March 30, 1926.

C. NORTON

PNEUMATIC DOOR OPERATING MECHANISM

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4 Sheets-Sheet 1

Fig. 1.

Clifford Norton.

By my Attorney.
To all whom it may concern:

Be it known that I, CLIFFORD NORTON, a citizen of the United States, and a resident of New York, in the county of New York and the State of New York, have invented certain new and useful Improvements in Pneumatic Door-Operating Mechanisms, of which the following is a specification.

My invention relates to power actuated mechanisms for producing a reciprocating or to and fro movement of doors or other objects under the action of fluid pressure employed as the power. It is convenient to employ pneumatic power, but the invention as will be apparent from the following description, is not limited to power of that kind. My invention is particularly useful for moving or producing reciprocating movement of elevator doors and will accordingly be described as applied to that use.

The object of my invention is to provide a simple, durable and thoroughly reliable apparatus by means of which the movements of a door or other object in either direction may be speeded up without danger to the users of the service and without liability of violent rebound or shock when the door reaches the end of its closing or opening movement.

A further object of the invention is to permit the use of a liquid dashpot or check for both movements and to provide for the gradual application of the checking action and for the regulation thereof to suit various conditions.

In the preferred form of my invention pneumatic power is applied to the door by means of a pair of pistons connected with a pair of independently mounted dashpots through mechanism by which one or the other of the dashpots comes into action according to the direction of movement of the door and the operation of the pneumatically impelled pistons. In applying the motive power of the compressed air a suitable controlling valve is used which is operated in any desired way as for instance by a cam on the car. Said controller valve is properly connected to its operating mechanism in such manner that the valve may be thrown into neutral position in which pneumatic power may be cut off from both cylinders when the door is not in use.

To provide for the regulation of the cushioning or checking effect of the dashpot, I prefer to provide for the cylinder of the dashpot two or more liquid bypasses regulable independently of one another and adapted to come into action respectively at consecutive stages of movement of the door and through any portion of the stroke of the dashpot piston preferably towards the end of the stroke. This manner of regulating the action may be applied to one only of the two dashpots but is applied preferably to both.

By the use of my apparatus the difficulties experienced from the rebound in the previous forms of apparatus, where the attempt is made to throw the door at high speed by pneumactic power and the check or cushion is an air check, are entirely avoided and, by the regulation of the bypasses employed in the checking action, the door may be caused to reach the end of its excursion gently but yet may be speeded up in its action to the utmost limit without danger.

Furthermore, by regulating or adjusting the dashpot action to be more or less effective in the movement of the door in one direction than in the other, the time consumed in the opening movement, for instance, may be made much less than the maximum permissible speed for the closing so that using the same amount of applied pneumatic power for both closing and opening the headway or speed of the service may be greatly increased.

With proper regulation or adjustment of the relative checking or cushioning effects of the dashpots operating respectively on the opening and closing movements, the door may be moved in opening at a speed twice that permissible at the closing movement or at even a greater relative speed.

The invention consists also in the combinations of apparatus and the features of construction more particularly hereinafter described in connection with the accompanying drawings and then specified in the claims.

In the drawings:

Fig. 1 is a general side elevation and partial vertical section of an apparatus embodying my invention, showing the relation of the parts when the door is closed.

Fig. 2 shows the apparatus with the door open.

Fig. 3 is an enlarged vertical section through the two dashpots and shows them...
as employed to produce the graduated cushioning effect provided by independently regulable bypasses coming into action consecutively one after the other near the end of the stroke in the case of one dashpot, and acting through substantially the whole stroke but consecutively in the case of the other.

Fig. 4 is a cross-section through a dashpot cylinder at a portion thereof where it is counterbored to allow free movement of the dashpot piston.

Figs. 5, 6 and 7 illustrate in a partially diagrammatic fashion the several positions occupied by the pneumatic controlling valve for respectively opening the door, closing the same and for shutting off the air, so that the door cannot be operated in either direction.

Fig. 8 is a central, longitudinal section through the pneumatic controlling valve showing a preferred construction.

Fig. 9 is a detail view of the preferred connection between the valve stem arm and actuating device therefor.

Fig. 10 is an enlarged vertical section at the point of connection of the pneumatic piston rods.

It indicates the door mounted as usual and capable of sliding movement across an opening. In the present instance I have shown the same as provided with a system of operating levers acting after the manner of a toggle and comprising the two toggle members 2, 2′ pivoted together, one member 2 being pivoted, as shown, on a fixed mounting, support or bracket 3, the other being pivotally connected to the door itself.

The pneumatic pressure is applied to the levers to open and close the door by connection to the toggle arm or lever 2.

I do not, however, limit myself to the use of this particular system of operating levers for communicating movement to the door inasmuch as my invention may be carried out by use of any system of levers or other desired mechanism between the door itself and the pneumatic piston or pistons employed for applying power to the door.

Two pneumatic power cylinders used in the opening and closing operations are indicated respectively at 4, 4′. Each cylinder is provided with a suitable piston actuated by pneumatic power applied at the close end by means shown and the piston rods are connected integral so that as one piston is actuated the other is returned to position at or near the bottom of its cylinder.

The cross-head 7 is loosely connected by a yoke or arm 6 extending sidewise from the cross-head and engaging the piston rod.

Said cross-head is itself also preferably guided in its vertical movements by a guide rod 8 working in guides applied to the sides of the cylinders 4, 4′ as shown. To the cross-head are pivoted the links 9 of the upper one of which, namely 9, pivotally connects with an ear or arm fixed to and extending from the toggle lever or member 2 for the purpose of moving the door either to open or close the same. The lower link 9 extends in the opposite direction from 9 and downwardly for pivotal connection, as indicated at 10, with a lever 11 which serves to actuate the pistons of the dashpots in opposite directions respectively to one another when pneumatic power is applied through either one of the cylinders 4, 4′ to move the cross-head and the connected link, as well as the link 9, in opening or closing the door.

Said lever is pivoted on a bracket or support 12 mounted on a suitable fixed support or plate attached to the wall or studding near the door, and is connected at opposite sides of its fulcrum with the piston rods of the two dashpots respectively which act to provide a liquid check or cushion respectively for the opening and closing movements of the door.

The dashpot cylinders indicated at 13, 13′ are properly mounted in upright position by pivots or tramulions at their closed ends carried by the bracket or table 16 or by other means. By this manner of mounting they accommodate themselves to the movement of the opposite ends of the lever 11 in area of a circle when acting upon the piston rods to force the pistons through the cylinders, while moreover this manner of mounting largely avoids the difficulties from leakage of oil or other liquid in the cylinders owing to the fact that the stuffing box ends are uppermost.

The controller valve controlling the application of pneumatic power to the cylinders 4, 4′ is indicated at 15. The valve casting is furnished with an offset or boss 15′ threaded for attachment to the lower end of one of the cylinders 4′, as clearly shown, so as to provide a compact and rigid mounting of the parts. The valve stem 16 and valve are arranged horizontally and turn in a vertical plane. An arm 17 of the stem affords means for turning the valve in any suitable way, as for instance in the manner hereinafter described. Said valve is preferably of the rotary, flat disk type having a suitably formed disk or plate 18, as shown in the detail views Figs. 5, 6, 7 and 8, which works in the valve chamber 19 on the face of the casting 20 bored to provide suitable ports opened and closed by the rotation of the disk when the stem 16 attached to said disk is turned. The bores at the outside of the valve casting connect respectively with pipes leading to the air supply, to the two cylinders 4 and 4′ and to an exhaust, as indicated by the legends on the several drawings and the disk itself is of the mutilated or irregular contour indicated by the irregu...
larly curved full line, while its inner face engaging the face of the casting 20 is depressed to afford a passageway and chamber wholly contained on said inner face and having the boundary wall of the irregular curve or shape indicated by the dotted line.

Therefore, as will be seen by an inspection of the figures, air under pressure will be supplied to the cylinder 4' and valve will exhaust from the cylinder 4 when the valve is in position shown in Fig. 5. When the valve is moved to position indicated in Fig. 6, air will exhaust from 4' and be supplied under pressure to 4, while a further turning of the valve to the neutral position indicated in Fig. 7 will cut off the supply to both cylinders and leave them both connected to the exhaust.

An actuating rod or other device for operating on the valve stem arm is indicated at 21. Said actuator connects with the arm preferably by a hook, jaw or yoke on its end, such as shown with Fig. 9, wherein the lower branch or arm of the yoke is shown as pivoted at 22. The ordinary range of movement of the stem to place the valve in the two positions for opening and closing the door, and indicated respectively in Figs. 5 and 6, is accomplished by moving said yoke from one to the other of two positions with the pivoted arm of the yoke retained in the position shown in the drawing Fig. 9. This movement is a limited movement between two extremes limited by suitable stops or by other means associated with the actuator rod 21 in any usual or proper way.

When it is desired to throw the valve to neutral or inoperative position, the lower or pivoted hook or arm engaging the valve arm is thrown back from position shown in Fig. 9, thus permitting the valve arm to be thrown down into the position indicated by the lower bent line of Fig. 8, which is the position corresponding to the position indicated in Fig. 7. In this position of the valve the door may be moved freely for any purpose by hand without interference from the pneumatic pressure employed in producing the opening and closing movements.

The valve actuator rod 21 may be operated in any desired way as for instance by a cam 23 of an elevator car suitably mounted and operated by a foot pedal or otherwise, adapted to be projected against one arm of a bell crank lever 24 mounted in fixed position and connected, as to its horizontally extending arm, on the vertically guided rod 21. Said rod passes through the guide or other bracket 25 fixed in position and is suitably provided with a retractor spring 26 compressed between the guide bracket 25 and a collar on the rod when the rod is lifted by the action of the bell crank or other means. Its upward motion serves to raise the valve in position for applying pneumatic power to the cylinder 4', as will be obvious from the foregoing description, and opens the door by throwing the parts into the position indicated in Fig. 2. The spring 26 serves to return the valve to normal position when the lifting effect upon the rod 21 ceases, thereby admitting the air under pressure to the cylinder 4 and exhausting the air from the cylinder 4', so that, under pneumatic power, the door will be closed.

As will be seen, on the opening movement the piston of the liquid check or dashpot 13 is forced downward and that of 13' is at the same time raised. On the reverse or closing movement of the door, effected by pressure in the cylinder 4, the piston of the dashpot 13 is raised and that of 13' is forced downward. These reverse actions take place through the reversal of the motion of the lever 11 whose opposite ends reciprocate in opposite directions respectively. To allow free upward movement of each dashpot piston each has an upward check valve as shown, which opens when pressure is applied above the piston. Said valve closes when pressure accumulates beneath the piston. To insure greater freedom of movement of either piston in that portion of its cylinder where the retarding action of the bypass is not employed or desired, said cylinder may be counterboared at intervals around its inner circumference, leaving parts which will sufficiently guide the piston and as indicated in the cross-section Fig. 4.

The dashpot action on the down stroke of the piston is controlled, in each instance, by a regulable bypass in the cylinder around from one side to the other of the piston. For each cylinder I prefer to employ two or more regulable bypasses acting respectively in consecutive stages of the down movement of each piston. The retarding action may be exerted through any portion or all of the movement of each but in the case of the cylinder 13 it is preferable to arrange them to come into action only as the door approaches its open position, leaving it free to move without being checked during a large part of the opening movement.

Any number of bypasses may be used but as an example I show two indicated at 27 27'. Each is furnished with the usual regulating valve like a needle valve, as clearly shown. When the dashpot piston for dashpot 13 reaches position number 2 indicated in dotted lines, up to which time it applies no or very little check upon movement of the door, owing to the presence of the counterbore described, the checking liquid can circulate only through bypass 27 in the regulated checking or retarding amount and continues to check the opening movement until near the termination of the same the piston reaches the position number.
3. When the checking action of bypass 27 begins. At this time bypass 27 is cut off and ceases to act. By means of the additional regulable bypass 27 it is obvious that increased or diminished checking action may be introduced or, in other words, that a regulated checking action for different stages of movement of the door in opening may be introduced which will vary at different stages as may be desired, by relatively adjusting the bypass regulating valves.

Similarly the dashpot 15' may have two or more bypasses 28 28' preferably regulable independently of one another, which may be applied to act during the whole or a portion only of the down movement accompanying the closing movement of the door. In this case as in the case of cylinder 13 the bypasses may be of any desired relative length and capacity for adjustment. Also, the piston of 13' might have no effective action near the beginning of its stroke by properly positioning the bypasses or in effect by dispensing with the upper one of the two shown.

In the particular case illustrated, on the closing movement of the door and down movement of the piston in 13' the checking action of bypass 28' is first effective but on the piston's reaching position 2 the checking action of the bypass 28 which may be either an increased or a lessened checking action is introduced and continues to the completion of the closing movement. This checking action may begin obviously as near as desired to the closing position of the door and is likewise regulable by the action of the bypass regulating valve. In some cases one bypass for the dashpot checking the closing movement may serve but preferably two or more are used and act at several successive consecutive stages of the action, each being regulable independently of the others, as might be found desirable under the particular conditions of use of the apparatus.

For convenience the pistons of both dashpots are shown in the enlarged view as in their uppermost position but it will be understood that, as illustrated in the other figures showing the same properly assembled with their operating devices, when one occupies its uppermost position the other would occupy its lowermost position.

In the action of the apparatus, therefore, and on opening the door, both pistons move, for the major part of the opening movement, freely (the piston of 13 being forced down and that of 13' being raised) the presence of the counterbore around the piston of 13 as it begins to move down contributing to this freedom of movement while, due to the opening of the valve in the piston of 13' as it rises, no effective opposition to a quick opening movement is produced by the piston of 13'. The piston for 13, however, during the latter part of such quick opening movement, is subjected to the opposition of the liquid flowing in the bypasses and therefore exerts its required checking or cushioning action as the door nears the end of its rapid opening movement. When the door is closed the piston of 13 rises and that of 13' is forced down simultaneously through the action of the lever 11. That of 13 does not oppose the free action owing to the operation of the valve in its piston in that zone of action where it had been previously subjected to the dashpot action and where the regulated bypasses are present, while above that position the counterbore, in addition to the opening of the valve, allows a perfectly free and unobstructed movement of the piston which will not oppose the closing movement or interfere with the action of the piston in 13' which, in the meantime, has been acting in conjunction with its bypass or bypasses to produce a dashpot check to the closing movement.

As will be readily seen the retarding action of the dashpot 13 near the end of the opening movement of the door may be readily adjusted or regulated in the one or more stages of the last or final movement without interfering or disturbing the regulation of the action of the dashpot 15' by its bypass which is effective in cushioning the closing movement of the door and vice versa. Also the extent and nature of the dashpot action at the different stages of movement may be readily determined in each case owing to the capacity for regulation at each stage independently of the other or others, thus permitting a complete control and smooth operation under all conditions of requirements.

It will be also seen that by the use of my invention the door may be made to close very slowly through its whole closing movement or it may be speeded up as desired at the beginning of such movement and checked or retarded at any desired rate as it approaches the closed position and at any desired different rates in the different stages of such final movement.

It will also be obvious that by suitable regulation or adjustment of the respective dashpot actions the time consumed in the closing movement might be made less than that consumed in the opening movement under the application of the power. My invention, however, is especially useful in speeding up the opening movement.

What I claim as my invention is—

1. The combination with power actuated mechanism for imparting reciprocating motion to doors or other objects, of two dashpots each including a cylinder and a piston whose cylinders are mounted upright on their
closed ends and each adapted to exert its cushioning effect as its piston descends into the lower end thereof and means connected with the door or other reciprocating object for operating said dashpot pistons in opposite directions respectively in correspondence with the opening and closing movements of the door.

2. In an apparatus of the character described for reciprocating doors or other objects, the combination of a pair of closed dashpot casings mounted in upright position with their closed ends down and each provided with a regulable bypass near its lower end pistons movable in said casings and means operatively connected with the door for causing the pistons of said dashpots to reverse their movements so that as either enters the zone of action of the bypass at its lower end the other will move upward through an unregulated zone to position for acting on its reverse movement to check the action of the other. The combination with power actuating mechanism for reciprocating doors or other objects, of a cylinder and piston and a liquid dashpot acting to cushion the door or other object as it reaches a stage of movement near its extreme position and provided with a regulable bypass adapted to come into action at said stage of movement.

4. In a power actuating mechanism for producing reciprocating motion of doors or other objects, the combination of a power motor, means for controlling the application of power to said motor to reciprocate said doors or other objects according to the directing motion desired, a pair of dashpots for cushioning the movements of the doors mounted beside one another in upright position, a lever to the opposite ends of which said dashpots are respectively connected and means connecting said mechanism with said lever.

5. The combination with a power actuated mechanism for producing a reciprocating movement of a pair of dashpots for cushioning the movements of the door, a lever connected on opposite sides of its fulcrum with the pistons of said dashpots and means connected with said lever for moving one of said pistons downward from its uppermost position and the other upward from its lowermost position upon movement of the reciprocating device in one direction and vice versa when the mechanism operates to move the reciprocated device in the opposite direction.

6. In an apparatus of the character described, the combination of a power operated actuating mechanism, a pair of dashpots for cushioning the movements of the door having their cylinders supported parallel to one another in upright position and means for moving the pistons of said dashpots respectively in opposite directions simultaneously as the mechanism reciprocates.

7. The combination with power actuated reciprocating mechanism for reciprocating doors or other objects, of a pair of liquid dashpots for cushioning the movements of the door, pivotally supported in upright position on their closed ends substantially parallel to one another and each provided with a bypass near its lower end, and a lever connected at opposite sides of its fulcrum to the piston rods and provided with means for actuating it from the door or other object when the same is moved in either direction whereby one piston is moved downward into the checking zone of a bypass while the other is moved upward from its lowermost position and vice versa.

8. The combination with power actuating mechanism for reciprocating doors or other objects, of two dashpots acting respectively on the opening and closing movements and having respectively different checking actions so as to speed up the opening as compared with the closing movement.

9. The combination with means for applying power to open and close a door, a dashpot for checking the closing movement and a dashpot co-acting with said door and means and adjusted to have a lesser effect than the first mentioned for checking the opening movement.

10. The combination with power actuated means for operating a door or the like, of two dashpots operatively connected with the power-actuated means and door and operating to check respectively the opening and closing movements and means for regulating the checking action of said dashpots independently of one another.

11. The combination with a reciprocating actuating device for producing movement of a door or the like both backward and forward of two dashpots operatively connected with said actuating device and with the door for checking respectively the forward and backward movements and each provided with a regulable bypass regulable independently of that for the other.

12. The combination with mechanism for actuating doors to cause them to reciprocate under applied power, of two dashpots operatively connected with said actuating mechanism and acting respectively to check the opening and closing movements, said dashpots being adjusted or regulated to permit a movement in one direction at a higher speed than the movement in the other.

13. The combination with pneumatic actuating means for moving a door in both directions, of two dashpots operatively connected with said actuating means for cushioning the movement of the door respectively in the opening and closing movements and a plurality of regulable bypasses for each dash.
spot applied to act at consecutive stages of movement of the door and independently regulable.

14. The combination with means for moving a door or other object, application of pneumatic power to said piston of a liquid dashpot acting to cushion the door near the completion of the movement and provided with a plurality of regulable bypasses regulable independently and acting respectively at consecutive stages of the movement.

15. In an apparatus of the character described, the combination with power operated controlling means for moving a door or other object, of a liquid dashpot acting to check said movement and provided with a plurality of regulable bypasses regulable independently and acting respectively at consecutive stages of the movement.


CLIFFORD NORTON.
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14. The combination with means for moving a door or other object, application of pneumatic power to said piston of a liquid dashpot acting to cushion the door near the completion of the movement and provided with a plurality of regulable bypasses applied to act at consecutive stages of the movement and independently regulable.

15. In an apparatus of the character described, the combination with power operated controlling means for moving a door or other object, of a liquid dashpot acting to check said movement and provided with a plurality of regulable bypasses regulable independently and acting respectively at consecutive stages of the movement.


CLIFFORD NORTON.

Certificate of Correction.

It is hereby certified that in Letters Patent No. 1,578,678, granted March 30, 1926, upon the application of Clifford Norton, of New York, N. Y., for an improvement in "Pneumatic Door-Operating Mechanisms," errors appear in the printed specification requiring correction as follows: Page 5, line 91, claim 9, strike out the word "of"; page 5, lines 5 and 6, claim 14, strike out the words "application of pneumatic power to said piston"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of December, A. D. 1926.

M. J. MOORE,
Acting Commissioner of Patents.
Certificate of Correction.

It is hereby certified that in Letters Patent No. 1,579,675, granted March 30, 1926, upon the application of Clifford Norton, of New York, N. Y., for an improvement in "Pneumatic Door-Operating Mechanisms," errors appear in the printed specification requiring correction as follows: Page 5, line 91, claim 9, strike out the word "of"; page 6, lines 5 and 6, claim 14, strike out the words "application of pneumatic power to said piston"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 14th day of December, A. D. 1926.

[SEAL]

M. J. MOORE,
Acting Commissioner of Patents.