

(12) UK Patent Application (19) GB (11) 2 146 472 A

(43) Application published 17 Apr 1985

(21) Application No 8420551

(22) Date of filing 13 Aug 1984

(30) Priority data

(31) 522726
638725

(32) 12 Aug 1983
8 Aug 1984

(33) US

(51) INT CL⁴
G07D 3/00

(52) Domestic classification
G4X 5

(56) Documents cited
GB A 2124814 GB 1484858
GB A 2124813 GB 1375390
GB 1566202 GB 1026883

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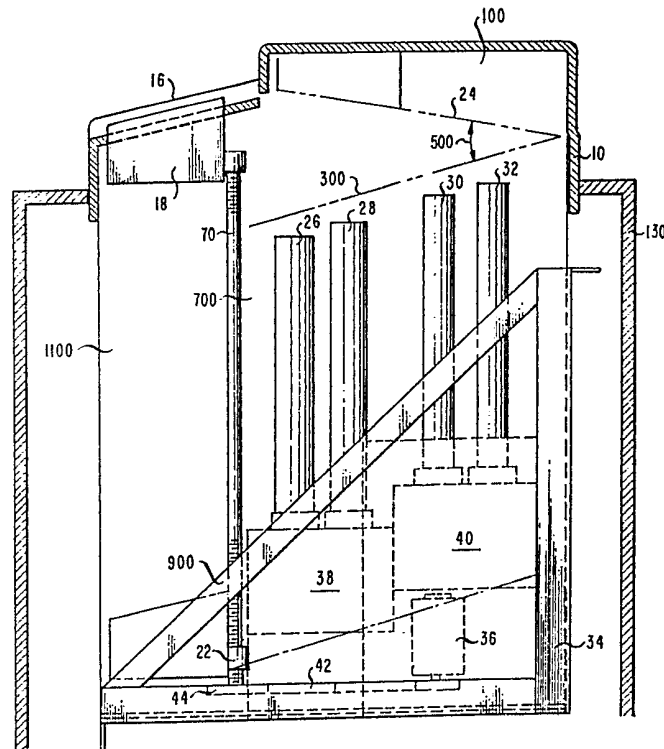
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(58) Field of search
G4X

(54) Coin handling system

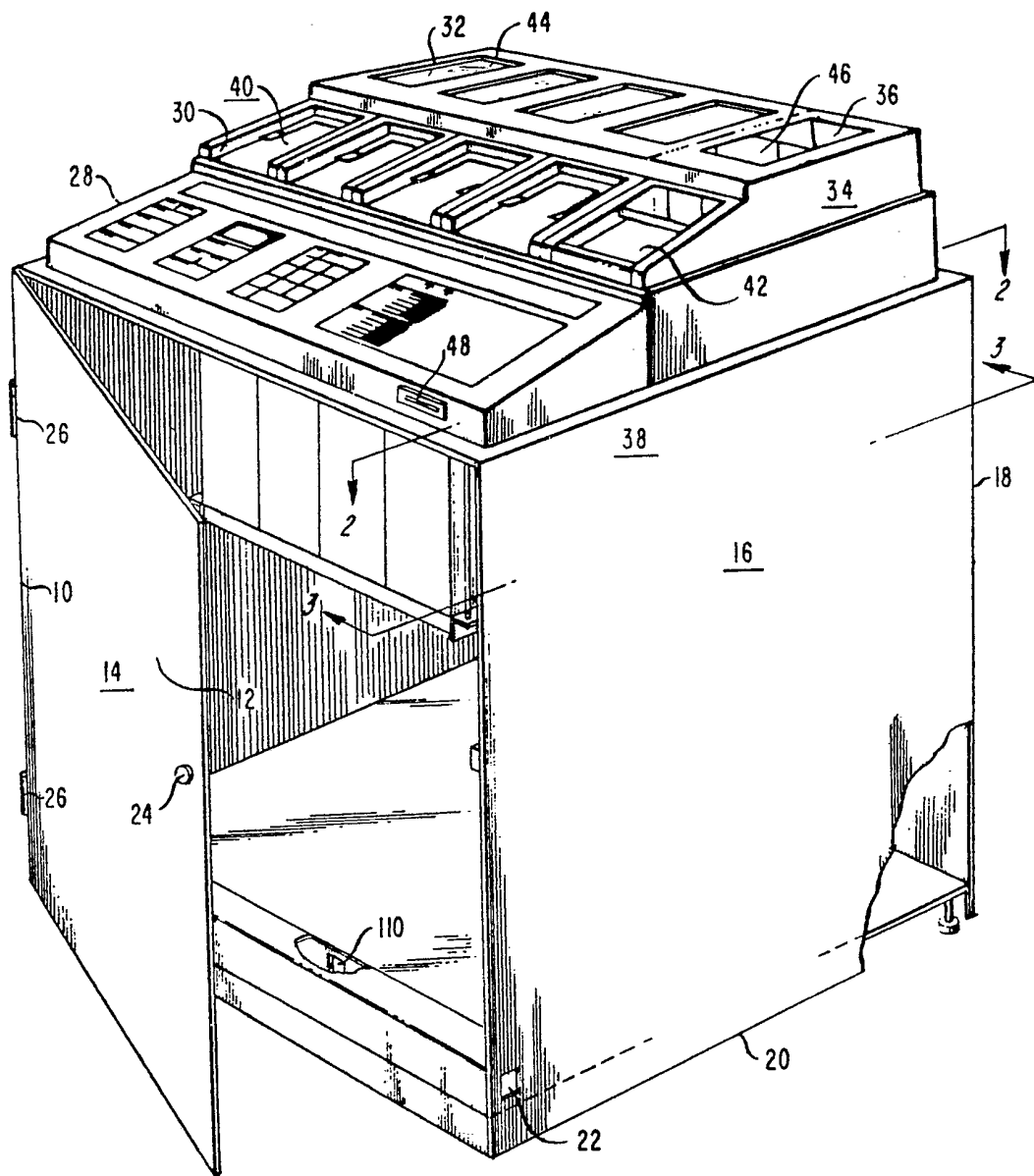
(57) An automatic money handling machine having a housing containing a coin receiver 16, a coin ramp 100 leading to a coin sorter 300, a coin storage device 700 for storing coins by denomination, a coin storage device for storing coins without regard to denomination, a coin dispenser 900 able to dispense more than one coin at a time, a coin elevator for returning coins to a different level from that at which the coins are dispensed and computing devices adapted to count coins received and coins dispensed, the device also has a coin detector for identifying coins by denomination and for detecting coins which are not proper and a coin diverter for directing improper coins to the coin storage without regard to denomination, the computing device providing the logic control for all electromechanical functions.

FIG. 18



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FIG. 1



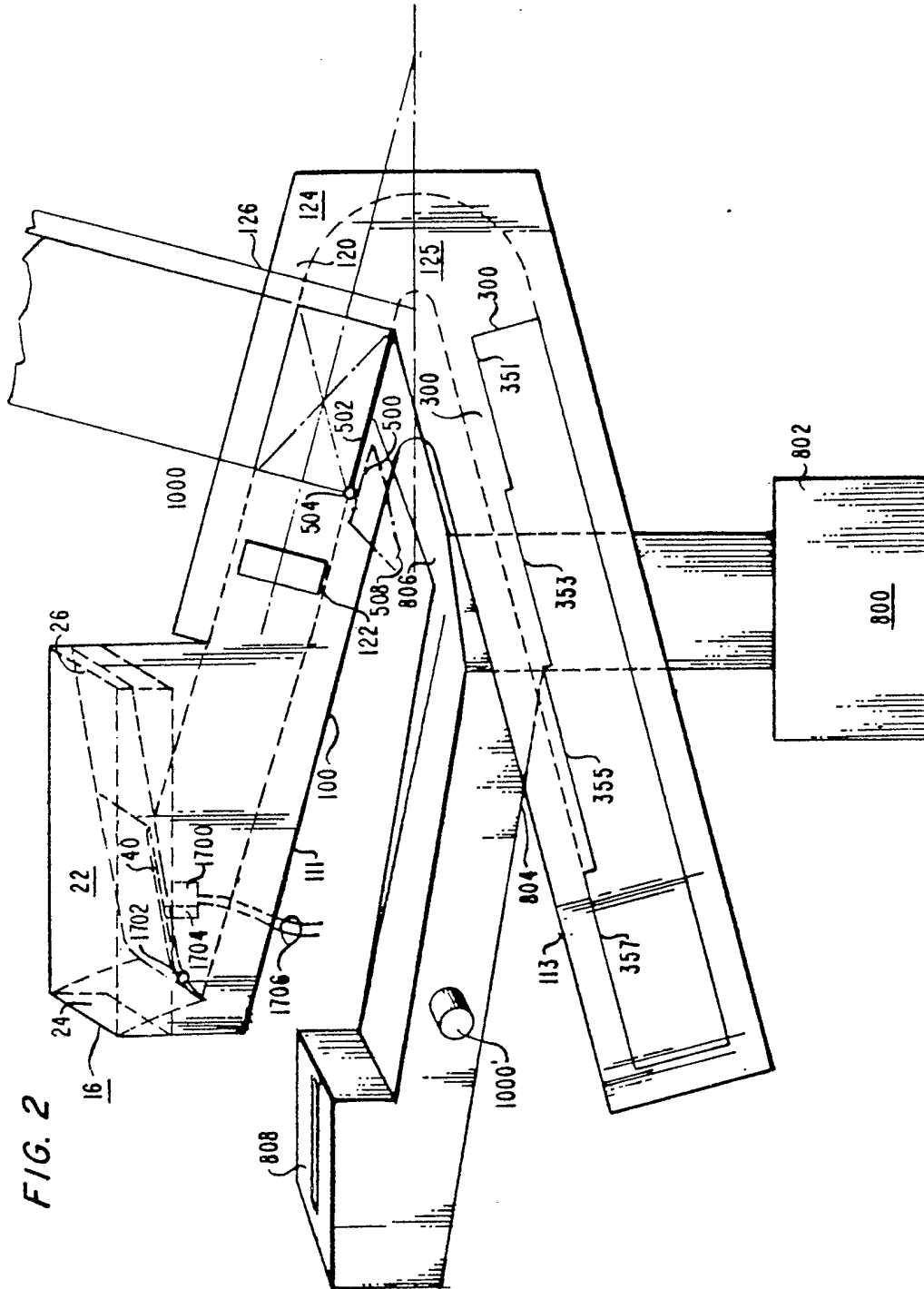


FIG. 3

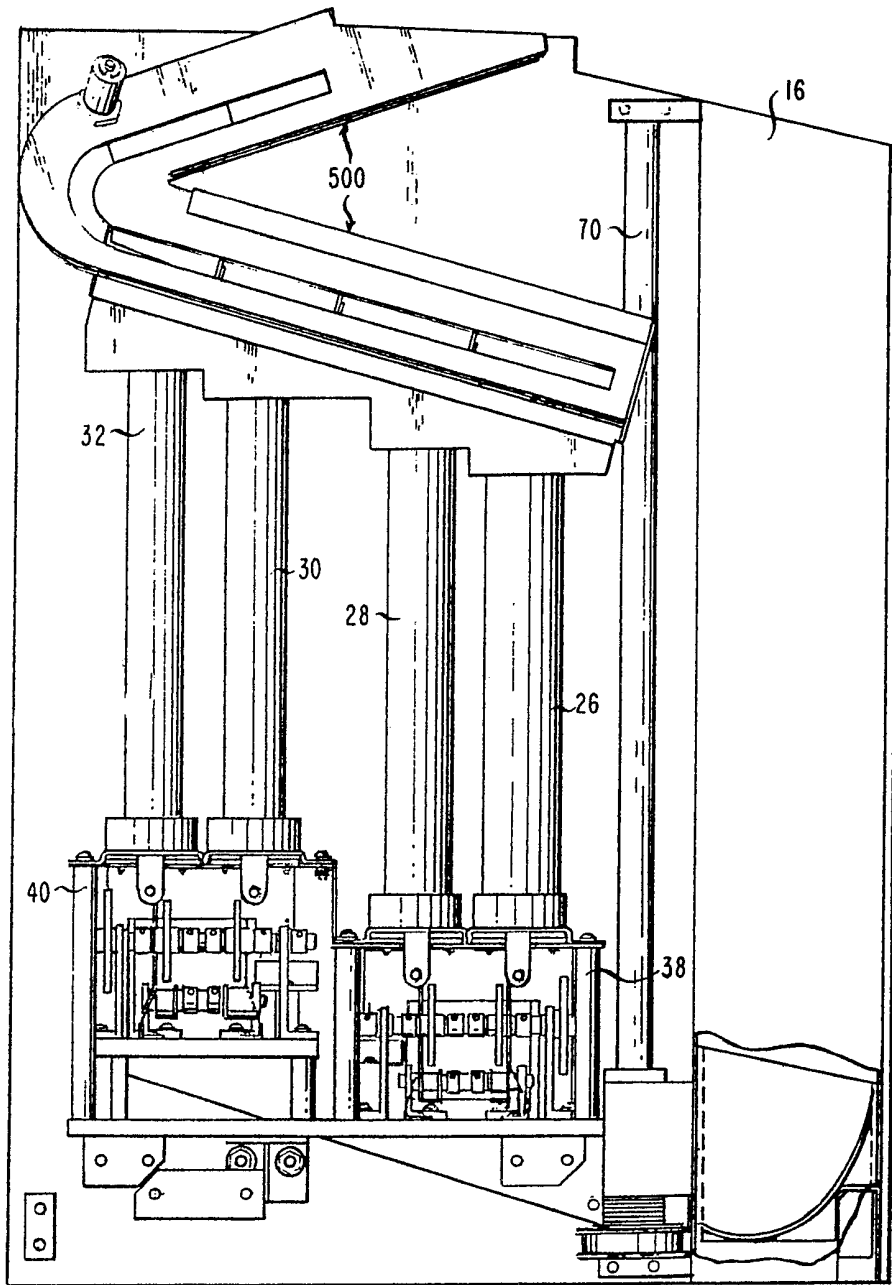


FIG. 4

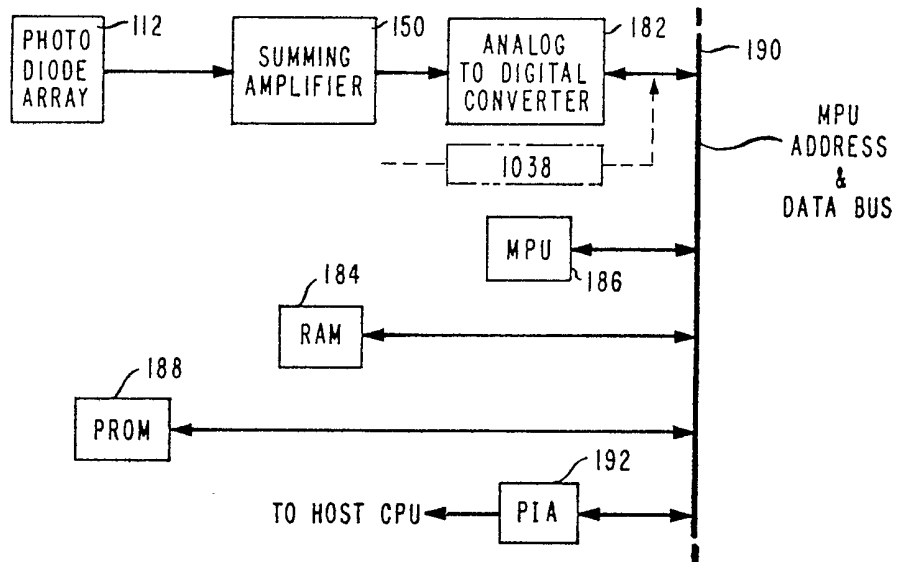


FIG. 5

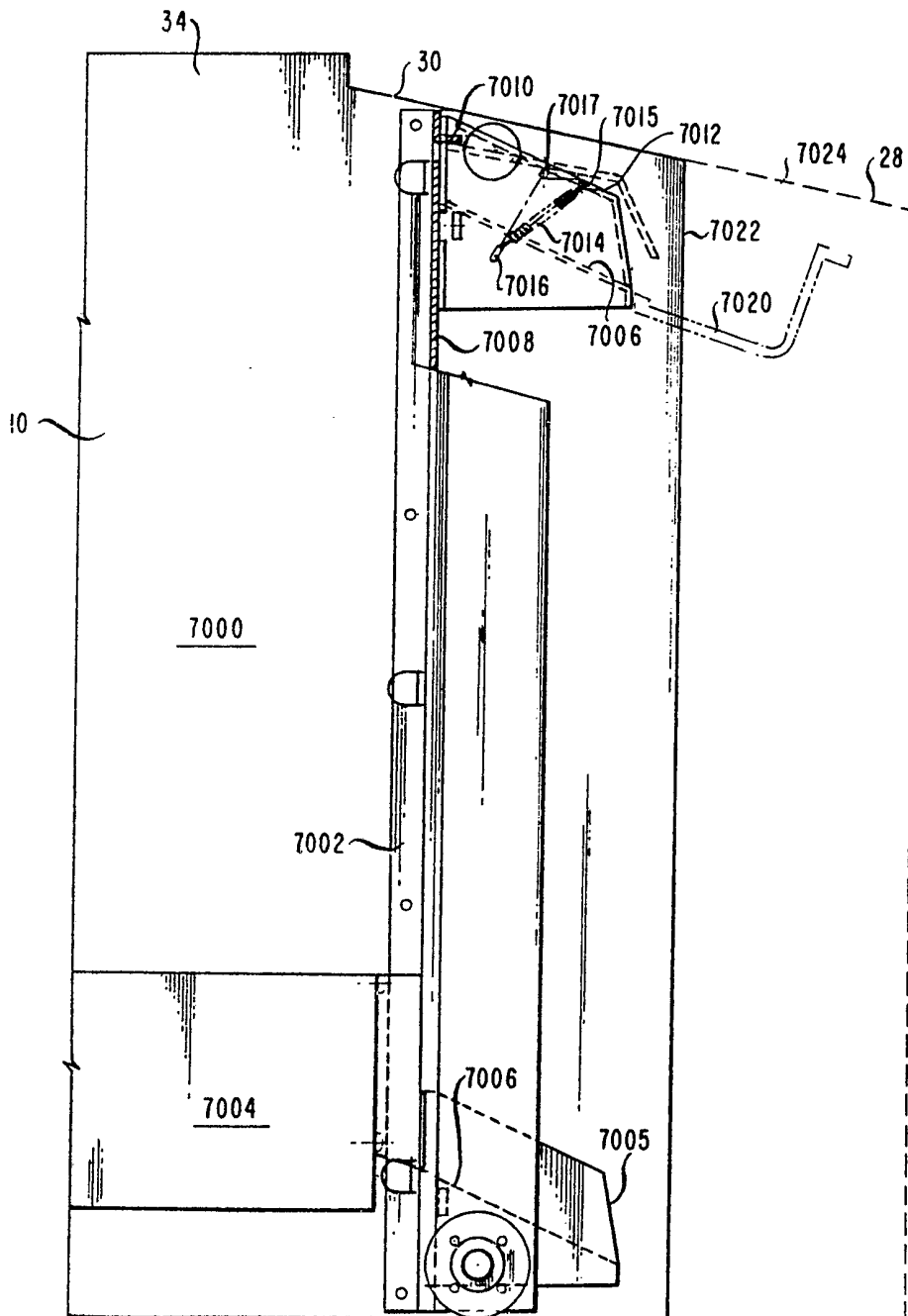


FIG. 6

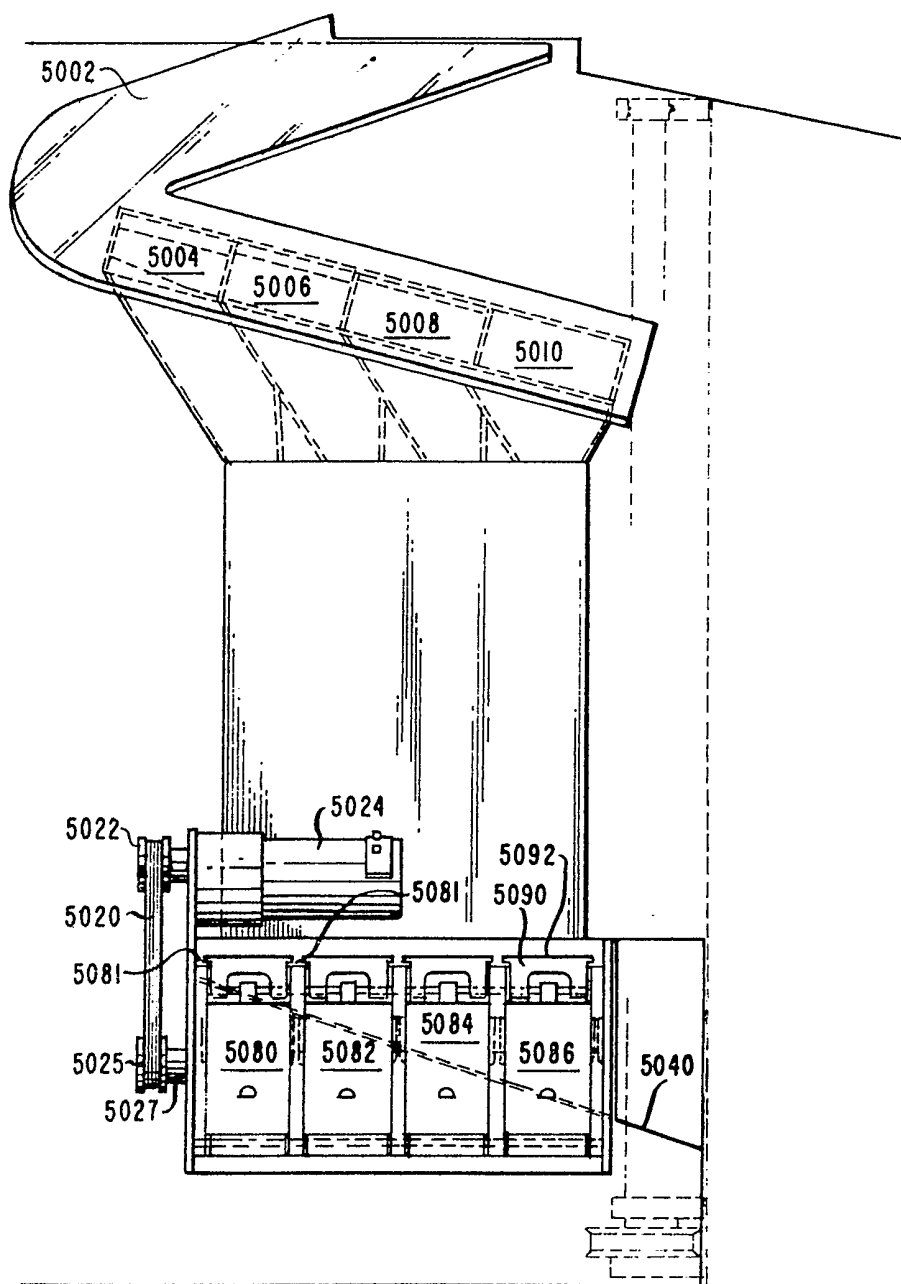


FIG. 7

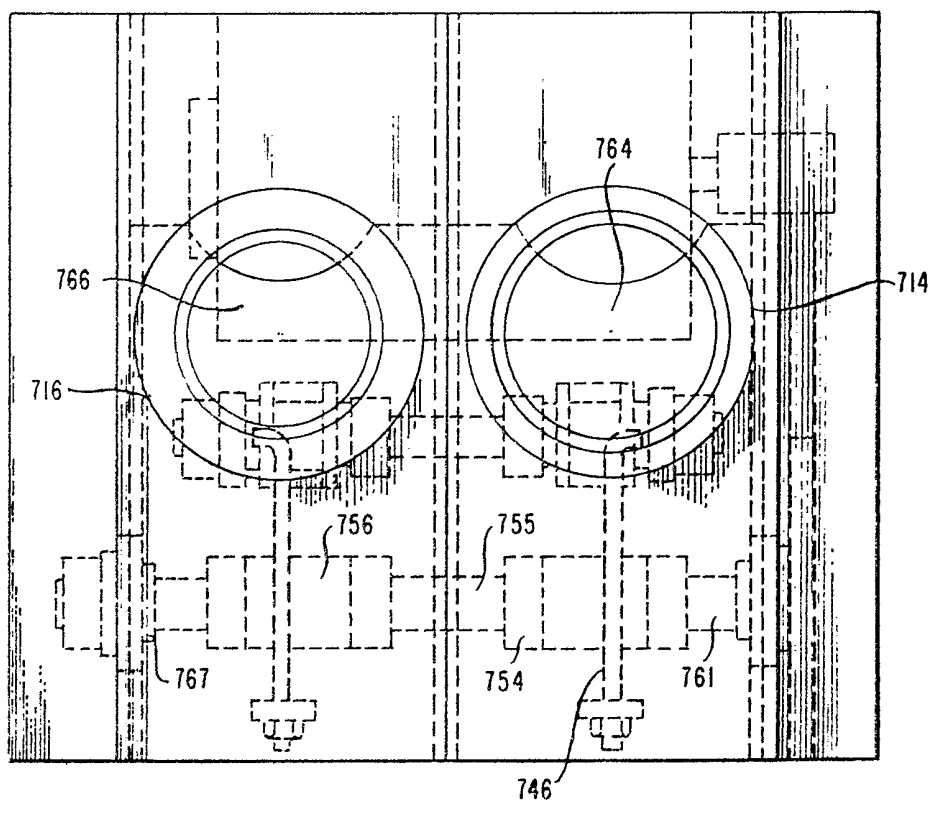


FIG. 8

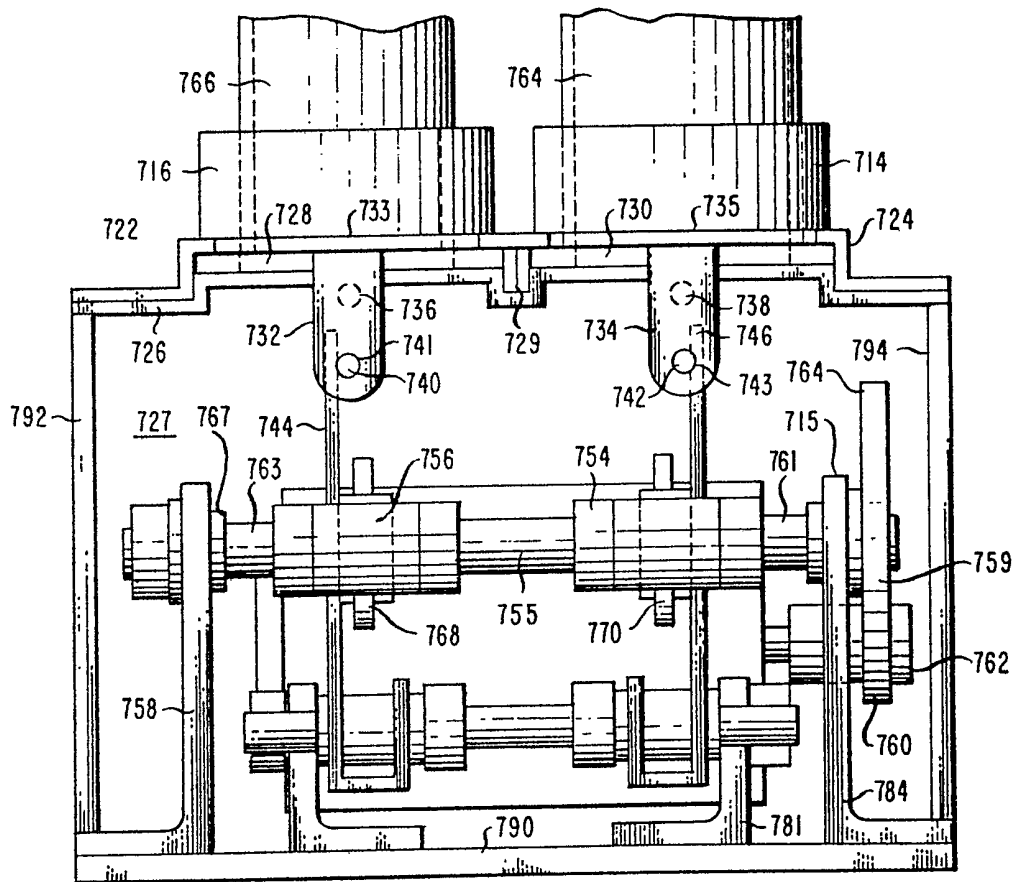


FIG. 9

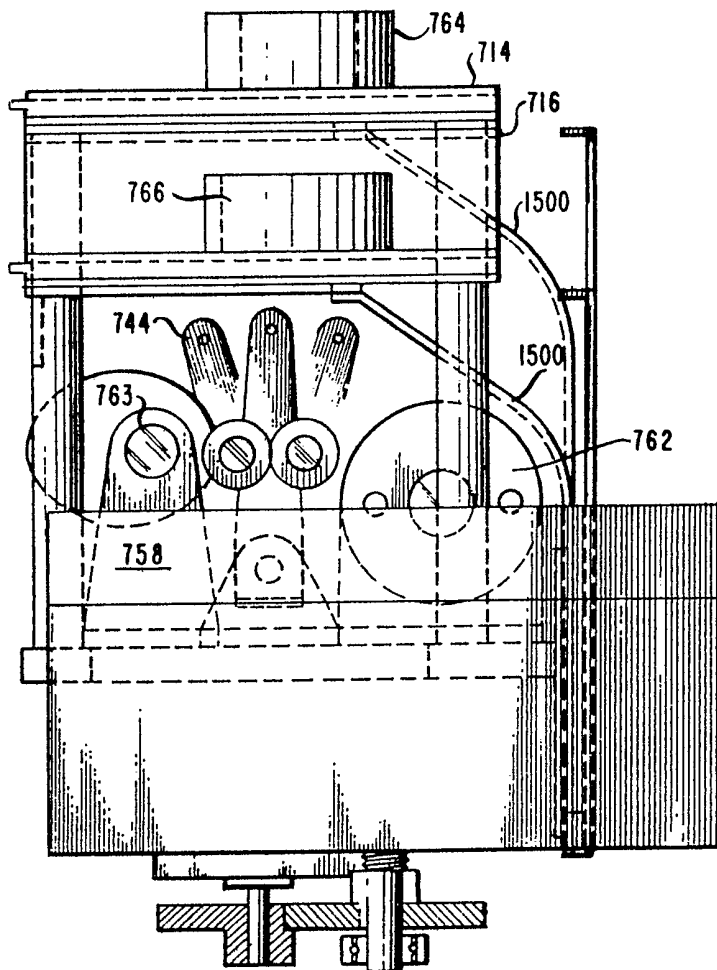
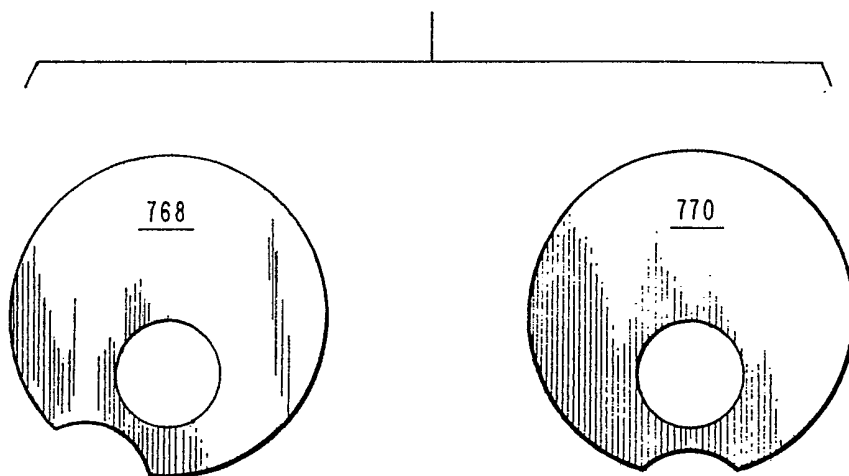


FIG. 10



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FIG. 11

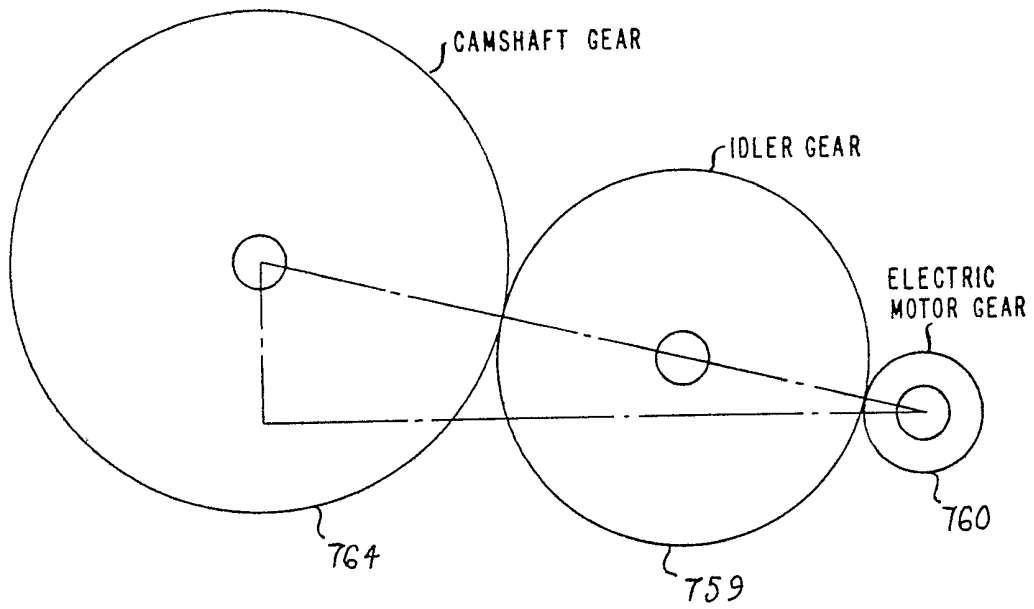


FIG. 12

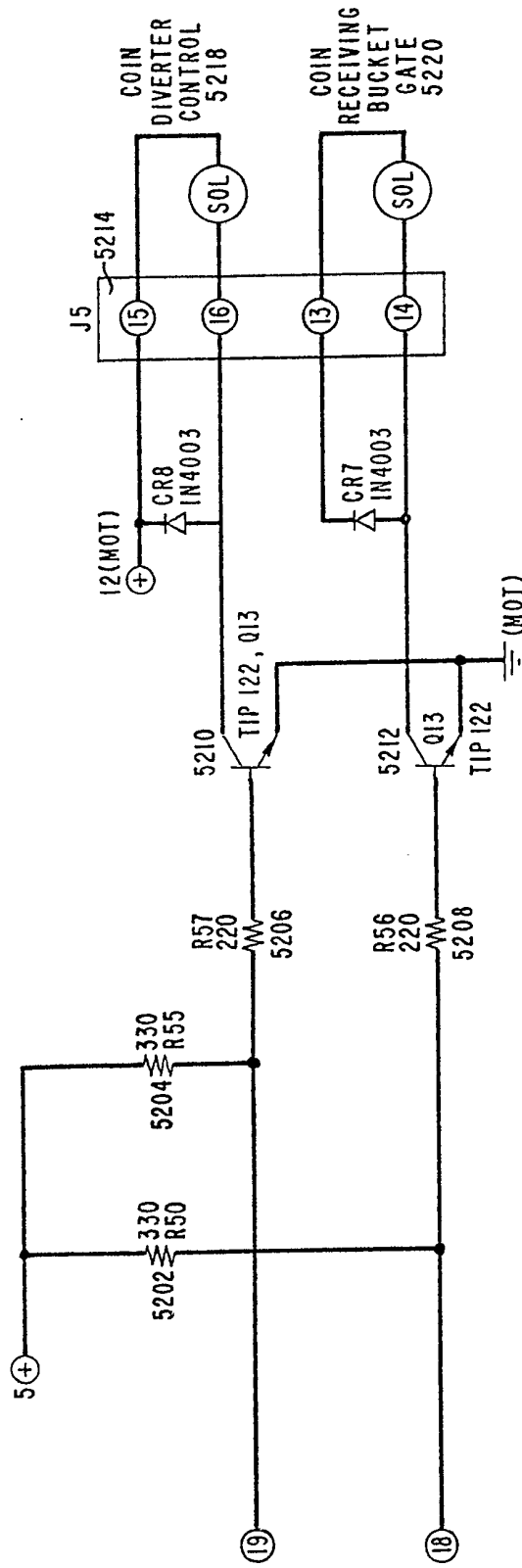


FIG. 13

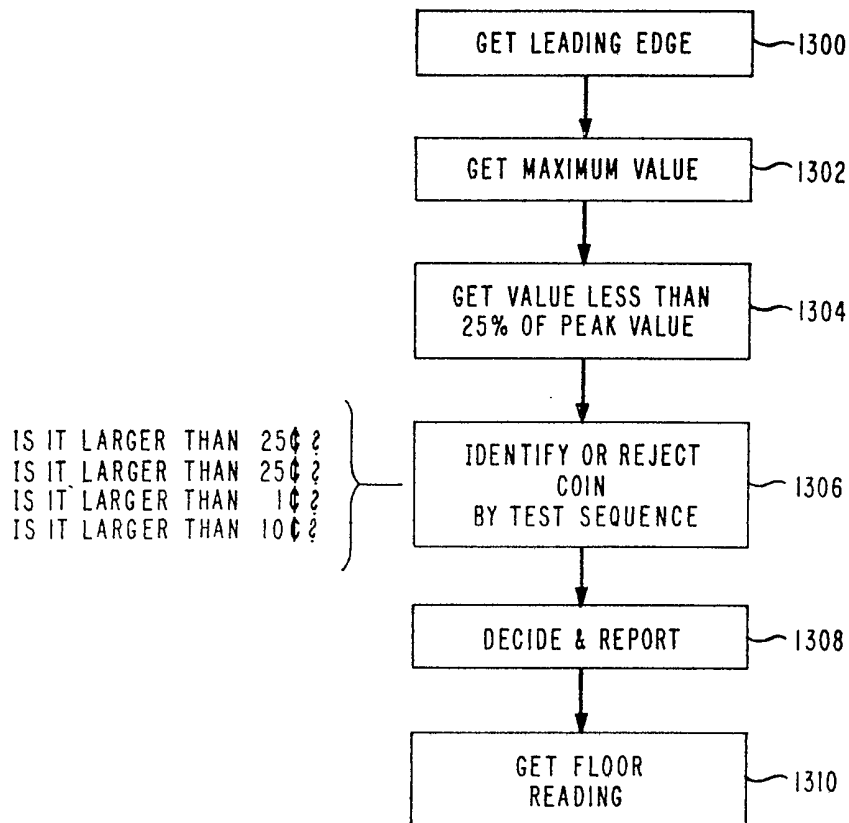


FIG. 14

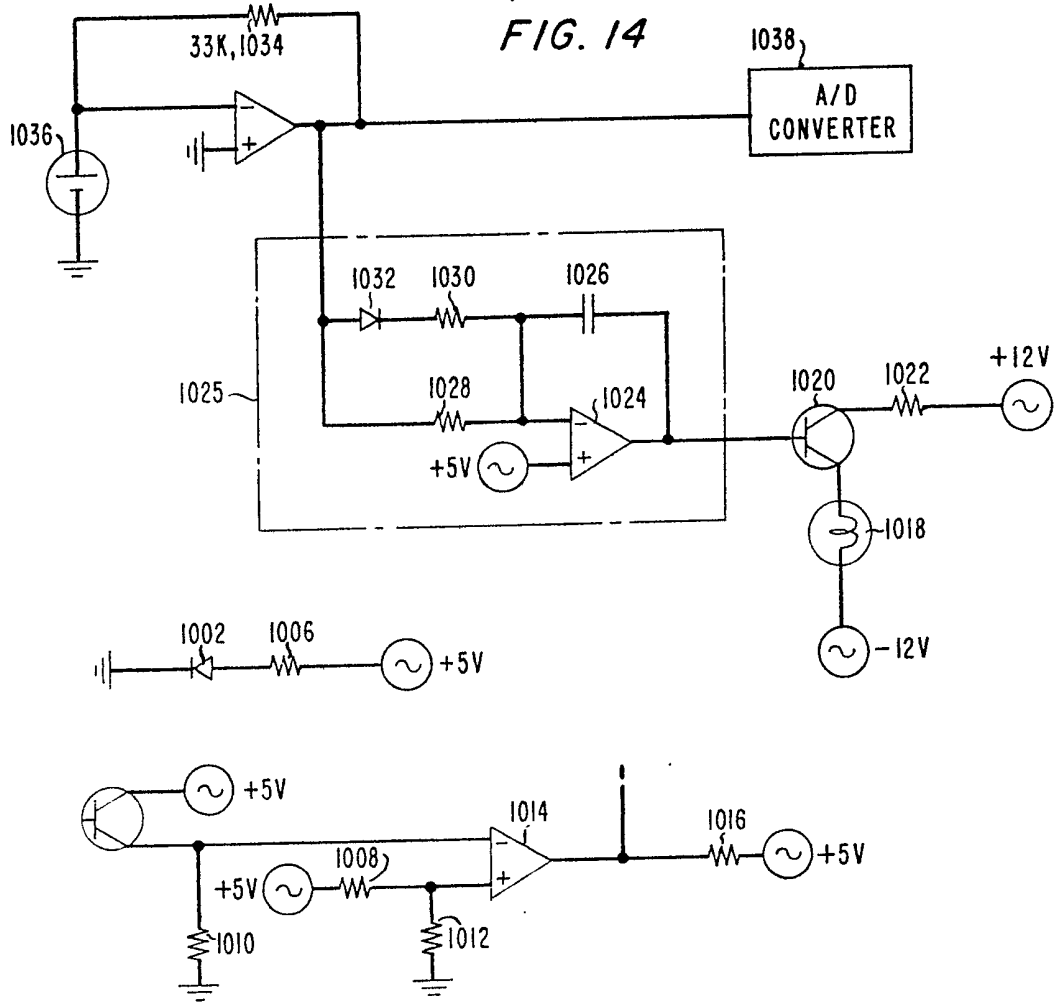


FIG. 15

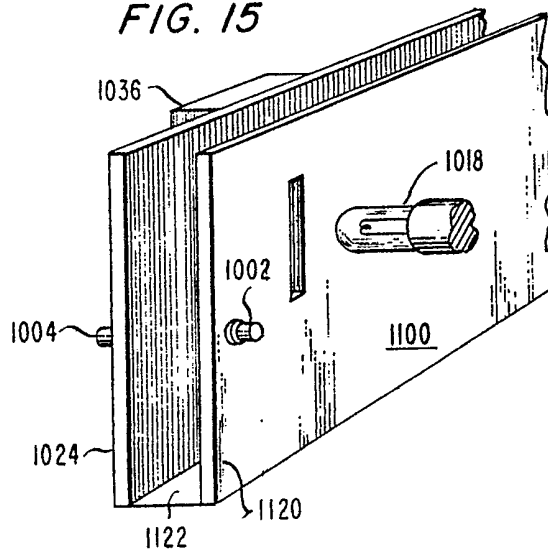


FIG. 16

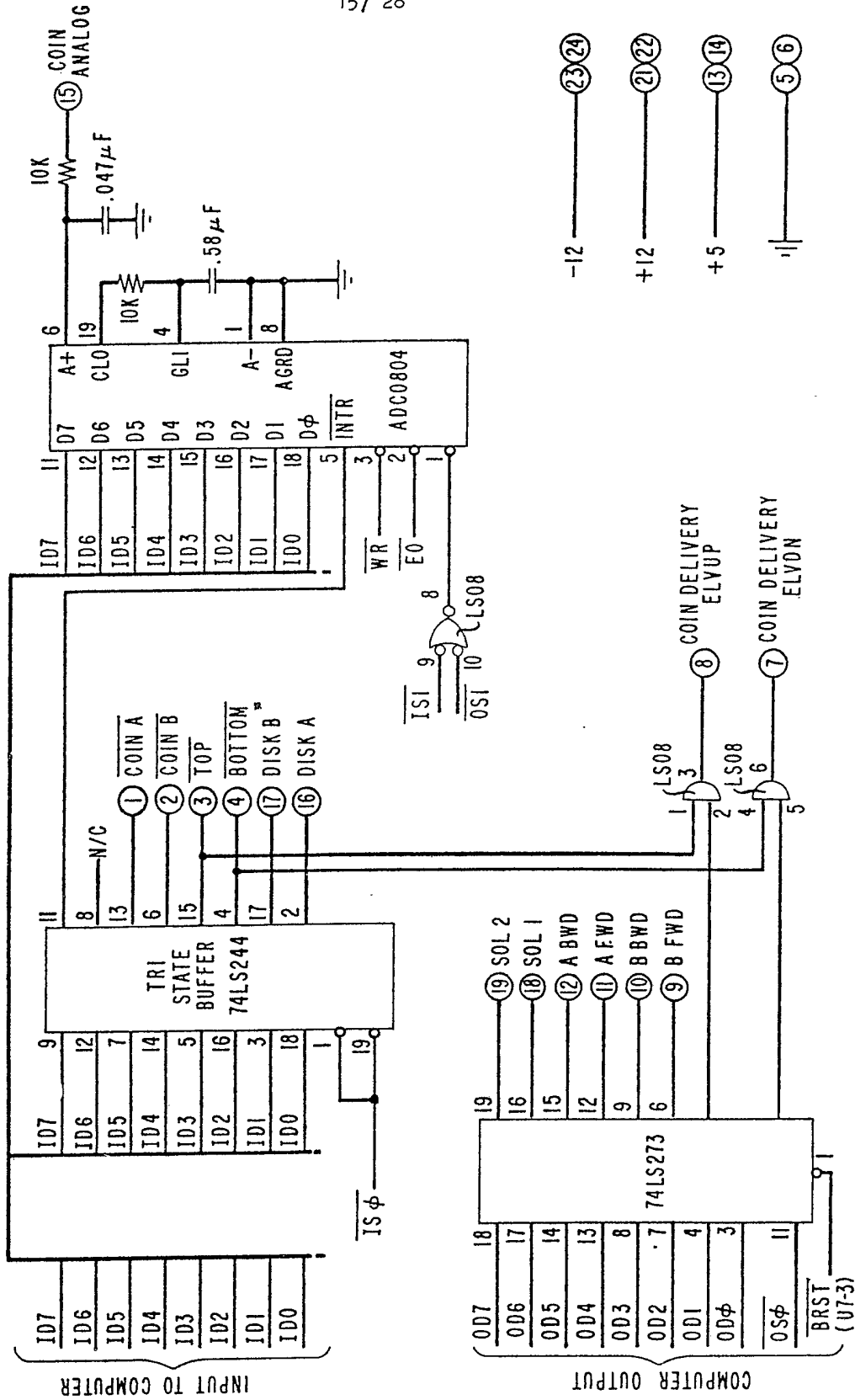


FIG. 17

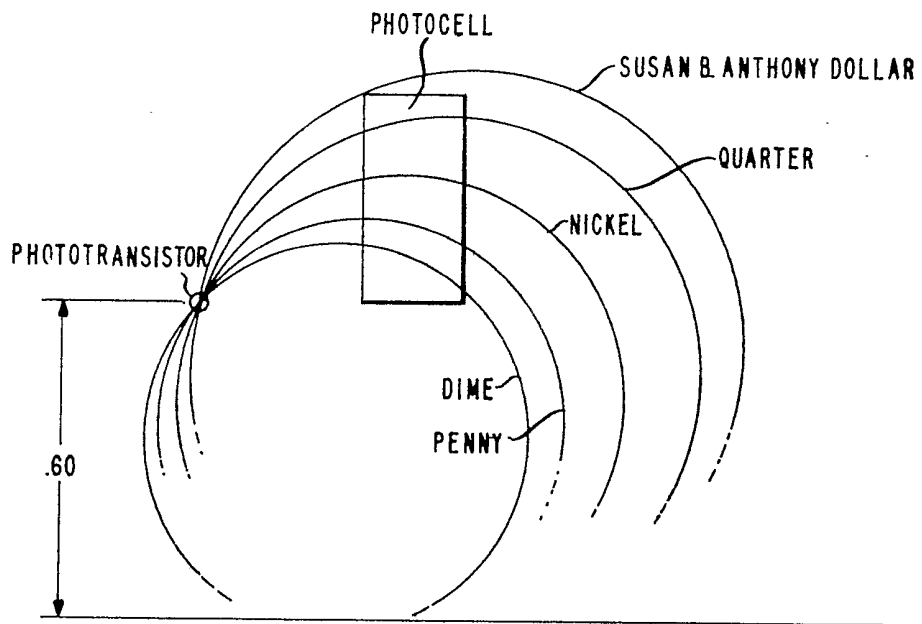


FIG. 18

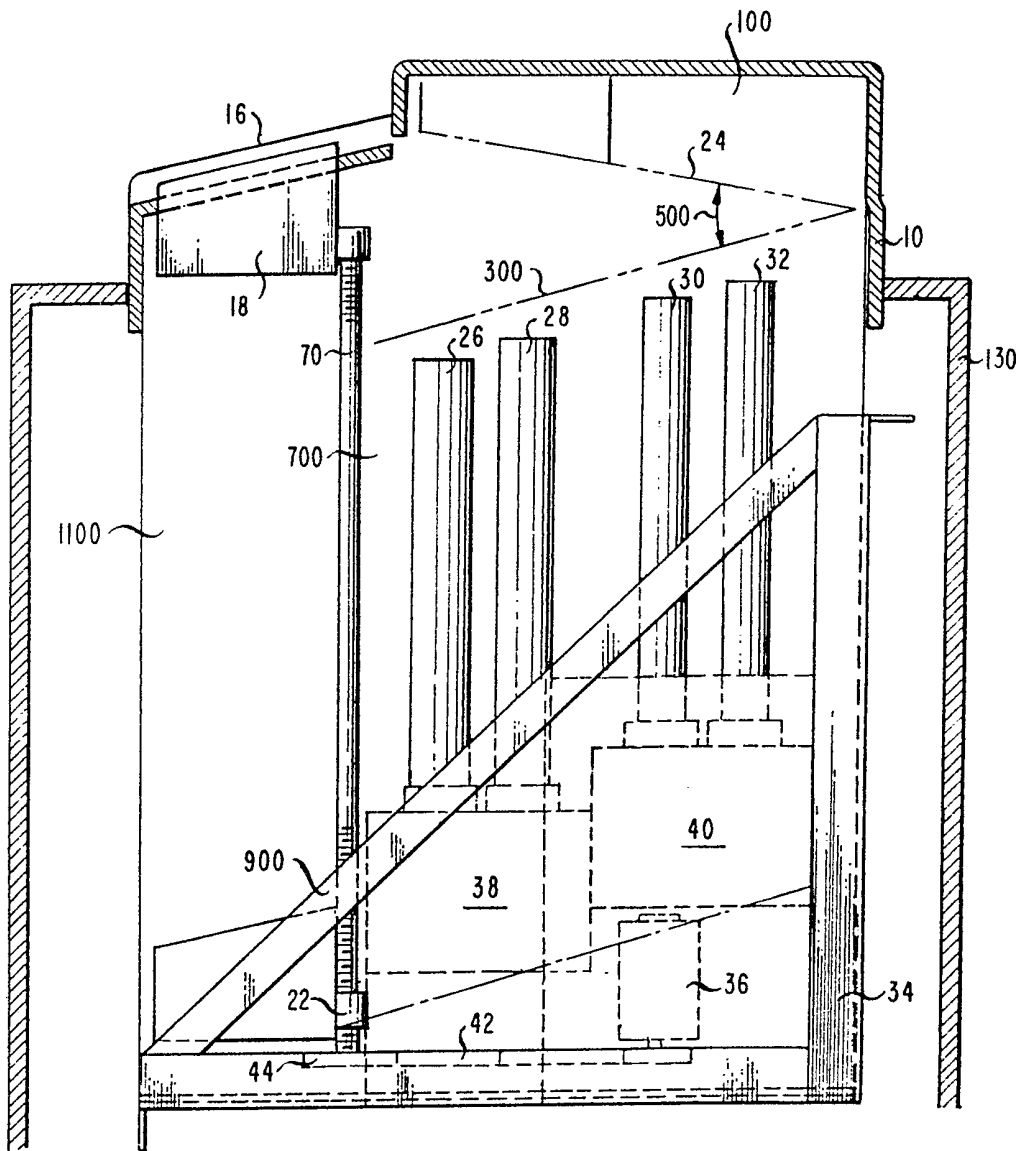


FIG. 19

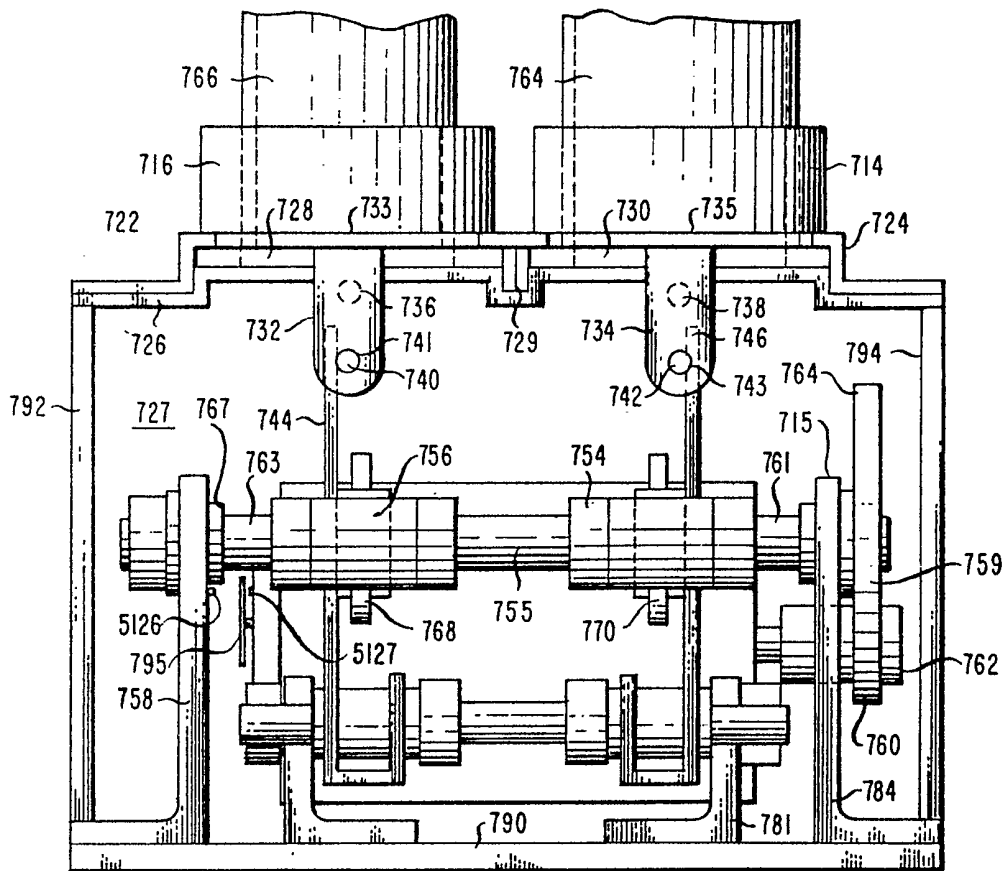
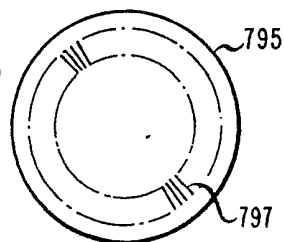
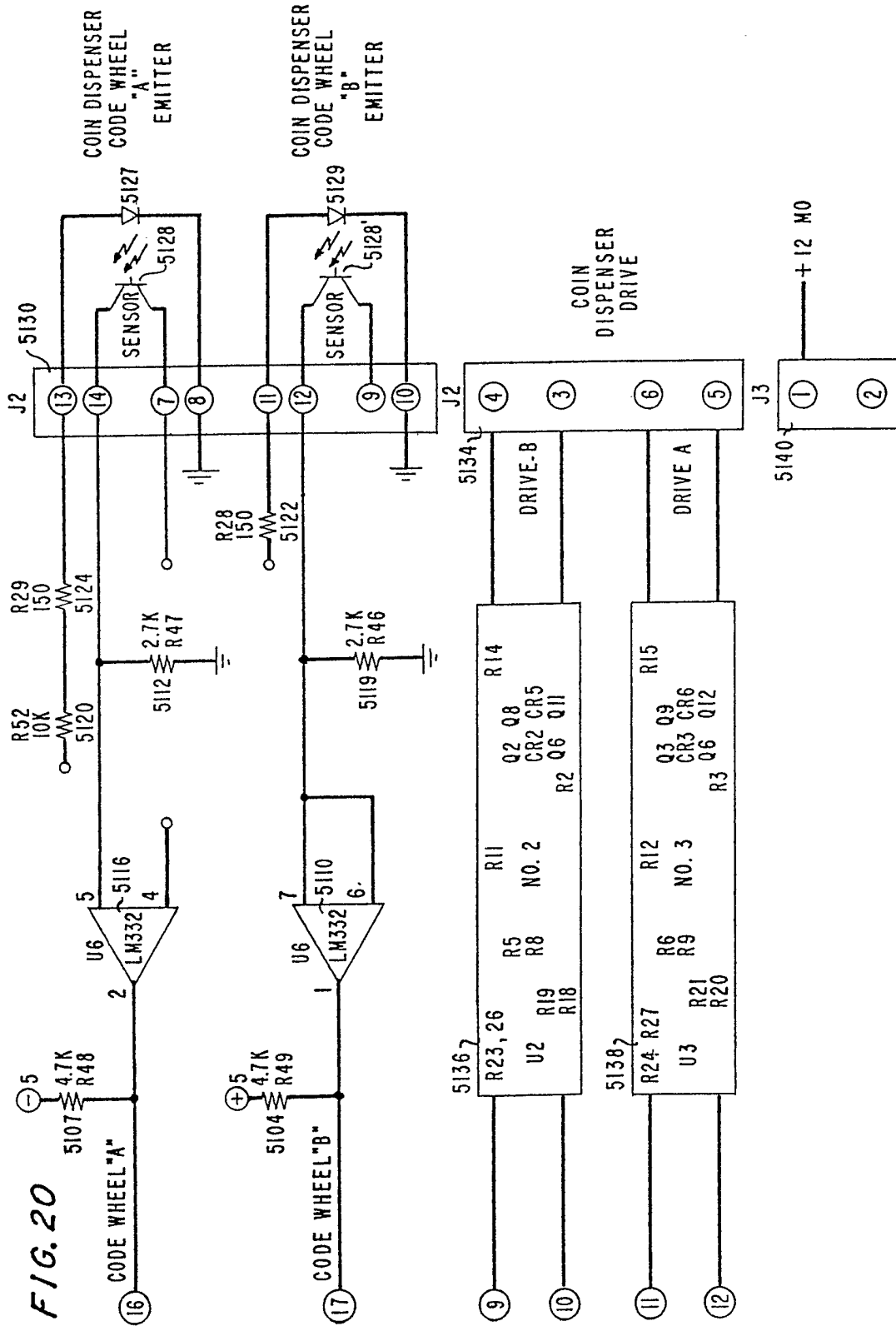


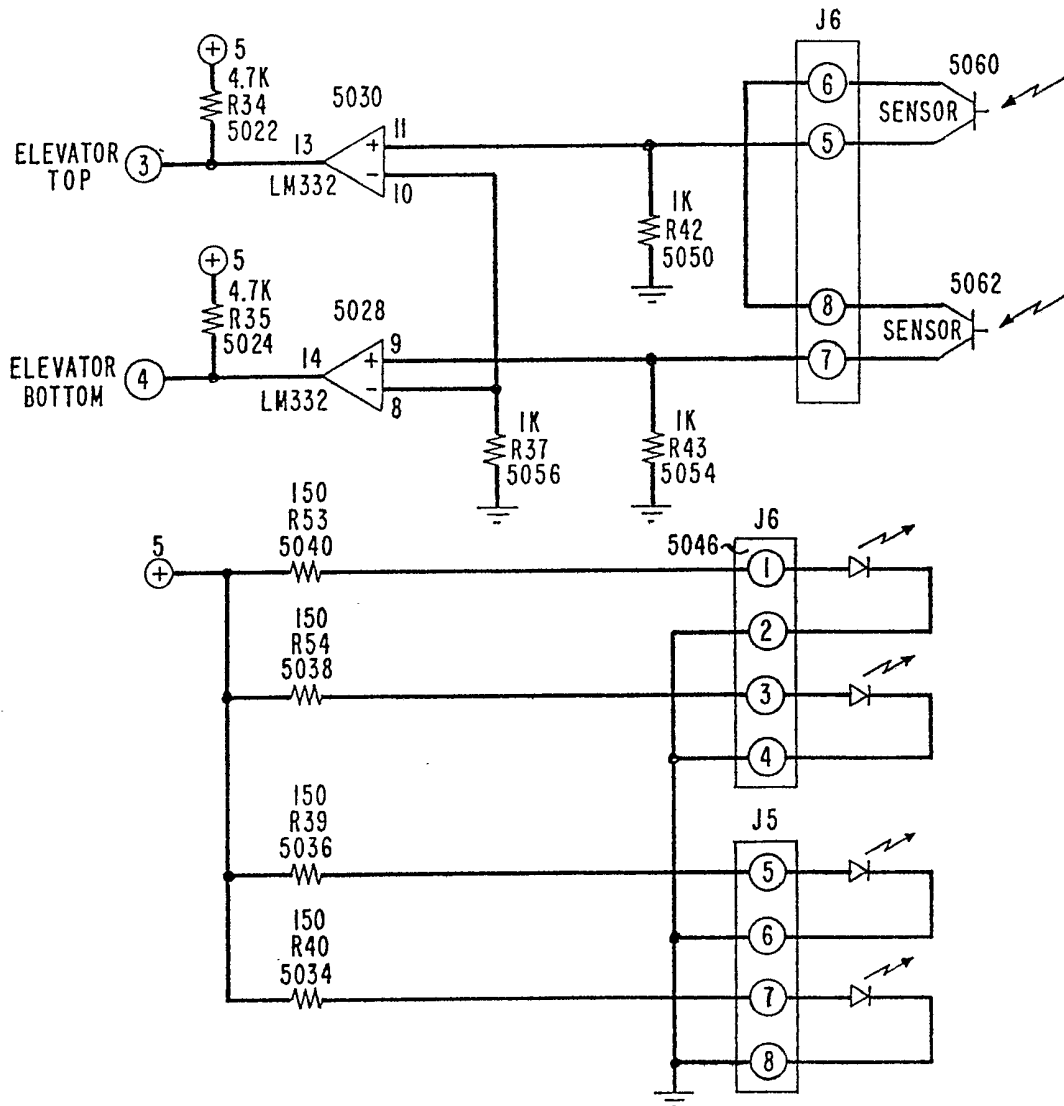
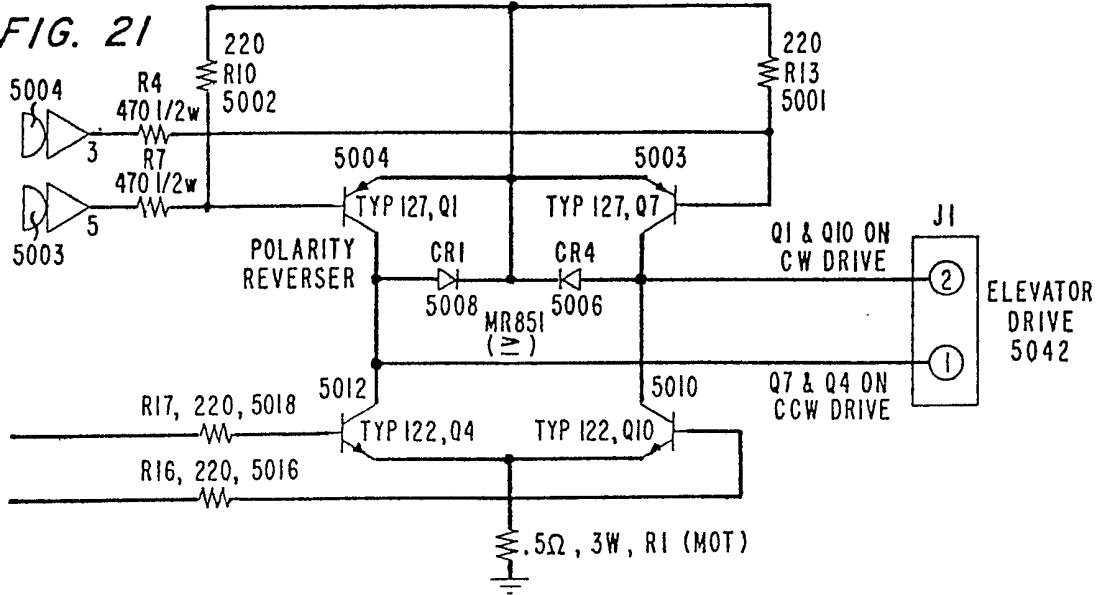
FIG. 19A

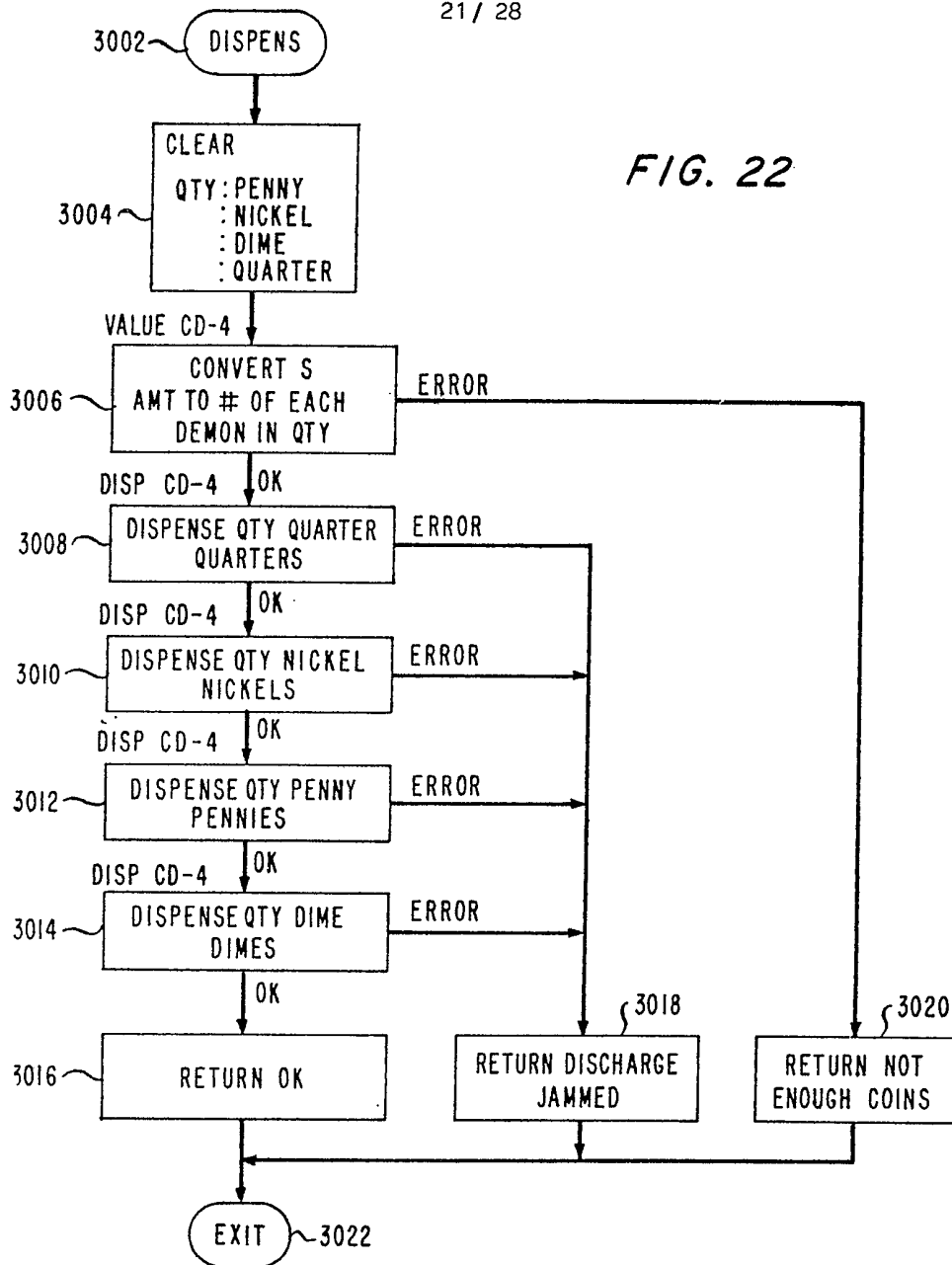




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FIG. 21





ON ENTRY:

A IS TOTAL AMMOUNT TO
DISPENSE IN A B C

ON EXIT:

A =

0	OK
1	NOT ENOUGH COINS
2	DISPENSER JAMMED

3024

FIG. 23

FIG. 24

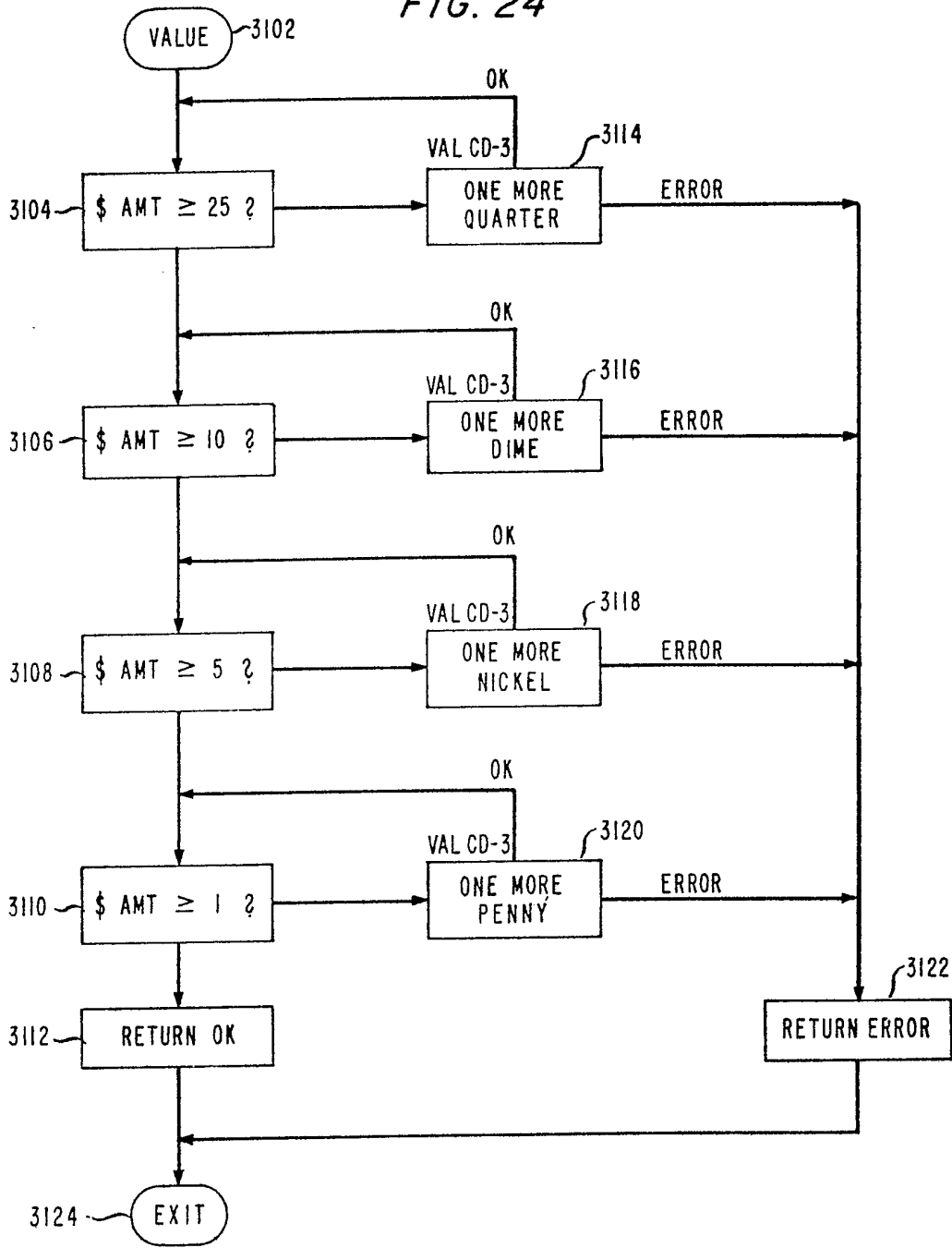


FIG. 25

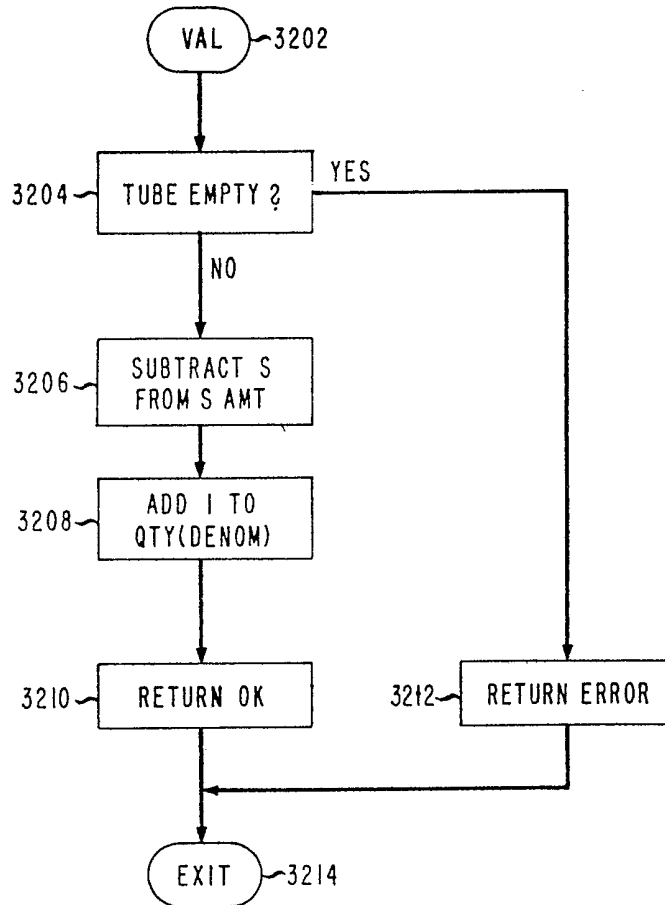


FIG. 26

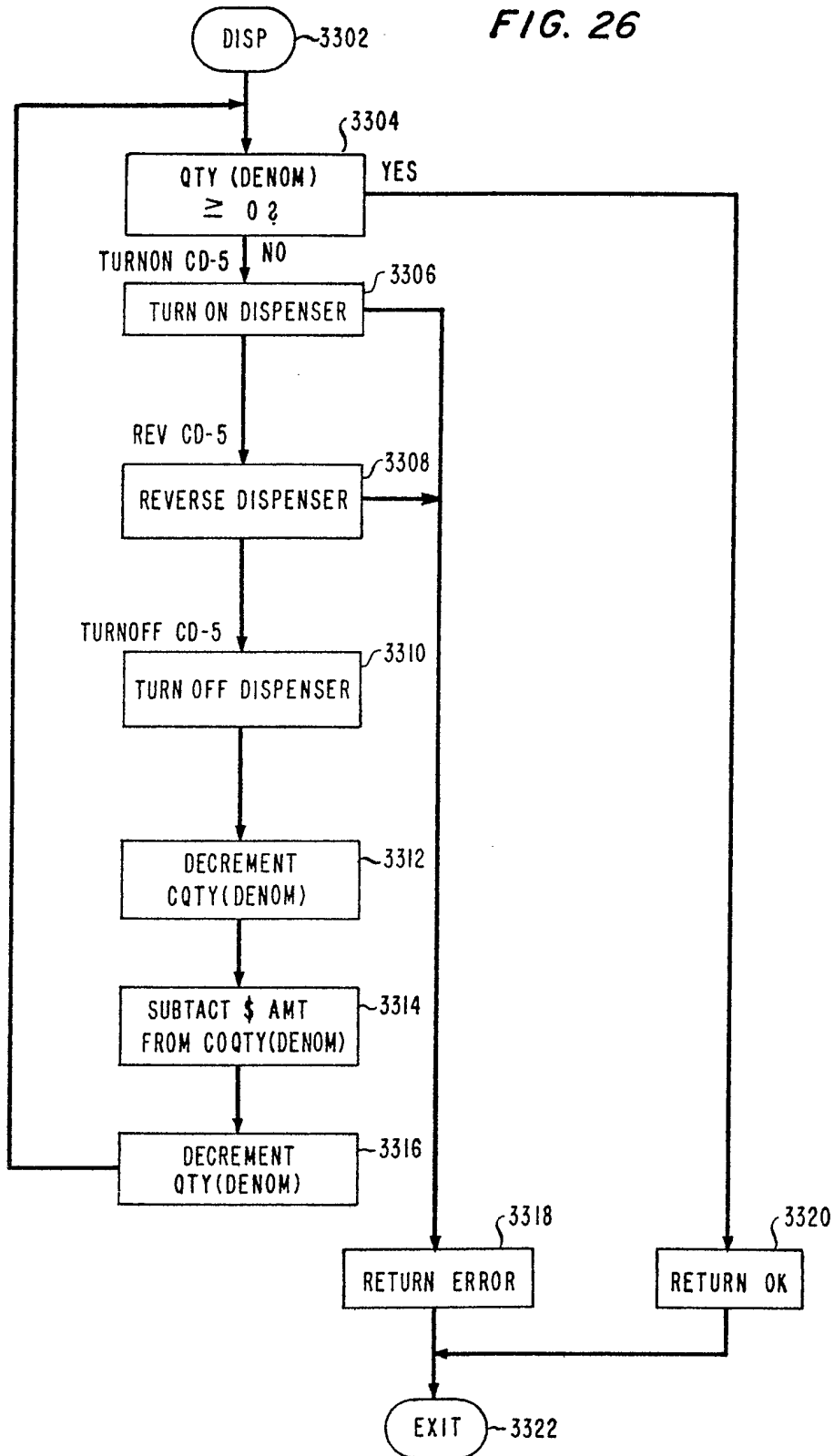


FIG. 27

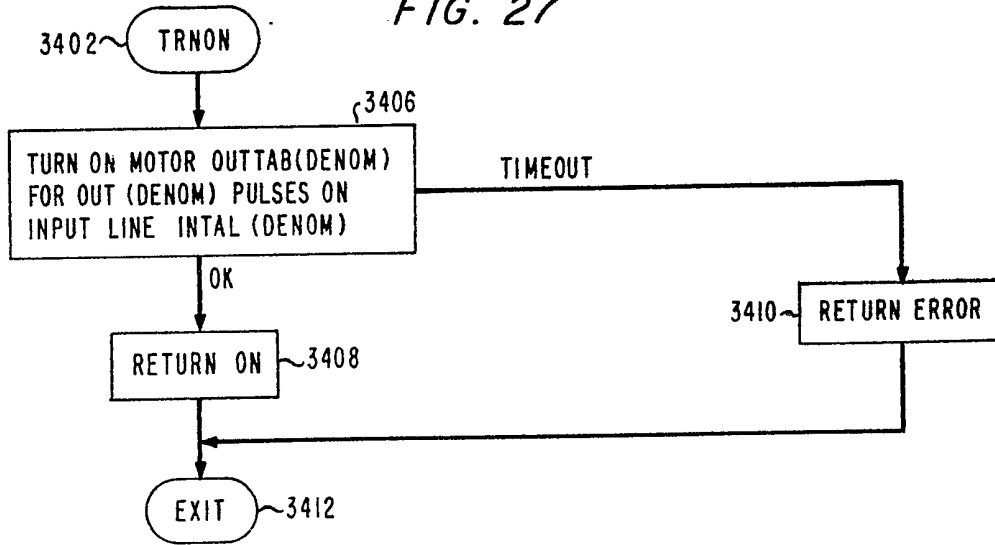


FIG. 28

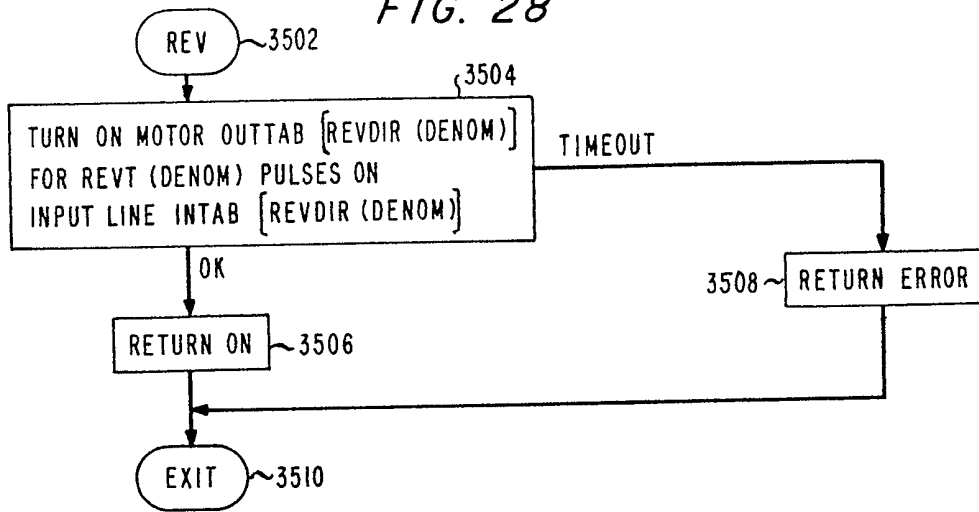


FIG. 29

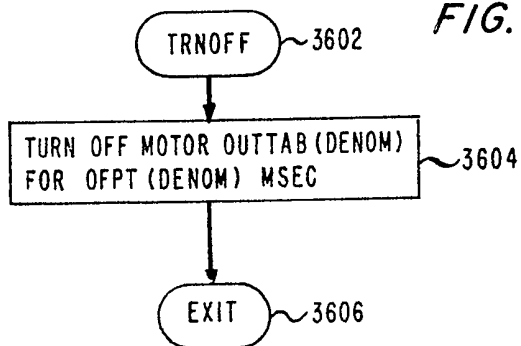


FIG. 30

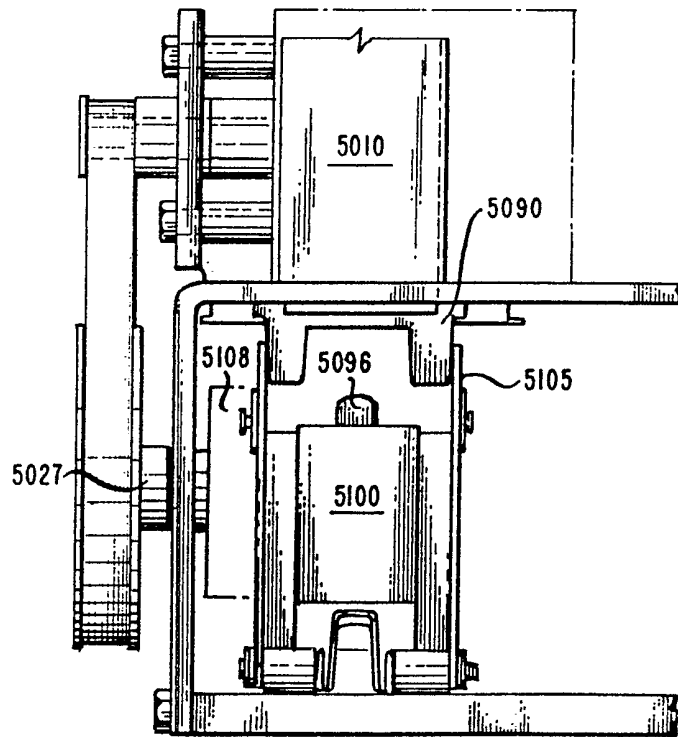
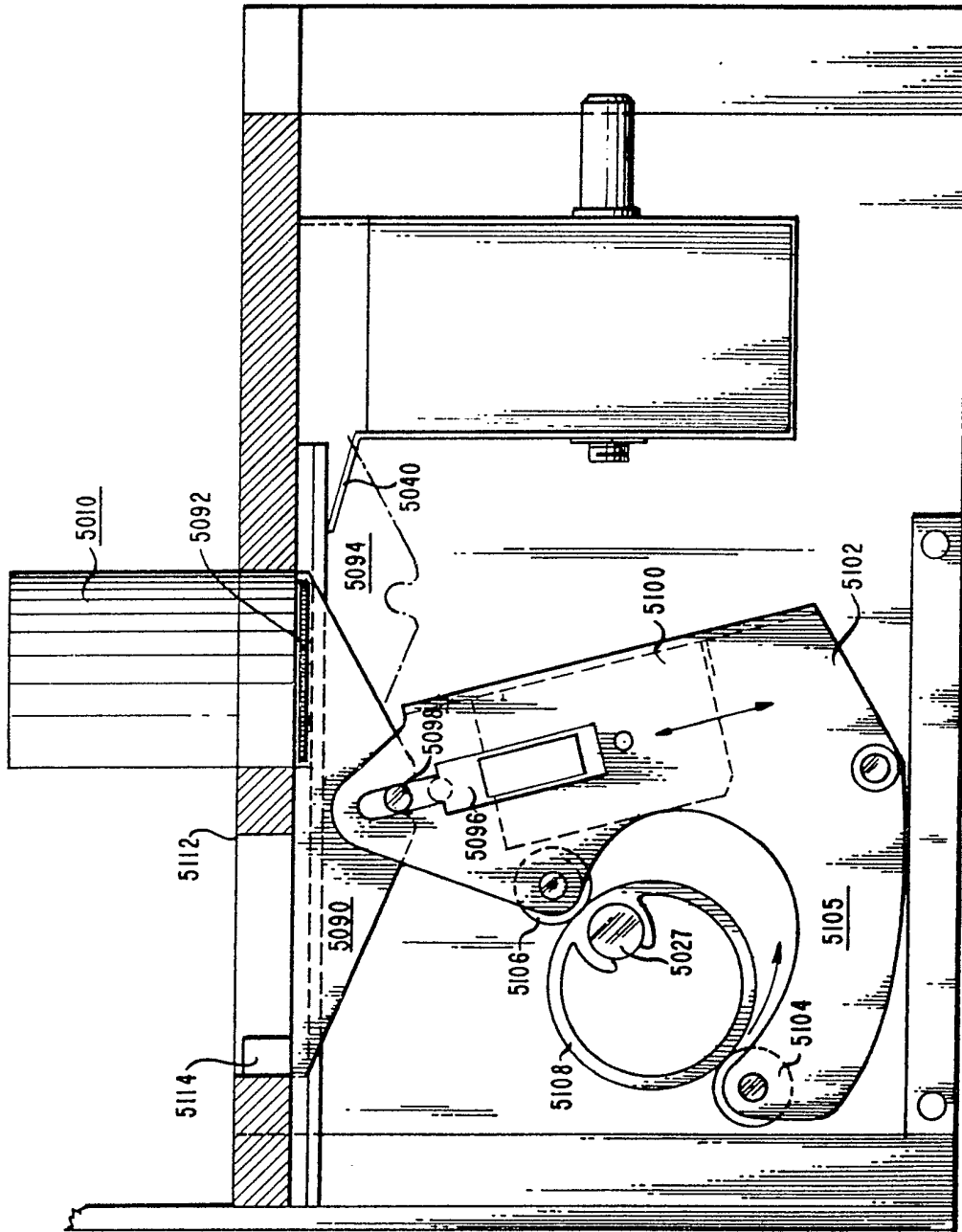


FIG. 31



SPECIFICATION

Coin handling system

5 The inventors of the present invention have been working for some time to improve the performance of the devices disclosed in United States patents 4,249,552 and 4,310,885. In particular further investigation has shown that those devices could be improved by the invention of coin handling equipment intended for use specifically in automatic money handling machines.

10 The present invention discloses a coin handling system specifically intended to perform as part of an automatic money handling device which may either have an integral point of sale terminal or an attached point of sale terminal. Naturally the present invention can be used in conjunction with other devices or alone to handle coins.

15 The present invention has seven major subparts: I - Coin Identifier; II- Coin Diverter; III-Coin Storer; IV- Coin Dispenser; V-Coin Deliverer; VI- Coin Receiver; VII- Coin Systems and Electronics. The present application contains claims to the individual subparts, which are believed to be inventive, as well as to the overall combination of devices which is also believed to be inventive. No known coin handling system performs all of the functions which are performed by the present invention including identifying coins, diverting certain coins for separate storage, dispensing from two coin storage columns with a single motor and delivering coins to a level above that of the coin dispenser.

20 The present invention discloses a novel coin receiving bucket which is shaped to receive coins and arrange them in single file to proceed down a ramp for being identified.

25 The present invention discloses a novel coin ramp which has a sharp curve in which is placed a coin diverter control for intercepting a coin on its way to one storage place and causing it to be directed to another storage place.

30 In one embodiment of the present invention the coin receiving bucket is prevented from receiving coins until the proper directions are given to the automatic money handler and possibly the point of sale device. In such an operation the coins in the bucket are able to scanned by an operator for improper coins such as slugs, bent coins and coins of the wrong denomination.

35 The present invention contains two separate coin storage chambers in one embodiment. One chamber permits the return of coins received, the other chamber does not.

40 The inventive device is intended in one embodiment to accept all denominations of United States coins. The coins are accepted in one group of denominations in one coin input and stored in a designated storage area and another group of denominations are accepted in a second coin input area and stored in a second storage area.

45 The present invention discloses one embodiment of an electronic coin identifier. One embodiment discloses an invention having two light sensors and a single light source. This embodiment's sensor's

50 detect the area of photo-detector covered and employ an analog to digital converter feeding a microprocessor to determine coin size and therefore coin denomination. The ramp is used as a reference or base line for coin diameter measurement.

55 One embodiment of the present invention employs a coin dispenser which utilizes a reversible electric motor to drive a pair of cams through overrun clutches to dispense coins. No solenoids are used in the coin dispenser resulting in a dispenser which is both quieter and more trouble free than those currently known.

60 Another embodiment of the present invention uses a single electric motor to drive a shuttle through a cam to dispense coins from two or more columns of stored coins. In this embodiment, solenoids when activated cause the engagement of a coin dispensing shuttle during the dispense cycle.

65 In the present invention, coins deposited in the device are gravity fed from the top of the device to a storage position located at a much lower level. In one embodiment of the present invention, coins will be placed in a receptacle at counter level, about 33 inches above the floor and stored at a level about 16 inches lower than that. Because either a clerk or a customer would have to retrieve the coins returned as change, it was thought imperative to have a device to bring the change back to counter level. The present invention discloses a novel coin elevator operated by an electric motor which drives a lead screw to which is attached a coin bucket. The motor is reversible and the lead screw has a pitch which allows the bucket to travel easily in either direction. Sensors at the top and bottom of the shaft in which the bucket travels indicate the position of the change bucket. The coin elevator interacts with the coin dispenser to prevent the dispensing of coins if the coin bucket is not in the proper position to receive coins. Another embodiment of the coin elevator uses a timing belt and gears to replace the lead screw-driven bucket. This second embodiment has a coin elevator bucket which is covered by a pivoting top and which when the bucket is brought to the top of the shaft has the top opened to dump the coins into a receiving bucket which blocks access to the elevator shaft.

70 One embodiment of the present invention is for use in an automatic money handling device which is required to fit into a volume smaller than that required by any known device performing the various functions which the present invention performs. The entire envelope available is about 13 inches by about 19 inches by about 6 inches or less than one cubic foot in volume. This size limitation required the utilization of structures unknown in the prior art.

Brief description of the drawings

75 *Figure 1* shows a top perspective view of an automatic money handler showing coin receiving and coin dispensing buckets. The Figure also shows one embodiment of the device having a keyboard and four bill handling channels.

80 *Figure 2* is a side view showing the coin receiving bucket and a part of the coin track being a part of one

embodiment of the present invention.

Figure 3 is a front view showing many of the basic elements of one embodiment of the coin handling system.

5 *Figure 4* shows a block diagram of the electrical elements which form a part of one embodiment of the present invention.

Figure 5 is a side view of one embodiment of the coin elevator mechanism being a part of the present
10 invention.

Figure 6 shows a side view of one embodiment of the inventive coin handler with the near side of the cover removed.

Figures 7, 8, and 9 shows top, side and bottom views of one embodiment of the coin dispensing portion of the present invention.

Figure 10 shows a detailed view of two of the cams shown in *Figure 9*.

Figure 11 shows a side view of the motor and gear arrangements used to drive the cams shown in
20 *Figures 9 and 10*.

Figure 12 shows an electrical circuit for the control of the coin diverter and for control of a coin receiving bucket gate.

25 *Figure 13* is a block diagram showing the method steps which the microprocessor shown in *Figures 2 and 4* employ to identify a coin which has passed in front of the sensors.

Figure 14 is an electrical circuit showing a second embodiment of a coin identifier forming a part of the
30 present invention.

Figure 15 shows a side perspective view of a second embodiment of a coin identifier forming a part of the present invention showing the location of
35 the coin sensors and light source and the coin ramp.

Figure 16 shows a further detail of the electrical interconnection between the coin elevator and the computer which controls its operation under program control.

40 *Figure 17* shows the physical interrelationship between the coin sensors, certain United States coins and the ramp shown in the embodiment as shown in *Figures 14, 15 and 16*.

Figure 18 is a view of part of the coin dispenser mechanism showing one of the coin tracks leading to the coin dispenser.

Figure 19 is a view of part of one embodiment of a dispenser motor drive.

50 *Figure 20* is an electrical circuit showing the electrical elements and their interconnection for controlling the coin dispenser.

Figure 21 is an electrical circuit showing the electrical elements and their interconnection for controlling the coin delivery mechanism.

55 *Figure 22* is a block diagram showing the subroutine for dispensing coins as change and is a general guide to the compute program for dispensing coins.

Figure 23 is a block diagram showing a part of another subroutine required by the system to execute the dispense subroutine shown in *Figure 22*.

Figure 24 is a block diagram showing the subroutine for computing the amount of change to be dispensed by the coin dispenser.

65 *Figure 25* is a block diagram showing a further

subroutine for computing the amount of change due if a particular coin denomination were not available for change making.

70 *Figure 26* is a block diagram showing how the computer controls the various dispenser physical elements and interacts with the counting routine during the dispensing of change.

Figures 27, 28 and 29 are block diagrams showing the general plan for program control of motor driven
75 coin dispensers. These block diagram are in table form and show the interaction with the block diagrams shown in *Figures 22 through 26*.

Figure 30 shows is a side view of the part of the invention shown in *Figure 31*.

80 *Figure 31* is a top view showing a part of the coin dispenser mechanism of a second embodiment of the present invention.

Figure 32 is a top view of part of the coin elevator being another embodiment of the present invention.

85

Description of the invention

General

The present invention relates to the structure and operation of a novel coin receiving, counting, storing, dispensing and delivering system. This application is related both to the various inventive subparts and to the system which they interact to produce. It is expected that either the applicants or the Patent Office will require that the application be divided into
90 separate applications.

From a systems approach the present invention is required to fit into a small volume and perform the functions of receiving, detecting, counting, storing, dispensing and delivering. These functions must be performed at least as quickly as they could be performed by a human operator and more accurately. Further the entire device must have a mean time between failures of not less than six months use based on a twenty-four hour operating day. The operation of the device must be relatively free from vibration and noise in order to be acceptable in a fast food restaurant, a convenience food store, family restaurant, bank teller's window or other similar location. The embodiments shown in the present
100 invention are specifically intended for use by a trained operator who places the coins in the device. Minor modifications can be made to the disclosed embodiments to make the device suitable for either unattended operation or for attended operation in
105 which the customer inserts coins into the device.

The present invention will be described in its operation as though it were always working with United States coins. Such a description is a matter of convenience only. Although the system will be described in relationship to United States pennies, nickels, dimes, quarter, half-dollars and dollar coins (Susan B. Anthony dollars), the system can easily be adapted to work with any coinage by the exercise of a technician's skill without the requirement for
120 further invention. The assignee and the applicants of the present invention intend to modify the devices disclosed in this application to handle the coins of many nations including France, Germany, United Kingdom, Sweden, Norway, Denmark, Japan, Australia, Italy, The Netherlands and others.
130

The present invention will be described in connection with specific structures. Those skilled in the art to which the inventions relate will understand that other equivalent structures and systems can be used which are within the scope and spirit of the present inventions and which are therefore intended to be covered by the claims which form a part of this application.

Figure 1 shows a perspective view of an automatic money handler 10 having a cabinet 11 described in detail in two co-pending patent applications. The money handler 10 has a top 25 with three separate sections, the first of which 12 has a plurality of viewing windows and a coin receiving bucket 16. The coin receiving bucket is shaped to cause the coins to line up single file and proceed down the coin ramp 100 best seen in Figure 18.

Figure 18 shows the ramp 100 having a side surface 120 and a bottom surface 122 which lead the coin single file to a coin identifier which is shown in either of two embodiments generally as 1000. Once past the identifier 1000, the coins ride the ramp to a diverter 500 which if opened leads to a second ramp 800. If the diverter is not open, the coins proceed through a turn 125 in the ramp to a coin sorter 300.

The coin sorter 300 and coin storage and dispensing area is also shown in Figure 6 in a side view with the cover of the cabinet 11 removed. The coin storage area 700 [also shown in Figure 18] shows four storage tubes 710, 712, 714, 716 which lead to coin dispensers 900. As seen in Figures 6, 9 and 18, coins dispensed from the coin tubes are conveyed by coin tracks 1500 to a bucket 20 which is in turn connected to lead screw 1600 [in one embodiment of the present invention] for being raised to the upper surface of the housing as shown in phantom in Figures 5 and 6. This brief overview describes the general behavior of a coin from deposit in the receiving bucket to return of change in the dispenser bucket 20. A more detailed description of the various components follows.

Automatic money handler

Figure 1 shows a perspective view of an automatic money handler 10 which has a top 25 with three separate areas. The first area 12 has a plurality of viewing windows 14 and a coin receiving bucket 16. The second area 17 has a plurality of bill guides 18 and a coin delivery bucket 20. A third area 15 shows a keyboard 23 having certain display lights 22 and two special locks 24 and 26. The display lights are individually related to specific bill and coin denominations, to a number pad and to various functions which the microprocessor can perform which are generally described in detail in the cross referenced patents and in the some of the co-pending applications.

Coin receiving bucket and ramp

Figures 1 and 18 show the automatic money handler 10 and its receiving bucket 16 in detail. Figure 18 shows the construction of the receiving bucket 16 and the coin ramp 100 which leads from it. The coin ramp 100 is formed of two mated mirror-image plates 124 and 126 which when joined

together form a ramp 100 having sidewalls 120 and base and top walls 122. The coin track sidewalls have a maximum interior dimension no less than the thickness of the largest coin to travel down the track and not greater than twice the thickness of the thinnest coin to travel down the ramp. For example if the ramp is intended to carry pennies, dimes, nickels and quarters, the track must be larger internally than the thickness of a quarter but not large enough to permit two dimes to travel side-by-side down the ramp.

Normally the coins are gravity fed down the coin ram. The upper end of the ramp mates smoothly with the lower end of the coin receiving bucket 16. The bucket is shaped to guide coins into a single file relationship into the outlet 40 formed in its bottom. This effect is achieved by having steep sides 22 at about a sixty-five degree angle to the vertical which run from shallow short wall 24 at one end to a steep long wall 26 at the other end of the bucket. In cross section, this construction give the coin receiving bucket 16 a "V" cross section with the size of the "V" increasing as the coin moves from one end of the bucket 16 to the other. The "V" narrows to a width at the bottom of the "V" to a dimension substantially identical with that of the coin ramp 100.

Coin ramp 100 has in one embodiment two independently operated controls along its path to control access to parts of the ramp. The first control 1700 prevents coins from gaining access to the ramp until the money handler 10 is ready to receive money. The first control has a gate 40 hinged at pivot 1702 and controlled by solenoid 1704 which is controlled by signals from wires 1706. The signals sent along wires 1706 originate from microprocessor 186 shown in Figure 6. The microprocessor will open gate 40 when it is armed to receive money. One embodiment of the present invention does not employ a coin gate near the entrance to the coin ramp.

The keyboard 23 contains an "accept" key 25 which can be actuated by the operator of the device after he or she has examined the coins which have been deposited in the coin receiving bucket 16. The operator is to examine the contents of the bucket prior to actuation of the "accept" key for slugs, foreign coins, bent coins and coins or other objects which are not suitable for the device. Actuation of "accept" key 25 causes gate 40 to be moved to a second unblocking position to allow coins to roll down ramp 100. Naturally, the embodiment of the invention which does not use a coin gate will not have use for the accept key function described above.

Gate 40 may alternatively be opened after a specified time delay after the completion of an "order", for example, 15 seconds. In such an arrangement gate 40 is opened unless a contrary command is received by the device, such as actuation of reject key 27 which keeps the gate 40 in a closed position.

Downstream of the coin identifier 1000, is positioned a second control gate 500 having a gate 502 pivoted on a hinge 504 fixed to the bottom of the track 122. A solenoid 506 is controlled by current

through wires 508 to operate gate 502. The current through wires 508 is controlled by microprocessor 186 shown in Figure 6. Microprocessor 186 receives information from the coin storage device 700 informing the microprocessor if any of the coin tubes 710, 712, 714 or 716 are full. If any tube is full, the microprocessor 186 will cause the gate 502 to open which will in turn cause coins rolling down ramp 100 to fall into secondary ramp 40. The microprocessor 186 can be programmed differently from the function described above. If the microprocessor determines that any coin tube is full, it can cause coins to be diverted to prevent a coin jam.

15 *Coin identifier*

The position of the coin identifier in either of the embodiments to be described in the following paragraphs is shown in the coin ramp 100 in Figures 2 and 15.

20 The physical structure and operation of the embodiment of the coin identifier is described with reference to Figures 2, 4 and 15. When gate 40 is positioned to allow the coins access to coin ramp 100, coins in the receiving bucket 16 will roll down ramp 100 toward the coin detector assembly. As previously described of the tilt and slope of the ramp the coins roll down the ramp 100 in single file. Because of the thickness of the ramp 100 as previously described one coin cannot pass another on ramp 100.

Mounted on the sides 120, 124 of the ramp 100 between the first and second control gates 40 and 502 is an array of Figures 14 and 15 show an embodiment of a coin identifier. This embodiment of identifier is shown generally by the numeral 1000. A coin ramp 1100 has sides 1120 and 1124 and a bottom 1122. Mounted on the ramp 1100 are an LED 1002 and a phototransistor 1004 to detect the presence of a coin. A second photocell 1036 having dimensions of about 1 centimeter by about one-half centimeter. A Sensor Technology device called ST-102 is a good choice for such a photocell. A lamp 1018 such as IEE 6838 is located in the ramp wall opposite the photocell 1036. Figure 17 shows the positioning of the phototransistor 1004 and the photocell for United States coins ranging in size from a dime to a Susan B. Anthony dollar. The phototransistor is located about six-tenths of an inch above the bottom of the coin ramp bottom 1122. The diagram shows very clearly how different size coins shade the photocell.

Figure 14 shows the electrical circuit for operating the photocell, lamp, phototransistor and LED. The photocell 1036 output is set at a specific level, 150 microamps for example. That output is fed to a resistor 1034 and an amplifier whose output is then fed to an Analog-to Digital converter 1038 and to a diode resistive, capacitive, amplifier network 1025 having a five volt reference signal. The output of integrator 1025 is in turn fed to an emitter-follower buffering transistor 1020 which then provides power to the lamp 1018. The integrator 1025 has a long time constant compared to the time of passage of a coin down the ramp 1100. The time constant of the integrator 1025 is really at two different levels. One

through diode 1032 and resistor 1030 and the other through larger resistor 1028. The diode 1032 and resistor 1030 have a much smaller time constant than that caused by resistor 1028.

70 The A to D converter 1038 which receives the output of the photocell can operate in a variety of ways. One implementation is to have the A to D converter consist of a series of comparators, each comparing the amplifier voltage to a voltage produced by a different size of coin. The output of the comparators is if fed to the D input of flip-flops and the strobe signal. In this way the information is placed in the flip-flops to be read by a microprocessor 186 as shown in phantom lines in Figure 4.

80 The block diagram in Figure 4 shows how the electrical devices shown in Figures 14 and 15 are inter-connected functionally. The photo-diode array 112 output is fed to a summing amplifier 150 which is in turn fed to an analog-to-digital converter 182. The output of the A to D converter 182 is fed to a microprocessor and data bus 190. The bus line 190 interconnects a microprocessor 186, a random access memory (RAM) 184, a programmable read only memory (PROM) 188 and a peripheral interface access device (PIA) 192. The PIA may in turn be connected to another processor called a central processor (not shown) which might be associated with a point of sale device or other central computer.

The computer 186 can be implemented by any one of a number of commercially available devices such as the 6502, 6800, 6809 or many others. The data bus and address bus 190 are shown as a single bus but could be multiple busses. The basic operation of such microprocessor systems are well known in the art. The *M6800 Microprocessor Applications Manual* published in 1975 by Motorola, Inc. details the operation of one such microprocessor system That manual is incorporated by reference into this application.

105 United States coins have diameters which are approximately: 0.957 inches, 0.838 inches, 0.750 inches and 0.704 inches, respectively.

Figure 13 shows in block diagram form another six step method for identifying coins. Block 1302 shows that the computer through the A to D converter identifies the leading edge of a coin. In block 1302, the computer determines the maximum value of the A to D converter and then, as shown in block 1304, the computer determines when the value has descended to less than 25 % of the peak value (to insure that a peak was truly reached). Thereafter the computer compares the peak value to the stored values by answering to the extent necessary: is the value greater than a dime; is the value greater than a penny; is the value greater than a nickel; is the value greater than a quarter. If the value is not greater than any of those, the computer will ask if the value is the same as the coin in question, within the range of allowable variation. The computer as shown in block 1308 then makes a decision and prints either "bad coin" or the description of the coin identified and can be directed to generate either a visual or audible signal.

Prior to getting ready for the next coin, the microprocessor can be directed to generate a signal

for transmission to a host computer which can take some action based on the information it has received.

5 *Coin sorter*

The coin sorter is shown clearly in Figures 3, 6 and 18. Figure 6 shows a top view of the coin ramp having a general "V" shape with about a 40 degree angle between its legs 111 and 113. After coins roll down ramp 100 they make the turn to a set of slots which have progressively larger widths shown by the step surfaces 351, 353, 355 and 357. Inspection of the Figures shows that the slots are intended to let fall into the appropriate slot progressively dimes, pennies, nickels and quarters.

Beneath the slots are coin storage tubes 760, 762, 764 and 766 which are interconnected to the slots by generally fan shape manifolds 352, 354, 356 and 358. The tubes store coins stacked vertically on their flat surfaces in a column.

Coin dispenser

Figures 7, 8 and 19 show top, front and side view of part of one embodiment of the coin dispenser mechanism 700 which is shown more generally in Figure 6. Figure 6 shows that in this embodiment of the invention described in this application there are four coin receiving and storing tubes each with a coin dispenser located at the base of the tubes. Because functionally all four coin dispensers are alike only one pair is shown and described in detail. The description of one pair clearly applies equally well to another pair.

One pair of coin dispensers are shown in detail in Figures 7, 8 and 19. The general relationship of the coin dispenser 700 to the remainder of the coin handling system is shown in Figure 6. The support structure is made of a base member 790 and two vertical support members 792, 794. Cover plates 722, 724 cap the outer housing of the coin dispenser 700. Underneath the cover plates 722, 724 is a shuttle floor plate 726. The cover plates and the shuttle floor plate define first and second shuttle cavities 728, 730 which are separated by a divider 729.

The dispenser housing members 790, 792, 794 define a volume 725 which contain "L" shaped support members 780 and 781 and outer "L" shaped support members 758, 784. The outer support members support a dispenser drive motor 762 and shafts 761 and 763 which are respectively supported by bearings 765, 767. Motor 762 drives the shafts through gears 760, 759 and 764. These gears reduce the speed of the motor and increase its torque.

Shaft 761 drives clutch 754 which is linked to shaft 755 which in turn drives clutch 756 which in turn is linked to shaft 763. Motor 762 is reversible. Cams 768, 770 are mounted respectively on one side of clutches 756, 754. When motor 762 rotates in one direction cam 770 is rotated and cam 768 is still.

Reversal of motor 762 causes rotation of cam 768 and cam 770 is still. The clutches 756, 754 are Torrington overrunning clutches which are commercially available. The effect of rotation of a cam is shown in Figure 18. Cam follower 788 rides on cam 768 which causes the oscillation of shaft 746 which

has an "eye" 740 formed in one end for engaging shaft 743. Shaft 743 is fastened to shuttle driver 734 which is in turn connected to shuttle 735. Shuttle return spring is confined between driver 734 and the housing for returning the shuttle to its rest position.

Motor 760 can take one of several embodiments. It can be a stepper motor or it can be a conventional DC motor having a wheel attached to its shaft having a number of slots formed therein for enabling its position to be determined. One such wheel has 100 divisions formed therein. A light source and sensor disposed on either side of the wheel as shown in Figure 19. The circuitry shown in Figure 20 is able to track the angular position of the wheel and the number of rotations it makes. Each rotation of the wheel in a given direction results in the dispensing of a coin.

In a system with four coin tubes, coins can therefore be dispensed from two tubes simultaneously if the control system has adequate capacity to direct the motors independently. Each pair of coin tubes has a coin track 1500 leading away from it to a coin delivery system 1100. The track has sides 1502, 1504 and a bottom 1506 which guide dispensed coins to a coin receiving bucket 20 as shown in Figure 6.

Figures 6 and 31 show in detail in two different views a second embodiment of a coin dispensing device. Figure 3 shows a partial front view showing a coin track 5002, leading to the coin sorter-coin tubes assembly having four subparts 5004, 5006, 5008, 5010 for [in this embodiment] dimes, pennies, nickels and quarters in United States coins. A motor 5024 drives a pulley 5022 which in turn drives a belt 5020 which drives another pulley 5025 which powers cam shaft 5027. the Cam shaft 5027 actuates dispenser drives 5080, 5082, 5084 and 5086 which are shown in more detail in Figure 31.

Figure 31 shows a side view of part of one coin dispenser drive 5086. Shaft 5027 is connected to cam 5108 which is mated to scotch yoke 5105. Yoke 5105 has a "C" shaped arm 5102 which has bearings 5104, 5106 at opposing ends for engaging cam 5108. Arm 5102 contains a solenoid 5100 which as an outwardly extending shaft 5096 to which is connected a crossed bar 5098 for engaging shuttle 5090. Shuttle 5090 rides in a track formed by arms 5081. Shuttle movement is reciprocating. Shaft 5027 rotates and causes cam 5108 to describe an oval shaped path because of its eccentric connection to shaft 5027.

When shaft 5027 is rotating, coins are dispensed from those coin tubes in which solenoid 5100 is actuated by the direction of computer 186. When the solenoid is actuated shuttle 5090 engages coin 5092 and propels it to coin ramp 5040. Only those coins selected for dispensing have the appropriate shuttle engaged by pin 5098.

This second embodiment of coin dispenser is capable of dispensing coins from all coin tubes at the same time. This second embodiment lends itself to a more rapid emptying of the coin tubes than the first embodiment. The motion of the shuttles is limited by stops 5112 and 5114. The most forward position of the shuttle 5090 is shown by shuttle 5094 shown in phantom.

Coin delivery

The coin delivery system 1100 has a bucket 20 having interior walls 1640 which have sufficient depth to handle more than one dollar's worth of change. A well 1102 reaches from below the coin delivery ramps 1500 to the top surface of the automatic money handler 10. The well has sides 1104, 1106, and bottom 1108.

Along one side wall of the well 1106 runs a shaft having a length nearly to depth of the well. That shaft 1600 has threads 1602 formed thereon. Shaft 1600 is mounted for rotation on bearing 1609, 1622 which are in turn mounted in the well by retainers 1618, 1620. A gear 1606 is mounted on shaft 1600 and driven by belt 1610 which is in turn driven by gear 1614 which is mounted on shaft 1610. Shaft 1610 is driven by electric motor 1628 mounted to a convenient part of the coin system as shown in Figure 6. Sensors 1630 and 1632 are located in the well 1100 near the top and bottom of the well 1100. The detectors can be either photosensitive devices or mechanical devices. In the present embodiment the sensors are photocell and emitter pairs.

Figure 21 show the electrical circuit for driving and controlling the movement and position of the coin delivery bucket 20. When the system is properly armed for giving change and coins are dispensed down ramp 1500 and over the high side 1640, a signal is generated by the microprocessor 186 that change making is complete. The microprocessor then generates a signal directing the raising of change bucket 20. Power is delivered to electric motor 1628 which through the previously described gear and belt system rotates shaft 1600 which cause mating threaded nut member 1650 to move vertically with respect to the shaft until it passes upper sensor 1632 which generates a signal for transmission to microprocessor 186 to stop the rotation of motor 1628.

Microprocessor 186 will retain bucket 20 at the top of the money handler 10 until is it nearly time to begin another coin delivery. At that time, microprocessor 186 will control the rotation of motor 1628 in the reverse direction which will bring the bucket 20 back in position as controlled by sensor 1630 to receive coins from ramp 1500.

Figures 5 and 32 show side and top views of a second embodiment of coin elevator system 7000. This embodiment is similar to the first embodiment described previously. the differences between the two embodiments are primarily that the ultimate receiving bucket in the second embodiment, bucket 7020 is separate element which leads to the movable bucket through a blind alley. This change keeps the elevator shaft 7002 closed to the outside so that no operator or customer can possibly get pinched fingers or hands and so that no one can use the shaft 7002 to gain access to the inside of the money handler.

Figures 5 and 32 show a motor 7030 which drives a shaft 7032 to which is connected a timing belt 7072. The belt is held onto the bucket 7005 by a clamp formed of elements 7003 and 7007 which are tabs simply formed as a clamp.

The bucket 7005 itself has a lid 7012 pivoted on the body 7005 about shaft 7017. A spring 7014 is attached to outwardly extending arm 7015 on one end and to slot 7016 to provide a positive closing force to the lid 7012. A ramp surface 7006 is formed in the bucket 7005 so that coins will move from the coin dispenser to the delivery bucket 7020. The final force to move the coins to bucket 7020 comes from the inertia produced the raising of the bucket 7005 to the top of the track where it is abruptly braked and tang 7010 strikes top 7012 with some detectable force. The result of these collisions is that the coins on the ramp 7006 seem to jump upward and then roll or slide down the ramp into bucket 7020.

Shown in phantom in Figure 5 is the remainder of the cabinet showing that in one embodiment of the present invention the bucket 7020 is recessed into the top surface of the money handler. This arrangement can be visualized by examining Figure 1 and recognizing that the coin receiving bucket shown there can be bucket 7020.

Electronics and systems

Figures 22 through 29 show the control arrangements for operating the various motors of the coin diversion, coin dispensing and coin delivery system. In dispensing coins, the microprocessor is instructed to determine that the amount paid equals or exceeds the amount due. If equal, no change is required. If the amount paid exceeds the amount due, the microprocessor is instructed to determine the difference and to compute the change required in bills and coins. If no coins are required for change, the coin handling system is not required to be active. If change in coins is due, the diagrams shown in Figures 22 through 29 are useful for understanding the control of the mechanisms operating under the control of the microprocessor. The microprocessor is controlling the rotation of a number of small motors as described in detail in previous sections of this application.

Figure 22 shows that when the microprocessor has determined that change should be dispensed, the microprocessor is directed by program to execute a subroutine called "DISPENSE". The registers which may have stored any information from an earlier transaction are cleared and the microprocessor calculates the number (quantity) of coins of each type to be dispensed as shown in blocks 3004 and 3006. Having determined the number of coins of each denomination to be dispensed, the microprocessor then directs the dispensation serially.

In the embodiment of coin dispenser previously described there is one motor reversibly driven to dispense coins from either or both of two coin storage tubes. In this embodiment it is possible to dispense coins simultaneously from either separate pair of coin tubes, but it is not possible to dispense coins simultaneously from coin tubes driven by a common motor. In the embodiment of computer implementation shown in Figure 22, the coin dispensers are driven one-at-a-time with adjacent tubes driven by the same motor driven first. The coin dispense cycle is so fast that there is no utility in dispensing coins simultaneously.

Figure 22 shows the progression of dispense cycles from quarters to dimes in blocks 3006 through 3014. The subroutine allows for the generation or error signals if coins either jam or are in short supply as shown in Figure 23 table 3024. Figure 25 shows the subroutine for returning the microprocessor to th proper state if a tube were empty.

Figure 23 shows that the subroutine employed for the dispensation of coins is a "countdown" type and that the microprocessor is continuously updating its balance and not merely counting to a previously determined number to be dispensed.

CLAIMS

1. An automatic money handling device comprising means for receiving and dispensing coins having means for detecting the denomination of coins, means for sorting the coins by denomination, means for dispensing the coins by denomination and means for delivering the coins dispensed to a location different from the location dispensed and means for counting coins received and dispensed.
2. In a device for receiving, identifying, sorting, storing, dispensing and delivering coins the combination comprising:
- a housing means having internal space to accommodate a coin handling means and an external surface upon which to receive and deliver coins;
 - coin receiving means disposed within the housing means and extending to the external surface of the housing means;
 - coin sorting and storing means located within the housing means;
 - coin dispensing means located within the housing means;
 - coin delivery means located within the housing and communicating with an external surface of said housing means;
 - coin identifying means located within the housing means;
 - ramp means interconnecting said coin identifying means and said coin receiving means and interconnecting said coin identifying means with said coin sorting and storing means;
 - second ramp means interconnecting said coin dispensing means and said coin delivery means.
3. The device claimed in claim 2 wherein said dispensing means, said delivery means, said identifying means are connected to a computing means and said dispensing means and said delivery means are under the control of said computing means.
4. The device claimed in claim 3 including further:
- second coin storage means;
 - third coin ramp means interconnecting said second coin storage means and said first coin ramp means;
 - diverting means located on said first coin ramp means for causing coins on said first ramp means to travel to said third coin ramp means and fall into said second coin storage means.
5. The device claimed in claim 4 including further:
- said coin identifying means recognizes coins by

denomination and sends a signal to said computing means separately identifying each coin by denomination;

- said coin dispensing means is controlled by said computing means which keeps count of each coin dispensed by denomination;
- said computing means has stored in memory the capacity of said coin storing means and the beginning count of coins by denomination;
- said computing means actuates said diverting means when at least said storing means can hold no more coins of one denomination.
6. The device claimed in claim 5 including further:
- second coin receiving means for receiving coins having a physical dimension larger than the size of said first coin ramp means.
7. The device claimed in claim 6 including further a second coin identifying means located adjacent said second coin receiving means for recognizing coins deposited in said second coin receiving means.
8. The device claimed in claim 2 wherein said coin dispensing means has at least one electric motor with a controllable degree of rotation for positively dispensing coins.
9. The device claimed in claim 2 wherein said coin delivery means returns coins to the level at which they are received into the coin receiving means.
10. The device claimed in claim 3 including further one or more bill handling means and a keyboard means for controlling the bill handling means and the coin handling means.
11. In a device for determining the value of a coin the combination comprising: a first ramp means having a base path along which coins can roll; a first illumination means means disposed along a path which can intersect the base path; a first sensing means disposed along a path substantially parallel to said first illuminating means path; said first sensing means having an electrical output proportional to the intensity of light incident thereon; means for feeding said electrical output to an analog to digital conversion means.
12. The device claimed in claim 11 wherein said light sensing means comprise a phototransistor means and an integrating means wherein said integrating means has time constant which is long compared to the time of passage of coin past the phototransistor means.
13. The device claimed in claim 11 including further a feedback control loop means for regulating the intensity of the light source means such that its sensed output is substantially constant in the absence of a coin.
14. In a coin delivery means for use with a change dispensing means the combination comprising: a housing means having a hollow shaft means having a top and a bottom; a movable bucket means fitting said shaft means and having coin receiving means; elevator means for raising and lowering said bucket means within said shaft; said elevator means having reversible drive means and sensing means for controlling said reversible drive means.

15. The coin delivery means claimed in claim 14 wherein said hollow shaft means leads to a partially covered coin receiving means and has door opening means attached thereto.

5 16. The coin delivery means claimed in claim 15 wherein said bucket means has a door member operable by said door opening means attached to said shaft.

17. In an automatic money handling device the
10 combination comprising: a coin receiving means having ramp means; said ramp means leading to two or more coin storage means; diverting means attached to said ramp means to control which of said coin storage means receives coins inserted in said
15 coin receiving means.

18. The device claimed in claim 17 wherein said automatic money handling means has coin detecting and recognition means mounted on said ramp means upstream of said diverting means.

20 19. The device claimed in claim 18 including further computing means for controlling the actuation of said coin diverting means dependent on the information detected by said coin detecting and recognition means and analyzed by said computing
25 means.

20. In a device for receiving and dispensing coins of different sizes the combination comprising: a housing means having upper and lower levels; means for counting coins received by size; means
30 for storing coins received by size; means for storing coins without regard to size; means for dispensing coins from the coin storage means; means for delivering coins to an upper level received from said dispensing means.

35 21. The device claimed in claim 20 including further diverting means for controlling which of said coin storage means receives coins.

22. The device claimed in claim 20 including further wherein said coin delivery means is adapted
40 to dispense two or more coins at the same time.

23. In an automatic money handling device the combination comprising: a first secure housing means; two coin storage means; coin ramp means; coin receiver means; the coin ramp means intercon-
45 necting the coin receiver means and the coin storage means; coin diverter means upstream from the coin storage means; coin identifying means upstream of the coin diverter means; coin dispensing means downstream of the coin storage means; second coin
50 ramp means; coin delivery means connected to said coin dispensing means by said second coin ramp means.

24. The device in claim 23 including further: computing means for controlling the coin identifying
55 means, coin diverter means, coin dispensing means and coin elevator means.

25. The device claimed in claim 24 wherein the coin dispensing means has a coin shuttle means and a coin dispensing drive means; the coin shuttle
60 means and the coin dispensing drive means being interconnected by linkage means controlled by said computing means.

26. The device claimed in claim 24 wherein the coin dispensing means has a coin shuttle means and
65 a coin dispensing drive means interconnected by a

cam means; the cam means interconnected to the coin dispensing drive means by overrunning clutch means.

27. The device claimed in claim 23 wherein the
70 coin dispensing means comprises a movable bucket means riding in a shaft means formed in the housing means.

28. The device claimed in claim 23 wherein the coin dispensing means comprises a blind shaft
75 means having a movable bucket mounted therein; the movable bucket having a cover thereon operable to coin or release coins depending on the position of the cover.

29. The device claimed in claim 23 wherein the
80 coin dispensing means comprises a shaft means containing a movable bucket means having first and second sensors mounted in the shaft for detecting and controlling the position of said bucket means.

30. The device claimed in claim 22 having coin
85 receiving bucket means adapted to cause the coin to line up single file and to roll and slide down said coin ramp means

31. The device claimed in claim 22 wherein said
90 first coin ramp means is oriented at an angle to both the horizontal and vertical planes.

32. The device claimed in claim 22 said coin identifying means is self-calibrating.

33. The automatic money handling means substantially as shown and described.

95 34. The automatic money handling means substantially as shown in Figures 1 through 32.

35. As an independent invention, the additional feature of any of claims 3 to 10, 12, 13, 15, 16, 18, 19, 21, 22, and 24 to 32.