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A. GOTTSCHALK

PNEUMATIC MOTOR MECHANISM

Filed March 22, 1919

3 Sheets-Sheet 1

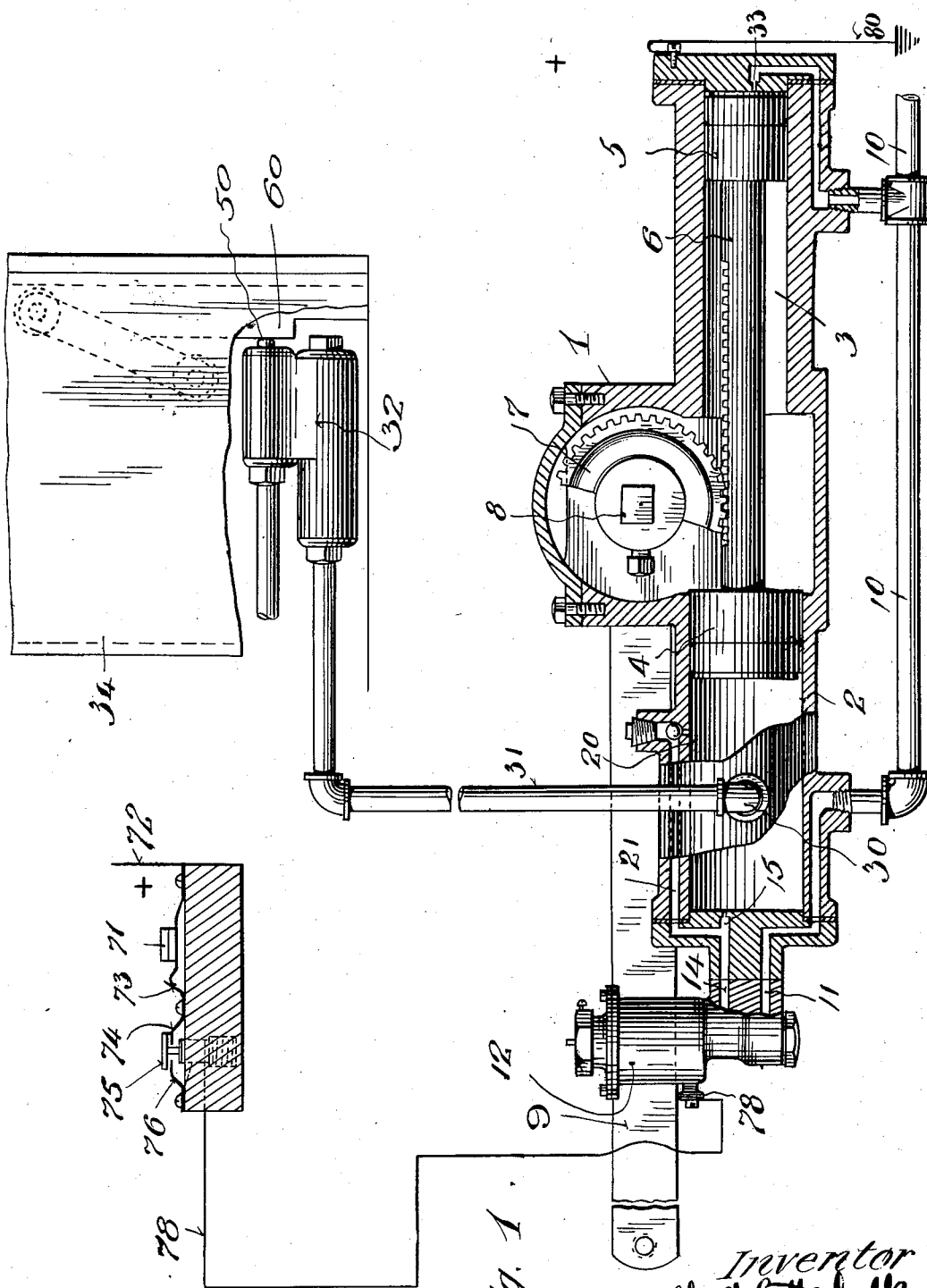


Fig. 1.

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by his atty Samuel E. Peck

Oct. 20, 1925.

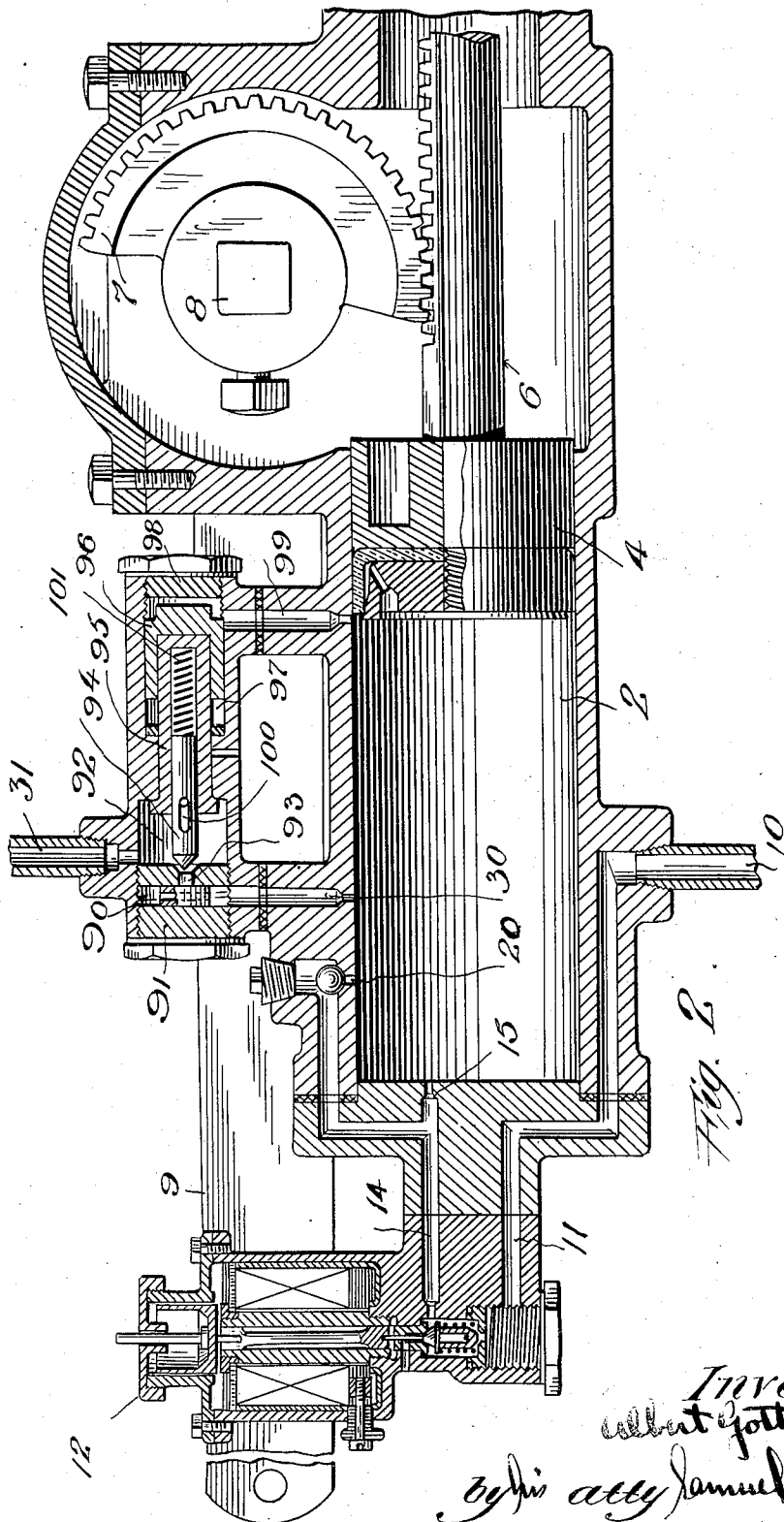
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3 Sheets-Sheet 2



UNITED STATES PATENT OFFICE.

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PNEUMATIC-MOTOR MECHANISM.

Application filed March 22, 1919. Serial No. 284,480.

To all whom it may concern:

Be it known that I, ALBERT GOTTSCHALK, a citizen of the United States, residing at New York, county of Bronx, and State of New York, have made a certain new and useful Invention in Pneumatic-Motor Mechanism, of which the following is a specification.

This invention relates to pneumatic motor mechanism.

The object of the invention is to provide a pneumatic motor and control therefor for use in connection with actuating doors, or the like, which is simple in construction, efficient in operation, and economical of manufacture.

A further object of the invention is to provide a motor of the character described used for actuating doors, and the like, wherein provision is made for reversing the direction of the motor if the door in closing encounters an obstruction in its path.

A further object of the invention is to provide a motor of the character referred to which is electrically controlled.

Further objects of the invention will appear more fully hereinafter.

The invention consists substantially in the construction, combination, location, and relative arrangement of parts, all as will be more fully hereinafter set forth as shown by the accompanying drawings and finally pointed out in the appended claims.

Referring to the drawings:—

Fig. 1 is a view partly in vertical longitudinal section and partly in side elevation of a motor mechanism and door employed in accordance with my invention.

Fig. 2 is a view in vertical longitudinal section of one end of a modified construction of a motor mechanism embodying my invention.

Fig. 3 is a view in section of a magnet valve employed in accordance with my invention.

Fig. 4 is a sectional view of a switch control employed in connection therewith.

Fig. 5 is a view partly in section, parts in elevation, of a portion of a door and reversing mechanism employed in accordance with my invention.

The same part is designated by the same

reference character wherever it occurs throughout the several views.

While I have shown and will now describe my invention as applied to pneumatic motors employed in the street car art for opening and closing doors to allow the ingress and egress of passengers to and from the car, I wish it to be understood that my invention is not to be limited or restricted in this respect as the same is applicable to all instances where it is desired to effectively control the movement of a movable body.

It is the present custom in the street car art to open and close the doors of the car with pneumatic motors, which pneumatic motors are in turn controlled manually either by manually operated valves or a pneumatic valve controlled from an electric switch such as a push button. Pneumatic motors of the differential type, that is, of cylinders of different diameters with pistons of correspondingly different diameters operating therein are known to the art, and it is this particular type of motor mechanism which I have selected for the purpose of illustrating my present invention. In accordance with my invention I maintain the motor in one of its extreme positions when the door is completely closed by maintaining a supply of fluid pressure against a pair of pistons one of which is of larger diameter than the other. The motor opens the door when the fluid pressure on the piston of larger diameter is released. Many devices have been employed in the art for insuring the door operating motor to either cease its closing movement or to reverse its movement when an obstruction is encountered by the door in its closing movement. A great difficulty with the motors heretofore designed to accomplish this purpose is that in one instance, namely, where the motor movement is stopped but not reversed it can readily be conceived if the obstruction is encountered at or near the completely closed position of the door difficulty might be encountered in extricating the obstruction. For example, if the door starts its closing movement upon a person entering the car at or near the initial closing movement of the door there is plenty of space between the edge of the door and the door jamb to allow the person to get through in one direction or the other

through the door, especially, if, as is generally the custom, a collapsible shoe is carried by the door. Where a reversing mechanism is employed to reverse the operation of the door motor whenever the obstruction is encountered it is obvious that at or near the initial closing movement of the door the reversal of the operation of the motor consumes a considerable amount of time in drawing the door away from contact with the obstruction, then upon the breaking of contact therewith the motor again reversing itself, which delay is a serious question in systems running on time schedule where a certain predetermined length of time is allowed for taking on or letting off passengers. Thus it will be seen that a motor which is not reversed upon the door meeting the obstruction at the initial movement of the door is the preferable type from an operating view point. If the obstruction is encountered at or near the end of the closing movement of the door, however, the reverse condition of affairs is secured, namely, the motor which will allow a reversal upon meeting the obstruction is preferable. This will be readily apparent when it is taken into consideration even though a collapsible shoe is provided for the door a small obstruction such as an arm or leg of a person might be caught between the door jamb and the shoe and even though the motor itself is arrested it is impossible to extricate the arm or leg from between the door and jamb and the only safe appliance for this purpose is consequently a reversing motor. The objections to both of these types of motors therefore are obvious, and it is among the special purposes of my present invention to provide a reversing mechanism for the motor so constructed that the door is neither arrested nor reversed in its initial movement if an obstruction is met but is reversed if an obstruction is met within a predetermined adjustable distance from its completely closed position.

Referring to Fig. 1 of the drawings, I show a simple construction of motor and motor control for accomplishing the purpose of my invention, and wherein the motor is designated generally at 1 comprising differential cylinders 2 and 3 in which operate the differential pistons 4 and 5 respectively. The pistons 4 and 5 are connected by piston rod 6 provided with teeth in the form of a rack which mesh with segment gear 7 mounted on shaft 8 to which shaft is secured the door operating arm 9 in the usual well known manner. Fluid pressure is supplied from a suitable source through pipe line 10 to the end of the cylinder of small diameter 3 behind the piston 5, and the piston 5 is at all times in open communication with the source of fluid pressure supplied. The fluid pressure is likewise constantly in communi-

cation with the passage 11 of magnet valve 12. When the magnet valve is deenergized fluid pressure is allowed to pass by a valve 13 and the passage 14 of the magnet valve through port 15 into the end of the cylinder 2 of larger diameter. It will thus be seen that pressure is applied to the face of each of the pistons 4 and 5 and the piston 4 being of larger diameter maintains the pistons in the respective positions shown in Fig. 1 which is the normal door closed position. When it is desired to open the door the circuit of the magnet valve 12 is closed causing the valve 13 to become seated at its lower end thus closing communication between passages 11 and 14, (see Fig. 3), and opening communication between passages 14 and 16 to exhaust the fluid pressure contained in the cylinder 2 behind piston 4. To prevent the door slamming upon reaching its open position the port 15 is restricted in size, so as to allow the air within the cylinder 2 to be compressed at the end of the movement of the piston 4 and to be allowed to escape slowly. To allow free movement of the piston during the initial movement of the door to its open position I provide a larger port 20 positioned intermediate the ends of the cylinder 2 and controlled by a ball check in the usual well known manner, which port 20 communicates with passage 21 which in turn communicates with passage 14 and thence to exhaust as above explained. It will be seen that the initial movement of the piston 4 to the left from the position shown in Fig. 1 causes a free rush of air to exhaust through the port 20, but as soon as the piston 4 covers the port 20 the only exhaust from the cylinder 2 is secured through restricted port 15, and consequently the proper cushioning effect of the motor and door at the completion of its movement is secured. It will be apparent that by suitably positioning the port 20 between the ends of the cylinder 2 it is possible to control the point in the travel of the door at which the cushioning effect takes place. Likewise it will be apparent that the port 33 leading into the cylinder 3 behind the piston 5 is also of restricted area and in the same manner secures proper cushioning for the door in its closing movement, and in the form shown throughout its closing movement preventing the slamming thereof. In addition to the restricted port 33, as above stated, there is always a constant pressure from the source of fluid supply which also aids in preventing slamming of the door through the closing movement thereof. The cylinder 2 is tapped at a suitable place, for example, at 30, and a pipe line 31 leads to a cylinder 32 positioned on the door. In Fig. 5 I show in section the construction of the cylinder 32 and it consists essentially of a casting provided with a bore 35 closed at its one end by a hollow plug

36 to which the pipe line 31 leads. Positioned in the bore 35 is a spring pressed valve 37 which normally closes passage 38 which communicates with passage 39 to the atmosphere. The valve 37 is in contact with a series of plungers 40, 41 and 42 of increasing diameter, the plunger 42 being of comparatively large diameter and located in the cylinder 43 bored out of the opposite end of the casting 32, the opening of which is closed by a suitable plug 44. The right hand end of the cylinder 43 communicates through passage 45 with passage 46 which is normally closed by spring pressed valve 47 from a bore 48 provided in the casting 32 parallel to the bore 35 which bore communicates through hollow plug 48^a which closes the same with the pipe line 49 communicating with source of fluid pressure supply. The valve 47 is of the so-called "cage" type, that is, it is open throughout its body to permit the free passage of fluid pressure therethrough, but the valve face thereof shown substantially cone shaped is solid to effectively shut off communication through passage of the valve seat when the valve is seated thereon. A plunger 50 is secured to the valve 47 and adapted to rest adjacent the edge of the door shoe where a collapsible shoe is employed, so that by properly positioning the casting 32 or by properly determining the size of the plunger 50 when the shoe collapses due to the door meeting obstructions during its closing movement, the plunger 50 unseats valve 47 allowing fluid pressure to flow from supply 49, port 48, passage 46, passage 45 behind the piston 42 moving the piston or plungers 42, 41 and 40 to the left unseating valve 37 and allowing fluid pressure to flow from the cylinder 2 through pipe line 31, port 35, passage 39 to exhaust. As soon as the shoe comes out of contact with the plunger 50 the spring of the valve 47 causes the valve to seat and the fluid pressure in the passage 45 is allowed to leak through to exhaust through restricted passage 51 in the casting 32, and as the pressure behind piston 42 has been removed the spring of the valve 37 causes the same to again seat and close communication between pipe line 31 and the exhaust port 39. Thus it will be seen that when the door is moved toward its closed position, that is, when the pistons 4 and 5 are moved from their extreme left position of Fig. 1 to the right position shown in Fig. 1, if the door meets an obstruction in its closing movement the plunger 50 being depressed by the shoe 60 through the mechanism above described opens the cylinder 2 to exhaust, thereby relieving the pressure on the piston 4 and allowing pressure on the piston 5 to reverse the movement of the door. It will be seen that the piston 4 does not uncover the port 30 until it has traveled a certain distance and consequently by positioning the port 30

at any suitable position throughout the length of the cylinder 2 the reversing action of the motor can be controlled for any desired distance between the door and its complete closed position. In other words, it can be located so that the motor will not be reversed if an obstruction is encountered in the closing movement of the door unless the door is, for example, say, twenty-four inches away from its completely closed position. It is understood, of course, that this distance is arbitrary and can be located at will. While I have shown and will now describe my invention as applied to an electrically controlled motor, I wish it to be understood that I do not desire to be limited or restricted thereto. However, it is apparent that when the door is normally closed it is desired to maintain fluid pressure in both cylinders of the motor, and I will now describe one simple means for accomplishing this purpose employing the magnet valve 12. I provide what I will term an opening and closing button which control the circuit of the magnet valve. The opening button is designated as 75 and it normally completes the circuit from source 72, closing button 71, contact 73, contact 74, button 75, which bridges contacts 74 and 76 when said button is depressed, solenoid coil 77 (see Fig. 4) line 78 to terminal 79 of the magnet valve, the other terminal of the magnet coil being grounded on the machine and ground 80. When the opening button 75 is depressed to bridge the contacts 76 and 74 current then flows through the circuit 72, 71, 73, 74, 75, 76, 78, and through the magnet valve as will be apparent. Included in this circuit is the solenoid 77 which on becoming energized holds the core 81 to which is secured button 75 in energized position thereby maintaining the circuit closed and the circuit thus closed is maintained closed until the circuit is again broken at another point. Energizing the magnet valve draws the valve 13 thereof into position to close communication between passages 14 and 11 and open communication between passages 16 and 14 as heretofore described, and, in other words, cutting off fluid pressure from source of supply into the cylinder 2 thus opening the door and maintaining the door in its opened position. When it is desired to close the door it will be seen that it is merely necessary to break the circuit of the magnet valve which is accomplished by merely depressing button 71 which breaks the circuit through the solenoid and the spring 82, forces the button 75 to its open circuit position, as will be readily understood.

It may sometimes be desired to provide means for preventing accidentally or otherwise collapsing of the shoe after the door has reached its closed position to thereby prevent a passenger or motorman from ac-

cidently or deliberately collapsing the shoe to secure the opening movement of the door. It will be apparent in the structure of the apparatus described in connection with Fig. 1 that while in the illustration given the motor will reverse at any time during the travel of the piston twenty-four inches after an obstruction to the door is encountered it also will cause a reversal of the motor movement if it is collapsed after the door has reached its completely closed position. In Fig. 2 I show an arrangement whereby I provide a cut off valve which eliminates this possibility. This cut off valve may, if desired, be mounted right on the motor casting or form a part thereof. In this instance the port 30 communicates with the peripheral groove 90 of a plug 91 secured in one end of a cylinder 92 formed in the casting. The inner end of the plug 91 is provided with a perforation 93 which communicates with the cylinder 92, thence with the pipe line 31 and mechanism 32 heretofore described. The perforation 93 in effect forms the valve seat in which seats a needle valve 94 slidably mounted in a sleeve 95 which in turn is slidably mounted in the casting, one end thereof being telescoped by the plunger or piston 96 fitted in the cylinder 97 formed in the opposite end of the casting, which cylinder is plugged up in the usual manner, for example, by means of plug 98, and which is in communication through port 99 with the cylinder 2 when and not until the piston 4 has reached the limit of its closing movement. A pin carried by sleeve 95 and projecting into a slot 100 of the needle valve 94 allows a limited movement of the needle valve 94 relative to the sleeve 95, and a spring 101 located within the sleeve 95 and interposed between one end thereof and the end of the needle valve normally maintains the needle valve pressed towards the left under a tension which is increased as the piston 96 is moved towards the left thus maintaining a tight fit between the needle valve 94 and the valve seat 93 formed in the end of the plug 91. Thus it will be seen that after the piston 4 has started its initial closing movement the port 30 is not uncovered until the door has traveled a predetermined distance according to the location of the port 30 on the cylinder 2 so that if within that predetermined distance of travel an obstruction is met to actuate the plunger 50 of the mechanism 32 the fluid pressure in the cylinder 2 is allowed to escape through port 30, passages 90 and 93, the needle valve being open or forced open by the pressure through the pipe line 31 to exhaust as above explained. As soon, however, as the piston 4 reaches its extreme movement to uncover the port 99 fluid pressure passes through the port 99 into the cylinder behind the piston 96 causing the piston

96, sleeve 95 and needle valve 94 to move towards the left, the needle valve immediately seating in the seat 93. The pin and slot connection between the sleeve and needle valve allows the piston 96 and sleeve 95 to continue its movement until the limit thereof whereby the pin locks the needle valve 94 in its closed position so that if the shoe or jamb 60 is collapsed no reversal of the movement of the motor is secured.

Many changes and modifications will occur to those skilled in the art without departing from the spirit and scope of my invention as defined in the claims, and I therefore desire to have the foregoing illustrations and description to be regarded in an illustrative sense and not in a limiting sense.

Having now set forth the objects and nature of my invention, and having shown and described structures embodying the principles thereof, what I claim as new and useful, and of my own invention, and desire to secure by Letters Patent, is:—

1. The combination with a door and a yieldable member associated therewith adapted to collapse when pressure is exerted thereagainst, of a motor for actuating said door to open and close the same, and fluid pressure controlled means actuated by the collapsing of said yieldable member only after the door has completed a prescribed distance of its travel towards closed position, for reversing said motor.

2. The combination with a door and a yieldable member associated therewith adapted to collapse when pressure is exerted thereagainst, of a motor for actuating said door to open and close the same, and fluid pressure controlled means actuated by the collapsing of said yieldable member only after the door has completed a prescribed distance of its travel towards closed position, for reversing said motor, and means for preventing the reversing of said motor if said yieldable member is collapsed after said door has reached its closed position.

3. The combination with a door, and a yieldable shoe carried thereby adapted to move relative to said door if an obstruction is encountered during the closing movement of said door, of a motor for actuating said door to open and close the same, and fluid pressure controlled means actuated by the movement of said shoe relative to the door only after the door has traveled a prescribed distance toward its completely closed position, for reversing said motor.

4. The combination with a door, and a yieldable shoe carried thereby adapted to move relative to said door if an obstruction is encountered during the closing movement of said door, of a motor for actuating said door to open and close the same, and fluid pressure controlled means actuated by the movement of said shoe relative to the door

only after the door has traveled a prescribed distance, towards its completely closed position, for reversing said motor, and means for preventing the reversing of said motor if said shoe is moved relative to the door after the door has reached its completely closed position.

5. The combination with a differential piston, fluid pressure actuated motor, means for maintaining a supply of fluid pressure to both of said pistons to normally maintain said motor at one limit of its movement, means for exhausting the pressure from behind the piston of larger diameter, and for coincidentally shutting off the supply of fluid pressure thereto, a door actuated by said motor, a normally closed by-passage from the cylinder of larger diameter of said motor positioned intermediate the ends thereof, and means actuated by said door encountering an obstruction during the last portion of its closing movement for opening said by-passage to exhaust substantially as and for the purpose set forth.

6. The combination with a differential piston, fluid pressure actuated motor, means for maintaining a supply of fluid pressure to both of said pistons to normally maintain said motor at one limit of its movement, means for exhausting the pressure from behind the piston of larger diameter, and for coincidentally shutting off the supply of fluid pressure thereto, a door actuated by said motor, a normally closed by-passage from the cylinder of larger diameter of said motor positioned intermediate the ends thereof, means actuated by said door encountering an obstruction during the last portion of its closing movement for opening said by-passage to exhaust, and means for preventing the opening of said by-passage to exhaust after the door has assumed its completely closed position.

7. The combination with a fluid pressure actuated motor comprising differential cylinders and connected pistons operating therein, of means for maintaining a constant source of fluid pressure supply to the cylinder of smaller diameter, means for admitting pressure to and exhaust pressure from the end of the cylinder of larger diameter, a port positioned intermediate the ends of said cylinder of larger diameter, and adapted to be uncovered by the piston of larger diameter after the same has been actuated a predetermined distance, a by-passage communicating with said port and normally closed to exhaust, a door actuated by said motor and means actuated by the door meeting an obstruction during its closing movement after said port has become uncovered

by said piston of larger diameter, for opening said by-passage to exhaust to thereby reverse the movement of said motor.

8. The combination with a fluid pressure actuated motor comprising differential cylinders and connected pistons operating therein, of means for maintaining a constant source of fluid pressure supply to the cylinder of smaller diameter, means for admitting pressure to and exhaust pressure from the end of the cylinder of larger diameter, a port positioned intermediate the ends of said cylinder of larger diameter, and adapted to be uncovered by the piston of larger diameter after same has been actuated a predetermined distance, a by-passage communicating with said port, and normally closed to exhaust, a door actuated by said motor and means actuated by the door meeting an obstruction during its closing movement after said port has become uncovered by said piston of larger diameter, for opening said by-passage to exhaust to thereby reverse the movement of said motor, and means for preventing said by-passage being opened to exhaust after said door has completed its closing movement.

9. The combination with a fluid pressure actuated motor comprising differential cylinders and connected pistons operating therein, of means for maintaining a constant source of fluid pressure supply to the cylinder of smaller diameter, means for admitting pressure to and exhaust pressure from the end of the cylinder of larger diameter, a port positioned intermediate the ends of said cylinder of larger diameter, and adapted to be uncovered by the piston of larger diameter after the same has been actuated a predetermined distance, a by-passage communicating with said port and normally closed to exhaust, a door actuated by said motor and means actuated by the door meeting an obstruction during its closing movement after said port has become uncovered by said piston of larger diameter, for opening said by-passage to exhaust to thereby reverse the movement of said motor, an auxiliary cylinder communicating with cylinder of larger diameter and adapted to be uncovered only after the piston of larger diameter has reached the limit of its movement, a piston acting in said auxiliary cylinder, and a valve positioned in said by-passage to close the same upon actuation of the piston in said auxiliary cylinder.

In testimony whereof I have hereunto set my hand on this 26th day of March, A. D. 1919.

ALBERT GOTTSCHALK.