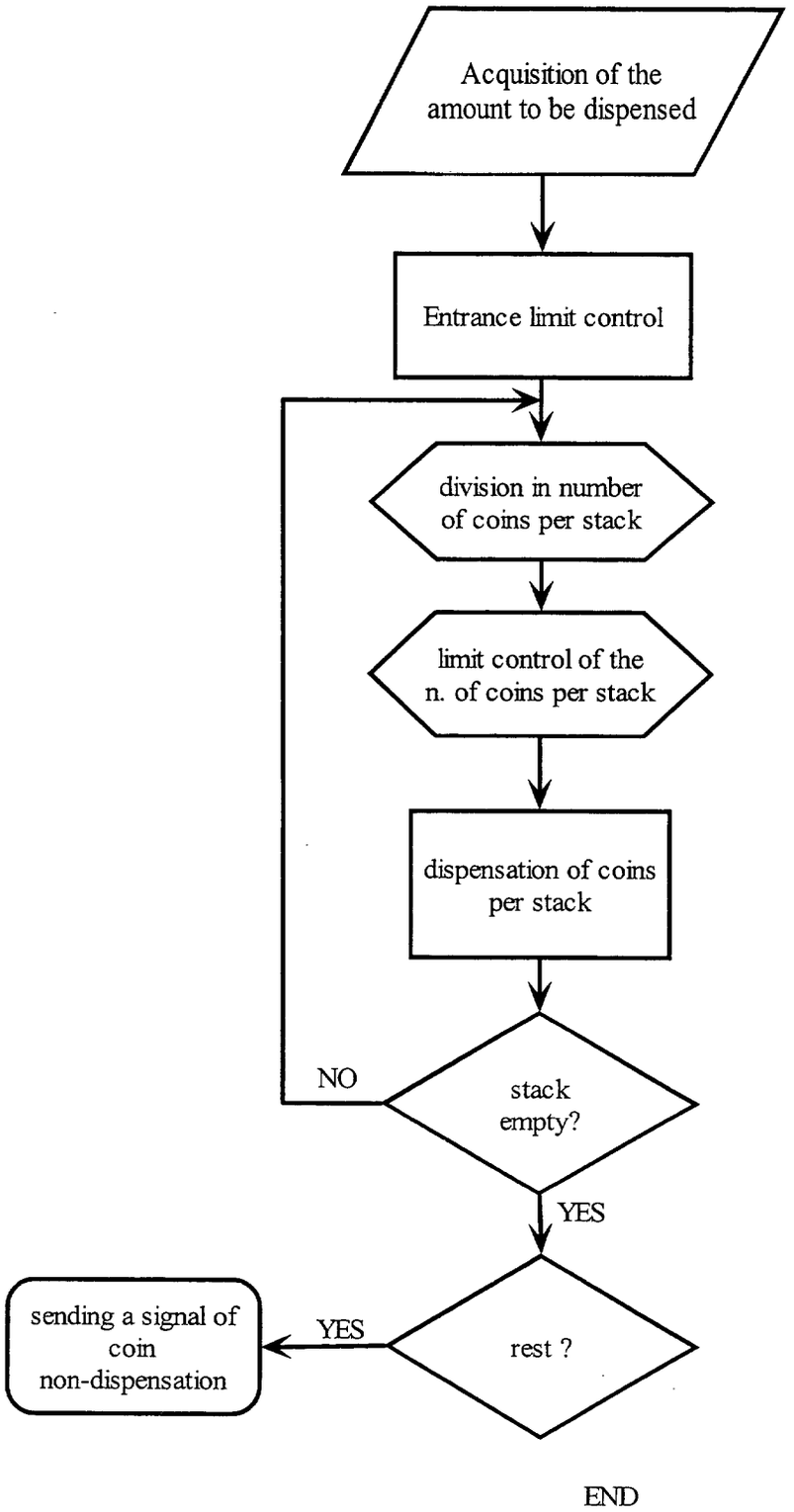

FIG. 9

ODD STACK COIN DISPENSATION (N=1, 3, 5, 7)

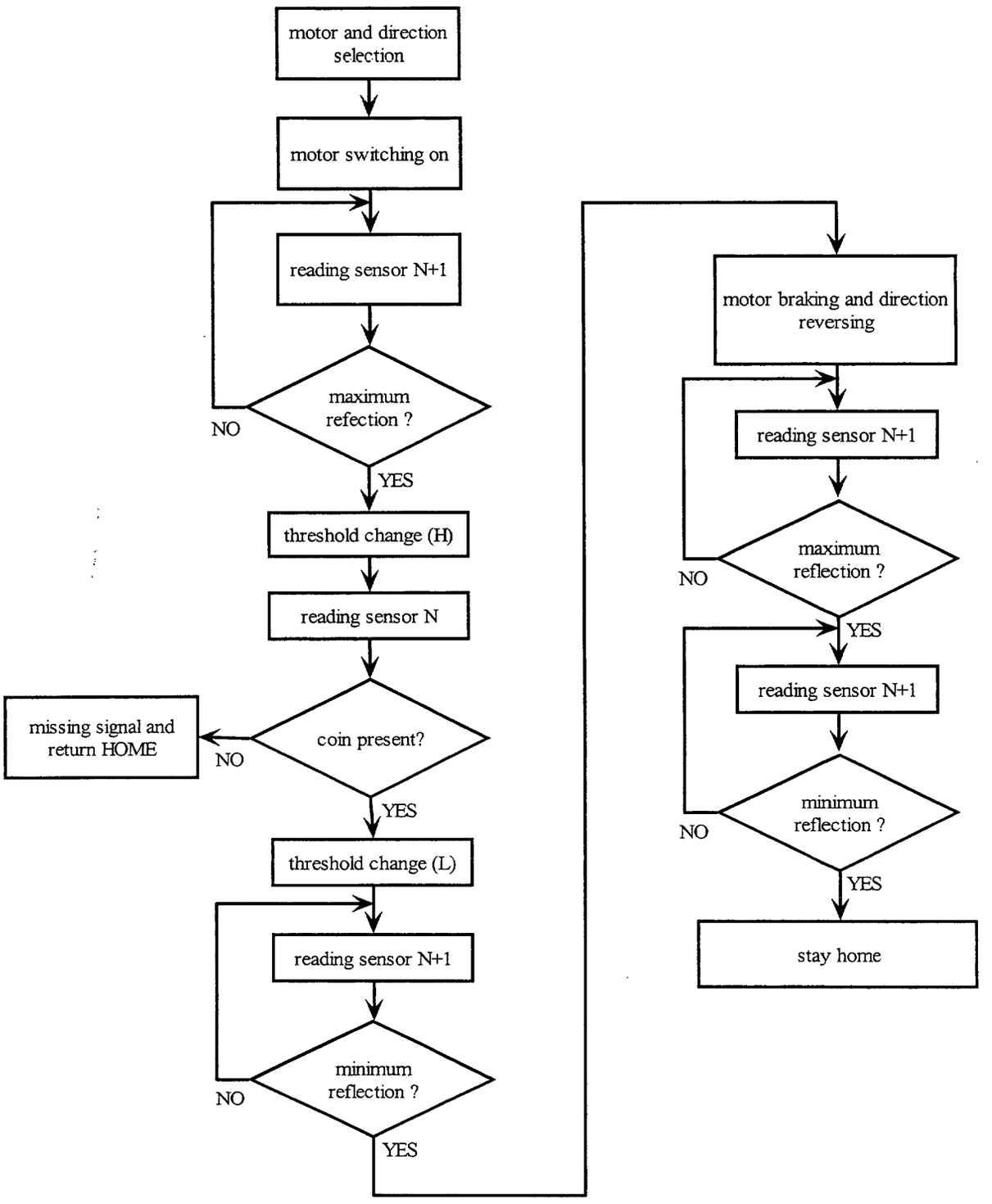

FIG. 10

STAY HOME

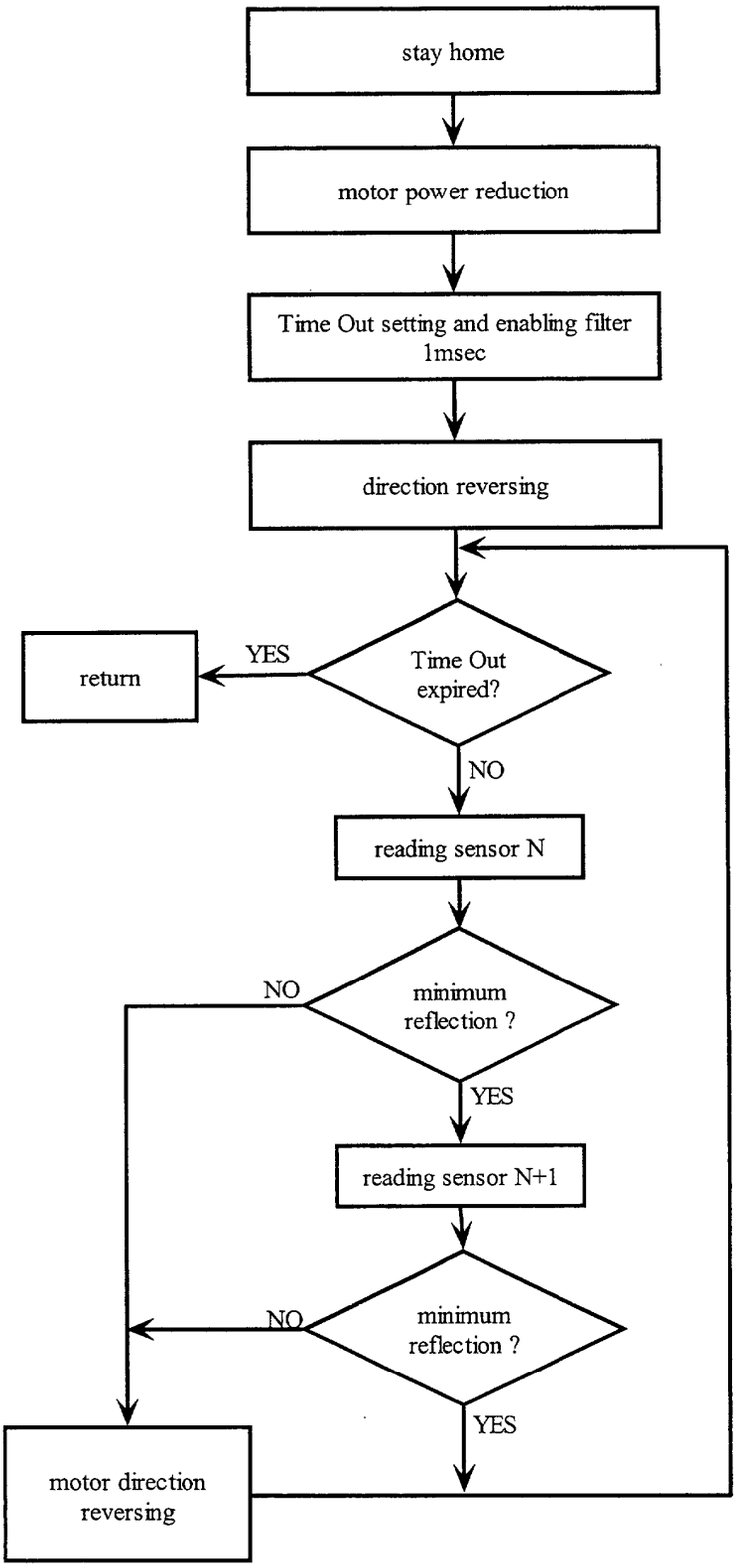

FIG. 11

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 83 0640

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	27 March 2002	Neville, D

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