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MULTIPLE COIN-CONTROLLED MEANS FOR VENDING MACHINES

Original Filed Nov. 10, 1951

3 Sheets-Sheet 1

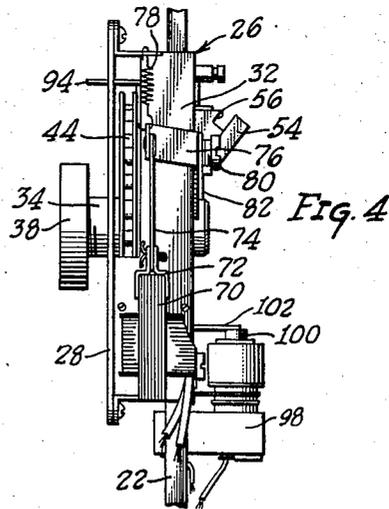
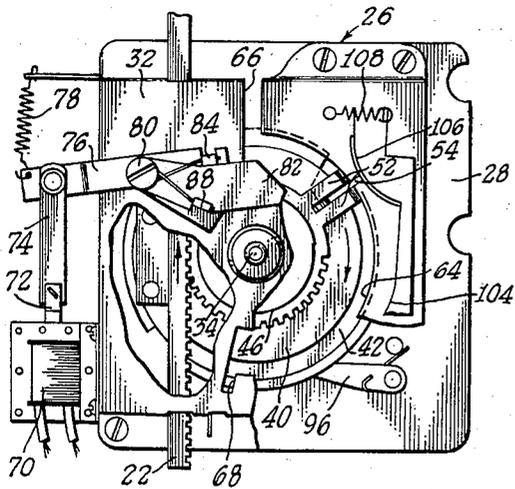
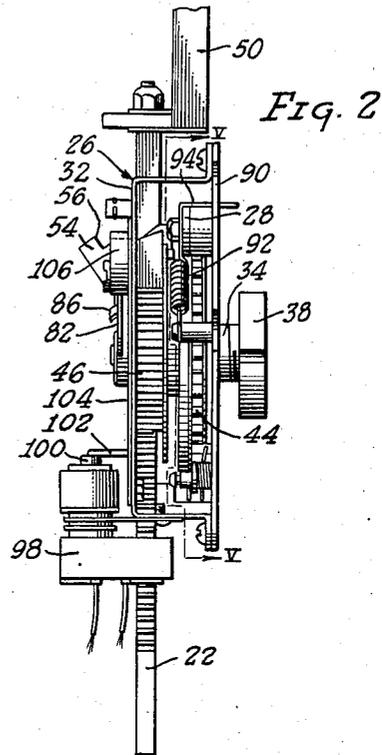
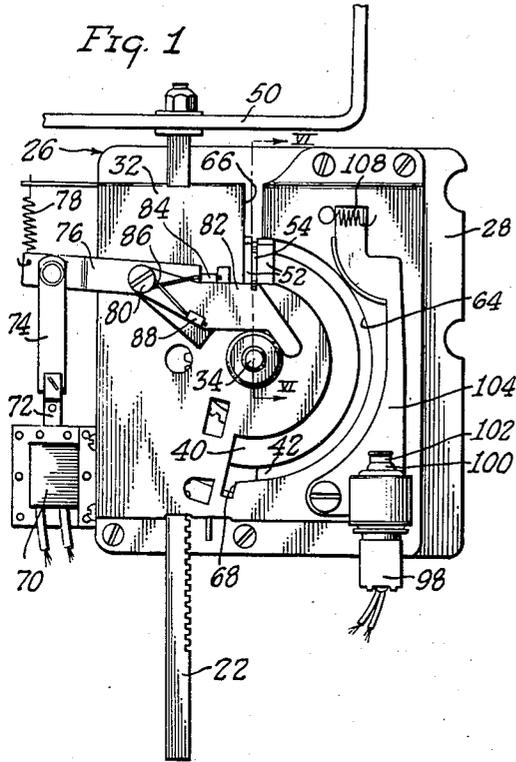


Fig. 3

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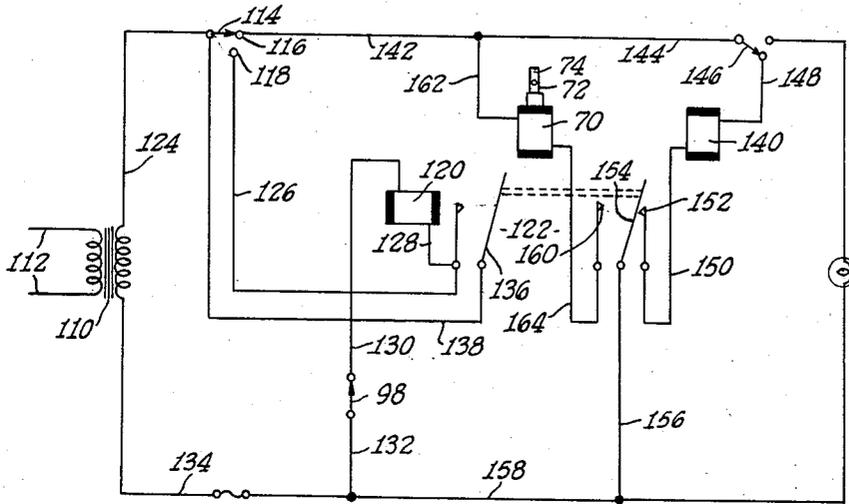


FIG. 8

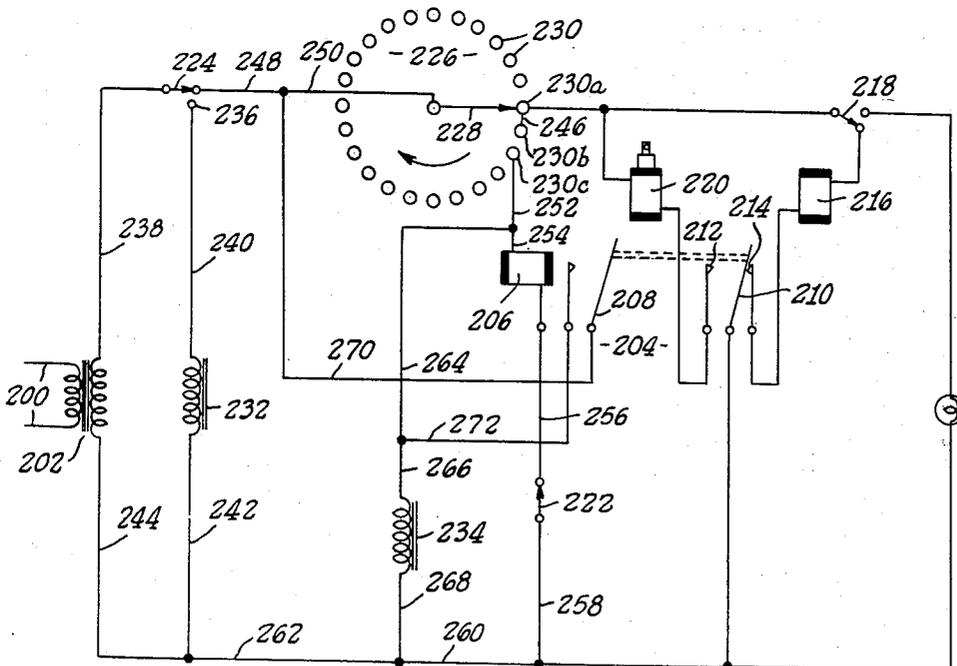


FIG. 9

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1

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MULTIPLE COIN-CONTROLLED MEANS FOR VENDING MACHINES

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Original application November 10, 1951, Serial No. 255,827, now Patent No. 2,711,236, dated June 21, 1955. Divided and this application April 19, 1955, Serial No. 502,343

16 Claims. (Cl. 194—10)

This invention relates to vending machines of the kind disclosed in U. S. Letters Patent No. 2,474,053, of June 21, 1949 (Elmer C. Johnson et al.), and has for its primary object the provision of improved control structure operable by the customer, through opening of an access door, to rotate an index plate and a magazine, step-by-step on insertion of one or more coins in payment for merchandise vendable through the opening made available by actuation of said door.

It is the most important object of the present invention to provide a control unit for governing rotation of the aforesaid magazine and guard plate within the vending machine cabinet, which unit includes novel mechanism to interconnect a drive shaft and a driven shaft upon insertion of the purchase price of the merchandise to be vended, which interconnection is operable separately from the coin or coins rather than being connected thereby as in the case of the aforesaid patent.

It is another object of the present invention to provide in a bottle vending machine, a reciprocable access door that is in turn connected with a rotatable pinion through the medium of an elongated rack, the pinion being connectable with a notched disc joined rigidly to a drive shaft through the medium of a swingable latch that is actuated upon insertion of the coin by a potential customer.

Another object hereof is to provide a control unit wherein the aforesaid latch is held at one end of its path of travel connecting a pair of rotatable members by means of an arcuate plate, the latch having a notch formed therein for receiving the plate and being automatically released as the rotatable members are moved to one end of their paths of travel.

Another object hereof is to provide a control unit wherein the aforesaid latch is rendered releasable for subsequent operations notwithstanding the possibility that the access door is open at the time of insertion of the coin.

Another important feature of the present invention lies in the provision of a novel electric circuit for the control unit so arranged as to avoid "jackpotting" by requiring a coin-control switch to return to its normal standby position before the rotatable members aforementioned, may be interconnected.

It is another object hereof to provide an electric circuit as aforesaid, that includes a stepping switch permitting use of the unit where a multitude of coins is required to purchase an article of merchandise and have the same vended from the machine.

Other objects include many important details of construction, all of which will be made clear or become apparent as the following specification progresses, reference being had to the accompanying drawings, wherein:

Figure 1 is a front elevational view of the control unit forming a part of multiple coin-controlled means for vending machines made pursuant to the present invention, with the case therefor entirely removed.

Fig. 2 is an edge elevational view thereof.

2

Fig. 3 is a rear elevational view of the control unit, parts being broken away for clearness.

Fig. 4 is an elevational view showing that edge of the unit opposite to Fig. 2.

Fig. 5 is a vertical, cross-sectional view taken on irregular line V—V of Fig. 2, looking in the direction of the arrows.

Fig. 6 is an enlarged, fragmentary, cross-sectional view taken on line VI—VI of Fig. 1, looking in the direction of the arrows.

Fig. 7 is a fragmentary, cross-sectional view through a vending machine such as disclosed in the aforesaid patent showing the control unit in plan, parts being broken away to reveal details of construction.

Fig. 8 is a schematic wiring diagram illustrating one form of electrical control for the unit.

Fig. 9 is a schematic wiring diagram illustrating another form of electrical control for the unit; and

Fig. 10 is a fragmentary perspective view of the reciprocable access door.

The control unit forming the subject matter of the present invention, and constituting an improvement over the control means of the aforesaid U. S. Patent No. 2,474,053, which is incorporated herein by reference, is designed for use with a vending machine similar to said patent and illustrated in part by Fig. 7 of the drawings.

Cabinet 10 is provided with a main door 12 hingedly secured for access to the interior of the cabinet and particularly to a rotatable magazine carrying merchandise to be vended such as beverage bottles. Such magazine is provided with a rack 14 meshing with a pinion 16 connected through a train of gears 18, with a driven shaft 20, all disposed within the cabinet 10.

A small access door is swingably secured to the main, hingedly mounted door in said Patent No. 2,474,053, but according to the present invention, it is contemplated that such relatively small access door 21 be vertically reciprocable between guide tracks 23 within the door 12 (Fig. 10) and connected with a vertically reciprocable rack 22 (Figs. 1—4) that extends upwardly through a top wall 24 of the control unit 26 (Fig. 7). Unit 26 includes a rear wall 28 secured directly to innermost wall 30 of the door 12, together with a U-shaped plate 32 having wall 24 integral therewith and joined to the wall 28. Plate 32 and wall 28 of the unit 26, rotatably carry a drive shaft 34, shafts 20 and 34 being provided with interlocking lugs 36 and 38 respectively, capable of separating to permit opening and closing of the door 12.

A pair of discs 40 and 42 are carried by the shaft 34 between the plate 32 and the wall 28, disc 42 being in turn secured to a gear 44 that is rigidly mounted on the shaft 34. Disc 40 is rigidly secured to a pinion 46, disc 40 and pinion 46 both being rotatable on the shaft 34. As shown in Fig. 7 of the drawing, the gear 44 is in mesh with an index or guard plate 48 within the door 12 and serving the same purpose as the guard plate illustrated in said Johnson et al. patent. The pinion 46 is in mesh with rack 22 and in accordance with the present invention, insertion of a suitable coin or coins by the customer, operates to interconnect the pinion 46 with the disc 42 so that upward movement of the access door and accordingly, of the rack 22, operates to rotate the shafts 20 and 34 substantially 180°, which in turn imparts rotative movement to the rack 14 and the plate 48.

A bracket 50, shown in Figs. 1, 2 and 10 of the drawings, serves to join the reciprocable door 21 with rack 22. A pair of outwardly extending radial ears 52 on the pinion 46, swingably carries a latch 54 having a notch 56 formed therein. The disc 40, cut away to receive the ears 52 and the latch 54 as shown in Fig. 6, permits swinging movement of latch 54 toward and away from the disc

42 and into either of a pair of notches 58 and 60 formed in the disc 42. It is notable in Fig. 5 of the drawings, that the disc 42 is not truly circular but comprises a pair of relatively offset semi-circular portions on each side respectively of the notches 58 and 60.

Latch 54 is held biased toward the outermost end of its path of travel as illustrated by full lines in Fig. 6 of the drawings, through the medium of a leaf spring 62 secured to the innermost face of the disc 40. Latch 54 is disposed within a substantially semi-circular slot 64 formed in the plate 32 concentric with shaft 34. Plate 32 is also provided with a pair of diametrically opposed latch-receiving openings 66 and 68, defining the opposite ends of the semi-circular slot 64.

Means for actuating the latch 54 to move the same to the innermost end of its path of travel within one of the notches 58 or 60, as illustrated by dotted lines in Fig. 6 of the drawings, includes an electromagnet 70, having a reciprocable core 72 pivotally joined to a short link 74 that is in turn pivotally secured to an arm 76. Core 72 is held biased toward the uppermost end of its path of travel by a spring 78 joined to the arm 76. Arm 76 is pivotally secured by means of pin 80 to the plate 32, the latter also swingably mounting a finger 82 that partially overlaps the arm 76. Finger 82 is disposed beneath a lug 84, struck from the arm 76, and a spring 86 on the pin 80 is provided with crossed legs engaging the lug 84 and a similar lug 88 on the finger 82. Spring 86 yieldably holds the finger 82 biased against the lug 84, finger 82 being disposed between the latch 54 and shaft 34, swings the latch 54 to the dotted-line position shown in Fig. 6 of the drawings upon energization of electromagnet 70 to retract core 72 downwardly against the action of spring 78.

A pawl 90, swingably carried by the wall 28 between plate 32 and wall 28, is held biased against the periphery of disc 42 by means of a spring 92. Pawl 90 normally engages the disc 42 within one of the notches 58 or 60 as shown in Fig. 5 of the drawings, to hold the disc 42 and accordingly, the shafts 34 and 20 against rotation clockwise, viewing Fig. 5.

A cam 94 on the pawl 90 is disposed within the path of travel of the latch 54 when the same is in the dotted-line position shown in Fig. 6 of the drawings, and upon rotation of the pinion 46 as will hereinafter be made clear.

Another spring-loaded pawl 96 on the wall 28, engages the teeth of gear 44 to hold the latter against rotation anti-clockwise viewing Fig. 5.

A normally closed switch 98 secured to the unit 26 is provided with an actuating button 100, within the path of travel of a lateral extension 102 on an arm 104 swingably secured to the plate 32. Arm 104 has an arcuate cam 106 near the uppermost end thereof within the path of travel of latch 54 when the same is rotated, and a spring 108 holds the arm 104 biased toward the slot 64.

Operation of the unit 26 may be more easily understood after reference to the wiring diagram of Fig. 8, wherein is shown an electric circuit receiving power through a transformer 110 coupled with lead lines 112 that are in turn connected with a source of electrical power not shown.

The machine is normally provided with a slug rejector not shown, which receives all coins inserted by the customers and accepted coins emanating from the rejector, engage a switch 114, moving the same from a stationary contact 116 to a contact point 118. Such movement of switch 114 energizes coil 120 of a holding relay 122 through the following circuit:

From transformer 110 through line 124, switch 114, contact point 118, lines 126 and 128, coil 120, line 130, normally closed switch 98 aforementioned, and lines 132 and 134 to transformer 110.

Such energization of the coil 120, closes switch 136 to hold the relay 122 closed after switch 114 returns to the

position illustrated in Fig. 8, engaging contact 116 through the following circuit:

From transformer 110, through lines 124 and 138, switch 136, line 128, coil 120, line 130, switch 98 and lines 132 and 134, to transformer 110.

It is thus seen that the coin switch 114 must return to its normal position before electromagnet 70 is energized, thereby preventing the machine from "jackpotting" in case the coin switch 114 should fail and remain in the actuated position engaging contact point 118.

The coin rejector aforementioned, is provided conventionally with a gate not shown, for blocking inserted coins or for deflecting the same to a coin-return chute. Such gate is operated through the medium of a solenoid 140 that is normally energized through the following circuit:

From transformer 110, through line 124, switch 114, lines 142 and 144, normally closed "Sold-Out" switch 146, line 148, solenoid 140, line 150, stationary contact 152, swingable contact arm 154 and lines 156, 158 and 134 to transformer 110.

Switch 136 and arm 154 are ganged together for simultaneous movement and accordingly, when the coil 120 of relay 122 is energized, the arm 154 will move away from the contact 152 into engagement with a stationary contact 160 to deenergize the solenoid 140, thereby closing the gate of the coin-reject mechanism.

While the vending machine hereof is in operation, therefore, any coins subsequently inserted, will be deflected and returned to the customer. Similarly, structure is provided and not herein shown for operating switch 146 when the machine is sold out of merchandise, thereby deenergizing the solenoid 140 and causing the machine to reject coins inserted by a potential customer. With relay 122 thus held closed, and arm 154 engaging contact 160, the electromagnet 70 is energized through the following circuit:

From transformer 110, through line 124, switch 114, contact 116, lines 142 and 162, electromagnet 70, line 164, contact 160, arm 154 and lines 156, 158 and 134, to transformer 110.

Energization of the electromagnet 70, pulls the core 72 downwardly to swing arm 76 and finger 82 on pivot pin 80. Upward movement of the finger 82 swings the latch 54 from the full-line position shown in Fig. 6 of the drawings, to the dotted-line position, through the uppermost opening 66 and into one of the notches 58 or 60 of plate 42. Notch 56 of latch 54 becomes aligned with the plate 32, and as soon as the customer shifts the access door upwardly, rack 22 likewise moves from the position shown in Fig. 1 of the drawings in the direction of the arrow illustrated by Fig. 3. Rack 22, acting on the pinion 46, actuates the latter together with the disc 40 in the direction indicated by the arrow in Fig. 3 of the drawings.

Latch 54 is held in the dotted-line position shown in Fig. 6 of the drawings even after moving away from the finger 82 by virtue of its engagement through notch 56 with the plate 32 adjacent the arcuate slot 64 within which latch 54 swings. During its initial swinging movement from the position shown in Fig. 1 of the drawings toward the opening 68, the latch 54 engages the cam 94, thereby swinging the pawl 90 to the dotted-line position shown in Fig. 5, releasing the disc 42 and accordingly, the gear 44, as well as the shafts 34 and 20 for rotative movement. Pawl 90 is held biased against the periphery of disc 42 by spring 92 until notch 60 moves to a point adjacent pawl 90 whereupon the latter again engages disc 42 to hold the same against further movement in the direction of the arrow shown in Fig. 3.

As the latch 54 moves to the position illustrated in Fig. 3 of the drawings, it engages the cam 106 to swing the arm 104 against the action of spring 108, whereupon the switch 98 is opened through lateral extension 102 and actuating button 100. Such opening of the switch 98 deenergizes the coil 120 of holding relay 122

(Fig. 8), which in turn releases switch 136 and arm 154 to deenergize the electromagnet 70. Finger 82 returns to the lowermost end of its path of travel as shown in Fig. 1 of the drawings, by the action of spring 78. After the customer has moved the access door to the uppermost end of its path of travel, latch 54 will have moved along the slot 64 to a point within the lowermost opening 68 of the plate 32, at which time spring 62, acting on latch 54, swings the latter outwardly and out of engagement with the notch 58 of disc 42. Pawl 96 operates to hold the shafts 34 and 20 against rotation in one direction, and the pawl 90 operates to hold such shafts against rotation clockwise, viewing Fig. 5. As soon as latch 54 thus moves out of engagement with the plate 32, the access door may be closed, thereupon returning the rack 22 to the position shown in Fig. 1 of the drawings, and rotating the pinion 46 as well as the disc 40, and the latch 54 back to the normal position shown in Fig. 1.

During the next cycle of operation, the latch 54 engages within the notch 60 of the disc 42.

In the event the access door is left open and remains open after insertion of a coin by a subsequent purchaser, such energization of the electromagnet 70 does not retard the return of latch 54 to its normal position. In other words, if finger 82 is at the uppermost end of its path of travel by virtue of a subsequent coin insertion, the next purchaser must, and may, re-close the door which swings the latch 54 in alignment with the opening 66. As latch 54 contacts finger 82, the latter will be swung downwardly toward the shaft 34, against the action of spring 86 on pivot 80. As soon as latch 54 aligns with opening 66, it will be forced toward the disc 42 by the finger 82, through the action of spring 86, whereupon re-opening of the door will rotate shaft 20, rack 14 and index plate 48, as above described.

The above described construction contemplates the insertion of but a single coin in the machine as the purchase price of an article of merchandise to be vended thereby. In Fig. 9 of the drawings, there is illustrated a wiring diagram including parts for rendering the machine operable only upon insertion of one or more coins, it being understood however, that the arrangement of Fig. 8 is to be preferred if only a single coin is used. Lead lines 200, transformer 202, holding relay 204 having a coil 206, switch 208, movable contactor 210, stationary contacts 212 and 214, solenoid 216, switch 218, electromagnet 220 and switch 224 in Fig. 9 of the drawings, are all comparable to like parts above described and shown in Fig. 8 of the drawings. In Fig. 9 however, there is additionally provided a stepping switch 226 having a rotatable contact arm 228 and a plurality of stationary contacts 230 within the path of travel of arm 228.

A stepping coil 232 and a re-set coil 234, are provided for the stepping switch 226. The coil 206 of relay 204, is connected with one of the contacts 230 depending upon the number of coins to be inserted in the machine for receiving an article of merchandise.

When the first coin is inserted, switch 224 is moved into engagement with contact 236, comparable to contact 118, to energize the stepper coil 232, through the following circuit:

From transformer 202, through line 238, switch 224, contact 236, line 240, coil 232 and lines 242 and 244, to transformer 202.

Such energization of coil 232 moves arm 228 from stationary contact 230a to contact 230b, that are connected by line 246. Upon insertion of a second coin, switch 224 is again actuated to operate coil 232, thereby moving arm 228 into engagement with stationary contact 230c. Relay coil 206 is thereupon energized as follows:

From transformer 202, through line 238, switch 224, lines 248 and 250, arm 288, contact 230c, lines 252 and

254, coil 206, line 256, switch 222, and lines 258, 260, 262 and 244, to transformer 202.

Simultaneously, reset coil 234 is energized to return arm 228 to its normal position engaging contact 230a, through the following circuit:

From transformer 202, through line 238, switch 224, lines 248, 250, arm 228, contact 230c, lines 252, 264 and 266, coil 234 and lines 262 and 244, to transformer 202.

Relay 204 is held closed after closing of switch 208, through the following circuit:

From transformer 202, through line 238, switch 224, lines 248 and 270, switch 208, lines 272, 264 and 254, coil 206, line 256, switch 222 and lines 258, 260, 262 and 244, to transformer 202.

The remaining operation is identical with that above described and need not be repeated. While, in Fig. 9, line 252 is shown joined with contact 230c, it can now be appreciated as aforementioned, that such coupling may be changed as desired to force the customer to insert a relative large number of coins in order to secure vending of the merchandise desired.

This is a division of my copending application, Serial No. 255,827, filed November 10, 1951, now Patent No. 2,711,236.

Having thus described the invention what is claimed as new and desired to be secured by Letters Patent is:

1. In a vending machine, a cabinet provided with article vending apparatus rotatable therewith and a door slidably supporting a manually operated, upright closure vertically reciprocable rectilinearly to and from an open position rendering said apparatus accessible, in combination with means for rotating said apparatus upon shifting of the closure to said open position comprising a rotatable driven device; mechanism operably connecting the device with said apparatus for rotating the latter as said device is rotated; a drive element normally rotatable with respect to said device; structure coupling the closure with said element for converting reciprocable motion to rotative motion whereby said element is rotated as the closure is shifted; a member shiftable to and from a locked position interconnecting said element and said device for driving the latter as the closure is shifted to said open position; power means engageable with said member for shifting the latter to said locked position, whereby shifting of the closure operates to rotate said apparatus only after energization of said power means; and an assembly responsive to movement of the closure means to said open position when the member is in its locked position for deenergizing the power means.

2. The invention as set forth in claim 1 wherein said power means includes an electric prime mover; an electric circuit for the prime mover; and coin controlled switch means movable to and from a position closing the circuit through the prime mover.

3. The invention as set forth in claim 2 wherein is provided electric holding means coupled with circuit for maintaining the prime mover energized after opening of the switch means.

4. The invention as set forth in claim 3 wherein said member is rotatable with the element and wherein is provided guide means engageable with said member as the same rotates with said element for holding the member in the locked position after deenergization of the holding means.

5. The invention as set forth in claim 4 wherein said assembly is operably coupled with the holding means for deenergizing the latter, said assembly having a movable part disposed within the path of rotation of the member for engagement and movement by said member as the latter moves with said element.

6. In a vending machine, a cabinet provided with article vending apparatus rotatable therewith and a door slidably supporting a manually operated, upright closure vertically reciprocable rectilinearly to and from an open position rendering said apparatus accessible, in combina-

tion with means for rotating said apparatus upon shifting of the closure to said open position comprising a rotatable driven device; mechanism operably connecting the device with said apparatus for rotating the latter as said device is rotated; a drive element normally rotatable with respect to said device; structure coupling the closure with said element for converting reciprocable motion to rotative motion whereby said element is rotated as the closure is shifted; a member carried by said element for rotation therewith and shiftable with respect to the element to and from a locked position interconnecting said element and said device for driving the latter as the closure is shifted to said open position; power means engageable with said member for shifting the latter to said locked position, whereby shifting of the closure operates to rotate said apparatus only after energization of said power means; and an assembly responsive to movement of the closure means to said open position when the member is in its locked position for deenergizing the power means.

7. The invention as set forth in claim 6 wherein is provided means within the path of rotation of said member when the member is in said locked position and as the same rotates with said element for holding the member in the locked position after deenergization of the power means.

8. The invention as set forth in claim 7, said assembly having a movable part disposed within said path of rotation of the member when the latter is in said locked position and as the same moves with said element for engagement and movement by the member.

9. In a vending machine, a cabinet provided with article vending apparatus rotatable therewith and a door slidably supporting a manually operated, upright closure vertically reciprocable rectilinearly to and from an open position rendering said apparatus accessible, in combination with means for rotating said apparatus upon shifting of the closure to said open position comprising a rotatable driven device; mechanism operably connecting the device with said apparatus for rotating the latter as said device is rotated; a pinion normally rotatable with respect to said device; a vertically reciprocable rack coupling the closure with said pinion for rotating the latter as the closure is shifted; a member shiftable to and from a locked position interconnecting said pinion and said device for driving the latter as the closure is shifted to said open position; power means engageable with said member for shifting the latter to said locked position, whereby shifting of the closure operates to rotate said apparatus only after energization of said power means; and an assembly responsive to movement of the closure means to said open position when the member is in its locked position for deenergizing the power means.

10. In a vending machine, a cabinet provided with article vending apparatus rotatable therewith and a door slidably supporting a manually operated, upright closure vertically reciprocable rectilinearly to and from an open position rendering said apparatus accessible, in combination with means for rotating said apparatus upon shifting of the closure to said open position comprising a rotatable driven device; mechanism operably connecting the device with said apparatus for rotating the latter as said device is rotated; a pinion normally rotatable with respect to said device; a vertically reciprocable rack coupling the closure with said pinion for rotating the latter as the closure is shifted; a member carried by said pinion for rotation therewith and shiftable with respect to the pinion to and from a locked position interconnecting said pinion and said device for driving the latter as the closure is shifted to said open position; power means engageable with said member for shifting the latter to said locked position, whereby shifting of the closure operates to rotate said apparatus only after energization of said power means; and an assembly responsive to movement of the closure means to said open position when the member is in its locked position for deenergizing the power means.

11. In a vending machine having rotatable apparatus and a reciprocable access door, a control unit for rotating said apparatus upon opening of the door, said unit including a shaft coupled with said apparatus; a rotatable member; means coupling the door and the member; a latch swingable to and from a position interconnecting the member and the shaft; power means for swinging the latch to said position and an assembly responsive to opening of the door when the latch is in said position for deenergizing said power means.

12. In a vending machine having rotatable apparatus, and a reciprocable access door, a control unit for rotating said apparatus upon opening of the door, said unit including a shaft coupled with said apparatus; a rotatable member; means coupling the door and the member; a latch swingable to and from a position interconnecting the member and the shaft; power means for swinging the latch to said position; an assembly responsive to opening of the door when the latch is in said position for deenergizing said power means; and means for maintaining the latch in said position during opening of the door and after deenergization of said power means.

13. In a vending machine having rotatable apparatus, and a reciprocable access door, a control unit for rotating said apparatus upon opening of the door, said unit including a shaft coupled with said apparatus; a rotatable pinion; a reciprocable rack coupling the door and the pinion; a latch swingable on the pinion to and from a position interconnecting the pinion and the shaft; power means for swinging the latch to said position; and an assembly responsive to opening of the door when the latch is in said position for deenergizing said power means.

14. In a vending machine having rotatable apparatus, and a reciprocable access door, a control unit for rotating said apparatus upon opening of the door, said unit including a shaft coupled with said apparatus; a rotatable member; means coupling the door and the member; a latch swingable on the member to and from a locking position interconnecting the member and the shaft; structure including electromagnetic means for swinging the latch to said position; a power circuit for said electromagnetic means; a holding circuit; a switch movable to a position closing said power circuit through the holding circuit; and an assembly responsive to opening of the door when the latch is in said locking position for deenergizing said holding circuit.

15. In a vending machine having rotatable apparatus, and a reciprocable access door, a control unit for rotating said apparatus upon opening of the door, said unit including a shaft coupled with said apparatus; a rotatable member; means coupling the door and the member; a latch rotatable with the member and swingable thereon to and from a position interconnecting the member and the shaft; structure including electromagnetic means for swinging the latch to said position; a power circuit for said electromagnetic means; a holding circuit; a switch movable to a position closing said holding circuit and thence to a position closing said power circuit; and a normally closed switch in said holding circuit and having an actuator within the path of rotation of said latch for deenergizing the electromagnetic means as the door is opened.

16. In a vending machine having rotatable apparatus, and a reciprocable access door; a control unit for rotating said apparatus upon opening of the door, said unit including a shaft coupled with said apparatus; a rotatable member; means coupling the door and the member; a latch rotatable with the member and swingable thereon to and from a locking position interconnecting the member and the shaft; an electromagnet for swinging the latch to said position; a stepping device; means for stepping said device; an electric circuit for the electromagnet; means coupling the circuit with said electromagnet through said device upon stepping of the latter to

a predetermined position; and an assembly responsive to opening of the door when the latch is in said locking position for deenergizing said electromagnet.

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