

Oct. 29, 1963

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3,108,741

ELECTRICAL INTERLOCK SYSTEM FOR FARE COLLECTION APPARATUS

Filed Oct. 30, 1961

3 Sheets-Sheet 1

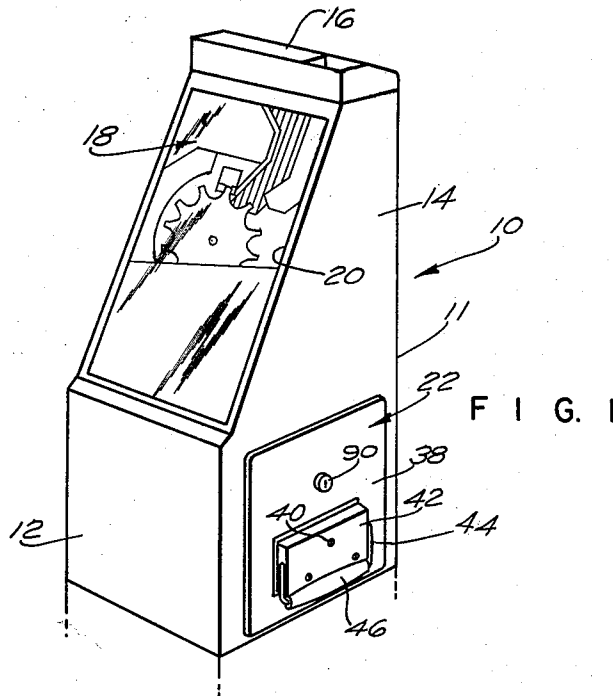


FIG. 1

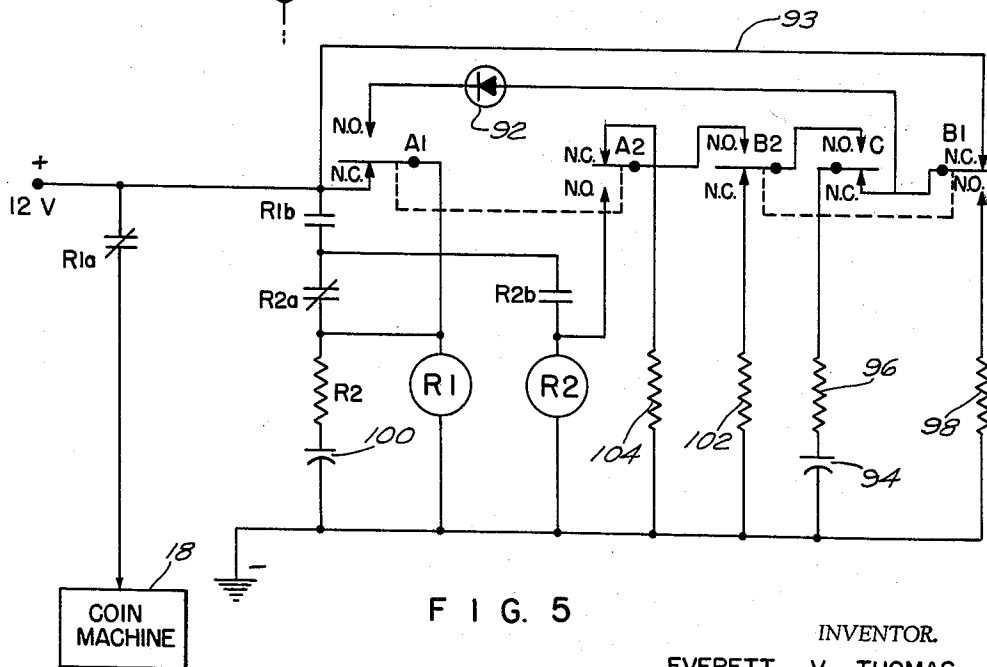


FIG. 5

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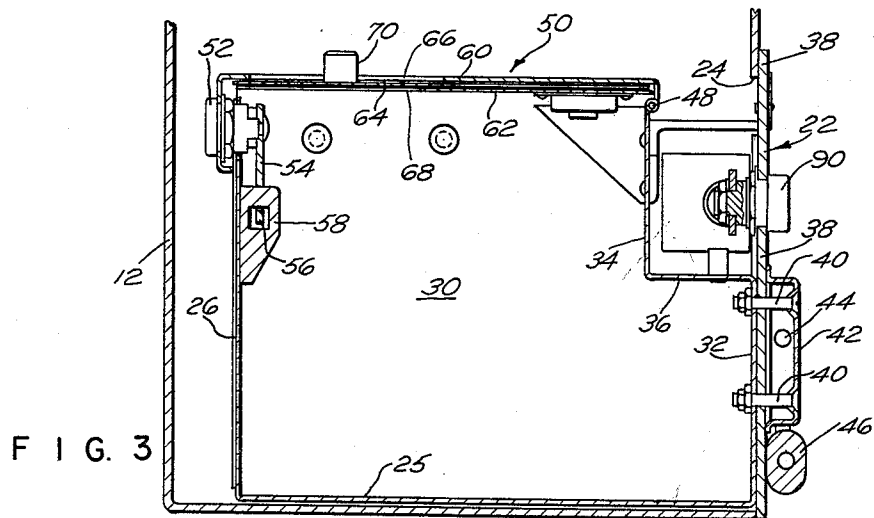
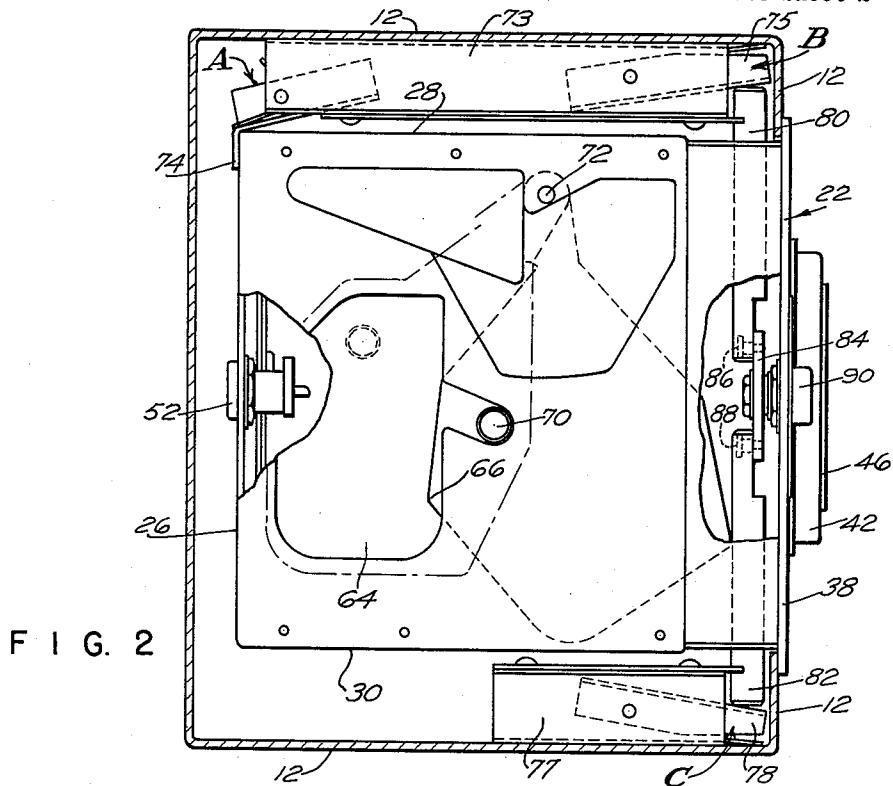
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3 Sheets-Sheet 2



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ELECTRICAL INTERLOCK SYSTEM FOR FARE COLLECTION APPARATUS

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Filed Oct. 30, 1961, Ser. No. 148,418
9 Claims. (Cl. 232-1)

The present invention relates to an electrical interlock system for fare collection apparatus. More particularly, the present invention relates to a system for preventing the operation of a coin machine by unauthorized personnel after the cash vault therefor has been removed from communication therewith. The invention further relates to a system that provides for operation of the coin machine only after the cash vault has been installed in communication therewith, during which installation a plurality of switches are actuated in a predetermined sequence to electrically connect the coin machine to a source of power.

In fare collection devices that are electrically operated, it is desirable to disconnect the coin machine after removal of the cash vault from communication therewith. Prior to the instant invention, this was accomplished by providing a simple disconnect switch that was actuated upon removal of the cash vault from the housing in which the coin machine and cash vault were normally mounted. Although this satisfied the intended purpose of disconnecting the coin machine from the source of electrical power, unauthorized personnel could easily operate the coin machine by closing the simple disconnect switch and thus remove coins or tokens that remained in the coin path of the coin machine. In order to prevent the unauthorized operation of the coin machine, the present invention utilizes a novel arrangement of switches that are adapted to be sequentially actuated upon insertion and locking of the cash vault in communication with the coin machine. The switches are so arranged that only the proper sequence of operation thereof will close the circuit to the coin machine for the actuation thereof.

In the practical form of the invention, one of the switches is adapted to be closed upon insertion of the cash vault into the housing of the coin collection apparatus. A pair of switches located on opposite sides of the cash vault are adapted to be closed in timed sequence by plungers that are moved into engagement therewith upon locking of the cash vault within the housing. The sequential operation of these latter switches is provided for by positioning one of the switches in closer spaced relation with respect to its respective plunger than the other switch. An electrical circuit utilizing a system of relays cooperates with the switches to provide for electrical communication of the coin machine with a source of power only if the proper sequence of closing of the switches is carried out during the locking of the cash vault in the housing. Thus, when the cash vault is removed from the housing, the coin machine is electrically disconnected from the source of power, and operation thereof can be resumed only when the switches are actuated in the predetermined sequence upon reinsertion of the cash vault into the housing.

Accordingly, it is an object of the present invention to provide an electrical interlock system for fare collection

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apparatus wherein the coin machine associated with said apparatus is operative only upon the insertion of a cash vault in communication therewith.

Another object of the invention is to provide an interlock system for use with a coin machine that prevents unauthorized personnel from operating the coin machine after the cash vault associated with said coin machine has been removed from communication therewith.

Still another object is to provide an interlock system for use in fare collection apparatus wherein a cash vault is adapted to electrically connect a coin machine with a source of power when the cash vault is inserted and locked in the fare collection apparatus.

Still another object is to provide an electrical interlock system for use in fare collection apparatus, wherein a plurality of switches are adapted to be sequentially actuated upon insertion of a cash vault in said apparatus for electrically connecting a coin machine to a source of power.

Still another object is to provide a system for electrically interconnecting a coin machine to a source of power upon insertion and locking of a cash vault in communication therewith, the cash vault including a pair of locking plungers that are adapted to sequentially actuate switches for electrically interlocking the coin machine to the source of power.

Other objects, features and advantages of the invention will become apparent as the description thereof proceeds when considered in connection with the accompanying illustrative drawings.

In the drawings which illustrate the best mode presently contemplated for carrying out the present invention:

FIG. 1 is a perspective view of one form of a fare collection device which includes a housing having a coin machine mounted therein in communication with a cash vault, the cash vault being located below the coin machine and being adapted to receive coins processed there-through;

FIG. 2 is a horizontal sectional view taken through the housing of the fare collection device illustrated in FIG. 1 and showing the cash vault in plan view with portions broken away;

FIG. 3 is a vertical sectional view taken through the housing and cash vault as they are illustrated in FIG. 2;

FIG. 4 is a front elevational view of the cash vault showing the unlocked or retracted position of the cash vault locking plungers with respect to the switch levers they are adapted to actuate; and

FIG. 5 is a diagrammatic illustration of the electrical circuit embodied in the present invention.

The electrical interlock system as described hereinafter has particular application in fare collection apparatus for use on buses, toll bridges, toll highways and other similar locations where a fare is adapted to be deposited for gaining access through a toll area. However, it is understood that the basic concept of the electrical interlock system embodied herein may be utilized in connection with other coin processing devices, such as vending machines, automatic ticket issuing equipment and other similar devices.

Referring now to the drawings and particularly to FIG. 1, a fare collecting device generally indicated at 10 is illustrated and as shown comprises a housing 11, the housing 11 including a lower substantially square por-

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tion 12, an upper truncated portion 14, and a hopper 16 mounted on the uppermost end of the truncated portion 14. Mounted within the housing 11 is a coin machine generally indicated at 18 that is adapted to be electrically operated and may be of that type illustrated and described in the patent to Miller No. 2,848,158. As shown in FIG. 1, the truncated portion 14 of the housing 10 is provided with a front window 20 that is inclined and that is adapted to permit ready inspection of a coin or fare after it has been deposited into the hopper 16 of the coin machine by a patron. The coin machine 18 is adapted to receive the coins deposited in the hopper 16 and processes them through a coin path, finally depositing the coins in a cash vault generally indicated at 22. The cash vault 22 is normally mounted within the lower square portion 12 of the housing 11 and is located immediately below the coin machine 18, being in communication therewith through a suitable discharge chute. As will be described, the cash vault 22 is adapted to be removed from the housing 11 in a sealed condition for transporting to a counting area where the coins are removed therefrom by authorized personnel.

As described above, the cash vault 22 is adapted to be slidably mounted within the housing 11, and for this purpose an opening 24 is formed in a side wall of the lower square portion 12 of the housing. As shown in FIGS. 2 and 3, the cash vault 22 is substantially rectangular in cross section and is defined by a bottom wall 25, a rear wall 26, side walls 28 and 30, a lower inner front wall 32, and an offset upper inner front wall 34 that is interconnected to the lower inner wall 32 by a horizontal portion 36. An outer front wall 38 is bolted to the lower inner wall 32 by bolts 40 and defines the outside wall of the cash vault 22. As illustrated in FIGS. 2 and 3, the outer wall 38 is somewhat larger than the opening 24 and is adapted to engage the housing wall, thereby acting as a stop for the cash vault 22. A box-like member 42, through which the bolts 40 extend, is secured to the outer wall 38 and receives in the side walls thereof the intumed ends 44 of a handle 46 which may be grasped to withdraw the cash vault 22 when desired.

Pivotaly connected to the uppermost edge of the upper inner front wall 34 by a suitable hinge connection 48 is a cover assembly generally indicated at 50, the cover assembly 50 being normally locked in position on the cash vault by a lock 52. Operatively connected to the lock 52 is a shaft 54 that extends downwardly through an opening 56 formed in a plate 58 that is secured to the rear wall 26 of the cash vault 22. Prior to inserting the cash vault 22 within the opening 24 of the housing 11, the cover assembly 50 is locked in position by the lock 52. In this position, the cover assembly 50 prevents access to the interior thereof until it is inserted into the housing 10. When the cash vault 22 is removed from the housing 11 to a counting area, the coins therein are extracted by unlocking the lock 52 and pivoting the cover assembly 50 to the open position thereof. With the cash vault 22 inserted in place in the housing 11, communication with the interior thereof and the discharge chute of the coin machine is provided for by a slide closure construction. As shown in FIG. 3, the cover assembly 50 is formed with plates 60 and 62 between which a closure 64 is slidably mounted. Both the plates 60 and 62 are formed with openings indicated at 66 and 68, respectively, which the closure 64 normally covers when the cash vault 22 has been removed from the housing 11 of the fare collection device. The closure 64 is adapted to be automatically opened to uncover the openings 66 and 68 when the cash vault is inserted into the housing 10, and for this purpose, has a stud 70 secured to the upper surface thereof, the stud 70 projecting through the opening 66 in the plate 60. The closure 64 is further pivotaly mounted at 72 between the plates 60, 62 as indicated in FIG. 2, movement of the closure 64 to the open position thereof being effected by engagement

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of the stud 70 with a cam plate, not shown, that is mounted on the underside of the coin machine. Thus, when the cash vault 22 is inserted within the opening 24 of the housing 11, the stud 70 engages the cam plate, and upon continued movement of the cash vault within the housing, the closure 64 will be pivotally shifted to uncover the openings 66 and 68. The positions of the closure 64 are more clearly illustrated in FIG. 2 wherein the closure 64 is shown in dot-dash lines which defines the closed position thereof, and in dotted lines which defines the open position thereof after the cash vault 22 has been completely inserted within the housing 11. In this latter position, the openings 66 and 68 communicate with the discharge chute of the coin machine 18 and the cash vault 22 is adapted to receive the coins processed therethrough. It is understood that upon removal of the cash vault 22 from the housing 10, the closure 64 will be moved to the closed position thereof by the cam plate, thereby sealing communication between the openings 66 and 68 and locking the cash vault against unauthorized personnel. In connection with the operation of the cash vault closure, reference is made to the patent to Grant et al. No. 2,884,188.

Once the cash vault 22 has been removed from the housing 10, the interior of the coin machine is open, and if any coins had remained in the coin path, it normally would be possible for unauthorized personnel to remove these coins by simply actuating a switch that electrically connects the coin machine to a source of power. In order to avoid this contingency, the coin machine 18, in the present invention, is adapted to be electrically connected to a source of power only after a series of switches are actuated in a predetermined sequence. In order to provide for sequential operation of the switches, the cash vault 22 is constructed with switch operating devices whereby the switches will be closed in the predetermined sequence upon insertion of the cash vault into the housing 10. By providing the electrical interlock system as will be described, once the cash vault 22 has been removed from the housing 11, the coin machine is rendered inoperative and the only way that the coin machine 18 can be made operative again is by closing the switches in the predetermined sequence. This can only be practically accomplished by inserting the cash vault within the housing 11.

Mounted in the lower portion 12 of the housing 11 and secured to an inside wall thereof is a switch housing 73 in which a switch generally indicated at A and a switch generally indicated at B are mounted. Switch A, which is of the double-pole, double-throw type, is located adjacent the rear of the lower portion 12 and is provided with a spring urged switch lever 74 that projects outwardly into the path of the rear wall 26 of the cash vault 22. Switch B, which is also of the double-pole, double-throw type, includes a switch lever 75 that is normally urged to an outer position by a spring 76. Mounted in the opposite side of the lower portion 12 of the housing 11 is a second switch housing 77 in which a switch generally indicated at C is positioned. The switch C is of the single-pole, double-throw type and includes a switch lever 78 that is normally urged to an outer position by a spring 79.

It is seen that when the cash vault 22 is inserted within the opening 24 of the housing 11, the rear wall 26 will strike the switch lever 74 and will close switch A. This is the first step in the sequence of operation of the electrical interlock system.

As will be described, switches B and C are adapted to be closed in a predetermined sequence after switch A is closed, and for this purpose a pair of locking plungers 80 and 82 are provided that are located within the space defined by the offset upper inner wall 34 and the lower inner wall 32. The locking plungers 80 and 82 are interconnected by a lock lever 84 through pivotal connections 86 and 88, respectively, a lock 90 being secured to the

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lock lever 84 and extending outwardly of the outer wall 38 for external access thereto. The locking plungers 80, 82 are adapted to protrude beyond the edges of the cash vault side walls 28, 30, respectively, whereby they latch behind the housing lower portion 12 and are thereby adapted to lock the cash vault within the housing 11. In addition to locking the cash vault in place, the locking plungers also actuate the switches B and C by engaging the levers 75 and 78, respectively, during the outward movement thereof. Thus, it is seen that when a key is turned in the lock 90 to lock the cash vault in place, the lock lever 84 is moved from a horizontal to a vertical position, and the plungers 80, 82 are caused to protrude beyond the edges of the cash vault.

Referring to FIG. 4, the plunger 80 is shown located more closely adjacent the switch lever 75 than the plunger 82 is to the switch lever 78. This relationship of the plungers and switches provides for closing of the switch B just before the switch C is closed. The difference in spacing of the plungers with respect to their respective switch levers is predetermined so as to provide for a specific time lag for closing of switch C after switch B is closed. This predetermined time lag is utilized together with the initial closing of switch A to establish a circuit to the coin machine as will be described hereinafter.

Referring now to the schematic diagram of the electrical circuit illustrated in FIG. 5, the operation of the electrical interlock system will be described. In this connection, the two poles of switch A are designated as A1 and A2, while the two poles of switch B are designated at B1 and B2. The coin machine which is illustrated diagrammatically in FIG. 5 is adapted to be interconnected to a 12-volt source of power through the normally closed contacts R1a of a Relay R1. Thus, when the relay R1 is deenergized, the coin machine is connected to the source of power. Since the relay R1 is normally energized through the normally closed contact of pole A1 of switch A, the contact R1a is opened; and thus, when the cash vault 22 is removed from the housing 10, the coin machine is inoperative. When the cash vault 22 is first inserted within the housing 10, the normally open contact of pole A1 of switch A is closed. This disconnects the source of power to the relay R1 through the normally closed contact of A1 but the relay R1 remains energized since a circuit is now completed thereto through the normally closed contact of pole B1 of switch B, a diode 92 and the normally open contact of A1. With relay R1 energized, contact R1a remains open, and the coin machine remains inoperative. With the relay R1 energized, it will remain energized regardless of the position of any of the switches, considered individually. This is so since the relay R1 locks up to the power input line through the normally closed contact R2a and the now-closed normally open contact R1b. It will be apparent that in order to establish a circuit to the coin machine 18, the relay R1 must be deenergized; however, in order to deenergize relay R1, it is necessary for the relay R2 to be energized. In order to drop out or deenergize relay R1, the relay R2 must receive a pulse which is at least equal to the operating time thereof. In order for the relay R2 to receive the required pulse, a capacitor 94 is provided that is normally charged to a predetermined charge through a current path provided through a line 93, the normally closed contacts of pole B1 of switch B and the normally closed contact of switch C and a resistor 96. The relay R2 is designed such that it will operate only when it receives a predetermined charge of 1800 micro-coulombs. Since the charge stored by the capacitor 94 is 2400 micro-coulombs (12 volts) and is in excess of the predetermined charge to be received by the relay R2, a portion of the stored charge in the capacitor 94 may be dissipated through a resistor 98 that has an approximate value of 500 ohms. Consequently, when the switch B is closed in the next step in the se-

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quence of actuation of the switches upon plunger 80 engaging switch lever 75, a circuit is completed to the 500 ohm resistor 98 through the normally closed contact of switch C and the normally open contact of B1. The circuit is designed such that the initial charge of the capacitor 94 will take a predetermined period of time to fall to the prescribed level of 1800 micro-coulombs. Consequently, the switch C is closed after a predetermined interval of 28 milliseconds has elapsed after the closing of switch B, the time lag of 28 milliseconds being sufficient to allow the capacitor 94 to fall to the prescribed level. When the switch C is closed upon engagement of the lever 78 by the plunger 82, the remaining charge in the capacitor 94 is directed to relay R2 through normally open contact of switch C, normally open contact of B2 and the normally open contact of A2. Since the charge applied to the coil of relay R2 is sufficient to energize the relay, the normally closed contact R2a is opened, and normally open contact R2b is closed. Relay R2 now locks to the normally open contact R1b to retain the relay R2 energized. The normally closed contact R2a will now open and break the holding path to the coil of the relay R1. However, relay R1 will not drop out immediately. A capacitor 100 is provided in the circuit with the relay R1 and will hold relay R1 energized for several milliseconds after the normally closed contact R2a opens. The capacitor 100 that is located across the coil of relay R1 is also adapted to maintain the relay R1 energized during any momentary opening of the normally closed contact R2a of relay R2. This momentary opening of the contact R2a could be caused by a shock to the coin machine housing, such as a hammer blow. Without the capacitor 100 in the circuit, it would be possible to deenergize relay R1 merely by striking the housing with a heavy object. By providing the circuit as described, this cannot happen.

Relay R2 will remain energized until relay R1 finally drops out. When the charge of the capacitor 100 is dissipated, relay R1 will drop out since the holding contact R2a has been opened by energization of relay R2. Since relay R2 had been holding through the normally open contact R1b and its own contact R2b, it will drop out immediately after relay R1 drops out. When relay R1 is deenergized, the normally closed contact R1a again closes to complete the circuit to the coin machine 18.

The diode 92 is provided in the circuit since it represents a very low resistance to current flow in a direction toward the pole A1 of switch A but represents an extremely high resistance to current in the opposite direction. Accordingly, it prevents current from feeding back and recharging the capacitor 94 after switch B has been closed. The diode 92 further prevents the coin machine 18 from being operated if the switch A is tampered with. Thus with the vault removed and if pole A1 of switch A were prevented from returning to its normally closed position, ordinarily there would not be any positive current path to the coil of relay R1. In this condition, relay R1 could not energize and power would be applied to the coin machine. However, with the diode 92 in the circuit, the relay R2 will energize in spite of the trapped position of switch A, and power will be applied to the coil of relay R1 through the normally closed contact of B1, the diode 92 and the normally open contact of A1.

In the operation of the circuit, it is clear that the closing of switches A, B and C in proper sequence is essential in order to complete the circuit to the coin machine. If switch C were operated first and not in the order of sequence as described, the capacitor 94 would fall to an ineffective level after only five milliseconds. In this case, the capacitor discharge path would be through the normally open contact of switch C, normally closed contact of B2, and a resistor 102. In the event that switch B were actuated first, the capacitor 94 would discharge at a somewhat slower rate, since the capacitor 94 must pass through the 500 ohm resistor 98 to ground.

In this case, the discharge path of the capacitor 94 would be normally closed contact of switch C, normally open contact of B1, and resistor 98. It will now take the prescribed amount of time of 28 milliseconds for the capacitor to fall to an ineffective level. During this interval, the switches C and A must also be actuated. Should switch C be the next switch actuated and before A, then the capacitor 94 will take the discharge path through the normally open contact of switch C, normally open contact of B2, normally closed contact of A2, and a resistor 104 to ground. It is seen that in these latter instances, the prescribed charge will not be directed to the coil of relay R2, and the circuit will be inoperative.

Closing switch A before the closing of switches B and C is easily accomplished by providing that the rear wall 26 of the cash vault 22 engages the lever 74 of the switch as the cash vault is inserted into the housing. Switch B is closed in the next order of sequence by its plunger 80 by positioning the lever 75 in closer proximity to the plunger 80 than the lever 78 to the plunger 82. In the practical application of this principle, the lever 75 is located $\frac{1}{2}$ inch from the plunger 80 when the plunger 80 is in the retracted position thereof. Lever 78, on the other hand, is located $\frac{5}{8}$ of an inch from the end of the plunger 82 in the retracted position thereof. Thus when the locking lever 84 is rotated to the horizontal position thereof by the lock 90 and the plungers 80 and 82 are moved outwardly beyond the edges of the cash vault for latching behind the housing frame, plunger 80 will strike the lever 75 for closing switch B immediately before plunger 82 strikes the lever 78. The proper order and sequence of the closing of the switches is maintained and the circuit is operative to provide power to the coin machine for the operation thereof. It is understood that when the cash vault 22 is removed from the housing 10, switch A will be actuated to close the normally closed contact of A1, thereby supplying current to relay R1 for energizing the coil thereof. The normally closed contact R1a will then open to disconnect the coin machine from the circuit.

While there is shown and described herein certain specific structure embodying the invention, it will be manifest to those skilled in the art that various modifications and rearrangements of the parts may be made without departing from the spirit and scope of the underlying inventive concept and that the same is not limited to the particular forms herein shown and described except insofar as indicated by the scope of the appended claims.

What is claimed is:

1. In fare collection apparatus, a housing, an electrically operated coin machine mounted in said housing for receiving and processing fare parts, a cash vault removably mounted in said housing and communicating with said coin machine for receiving the fare parts processed therethrough, means responsive to mounting of said cash vault in said housing for completing an electrical circuit to said coin machine, whereby said coin machine is operative to process said fare parts therethrough, said means including a first switch that is closed upon insertion of said cash vault in place in said housing, and second and third switches that are sequentially closed after said cash vault is mounted in place, thereby completing the circuit to said coin machine.

2. In fare collection apparatus, a housing, a coin machine mounted in said housing, a cash vault removably mounted in said housing and adapted to communicate with said coin machine for receiving fare parts received and processed thereby, and means responsive to mounting of said cash vault in said housing for operatively connecting said coin machine in circuit to a source of electrical power, whereby said coin machine is operative to process said fare parts therethrough, said connecting means including a plurality of switches that are mounted in said housing and switch operating means mounted on said cash vault and adapted to engage said switches in

sequential relation when said cash vault is secured in said housing, the sequence of actuation of said switches being predetermined so that an electrical circuit to said coin machine is completed only when said cash vault is securely locked in position in said housing.

3. In coin processing apparatus, a housing, an electrically operated coin machine mounted in said housing and receiving coins for the processing thereof, a cash vault removably mounted in said housing below said coin machine and communicating therewith for receiving said coins after passage through said coin machine, means for locking said cash vault in said housing, means for supplying electrical current to said coin machine for the operation thereof, and means for electrically interlocking said coin machine to said current supplying means, said electrically interlocking means including a first switch that is adapted to be closed upon insertion of said cash vault in said housing, and second and third switches that are responsive to said locking means and cooperating with said first switch to complete an electrical circuit to said coin machine, said switches being actuated in sequence when said cash vault is inserted in said housing and locked therein, the sequential actuation of said switches providing for the completing of the circuit to said coin machine.

4. In coin processing apparatus as set forth in claim 3, said first switch being located in said housing rearwardly of the mounted position of said cash vault and actuated by said cash vault when it is inserted in said housing, said second and third switches being located in said housing on opposite sides of said cash vault, said locking means including oppositely extending plungers that are moved to a locking position for locking said cash vault in said housing, said locking plungers engaging said second and third switches in sequential order during the movement thereof to their locking position.

5. In coin processing apparatus, a housing, an electrically operated coin machine mounted in said housing and receiving coins for the processing thereof, a cash vault removably mounted in said housing below said coin machine and communicating therewith for receiving said coins after passage through said coin machine, means for locking said cash vault in said housing and for simultaneously establishing electrical communication between said coin machine and a source of electrical current, said locking and current establishing means including oppositely disposed plungers that are mounted on said cash vault for outward movement with respect thereto and a plurality of switches located in said housing and responsive to the mounting of said cash vault in said housing and movement of said plungers to the outer position thereof for establishing electrical communication between said source of current and said coin machine.

6. In coin processing apparatus as set forth in claim 5, said switches being actuated in a predetermined sequential order for establishing the electrical circuit to said coin machine, one of said switches being located in said housing for actuation by the rear of said cash vault when said cash vault is inserted in said housing, the other switches being located predetermined distances from said plungers so that the actuation thereof by said plungers when said plungers are moved outwardly is sequential.

7. In coin processing apparatus, a housing, a coin machine mounted in said housing, a cash vault adapted to be removably mounted in said housing in communication with said coin machine, means responsive to mounting of said cash vault in said housing for electrically interlocking said coin machine to a source of power, said electrically interlocking means including a plurality of switches that are actuated in a predetermined sequence when said cash vault is inserted in said housing, the establishment of electrical communication between said coin machine and the source of power being accomplished only by the sequential operation of said electrically interlocking means, whereby when said cash vault is withdrawn

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from said housing said coin machine is inoperative and cannot be made operative other than by insertion of said cash vault in said housing.

8. In coin processing apparatus as set forth in claim 7, said cash vault having switch operating elements associated therewith that are actuated upon locking of said cash vault in said housing, said switch operating elements being movable into engagement with said switches in a predetermined manner in order to actuate said switches in accordance with said predetermined sequence, said switches being located in the path of the movement of said elements.

9. In coin processing apparatus as set forth in claim 8, said switch operating elements being defined by a pair of plungers that are mounted for reciprocating movement

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on said cash vault and that are adapted to simultaneously lock said cash vault in said housing and to sequentially actuate the switches located in the path of their movement.

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