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Golland et al.

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[54] **COIN HANDLING SYSTEM**

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[52] **U.S. Cl.** .... **302/2 R,** 133/3, 302/11, 302/57, 302/59

[51] **Int. Cl.** **B65g 53/00**

[58] **Field of Search** .... 302/2 R, 58, 11, 57, 62, 302/59; 243/23; 194/1 B, 9 T; 133/3

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[57] **ABSTRACT**

A coin handling system for transferring coins pneumatically from a bus fare box to stationary coin processing equipment in which the coins are sorted according to denomination and delivered to a compartmented vault. The vault is later removed from the equipment and transported to a bank or other counting facility for further coin processing. The system includes the bus fare box and a hose having a probe on one end designed to interconnect a fare box with the coin processing equipment. As the system is activated and the probe manually inserted in the fare box to withdraw coins, actuation of a ring on the probe causes coacting tubes on the probe and fare box to align their ports and thereby provide an open avenue for coins to flow from the fare box into the probe and hose. Simultaneously, ring actuation causes a vacuum pump in the equipment to create a vacuum at the probe-fare box ports. This vacuum creates an air stream which lifts the coins into the open ports and carries the coins through the hose to the coin processing equipment. Upon arrival there, the coins are slowed down to minimize mutilation and then sorted according to denomination and deposited in separate compartments in the vault. Both mechanical and electrical operating locks must be activated to open the vault door. As the vault is being removed, a cover on the vault automatically closes the openings through which the coins initially dropped into their respective compartments, thereby safeguarding the vault contents. To provide high security to the system, multiple mechanical and electrical locks and interlocks are used throughout the system and with the individual system components.

25 Claims, 19 Drawing Figures

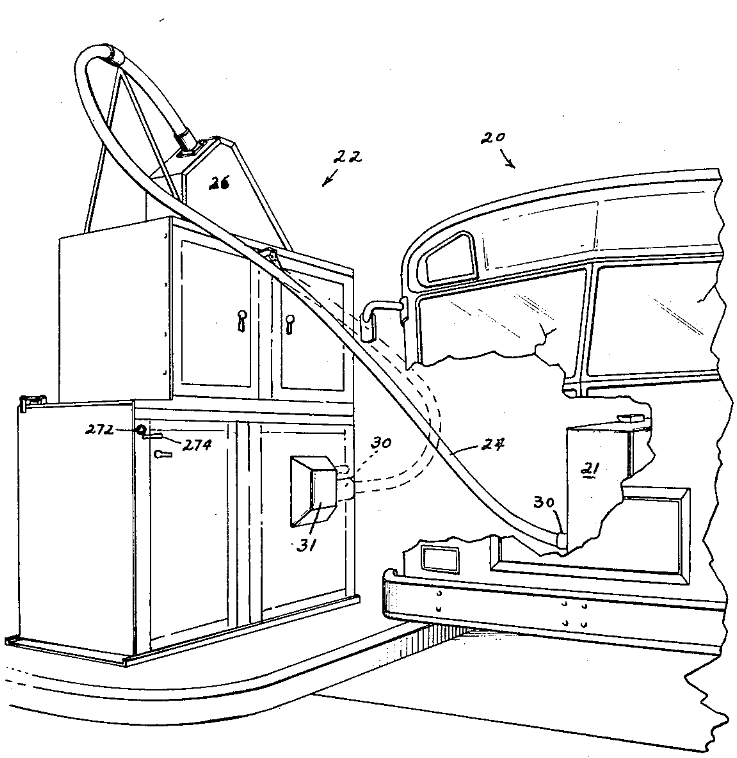
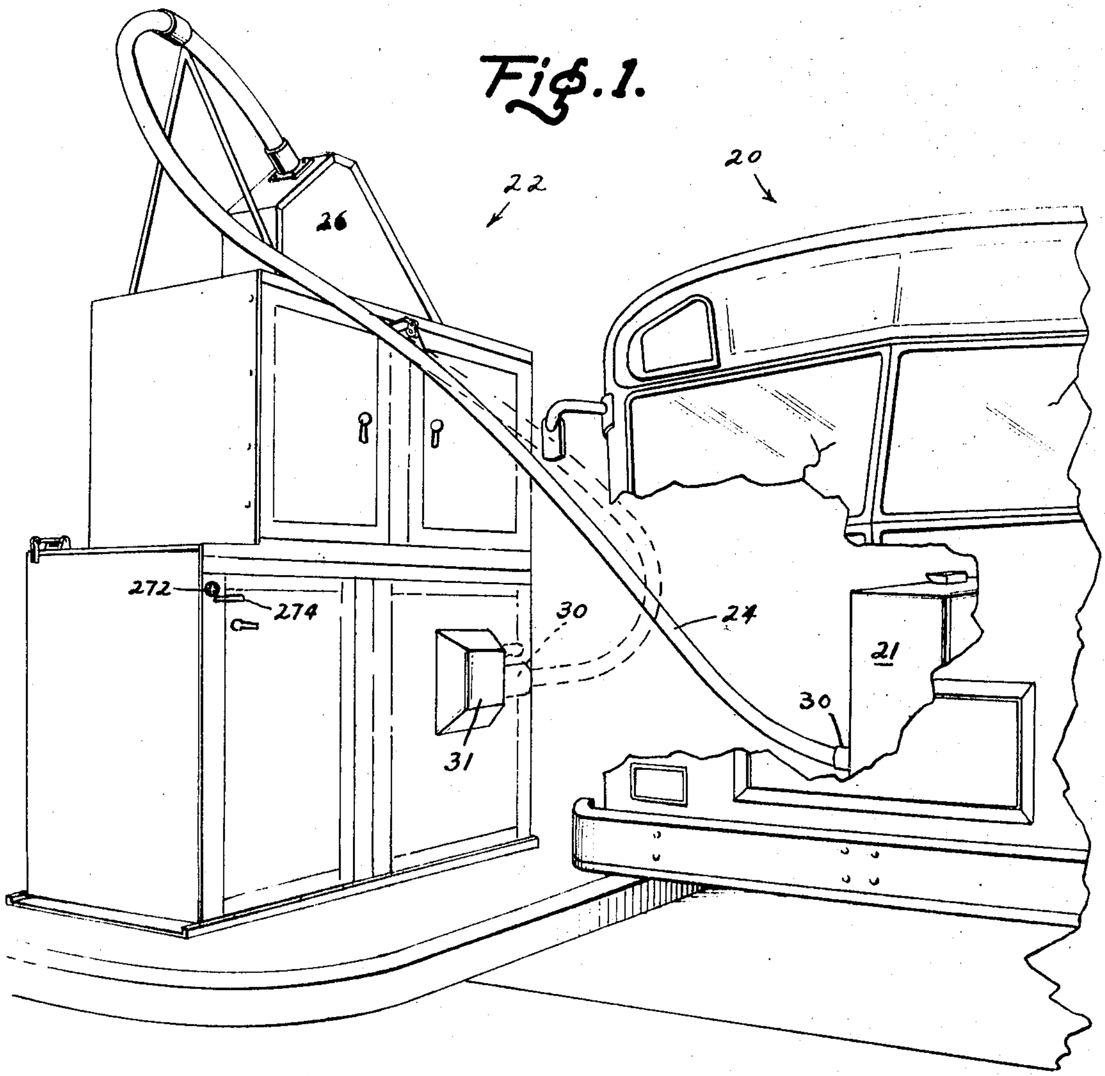


Fig. 1.



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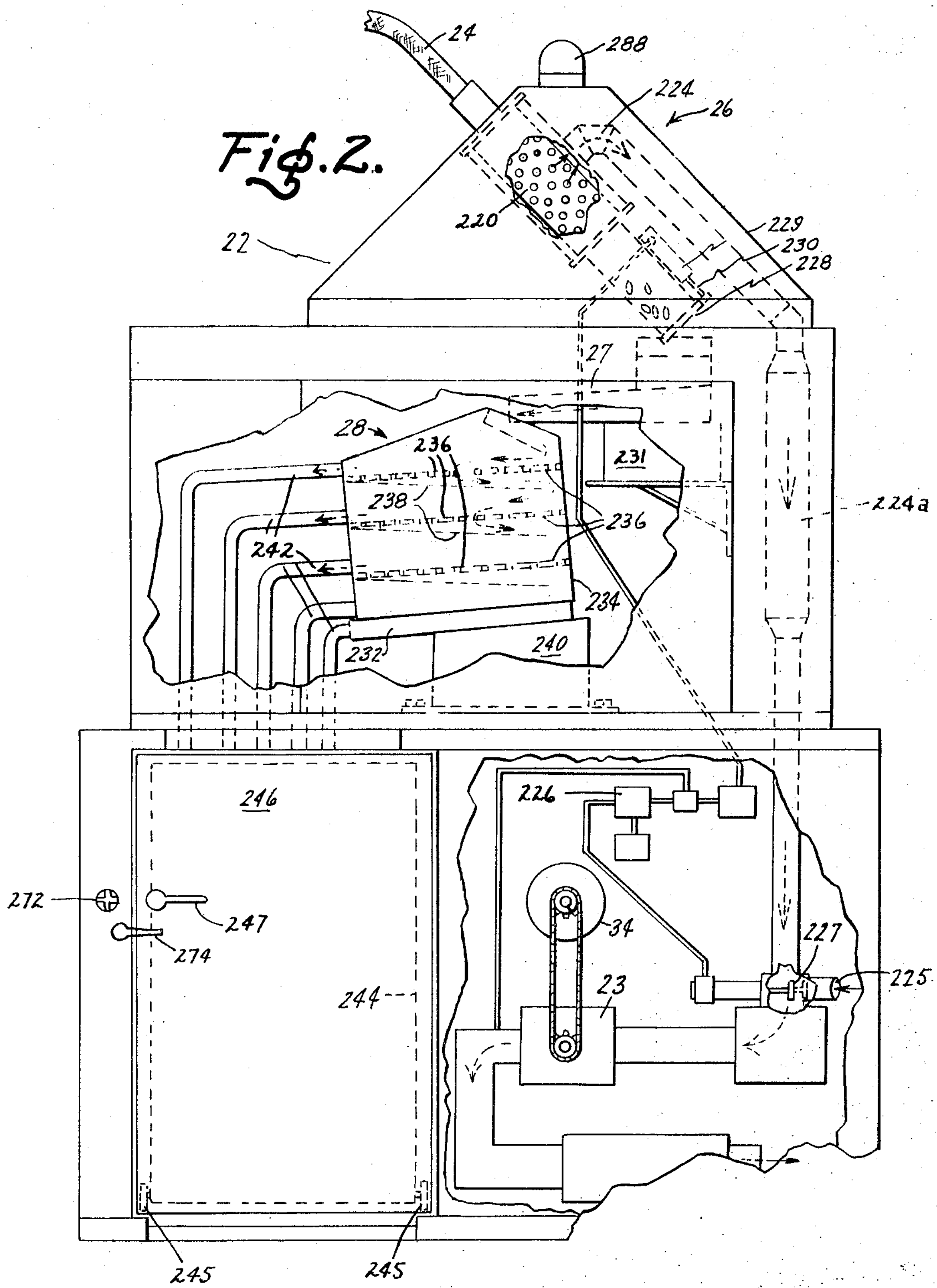
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Fig. 2.

Fig. 3.

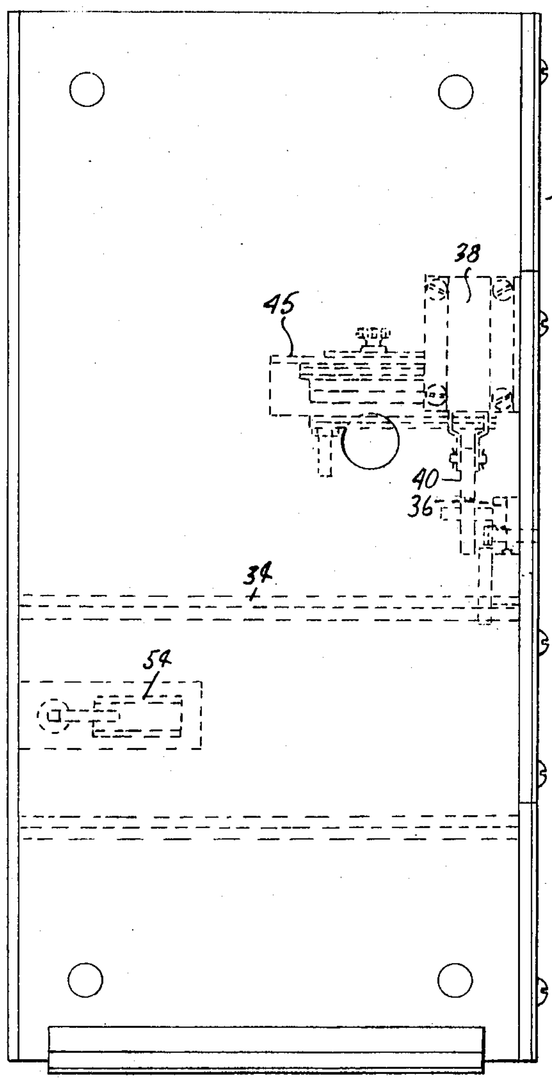
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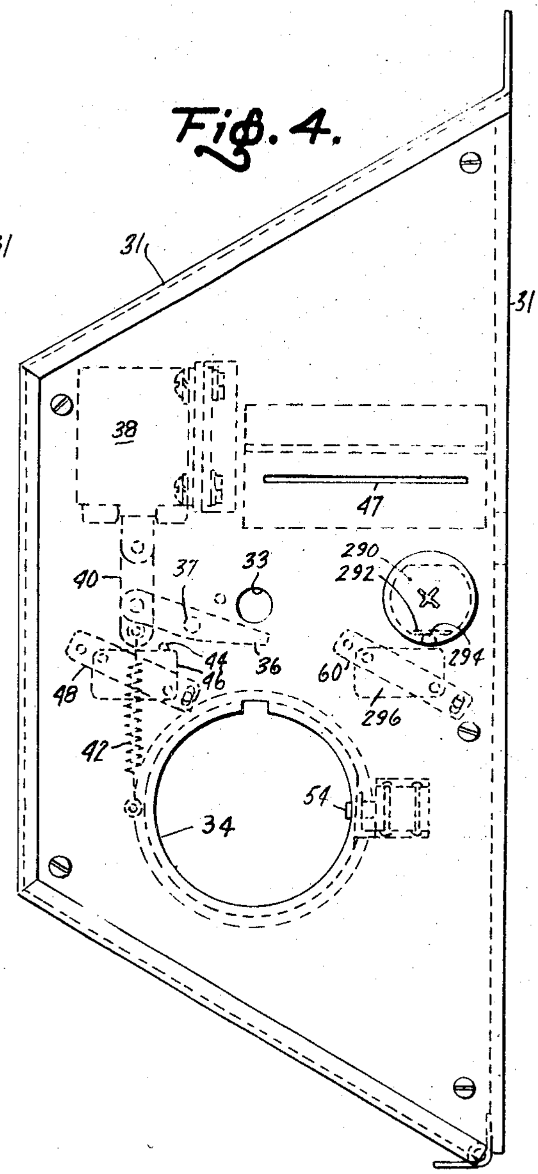
Fig. 4.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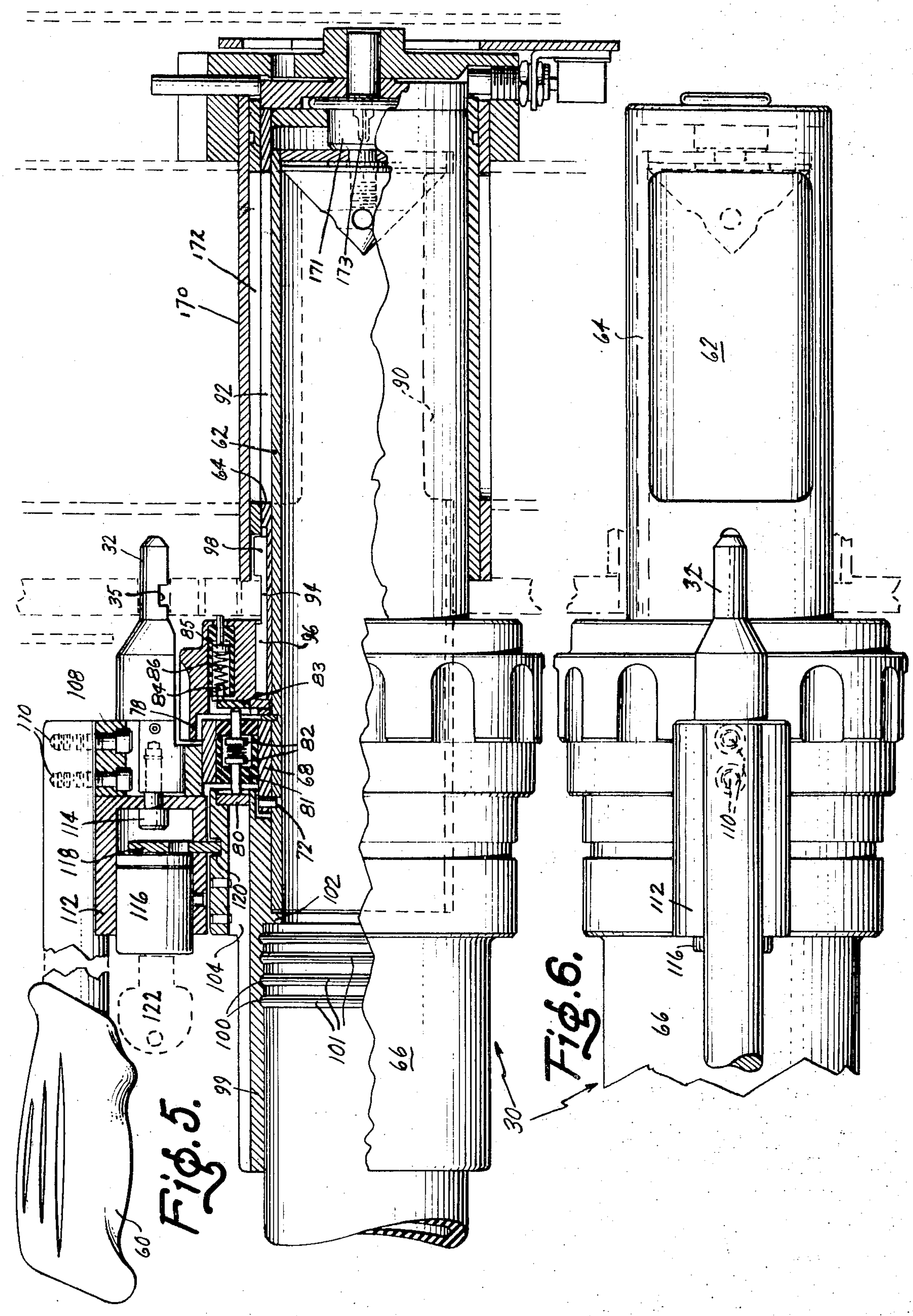
Fig.5.
Fig.6.

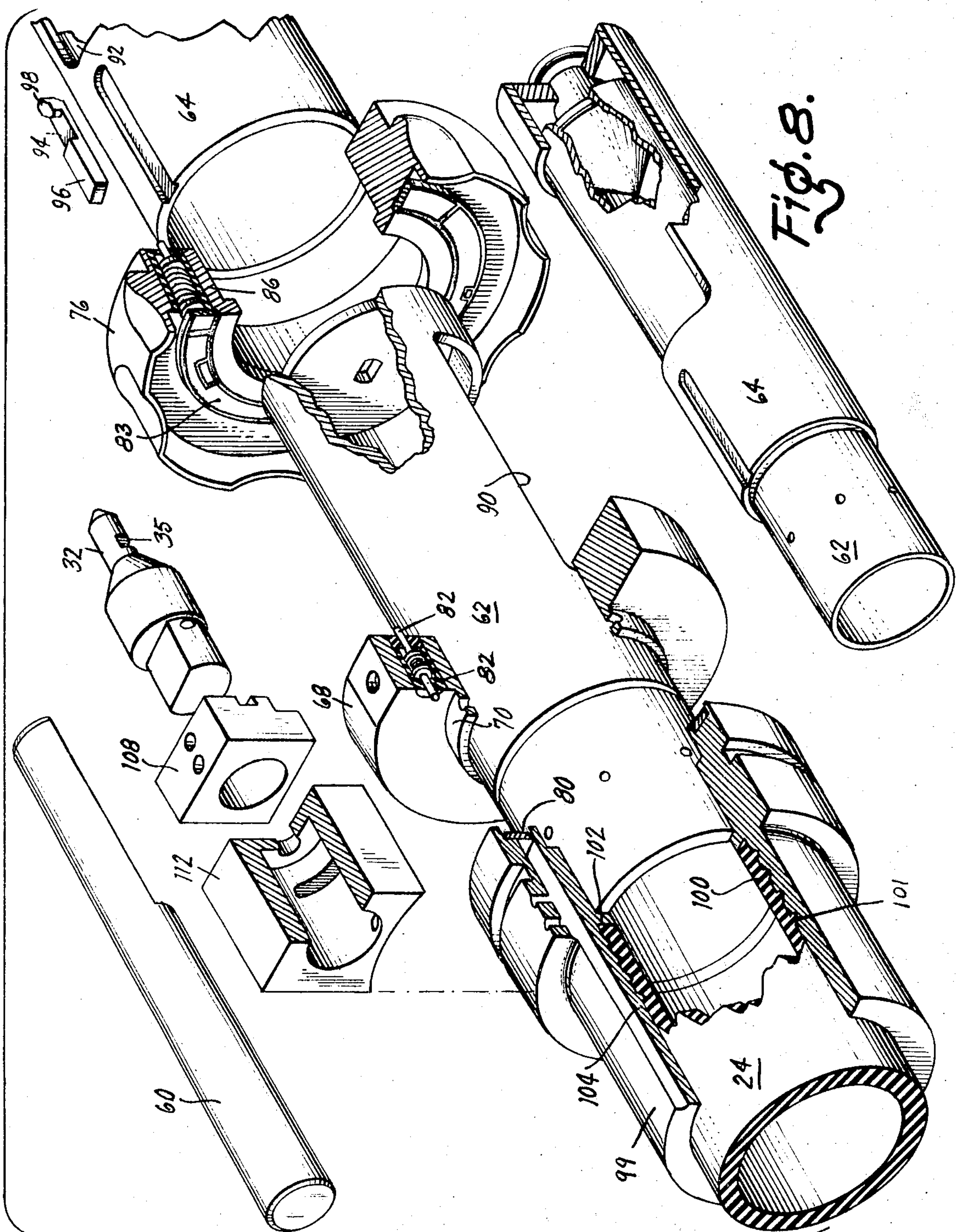
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Fig. 8.

Fig. 7.

Fig. 9.

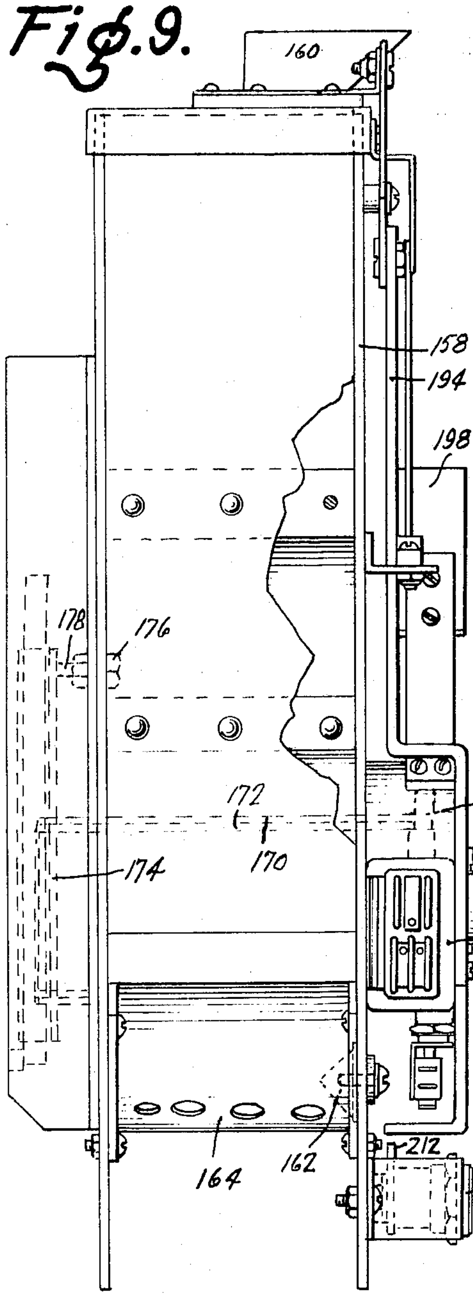
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Fig. 10

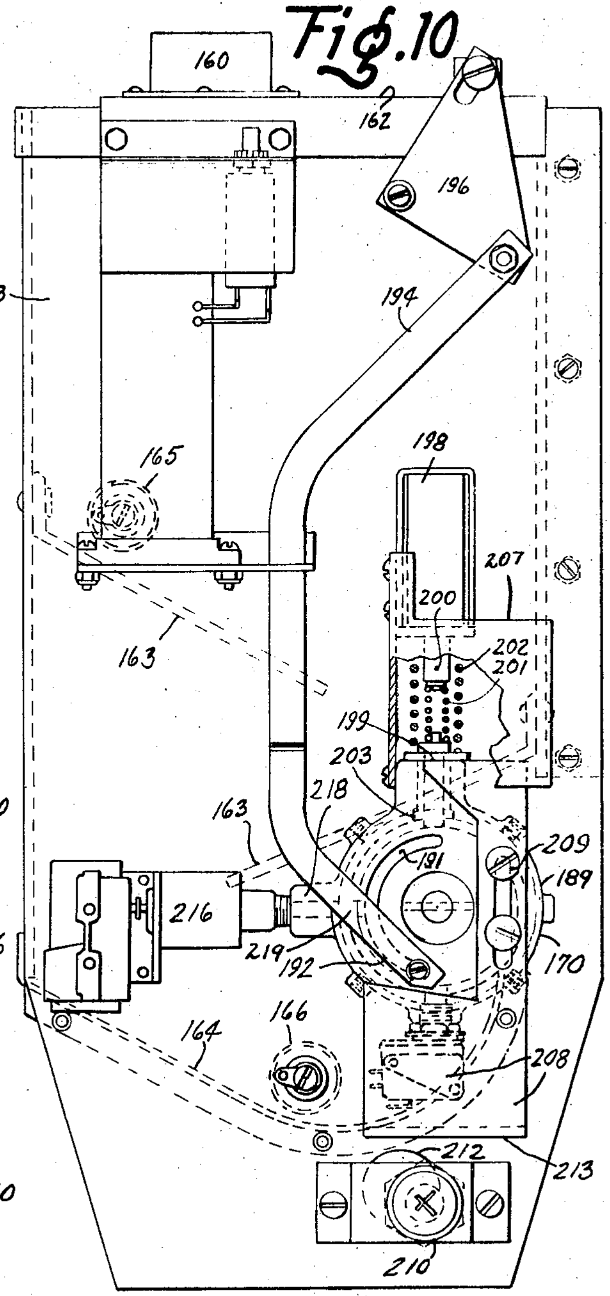
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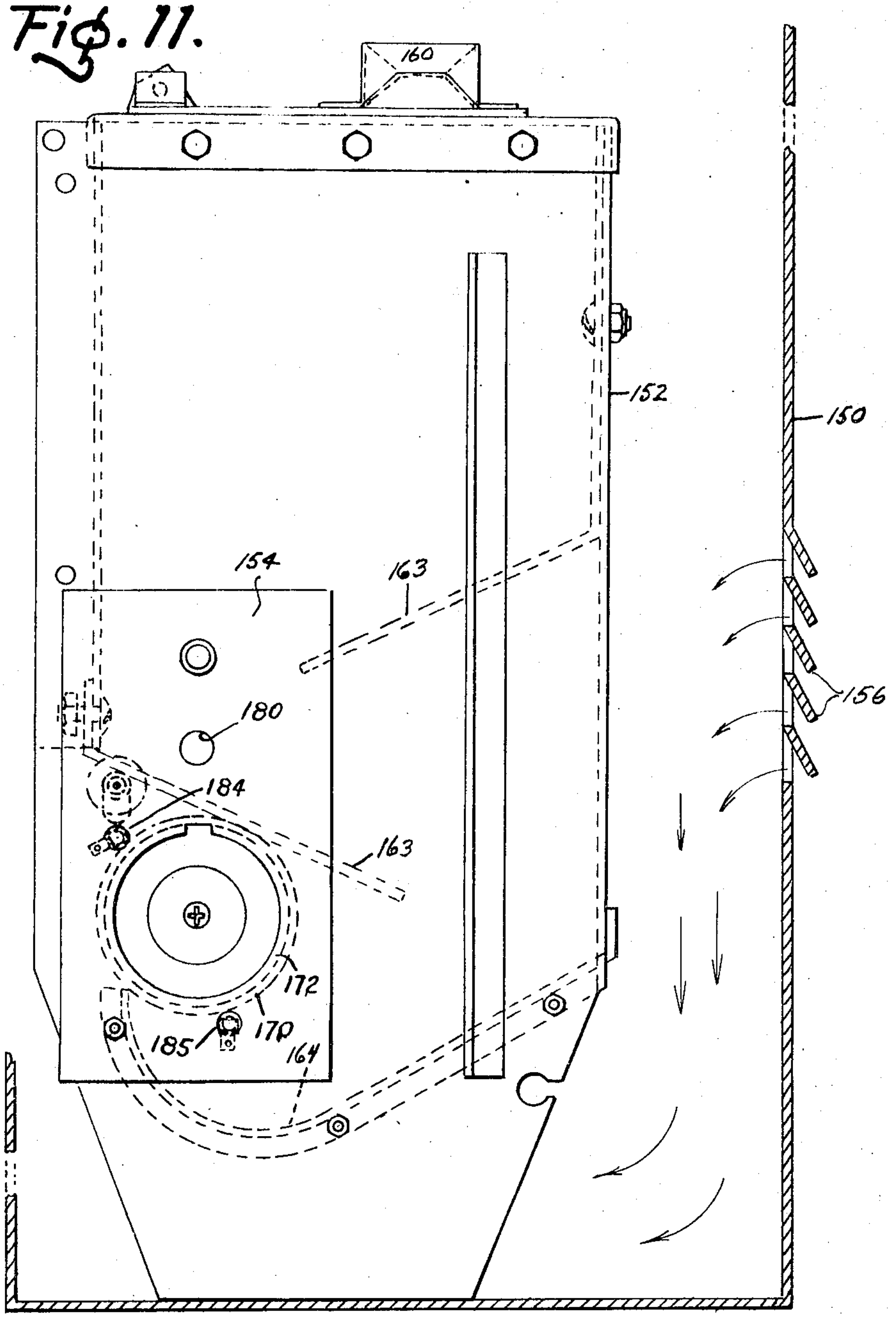
Fig. 11.



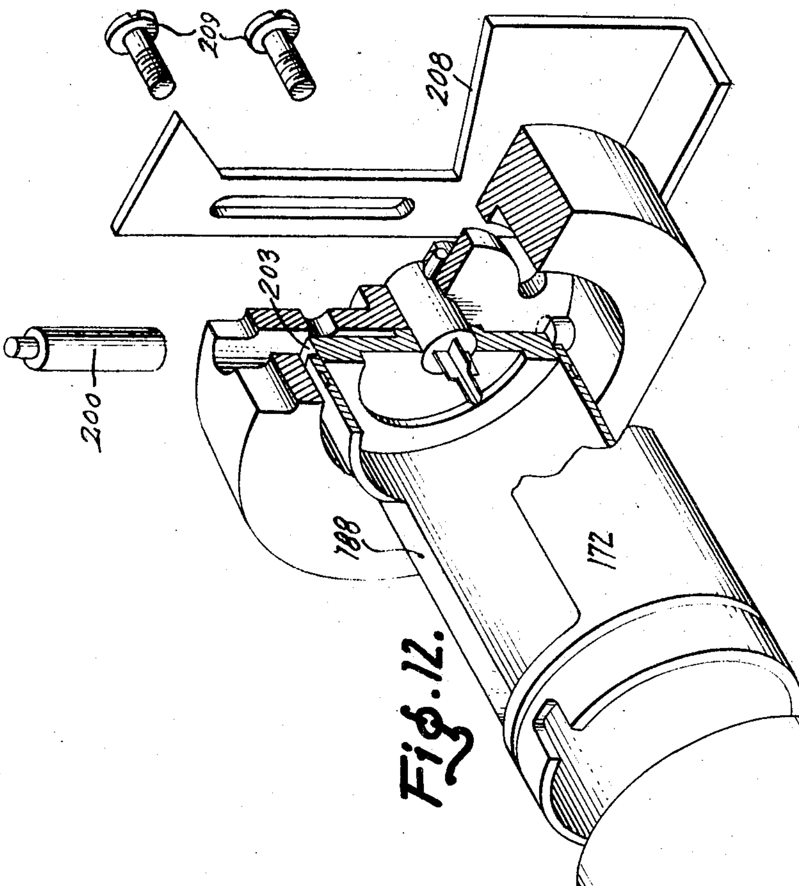
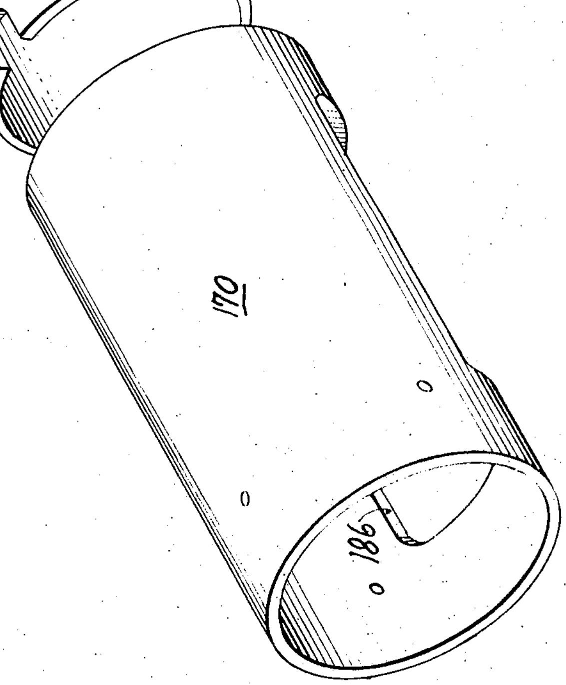



Fig. 12.

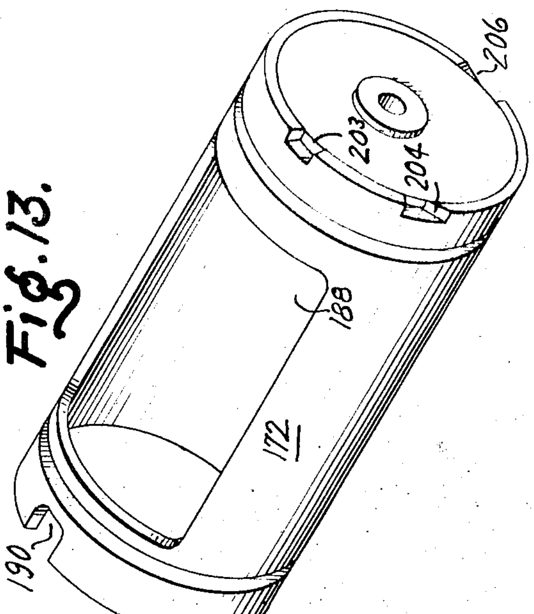


Fig. 13.

Fig. 14.

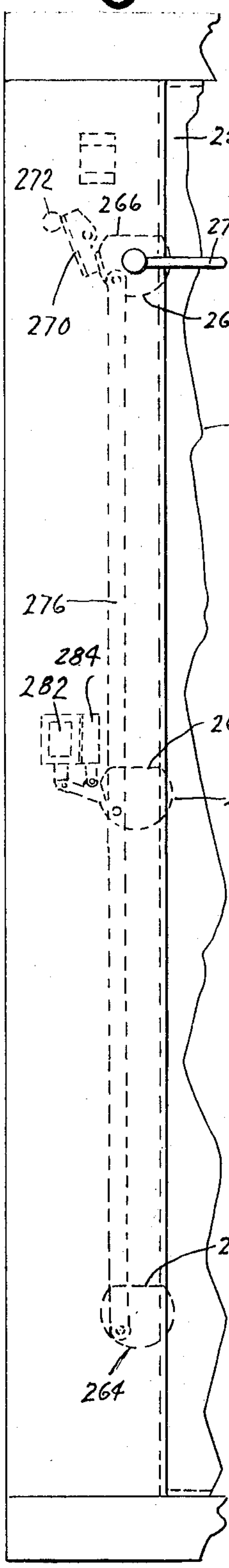


Fig. 16.

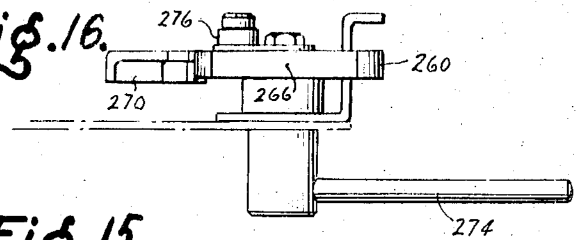


Fig. 15.

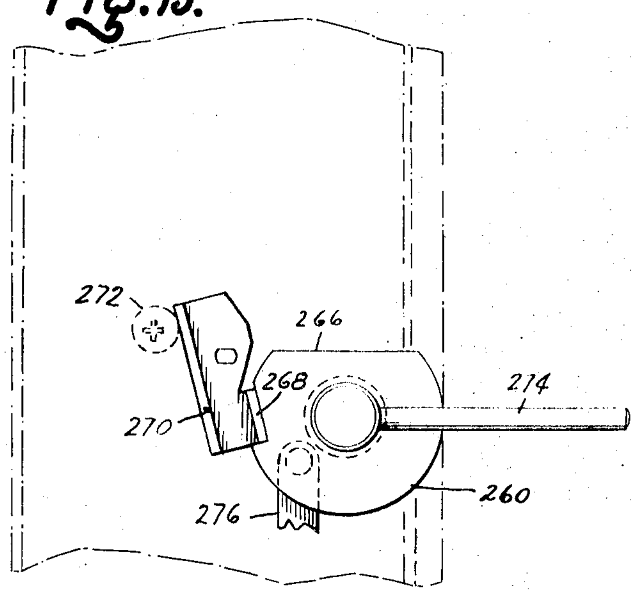


Fig. 18.

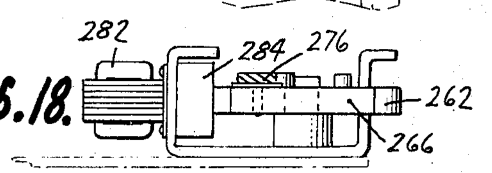
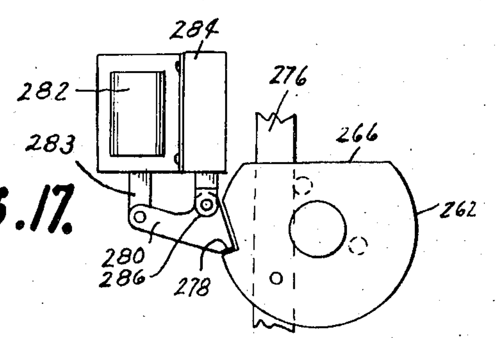


Fig. 17.



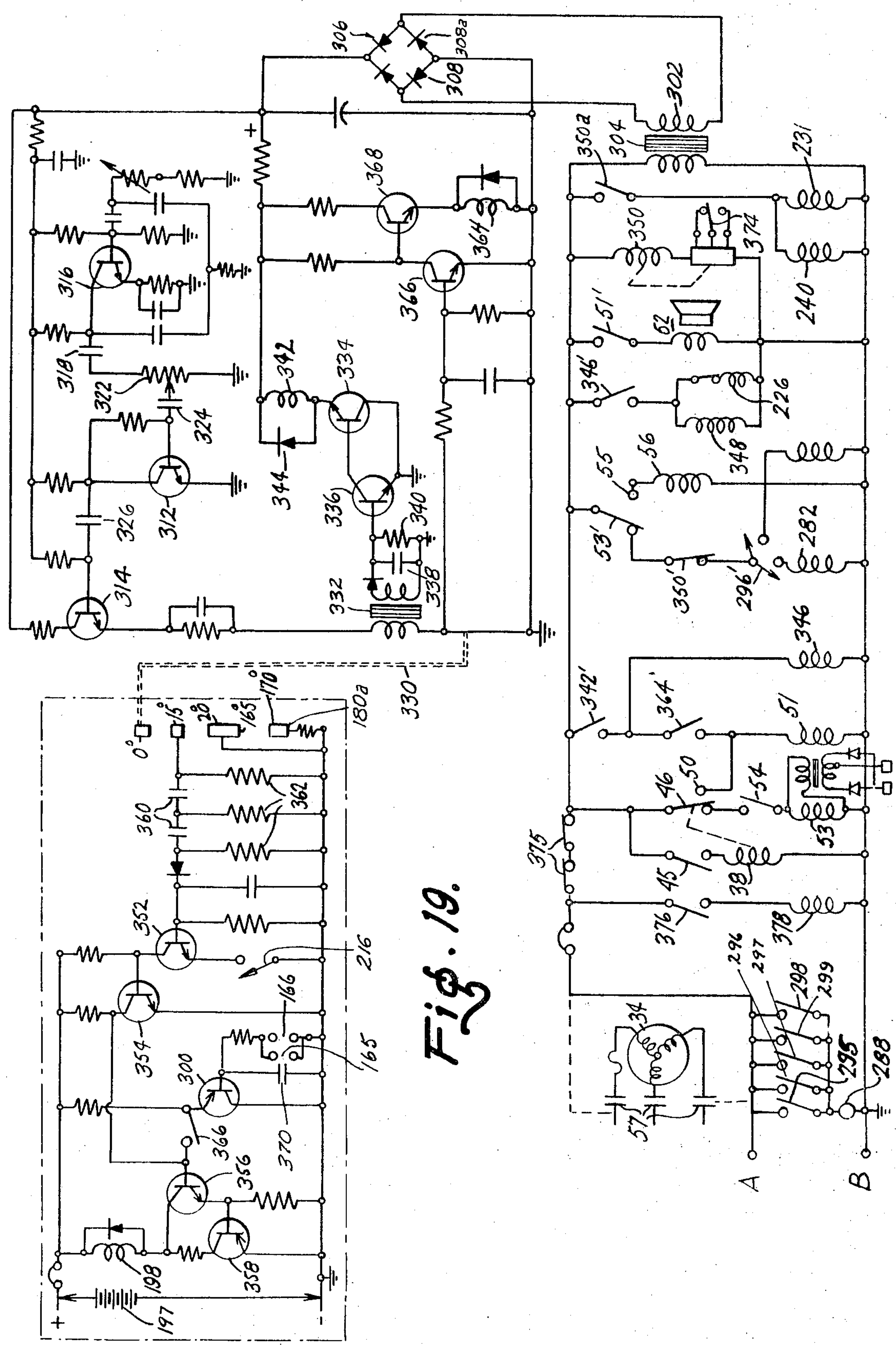


Fig. 19.

COIN HANDLING SYSTEM

BACKGROUND OF THE INVENTION

The invention described herein relates to coin handling equipment and more particularly to an improved pneumatic system for transferring coins from a vehicular fare box to a stationary vault located alongside the vehicle.

Each year in the United States, more than a billion dollars in coins and tokens are deposited in transit system fare boxes and turnstiles, parking meters and other coin-type depositories. Since $1,000 in coins weighs approximately 55 pounds, it is apparent that extensive facilities and manpower are required to ahndle this massive volume and tonnage of coins. Also, a related problem involves the fact that the total value of coins collected from paying passengers is frequently greater than the total amount ultimately deposited in a bank. This situation creates serious security and accounting problems.

In recognition of the need to cope with the volume, security, accounting and related problems, fare box manufacturers have continuously incorporated design improvements in the fare box coin-registering mechanisms and in the fare box vaults used for transferring the collected coins from the bus fare box to a coin counting room. The prior art shows that at the present time the coin registering mechanisms in the fare boxes consistently produce highly accurate and reliable registrations of coins deposited by passengers. Likewise, the vaults contain sophisticated design features which impart the desired degree of security to the overall unit. As a result, discrepancies between registrations and actual coin counts for a given number of coins rarely occur.

The major problem now resides in the lack of efficiency and in the high costs involved in withdrawing coins deposited in a bus fare box and in carrying out the subsequent, multiple steps in the coin handling process until the coins are transferred to a bank. According to the most advanced procedures, selected employees remove the vault from the pedestal or under-portion of each fare box when the bus is being serviced with fuel and oil at the end of a day's operations. An empty vault is promptly replaced in the bus and the coin-laden vault is delivered to a counting room for coin sorting and counting. This straightforward procedure is relatively efficient for a bus fleet of about twenty-five buses or less. However, bus garages in relatively large-size cities usually accommodate fleets of 200–300 buses and the aforementioned procedure then becomes very inefficient and costly. In the circumstances of large garages, only a small time period each day is available for normal bus servicing thus requiring numerous employees to exchange the vaults, take meter recordings of deposited fares and deliver the vault to a coin counting room. Since the vaults cannot be emptied immediately, storage facilities are required for the coin-laden vaults.

Each vault must be separately handled by the counting room personnel because access to the coins is acquired only by the use of an especially designed four-way key which unlocks the vault cover. After the coins are dumped in a coin sorter and sorted, the separate coin denominations must be bagged or otherwise packaged for delivery to a bank.

The multitude of detailed steps required to be performed in the complete operation from the time of vault removal from a bus until the transfer of coins to a bank requires a large number of employees, which adds materially to the labor cost of operating a transit system. None of the steps described above can be eliminated from the process, and as a result, labor cost reductions cannot be made in these areas to achieve improved financial performance.

Obviously, since two vaults are needed for each bus, the initial material costs and subsequent maintenance costs are greater in those operations where two vaults are used for maximizing efficiency.

To eliminate manual handling of coins and to speed up the coin collection and handling process in other related systems, such as parking meters and telephone coin receptacles, pneumatic systems have been suggested, but these are of relatively simple design not requiring the maximum degree of security required wth vehicular fare boxes. In such low-volume systems, a simple hose connection is made to the coin meter or receptacle housing and a negative pressure is established therein. As air rushes in the housing openings, the coins are agitated and lifted into the hose for delivery to a small, portable conveyance. These systems are not adaptable to operations where much larger volumes of coins must be transferred rapidly over greater distances and under conditions where succeeding transferrals must be effected promptly at minimum cost.

Pneumatic systems previously have been suggested for transferring coins from bus fare boxes to a depository, but such systems cause coin mutilation resulting from the high speeds at which the coins move in the transferring hose and from the high impact forces imposed on the coins as they are brought to an abrupt halt. Also, such systems do not contain adequate design features necessary for imparting security to the operating components.

SUMMARY OF THE INVENTION

Briefly stated, we eliminate the disadvantages in the prior art by providing a high security coin handling system which pneumatically transfers coins from a fare box to a centralized coin processor at high speeds without mutilating or otherwise defacing the coin surface. The coin processor sorts the coins according to denomination during the process and deposits them in a vault for later removal to a bank or other depository. The mechanism used for transferring the coins includes a probe which connects the fare box to a hose running to the coin processor. Electrical circuits and a vacuum system incorporated in the complete coin handling system control the admission of air to the fare box for lifting the coins into the probe and hose and for carrying the coins to the coin processor which sorts the coins according to denomination prior to discharging them to separate compartments in a vault. The electrical circuits and vacuum system further control the operation of components in the coin processor which decelerates the coins and sorts them before delivery to the vault. A number of interlocks associated with the various operating components provides a high degree of security to the overall coin handling system.

An object of the present invention therefore is to provide a new and unique high security coin handling system which transfers coins without manual handling from a bus fare box to a centralized coin processor which sorts the coins by denomination and stores them in a compartmented vault to await transportation to a bank.

Another object of the present invention is to provide a coin handling system capable of transferring coins to a coin processor at a high velocity with subsequent deceleration without coin mutilation prior to deposit in a coin processor vault.

Still another object of the present invention is the provision of a modified fare box incorporating features which preclude accessibility to coins therein during normal vehicle operation.

Another object of the present invention is the provision of a high-security probe designed for coaction with the bus fare box for effecting transfer of coins to a centralized coin processor.

Another object of the present invention is the provision of electrical and pneumatic control systems for controlling the transfer of coins from a bus fare box to a coin processor and for imparting a high degree of security to the overall coin handling system.

Still another object of the present invention is the provision of an improved design of vault for safeguarding coins after sorting according to denomination.

BRIEF DESCRIPTION OF THE DRAWING

The subject matter of the invention is particularly pointed out and distinctly claimed in the concluding portion of this specification. The invention however, both as to organization and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective view of the coin handling system including a bus fare box and coin processor;

FIG. 2 is a view in elevation with parts broken away, illustrating the components located in the centralized coin processor shown in FIG. 1;

FIG. 3 is a front view of a housing attached to the coin processor in which the probe is stored during nonuse;

FIG. 4 is a side view of FIG. 3 showing the arrangement of parts for locking the probe in the housing;

FIG. 5 is a view in elevation, partly in section, illustrating details of the probe and the arrangement of parts when the probe is inserted in a fare box;

FIG. 6 is a plan view of the probe of FIG. 5;

FIG. 7 is an exploded view showing the relative arrangement of parts comprising the probe;

FIG. 8 is a perspective view of concentric tubes adapted for attachment to the probe;

FIG. 9 is a side view of a vacuum chamber assembly before installation in a bus fare box;

FIG. 10 is a back view of the vacuum chamber of FIG. 9;

FIG. 11 is a front view of the vacuum chamber of FIG. 9 and showing its position in a fare box pedestal;

FIG. 12 is an exploded view of the vacuum chamber inner and outer tubes which coact with the probe tubes for effecting removal of coins from the vacuum chamber;

FIG. 13 is a perspective view of the inner tube shown in FIG. 12;

FIG. 1 is a front view of a portion of the vault door illustrating the door locking mechanism.

FIGS. 15 and 16 are front and top views respectively of the door upper locking mechanism;

FIGS. 17 and 18 are front and top views respectively of electrical lock used on the vault door; and

FIG. 19 is a schematic diagram of the circuitry used for controlling system operation.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in FIG. 1, a bus 20 having either a registering or nonregistering fare box 21 of the type manufactured by Keene Coin Handling Division, Inc. The pedestal or base of the fare box disclosed herein is equipped with a vacuum chamber which holds coins deposited therein by passengers during bus operations, rather than a vault of the type used in the prior art.

The primary objective is to transfer coins and tokens without mutilation from the bus fare box to a vault in a coin processor 22 efficiently while maintaining the maximum degree of security to help assure that all fares collected will eventually reach a bank or other depository. Stated generally, a pneumatic system is used for this purpose. The system includes a vacuum pump 23, FIG. 2, which draws a vacuum on the fare box and thereby causes in-rushing air to move coins at a high velocity from fare box 21 through hose 24 to an interconnecting coin slowdown chamber 26. After deceleration, the coins are dumped into a coin feeder 27 and from there, on to a sorter 28 (both shown in FIG. 2) which separates coins according to denomination, prior to dropping them into a vault for later removal from the coin processor.

As a bus or other vehicle drives into a service area for removal of coins from its fare box, the complete system is in a static condition. Electric power is supplied to the coin processor 22 but the equipment is not operating. A probe 30 on the end of hose 24, which is used for connecting the fare box to the cointransferring hose 24, is parked in a housing 31 attached to the side of the coin processor. The probe is locked in place by a mechanical locking device which is electrically operated and can be withdrawn only upon insertion of a magnetically coded card into a switch located in the housing. Action of the switch energizes certain circuits, hereafter described, which permits removal of the probe from the housing. Upon removal, the probe is designed to be manually inserted in a complementary opening in the fare box for withdrawing the coins by vacuum and transferring them to the slowdown chamber 26 in the coin processor.

PROBE HOUSING

As shown in FIGS. 3 and 4, the probe 30 of FIGS. 5 and 6 is centered in housing 31 by aligning and inserting probe locating pin 32 in a locating pin hole 33. The probe body rests in cylinder 34 supported by the housing, and is designed to be locked in the housing by a probe pawl 36 which moves into notch 35 on the locating pin thus precluding probe withdrawal from the housing. To effect The withdrawal a commercially available card key lock having an integral switch 45 is mounted on the housing side wall. the lock and therefore the switch, is actuated by a card key of the size and form of a conventional credit card but the card is equipped with small thin magnetic shims hidden in the card and positioned therein according to a predetermined code. The lock elements of switch **45** contain magnetic shims which are compatible with the code in the card key so that upon insertion of the card key in slot **47**, the switch **45** is actuated to a closed position; thus energizing solenoid **38**. The switch further is spring loaded, thus requiring the card to be held against the spring until the probe is removed from its housing. If the card key is only partially inserted or the wrong card used, the magnetic shims in the card key and card key lock magnets will not have their polarities aligned or will be of different polarity respectively and the switch therefore will not close. Solenoid **38**, which is energized by switch **45**, includes an armature or plunger **40** connected to pawl **36** which moves about pivot point **37**. Solenoid plunger movement causes corresponding displacements in pawl **36** and it therefore moves into and out of notch **35** for either locking or unlocking the probe in housing **31**. The plunger is biased downwardly by spring **42**, so that when the solenoid is deenergized, spring **42** pulls the plunger downwardly, pawl **36** pivots about pivot **37** and the upper edge of pawl **36** engages the notch to hold the probe in a locked position in the coin processor. When the solenoid is energized, the solenoid coil pulls the plunger upwardly and pawl **36** pivots out of engagement with notch **35**, thereby permitting removal of the probe from the housing.

As the solenoid plunger moves vertically, the lower edge of pawl **36** alternately engages button **44** of a second switch **46** in the housing. When the plunger moves upwardly, pawl **36** moves off the switch button **44** and it transfers its contacts as explained later. When the solenoid **38** is de-energized, spring **42** pulls the pawl downwardly and the switch contacts are again changed.

A third switch in the housing, switch **54**, is normally open when the probe is parked in housing **31**. Upon probe withdrawal, the switch button moves outwardly, switch **54** closes and completes a circuit to start motor **34** for vacuum pump **23**.

To maintain security in the system, switches **45, 46**, and **54** are actuated when the probe is in the parked (locked) and unparked (unlocked) positions.

The function and circuit operation of switches **45, 46** and **54** is shown in FIG. **19** as follows: 208 volt, 3-phase power is supplied to the motor windings. By connecting across one phase and ground, 120 volt AC is made available at terminals A-B. As the card is inserted in slot **47**, card key switch **45** closes to complete a circuit through the coil of probe lock solenoid **38**. The solenoid plunger moves upwardly, carrying pawl **36** with it to unlock the probe and simultaneously permit switch button **44** to move outwardly and transfer switch **46** to contact **50**. When in this position, relay **51** having a time delay of 10–20 seconds, is energized for the following reason. For security purposes, it is essential that the operator always have possession of the card key, and to assure this, the circuit is arranged to sound a siren should the card be left inslot **47** for longer than about 20 seconds. in slot time period therefore starts to run upon removal of the probe from its housing. If the card key is not removed within this interval, and 20 seconds elapse, relay **51** causes **51′** to close and sound siren **52**. The noise made thus notifies the operator to remove the card from its slot for safekeeping.

It will be noted that upon card removal, switch **45** opens to de-energize solenoid **38** whose spring **42** then moves probe pawl **36** to the probe locking position even though the probe has been withdrawn. It is not necessary to again insert the card when the probe is replaced in the housing since upon replacement, the rounded end of the probe centering pin **32** rides over the probe pawl **36** upper edge until it slips into notch **35** and locks the probe pawl **36** upper edge until it slips into notch **35** and locks the probe in place. If the probe is not fully housed upon reinsertion in housing **31**, switch **46** will engage contact **50** and energize the time delay solenoid **51** to sound the siren after **20** seconds elapse.

The circuit of FIG. **19** further shows that as the card key is removed and switch **45** opens to de-energize solenoid **38** and transfer switch **46** from contact **50** to the position shown, power is then applied to relay **53** since removal of the probe automatically closes switch **54**. The application of power to relay **53** transfers switch **53′** to contact **55** and line voltage is applied to magnetic starting coil **56** for vacuum pump motor **34**. The coil pulls in contactors **57**, thus starting the vacuum pump motor **34** which provides the required vacuum in the system for coin removal from the vacuum chamber as described hereafter. When the probe is replaced in the housing, switch **54** opens, relay **53** and starting coils **56** are de-energized and the vacuum pump motor stops running.

With the probe removed from its housing **31** and the circuits conditioned as described above, the system is set for withdrawal of coins from the fare box vacuum chamber. At this time however, neither electric power nor a vacuum is applied to the probe, even though the vacuum motor is running, because valve **227** in vacuum pump inlet **225** is in the open position. They are temporarily withheld for the purposes of security until the probe is actually inserted in the fare box vacuum chamber.

PROBE

The probe serves as a control agent and an interface coupler when inserted and locked in the vacuum chamber. Except for starting the vacuum motor, it controls the application and removal of vacuum from the system and most electrical components used in the system operations. The probe further provides accessibility to the fare box coins and facilitates their transfer from the fare box to the hose for delivery to the vault in the coin processor **22**.

Referring now to FIGS. **5** through **8**, the probe specifically shown comprises a handle **60** supporting on one end, a pair of concentric cylinders or tubes **62** and **64** adapted for insertion in the fare box vacuum chamber, and a coupler **66** on the other end for removably coupling the hose to the probe body. The arrangement used for supporting probe inner tube **62** from the handle **60** includes a block **108** attached to the handle by screws **110**. The bottom side of block **108** is attached to a stationary ring **68** which includes a flange **70** and a central bore through which an end of stationary inner tube **62** projects. Set screws **72** extend through the flange and inner tube **62** for preventing relative movement between the inner tube and stationary ring **68**.

A rotating ring **76** encompasses inner tube **62** and includes an axially directed portion **78** which extends over stationary ring **68** a distance sufficient to prevent insertion of a tool which might be used for prying the rings apart for ultimately gaining access to coins in the fare box.

The probe is designed to sense the continuity of electrical circuits in the system which operate components serving particular functions. To transmit electric power through the probe, conductors extending from the coin processor **22** run the length of the hose and are brazed or otherwise secured to a conductive ring **80** mounted in the end of hose coupler **66**. An insulator **81** located in stationary ring **68** carries a pair of contact buttons **82** biased outwardly by a spring therebetween. The outermost button is in contact with a conductor ring **83** having conductive and non-conductive sections mounted on the inner face of rotating ring **76**. Rotating ring **76** also carries a pair of contact buttons **84, 85** biased outwardly by a spring **86**. The outer end of button **85** is constantly in contact with the exposed surface of the fare box to sense infinity or ground conditions when the rotating ring **76** is turned during the coin removal operation. By utilizing this kind of arrangement, it is possible to transmit voltages through the separate rings in the probe for controlling operation of the system as more fully described hereafter.

One of the more important security features in the system includes the arrangement for safeguarding coins in the vacuum chamber and making them inaccessible to anyone at any time, including the time during which the coins are transferred from the vacuum chamber to the coin processor **22**. It is obvious that the probe access opening in the fare box vacuum chamber must be closed at all times except when coins are being transferred to the coin processor. Likewise, the opening into the probe must always be closed except during the coin transfer process. The construction used for imparting a high degree of security to this part of the system includes permanently mounting the inner tube **62** in stationary ring **68** and thereby making it immovable. The outer tube **64** encompasses the inner tube and is attached to rotating ring **76**. It therefore rotates on inner tube **62** when the rotating ring **76** is turned during the coin removal operation.

Both the inner and outer tubes **62** and **64** respectively contain elongated openings or ports **90** and **92**. Since inner tube **62** is stationary, port **90** always faces downwardly toward coins in the bottom of the fare box vacuum chamber. Port **92** on outer tube **64** faces upwardly and is rotated into alignment with port **90** as ring **76** is rotated to a port open position during the time the probe is located in the vacuum chamber for removing coins.

Outer tube **64** is equipped with a slot containing an axially extending key **94** having a pair of projections **96** and **98**. Projection **96** fits into a groove milled in the inner surface of rotating ring **76**, so that as ring **76** is manually rotated, it carries outer tube **64** with it thereby moving its port **92** into alignment with inner tube port **90**.

The corresponding tubes **170** and **172** in the fare box vacuum chamber are similarly arranged. Outer tube **170** is stationary and its port **186** faces the coins. Inner tube **172** is rotated to align its port **188** with port **186**. To achieve rotation of inner tube **172**, projection **98** on key **94** engages slot **190** on tube **72** so that as rotating ring **76** is turned, the projection **98** causes the inner tube to rotate and achieve alignment of ports **186** and **188**.

When in this position, the aligned ports **90** and **92**, **186** and **188**, face coins in the bottom of the fare box and thereby provide an avenue for flow of coins into the hose. As air is drawn at a high velocity through fare box openings and into the probe aligned and open ports, it causes coins in the fare box to be air lifted through the ports in the probe and vacuum chamber tubes and into the hose for passage to the slowdown chamber **26** on coin processor **22**.

The coupler **66** on the other end of probe **30** is designed to couple hose **24** to the probe body. As shown, the coupler includes a machined cylindrical element **99** having internal grooves **100** which receive complementary ribs **101** formed on the hose outer surface. The hose further is firmly bonded by cement to the coupler, to provide the strongest joint reasonably possible. A stop **102** abuts the end of inner tube **62**, thus limiting its forward travel into the probe body. To provide electric power to the contacts **80** through **85** aforementioned, the coupler includes a bore **104** designed to receive a conductor welded or otherwise secured to the hose coupler conductor ring **80** which is attached to the coupler by set screws.

Probe handle **60** is connected to stationary ring **68** by a block **108** and screws **110**. The screws connecting the other end of the block to the stationary ring **68** are not shown. A lock housing **112** attached to block **108** by screw **114** contains a four-way hose coupling lock **116** having a lock blade **118** of eccentric shape for engaging slot **120** extending around the coupling periphery. The function of lock blade **118** which is activated by key **122**, is to removably hold hose coupler **66** on inner tube **62**. Since the hose **24** can be decoupled from the probe, decoupling is resorted to only in those emergency situations where the probe for any reason cannot be removed from the fare box. It is essential that a decoupling arrangement be provided since otherwise buses could not be moved through the coin removal service area under circumstances where a probe could not be withdrawn from a fare box. By using this design, decoupling can be effected by key **122** which rotates the hose coupling lock plate **118** out of its groove **120** in the coupling. This action releases the coupler and its connected hose from the probe and thereby permits an operator to drive the bus away from the coin removal service station and extract the decoupled probe at a more convenient time. In order to continue the process of removing coins from succeeding buses, a new probe is locked on the end of coupler **66** by actuating lock **116** and moving the lock blade **118** into a locking position. The coin removal process can then be resumed without disruption to the bus servicing operations.

VACUUM CHAMBER

Referring to FIGS. **9, 10** and **11**, the conventional bus fare box **21** includes a coin collection chamber into which passengers deposit coins, a coin registering mechanism (not shown) and a pedestal **150** which supports these two mechanisms. The pedestal illustrated does not include the conventional vault, but rather, comprises an outer casing enclosing a vacuum chamber assembly **152** into which coins drop from the fare box registering mechanism. The pedestal is closed on all sides and is adapted to be bolted to the floor of a bus. It further includes a slidable door **154** which simply closes the opening into which the probe is inserted for withdrawing coins. Air inlet openings **156** located in the sides of the pedestal permit ingress of air to the vacuum chamber for lifting the fare box coins into the hose during vacuum pump operation.

The vacuum chamber assembly positioned in the casing includes a housing **158** having an escrow chute **160** through which coins drop from the fare box opening, or from the coin registering mechanism if one is used. The chute is open when the bus is carrying passengers but is closed by a slidable door **162** when coins are being removed from the vacuum chamber so as to limit the flow of air through pedestal air inlets **156** to the vacuum chamber. As the coins leave chute **160**, they are directed by internal baffles **163** toward the curvilinear base **164**. The base is perforated as shown to permit the ingress of air from pedestal openings **156** for lifting coins into the probe and hose for delivery to the island unit. To help assure the removal of all coins, high and low level detector switches **165** and **166** are used for detecting the presence of unremoved coins. Should either of these switches, FIG. **19**, be closed by a coin, a relatively negative voltage is applied to the base of transistor **300** thus negating the operation of transistor **356**, with the result that the coin chamber release solenoid is not energized thus preventing removal of the probe. The remedy is simply to rotate probe ring **76** clockwise then counterclockwise to modulate the air stream and dislodge a coin or coins in contact with level switches **165** or **166**.

A pair of concentric tubes **170** and **172** similar to the probe tubes **62** and **64** are mounted in the vacuum chamber assembly as shown in FIGS. **5** and **9** through **13**. As indicated above, the purpose and function of the set of concentric tubes **62** and **64** on the probe and concentric tubes **170** and **172** in the vacuum chamber is to establish aligned openings or ports through which coins pneumatically move from the vacuum chamber to the hose for delivery to coin processor **22**. one tube of each set is stationary and its port always faces the coins. The other tube of each set is rotated by probe rotating ring **76** when the probe is inserted in the vacuum chamber. When rotated, the ports on all four tubes are aligned, an avenue is provided for movement of coins from the fare box through the probe to the hose for delivery to the island unit. As described hereafter, the tubes rotated by rotating ring **76** can only move when certain mechanical and electrical conditions in the circuitry are satisfied. The ultimate purpose for this kind of arrangement is to safeguard the coins in the vacuum chamber. The coins cannot be transferred unless tube rotation takes place to align their ports.

In FIGS. **9** and **10**, the outer tube **170** extends through and projects beyond the front and rear walls of the housing. It is welded or otherwise fixed to plate **174**, which in turn is attached to the housing wall by a spacer **176** and bolt **178**. The plate **174** includes a centering hole **180** for receiving the locating pin **32** when the probe is inserted in the vacuum chamber. A pair of contacts **184** and **185** are secured in the face of plate **174**.

The inner tube **172** is supported and rotates in outer tube **170**. A notch **190** located in the top of tube **172** is engaged by the driving projection **98** of key **94** mounted on probe outer tube **64** (FIG. **5**). When the probe is inserted in the vacuum chamber, rotation of ring **76** causes key **94** to simultaneously rotate tubes **64** and **172** to the port alignment position to provide an avenue for the flow of coins from the vacuum chamber into the hose.

Referring now to FIG. **10** which shows the back side of the vacuum chamber, as aforementioned, the outer tube **170** projects beyond the wall of housing **158.** A plate **189** having an arcuate slot **191** is mounted on the closed end of tube **170.** Connector **192** extends through the slot and is attached at one end to the back wall of the inner tube and at its outer end to an escrow door drive arm **194** which is connected to the slidable escrow door **162** through bell crank **196.** As the inner tube **172** is rotated to a port open position by ring **76** on the probe, connector **192** rides upwardly in the arcuate slot, thus moving the escrow door drive arm upwardly and, through the action of the bell crank, causes the escrow door to close. This action blocks the opening through which coins drop and prevents the ingress of air at the top of the vacuum chamber and provides for maximum coin lift at the bottom thereof during the coin removal process.

A lock pin solenoid **198** mounted on the back of the vacuum chamber, includes a plunger **200**, a flexible coupling spring **201** and spring **202** biases the plunger in a downward direction. The end of the plunger is adapted to move through a hole in the pedestal outer tube and into engagement with a notch **203** formed on inner tube **172**,. The notch is in alignment with the plunger when the outer tube is in a closed position. This locking arrangement of plunger **200** in notch **203** constitutes a security device since it precludes anyone from reaching in the open end of tube **170** and turning the inner tube **172** to a port open or coin accessible position when the probe is not in the pedestal. A further security feature resides in the use of a heat treated steel cover plate **207** which surrounds the solenoid plunger **200.** Should a hole be cut in the pedestal wall for the purpose of using a tool to lift the plunger to permit rotation of tube **172** to a port open position, the cover plate would be effective in resisting such action since it bars access to the plunger.

The inner tube has two notches **204** and **206** in its outer surface, FIG. **13**, which serve the following purpose. When the probe is inserted in the pedestal for withdrawing coins and ring **76** is rotated to move the tubes **64** and **92** to port open positions, the solenoid is energized and the plunger **200** is withdrawn from its locked position in notch **190.** After the ring is turned through 15°, the solenoid is de-energized as described hereafter, and the spring biases the end of the plunger downwardly through the hole to ride on the outer edge of the pedestal inner tube **172.** As the ring is rotated to 35°, the plunger falls into notch **204** and prevents rotation of the ring back to the 0° position in the event that probe removal was desired without going through the complete coin withdrawal cycle. It will be apparent that as the commitment is made to remove coins by rotating the ring past 35°, the cycle must be completed, since the inner tube cannot be returned to a point to permit probe removal. This comprises a security feature because the probe cannot be removed after the pedestal inner tube has been rotated a distance to at least partially open its port **92.**

In the event of an electric power failure to the system during the process of withdrawing coins from the vacuum chamber, it is important that the probe be removed from the vacuum chamber to permit buses to move through the bus service area. To accomplish this, an actuating lever 208 is slidably attached to the back of the pedestal plate 189 by a pair of screws 209 which allows loose movement of the lever vertically. The upper end of lever 208 is arranged to move beneath a lip 199 on the solenoid plunger 200 to move the plunger out of locking engagement with the inner tube 172 and thereby permit rotation of ring 76 and tubes 64 and 172 to a probe withdrawal position. Such vertical movement of lever 208 is accomplished by a four-way lock 210 mounted on the housing. A cam-like member 212 mounted on the lock is arranged to be rotated as the key is turned, thus moving it into engagement with the bottom edge 213 of lever 208. Lever 208 then rises, and its upper surface engages the solenoid plunger lip 199 to move the plunger upwardly out of contact with the tube. This action releases the mechanical operating components and thus permits withdrawal of the probe from the pedestal.

A commercially available vacuum switch 216 set for about 4 inches mercury carries an open-ended conduit 218 which extends through the outer tube 170 for exposing the vacuum switch to the pressure prevailing in the vacuum chamber. However, the openended conduit normally sees only the walls of tube 170 and cannot sense the true pressure in the vacuum chamber. To sense the pressure, a hole 219 drilled through the wall of tube 172 is located in a position to align with the open-ended conduit 218. As the tube 172 is rotated by ring 76 to the 15° position, the hole 219 is aligned with conduit 218 which permits accurate sensing of the pressure in the vacuum chamber. In the event that vacuum chamber pressure is less than 4 inches mercury, switch 216 will not close and the system will not operate, as described later in relation to FIG. 19.

COIN PROCESSOR

Referring to FIGS. 2, 9, 10 and 11, and specifically considering the air circuit, vacuum pump 23 is placed in operation when the probe is removed from housing 31. When ring 76 is rotated to align ports on the four tubes, valve 227 closes inlet 225 and the vacuum pump draws a suction on hose 24 and the open ports in probe 30. Air surrounding the pedestal is drawn through the pedestal air inlets 156 by the suction established at the ports to the probe. The configuration of the vacuum chamber and the pedestal causes the air to flow downwardly, then upwardly through the perforations in chamber base 164 and in so doing, lifts the coins into the open ports on the probe for transfer by the hose 24 to the coin processor 22. The velocity of air flowing through the perforations and into the probe must be sufficiently great to both overcome the weight of the coins and to accelerate them to that speed necessary to reach the slowdown chamber 26 and to overcome the frictional and other forces presented by the hose inner walls and the tumbling coins. Although the coins move at a high speed in the hose, they must decelerate within a short distance without harmful effects to the coins, if efficiency is to be derived in the system. Experiments show that if coins are decelerated by striking a solid barrier, the impact forces cause severe mutilation and damage to the coin surfaces. Such mutilation takes the form of multiple indentations on the coin surface roughly the size of a pinhead or less. Coins recycled about 25 times in a system such as that disclosed herein, and slowed by striking a barrier, result in surface mutilation so extensive that the coin markings are obliterated.

This problem is overcome in the present invention by providing a coin slowdown chamber 26 in the coin processor 22. As shown in FIG. 2, the end of hose 24 is attached to the end of chamber 26 into which both the coins and coin carrying air are discharged. The chamber is positioned at an angle to the vertical to assure having the coins come to rest in the bottom thereof. The slowdown chamber contains a perforated cylinder 222 which serves to rapidly vent the coin carrying air through outlet 224, noise mufler 224*a* and a pipe leading to the vacuum pump inlet. The suction drawn by the vacuum pump establishes an area of reduced pressure in the slowdown chamber thus effectively diverting the air outwardly and consequently removing all the force which acted to propel the coins at a high speed. As the air changes its direction of travel prior to discharge from the perforated cylinder 220, it cuts across the fowardly moving coins and this action also helps to reduce the coin velocity. As air leaves the cylinder, the coins fall by gravity to the bottom of the chamber.

As indicated above, as the probe is removed from housing 31, the electrical circuitry starts the vacuum pump motor 34. The vacuum pump 23 has two inlets, the first through inlet 225 which is controlled by a bleeder air solenoid 226 and an air valve 227. The other inlet is through the fare box vacuum chamber and ports in probe 30, hose 24 and the slowdown chamber 26. As the vacuum pump motor starts, air is drawn through the inlet 225 because probe ring 76 has not been rotated and the probe ports are closed. When the probe is inserted in the fare box pedestal, and ring 76 rotated, the bleeder air solenoid is energized to close air valve 227 and suction is thereby shifted from inlet 225 to the probe ports.

A escrow door 228 hinged to the bottom of the slowdown chamber is actuated by air cylinder 229 and its associated linkage 230, to an open position to discharge the coins into coin feeder 27 when the probe is relocated in housing 31.

Although the slowdown chamber is of relatively simple design, it is extremely effective in rapidly decelerating the coins and without mutilating the coin surface. The coins move at approximately 80 mph in the hose and the normal time for emptying a fare box, including time delays incorporated in the circuitry, is less than 30 seconds. Coin slowdown and air venting occur simultaneously. To illustrate the effectiveness of this design, an assortment of 100 each of unused quarters, tokens, dimes, nickels and pennies were cycled through the above-described system 200 times. Upon examination of the coins after the last cycle, it was difficult ot visually determine any marks, burrs or other indentations in the coin surface.

The coin feeder 27 serves to transfer coins between the slowdown chamber and coin sorter 28. The feeder simply comprises a steel trough which is vibrated by a magnetic vibrator 231 to meter the coins on to the coin sorter at a predetermined rate.

The coin sorter 28 is one of many different commercially available types. The sorter comprises a base 232 having upstanding stanchions 234 which support a number of coin receiving trays 236. Each tray has openings in its surface of different diameter for permitting coins of different denominations to fall therethrough. The uppermost tray has openings of a size sufficient to permit all coins except the largest size, in this case quarters, to fall through the openings and on to the next lower tray. That tray has slightly smaller sized openings and permits nickels, pennies and dimes to fall through while retaining tokens. The next tray retains nickels, and so on, until all coins have been sorted according to denomination.

The trays may be positioned substantially end to end or at right angles to each other and at different depressions from the horizontal. In this embodiment, a separate plate **238** mounted below each tray returns the coins which have fallen through openings in the tray immediately above it, to the right as shown in FIG. **2.** The mass of coins then move in the reverse direction to again isolate the next size larger coins, and so on until all coins have been sorted. In order to shake, mix or otherwise disarrange the coins to have them fall through the appropriate openings, a commercially available magnetic vibrator **240** anchored to the coin processor base is attached to the tray assembly. It vibrates the tray assembly at 3,600 c.p.s. to continually keep the coins in motion and moving toward the end of each tray.

The arrangement of trays is such that the coins separated according to denomination fall through pipes **242** directly into separate compartments in a vault **244.** The vault **244** is mounted on rollers **245** which move on a track in the coin processor. The vault **244** is constructed of heavy steel plates and is internally divided into compartments for the different coin denominations. A slidable plate attached to the underside of the top of the vault holds a toothed bar which projects above the top surface. A toothed gear, not shown, on the coin processor housing engages the toothed bar when the vault is in the coin processor. As the vault is pulled outwardly, the gear remains stationary and its teeth pull the toothed bar and the connected cover to a position which closes the openings through which coins dropped into the compartmented vault.

To safeguard the vault contents, that portion of the coin processor which houses the vault comprises heavy steel plating including a locked security door **246** having a door handle **247.** The door is designed to be opened by two custodians, each of whom have a different key for the two vault locks, as described hereafter.

As illustrated in FIGS. **14** through **18,** the construction for locking the security door **246** consists of moonshaped discs **260, 262** and **264** mounted on the inside of a framing member for the door. Each disc has a flat side **266** which when moved vertically, is in a door unlocked position. The round portion on each disc extends across the door to lock it in position.

Disc **260** is provided with a notch **268** engageable by a latch **270** which when engaged, holds the door in a locked position. A four-way lock **272** having an eccentric disc, not shown, moves the latch out of notch **268** when a key is inserted in the lock and turned. This action merely moves the latch to a door unlocked position. The lever arm **274** on disc **260** is used for manually rotating the disc after the latch **270** is moved out of notch **268.**

A longitudinally extending bar **276** interconnects discs **260, 262** and **264** so that upon rotation of lever arm **274,** all discs turn simultaneously.

Disc **262** is likewise equipped with a notch **278** and a latch **280** which is operated by a solenoid **282** and plunger **283.** Latch **280** is pivoted at **286,** the arrangement being such that when the plunger moves upwardly to disengage latch **280** from notch **278,** switch **284,** FIG. **17,** also is closed.

To move disc **262** to a door unlocked position, solenoid **282** is energized from a remote source on the coin processor thus requiring two custodians to carry out the vault door unlocking operation. A four-way lock **290** located in housing **31,** FIG. **4,** energizes solenoid **282** which moves latch **280** out of locking engagement with disc notch **278.** The lock **290** contains a cam **292** which depresses switch button **294** and closes security switch **296′** located in the circuit, FIG. **19,** to the vault door. Closure of switch **296′** contacts also energizes solenoid **282** which moves latch **280** out of notch **278.** With latch **280** disengaged, a second custodian using a different four-way key for lock **272,** disengages latch **270** from notch **268** in disc **260.** Since both discs are now free to turn, a custodian rotates handle **274** thus permitting bar **276** to move upwardly and rotate the discs to a door unlocking position. As the door is opened to remove the vault, switch **298** on the door frame closes and completes a circuit to a red flasher **288** mounted on top the coin processor **22.** Flashing of the red light shows that an operation involving the security vault is under way. Also, as the vault is moved outwardly, a switch **299,** FIG. **19,** mounted on the back wall of the coin processor, which had been held open by the vault pressing against it, closes and completes a circuit to the flasher **288.**

The door permitting access to the coin processor section containing the coin sorter also actuates a switch **295** on the door frame to a closed position when the door is opened. Also, the door permitting access to the coin processor section containing the vacuum pump and other components actuates a switch on the door frame to a closed position when the door is opened.

Since it is essential for the purposes of security that the system operator will be aware of any activities involving the doors in the coin processor **22,** the door switches have been incorporated in the flasher circuit to cause operation of the flasher should any door be opened. If any of switches **295** through **299** be closed, the circuit to the flasher will be closed and it will flash to show that one or more of the doors to the coin processor are open or that the vault has been removed from the system.

OPERATION

In the following discussion of system operation, the components are initially considered to be in a static condition, i.e., 120 volt, 60 hertz, single phase power is available at the coin processor **22** input terminals A-B, 208 volt, 3-phase power is available for the vacuum pump motor, and 12 volt, D.C. power is supplied to the fare box pedestal from the bus battery but none of the components are operating. The electrical circuit of FIG. **19** shows the static condition. At this time, the vault is positioned in the coin processor, the doors are closed and locked, the vacuum motor, coin feeder and coin sorter are in an "off" condition and the probe is parked in its housing **31** on the coin processor.

Stated generally, as a bus drives into the service area for removal of coins from its fare box, the probe **30** is removed from its position in housing **31** and inserted in the fare box. Probe removal starts the vacuum pump. The rotating ring **76** is rotated to its full position to open the probe ports and air drawn into the vacuum chamber, lifts the coins into the probe and connected hose 24 for delivery to the slowdown chamber 26 on the coin processor. The coins come to rest and the air is vented from the chamber. The probe is withdrawn from the fare box, replaced in its housing and the vacuum pump stops. Thereupon, the coins are dumped into a coin feeder, and metered on to a coin sorter which sorts the coin according to denomination prior to depositing them in separate compartments in a vault. At the end of a day's operations, the vault is removed from the coin processor, emptied at a bank or money counting room, replaced in the coin processor and the doors locked. At this time, the system is again in a static state and conditioned for the next coin removal operation.

More specifically, as a bus drives into the coin removal area, probe 30 is removed from housing 31 by first inserting the card key which closes switch 45, FIG. 3. Probe lock solenoid 38 is energized and upward movement of its plunger moves pawl cam 36 downwardly to unlock the probe and simultaneously transfers switch 46 to contact 50, FIG. 19. Closing of contact 50 completes a circuit through time delay relay 51. This circuit arrangement is employed to require full replacement of the probe in its housing. If it is not fully inserted within 20 seconds after removal from the fare box pedestal, relay 51 closes switch 51' which sounds siren 52 until the probe is re-housed properly.

It will be noted from FIG. 19 that the probe can be removed from housing 31 only so long as the card key keeps switch 45 closed and solenoid 38 energized. Upon removal of the probe from its housing, and subsequent withdrawal of the card, switch 45 opens and solenoid plunger spring 42 moves switch 46 to its initial static position thus opening the circuit to time delay relay 51.

As the probe is removed, probe switch 54 automatically closes and power is applied to solenoid 53 which transfers switch 53' to contact 55. This action applies line voltage to magnetic starter 56 which closes contactors 57 to start vacuum pump motor 34 in the coin processor. Vacuum pump 23 suction is taken through inlet 225 and is not applied to the probe end until the probe is actually placed in the fare box. This is accomplished by keeping the bleeder air valve solenoid 226 deenergized thereby permitting air to be drawn into the vacuum pump from the parallel source. At this time, the probe tubes are closed for security purposes and since a slight vacuum is present at the probe, tube closure prevents ingress of foreign material into the probe.

As the probe is placed in the fare box pedestal, neither electrical power nor a vacuum appear at the probe end. The probe rotating ring 76 is in the 0° position. However, 12 volt, DC power from the bus battery is applied to the vacuum chamber as shown in FIG. 19. The vacuum pump is operating at this time.

As the probe is placed fully in the vacuum chamber, lock 171 on the end of probe outer tube is pushed on to four-way key 173 which is permanently installed inside the vacuum chamber. The key 173 unlocks the probe inner tube 62 from the outer tube 64 and permits the ring 76 to be rotated 15° and intitiate turning of outer tube 64 counterclockwise to align its coin receiving port 92 with the inner tube port 90.

When ring 76 on the probe is rotated from the 0° to the 15° position, a 2.7 KC signal is applied to the pedestal circuit from the components in the coin processor. Signals having other characteristics may be used. As indicated in FIG. 19, 120 V AC supplies the circuit in the lower part of the diagram. The secondary winding 302 of a step-down transformer 304 furnishes 24 V AC to a full wave rectifier bridge 306. Diodes 308 and 308*a* rectify the AC voltage from the transformer to provide pulsating DC power to the circuit.

The 2.7 KC signal is generated in the oscillator circuit including transistors 310, 312 and 314. The oscillator is of a conventional type which provides an AC signal from collector 316 to the capacitors 318 and 320 and potentiometer 322. Capacitor 324 is a coupling device for passing the AC portion of the signal and withholding the DC. These components coact with transistor 312 which serves as a buffer amplifier to maintain oscillator stability. The amplified signal from this buffer stage is passed through coupling capacitor 326 to the final amplifying stage of transistor 314.

This amplified signal is transmitted through the sheathed cable 330 to the probe inserted in the fare box pedestal. Since the ring 76 has not rotated off the 0° position, the signal is made available through the slip ring conductors 80 and 83 and their respective contact buttons to button 85 which bears against plate 154 in the pedestal.

As probe ring 76 is rotated to the 15° position, the 2.7 signal is transmitted through impedance matching transformer 332 to a cascaded amplifier including transistors 334 and 336. The capacitor 338 and resistor 340 filters out unwanted noise and frequencies. A relay 342 and diode 344 are connected to the collector of transistor 334 and when the relay is energized as a result of transistors 336 and 334 conducting, switch 342' closes which in turn energizes relay 346 and its switch 346' closes. Closing of 346' energizes the escrow air cylinder 348 and the air bleeder solenoid 226 to provide a vacuum at the probe of 10 inches to 12 inches mercury.

Simultaneously, time delay relay 350 is energized to close switch 350' and the coin feeder vibrator 231 and the coin sorter vibrator 240 are energized and become operative.

Also, as the probe ring 76 is rotated to the 15° position, the small hole in the outer tube of the probe aligns with the vacuum switch 216 which senses the reduced pressure and causes its contacts to close. Since the vacuum switch is in the emitter circuit of transistor 352, the transistor conducts and its output is applied to transistor 354 which inverts the signal and applies it to the base of transistor 356 which is coupled to transistor 358 to provide a signal of sufficient amplitude to energize the coin chamber release solenoid 198. As the end of armature 200 of solenoid 198 lifts, the probe inner tube 172 is unlocked and probe ring 76 can then rotate the tube toward a port open position.

The capacitors 360 and resistors 362 in the pedestal circuit are used to pass only the 2.7 kc signal and filter out other unwanted frequencies.

Withdrawal to the end of locking plunger 200 now permits the probe ring to be turned to the 170° to 180° position. During the time the ring 76 is being rotated, if it remains in the 20° to 165° zone, the probe contact will be grounded thus causing relay 364 to become energized. Transistors 366 and 368 constitute a monitoring circuit and the output of transistor **366** applies a voltage to the base of transistor **368** and as the latter conducts, relay **364** in the emitter circuit will be energized thus closing switch **364'**. Since switch **342'** has been closed by the relay **342** in the cascaded amplifier circuit, closing of switch **364'** energizes time delay relay **51.** If the ring **76** is not moved off the **20°** to 165° zone within the time of 10 to 20 seconds set by the relay, switch **51'** will close and sound siren **52** to alert the operator to continue moving ring **76.** Therefore, the ring **76** must be turned to the 170° to 180° position within 10 to 20 seconds.

As the ring **76** turns the probe tube **64** and pedestal tube **172** to the port open position, i.e., to the 170° to 180° position, the suction drawn by the vacuum pump at the ports leading into the probe, causes air to enter the pedestal air inlets **156,** flow toward the bottom of the vacuum chamber then upwardly through the perforations to lift the coins into the probe and carry them to the slowdown chamber.

The coin level switches **165** and **166** in the vacuum chamber determine whether the probe can be removed. If coins bridge either switch contact to the metal frame of the vacuum chamber, the probe cannot be removed for the following reason. As the probe ring **76** was initially moved from the 15° to the 20°–165° position, the 2.7 kc signal was no longer applied to the base of transistor **352** with the result that transistors **354, 356** and **358** became nonconducting and the coin chamber release solenoid **198** was de-energized. As indicated previously, the end of the solenoid armature of plunger **200** then rides on the peripheral edge of the pedestal inner tube **172** and falls into a notch provided on its outer surface after the ring **76** is moved from the 15° position. This locking arrangement thus precludes removal of the probe since the commitment has been made to remove coins.

As the ring **76** also is moved to the 20°–165° position, the **35°** switch **366** in the base circuit of transistor **356** closes because the outer contact button **85** in the probe ring **76** moved off the contact button **184** and senses the ground conditions in the circuit. However, if all the coins are evacuated from the vacuum chamber, transistor **356** will conduct and energize the coin chamber release solenoid **198.** Should a coin remain in the coin chamber and contact one of the level switches **165** or **166,** the closed circuit to the base of transistor **300** negates the operation of transistor **356,** solenoid **198** is de-energized and the probe therefore cannot be removed from the vacuum chamber. In any event, the capacitor **370** in the base circuit of transistor **300** comprises a time delay device which delays the operation of transistor **356,** the delay being sufficient to clear the hose of the last coins removed from the chamber.

The probe ring **76** can be turned to the zero degree position when level switches **165** and **166** are open and the 35° switch is closed. The arrangement is such that the 35° switch contacts open before the probe can be removed, permitting the coin chamber release solenoid to de-energize and lock the pedestal port in a closed position.

As the 0° contact is reached, relay **342** opens switch **342'** and de-energizes **346.** The opening of switch **346'** de-energizes the bleeder air solenoid **226** and the escrow air solenoid **348.** The escrow door therefore opens and the coins are dropped on to the coin feeder which meters the coins on to the coin sorter. Both the coin feeder and the coin sorter magnetic vibrators **231** and **240** are operating and the coins pass from the sorter directly into the compartmented vault.

After a predetermined time delay set by relay **350,** usually 3 minutes, its contacts **350*a*** open and power is removed from the coin feeder and coin sorter.

Since the operation has been completed, return of the probe to its housed position on the coin processor, opens the probe switch **54,** relay **53** is de-energized and contacts **53'** open to remove power from the vacuum motor magnetic starting coil **56.**

To remove the master vault from the coin processor, the circuits and equipment must be conditioned so that the hose probe is in the parked position and power to the vacuum pump motor, coin feeder and coin sorter is disconnected. At this time, a custodian actuates four-way lock **290** to close switch **296'** in housing **31** and cause solenoid **282** to move latch **280** out of its locked position. A second key simultaneously and independently actuates lock **272** to move latch **270** from its notch **268.** This action then permits the raising of bar **276** to unlock the vault door.

As the vault is moved outwardly, proximity switch **376** on the vault door closes and applies power to relay **378,** FIG. **19,** which in turn disconnects switches **375** controlling the hot power lead to the control circuits.

Switches **295** through **299** apply power to the flasher light during the time that the door is open or the vault removed for service or maintenance.

In view of the above, it will be apparent that many modifications and variations are possible in light of the above teachings. It therefore is to be understood that within the scope of the following claims the invention may be practiced otherwise than as specifically described.

What we claim as new and desire to secure by U.S. Letters Patent is:

1. A coin handling system for transferring coins from a receptacle to a depository comprising:

a receptacle having a chamber for holding coins, and air openings in said chamber;

a recess in said chamber;

a hose having means on one end adapted for insertion in the chamber recess, said means being operable to selectively establish an avenue for the flow of coins from the chamber into the hose;

a coin processor spaced from the receptacle and having a coin slow-down chamber therein, and means connecting the outlet end of said hose to the slow-down chamber;

vacuum generating equipment in said processor and a conduit connecting the slow-down chamber with an inlet to the vacuum equipment thereby providing an air flow path including the inlet at the means attached to the hose end, the hose, slow-down chamber, conduit and inlet to the vacuum equipment;

said vacuum equipment having an outlet for discharging air to the atmosphere;

coin conveying means located adjacent said coin slow-down chamber for receiving coins therefrom and discharging them into said depository;

control means connected to said vacuum equipment for controlling the operation thereof and the application of a suction at the inlet to said hose for transferring said coins to said depository;

a escrow door attached to said slow-down chamber; and an actuating device connected to said door for discharging the coins to the coin conveying means when the door is actuated to an open position;

whereby when the vacuum equipment is placed in operation and the means on said hose is inserted in the receptacle chamber recess, an air suction established at the inlet to the means on said hose, causes atmospheric air to flow into the receptacle chamber and lift the coins into the inlet and carry them through the hose to the slow-down chamber, whereupon the coins are brought to a halt without mutilation, and subsequently discharged to the coin conveying means for transfer to the depository.

2. The combination according to claim **1** wherein said slow-down chamber comprises a cylinder mounted in and spaced from a housing on the coin processor; and

perforations in said cylinder for permitting the air carrying said coins to escape to said conduit and the vacuum equipment and for assisting in the coin decelerating process.

3. The combination according to claim **1** wherein a time delay relay is connected in a control circuit controlling the operation of said vacuum equipment, said relay being effective to continue operation of said equipment for a predetermined time after removal of the means on the end of said hose from the recess in said vacuum chamber;

said control circuit further including a switch responsive to the vacuum generated by said equipment so that upon closing of said switch, said actuating device is made operative to open said escrow door to discharge the coins in the slow-down chamber to said coin conveying means.

4. The combination according to claim **1** wherein the means on the end of said hose comprises a probe having a handle on one end and a movable member on its other end, said member being movable to open and close the coin entrance to said hose; and

an actuator on the probe connected to said movable member for selectively moving it between open and closed positions.

5. The combination according to claim **4** wherein locking means mounted on said probe is adapted to engage said receptacle chamber for locking the probe therein when the probe movable member is positioned in the chamber recess for withdrawing coins.

6. The combination according to claim **4** wherein an alignment guide is mounted on the probe for orienting the probe to a predetermined position upon insertion of the probe in the receptacle chamber.

7. The combination according to claim **4** wherein the receptacle end of said hose is adapted to be detachably locked in said probe by a key actuated lock mounted on said handle; an eccentrically mounted lock blade attached to the end of said lock;

a coupling member attached to the end of said hose removably mounted on the end of said inner tube, said coupling member having a groove in its peripheral surface adapted to be engaged by said lock blade to hold the coupling member on the end of the inner ring, whereby in the event the probe cannot be withdrawn from the receptacle chamber, a key may actuate the lock blade to a blade disengaged position to permit the hose to be decoupled from the probe by withdrawing the hose end axially outward from the probe.

8. The combination according to claim **4** wherein said probe includes a stationary inner tube of cylindrical configuration having a coin receiving port therein positioned to face coins in said receptacle chamber; and

said movable member on the probe comprises a similarly shaped outer tube concentrically mounted on the stationery inner tube and having a port of similar size therein; and

means connecting said actuator to the outer tube, the parts being arranged such that to withdraw coins from the receptacle chamber, the actuator rotates the outer tube port into alignment with the inner tube port to thereby establish an avenue for the flow of coins from the receptacle chamber into the probe and connected hose for delivery to the slow-down chamber.

9. The combination according to claim **8** wherein said actuator connected to the outer tube for rotating it between port open and closed positions comprises a manually operable ring concentrically disposed around said tubes; and

said means connecting the actuator to the outer tube includes a key having one side fixed in a slot on the outer tube and the other side in engagement with the inner surface of said ring.

10. The combination according to claim **8** wherein said probe includes a terminal and a conductor attached to said terminal;

a conductive slip ring attached to a side of said actuator and electrical conducting means interconnecting said terminal with the slip ring;

A pair of contactors in said actuator spring biased in an outward direction so that one of said contactors constantly is in engagement with a side of the slip ring and the other contactor projects beyond the actuator to contact the receptacle chamber;

a pair of contact buttons on but insulated from the receptacle chamber preferably spaced at **15°** and **170°** respectively from the vertical so that when the actuator is rotated, its outwardly projecting contact senses a ground condition when in contact with either of said buttons and infinity when not in contact therewith; and

control means responsive to the sensed ground conditions when said contactor engages either of said buttons for permitting movement of the actuator to a port open position.

11. The combination according to claim **8** wherein said receptacle comprises a fare box having an opening at the top through which passengers drop coins into said receptacle chamber; and

a closure on said receptacle chamber for closing said opening during a coin withdrawal process.

12. A coin handling system for transferring coins from a receptacle to a depository comprising:

a receptacle having a chamber for holding coins, and air openings in said chamber;

a recess in said chamber;

a hose having means on one end adapted for insertion in the chamber recess, said means being operable to selectively establish an avenue for the flow of coins from the chamber into the hose, said means comprising a probe having a pair of concentrically disposed tubes each being provided with a port which when aligned establishes an opening through which coins may flow into the hose;

a coin processor spaced from the receptacle and having a coin slow-down chamber therein, and means connecting the outlet end of said hose to the slow-down chamber;

a housing mounted on the coin processor for storing said probe when in non-use;

said housing including a selectively operable pawl movable into and out of engagement with a notch on said probe for either locking or unlocking said probe in the housing;

means on said housing for moving said pawl into and out of the notch on said probe;

vacuum generating equipment in said processor and a conduit connecting the slow-down chamber with an inlet to the vacuum equipment thereby providing an air flow path including the inlet at the means attached to the hose end, the hose, slow-down chamber, conduit and inlet to the vacuum equipment;

said vacuum equipment having an outlet for discharging air to the atmosphere;

coin conveying means located adjacent said coin slowdown chamber for receiving coins therefrom and discharging them into said depository; and

control means connected to said vacuum equipment for controlling the operation thereof and the application of a suction at the inlet to said coins for transferring said cons to said depository;

whereby when the vacuum equipment is placed in operation and the means on said hose is inserted in the receptacle chamber recess, an air suction established at the inlet to the means on said hose, causes atmospheric air to flow into the receptacle chamber and lift the coins into the inlet and carry them through the hose to the slow-down chamber, whereupon the coins are brought to a halt without mutilation, and subsequently discharged to the coin conveying means for transfer to the depository.

13. The combination according to claim **12** wherein the means for moving the pawl comprises a solenoid mounted on said housing; and

switch means in a circuit to said solenoids, so that when the switch means is actuated and power is applied to the solenoid, the solenoid plunger moves in a direction to release the pawl and thereby permit withdrawal of the probe from said housing.

14. The combination according to claim **13** wherein said switch means comprises a card key switch;

and a coded card adapted to be inserted in said switch closes the circuit to said solenoid.

15. The combination according to claim **14** wherein upon energization of said solenoid, said pawl closes a second switch on said housing to complete a circuit through a time delay relay set for a time considered reasonable to effect removal of the probe from the housing;

said relay being connected in a switch-controlled circuit including a siren which sounds in the event the probe is not removed within the time set in said relay.

16. The combination according to claim **12** wherein a first switch mounted on said housing includes an actuating button engageable by said probe to open the switch contacts when the probe is positioned in the housing, and upon withdrawal of the probe, said switch contacts close;

a relay connected in series with said switch across a voltage source; and

a second switch controlled by said relay in series with a magnetic motor starter for a motor connected to said vacuum generating equipment, so that upon withdrawal of said probe, said first switch contacts close to energize the relay which closes the second switch contacts which start the motor for the vacuum equipment thus providing air to create a vacuum at the inlet to said hose.

17. A coin handling system for transferring coins from a receptacle to a depository comprising:

a receptacle having a chamber for holding coins, and air openings in said chamber;

a recess in said chamber;

a hose having means on one end adapted for insertion in the chamber recess, said means being operable to selectively establish an avenue for the flow of coins from the chamber into the hose, the means on the end of said hose comprising a probe having a handle on one end and a stationary inner tube supported by said handle;

said inner tube being of cylindrical shape and having a coin receiving port therein positioned to face coins in the receptacle chamber;

a rotatable outer tube of similar shape concentrically mounted on said stationary inner tube and having a port of similar size therein; an actuater on the probe;

means connecting said actuator to said outer tube so that when the outer tube is rotated, the ports of both tubes align to provide an avenue for the flow of coins from the receptacle chamber into said hose;

a stationary outer cylinder having a port of substantially the same size as the tube ports mounted in the recess in the receptacle chamber, said cylinder being positioned to have its port face coins in the chamber;

a rotatable inner cylinder having a similar size port mounted inside said outer cylinder;

means connecting said actuator to said inner cylinder, so that upon rotation of said actuator, said outer tube and the inner cylinder are caused to rotate to effect alignment of the tube and cylinder ports and thereby provide an avenue for the flow of coins from the receptacle chamber into said hose;

a coin processor spaced from the receptacle and having a coin slow-down chamber therein, and means connecting the outlet end of said hose to the slow-down chamber;

vacuum generating equipment in said processor and a conduit connecting the slow-down chamber with an inlet to the vacuum equipment thereby providing an air flow path including the inlet at the means attached to the hose end, the hose, slow-down chamber, conduit and inlet to the vacuum equipment;

said vacuum equipment having an outlet for discharging air to the atmosphere;

coin conveying means located adjacent said coin slow-down chamber for receiving coins therefrom and discharging them into said depository; and control means connected to said vacuum equipment for controlling the operation thereof and the application of a suction at the inlet to said hose for transferring said coins to said depository;

whereby when the vacuum equipment is placed in operation and the means on said hose is inserted in the receptacle chamber recess, an air suction established at the inlet to the means on said hose, causes atmospheric air to flow into the receptacle chamber and lift the coins into the inlet and carry them through the hose to the slow-down chamber, whereupon the coins are brought to a halt without mutilation, and subsequently discharged to the coin conveying means for transfer to the depository.

18. The combination according to claim **17** wherein the inner and outer tubes carry a lock having lock elements in engagement with a closed end on said outer tube which prevent its rotation; and

a key permanently mounted on the wall of said receptacle chamber opposite from the recess entrance, said key being positioned such that when the probe tubes are inserted in said recess the lock is pushed on to said key thus removing said elements from their locked position and allowing the outer tube to be rotated to a port open position by said actuator.

19. The combination according to claim **17** wherein stop means is mounted on said receptacle chamber; and

a lock pin connected at one end to said stop means and terminating at its other end in a notch in said inner cylinder for preventing said inner cylinder from rotating to a port open position unless the stop means removes said pin from its notch engaging position.

20. The combination according to claim **19** wherein said stop means comprises a solenoid having said lock pin connected to the outer end of its plunger;

spring means biasing said plunger and lock pin in a downward direction for engaging said notch on the inner cylinder peripheral surface; and

a power source connected to the solenoid for lifting the plunger to permit rotation of the inner cylinder.

21. The combination according to claim **20** wherein a vacuum device including a switch connected to the recess in said receptacle chamber for sensing the level of vacuum therein,

means connecting said switch in a circuit with said solenoid so that when the probe is inserted in the receptacle chamber and a vacuum is applied to the end of the probe, said vacuum device senses the reduced pressure and actuates said switch which closes and applies power to the solenoid for retracting the lock pin from the inner cylinder notch.

22. A coin handling system for removing coins from a number of public transportation vehicles and placing them in a depository comprising:

a receptacle in each such vehicle having air openings and a chamber for holding said coins, each receptacle comprising a pedestal supported fare box having a coin deposit chute therein with said air openings in the pedestal thereof and means for closing the coin deposit chute during removal of coins from the coin holding chamber;

a hose adapted for engagement with a receptacle for transferring the coins therein to said depository;

coin decelerating means attached to the other end of said hose comprising a cylinder having its axis displaced from vertical;

vacuum generating equipment having its air inlet connected with said coin decelerating means and therefore with said hose, so that as the vacuum equipment is placed in operation, an air suction is established at the receptacle end of said hose to cause air to be drawn through the receptacle openings to lift the coins into the hose and carry them to the coin decelerating means which stops coin movement without mutilating the coins;

a plurality of air discharge vents in the coin decelerating cylinder for diverting the coin carrying air to the vacuum equipment; and

apparatus connected near the lower end of the coin decelerating cylinder for discharging the coins into the depository.

23. A coin handling system for removing coins from a number of public transportation vehicles and placing them in a depository comprising:

a receptacle in each such vehicle having air openings and a chamber for holding said coins;

a hose adapted for engagement with a receptacle for transferring the coins therein to said depository;

coin decelerating means attached to the other end of said hose;

vacuum generating equipment having its air inlet connected with said coin decelerating means so that as the vacuum equipment is placed in operation an air suction is established at the receptacle end of said hose which causes air to be drawn through the receptacle openings to lift the coins into the hose and carry them to the coin decelerating means which slows coin movement without mutilating the coins;

an air discharge vent in said coin decelerating means for diverting the coin carrying air to the vacuum equipment;

apparatus connected with the coin decelerating means for discharging the coins into the depository; and

a time delay relay connected in a control circuit controlling the operation of the vacuum equipment, said relay being effective to continue operation of said equipment for a predetermined time after disengagement of the hose and said receptacle.

24. A coin handling system for removing coins from a number of public transportation vehicles and placing them in a depository comprising:

a receptacle in each such vehicle having air openings and a chamber for holding said coins, each said receptacle comprising a pedestal supported fare box having a coin deposit chute therein with said air openings being in the pedestal thereof and further comprising means for closing the coin deposit chute during removal of coins from the coin holding chamber;

a hose adapted for engagement with a receptacle for transferring the coins therein to the depository;

vacuum generating equipment having its air inlet connected with said hose so that as the vacuum equipment is placed in operation an air suction is established at the receptacle end of said hose to cause air to be drawn through the receptacle openings to lift the coins into the hose and carry them toward the depository.

25. The coin handling system of claim 24 further comprising coin decelerating means between the vacuum generating equipment air inlet and the hose having a plurality of air discharge vents for diverting coin carrying air to the vacuum equipment, and an escrow door on the coin decelerating means selectively movable between a first position preventing the discharge of coins from the coin decelerating means and a second position allowing coins to be discharged from the coin decelerating means toward the depository.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,843,203 Dated October 22, 1974

Inventor(s) Wesley A. Golland, Eugene T. Mahoney, Donald Minuk, Richard A Pim, Joseph Singer and Alvin A. Sugar

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 1, line 15, "ahndle" should be --- handle ---

Col. 2, line 19, "wth" should be --- with ---

Col. 3, line 66, "Fig. 1" should be --- Fig. 14 ---

Col. 4, line 63 "The" should be --- such ---

Col. 5, line 61, "inslot" should be --- in slot ---

Col. 5, line 62, "in slot" should be --- The ---

Col. 6, lines 9 and 10, "pawl 36 upper edge until it slips into notch 35 and locks the probe" is duplicated and should be deleted.

Col. 8, line 26 "the", second occurrence, should be deleted

Col. 9, line 38 "one" should be --- One ---

Col. 11, line 23,"openended" should be --- open-ended---

Col. 12, line 53 "ot" should be --- to ---

Col. 19, line 1 (Claim 1) "a" should be --- an ---

Col. 20, line 10, (Claim 8) "stationery" should be --- stationary ---

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CERTIFICATE OF CORRECTION -- Page 2

Col. 20, line 35 (Claim 10) "A" should be --- a ---

Col. 21, line 25 (Claim 12) "slowdown" should be --- slow-down ---

Col. 21, line 29 (Claim 12) "coins" should be --- hose ---

Col. 21, line 30 (Claim 12) "cons" should be --- coins ---

Signed and sealed this 28th day of January 1975.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents