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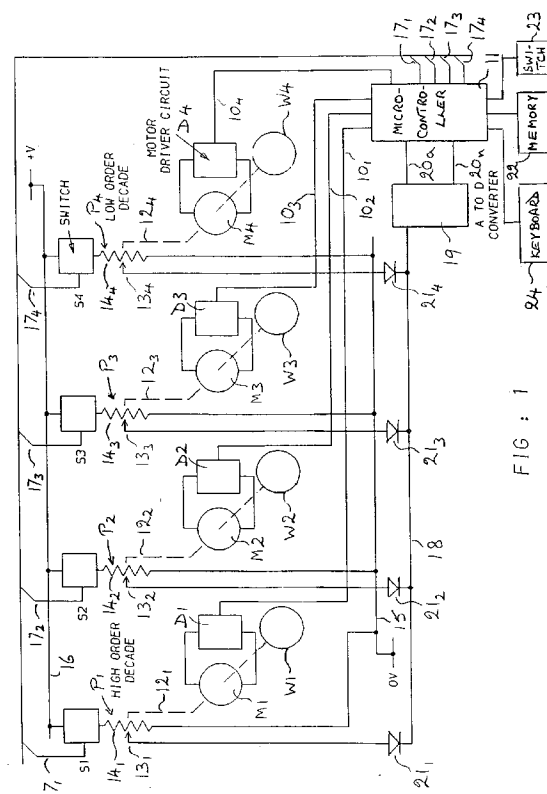
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(54) **Franking meter value selection mechanism.**

(57) A mechanism and control circuit for setting print wheels (W1 - W4) of a franking machine to print required postage values is disclosed. A position encoder comprising a potentiometer (P1 - P4) with a slider (13₁ - 13₄) mechanically coupled to the print wheels provides analogue position signals which are converted to digital signals by a converter (19) for input to a micro-controller (11). Initially each print wheel is driven to each of its printing positions in turn and while positioned in each printing position the feedback signal from the slider is stored as a position signal in a look-up table in a memory (22). In use when it is desired to position the print wheel to print a required digit, the position signal for that required digit position is read out and compared with the feedback signal obtained as the print wheel is driven to control the drive (M1 - M4) to position the print wheel with the required digit in the printing position.



This invention relates to setting of printing elements for the printing of a selected variable postage value in a franking impression and in particular to the control of setting of the printing elements.

Known postal franking meters include a print drum which carries fixed print dies for printing the invariable portion of a franking impression and also carries print wheels which are settable to print variable information such as the postage value of the frank and the date of franking. The wheels have type characters disposed around the peripheral edge thereof so that by selective rotation of the print wheels, prior to printing, required type characters can be brought into a position in which these characters are printed to provide the variable information in the franking impression.

It is necessary that the setting of the print wheels utilised for printing the postage value is effected with precision in order to ensure that the correct value of postage is printed and to ensure that the value printed corresponds precisely to the value for which accounting for usage of postage has been carried out.

The print wheels may be set by means of mechanical linkages connecting the wheels to levers or thumb wheels operated by a user of the franking meter. Encoders connected to these mechanical linkages provide electrical signals representing the value to which each print wheel is set for input to electronic circuits which carry out accounting functions in respect of the value of postage used. However with electronically operated franking meters it is desirable that electrical keys are provided for operation by a user to select a required postage value to enable direct electrical input of the value to the accounting means and accordingly it is required that the electronic circuits control electric motors to rotate the print wheels so as to set the wheels to print the required postage value. The control of the drive motors requires feedback elements to provide print wheel positional signals to the electronic circuits. Due to the need for precision positional control, the feedback elements need to be within close tolerance limits and would normally need to have high linearity and as a result are costly.

According to one aspect of the invention a franking meter including at least one printing element settable to a selected one of a plurality of positions to enable printing of a selected character; drive means operable to set the printing element is characterised by sensing means to provide positional feedback signals representing an instant position of said printing element; memory means storing a plurality of signals corresponding to positional feedback signals obtained when said printing element is set to each of the plurality of positions; control means responsive to that one of the stored signals corresponding to a required position to which the print wheel is to be set and to the positional feedback signal representing the

instant position of said print wheel to control energisation of said drive means to set the print wheel to the required position.

According to another aspect of the invention a method of setting a printing element in a franking meter to a selected one of a plurality of positions to enable printing of a selected character is characterised by the steps of generating feedback signals representing the current position of the printing element; storing a plurality of signals respectively representing each of the plurality of positions of the printing element; driving the printing element until the generated feedback signal corresponds to that one of the stored signals representing the selected position.

An embodiment of the present invention will now be described by way of example with reference to the drawings in which:-

Figure 1 is a block circuit diagram of a value selection control circuit, and

Figure 2 is a flow chart illustrating a program routine for controlling value selection.

Referring first to Figure 1, print wheels W1, W2, W3, W4 for four decades are rotatable by drive motors M1, M2, M3, M4 to set the print wheels independently to position a selected type character on the periphery of each of the wheels in an operative printing position. The motors M1 - M4 are energised by motor bridge driver circuits D1, D2, D3, D4 respectively which are controlled by drive control signals on lines 10₁ - 10₄ output from a micro-controller 11. The motors may be driven in either direction of rotation in dependence upon the drive control signals output from the micro-controller.

The motors M1 - M4, and hence the print wheels W1 - W4, are mechanically coupled 12₁ - 12₄ to the sliders 13₁ - 13₄ of potentiometers P1, P2, P3, P4 so that as the motors rotate the print wheels through a single revolution in which each of the type characters are positioned in turn in the operative printing position the sliders of the potentiometers move from one end of a resistive track 14₁ - 14₄ to an opposite end of the track. The resistive tracks are connected at one end to a ground line 15 (0V) and at the other end through switches S1 - S4 to a line 16 maintained at a fixed potential (+V). The switches S1 - S4 are operated by switching signals on lines 17₁ - 17₄ from the micro-controller 11. The sliders of the potentiometers are connected through isolating diodes 21₁ - 21₄ to a common line 18. The common line 18 is connected to the input of an analogue to digital converter 19. The digital output of the converter 19 is connected by lines 20_a - 20_n to an input of the micro-controller.

As an example, the setting of the low order decade print wheel W4 will be described. The switch S4 is closed so as to connect the track 14₄ of potentiometer P4 between the ground line 15 and the fixed potential on line 16. Accordingly as the print wheel W4 is rotated by the motor M4, the slider 13₄ is moved

along the track and the potential on the line 18 varies in dependence upon the angular position of the print wheel. The magnitude of this potential is converted by the analogue to digital converter 19 to a digital signal on lines 20_a - 20_n representing the angular position of the print wheel. Accordingly the micro-controller receives a digital signal which can be utilised to control energisation of the drive circuit D4 such as to bring the print wheel W4 to rest with the required type character, selected for example by an input on a keyboard 24, in its operative printing position. Similarly, the other print wheels W1, W2 and W3 are rotated into required angular positions. As shown in Figure 1 a single analogue to digital converter 19 may be shared between all the potentiometers in order to reduce cost. The potentiometers are selected by operation of the switches S1 - S4 in sequence. The multiplex rate at which the switches are operated may be sufficiently high as to enable simultaneous energisation of the motors and setting of the print wheels. However if desired separate analogue to digital converters may be provided for each potentiometer.

Potentiometers constructed with sufficient precision to provide linear change of potential on the slider for equal increments of angular rotation of the slider are costly. Potentiometers of reasonable cost may have a tolerance of 5% as between different devices of the same construction and same nominal resistance value. Also the linearity of resistance along the length of the track of such potentiometers may vary by as much as 2%. As a result the resistance measured from one terminal to a point on the track will fall within a 7% band but any specific potentiometer device will resolve with a repeatability only affected by the stability of the device. The stability of any specific device is substantially better than the band within which different devices may lie. If such a potentiometer is used to resolve positions 0 to 9 of a print wheel to provide positional feedback signals to the micro-controller 11 and if say the slider moves along 70% of the arc of the track, the change in resistance as the print wheel moves from one digit position to an adjacent digit position will be accompanied by a change in resistance of 7 - 8%. This is comparable with the tolerance of resistance to be expected due to manufacturing tolerances of the potentiometer and hence would not provide the precision of signal magnitude necessary to provide an unambiguous positional feedback signal to enable the drive motor to be controlled with sufficient precision as to ensure that a required type character is correctly positioned for printing.

In order to enable precision determination of the angular position of the print wheels when using potentiometers of reasonable cost, the digital signals input on lines 20_a - 20_n to the micro-controller 11 in respect of each of the angular positions of the print wheel in which a type character is in the printing position is stored in a table in a non-volatile memory 22 connec-

ted to the micro-controller 11. Thus when the print wheels W1 - W4 each have ten numeric value type characters on their peripheries, the table contains a digital value for each decimal value and for each print wheel.

Initially, a set up routine is employed in which the print wheels W1 - W4 are set to each of their ten positions in turn for example by means of a jig. For each operational printing position of each wheel the potentiometers provide analogue voltage signals which are converted to digital signals input to the micro-controller and stored in the table in the memory 22. Accordingly, the table contains digital values corresponding respectively to each operational printing position of each wheel.

In a franking meter, the printing wheels may be used to print the value of franking applied to a mail item or to print the date on which the franking is applied. For the latter purpose it is not essential, although it may be desirable, that the digital values corresponding to the printing position to which the wheels may be set are maintained secure from unauthorised tampering. However when the printing wheels are used for printing the value of franking the digital value contents of the table must be maintained secure to prevent any unauthorised change to the digital values which could have the effect of setting the print wheels to print a value which differs from that to which the microcontroller is controlled to set the wheels. The set up routine for writing the digital values to the table as the printing wheels are set to their printing positions may be co-resident in the microcontroller 11 and may be initiated by secure means, such as a switch 23, to which access is protected by known methods used in the postal meter art. Thus the set up routine can be initiated in manufacture of the postage meter to enable initial setting up of the table and can be initiated in the field by an authorised service representative should re-writing of the table be required but unauthorised initiation of the set up routine and unauthorised access to the contents of the table is prevented or inhibits further use of the meter for franking purposes.

In order to ensure that the print wheels are not set incorrectly due to corruption of the digital values stored in the table, it is desirable that means are provided to check the integrity of the table stored in the memory. Such means may be operated to carry out the integrity check periodically, for example, each time the franking meter is switched on. Commonly, print wheels are set by a fore and aft rotational drive motion limited by end stops corresponding to the decimal values zero and nine respectively. With such print wheels and end stops, the franking meter may carry out a switch on routine in which each wheel is driven to its end zero value position and then stepped through each decimal position in ascending value to the other end nine value position to ensure that each

wheel correctly completes the sequence of setting positions. Failure of this switch on routine to verify that each printing wheel has been stepped through all its decimal value positions may be used to inhibit operation of the meter for franking mail items.

Referring now to Figure 2, the flow chart illustrates a program routine for setting all of the print wheels to desired angular positions. In response to an input of a desired postage value, the digital value corresponding to a first decade of the postage value is read from the look up table. The digital value input from the converter 19 is compared with the value read from the table and if the comparison indicates that the print wheel for that decade is not at the required position the motor drive circuit drives the motor to move the print wheel toward the required position. When the comparison indicates that the print wheel is within one position of the desired position the motor drive circuit drives the motor at a slower speed. When the comparison indicates that the values are equal the motor is stopped. If the decade being sensed is not the last of the four decades to be set, the routine proceeds to repeat the above steps in respect of the next decade. If the decade being sensed is the last of the four decades and all the four motors are stopped at the required positions the program routine terminates. Otherwise, the program routine is repeated starting with the first decade. Thus each decade is sensed in turn while the motors are driven to move the print wheels toward their required positions. When the sensing indicates that the digital value derived from a potentiometer of a decade is equal to the digital value read from the table for that decade, energisation of the corresponding motor is terminated. The program routine for sensing the angular positions of the print wheels continues until all four of the print wheels are in the required respective angular positions.

The controlling software incorporates a dead band to prevent hunting of the drive motors when the print wheels are within a predetermined positional tolerance of the required position. Accordingly the system does not respond to very small difference signals which could cause hunting oscillation of the drive motors. As described hereinbefore, when the print wheels are approaching the required positions, the speed of rotation of the print wheels is reduced to prevent overshoot of the required position.

The control system described hereinbefore enables relatively low cost potentiometers to be used and these, apart from cost advantages over high cost precision potentiometers, may be of miniature construction instead of the relatively large size of precision potentiometers. Accordingly a more compact construction of franking meter may be obtained. Generally the long term stability of the potentiometers is sufficiently good that the digital values stored in the look up table will remain valid for a long period. However re-calibration of the setting system and storing

new values in the look up table may be carried out whenever necessary.

5 Claims

1. A franking meter including at least one printing element (W1 - W4) settable to a selected one of a plurality of positions to enable printing of a selected character; drive means (M1 - M4) operable to set the printing element; characterised by sensing means (P1 - P4) coupled to said printing element and operative to provide positional feedback signals representing an instant position of said printing element; memory means (22) storing a plurality of position signals corresponding to positional feedback signals obtained when said printing element (W1 - W4) is set to each of the plurality of positions; control means (11) responsive to that one of the stored position signals corresponding to a required position to which the print wheel is to be set and to the positional feedback signal representing the instant position of said print wheel to control energisation of said drive means (M1 - M4) to set the print wheel to the required position.
2. A franking meter as claimed in claim 1 further characterised in that the sensing means (P1 - P4) comprises a potentiometer including a resistive track (14₁ - 14₄) connectable across a potential difference (+V) and a slider (13₁ - 13₄) making electrical contact with said track and mechanically coupled (12₁ - 12₄) to the printing element, said slider being moved along the track in correspondence with movement of the printing element.
3. A franking meter as claimed in claim 2 further characterised in that the slider (13₁ - 13₄) of the potentiometer is electrically connected to an analogue input of an analogue to digital converter (19) effective to convert the electrical potential of the slider to a digital signal (20a - 20n) constituting the feedback signal to which the control means (11) is responsive.
4. A franking meter as claimed in claim 1, 2 or 3 further characterised in that the energisation of the drive means (M1 - M4) is controlled by the control means (11) to effect movement of the printing element (W1 - W4) by said drive means at a first speed when said printing element is outside a predetermined range of the required position and at a second speed lower than said first speed when said printing element is within said predetermined range of said required position.
5. A franking meter as claimed in any preceding

claim further characterised by a plurality of the printing elements (W1 - W4) and wherein said printing elements are coupled to corresponding ones of a plurality of sensing means (P1 - P4) to provide positional feedback signals for the plurality of printing elements respectively and the memory means (22) stores a plurality of sets of position signals corresponding to positional feedback signals for each of the printing elements respectively.

6. A franking meter as claimed in claim 3 further characterised by a plurality of printing elements (W1 - W4) and wherein said printing elements are coupled to corresponding ones of a plurality of sensing means (P1 - P4), each sensing means (P1 - P4) comprising a potentiometer having a slider (13₁ - 13₄); an analogue to digital converter (19) including an analogue input and wherein said sliders of said plurality of potentiometers are connected to said analogue input.
7. A franking meter as claimed in claim 5 or 6 further characterised in that the drive means (M1 - M4) for the plurality of printing elements (W1 - W4) are energisable simultaneously and the corresponding sensing means (P1 - P4) for said printing elements (W1 - W4) are interrogated by the control means (11, S1 - S4) repetitively in sequence until all said printing elements are set to the required positions.
8. A franking meter as claimed in any preceding claim further characterised in that the control means (11) is operable periodically to check integrity of the plurality of position signals stored in the memory (22).
9. A franking meter as claimed in any preceding claim further characterised in that the control means (11) is operable in a set up routine to write the position signals corresponding to each of a plurality of positions of the printing element into the memory (22) when the printing element (W1 - W4) is moved into each of said plurality of positions.
10. A franking meter as claimed in any preceding claim further characterised in that the printing element (W1 - W4) is a franking value wheel for printing a digit of a franking value in a franking impression.
11. A franking meter as claimed in claim 10 further characterised in that the control means (11) is responsive to input (24) of a required value of franking to set the printing element (W1 - W4) to a printing position corresponding to a digit of the

required value.

12. A method of setting a printing element (W1 - W4) in a franking meter to a selected one of a plurality of positions to enable printing of a selected character characterised by the steps of generating feedback signals representing the current position of the printing element; storing a plurality of position signals respectively representing each of the plurality of positions of said printing element; driving said printing element until the generated feedback signal corresponds to that one of said stored position signals representing said selected position.
13. A method as claimed in claim 12 further characterised by the step of initially moving the printing element to each of the plurality of positions and for each position to which said printing element is moved utilising the feedback signal generated to store a corresponding position signal representing the position of said printing element.
14. A method as claimed in claim 12 or 13 further characterised by the step of periodically checking the stored position signals as the printing element is driven to each of the plurality of positions in turn.

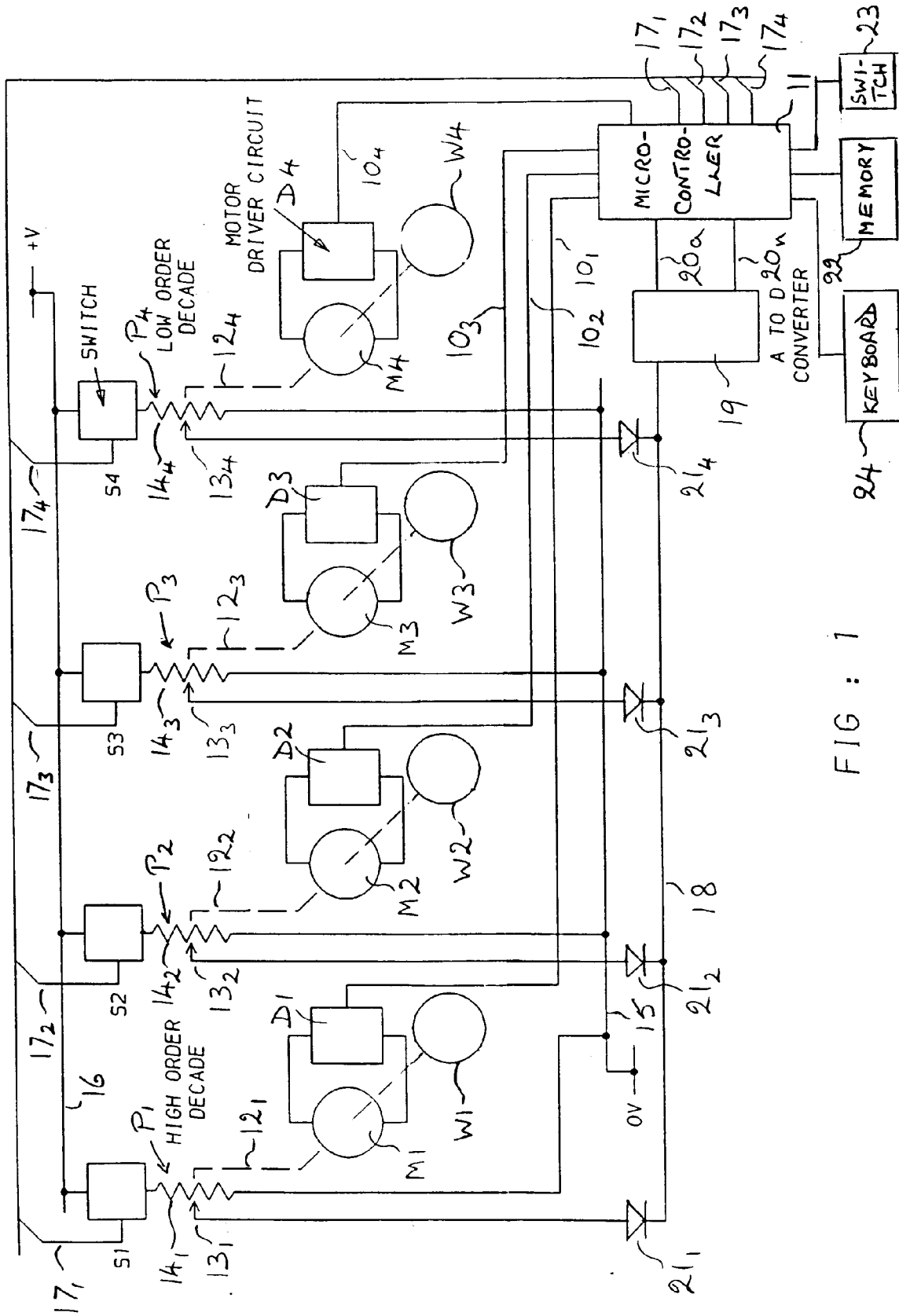


FIG : 1

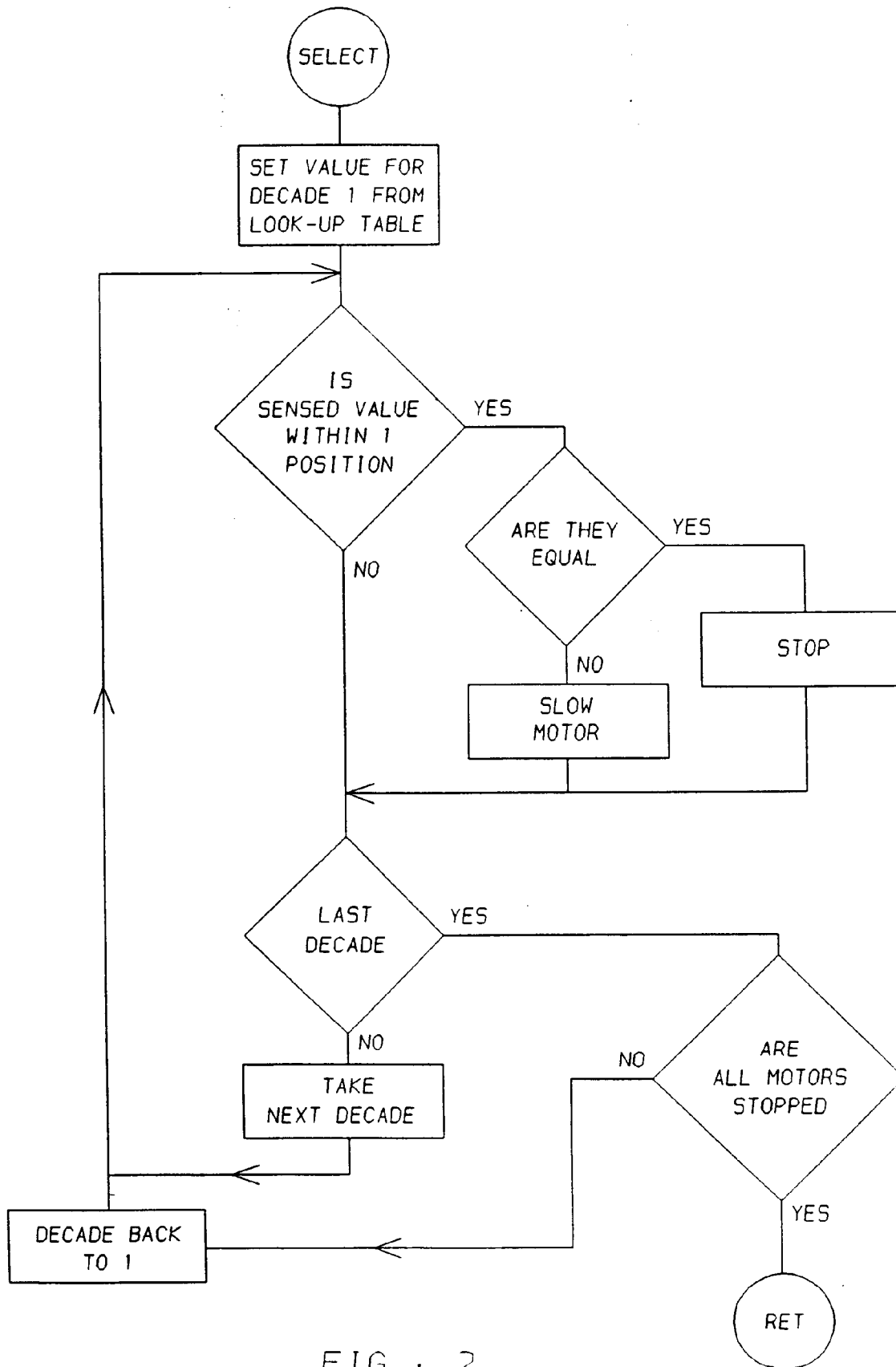


FIG : 2