

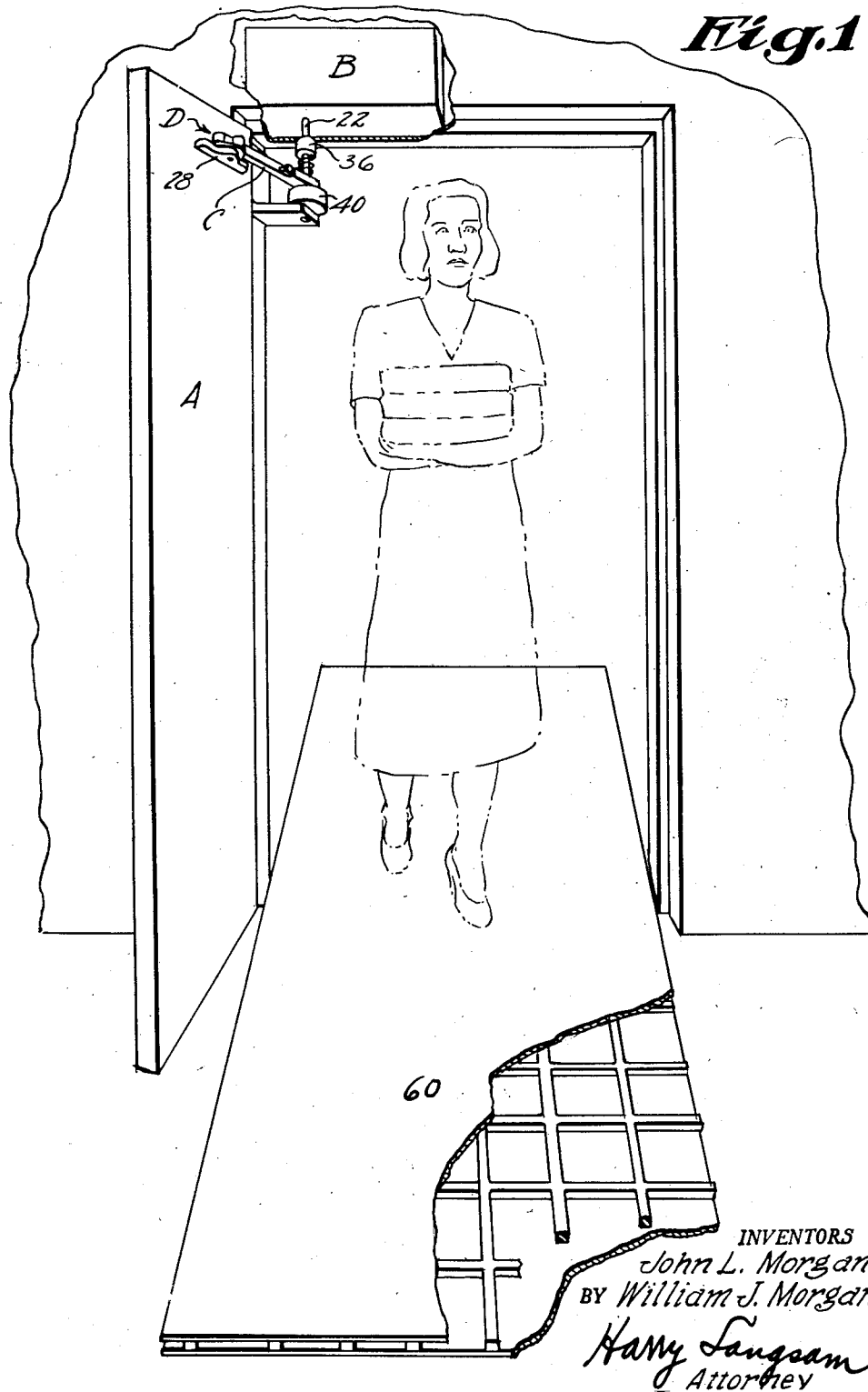
May 19, 1953

J. L. MORGAN ET AL
AUTOMATIC DOOR ACTUATOR

2,639,142

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Fig. 3

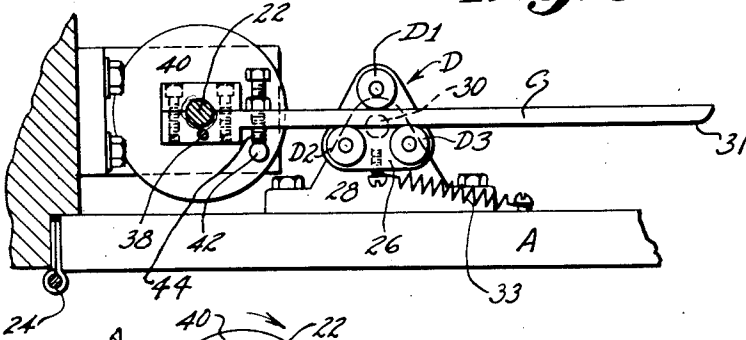


Fig. 4

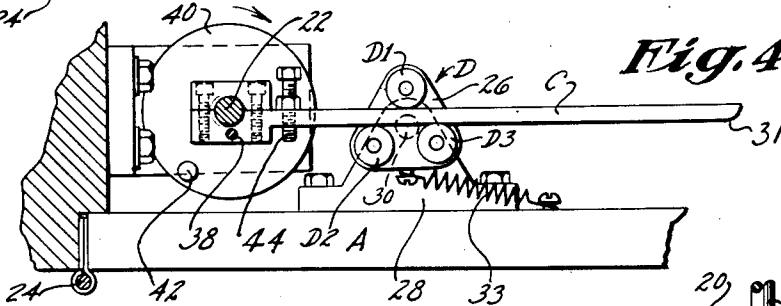


Fig. 6

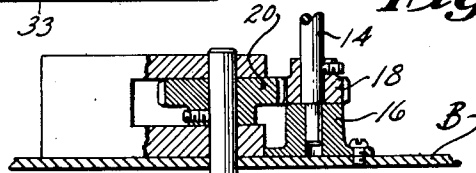
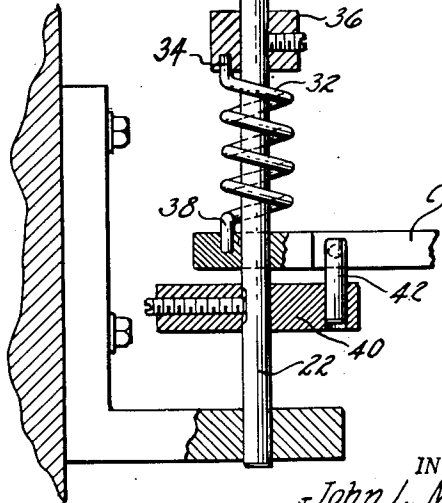
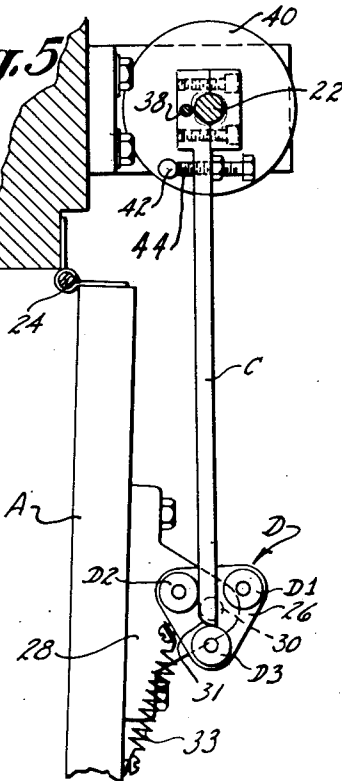


Fig. 5



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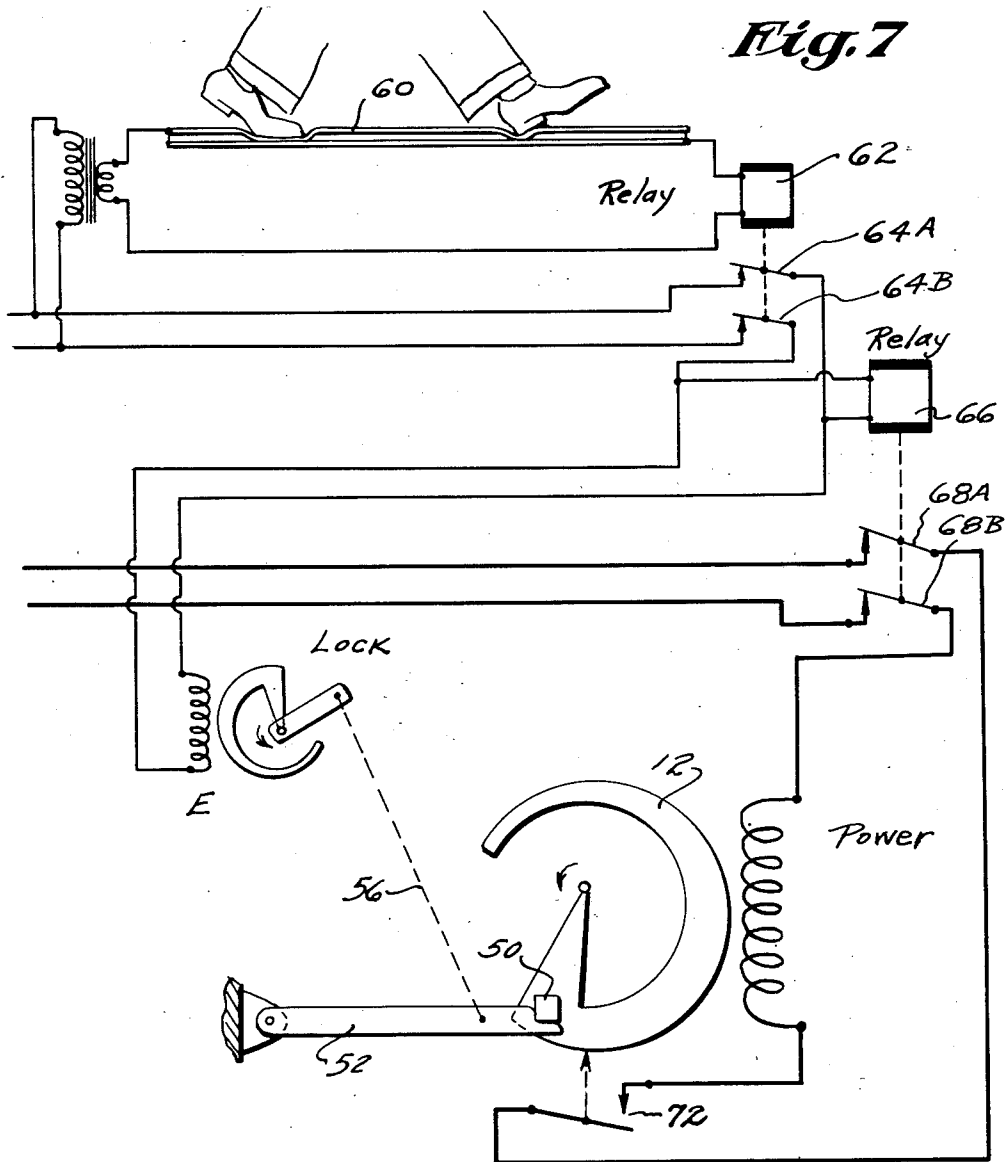
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Fig. 7



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AUTOMATIC DOOR ACTUATOR

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Our invention relates to mechanism for opening one or more doors automatically.

Heretofore, automatic door openers utilizing electric motors as well as hydraulic or pneumatic pressure have been used to open or close doors. Electric eye controls for utilizing compressed air have been used to open and to close doors. Problems which arise with the prior art automatic door openers are high initial costs, high maintenance costs, large and heavy parts, complicated and delicate mechanisms, and difficulty in converting old installations to utilize mechanism for automatically opening and closing a door or doors.

We have successfully overcome the problems heretofore set forth by employing an automatic door closing and opening mechanism embodying an electrically actuated power rotary solenoid which brings into play large power in a small unit and wherein a novel spring mechanism provides a closing mechanism.

It is an object of our invention to provide a door operator which may be concealed over the opening for the door or doors or it may be openly mounted above or below the door.

Another object of our invention is to provide a door operator which will open a swinging type of door or both leaves of a pair of doors, or of a sliding door.

Another object of our invention is to provide a door opening mechanism whereby a person standing in the path of the door during the time it is being opened will not be injured by the opening of the door.

Another object of our invention is to provide an electrically actuated door opening mechanism which may be manually actuated even though the current is on.

Another object of our invention is to provide an automatic door actuating mechanism whereby pressure is not needed upon the torsion spring.

Another object of our invention is to provide an automatic door opening mechanism which will open the door silently.

Another object of our invention is to provide an automatic door opening mechanism which will not provide a fire hazard in the event of a defect in the mechanism.

Other objects of our invention are to provide an improved device of the character described, that is easily and economically produced, which is sturdy in construction, and which is highly efficient in operation.

With the above and related objects in view, our invention consists in the details of construc-

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tion and combination of parts, as will be more fully understood from the following description, when read in conjunction with the accompanying drawings in which:

Fig. 1 is a perspective view of an embodiment of our invention adapted to open and close a swinging door.

Fig. 2 is a perspective view of the reciprocator and its actuating levers.

Fig. 3 is a plan view of the door opener when the door is in a closed position.

Fig. 4 is a view similar to Fig. 3 but wherein the door is about to be opened.

Fig. 5 is a view similar to Fig. 4 wherein the door is opened.

Fig. 6 is a fragmentary sectional view showing the door opening shaft.

Fig. 7 is a schematic view of the electrical circuit for actuating the door opening and door closing mechanism.

Referring now in detail to the drawings wherein similar reference characters refer to similar parts, we show a portion of a building having a door, generally designated as A, mounted upon vertically pivoted hinges so that the door A swings from a closed position to an open position and vice versa. However, the invention may be made applicable to a pair of swinging doors or a single sliding door, or to a pair of sliding doors.

The electrical actuation unit, generally designated as B, is shown as being mounted above the doorway and comprises a "Morgan reciprocator" as illustrated in the Morgan Engineering Co. bulletin. The actuating unit may be mounted in an open position either above or below the doorway. The Morgan reciprocator is an electro-mechanical device which will rotate a shaft in either a clockwise or a counterclockwise direction. The reciprocator operates on either alternating or direct current. Essentially, equal mechanical force can be developed at all points on the axis of rotation.

The prime mover develops a high torque so that it can move to approximately 180 degrees of rotation, but for our purpose the door is adapted to move through 90 degrees of rotation by virtue of a 2 to 1 gear reduction.

A rotor 12 of the reciprocator B is rigidly connected to a shaft 14 whereby both the rotor 12 and the shaft 14 move in unison. The shaft 14 has one end projecting into a fixed bearing 16 mounted on the casing 17 (see Fig. 2). It should be pointed out that the casing 17 contains all of the actuating mechanism. The rotor 12 oscillates approximately 180 degrees to open the door. The reciprocator comprises a fixed electromag-

netic field or solenoid in circular formation with a rotor 12 which is drawn into the interior of the electromagnetic coil 12A by the application of electric power to the field core 12A. The rotor 12 is circular and tapers from its free end to its attached end which is directly connected to the axis or shaft 14.

The shaft 14 carries a gear 18 which is in mesh with a gear 20 that is carried by a second shaft 22. The shafts 14 and 22 parallel one another for a portion of their length since the gear ratio is 2 to 1 and each gear is mounted upon one shaft.

A door actuating arm C is journaled on the shaft 22 so that the arm may oscillate independently about the shaft 22. The door actuating arm C is adapted to engage a bearing unit, generally designated as D, which has roller bearings D1, D2, D3 mounted upon a bracket or platform 26 which is pivoted to a second bracket 28, the latter being securely fastened to the door A so that the bracket 28 oscillates in unison with the door A.

However, the platform 26 may oscillate upon the pivot 30 which is carried by the bracket 28. In other words, when the shaft 22 rotates, the door actuating arm C rotates and it pushes upon the rollers D2, D3 so that the brackets 26 and 28 move about the door hinges 24 as a center, see Figs. 2 and 5.

At the end of the stroke (see Fig. 5) the roller D3 abuts against the free edge 30 of the actuating rod C whereby the door is retained in an open position.

Before relating the details of the closing and opening mechanism, we shall explain in detail the mechanism for actually closing and opening the door.

The vertically extending shaft 22, see Fig. 2, carries a loosely mounted actuating rod or arm C whereby the rod or arm C may freely rotate about the rod 22 if it were free; however, a coiled spring 32 has one end 34 firmly anchored in a collar 35, see Fig. 6, which collar is rigidly attached to the shaft 22, and the other end 36 of the coiled spring 32 is firmly anchored in the actuating rod C a distance spaced from the shaft 22 whereby a turning moment may be imposed on the actuating rod C by the turning of the shaft 22, its rigidly attached collar 35, and the coiled torsional spring 32. Hence, the turning of the spring 32 turns the rod C to open the door A.

The mechanism for actuating the door into held-open position has been described and the problem now is to have the door close without undue jerks or jars and without the use of exceptionally strong springs, without costly mechanism, and without unduly drawing an excessive amount of electric current to supply the door closing actuating power.

The shaft 22 carries a shaft collar 40 firmly affixed thereto. To close the door the shaft 22 is twisted in the reverse direction from its opening position. The shaft collar 40 carries an upwardly extending pin or eccentric 42 so that the pin 42 abuts against the side of the positioning pin 44 which is adjustably fixed to the actuating rod C; in this manner the roller D1 is abutted (see Figs. 2 and 5) whereby the platform 26 is oscillated about its pivot to unlock the rod C so that the spring 33 tends to free the roller D3 from the free end 31 of the rod C. Hence, the door A is closed.

The reciprocator 12 is electrically actuated to rotate in one direction and it is actuated in the reverse direction by a spring 46 that has one end

affixed to a spring drum 48 which is firmly attached to the same shaft 14 on which the reciprocator is securely mounted and the other end of the strong spring 46 is attached to a firm stationary member such as a wall or bracket. The solenoid draws the rotor against the torsion of the spring 46 to wind it up and the breaking of the circuit results in the spring 46 unwinding and rotating the shaft 22.

The reciprocator 12 carries an angularly shaped stud 50 which engages a complementary shaped pivoted hinged latch shaft 52 so that at the extreme end of the travel of the reciprocator the spring 46 cannot immediately return the reciprocator 12 to its normal position.

A second reciprocator, generally designated as E, is actuated when the electrical circuit is made in order to close the door by releasing the latch arm 52 from the stud 50 on the reciprocator 12.

The second reciprocator E mounted within the casing 17 has a stud 54 shift a cross rod 56 that is connected by a rod 57 so that the latch 52 is moved out of the way of the stud 50 when the current is broken; a spring 58 serves to manually shift the second reciprocator E to its normal position. The closing of the electrical circuit oscillates the second reciprocator E to move the rod 52 so that it will hold the stud 50.

Upon the actuation of the rotor 12 when the door is opened the power created would tend to open the door with a jerk and a noisy bang.

To eliminate the excessive noise we provide a brake on the shaft 14 which is controlled by a third reciprocator. The brake takes effect after the rotor 12 has turned approximately 150 degrees since the momentum of the door will carry the door to a full open position. The stud 50 will engage the latch 52 noiselessly since the full power developed by the rotor will not be effective as the braking action takes effect.

Referring to Figs. 1 and 7 the mat 60 provides the switch whereby the electrical circuit is closed when a person steps upon the mat. The mat 60 closes the #1 relay 62 which closes the power through the contacts 64A and 64B. When the electrical contacts are closed to the locking reciprocator E the #2 relay 66 is actuated to power contacts 68A, 68B so that the reciprocator rotor 12 is rotated. When the locking reciprocator is first energized it shifts the latch 52 with the tension of a spring 70 so that the latch 52 engages the stud 50. However, a micro-switch 72 in series in the power circuit of the main reciprocator is actuated to open the main electrical circuit so that power no longer is applied to the reciprocator even though a person is standing on the mat 60. The brake action heretofore explained shows the motion of the door, while the locking reciprocator is energized, so that when the door is fully opened the locking reciprocator holds it open.

If a person desired to close the door while the circuits are energized the door A could be closed since the door A need be pulled one way to release the arm C from the roller D3 and then or push the door A against the effect to the torsional spring 32. When the door A is to be closed from the position shown in Fig. 5 the door A is pulled or pushed so that a clockwise force is imposed upon the door. When the free end of the arm C is released from its engagement with the roller D3 the spring 33 would tend to pull D and hence D3 clockwise so that D2 and D3 take the position illustrated in Fig. 4 whereby the door may be closed.

Presuming that a person stepped in the path

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of the door while it was being opened then the person would not be injured since the force needed to stop the movement of the door would only be the force needed to overcome the torsion of the spring 32. Likewise, in the closing of the door the only force necessary to arrest the movement of the door would be to overcome the force of the torsional spring 46.

Hence, the automatic door opener of our invention cannot injure a person in its path and in any emergency it can be manually opened or closed.

The invention may be applied to any type of swinging or sliding doors.

Although our invention has been described in considerable detail, such description is intended as being illustrative rather than limiting, since the invention may be variously embodied, and the scope of the invention is to be determined as claimed.

We claim as our invention:

1. In combination with a door, a rotor shaft, a fixed electromagnetic solenoid of an arcuate construction, a rotor having a free end and an end attached to said rotor shaft tapering from its free end to its attached end and adapted to be drawn into said solenoid when said solenoid is energized, a second shaft, means joining said second shaft to said rotor shaft, an arm adapted to open or close said door, a member affixed to said door and engaged by said arm whereby said door is opened or closed, one end of said arm freely encircling said second shaft, and a torsional spring encircling said second shaft and having one end connected to said arm and the other end of said spring connected to said second shaft, said second shaft being adapted to turn said spring whereby the arm turns said door.

2. The invention of claim 1 wherein said member affixed to said door includes a base, three rollers located at the apices of a triangle, said rollers mounted upon said base, said base being pivotally connected to said door, and said arm movable between two of said rollers and being adapted to press against said rollers to open and against the third roller to close said door.

3. The invention of claim 2 including a spring having one end attached to said base and the other end attached to a fixed point whereby said spring normally tends to pull the rollers to a predetermined position.

4. The invention of claim 3 including a pin eccentrically positioned and rigidly attached to said second shaft, said pin being adapted to strike said arm and rotate said arm when said rotor returns to its closed door position.

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5. In combination with a door, a rotor shaft, a fixed electromagnetic solenoid of an arcuate construction, a rotor having a free end and an end attached to said rotor shaft tapering from its free end to its attached end and adapted to be drawn into said solenoid when said solenoid is energized, a second shaft, means joining said second shaft to said rotor shaft whereby rotation of said first shaft will rotate said second shaft, an arm adapted to open or close said door, a member affixed to said door and engaged by said arm whereby said door is opened or closed, one end of said arm freely encircling said second shaft, and a torsional spring encircling said second shaft and having one end connected to said arm and the other end of said spring connected to said second shaft, said second shaft being adapted to turn said spring whereby the arms turns said door, and a spring attached to said rotor shaft whereby said spring tends to pull said shaft so that said rotor shaft returns to its original position.

6. The invention of claim 5 including an eccentrically located pin rigidly attached to said shaft and being adapted to engage and to rotate said arm in one direction only when said spring attached to said rotor shaft rotates said rotor shaft.

7. The invention of claim 6 including means to hold said door in an open position.

JOHN LOWLER MORGAN.
WILLIAM J. MORGAN.

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