(12) PATENT ABRIDGMENT **(11)** Document No. **AU-B-24110/88**
(19) AUSTRALIAN PATENT OFFICE **(10)** Acceptance No. **610651**

(54) Title
PRINTWHEEL SETTING DEVICE FOR A POSTAGE METER

International Patent Classification(s)
(51)[4] **B41K 003/62** **G07B 017/02** **G07B 017/04**

(21) Application No. : **24110/88** (22) Application Date : **21.10.88**

(30) Priority Data

(31) Number	(32) Date	(33) Country
114358	27.10.87	US UNITED STATES OF AMERICA
114363	27.10.87	US UNITED STATES OF AMERICA

(43) Publication Date : **27.04.89**

(44) Publication Date of Accepted Application : **23.05.91**

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(56) Prior Art Documents
US 4608923

(57) Claim

1. A printwheel setting device for positioning a printwheel of a postage meter comprising:

a printwheel having a plurality of printing characters about the periphery thereof;

a motor;

a gear train drivingly connecting said motor to said printwheel;

said gear train including at least one gear having a greater number of gear positions than the number of the printing characters, wherein each printing character on the printwheel has a printing position corresponding to a respective plurality of said gear positions of said at least one gear;

means to determine the direction of rotation of said at least one gear to a nearest one of the plurality of gear positions corresponding to the printing position of a selected character on the printwheel;

means to operate said motor to move said at least one gear wheel in the determined direction to said nearest one of said plurality of gear positions.

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7. A postage meter of the type having a printing die carrying an indicia and printwheels for the printing of postal value, comprising means for setting said printwheels including:

a plurality of printwheels each having respective printwheels gears connected thereto;

a plurality of stepper motors having respective stepper motors shafts, each stepper motor being respectively associated with one of said printwheels;

each said stepper motor shaft having a pinion carried thereon;

a plurality of transfer gears, each respectively meshing with said printwheel gears;

gear means respectively connecting said transfer gears and said pinions for driving said printwheels to a desired position;

said transfer gears having a greater number of teeth than said printwheel gears wherein a predetermined position of the printwheel gears are associated with a plurality of positions of the respective transfer gears;

means for determining the rotation path for the rotation of each transfer gear to a nearest one of said plurali of positions to place the printwheel in a desired position; and

means for driving said stepper motor as required to rotate said transfer gear and thereby said printwheels to said desired position.

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Form 10

PATENTS ACT 1952

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE

Short Title:

Int. Cl:

610651

Application Number:
Lodged:

Complete Specification—Lodged:
Accepted:
Lapsed:
Published:

Priority:

Related Art:

TO BE COMPLETED BY APPLICANT

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Complete specification for the invention entitled:

PRINTWHEEL SETTING DEVICE FOR A POSTAGE METER

The following statement is a full description of this invention, including the best method of performing it known to me:—*

* Note: The description is to be typed in double spacing, pica type face, in an area not exceeding 250 mm in depth and 166 mm in width, on tough white paper of good quality and it is to be inserted inside this form.

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FIELD OF THE INVENTION

The invention relates to electronic postage meters and more particularly to a printwheel setting device for positioning a printwheel of a postage meter.

BACKGROUND OF THE INVENTION

Electronic meters of the flat-bed printer type are well-known and are described for example in U.S. Patent No. 4,579,054, issued to Buan, et al., which shows a stand-alone electronic mailing machine in which the electronic postage meter forms an integral part of the device. Aspects of such a stand-alone mailing machine are described in U.S. Patents 4,535,407 and 4,523,523 among others.

Of particular concern in postage meters and mailing machines developed for high throughput is the speed with which the printwheels can be set to a new value. U.S. Patent No. 4,034,669 teaches the use of a separate stepper motor for each printwheel in the print drum of a postage meter of the rotary press type. U.S. Patent No. 4,398,458 shows a setting device for the printwheels in a print drum in which separate stepper motors are used for each printwheel. U.S. Patent 4,451,053 describes a method for the parallel setting of printwheels using a particular

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Die protection assemblies incorporate various mechanical arms or projections which protrude from the printwheel area of the die in order to prevent a person from simply placing an envelope against the die to obtain an imprint.

U.S. Patent No. 2,795,186 issued to Bach shows a movable shroud which can be lowered to guard the printing die agains taking unauthorized impressions at any time between printing operations. The shroud completely covers the face of the value printing die when the printing mechanism is not in an operating cycle and is locked in that position until the cycle starts at which time the shroud moves to a position uncovering the die. U.S. Patent No. 4,559,444 issued to Erwin et al. teaches an interposer arrangement which extends upward from the platen into the space into which an envelope or other workpiece is to be inserted. These interposers are moved out of the way during a legitimate printing operation. The interposer blades are mechanically linked to the inking mechanism in order to move the blades out of the way as the mailpiece moves into position for imprinting. Copending U.S. Applications Serial No. 508,356 entitled Value Printing Die Protection Device in an Electronic Postage Meter Machine and Serial No. 523,507 entitled Value Printing Die Protection Mechanism in a Postage Meter Machine describe interposer devices which are linked to the motor driving the platen of the printer to move out of the way or actuated by a power switch to be moved out of the way so long as power is applied to the machine.

While these known devices work well in the particular environments in which the platen and the die are not expected to be physically separated, in a modular device where the meter with its secure die is removable from the assembly where the platen is retained, several new security issues are created in respect of a flat-bed printer type of postage meter.

SUMMARY OF THE INVENTION

~~The electronic meter in accordance with the invention~~

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According to the present invention there is provided a printwheel setting device for positioning a printwheel of a postage meter comprising:

a printwheel having a plurality of printing characters about the periphery thereof;

a motor;

a gear train drivingly connecting said motor to said printwheel;

said gear train including at least one gear having a greater number of gear positions than the number of the printing characters, wherein each printing character on the printwheel has a printing position corresponding to a respective plurality of said gear positions of said at least one gear;

means to determine the direction of rotation of said at least one gear to a nearest one of the plurality of gear positions corresponding to the printing position of a selected character on the printwheel;

means to operate said motor to move said at least one gear wheel in the determined direction to said nearest one of said plurality of gear positions.

Preferably, the means for determining the rotation path is operative to tend to place said at least one gear wheel in the mid-range of its rotation.

In a particular embodiment, the setting device comprises encoding means for enabling determination of the position of said at least one gear wheel. In a preferred form, the encoding means includes a two-channel sensor arrangement whereby the direction of rotation can be determined.

According to a further aspect of the invention there is provided a postage meter of the type having a printing die carrying an indicia and printwheels for the printing of postal value, comprising means for setting said printwheels including:

a plurality of printwheels each having respective printwheels gears connected thereto;

a plurality of stepper motors having respective stepper motors shafts, each stepper motor being respectively associated with one of said printwheels;

each said stepper motor shaft having a pinion carried thereon;

a plurality of transfer gears, each respectively meshing with said printwheel gears;

gear means respectively connecting said transfer gears and said

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pinions for driving said printwheels to a desired position;

said transfer gears having a greater number of teeth than said printwheel gears wherein a predetermined position of the printwheel gears are associated with a plurality of positions of the respective transfer gears;

means for determining the rotation path for the rotation of each transfer gear to a nearest one of said plurality of positions to place the printwheel in a desired position; and

means for driving said stepper motor as required to rotate said transfer gear and thereby said printwheels to said desired position.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an external perspective view of an electronic meter in accordance with the invention.

Fig. 2A is a perspective view of a meter in accordance with the invention shown in position on a mailing machine.

Fig. 2B shows one way of removing a meter in accordance with the invention from the mailing machine.

Fig. 3 is a bottom view of the meter which shows the sliding shutter that covers the die when the meter is removed from the mailing machine.

Fig. 4A is a perspective view showing the print die and solenoid-operated dead bolt with the sliding shutter in the closed position. Other meter internal assemblies except for the die are not shown for ease of viewing.

Fig. 4B is a similar perspective view of the meter as in Fig. 4A showing the sliding shutter in its retracted position.

Fig. 5 is a side view of a first embodiment of an operate-remove mechanism for attachment of the meter to the mailing machine.

Fig. 6 is a side view of an alternative embodiment of an operate-remove mechanism.

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Fig. 7 is a partially exploded view of a suitable internal configuration of the meter in accordance with the invention.

Fig. 8 is a functional block diagram of a computerized postage meter.

Fig. 9 is a block diagram showing communication between the mailing machine and the postage meter.

Fig. 10 is a flow chart of a suitable communication routine for releasing the dead bolt to allow retraction of the sliding plate.

Fig. 11 is a side view of the printwheel setting mechanism in the postage meter.

Fig. 12 is a section taken along the line 12-12 of Fig. 11.

Fig. 13 is a section taken along the line 13-13 of Fig. 11.

Fig. 14 is a section taken along the line 14-14 of Fig. 11.

Fig. 15 is an embodiment of a die protector arrangement in which the die protectors are disposed adjacent to the higher order printwheels.

Fig. 16 shows an embodiment wherein there is an aligner/protector mechanism for the lower order printwheels.

Fig. 17 is a flow chart for the operation of the die protector blades for the higher order printwheels.

Fig. 18 is a flow chart for the operation of the aligner/protector blades.

Figs. 19A - 19H comprise a flow chart for the operation of the printwheel setting mechanism.

DETAILED DESCRIPTION OF THE DRAWINGS

In Fig. 1 there is shown at 10 an electronic meter in accordance with the invention. The cover 12 of the housing 14 holds a keyboard and display 16. The keyboard and display are suitably similar to that shown in U.S. Patent 4,097,923 specifically incorporated herein by reference. Preferably, the keyboard is of conventional monolithic type and the display is liquid crystal with a capacity of twelve

digits. It will be understood that the meter keys and display of registers are not necessarily limited to those shown in this reference and may be varied as desired in accordance with the requirements of the meter. When the meter 10 is installed on a mailing machine, the keyboard and display may be hidden from view of the operator.

Fig. 2A is a perspective view of the meter 10 installed in a mailing machine or meter base 18. The mailing machine 18 has schematically shown therein a printing platen 20 reciprocally driven by motor 22 through rack and pinion mechanism 24. Lid 26 when closed during normal operation will cover the meter. Feeder module 28 feeds mailpieces to the base 18 which transports the mailpiece to the space between the print die 30 of the meter which carries the meter indicia and the platen 20, whereupon with upward reciprocation of the platen, an imprint of the indicia is placed upon a mailpiece such as mailpiece 32 shown being ejected from the mailing machine.

Platen drive arrangements are well known and are shown for example in U.S. 4,579,054 to Buan et al. and in U.S. 2,795,186 to Bach et al. It should be appreciated however that in respect of the meter in accordance with the invention the platen 20 is a part of the base 18 and the meter 10 includes only the print die 30. The mailing machine will not be further described except as necessary for the description of the operation of the meter 10.

In the preferred embodiment the print die is an elastomer print die in order to obtain the best print quality for a given platen force. It will also be appreciated as is well-known that the print die must be inked in order to print the indicia. Inking mechanisms are known and are also shown in the previously cited patents of Buan and Bach. Preferably the inker mechanism (which is not shown) also remains with the base 18. It will be understood that the inker could be a part of the meter instead.

Fig. 2B shows the meter being removably mounted on the base 18. The meter is inserted into pocket 34 which is pivotally mounted to the base 18. When the meter is

inserted into the pocket 34 connector 36 in the pocket mates with a corresponding connector 38 (not shown in Fig. 2B) on the meter 10.

The mating connectors 36 and 38 serve to enable communication between the mailing machine 18 and the meter 10 and preferably carry power to the meter as well. A suitable communication system is described in U.S. 4,301,507 issued to Soderberg et al specifically incorporated herein by reference. The communication between the units as described in this patent is serial character asynchronous, bit synchronous, in message form, with the bits of the messages being timed in accordance with a given schedule for synchronous control. It will be understood that other communication procedures and devices well-known in the art may be used in the alternative if desired.

Turning now to Fig. 3 which shows a bottom view of the meter, a sliding plate or shutter 40 is slidingly mounted on housing 12 and is locked in the illustrated closed position suitably by means of dead bolt 42, preferably spring-loaded, which extends into the hole 44 of shutter 40. The shutter is released by actuation of solenoid 46 (seen in the illustrated embodiment of Fig.4A and 4B) but it will be understood that means such as a cam-actuated, motor-controlled locking mechanism may be used in the alternative or in addition to such solenoid-actuated deadbolt if desired.

Fig. 4A and 4B show perspective views of the meter with the shutter 40 shown covering the print die 30 and in the retracted position with the print die exposed.

In order to prevent access to deadbolt 42 from the outside, it will be understood that hole 44 may be a blind hole or bore on the inside of the shutter 40.

As previously noted, the meter in accordance with the invention is a flat bed printer with elastomer printing dies and that the platen and inking mechanism preferably remain with the mailing machine. In order to protect the print die in this configuration, whenever the meter is removed from the mailing machine, in accordance with the

invention all of the printing elements are automatically covered by the shutter 40. This shutter which covers the die is only retracted as discussed below when the meter is in place on a legitimate mailing machine. The die cover or shutter 40 is one of three independent die protection mechanisms in this meter.

It should thus be appreciated that the die would still be protected from the "wiping" or fraudulent taking of prints by the other protection mechanisms. Exposure of the print die 30 however might still allow tampering to alter some of the artwork of the indicia or allow damage to occur or to expose the operator to ink from the die.

Fig. 5 is a side view of one embodiment of an operate-remove mechanism for the meter. Carry handle 48 (not shown in previous Figures) is pivotally mounted on meter 10 at pin 50. Slot 52 on the handle is operative to engage a mating pin (not shown) on the base 18 when the meter is pivoted downward as illustrated in Fig. 5 and the handle 48 is rotated in the clockwise direction. It will be understood that at this juncture the meter 10 is electrically connected to the meter base 18 through mating connectors 36 and 38 and is locked to the base by slot 52 engaging with the mating pin on the base.

With the meter and base operative, communication is established and using appropriate "handshake" messages between the meter and the base it is determined that a proper meter is in the home position on a legitimate base. Accordingly, deadbolt 42 (not shown in Fig. 5) is retracted, preferably only for a predetermined length of time. With the deadbolt retracted, the shutter 40 may be moved rearward (to the right in Fig. 5). In the illustrated embodiment, this is accomplished by means of the flexible cable 54 having handle 56 for grasping by the operator. The cable is suitably mounted on the pocket 34 by any convenient means (not shown). The other end of the cable is connected to pull slide 58 slideably mounted on the base 18 by any convenient means (also not shown). The side wall 60 carries pin 62 and pin 64. With the meter in the home position, that is in the lower position

illustrated, pin 62 engages slot 66 of slide pull 58. When the slide pull 58 is moved by the operator pulling forward on the flexible cable, the shutter 40 will also be retracted to uncover the print die shown at 30.

As shutter 40 moves, pin 64 will interlock with slot 66 of the carry handle 48 to prevent the meter from being lifted from the operating position when the shutter is retracted. Thus in order to remove the meter 10, The operator must push the flexible cable inward to push the shutter 40 into position again covering the print die 30. The deadbolt 42 is spring-loaded and re-engages the hole 42 in the shutter to lock the shutter in secure position.

Other methods and apparatus may be used for the purpose of retracting the shutter. Fig. 6 shows an alternative embodiment where the meter is installed by lowering it vertically into the base. In Fig. 6 the mechanism is shown in mid-position after the meter has been installed and locked in position but prior to the retraction of the shutter mechanism.

The meter shown in this embodiment is placed vertically downward on the base with square pin 100 on the meter being to the front of the meter and pin 110 on handle 120 clear for up and down movement of the meter from the base. The cam surface 130 on the meter captures the pin 110 and as the lever is pulled by the operator toward the front of the meter the vertical slot portion of the cam surface 130 is pushed toward the operator so that pin 100 is engaged in slot 140. At this point the meter is locked in place and communication between the meter and the base is established as described in connection with Fig. 5. With the appropriate "handshake" the deadbolt is raised to allow further movement of the handle. Pin 160 which is mounted on the shutter has also moved into contact with wall 170. Preferably, a lip or angled member shown at 200 also engages a slot 210 to lock the meter to the base.

As the handle 120 moves further forward, sector 220 engages pinion 230 which drives rack 240 affixed to member 260 that carries wall 170. The shutter plate is moved rearwardly by action of wall 170 on pin 160 until the

handle is stopped by the cam surface 130 and the shutter has exposed the print die.

Other means for locking the meter in place and for actuating the retraction of the shutter can be envisioned depending in part on the way the meter is required to be installed. It will be understood that the various operations for retracting the shutter described herein as performed by the operator can be motorized if desired.

Fig. 7 shows a partially exploded view of a meter in accordance with the invention. The meter 10 is shown with the cover 12 and keyboard and display raised from the bottom to expose a schematic layout of the meter hardware. The connector 38 feeds into the printed circuit boards 300 which comprise the accounting and printing control functions described below. The print wheels 310 are set by stepping motors 320 in an arrangement also described below. A dater assembly 330, PIN counter 340 and a slogan printer 350 are also provided as required. Preferably, a door 360 provides access as necessary to the slogan, PIN, and date printers.

Fig. 8 is a functional block diagram of a computerized postage meter. The system is controlled by a microprocessor which basically comprises a CPU which performs the functions of accounting, controlling the setting of the printwheels, die protection and the communication with the base and other peripherals as required. Three types of memory units are employed with the CPU. The permanent memory PM which may be a ROM or PROM stores the sequence of program operations to be performed by the CPU for its accounting calculations and control functions. The temporary memory TM which is a working RAM holds the data and calculation results on a temporary basis until they are stored in the non volatile memory NVM. The non volatile memory can be battery-backed RAM, EEPROM, EAROM, or MNOS as desired or any combination if two or more memories are utilized. Preferably, at least two nonvolatile memories are used and transaction accounting data is stored in nonvolatile memory for each transaction. A suitable method for such accounting is

shown in U.S. Patent No. 4,484,307. Other accounting methods are described in U.S. Patent No. 3,978,457. Funds may also be placed in or removed from memory by means as described in U.S. Patent No. 4,097,923 specifically incorporated herein by reference.

The system in accordance with the invention may operate in accordance with data input through the keyboard and display 16 and displays information on the same or it receives and transmits information to the mailing machine or other peripheral through connector 38 as shown in Fig. 9. The meter keyboard and display in a preferred embodiment would be useable only for the purpose of reading the various meter registers and/or for the purpose of refunding the meter and for various checks and accounting operations which may be required when the meter is not installed on its base. When the meter is installed on the base, the CPU in accordance with the data it receives from the base, operates the stepping motors 320 for setting the printwheels 310 shown in this Figure as the setting postage block SP and also controls the other die protector devices to allow the printing of postage to take place. These operations are indicated at the postage printing block PP.

Fig. 9 shows a block diagram of the communication between the meter and mailing machine. As mentioned previously it is preferred that all the communication be by way of the protocol described in U.S. 4,301,507.

Fig. 10 is a flow chart for the releasing of the deadbolt 42 to allow the shutter to be retracted. Once it has been determined that the meter is on an appropriate base, the solenoid is actuated for a predetermined amount of time to allow the operator to move the shutter.

Figs. 11-14 show the printwheel setting mechanism. The printwheel setting mechanism comprises five motor driven gear trains. Five stepper motors (each designated 320 since the drive trains are similar for each printwheel) are mounted on walls 400 each motor respectively driving an associated printwheel 310 via respective motor pinions 410, encoder assembly gears 420, transfer gears 430, and printwheel gears 440 attached to the printwheels 310. Each

gear train includes a two-channel encoder sensor assembly designated herein as 480. The encoder assembly gears 420, suitably of molded plastic, include ten (10)-tooth gears which mesh with the transfer gears 430 and twenty (20)-tooth gears that mesh with the motor pinions 410 along with the planar wheel portions which extend into the sensor assemblies 480.

Each sensor channel comprises a source, suitably an infrared-emitting diode and a detector, a photodiode with its associated circuitry. Such sensors are conventional and will not be further described.

Preferably the encoder wheel operates to produce ten (10) transitions per revolution as the encoder wheel passes through the sensor assembly and in each sensor channel alternately blocks and unblocks the radiation from the source. This results in two (2) sensor detector transitions (one for each channel of the two-channel sensor) for each move of one-digit.

The channels are physically separated such that as the encoder wheel rotates the detector outputs are in phase quadrature (the output of one of the two detectors leads or lags the output of the other detector by one quarter of a cycle).

The motor pinions 410 are twelve (12) tooth gears affixed to the motor shafts and mesh with the twenty (20) tooth gears of the encoder gear 420.

The stepper motors 320 turn through a complete revolution in 24 steps which, as transmitted through the gear train previously described, require 4 motor steps for movement of one digit of the printwheel. In this embodiment, the stepper motors are four-phase motors preferably driven by the drivers in a two-phase mode. The motor control sequence is discussed below in conjunction with the flow charts for the printwheel setting.

Each printwheel 320 is suitably a plastic component which forms a substrate for the molded rubber print characters located around the periphery of the wheel, one of which is designated 450. The printwheel also comprises ten (10)-tooth printwheel gear 440 which is used also as

described below for alignment of the printwheel when printing takes place.

It will be understood that the setting mechanism further accommodates shifting of the decimal point between the middle digit printwheels and the least significant digit printwheel to obtain various postal values as required.

The transfer gears 430 are thirty (30)-tooth gears, suitably of molded plastic, that mesh with the printwheels gears 440 and the ten (10)-tooth gears of the encoder gears 420. The transfer gears 430 include a protrusion 460 which in conjunction with a fixed feature 470 on the housing provides an end stop or zero-reference position for the mechanism.

When the transfer gear protrusion 460 is adjacent the stop 470 that there is a known fixed value on the print die plane. It will be appreciated that with thirty (30) teeth on the transfer gear meshing with the ten (10)-teeth on the printwheel gear there will be three (3) rotations of the printwheels for one rotation of the transfer gear. Because of the particular implementation of the end stop, there are in this embodiment twenty-six (26) transfer gear positions which correspond to the 10 digit position of the printwheel. In accordance with the invention, advantage is taken of the fact that a particular digit setting is available at a plurality of transfer gear positions in order to achieve the shortest path movement of the transfer gear to achieve setting of the required character on each printwheel.

In the embodiment shown in these Figures, a single solenoid 490 raises die protector blades 495 in tandem to enable the printing of postage. While this arrangement normally works well in conventional flat bed printers, there is further provided in the postage meter in accordance with the present invention further die protection as shown more particularly in conjunction with Figs. 15 and 16.

Fig. 15 is a perspective view of the die protector mechanism. In accordance with the present invention, two

die protector blades 500 and 510 are placed adjacent to the two highest order printwheels of the printwheel banks 310. When the meter is logically incapable of accepting a print request, these two blades protrude beyond the printing plane of the print elements to prevent the "wiping" of fraudulent prints from the die.

Particular conditions under which, for example, the meter may be disabled include lack of power, insufficient funds, value selection in progress in which the higher order printwheels are to be moved, and various sensed error conditions.

As is shown in Fig. 15, blades 500 and 510 are pivotally attached at shaft 520 and at the opposite end are engaged via pin 530 which is held in S-shaped slot 540 of member 550 to the armature 560 of solenoid 570. The solenoid 570 is under the direct control of the microprocessor. When the solenoid is energized it pulls in the member 550 against the force of a spring (not shown) and the elevated portion of slot 540 raises the die protector blades. The die protector blades will remain retracted until the microprocessor de-energizes the solenoid or until power is lost. When the die protector blades are retracted, they perform the alternate function of detenting the two higher order print wheels to improve their alignment.

Fig. 16 shows an additional die protector mechanism which comprise a set of protruding die protector blades, called here aligner/protector blades which are retracted for only a brief interval during each print operation. Preferably this retraction coincides with the meter accounting operation. In accordance with the invention, these aligner/protector blades shown at 600, 610, and 620 are disposed next to the lower order printwheels. The three blades are normally locked in position as shown suitably by projecting tooth 630 of rotatable cam 640. Solenoid 650 when actuated rotates cam 640 to move tooth 630 out of the way and to raise the aligner protectors by engagement of the tooth 660 on cam 640 with tooth 670 on the die protector blades. The rotation of cam 640 is also

against a spring (not shown) so that in the event of failure the cam will return to the locked position.

It will be appreciated that the actuation of these two types of die protection may be by way of either type of mechanism described herein and is not limited to either method so long as the locking is achieved.

For operation, the three blades are normally locked in the protruding position and external forces cannot cause them to retract. When the mailing machine communicates a request to print an imprint, the meter will consider the request and on the basis of availability of funds and other printing criteria, and if accepted will energize the solenoid and withdraw the aligner/protectors for a timed period in which the mailing machine can ink the die and take the print. Preferably, the aligner/protectors have the auxiliary function of detenting and aligning the lower order printwheels.

Figs. 17 and 18 are flow charts for the operation of the die protector and the aligner/protector mechanisms. The operation of each has been described and it is not believed to be necessary to describe the flow charts in any greater detail.

Figs. 19A-19H show the operation of the print wheel setting mechanism shown and described in conjunction with Figs 11-14. The flow chart shows the operation of the mechanism to enable advantage to be taken of the shortest path to the new setting. This is of great benefit to the increased setting speed required for the throughput of a meter in accordance with the invention for minimizing power comsumption.

Fig. 19A shows the normal set postage routine for setting the printwheels of the postage meter. In accordance with this routine, a success flag is first cleared and a flag indicating whether the position of the printwheels is known is checked. If the position-known flag is set, a software initialization routine is called. A subroutine SDIGITS calculates the digit distance for all five banks of printwheels and when this calculation is complete a set postage routine, SSTEP, is called. At the

end of the setting routine, the position is again checked and if it is known the success flag is set.

Fig. 19B shows the subroutine SDIGITS which computes the distance and direction that each digit wheel must move by subtracting the value of postage currently set, stored as old value from the desired value stored as new value. As mentioned in the discussion of Figs. 11 through 14, each printwheel character printing position is associated with multiple transfer gear setting positions. Thus in accordance with the routine, except when the meter setting mechanism is being initialized, ten (10) is added to the new digit to place the new number in the center decade of the transfer wheel. The value presently set in the printwheel is subtracted from the new value thus obtained to get the difference (DIFF). The sign resulting from the subtraction is also stored to determine the direction the printwheels must move.

A test is then made as to whether initialization is being done. If yes, the routine returns to the main loop. If initialization is not being done, the DIFF is tested to see whether it is greater than five (5). If DIFF is equal to or less than five (5) the program returns to the main loop. If the outcome of a test shows that the difference is greater than five (5), DIFF is tested again for being greater than, equal to, or less than ten (10). If the outcome is equal to ten (10), DIFF is made equal to zero (Ø) and the program returns to the main loop. If greater than ten (10), ten (10) is subtracted from the difference and the result is again tested. If DIFF then is less than ten (10), the direction is tested to see whether the printwheels are to move up or down.

If the wheel is to move up, the set value plus (ten minus DIFF) is tested and if less than or equal to twenty-six (26), the direction is reversed and DIFF is set equal to ten (10) minus DIFF. If no, the program returns to the main loop.

If the printwheel direction is down, then set value minus (10 minus DIFF) is tested as being greater than or equal to zero (Ø) and if it is then direction is reversed

and DIFF is set equal to ten (10) minus DIFF. If no, the program returns to the main loop.

Fig. 19C shows the subroutine SSTEP. This subroutine will move the printing wheels by the number of digits specified in the SDIGITS program and in the direction specified in that subroutine. In this subroutine, the position known flag is cleared and the number of motor steps required are calculated by multiplying the digit distance by four (4) since the stepper motor moves four (4) steps for each digit. The wheel position in sensor transition is also calculated as two (2) times the set value. This is determined for each bank. At this juncture, the subroutine SMOTOR is called to provide the step pulses to the stepper motor to drive the printwheels. The digit wheel position is calculated from the wheel position in sensor transitions which have been kept updated through the move, divided by two (2), since as mentioned previously there are two (2) sensor transitions per digit. The calculation is checked to see if its an exact multiple of two (2) and if not, an error routine is called. If yes, the set value is stored. A routine then follows to check whether the setting is initializing and if not, the print value is set equal to the set value. The print value is checked to determine whether it is greater than or equal to ten (10), if it is, the print value is made equal to the print value minus ten (10) and again checked.

If the print value is less than ten (10), the routine proceeds to check whether the print value now equals the new value and if not, an error routine is called. If the answer is yes, the subroutine determines if there are any remaining banks to be set. If there are, the wheel position for the next bank is checked until no banks remain to be checked. The position known flag is set before returning.

Fig. 19D shows the subroutine SMOTOR for providing step pulses to each motor. Each motor is provided output on a sequential basis during the setting cycle for the printwheel banks. For each bank then the motor steps are checked and if they are greater than zero (Ø) then an

output is set for the motor to move one (1) step and an "output ready" flag and "waiting for timer" flag are set. The sensor monitoring routine SSENDS is called and a check is made as to whether another bank is required to be set.

If at the check for motor steps, the bank shows zero (Ø) steps to do, the program branches to set up data for present position holding coil and a holding counter is decremented. If the counter has not reached zero (Ø) the program returns to the main loop of SMOTOR and the "output ready" flag and "waiting for timer" flags are set and the sensor monitoring routine is again called. If the counter has decremented to zero (Ø), then the flag is set for zero (Ø) and the "waiting for timer" flag is set with no "output ready" flag. The program operates until all the zero (Ø) flags are set at which point it returns to the main loop.

Fig. 19E shows the subroutine SSENDS which monitors the sensor channels to update the actual positions of the wheel. In this subroutine, each bank sensor is read and it is determined whether a transition has been made. If the answer is yes, the direction is determined by checking the transition sequence of the two channel sensor and if the direction is down, one is subtracted from the wheel position and if the direction is up, one is added to the wheel position. At this point the "waiting for timer" flag is checked and if it is clear the program returns. If the waiting for timer flag is not cleared then the next bank is read.

If no transitions were detected then the "waiting for timer" flag clear is checked. And if cleared, the program returns.

Fig. 19F shows the timer interrupt routine.

Fig. 19G shows the subroutine for initializing the printwheels. In this routine, the new value is set equal to twenty-six (26) for each wheel and the transfer gear is driven all the way to the stop. At this point, the "position known" flag is checked and if the "position known" flag is not set, the set value is set equal to all

zeros (Ø's). If the position known flag is set, the step of making all zeros (Ø's) is skipped.

The initialization flag is then set, the common initialization routine is called and the subroutine proceeds to check the printwheel positions at the middle and opposite end. At this point, the current set postage is set equal to zero (Ø) and the position known is tested and if the position is known, the success flag is set. If not, the success flag is not set and in both instances the program returns to the main loop.

Fig. 19H shows COMIN, the subroutine for common initialization. This routine is common to all motor hardware drivers and it initializes the registers and sets up the timer for interruption at predetermined times.

The claims defining the invention are as follows:-

1. A printwheel setting device for positioning a printwheel of a postage meter comprising:

a printwheel having a plurality of printing characters about the periphery thereof;

a motor;

a gear train drivingly connecting said motor to said printwheel;

said gear train including at least one gear having a greater number of gear positions than the number of the printing characters, wherein each printing character on the printwheel has a printing position corresponding to a respective plurality of said gear positions of said at least one gear;

means to determine the direction of rotation of said at least one gear to a nearest one of the plurality of gear positions corresponding to the printing position of a selected character on the printwheel;

means to operate said motor to move said at least one gear wheel in the determined direction to said nearest one of said plurality of gear positions.

2. The setting device of claim 1 wherein said means for determining the rotation path is operative to tend to place said at least one gear wheel in the mid-range of its rotation.

3. The setting device of claim 1 further comprising encoding means for enabling determination of the position of said at least one gear wheel.

4. The setting device of claim 3 wherein said encoding means includes a two-channel sensor arrangement whereby the direction of rotation can be determined.

5. The setting device of claim 3 further comprising a stop on said at least one gear, said stop cooperating with a fixed point on the postage meter to determine a known value for the printwheel and from which point other printwheel positions may be calculated from information provided by said encoding means.

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6. The setting device of claim 1 wherein said motor is a stepper motor.

7. A postage meter of the type having a printing die carrying an indicia and printwheels for the printing of postal value, comprising means for setting said printwheels including:

a plurality of printwheels each having respective printwheels gears connected thereto;

a plurality of stepper motors having respective stepper motors shafts, each stepper motor being respectively associated with one of said printwheels;

each said stepper motor shaft having a pinion carried thereon;

a plurality of transfer gears each respectively meshing with said printwheel gears;

gear means respectively connecting said transfer gears and said pinions for driving said printwheels to a desired position;

said transfer gears having a greater number of teeth than said printwheel gears wherein a predetermined position of the printwheel gears are associated with a plurality of positions of the respective transfer gears;

means for determining the rotation path for the rotation of each transfer gear to a nearest one of said plurality of positions to place the printwheel in a desired position; and

means for driving said stepper motor as required to rotate said transfer gear and thereby said printwheels to said desired position.

8. A postage meter according to claim 7 further comprising encoding means for enabling determination of the position of each printwheel.

9. A postage meter according to claim 8 wherein said gear means connecting said transfer gears and said pinions comprises a part of the encoder means, said encoder means further including sensor channels which are blocked and unblocked by rotation of the connecting gear means.

10. A postage meter according to claim 9 wherein the encoder sensors are two-

AUSTRALIAN PATENT OFFICE MTS

channel sensors for providing phase information from which the direction of rotation may be determined.

11. A printwheel setting device substantially as hereinbefore described with reference to the accompanying drawings.

DATED this 16th day of July, 1990

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PATENT & TRADE MARK ATTORNEYS
71 QUEENS ROAD,
MELBOURNE, 3004, AUSTRALIA

MNS

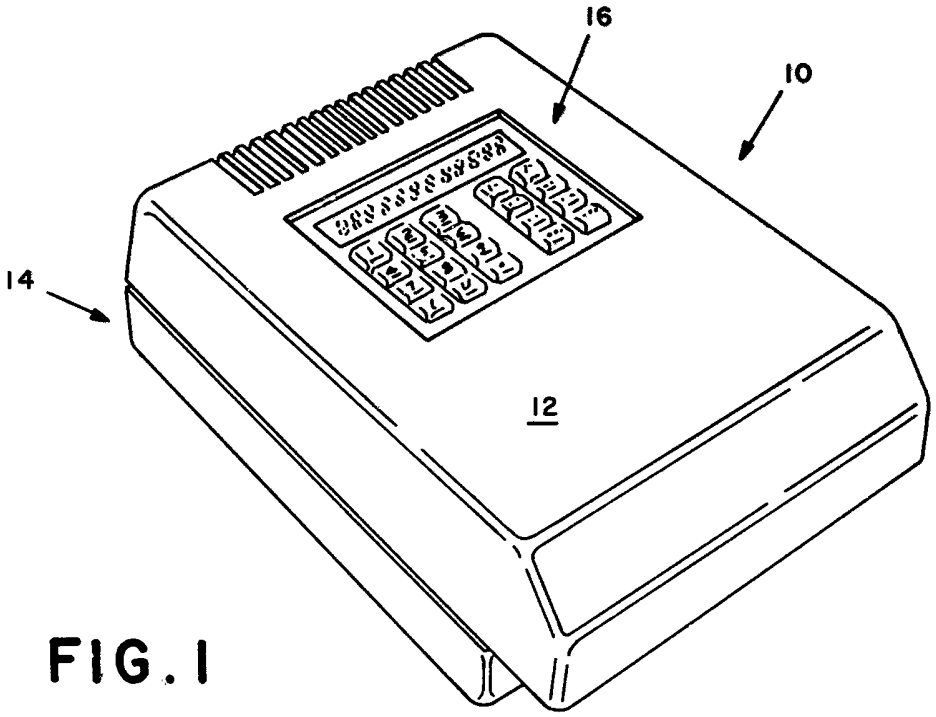


FIG. 1

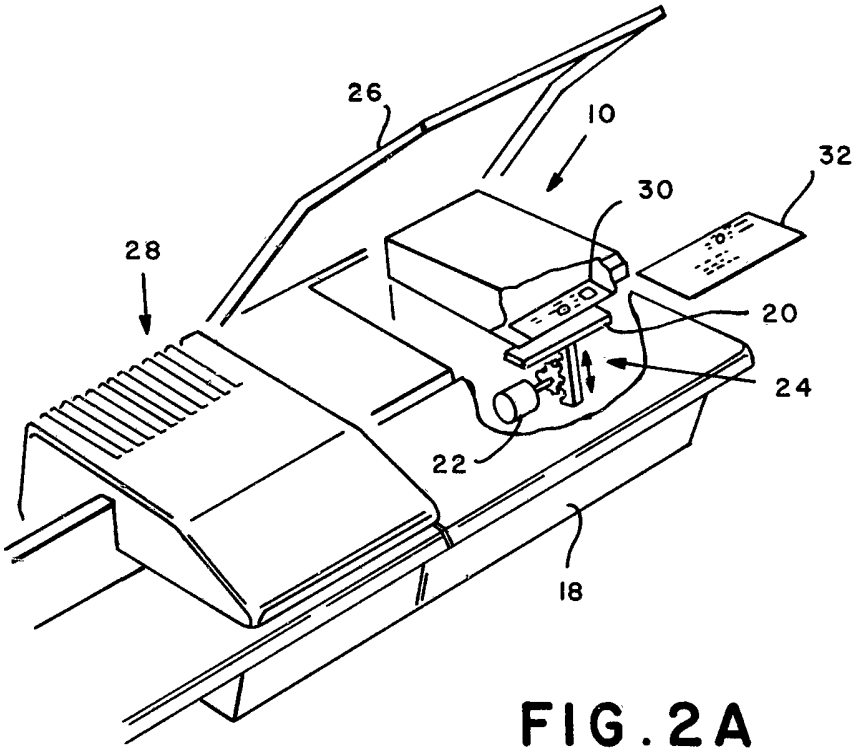


FIG. 2A

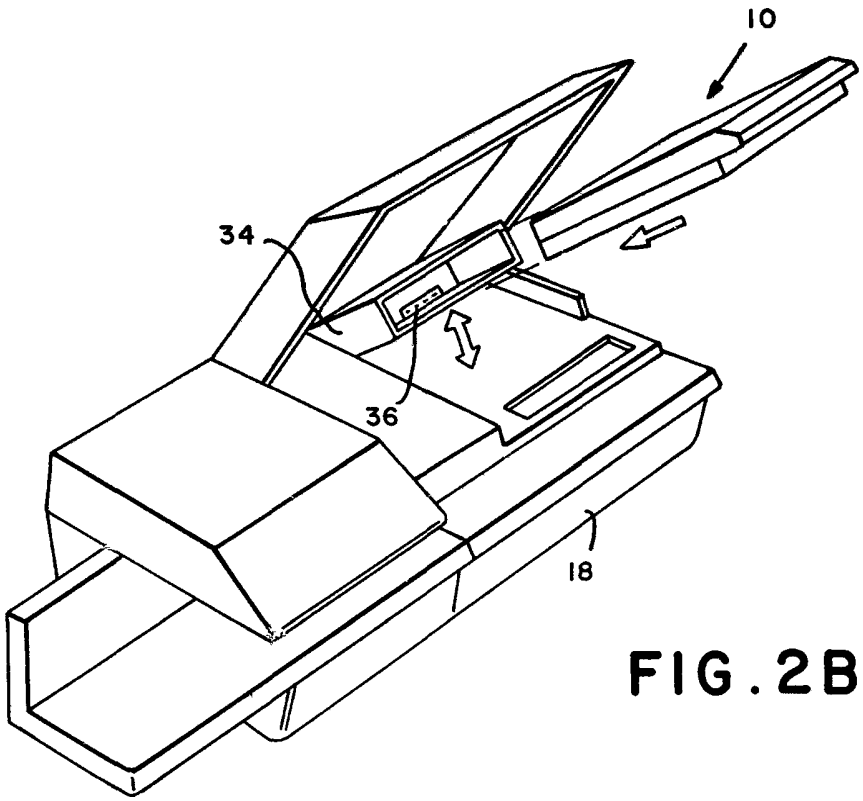


FIG. 2B

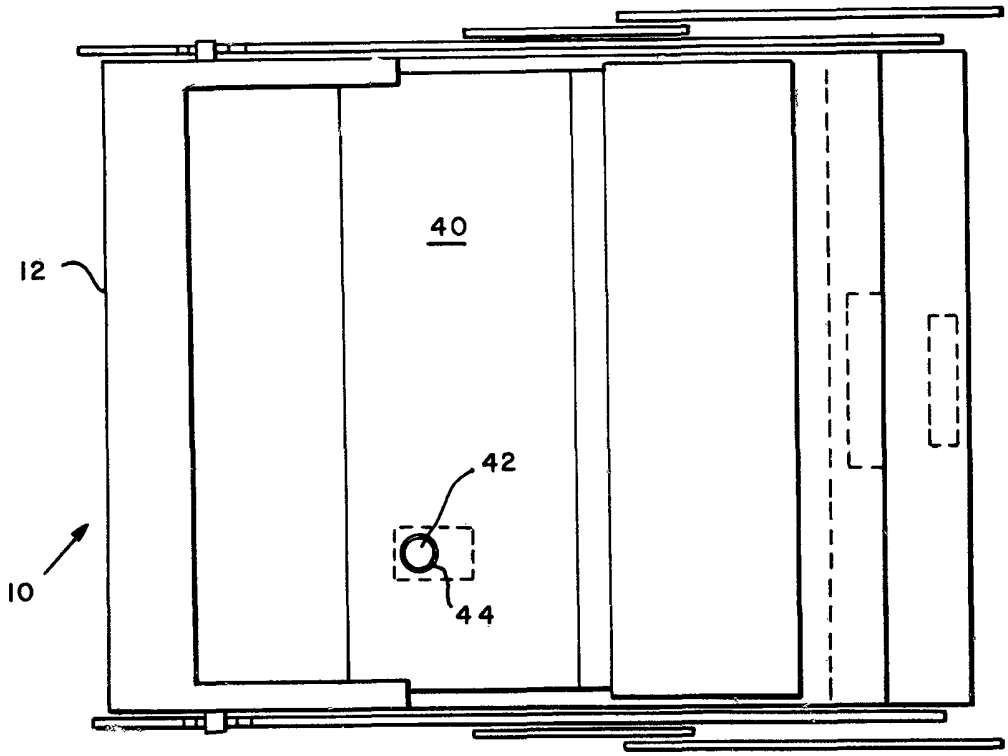


FIG. 3

FIG.4A

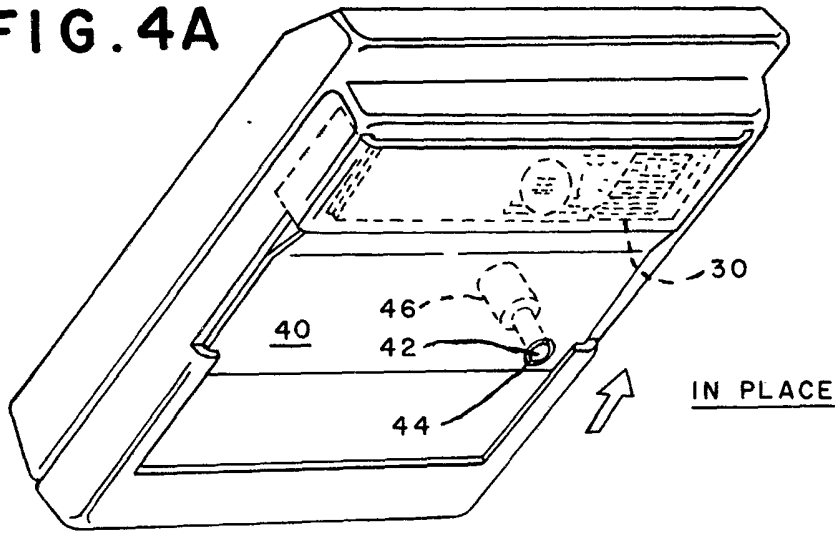
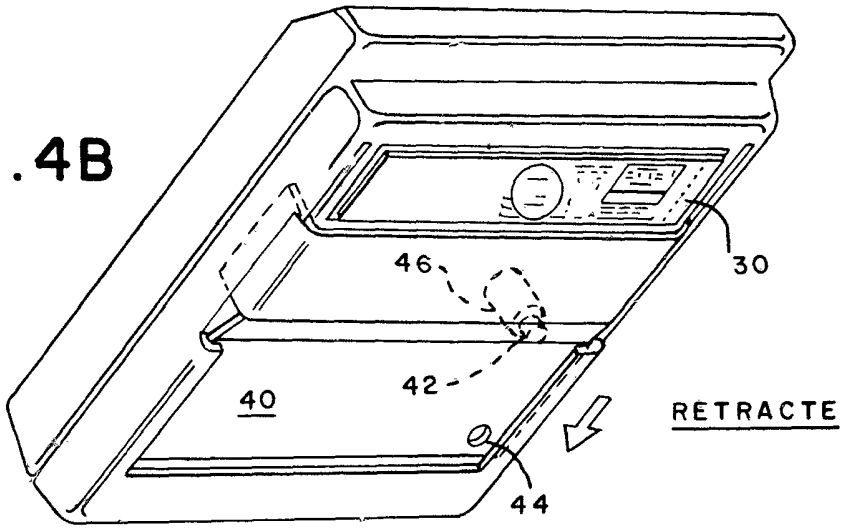
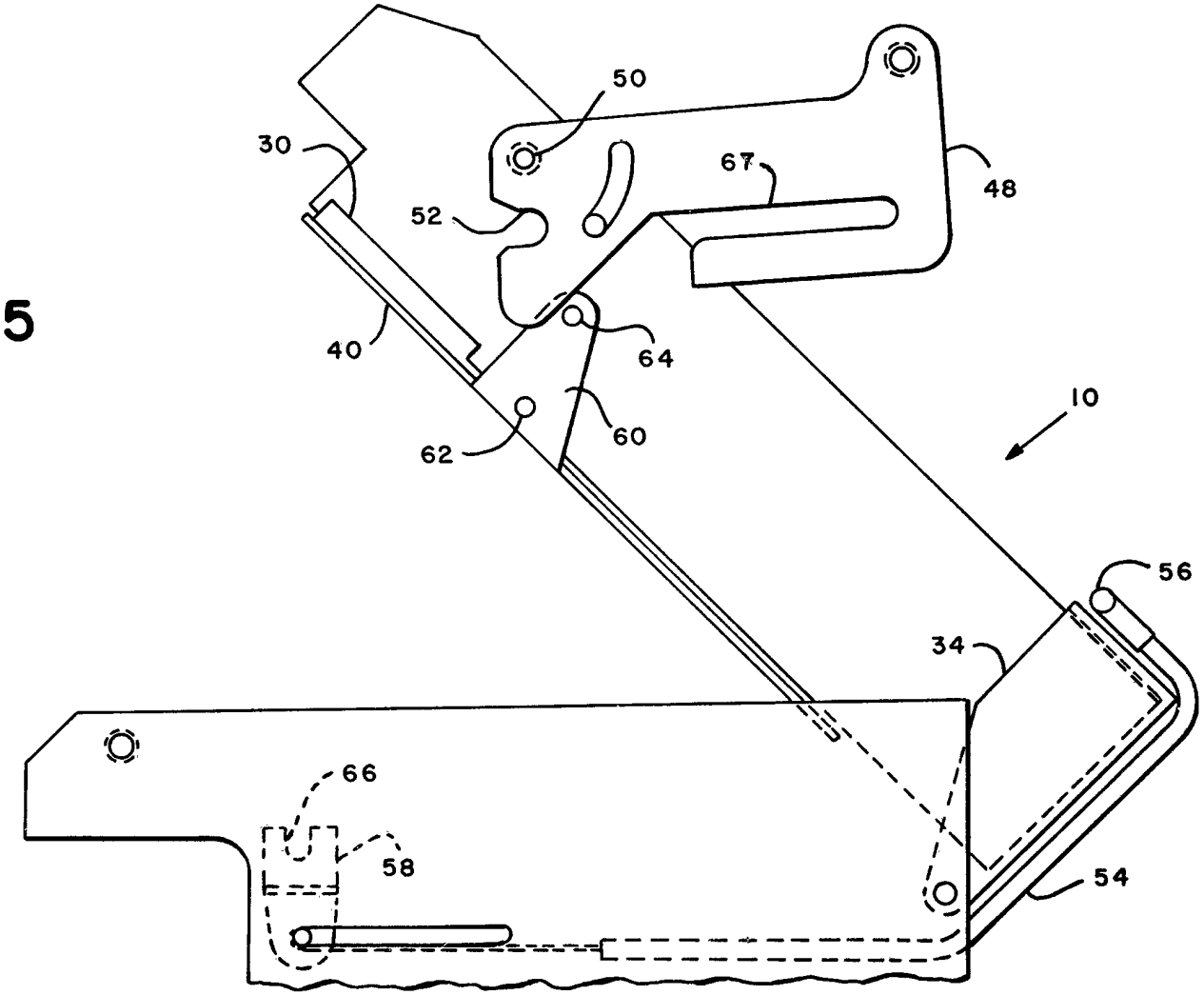


FIG.4B



21 10 88 24110

FIG. 5



2110824110

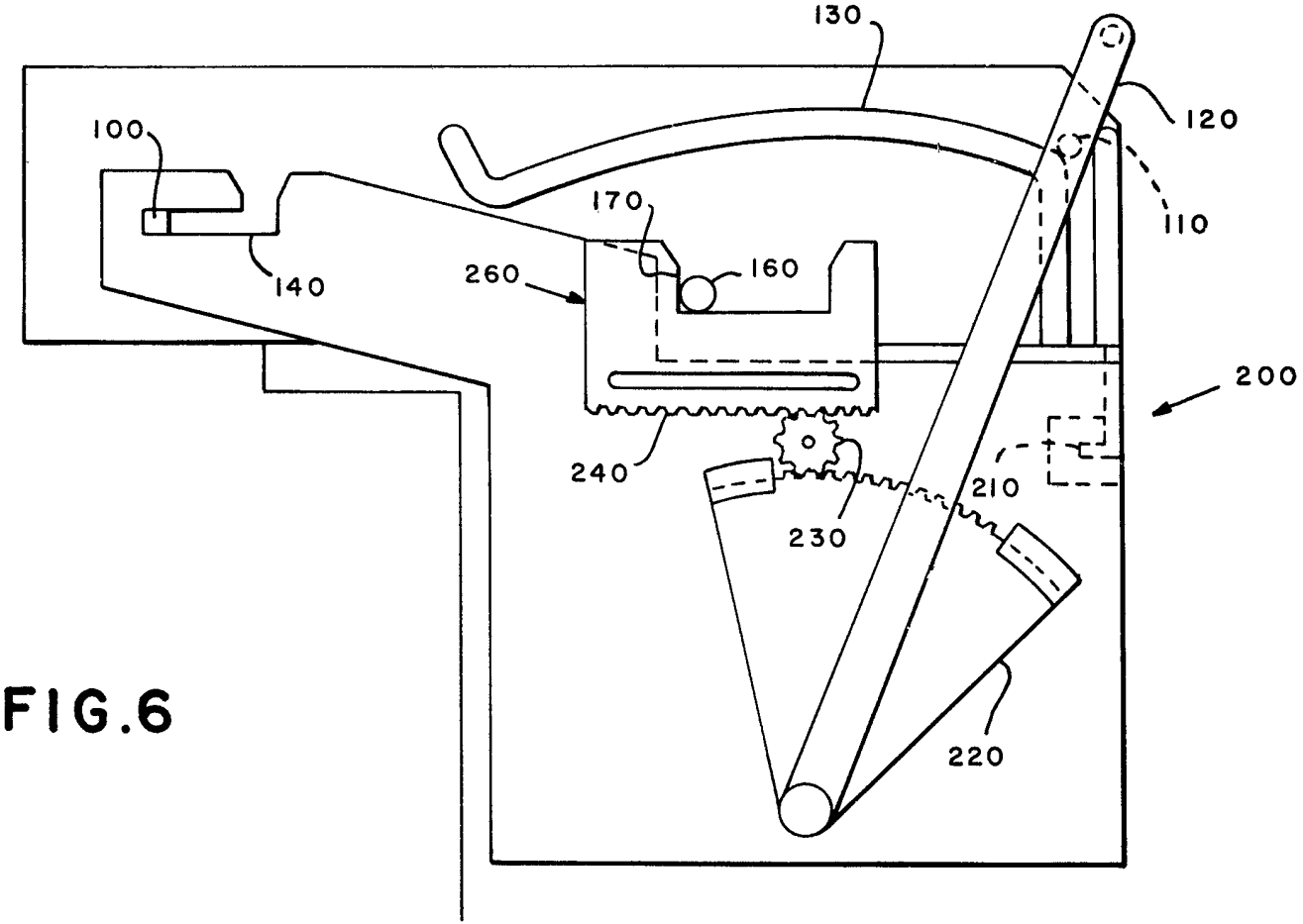


FIG.6

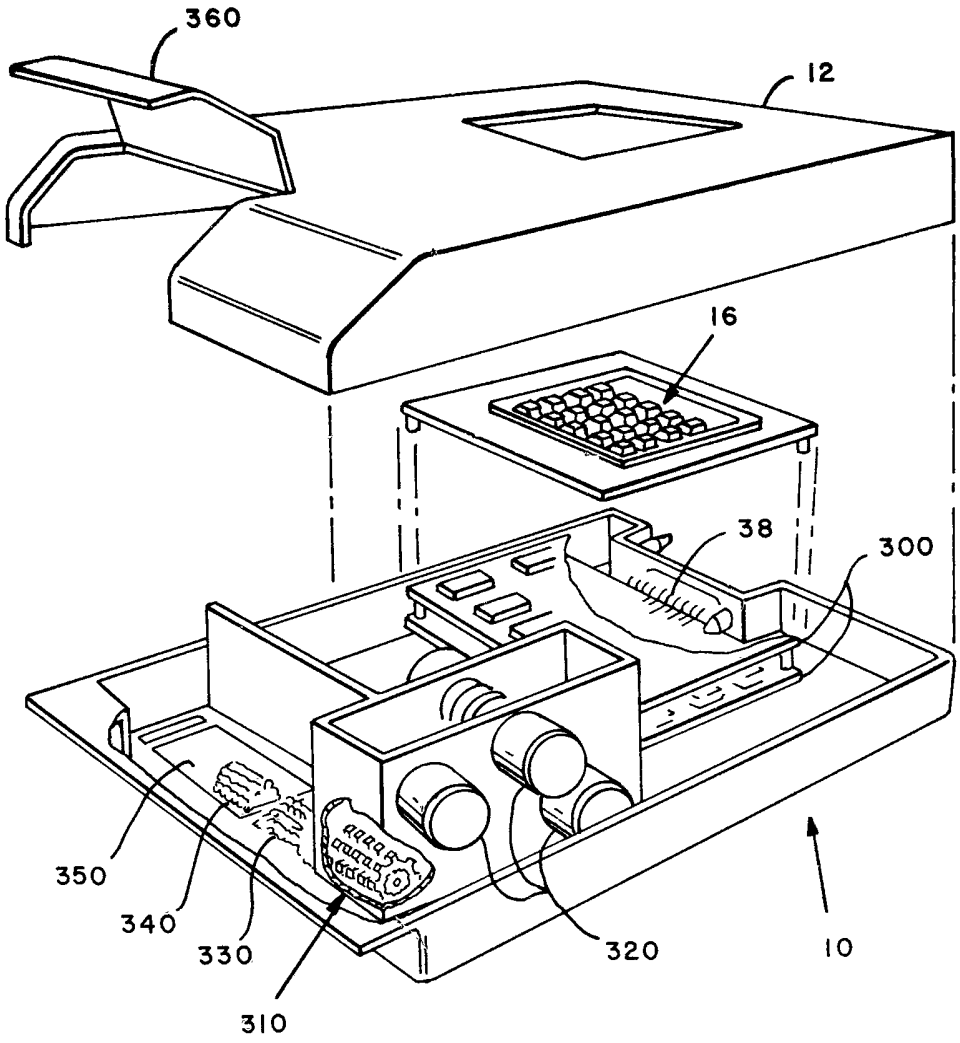


FIG. 7

FIG. 8

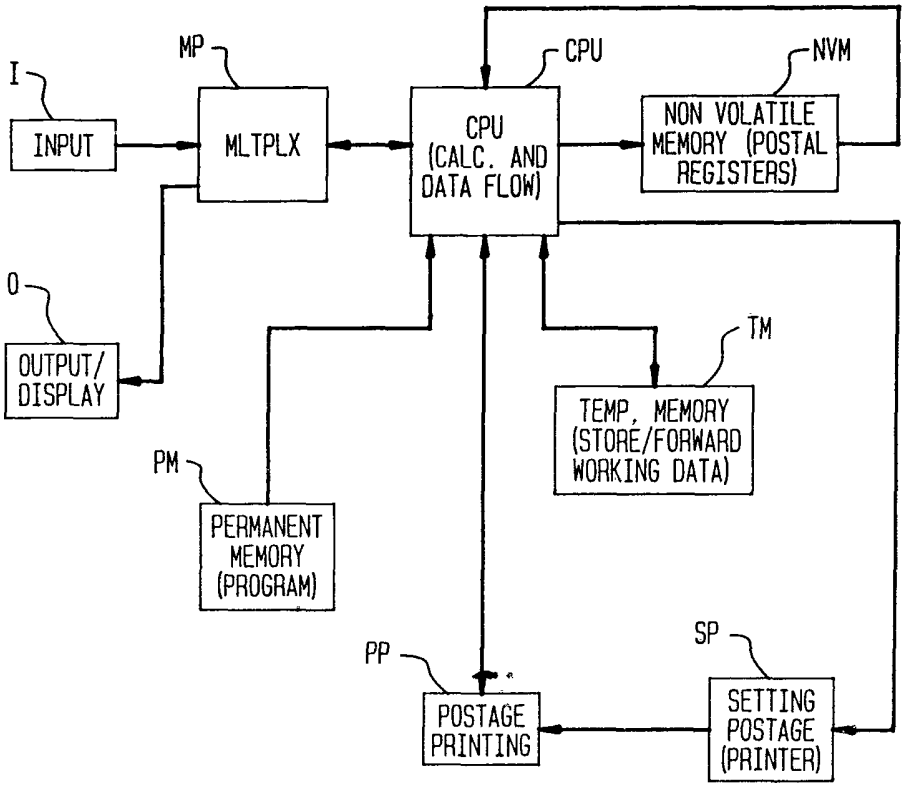

I
INPUT
MP
MLTPLX
CPU
CPU (CALC. AND DATA FLOW)
NVM
NON VOLATILE MEMORY (POSTAL REGISTERS)
O
OUTPUT/ DISPLAY
TM
TEMP, MEMORY (STORE/FORWARD WORKING DATA)
PM
PERMANENT MEMORY (PROGRAM)
PP
POSTAGE PRINTING
SP
SETTING POSTAGE (PRINTER)

FIG. 9

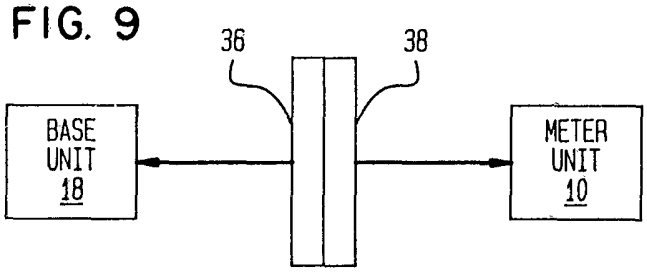
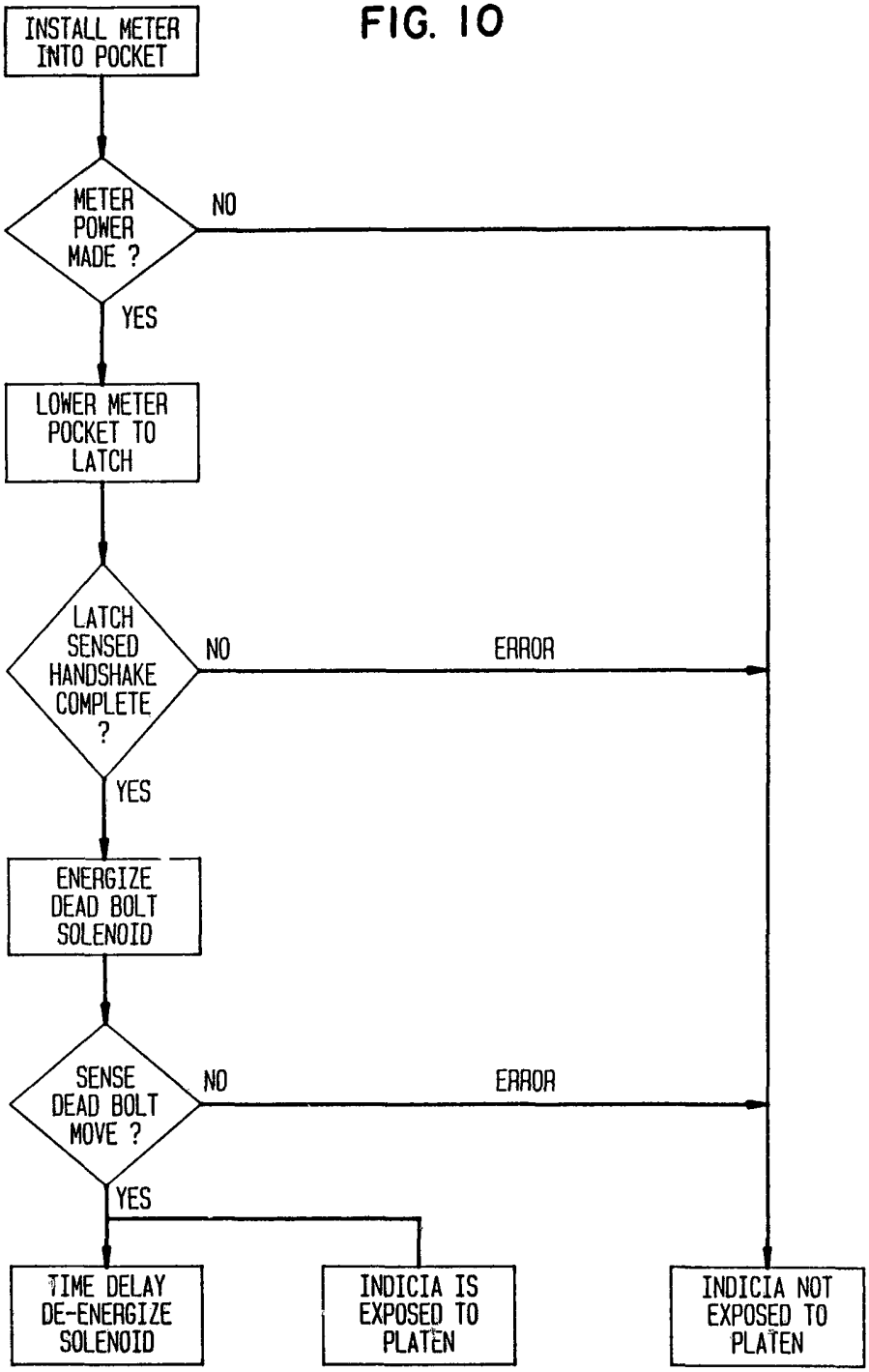

36
38
BASE UNIT 18
METER UNIT 10

FIG. 10


INSTALL METER INTO POCKET
METER POWER MADE ?
NO
YES
LOWER METER POCKET TO LATCH
LATCH SENSED HANDSHAKE COMPLETE ?
NO
ERROR
YES
ENERGIZE DEAD BOLT SOLENOID
SENSE DEAD BOLT MOVE ?
NO
ERROR
YES
TIME DELAY DE-ENERGIZE SOLENOID
INDICIA IS EXPOSED TO PLATEN
INDICIA NOT EXPOSED TO PLATEN

2110 88 241

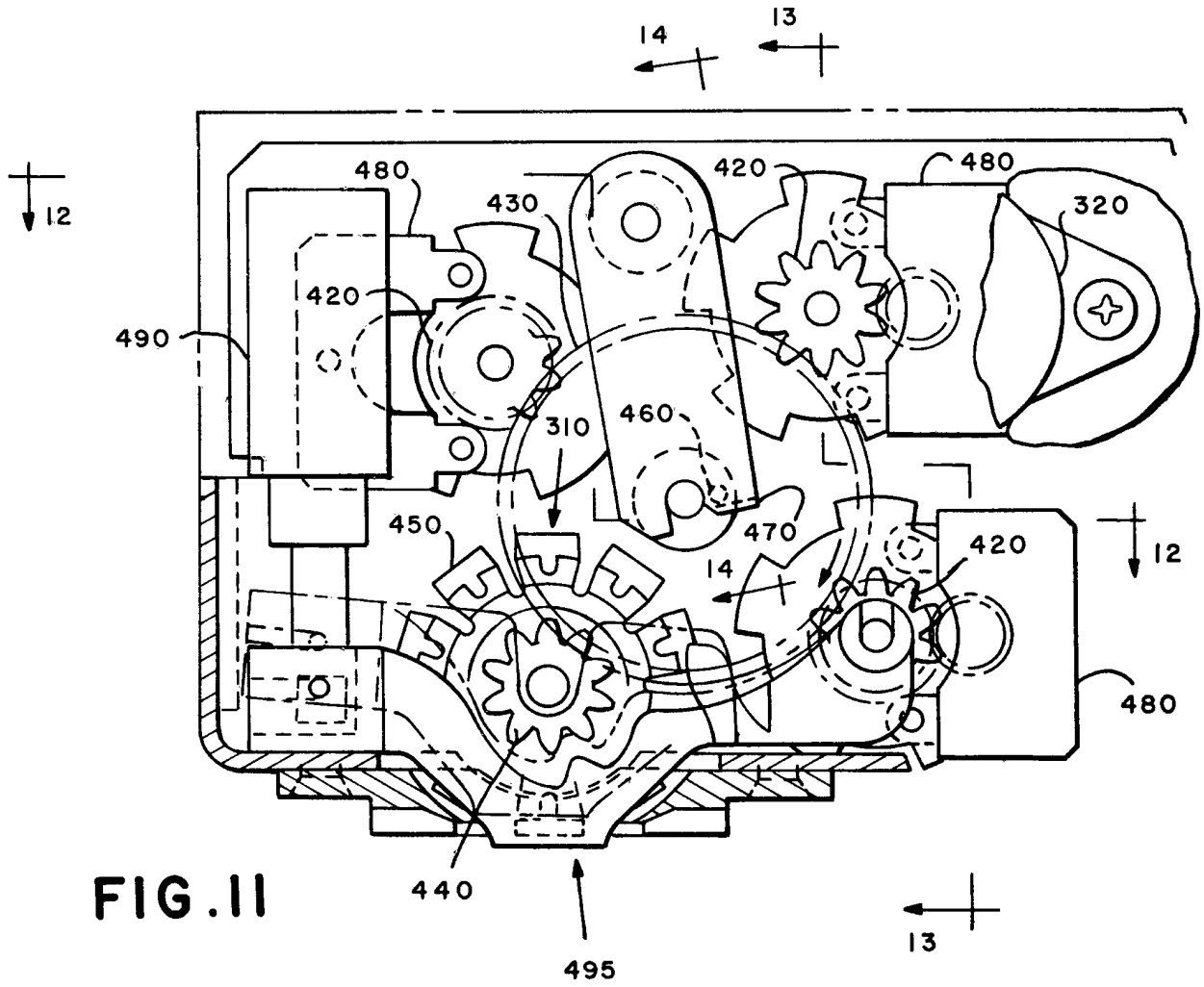


FIG. 11

21 10 88 24192

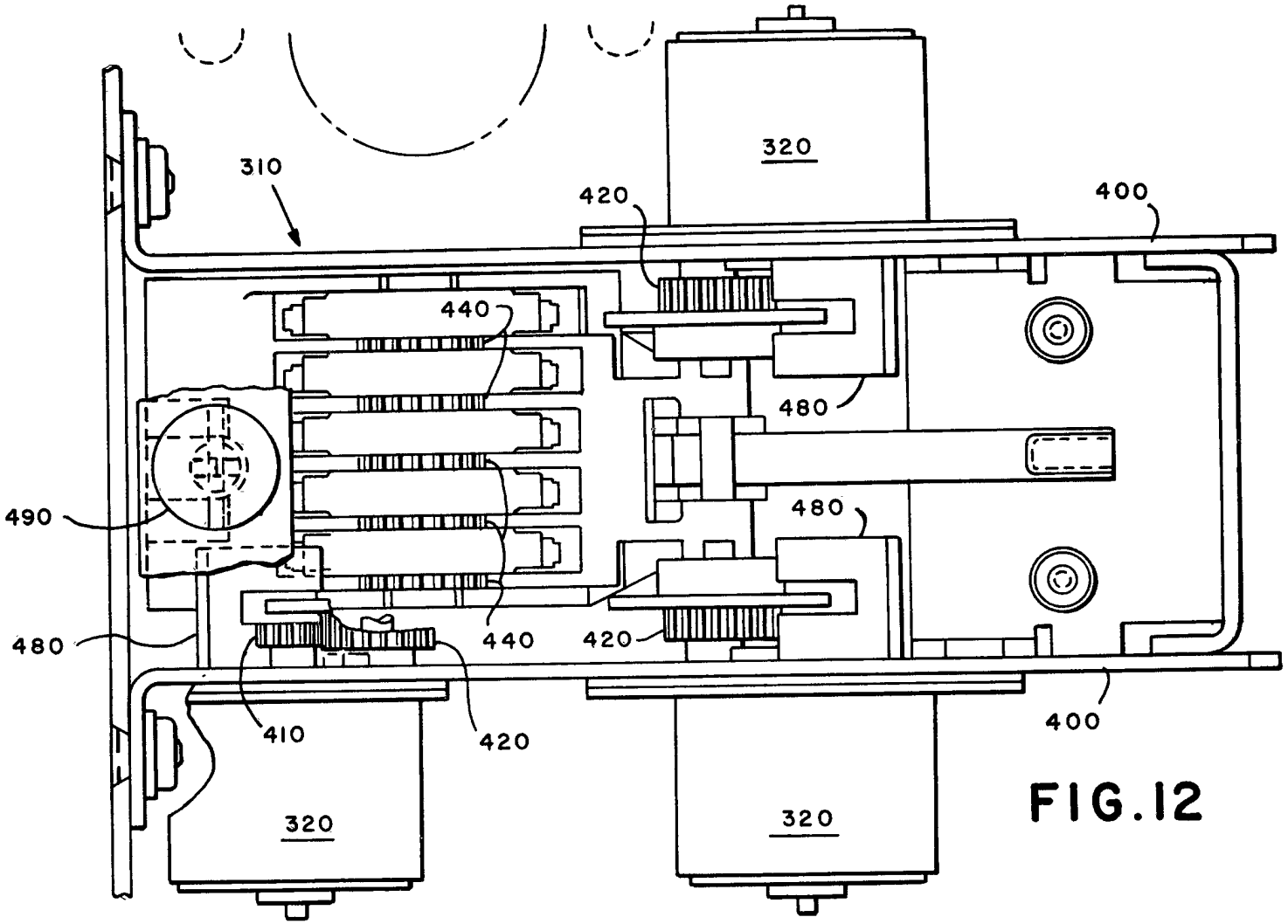


FIG.12

98/01142

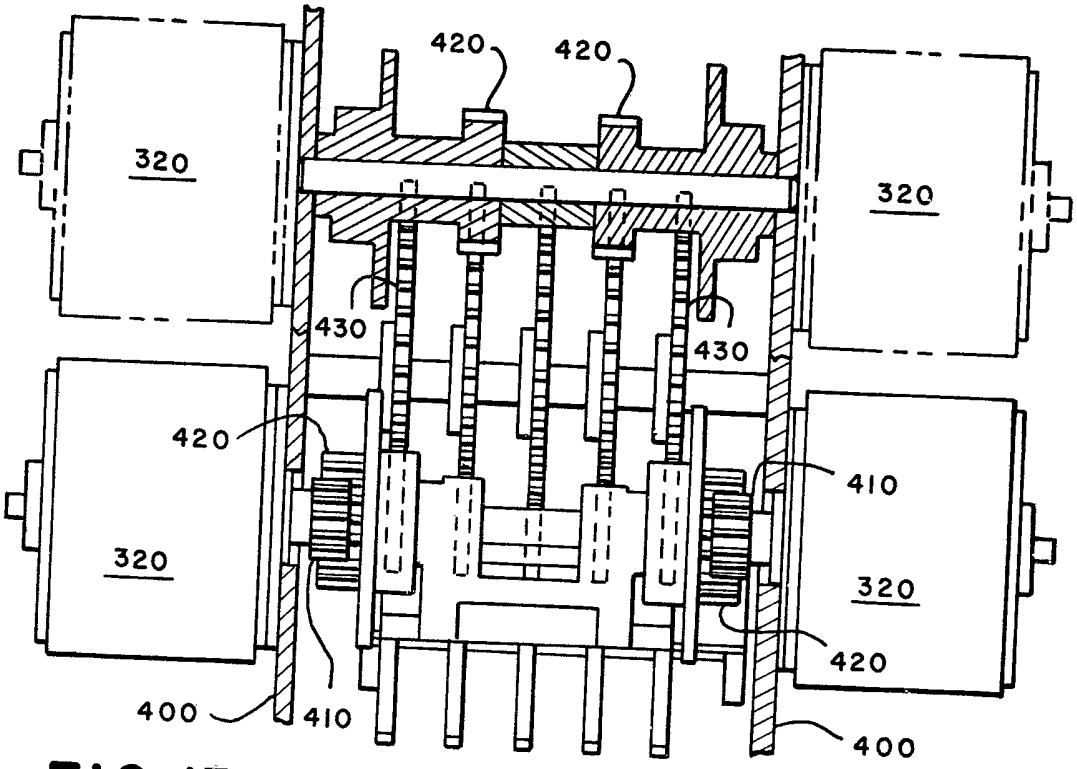

420
420
320
320
430
430
420
410
320
320
420
400
410
400

FIG. 13

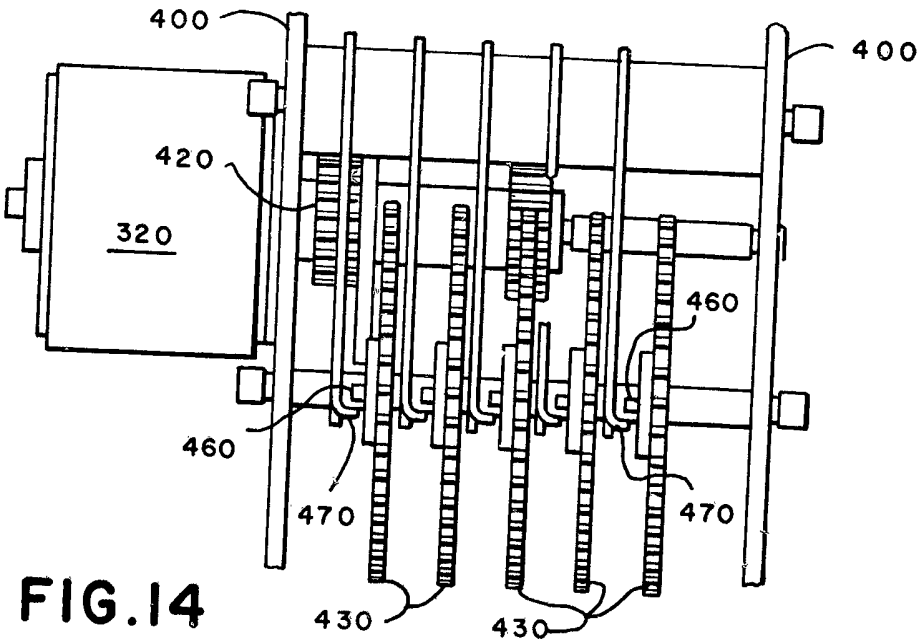

400
400
420
320
460
460
470
470
430
430

FIG. 14

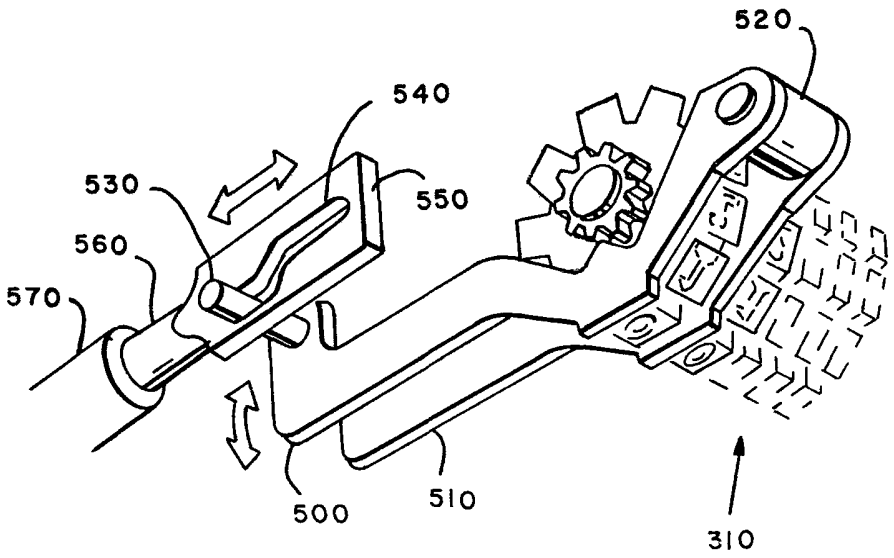

520
540
530
550
560
570
500
510
310

FIG. 15

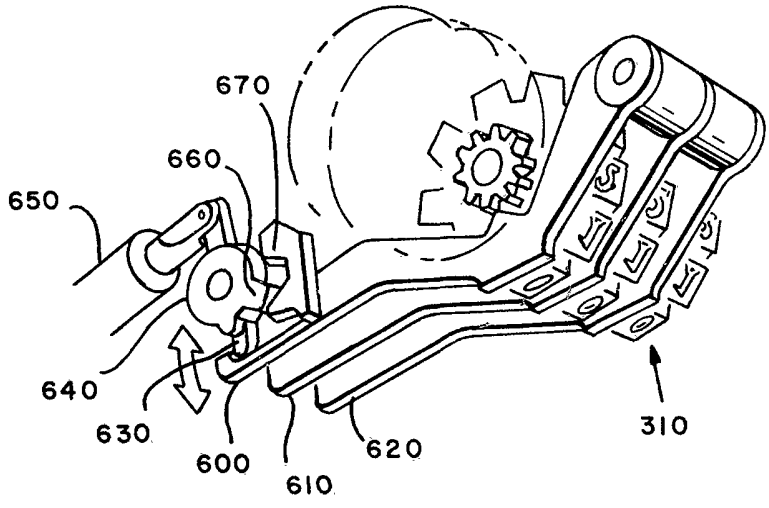

670
660
650
640
630
600
610
620
310

FIG. 16

FIG. 17

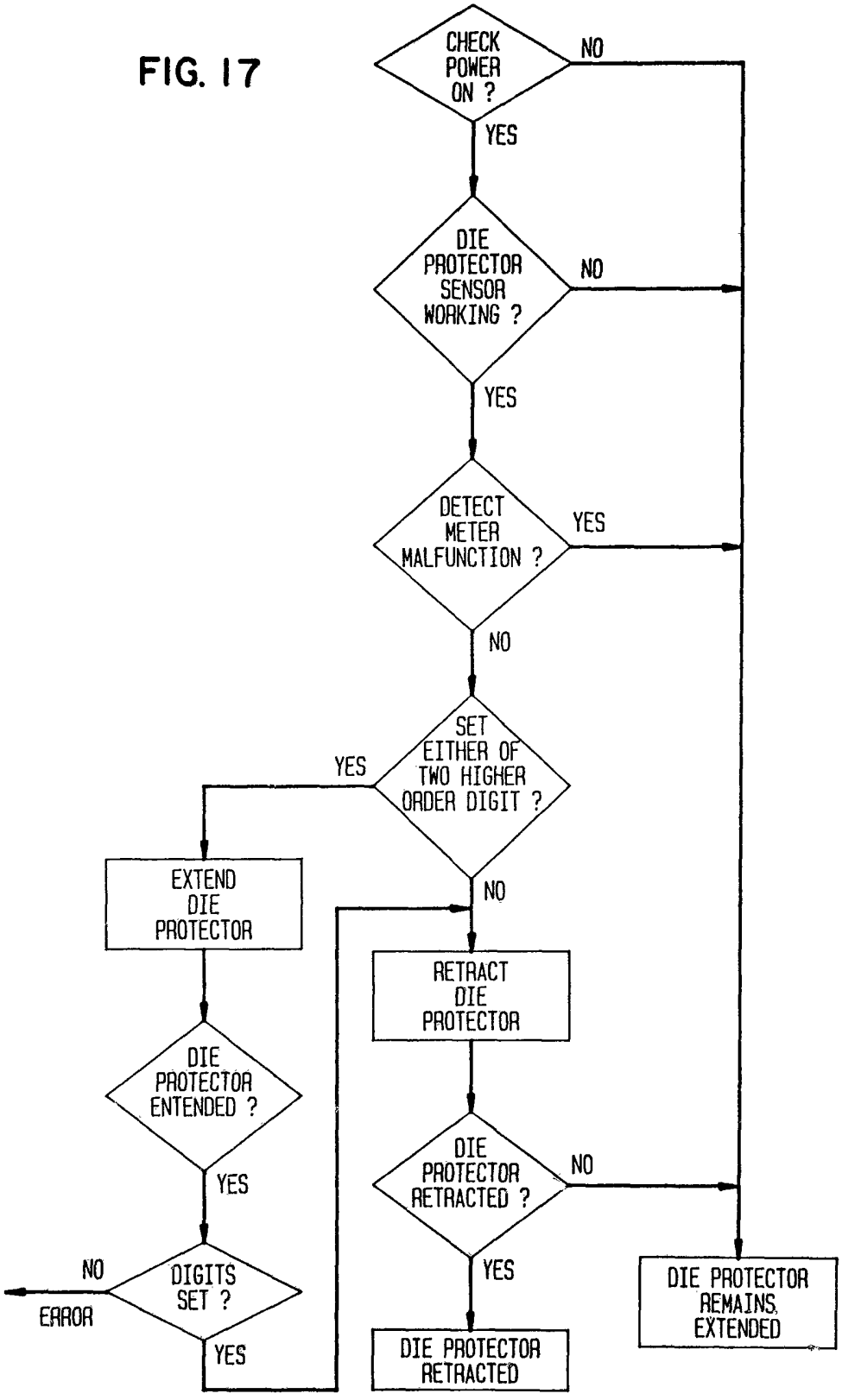

CHECK POWER ON ?
NO
YES
DIE PROTECTOR SENSOR WORKING ?
NO
YES
DETECT METER MALFUNCTION ?
YES
NO
SET EITHER OF TWO HIGHER ORDER DIGIT ?
YES
NO
EXTEND DIE PROTECTOR
RETRACT DIE PROTECTOR
DIE PROTECTOR ENTENDED ?
DIE PROTECTOR RETRACTED ?
NO
YES
YES
DIGITS SET ?
NO
ERROR
YES
DIE PROTECTOR REMAINS EXTENDED
DIE PROTECTOR RETRACTED

FIG. 18

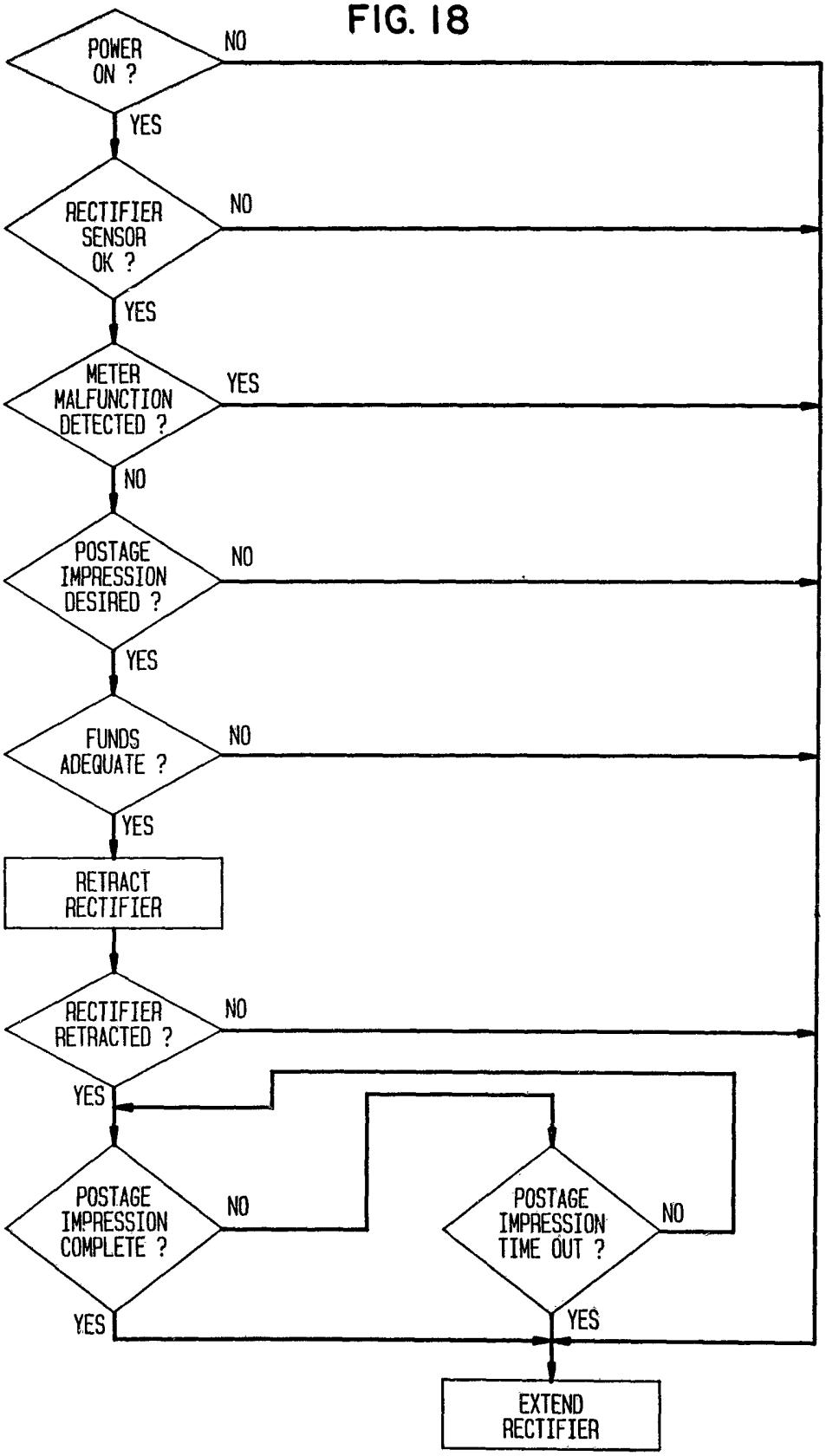

POWER ON ?
NO
YES
RECTIFIER SENSOR OK ?
NO
YES
METER MALFUNCTION DETECTED ?
YES
NO
POSTAGE IMPRESSION DESIRED ?
NO
YES
FUNDS ADEQUATE ?
NO
YES
RETRACT RECTIFIER
RECTIFIER RETRACTED ?
NO
YES
POSTAGE IMPRESSION COMPLETE ?
NO
YES
POSTAGE IMPRESSION TIME OUT ?
NO
YES
EXTEND RECTIFIER

FIG. 19A

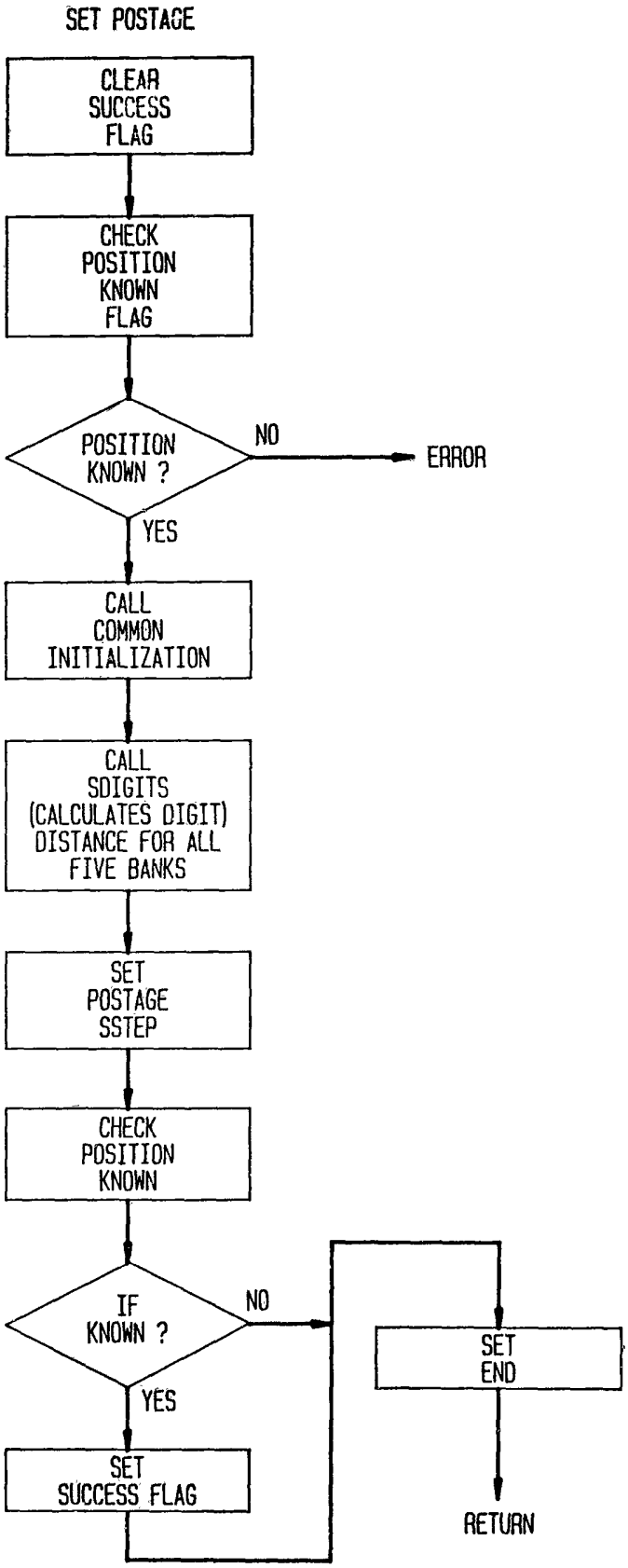

SET POSTAGE
CLEAR SUCCESS FLAG
CHECK POSITION KNOWN FLAG
POSITION KNOWN ?
NO
ERROR
YES
CALL COMMON INITIALIZATION
CALL SDIGITS (CALCULATES DIGIT) DISTANCE FOR ALL FIVE BANKS
SET POSTAGE SSTEP
CHECK POSITION KNOWN
IF KNOWN ?
NO
SET END
YES
SET SUCCESS FLAG
RETURN

FIG. 19B

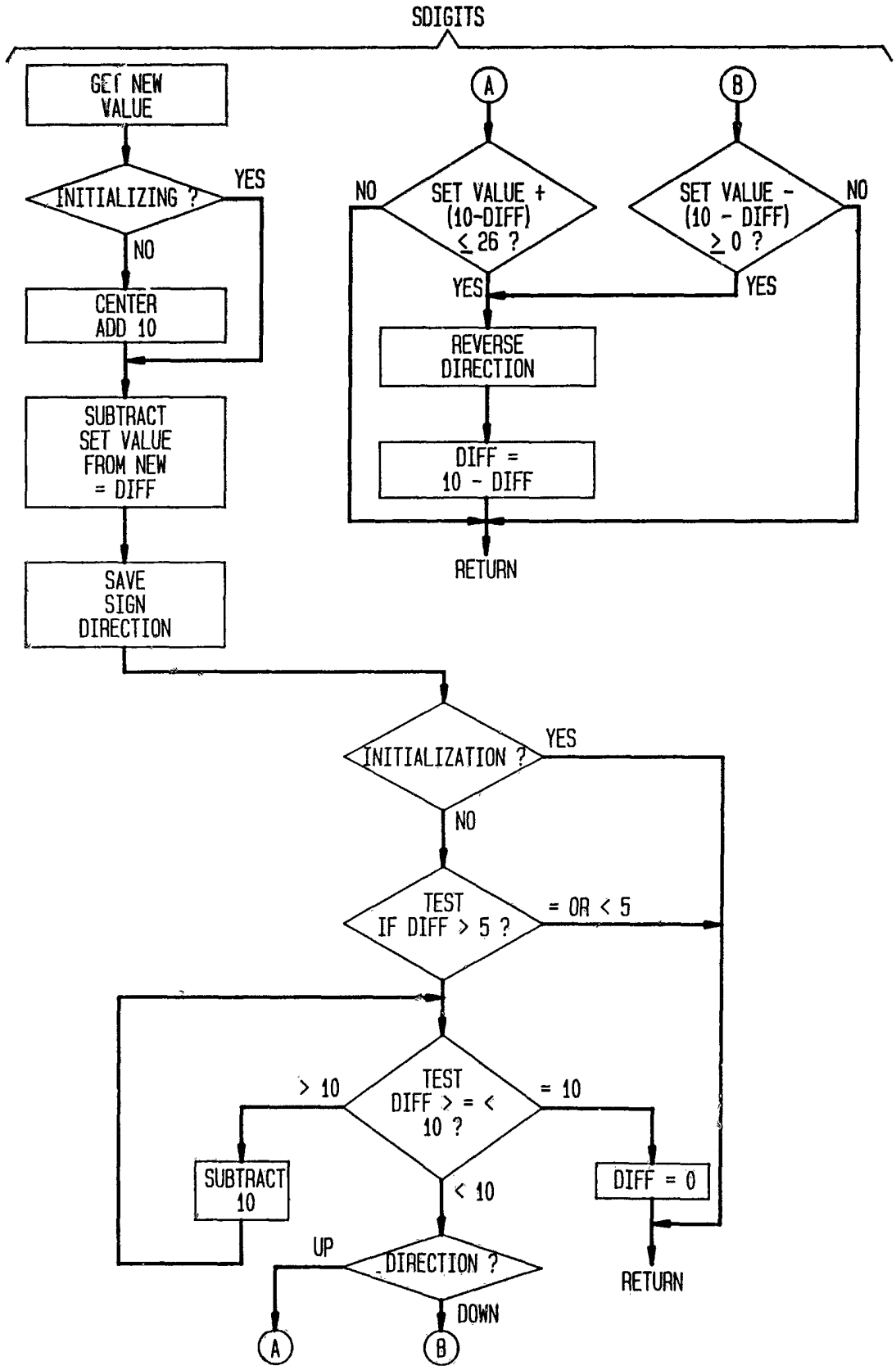

SDIGITS
GET NEW VALUE
INITIALIZING ?
YES
NO
CENTER ADD 10
SUBTRACT SET VALUE FROM NEW = DIFF
SAVE SIGN DIRECTION
A
B
NO
SET VALUE + (10-DIFF) ≤ 26 ?
SET VALUE - (10 - DIFF) ≥ 0 ?
NO
YES
YES
REVERSE DIRECTION
DIFF = 10 - DIFF
RETURN
INITIALIZATION ?
YES
NO
TEST IF DIFF > 5 ?
= OR < 5
TEST DIFF > = < 10 ?
> 10
= 10
< 10
SUBTRACT 10
DIFF = 0
RETURN
UP
DIRECTION ?
DOWN
A
B

FIG. 19C

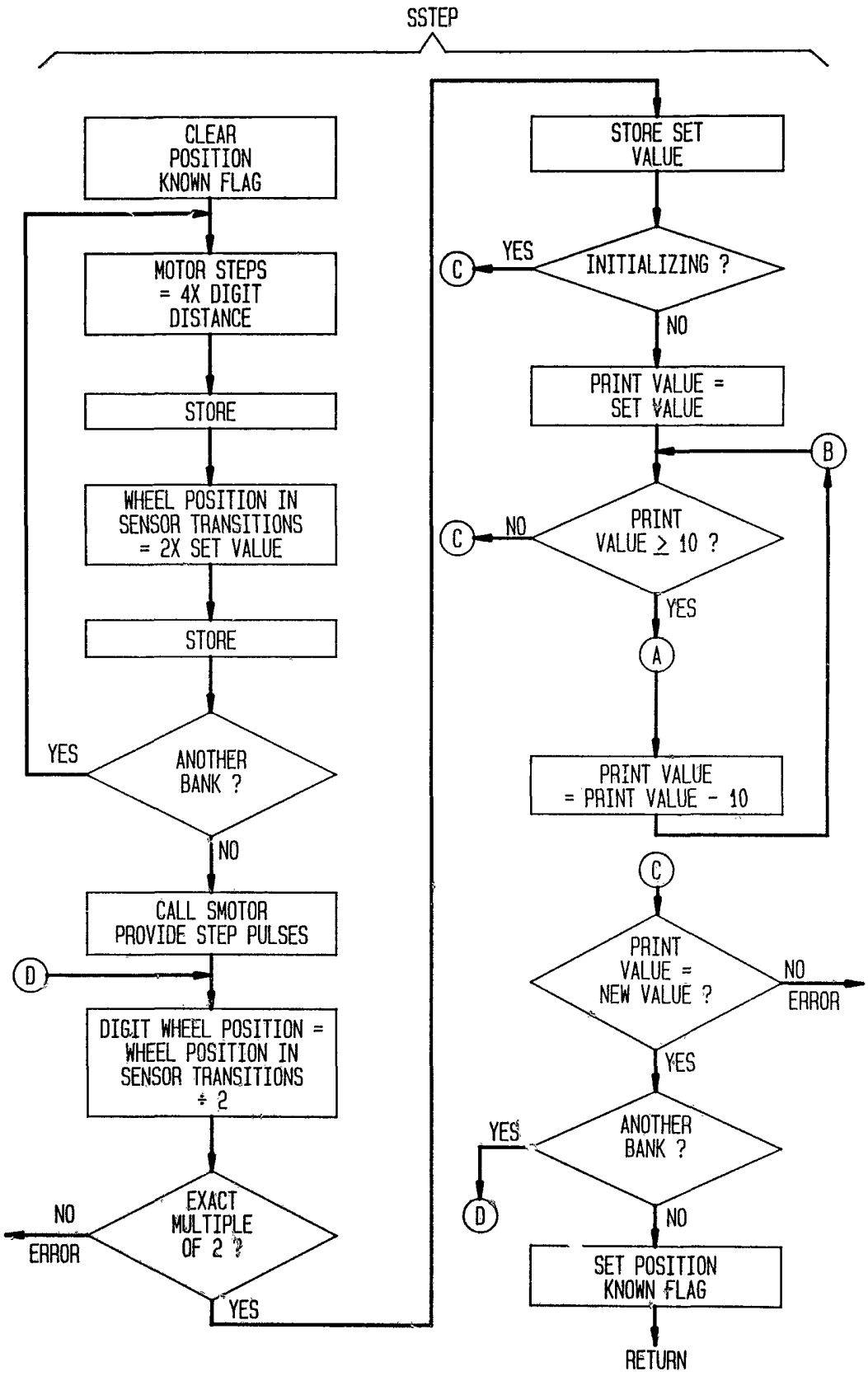

SSTEP
CLEAR POSITION KNOWN FLAG
MOTOR STEPS = 4X DIGIT DISTANCE
STORE
WHEEL POSITION IN SENSOR TRANSITIONS = 2X SET VALUE
STORE
ANOTHER BANK ?
YES
NO
CALL SMOTOR PROVIDE STEP PULSES
D
DIGIT WHEEL POSITION = WHEEL POSITION IN SENSOR TRANSITIONS ÷ 2
EXACT MULTIPLE OF 2 ?
NO
ERROR
YES
STORE SET VALUE
INITIALIZING ?
C
YES
NO
PRINT VALUE = SET VALUE
B
PRINT VALUE ≥ 10 ?
C
NO
YES
A
PRINT VALUE = PRINT VALUE - 10
C
PRINT VALUE = NEW VALUE ?
NO
ERROR
YES
ANOTHER BANK ?
YES
D
NO
SET POSITION KNOWN FLAG
RETURN

FIG. 19D

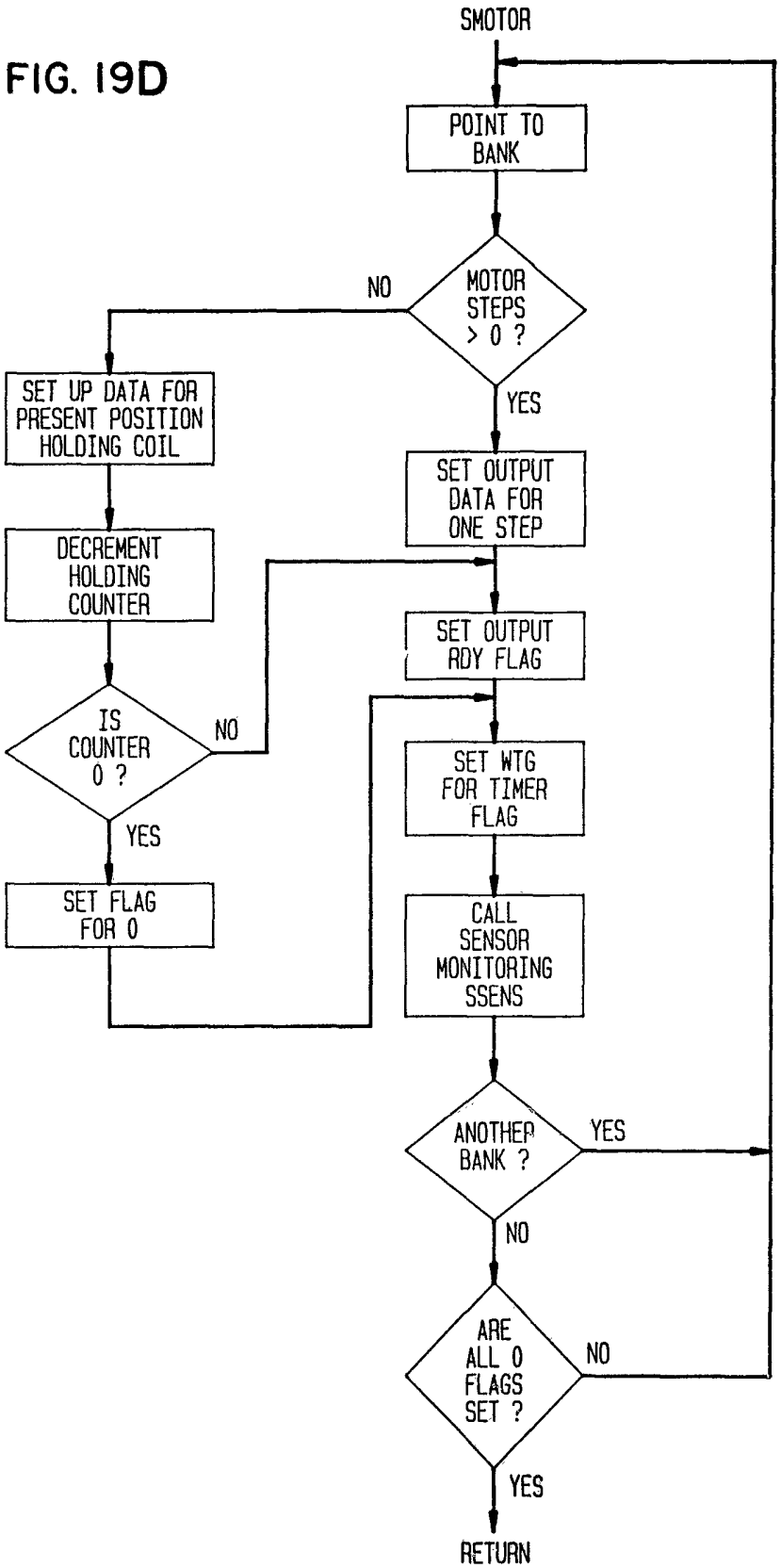

SMOTOR
POINT TO BANK
MOTOR STEPS > 0 ?
NO
YES
SET UP DATA FOR PRESENT POSITION HOLDING COIL
SET OUTPUT DATA FOR ONE STEP
DECREMENT HOLDING COUNTER
SET OUTPUT RDY FLAG
IS COUNTER 0 ?
NO
YES
SET WTG FOR TIMER FLAG
SET FLAG FOR 0
CALL SENSOR MONITORING SSENS
ANOTHER BANK ?
YES
NO
ARE ALL 0 FLAGS SET ?
NO
YES
RETURN

FIG. 19E

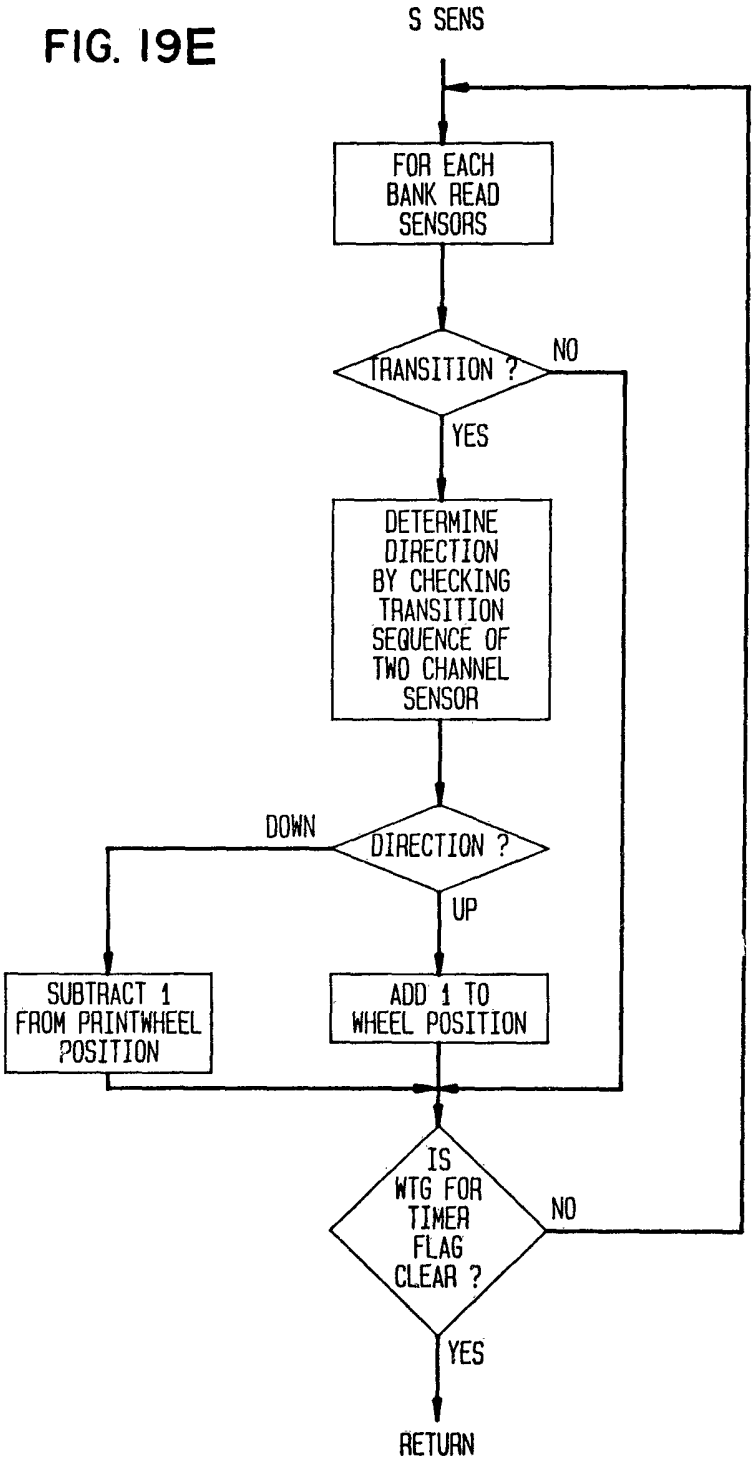

S SENS
FOR EACH BANK READ SENSORS
TRANSITION ?
NO
YES
DETERMINE DIRECTION BY CHECKING TRANSITION SEQUENCE OF TWO CHANNEL SENSOR
DOWN
DIRECTION ?
UP
SUBTRACT 1 FROM PRINTWHEEL POSITION
ADD 1 TO WHEEL POSITION
IS WTG FOR TIMER FLAG CLEAR ?
NO
YES
RETURN

FIG. 19F

TIMER INTERRUPT ROUTINE

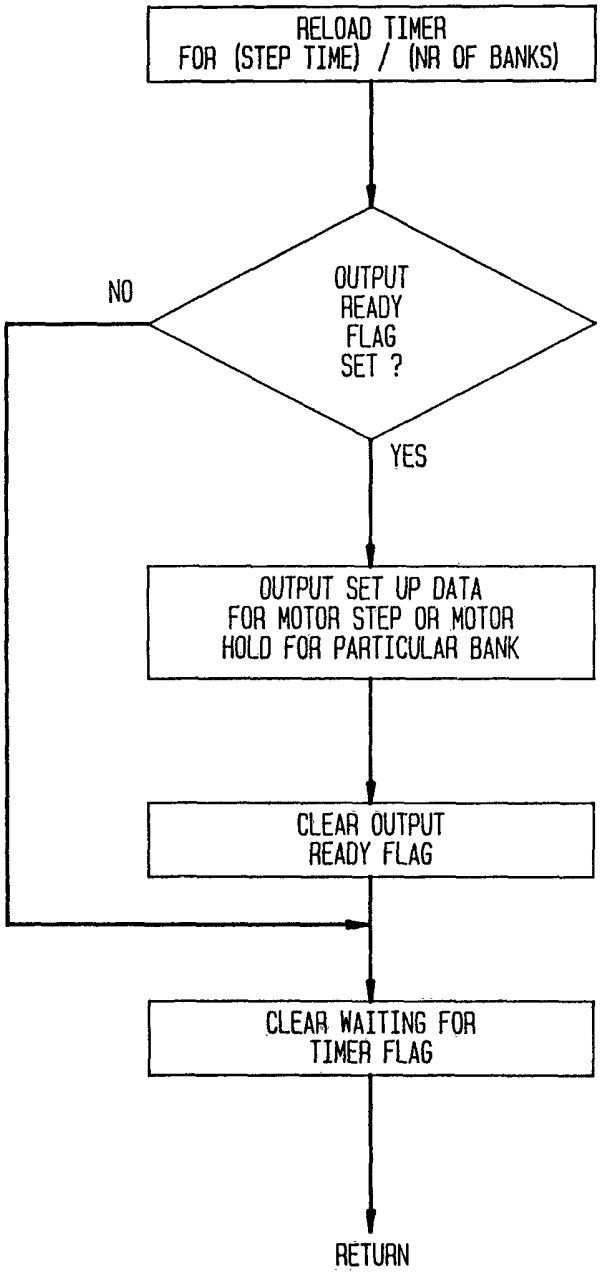


FIG. 19G

INITIALIZATION

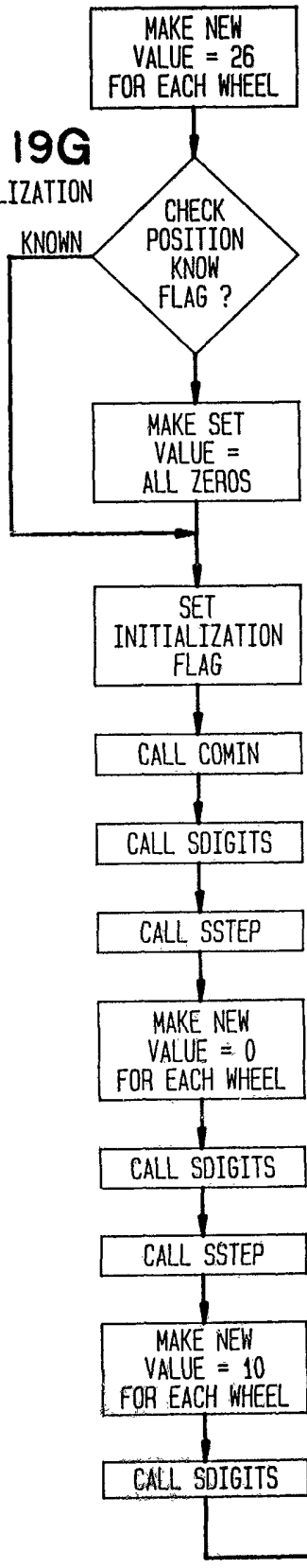
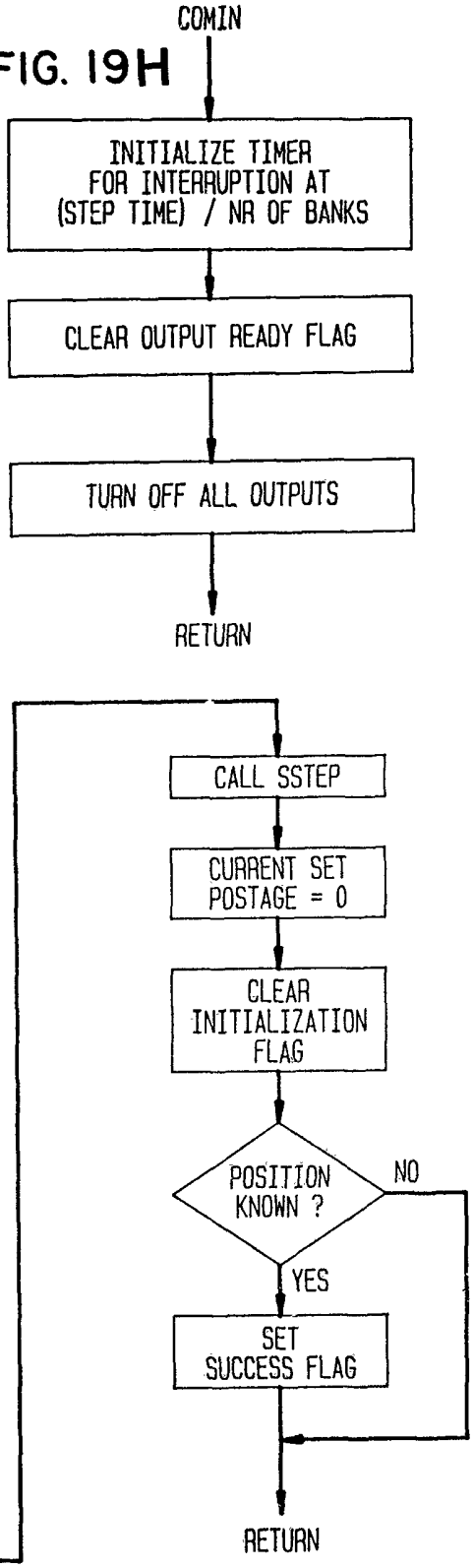



FIG. 19H