Dec. 23, 1958 H. L. HENKEL 2,865,629

AUTOMATIC DOOR SYSTEM

Filed June 7, 1955 5 Sheets-Sheet 1

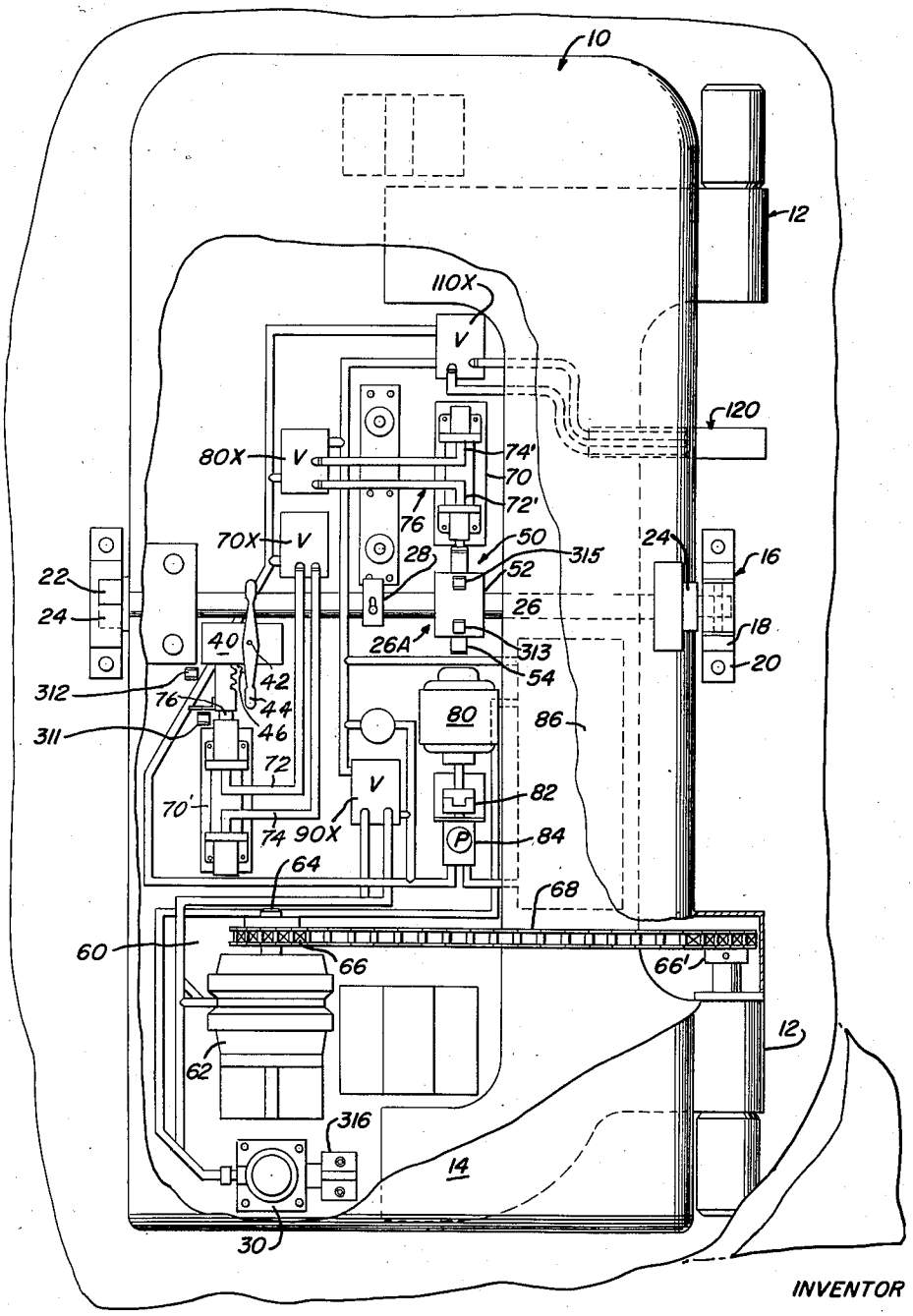


Fig. 1

INVENTOR
HARVEY L. HENKEL

BY Semmes & Semmes
ATTORNEYS

Dec. 23, 1958 H. L. HENKEL 2,865,629

AUTOMATIC DOOR SYSTEM

Filed June 7, 1955 5 Sheets-Sheet 2

Fig. 2

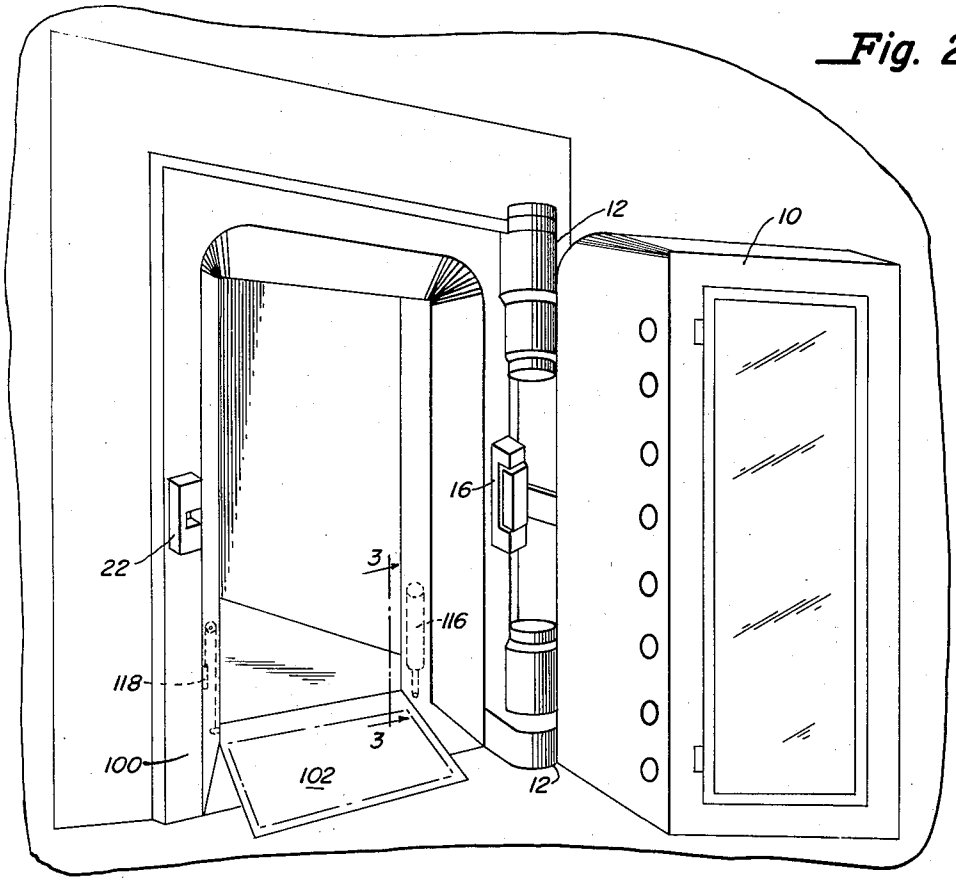
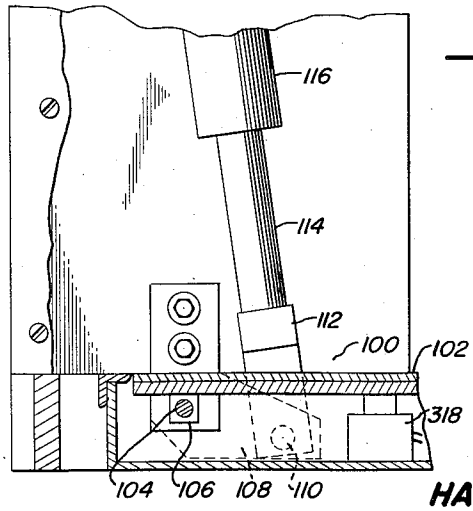


Fig. 3



INVENTOR

HARVEY L. HENKEL

BY

Semmes & Semmes

ATTORNEYS

Dec. 23, 1958 H. L. HENKEL 2,865,629

AUTOMATIC DOOR SYSTEM

Filed June 7, 1955 5 Sheets-Sheet 3

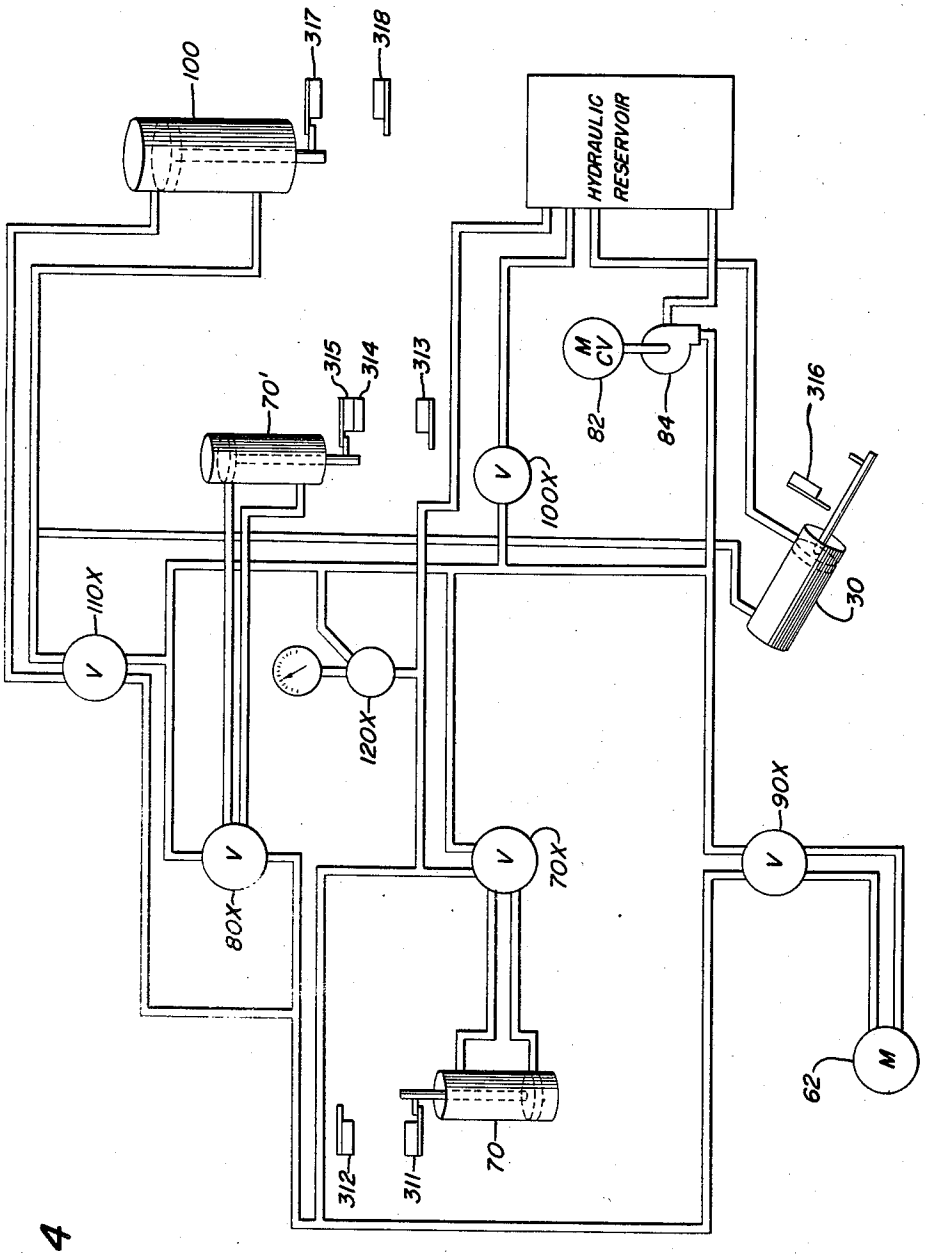


Fig. 4

INVENTOR
HARVEY L. HENKEL

BY Semmes & Semmes
ATTORNEYS

Dec. 23, 1958 H. L. HENKEL 2,865,629

AUTOMATIC DOOR SYSTEM

Filed June 7, 1955 5 Sheets-Sheet 4

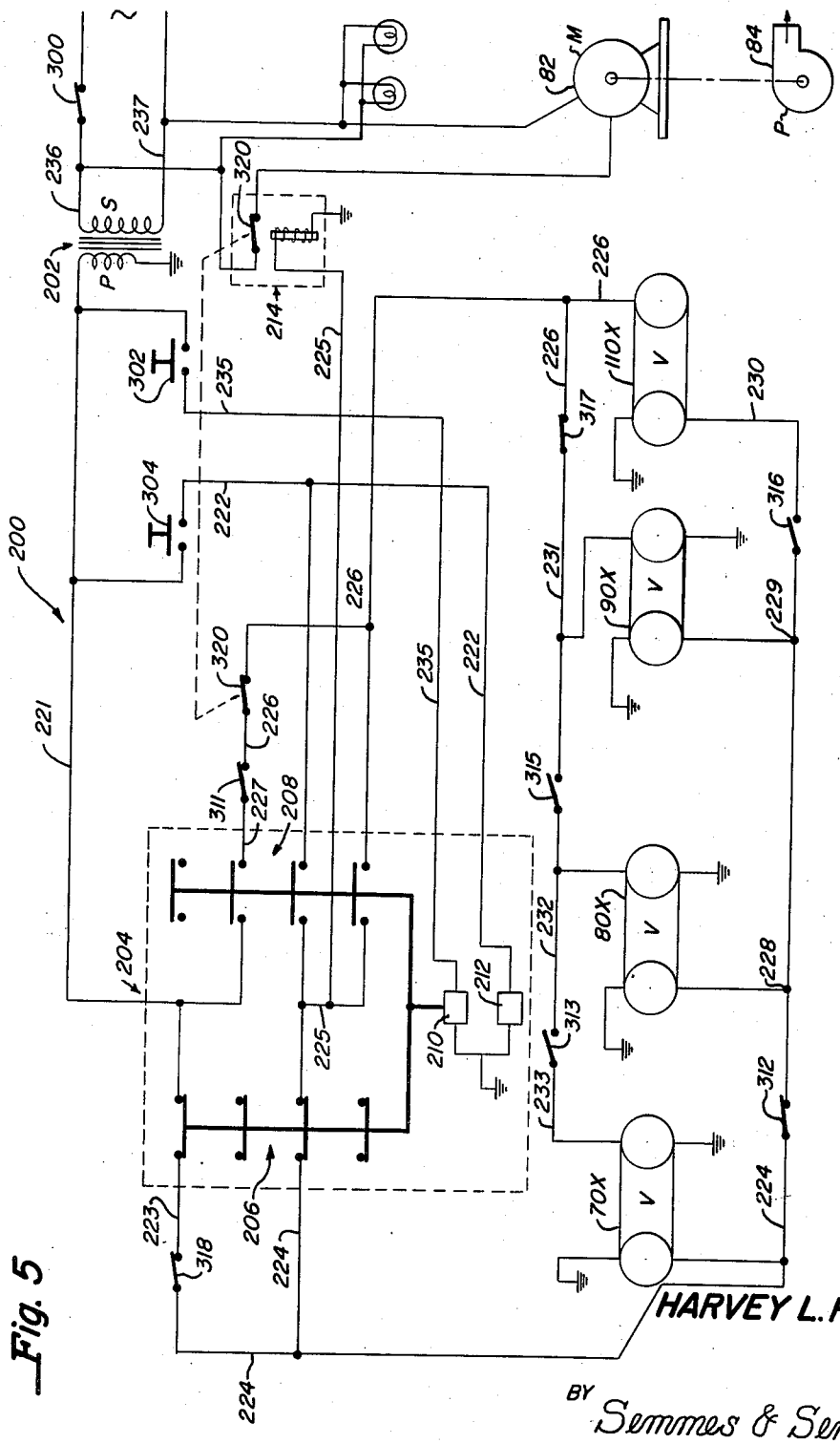


Fig. 5

INVENTOR
HARVEY L. HENKEL

BY Semmes & Semmes
ATTORNEYS

Dec. 23, 1958 H. L. HENKEL 2,865,629

AUTOMATIC DOOR SYSTEM

Filed June 7, 1955 5 Sheets-Sheet 5

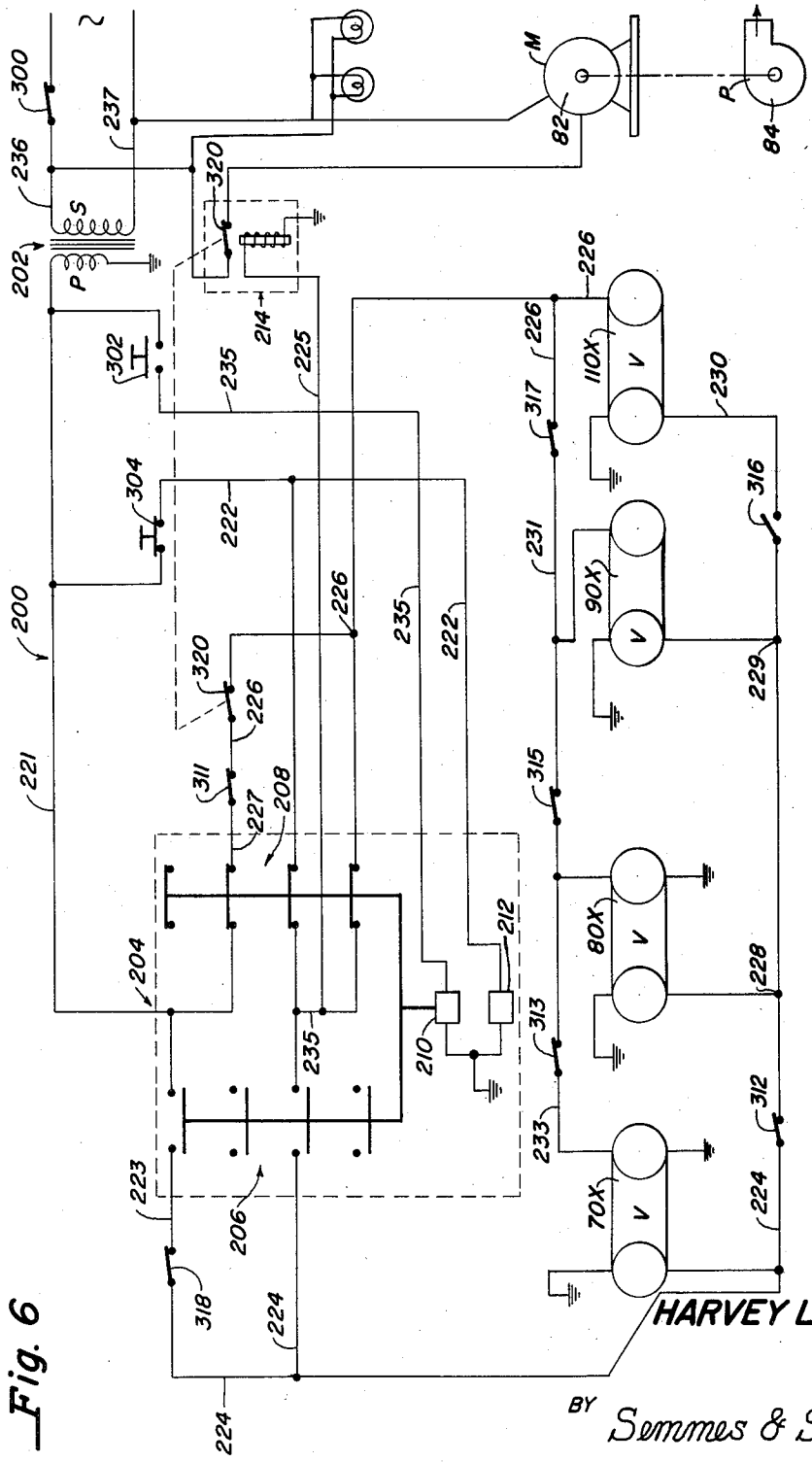


Fig. 6

INVENTOR
HARVEY L. HENKEL

BY Semmes & Semmes
ATTORNEYS

United States Patent Office 2,865,629 Patented Dec. 23, 1958

2,865,629

AUTOMATIC DOOR SYSTEM

Harvey L. Henkel, Hamilton, Ohio, assignor to Herring-Hall-Marvin Safe Company, Hamilton, Ohio, a corporation of Ohio

Application June 7, 1955, Serial No. 513,715

4 Claims. (Cl. 268—66)

The present invention relates to security vaults and has particular reference to means for effecting the automatic closing and opening of an access door thereof. More specifically, the invention relates to novel means for opening and closing a bank vault door and the like as by automotive power means, the invention including means for the automatic and timed actuation of pressure and boltwork elements to seat and firmly lock the door on closing.

The subject matter of the present invention is closely related to that defined in my copending application for patent Serial No. 450,619 filed August 18, 1954 and entitled Mechanized Vault Door. The invention there defined, related primarily to a combination door construction in which pressure and boltwork elements may be employed, the entire system including means for automatically actuating the boltwork and pressure elements to lock and unlock and seat and unseat the door in a predetermined sequence, the various elements of the invention being interconnected and operable through common hydraulic and electric circuits. The present invention, on the other hand, is an improvement of that system and construction; additionally, as will be defined hereinafter, novel means are provided for effecting automatic mechanical movement of the door from closed to open position and return. The various means for effecting movement of the door are synchronized with the operation of the boltwork and pressure systems which have been mentioned. As a further improvement, mechanical means are provided to overcome inertia whereby a door when once fully opened may be initially shoved exteriorly and sequentially moved hydraulically from open to closed position. Other novel features include unique means for giving impetus to the pressure elements prior to automatic actuation thereof.

It is an object of this invention to make a vault door system which is fully automatic to unlock and open or to close and lock a vault door.

It is another object of this invention to create a vault door system in which means for effecting locking, unlocking, closing and opening are disposed substantially integrally with the door.

As a further object of the invention, there is provided a vault door system in which the operating means of the system are synchronously related to effect arcuate movement of the door from opened to closed position or to any fractional point therebetween.

Yet another objective of invention is to provide in combination electric and hydraulic circuits for a vault door system wherein the vault door may be operated through locking, unlocking, closing and opening phases completely automatically upon actuation of power systems therefor, and wherein the entire system may be held in suspended animation as when any motion in the system meets interference.

Still a further object of the invention is to provide a closed circuit hydraulic system for locking and unlocking, closing and opening a vault door in which the elements of the entire system are inter-connected and interdependent.

As a further objective herein, it is intended that mechanical and hydraulic means may be used independently of one another to effect opening and closing in a vault door system, the elements for effecting manual automatic hydraulic movement thereof being inter-connected yet independently operable of one another.

Other objects of the invention will be apparent from reference to the accompanying drawings and ensuing description wherein like numerals relate to similar elements of the invention.

In the drawings:

Fig. 1 is a view in vertical elevation of the door, the face thereof being broken away to expose the major elements of the system;

Fig. 2 is a view in perspective of the invention wherein the vault door is open and the foot bridge lowered;

Fig. 3 is a vertical sectional view of the invention taken along the lines 3—3 of Fig. 2;

Fig. 4 illustrates schematically the electrical and hydraulic circuits as employed in the system;

Fig. 5 illustrates the electric circuit employed in a phase of operation; and

Fig. 6 illustrates the electric circuit employed during an advanced phase of operation of the system.

The system, it will be noted from reference to Fig. 1, consists in a vault door assembly **10** hinged as at **12** to a vestibule frame with the crane hinge assembly and principal operating parts of the device being encased in a hinged cover member **14**. The cam assembly **16** comprises fixed anchor members **20** and a rotatable pressure element bearing member or plate cam **18**. A corresponding bearing member plate cam **22**, axially aligned with cam **18**, is fixed to the frame on the free side of the door. Cams **18** and **22** respectively define cam grooves to receive and bear the eccentric elements **24** of the pressure system hereinafter defined, said eccentric elements being integrated with the pressure system spindle **26** to which is journalled hand arbor **28**. Spindle **26** is geared in mesh with the reciprocable rack assembly **50**. A reciprocable rack **54** is adapted to engage the geared portion of the spindle **26** of the pressure system as at **52**.

At the lower left hand portion of the door, there is secured means for absorbing shock during termination of outward movement of the door and for overcoming inertia in opening the door. The details of this assembly **30** will be pointed out hereinafter.

A hand arbor assembly **40** for shifting the boltwork of the vault door is disposed substantially midway between the top and bottom of the door. The assembly consists of a rotatable shaft **42** keyed to a pinion member to which is attached the hand arbor **44**. The arbor handle **44** is engaged as at **46** by a collar which is universally attached for transmitting automatic hydraulic or pneumatic arcuate motion to the hand arbor. Both the manual throw bolt assembly **40** and the manual pressure system assembly **28** are retained for facile operation in the event of power failure in the automatic system. It is to be noted that equivalent means such as rack and pinion may be employed to attain like results. When the necessity for manual operation arises, pressure is released from the hydraulic system and manual operation may be effected without the necessity of overcoming adverse hydraulic operating pressures.

The door swinging system is shown at **60** wherein it will be noted that a reciprocating rotary power hydromotor **62** carries a torque motive member **64** to which is keyed a sprocket pinion member **66**. Hydromotor **62** consists of a cylinder in which there is a shaft-vane assembly operable by force of the hydraulic or pneumatic medium

against the vane. Typical of this type of unit is the hydro-motor produced by The Bonnot Company, Canton, Ohio. The entire assembly **60** is securely mounted on the face of the door, beneath the cover **14** with the exception of the fixed sprocket pinion member **66'** which engages the fixed shaft of the hinge assembly **12** at the lower portion of the door. In operation, this inter-connected door hinge system is adapted to operate upon the planetary gear principle whereby the connecting flexible chain **68** constituting power transmission element is adapted to rock about the fixed fulcrum **66'**, power being imparted to the internal sprocket pinion **66** as through the hydro-motor **62**. Torque motion through pinion **66** upon chain **68** is translated into orbital movement of the chain and door about the fulcrum or fixed pivot **66'**.

For purposes of effecting automatic hydraulic or pneumatic movement to the respective boltwork and pressure system, hydraulic assemblies **70'** and **70**, are attached to the door, the former being mounted so that movement may be effected to the arbor system **40**, the latter, namely hydraulic system **70**, being fixed for reciprocal movement of piston extension **54** which engages the rack system **50**. In these hydraulic systems there are respectively hydraulic pressure lines **72'**, **74'** and **72**, **74** respectively, each being adapted to reciprocate its corresponding piston member. Valve assemblies **70***x* and **80***x* respectively serve the systems **70'** and **70**, being four-way valves defined in detail hereinafter, whereas, valve assembly **90***x* serves the piston assembly **30** and the door swinging assembly **60**. A clear understanding of the overall system can be obtained by referring to Fig. 4. Throughout the entire system, the respective hydraulic conduits are inter-connected and inter-dependent as is the electric circuit which is involved in the activation and deactivation of the hydraulic system.

In Figs. 2 and 3, there is shown a foot bridge assembly **100** consisting of an inclined plate **102** attached to and integral with a horizontal platform at its hinge end. Fixed to the inner surface of the platform is a torque bar **106** adapted to engage a rectangular orifice **104** within cranks **108** which are disposed at each lateral extremity of the platform. The torque bar being substantially rectangular throughout its length is preferably cylindrically shaped toward its ends for riding in a fixed bearing. The crank **108** is linked as at **110** through connector **112** and piston rod **114** to hydraulic piston assembly **116**. Suitable conduits connect hydraulic assembly **116** to the solenoid valve assembly **110***x* which is shown in Fig. 1 of the drawings as at the top of the hydraulic system. See also Fig. 4 herein. Conduits leading from valve **110***x* to the hydraulic bridge piston assembly pass through protective channel **120** which said channel is flexible to adapt it to arcuate movement of the door with respect to the frame. It will be noted that a counter-weight assembly **118** may be mounted within the vestibule of the vault to accommodate the crank assembly on the left side of the foot bridge.

The closed electrical circuit employed in the present invention is shown in Figs. 5 and 6. Solenoid valve assemblies **70***x*, **80***x*, **90***x* and **110***x* are superposed schematically and connected to the electrical circuit as shown; likewise, the motor **82** and pump **84** are illustrated. With the exception of valve **100***x*, the other valves are four-way valves each of which is a combination of two three-way valves arranged to incorporate common inlet and exhaust pipe connections, the two solenoids of each valve being alternately energized in operation. When the valves are not energized, inlet pressure is blocked and cylinder ports are open to the exhaust line. In circuit **200**, there is an electrical potential of 24 volts which may be advanced to conductor **221** through the use of the transformer **202**. Within the circuit there is a latching relay **204** consisting of a series of upper contacts **206** and lower contacts **208** respectively operable upon energization of coils **210** and **212**. A pump motor relay **214** is in connection with the latching relay and with the pump motor **82** shown.

The various circuits are shown as at **221** through **237** inclusive. Although not shown, it is customary, in systems of this nature, that an automatically operable time switch should be employed, such switches being automatically closed during predetermined periods of operation and open during periods of non-use. Additionally or in lieu of such a time switch, there is provided upon the door itself a key switch **300** in the circuit whereby the entire system may be de-energized or energized by the keeper of the vault having the key. Switches **302** and **304**, associated with switch **300**, are respectively operable for opening and closing the vault door, that is, for commencing the phases of operation during opening and closing, the former being used in opening and the latter being used in closing; both being normally open and of push-button type. Other switches in the system include switch **311** which is normally closed; switch **312** normally open, switch **313** normally open; switch **315** normally closed, switch **316** normally open; switch **317** normally open, switch **318** normally closed. Switches **320** are operable in unison to effect closing of the motor relay to energize the motor **82**.

To open the door as in Fig. 5, the keeper closes key switch **300** whereby to energize the system; thereafter depressing switch **302**, coil **210** is energized to close the upper contacts of the latching relay as at **206**. The foot bridge **100** being raised, switch **318** which is out of contact therewith is normally closed as in this instance. Thus, the circuit is closed to energize the motor relay **214** thereby actuating the pump motor **82**. Simultaneously, a solenoid of the boltwork valve is actuated to release pressure into hydraulic system **70'** as through the line **74** thereof thus opening normally closed switch **311**, which said switch is engaged by the piston of the hydraulic system when retracted. The hydraulic piston **76** of the boltwork assembly now moves to engage micro-switch **312** and in so doing imparts rotation to the arbor **40** thereby to retract the locking bolts of the vault door. The piston of the hydraulic system **70** being now fully extended, micro-switch **312** is engaged and closed. Micro-switches **313** and **315** which are associated with the pressure element hydraulic assembly **70** are likewise closed as are micro-switches **317** and **318** which are associated with the foot bridge assembly. With the closing of switch **312**, a solenoid of the pressure system four-way valve **80***x* is actuated and pressure introduced into the hydraulic system of the pressure system **70**. In this instance, the piston of the pressure system is actuated as by hydraulic fluid entering through conduit **74'** thrusting the piston outwardly, thereby to move rack assembly **50** downwardly and to turn the pressure system spindle **26** in a clockwise direction, thereby to disengage the eccentric **24** of the system from cam groves **22**. As the pressure system rack moves to its full downward position, switch **313** is permitted to revert to its normally open position and switch **315** is depressed to open the circuit. Simultaneously a solenoid of the door swinging four-way valve **90***x* is actuated to motivate the hydro-motor into its opening cycle.

The door now begins its outward swing by virtue of rotation of pinion **66** to move the chain **68** about fulcrum **66'**; clockwise turning rotating the door outwardly in its normal swing. Upon reaching the full open position, the piston associated with the hydraulic assembly **30** abuts a fixed shock absorber and is retracted within the cylinder whereby switch **316** which has been detained is disengaged and closed to energize the foot bridge solenoid valve **110***x*.

In this connection, micro-switch **317**, which has been closed heretofore, is now disengaged and opened. The foot bridge is gradually lowered into position, the platform thereof engaging normally closed micro-switch **318** thereby to open said switch and de-energize the upper contact portion of latching relay **204** thus cutting the pump motor and rendering the system inert.

Referring now to Fig. 6, we observe commencement of closing of the vault door and raising of the foot bridge. The phase here shown, that is, in Fig. 6, simulates closing as by depressing switch **304** hereby to energize the lowermost coil **212** of the latching relay and in this manner effecting contact between the lower contacts **208** of the latching relay to reverse the process hereinbefore described. It will be noted that the pump motor **80** is thus actuated and pressure once again applied to the hydraulic system. The respective pistons of the boltwork and pressure systems being retracted and extended respectively, micro-switch **312** is now closed and micro-switch **315** which is normally closed is now opened. Motor relay switches **320** are closed as are switches **311**, **312** and **316**. Thus, the second and reverse action solenoid of the four-way foot bridge valve **110***x* permits hydraulic pressure to now raise the piston of the foot bridge hydraulic system, whereupon the foot bridge is gradually rotated upwardly to its uppermost position and micro-switch **317** which is normally open is now engaged to close. Simultaneously, inertia piston system **30** is hereupon extended. The closing of switch **317** opens valve **90***x* which permits hydraulic pressure to be introduced into hydro-motor and the swing is actuated by the rotation of the sprocket within its planetary chain in a counterclockwise direction and the door commences closing. As the pressure system **30** reaches the full extent of its outward movement, micro-switch **316** is engaged and thus opened.

It is believed obvious that as the vault door continues its closing swing, substantially the reverse procedure of switching and hydraulic motion takes effect. Thus as hydraulic system switch **316** is opened, foot bridge switches **317** and **318** are closed to energize the branch circuit for the operation of the pressure element hydraulic system and sequentially the normally open micro-switch **313** is closed to prepare the boltwork hydraulic system for actuation; the second solenoid thereof being energized to permit the passage of pressure into said system. Following this, micro-switch **312** is opened as by retraction of the boltwork element to effect opening of micro-switch **311** whereupon the motor relay switches **320** are de-energized and the system returned to inoperativeness.

In construction, the angle of contact of the pressure system cams **22** is important. In this connection, the angle between the center axis of rotating spindle **26** and the center of the eccentric lug, which is off-set thereof, must be less than 90°. In closing, the off-set lug of the spindle **26** engages the cam groove and is given thereby an initial start or impetus upon closing to partially rotate the pressure system spindle **26**, whereby rack assembly **50** is moved sufficiently from switch **315** to close same, thus restoring it to its normal position, whereupon the boltwork four-way valve closing solenoid switch **313** is engaged and closed to cause the boltwork piston to retract, thereby to extend the boltwork and lock the door in position within the frame.

To regulate the flow of the hydraulic fluid from the main pressure line to the reservoir there is provided a hand operated globe valve **100***x*, its specific function residing in control of speed of operation by regulating the amount of fluid which is bled from the main pressure line to the reservoir **86**.

As a safety factor, a relief valve assembly **120***x* is employed in the system whereby upon build-up of excess pressure within the hydraulic system, the pressure will render the system in suspended animation until said pressure is released. This assembly includes a gauge as shown. Thus, if an individual were to attempt to stop movement of the door during any phase of operation

from opening to closing or from closing to opening, application of a predetermined pressure as by holding or interference would render the system inert beyond the build-up of further pressures. A suitable gauge and pressure relief valve are shown in Figs. 4 and 1 respectively.

It is believed apparent that the system could be equally as effective if operated on pneumatic principles.

Whereas, the invention has been defined with specificity it is to be understood that various modifications may be made to the system without departing from the spirit of invention as defined in the appended claims. Since a conventional combination locking system is employed, with the elements herein, no attempt has been made to define or claim same.

I claim:

1. In a vault door opening and closing system wherein the door is mounted for mechanical pivotal movement on a frame and in which door movement components are an integral portion of the door per se: a vault door and frame therefor, at least one fixed door pinion mounted upon the frame, a rotatable pinion mounted upon the door in spaced relation to said fixed pinion, endless flexible power transmission means connecting said rotatable pinion and said fixed pinion, rotary drive means mounted on the door actuably engaging the rotatable pinion, the rotatable pinion upon actuation transmitting torque through said power transmission means about said fixed pinion, whereby said rotatable pinion, said power transmission means and said door may be arcuately moved about said fixed pinion by orbital movement of said power transmission means about the rotatable pinion to effect opening and closing of the door.

2. In the system according to claim 1, including a pressure element to fully seat and unseat the door, automatic pressure element actuating means mounted on the door and interconnected with the opening and closing system including timing means to effect sequential actuation of the pressure element following closing and in preparation for opening.

3. The system according to claim 2 wherein the pressure element includes at least one rotatable eccentric mounted upon the door and at least one corresponding cam fixed to the frame, impetus means on the cam to augment operation of the eccentric sequentially preceding automatic actuation thereof during the closing cycle of the door.

4. The system according to claim 1 including impetus means carried by the door in engageable-disengageable relation to a fixed abutment, said impetus means being automatically actuable immediately precedent to operation of the closing of the door to overcome inertia thereof.

References Cited in the file of this patent

UNITED STATES PATENTS

656,699	Paidassy	Aug. 28, 1900
1,369,960	Brintnall	Mar. 1, 1921
1,797,144	Hitt et al.	Mar. 17, 1931
1,862,860	Morse	June 14, 1932
1,868,149	Munez	July 19, 1932
1,920,868	Kirk	Aug. 1, 1933
2,190,653	Dunn	Feb. 20, 1940
2,294,041	Mims	Aug. 25, 1942
2,304,556	Dunn	Dec. 8, 1942
2,558,867	May et al.	July 3, 1951
2,601,983	Schoelkopf	July 1, 1952
2,668,052	Johnson	Feb. 2, 1954