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Mandell

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[54] **SOLID STATE VEND CONTROL MEANS AND PROCESS OF OPERATION**

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[52] **U.S. Cl.** **194/10**

[51] **Int. Cl.** **G07f 11/00**

[58] **Field of Search** ..... 194/10, 1 N; 221/129

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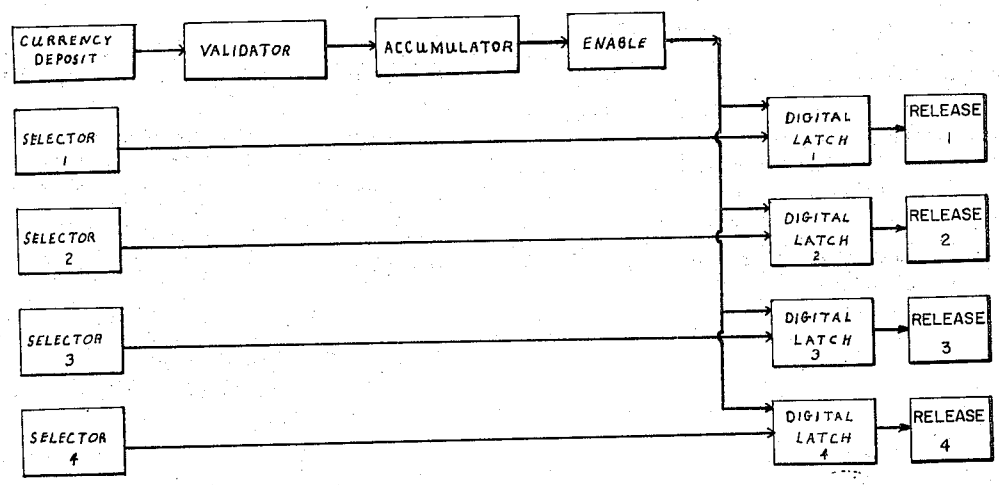
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[57] **ABSTRACT**

This apparatus is a modular solid state system for operating vending machines, which will contribute little to the bulk of the machines and allow either more space for the vended goods in the machine or allow design of smaller and more compact vending machines than contemplated in the prior art. Other advantages of the present invention are lower cost of manufacture than the cumbersome mechanical equivalents of the prior art and simple repair. Repair should be less frequent by the use of the solid state system described. Basically, the apparatus has a currency desposit, currency evaluator, a solid state accumulator to keep track of the currency deposit, an enable means, a solid state release control means and a release means. An additional aspect of the present invention lies in a release means which uses an electric motor having an extended armature which rotates and releases items to be vended.

13 Claims, 7 Drawing Figures



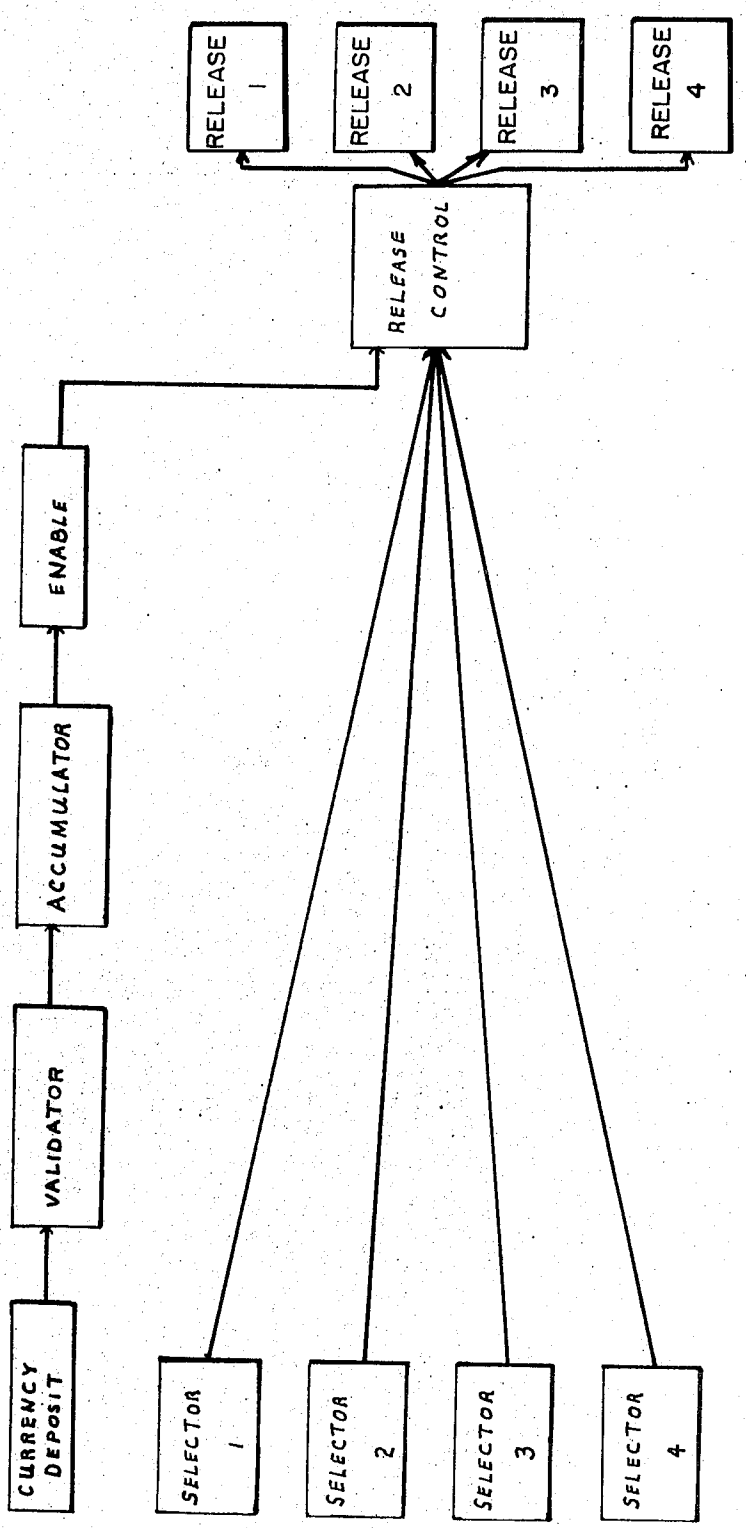

RELEASE 1
RELEASE 2
RELEASE 3
RELEASE 4
RELEASE CONTROL
ENABLE
ACCUMULATOR
VALIDATOR
CURRENCY DEPOSIT
SELECTOR 1
SELECTOR 2
SELECTOR 3
SELECTOR 4

Fig 1

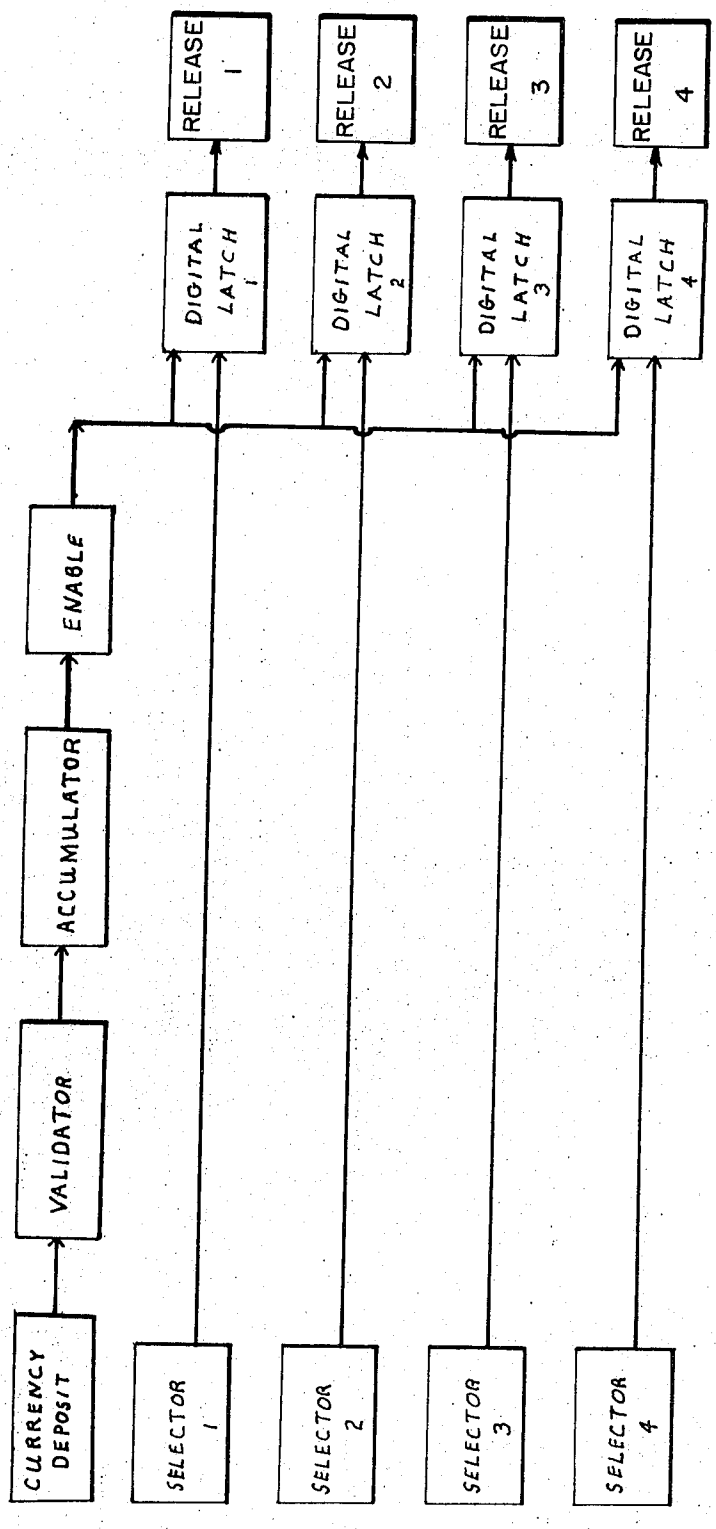

CURRENCY DEPOSIT
VALIDATOR
ACCUMULATOR
ENABLE
SELECTOR 1
SELECTOR 2
SELECTOR 3
SELECTOR 4
DIGITAL LATCH 1
DIGITAL LATCH 2
DIGITAL LATCH 3
DIGITAL LATCH 4
RELEASE 1
RELEASE 2
RELEASE 3
RELEASE 4

Fig 2

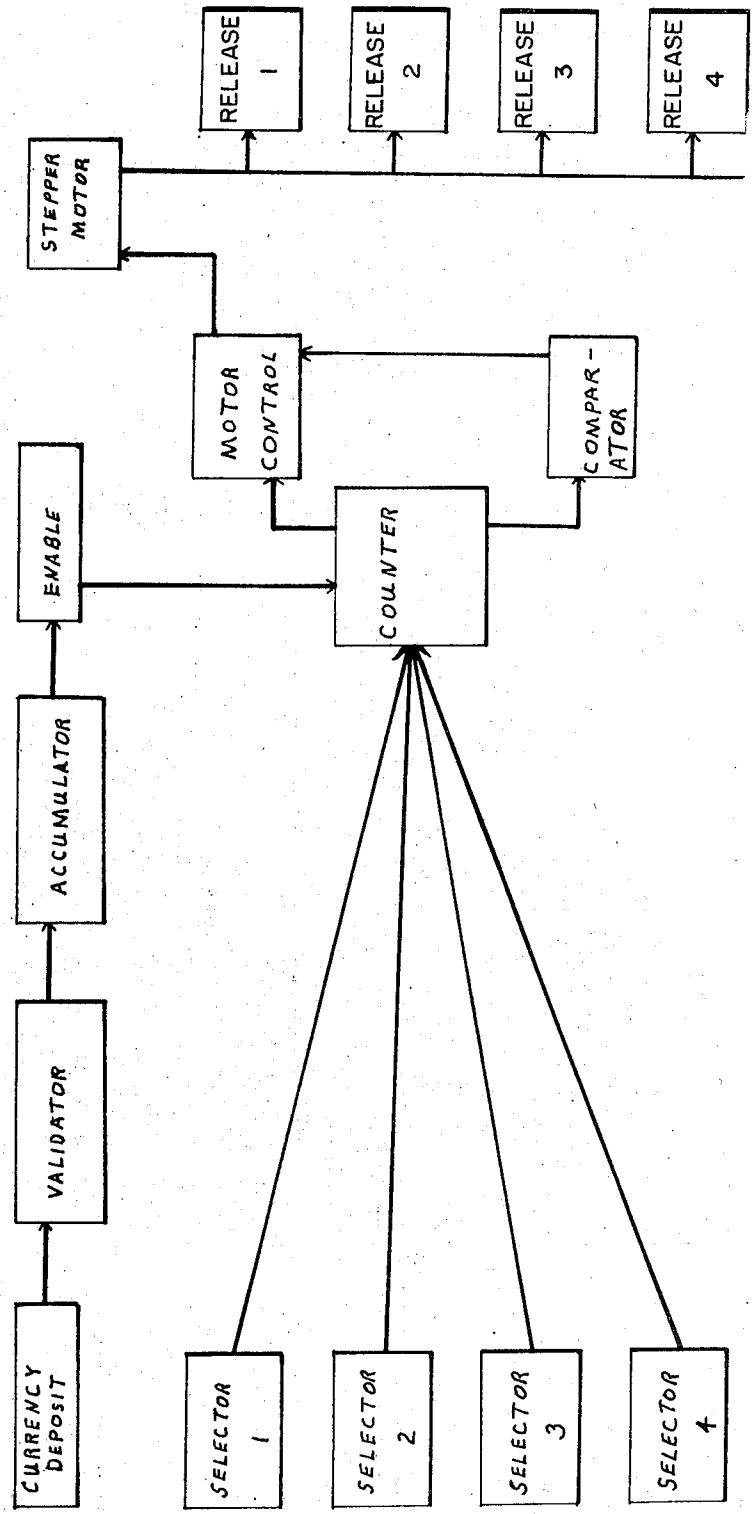

RELEASE 1
RELEASE 2
RELEASE 3
RELEASE 4
STEPPER MOTOR
MOTOR CONTROL
COMPAR-ATOR
ENABLE
COUNTER
ACCUMULATOR
VALIDATOR
CURRENCY DEPOSIT
SELECTOR 1
SELECTOR 2
SELECTOR 3
SELECTOR 4

Fig 3

Fig 4

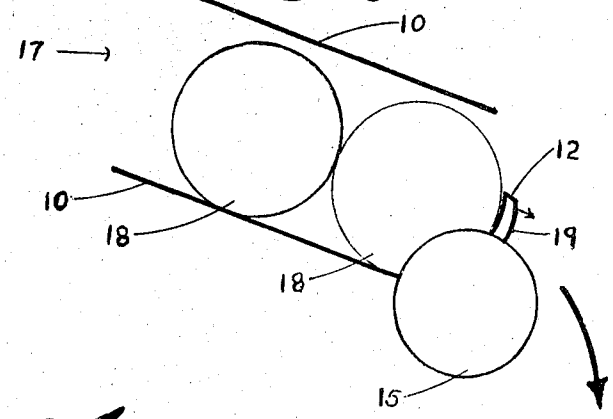


Fig 5

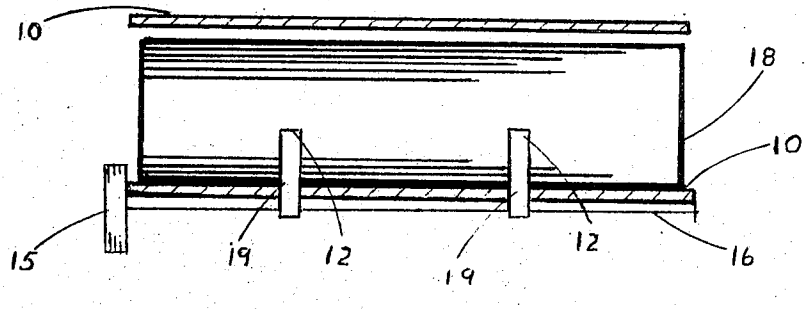


Fig 6

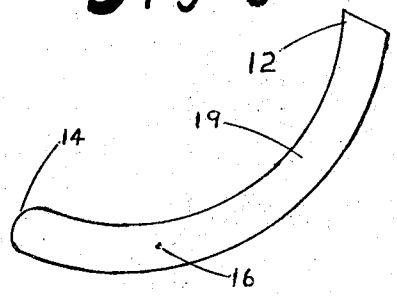
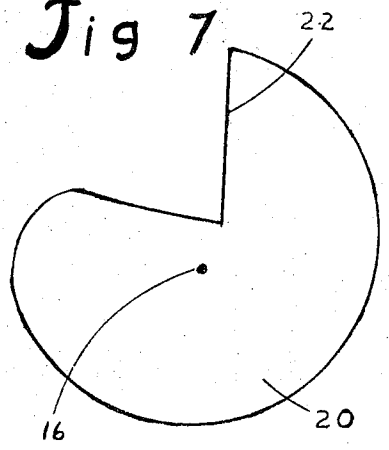


Fig 7



SOLID STATE VEND CONTROL MEANS AND PROCESS OF OPERATION

BACKGROUND OF THE INVENTION

The present invention relates to novel vending apparatus. More particularly, the present invention concerns a modular solid state system to perform all of the functions necessary in a vending machine including validation, accumulation, purchase selection and escapement means activation.

Vending machines have in the past been principally mechanical. Even those which were electrically operated have continued to be mechanical with an electrically driven power source. Similarly, the function of accumulation, that is, counting the amount of money deposited, has been a mechanical operation.

The use of so much mechanical hardware in vending machines has contributed greatly to their large size. However, no vending machine can be totally devoid of mechanical operations. In my invention, there are two mechanical operations —the insertion of the coin or currency into the machine and the mechanism that releases the goods and items being sold or dispenses the services to be sold. The remainder of the system operates through an arrangement of solid state modules. These solid state modules are each small and can be distributed at various convenient or available spaces in the vending machine, or they can very conveniently be placed on a single printed circuit board in such dead space as may exist in the machine.

It has been found that no additional space is required by the solid state circuitry of the present invention beyond that which will occur as a result of the usual dead space from cabinet design, such as the spacing between an outside design container and the internal storage area. Such available space is shown for example in my copending application Ser. No. 231,595 filed Mar. 3, 1972.

The modular solid state circuitry of the present invention is more economical to employ since the component parts are now very inexpensive and the amount of labor needed to install them is substantially less than that required for the mechanical substitutes.

The life expectancy of the modular solid state components is at least as good as that of the mechanical parts, since the modular solid state system of the present invention will exist in a very controlled environment, that is, the condition of use will be essentially the same each time since the system is acted on by a constant and controlled electrical force.

In a mechanical system there is the physical wear which can substantially affect the operation of the system and is generally more pronounced that that of a solid state system. Moreover, there is the constant variation in the force applied on a mechanical system from the user.

Furthermore, the modular arrangement of the present system simplifies troubleshooting and allows rapid repair of the circuitry of the machines.

Very briefly, my invention in its broadest aspect relates to a solid state system of modules, each of which is a preprogrammed digital logic circuit. Each such module can be described as a "computer" and the entire solid state system of individual modules may also be considered a computer in the sense that there is a program, an input and an output to the system. The

solid state vending apparatus of the present invention comprises:

means for receiving currency,

means for validating and accepting said currency,

solid state accumulator means for recording the amount of currency accepted by said vending machine, said solid state accumulator being programmed to emit an enable means when a predetermined amount of currency is recorded as having been accepted by said vending machine,

release control means controlling the operation of a release means and being activated by said enable means,

selector means operably connected to said release control means, and

release means.

Another aspect of the present invention is the use of a particular type of servo mechanism to operate the escapement mechanism. In the past an intermittent solenoid has frequently been employed as a means of operating the escapement mechanism that allows a vended item to pass out of the storage area into the delivery area where the customer can retrieve it. My new means of operating the escapement mechanism is a servo motor which has been found to be more dependable and quieter in operation than intermittent solenoids.

It is an object of this invention to provide a better overall system for operating a vending machine. It is a principal object of this invention to provide a modular solid state system for the operation of vending machines. It is a further object of the present invention to provide an integrated system of mechanical and modular solid state circuitry for the operation of vending machines. It is a further object of this invention to provide a means for operating the escapement mechanism.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram of the apparatus of the invention.

FIG. **2** is a diagram of one embodiment of the apparatus of the present invention employing a digital latch as the release control means.

FIG. **3** is a diagram of one embodiment of the apparatus of the present invention using a counter and stepper motor as the release control means.

FIG. **4** is a detail view in plan showing the escapement mechanism.

FIG. **5** is a front elevation of FIG. **4.**

FIG. **6** is a side elevation of retaining member **19.**

FIG. **7** is an alternate configuration of the retaining member.

DETAILED DESCRIPTION OF THE INVENTION AND SPECIFIC EMBODIMENTS

The present invention is readily adaptable to any type of vending machine, for example, food, records, toys, cigarettes, personal hygiene and grooming aids, and machines which vend services such as washing machines, driers, automated car washers and the like.

The term currency is used in a very broad sense and includes not only legal tender such as metal coins and paper bills but also includes script such as military payment certificates or especially prepared script, coins and the like for the particular machine.

In order to operate the vending apparatus as previously described, some form of currency is inserted into a receiver. Such receivers for coins, bills and script are well known in the art. Similarly, the boxes where these

items are deposited within the machine are well known and form no part of the invention.

The currency is carried into the currency validator which is also well known and commercially available device which is a part of this invention only in combination. Any of the commercially available currency validators can be employed. When the suitability of the deposited currency is verified, the currency is accepted and an electrical signal is sent to the accumulator which is the accounting section of the apparatus.

The accumulator must keep count of the currency which is deposited and when there is a sufficient quantity it will then send an electrical signal known as an "enable". The accumulator in this apparatus is a solid state digital circuit, and although it may represent a novel circuit, it is not part of the subject matter of this application. There are many solid state circuits which could be devised by those skilled in the art that would carry out this function of counting the currency and emitting a signal when the proper amount was accumulated.

The enabling signal emitted by the accumulator goes to the solid state release control means and actuates it. In order to cause the activated release control means to operate the release means, a signal must be sent from the selector means, which can be a button or switch which when closed sends a signal directly to the release control means. If the enable signal has been sent by the accumulator, then the two signals, i.e., the enable and the selector, cause the escapement to release one vended item or perform one task as the case may be.

There can, of course, be checks or safeguards incorporated into the system which will prevent the machine from giving out more than one selection or rendering more than one service for the accumulated amount. One such means is the deactivation of the system by the action of the release means (not shown). Similarly, means can be provided to prevent the selection of two items simultaneously. Such checks and safety devices are currently used with present-day and prior art machines and are of interest only in their practical commercial applications adjunct to the present invention.

In a further embodiment of the present invention, a particular release means is employed. The advantage of employing this particular release means is a much quieter, smoother operation of the machine over such commonly used prior art release means as intermittent solenoids and the like.

The release mechanism is shown in detail in FIGS. **4, 5, 6** and **7.** In essence, the mechanism involves a small motor which has an extended armature to which retaining members are attached. The motor can be preprogrammed to go through a certain sequence or can have its sequence of operation directed by the system described above. For example, a servo motor is rotated in one direction to release a vended item and rotated back into the off position to retain other items.

The operation will now be more fully described in regards to the figures. The servo motor release means is depicted here in FIGS. **4, 5, 6** and **7** in regard to a cylindrical object **18** to be vended from a downward sloping chute, however, the invention is not limited to that illustrative embodiment. The present invention is fully operable with other storage arrangements, such as vertical chutes and with containers of other shapes, such as, cubes or rectangles and the like.

The invention will be described in regard to FIG. **2.** The first step to initiate the operation of the apparatus is the deposit of currency. This is usually accomplished by some kind of holder which serves to place the currency into the currency validator where the currency, depending on its nature, is examined and evaluated by the validator. There are numerous types of validators available on the open market, however, an electrically operated type using solid state circuitry is preferred. Such a device for evaluating U.S. paper currency is available from National Rejectors Incorporated of St. Louis, Mo. If the currency is the proper type, it is validated and a signal (a bit) is transmitted to the accumulator which records each signal from the validator. For example, if the item being vended is priced at two dollars, the validator will validate each dollar bill deposited or the individual coins and transmit a signal for each that is accepted. The accumulator is adapted to record each signal in a cumulative manner and when the proper amount has been deposited and validated, the accumulator will send out a signal. In the present invention that signal is described as an "enable" and will be discussed shortly. The accumulator is programmed to accumulate a particular number of bits from the validator. The cumulative account kept by the accumulator can be derived from a single bit transmitted from the validator or a series of bits. In either event the effect is the same.

The enable which is sent out by the accumulator can also be described as a yes-bit, which is transmitted to each binary and-digital latch in the apparatus. In FIG. **2** there are illustrated four such and-digital latches. The digital latches operate in the usual manner. When a second signal or bit is fed to a particular latch from a corresponding selector, a signal is transmitted through the latch if the enable has been sent by the accumulator. The signal transmitted through the digital latch activates the actual mechanism that vends or renders a service. The number of digital latches in the system corresponds to the number of selections that can be made and will vary from one up. Usually there are from about 4 to 70 or 80 selections possible. The particular digital latches employed are and-digital latches. The enable signal provides one of the and-elements and the other and-element is supplied by the selection means. As stated above in one embodiment, the release mechanism can be a motor or servo motor.

Referring now to FIGS. **4, 5, 6** and **7** it can be seen that the items to be vended **18** are cylindrical. They can be containers used to carry the items or the items themselves.

The cylinders **18** are in a chute **17** formed by slanted trays **10.** The cylinders are held in place by retaining member **19** which is shown in detail in FIG. **6.** Retaining member **19** has a retaining end **12** and a stop **14** and is fixedly mounted on rod **16.** The rod **16** is attached to the armature of servo motor **15** (in the figures rod **16** is an extended armature). The figures show the retaining member **19** in the off or static position where retaining end **12** is holding the cylinders **18** in chute **17.** The inertia of the armature **16** in the motor **15** can be adapted to maintain the retaining member **19** in the off position or it can be aided by a biasing means (not shown) to hold the load against the pull of gravity.

The transmission of a signal from the digital latch will activate the motor **15.** The signal from the digital latch will usually activate a relay which allows a current to

pass to the motor **15**. The signal from the latch can be used to operate the motor **15**, however, it may be desirable to use different currents in the solid state system and the motor, thus the use of the relay would be desirable, in either event the effect is the same. The motor **15** is activated and rotates in a clockwise direction. The retaining member **19** depicted in FIGS. **4, 5** and **6** will rotate through an arc of less than 360°, usually less than about 180°, sufficient to allow the first cylinder **18** in chute **17** to fall forward by force of gravity. When retaining member **19** rotates clockwise end **12** is moved out of the path of the first cylinder **18**, and stop **14** comes into the path of the next succeeding cylinder **18** to prevent it from falling from chute **17**. In FIGS. **4, 5** and **6** motor **15** will rotate in a counterclockwise direction at the end of the predetermined arc and resume the off position. The nexy cylinder **18** in line will come to rest against end **12** of retaining member **19** and the apparatus will be ready for a repeat of the sequence described above. The same result can be achieved by attaching a slotted reciprocating arm (not shown) to a flywheel (not shown) on the motor **15** and to a lever arm (not shown) on rod **16**.

FIG. **7** shows an alternate form of retaining member **19** which can be used in the sequence described above or can be used with the motor **15** making one complete revolution. By making a complete revolution the entire outer surface of retaining member **20** acts as stop **24**. The retaining end is surface **22**. The retaining member **20** can be circular, elliptical or irregular in shape and is mounted on rod **16** so that the outer surface will serve to retain the cylinder **18** after the first one in line drops into chute **17**.

After the container drops from chute **17** it will arrive in an area (not shown) where it can be retrieved by the purchaser.

Although the release mechanism is shown at the lower side of the chute **17** it will be recognized that the mechanism can also be installed at the upper side of the lower end of the chute **17**.

Referring to FIG. **3**, a second embodiment of the apparatus of the invention is shown. In FIG. **3** the currency deposit, the validator, the accumulator and the enable operate as shown above in regard to FIG. **2**. However, in the apparatus shown in FIG. **3** the enable signal is fed to a counter means thus activating the counter means and allowing a selection to be made. There are selector means which are each connected to the counter means, a motor control means which controls a stepper motor, a comparator means and a release means.

The function of the counter means is to direct the motor control means to move the stepper motor. Each selector means is equivalent to a certain number of steps from a zero point for the stepper motor. Thus, the activation of a particular selector means (after the enable has been sent) will cause the counter means to direct the motor control means to move the stepper motor. In order to accurately regulate the operation of the motor control means, there is a comparator means which will stop the motor control means when the number of steps moved from the zero point corresponds to the number of steps keyed to the activating selector. Although not shown here, the comparator means can be equipped with a memory means so that the stepper motor will not have to return to the zero point after each selection. Instead, the memory means will record where the stepper motor stopped after its last use and when a subsequent selector, if different from the one which located the stepper motor in the preceding sequence, is activated (after the enable is sent) the memory means will direct the stepper motor in the correct direction from its starting location to result in the final position for that sequence corresponding to the number keyed to the second selector.

A stepper motor is defined as a motor the normal operation of which consists of discrete angular motions of essentially uniform magnitude, rather than continuous rotation. For example, each "step" could consist of a quarter of a degree of an arc, thus giving 1,440 steps. These steps can be correlated to a particular position along a path. In this example assume that there are ten vending chutes, each of said chutes having a release mechanism located at step **100, 200, 300,** etc., the final release mechanism being at step **1000.** There are 10 selector means corresponding to each of the chutes. For illustrative purposes, first on the apparatus without the comparator memory means, a selector corresponding to step **700** is activated. The counter means directs the motor control means to move the stepper motor 700 steps. When the motor reaches the 700th step the release mechanism is activated, releasing a vended item and the stepper motor then returns to the zero position and is deactivated. Each sequence is the same with the stepper motor returning to the zero position after release of the vended item.

In the same vending setup as described above but with a memory means on the comparator means, after the completion of a selection corresponding to 700 steps, the stepper motor remains at step **700.** If the next selection corresponds to step **300,** for example, the memory will direct the stepper motor to move towards the zero position until the motor control has moved the stepper motor 400 steps. The advantage of the memory as part of the comparator is a shorter delay between selections, since it is not necessary that the stepper motor return to the zero position. The counter means, the motor control means, the comparator and the comparator memory (not shown) are solid state modules of standard design for performing the particular functions described above and form a part of this invention in combination.

The invention claimed is:

1. A vending apparatus that receives and accepts currency comprising:

solid state accumulator means for recording the amount of currency accepted by said vending apparatus, said solid state accumulator being programmed to emit an enable means when a predetermined amount of currency is recorded as having been accepted by said vending apparatus, and

solid state release control means comprising a binary and-digital latch for controlling the operation of a release means and being activated by said enable means.

2. The vending apparatus according to claim **1** comprising:

means for receiving currency,

means for validating and accepting said currency, and

selector means operably connected to said release control means, and

release means.

3. The vending apparatus according to claim 2 comprising a plurality of selector means.

4. The vending apparatus according to claim 1 wherein said release means comprises a motor operably attached to a rod, said rod having a retaining member fixedly mounted thereon.

5. The vending apparatus according to claim 4 wherein said motor rotates in one direction through an arc of less than 360°, then rotates in the opposite direction through the same arc.

6. The vending apparatus according to claim 5 wherein said motor makes one complete revolution.

7. The process of operating a vending apparatus comprising the steps of:

a. receiving currency,
b. validating and accepting said currency,
c. recording the amount of currency validated and accepted in a solid state accumulator means,
d. emitting a bit from said accumulator means when a predetermined amount of currency is recorded,
e. receiving said bit in a solid state release control means comprising a binary and-digital latch enabling said release control means to function.
f. emitting a signal from a selector means operably connected to said release control means,
g. receiving said signal in said release control means, and
h. said release control means activating a release means.

8. The process of operating a vending apparatus according to claim 7 wherein said release means comprises a motor that rotates through an arc of less than 360° in one direction, then rotates in the opposite direction through the same arc.

9. The process according to claim 7 wherein said release means is a motor that makes one complete revolution.

10. The vending apparatus according to claim 3 wherein each selector means corresponds to a single predetermined sequence.

11. A vending apparatus that receives and accepts currency comprising:

a solid state accumulator means for recording the amount of currency accepted by said vending apparatus, said solid state accumulator being programmed to emit an enable means when a predetermined amount of currency is recorded as having been accepted by said vending apparatus, and,

solid state release control means for controlling the operation of a release means and being activated by said enable means, comprising a counter means being adapted to direct a motor control means to operate a stepper motor means through a predetermined sequence and a comparator means, operably associated with said counter means and said motor control means when said motor control means has operated said stepper motor through said predetermined sequence.

12. The vending apparatus according to claim 3 comprising a plurality of release control means comprising digital latches, each of said selector means corresponding to a single binary and-digital latch.

13. The vending apparatus according to claim 1 wherein said release control means comprises a counter means being adapted to direct a motor control means to operate a stepper motor means through a predetermined sequence and a comparator means, operably associated with said counter means and said motor control means, being adapted to deactivate said motor control means when said motor control means has operated said stepper motor means through said predetermined sequence.

* * * * *