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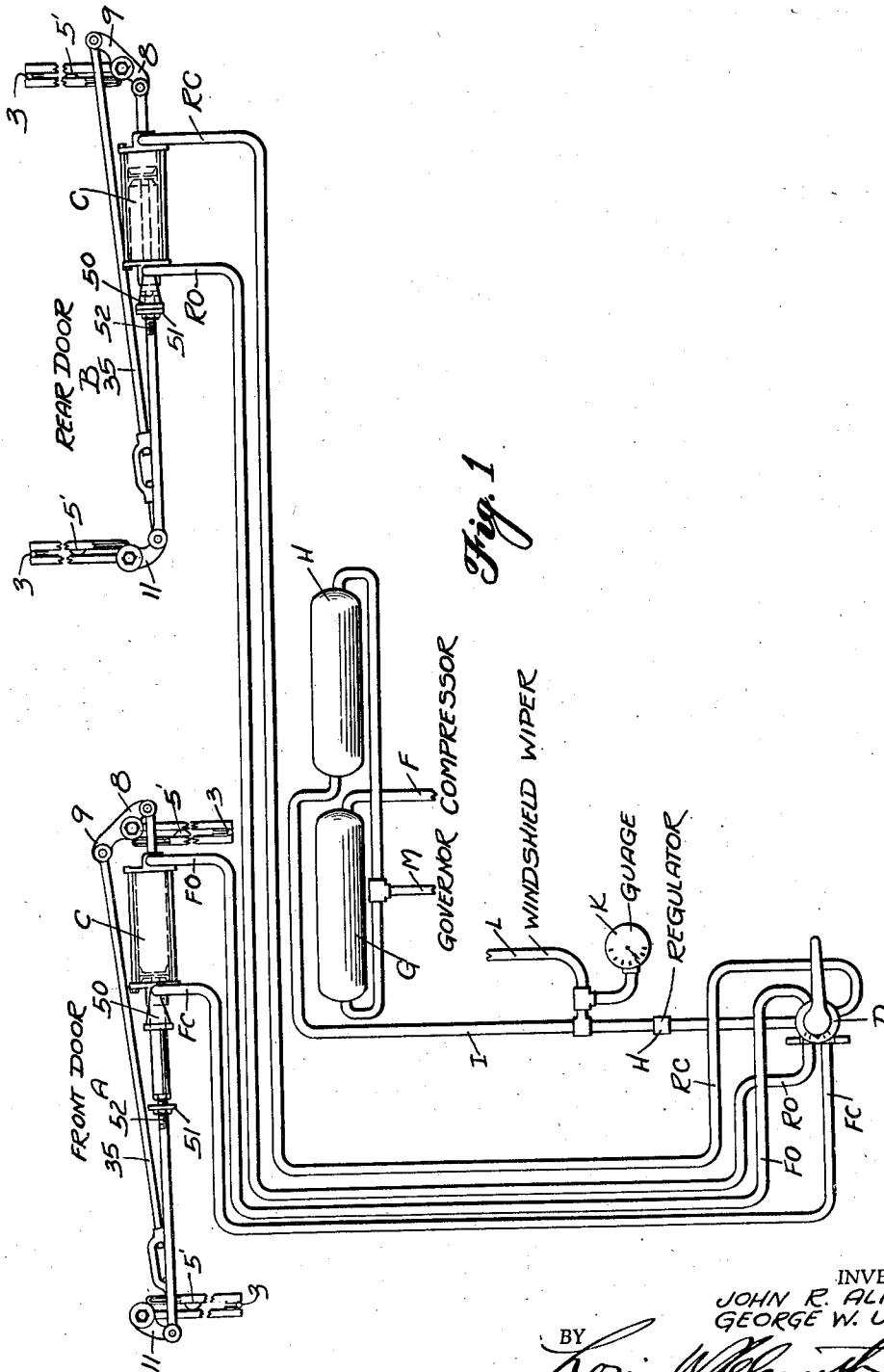
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BUS DOOR OPERATOR

Filed April 30, 1940

2 Sheets-Sheet 1



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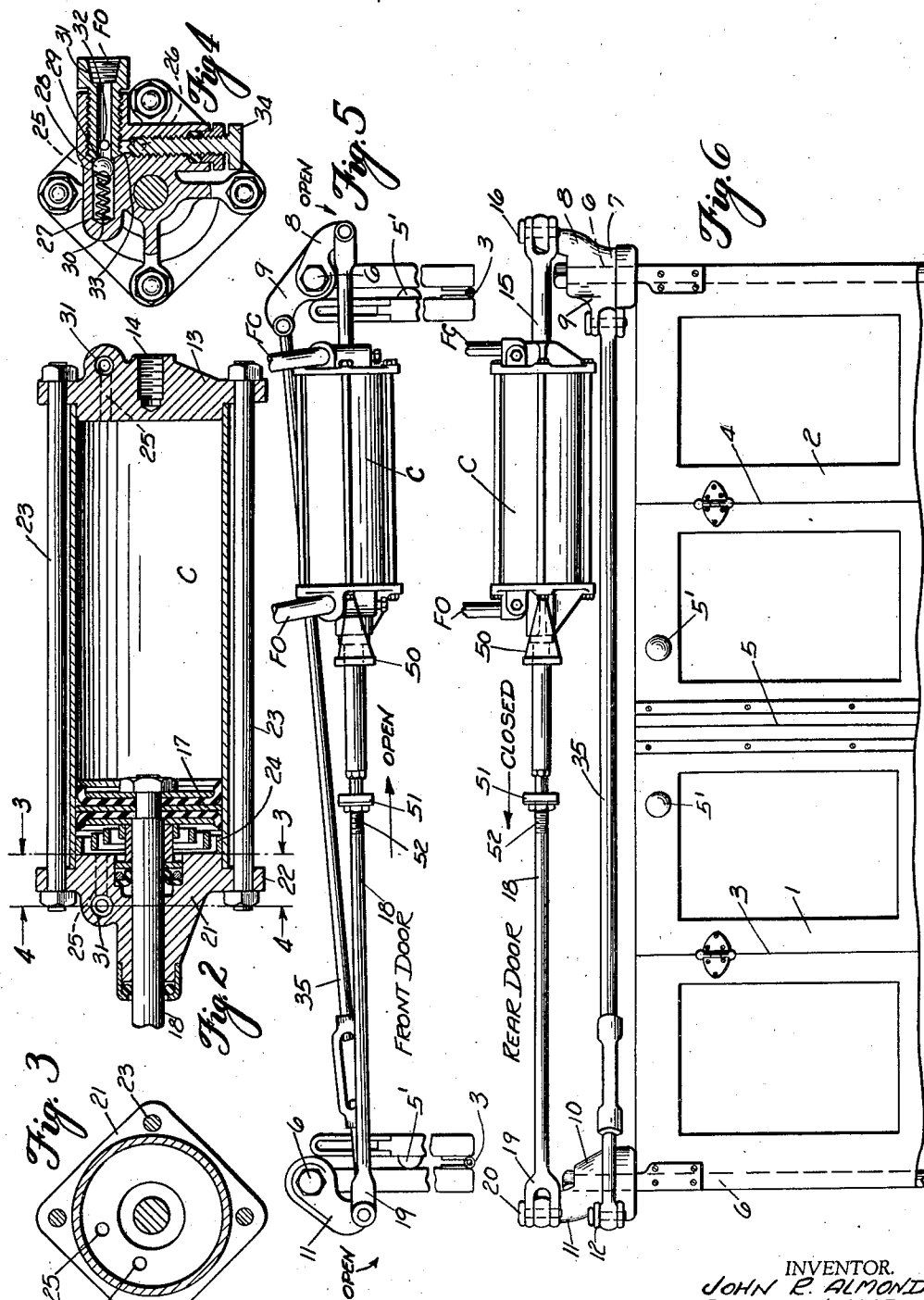
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BUS DOOR OPERATOR

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Application April 30, 1940, Serial No. 332,490

11 Claims. (Cl. 268—64)

This application is a continuation in part of our copending application Serial No. 160,304 filed August 27, 1937 and the invention relates to new and useful improvements in bus door operators and more particularly to operators for twin leaf doors for the front and rear doorways of passenger busses of the automotive type.

An important object of the invention is to provide a simple and effective linkage mechanism for operating a pair of such twin leaf doors with a bodily movable floating operating cylinder.

Other objects and advantages of the invention will become apparent during the course of the following description.

In the accompanying drawings forming a part of the application and wherein like numerals are employed to designate like parts throughout the several views,

Fig. 1 is a piping diagram of the apparatus,

Fig. 2 is an enlarged longitudinal section of the door operating cylinder or engine,

Figs. 3 and 4 are transverse sectional views of the same taken on the lines 3—3 and 4—4 of Fig. 2.

Fig. 5 is a top plan of a single pair of front doors illustrating the association of door linkage and cylinder mounting.

Fig. 6 is a front view of the same linkage of rear doors in closed position.

Referring now to the drawings and more particularly to the piping diagram in Fig. 1, the letter A designates the front door mechanism of the bus and the letter B are rear door operating mechanism adapted to be operated by compressed air or any other suitable fluid medium such as hydraulics or the vacuum obtained from any suitable source. Each door operating mechanism includes a power cylinder and piston C, the former having opposite ends piped to a control valve D, in such a manner that each end of the cylinder serves as intake and exhaust, alternately, during the operation of the cylinder C or door engine. The piping from the door engine to the control valve, which is located in a convenient place for the operator or driver of the bus is designated by legends indicating the position of the doors A and B, assuming that fluid medium is passing through the piping to the door engines. For example, the piping from the control valve D to the forward end of the front door engine C is marked with the legend FO which means front doors open, when the fluid medium under pressure enters the left hand side of the cylinder C. The pipe from the opposite end of the cylinder to the control valve is marked FC, designating front doors

closed as when fluid medium under pressure enters the right hand end of the cylinder and exhausts through the piping FO to the valve D at the left end of the cylinder.

The pipe from the forward end of the rear door engine C is designated RO, meaning, rear doors open, as when fluid under pressure enters the left hand end of the rear door engine C and exhausts through the pipe designated RC on the right hand end of the cylinder. This RC designation means, rear doors closed when fluid medium enters the cylinder at the right end through pipe RC and is exhausted from the cylinder through the pipe RO at the left end of the cylinder. This piping from the door engines to the control valve is connected to the latter in a novel manner as will be hereinafter described, for purposes of enabling the bus driver or operator to operate the front and rear doors of the bus with agility and the least possibility of error.

Fluid medium under pressure is delivered from a compressor, not shown, in the present instance to a pipe F into a primary reservoir G and then into a secondary reservoir H, from whence the air under pressure travels through pipe I and pressure regulator H into the control valve D. The pressure gauge may be branched from pipe I and a pipe L may lead from this branch to a windshield wiper or other adjunct operated by the fluid medium on the motor vehicle. The governor control is connected to the reservoir piping at a suitable point by the pipe M in order that predetermined pressure may be maintained in the reservoirs.

Referring to Sheet 2 containing Figs. 2 to 6 inclusive, the door operating mechanism is illustrated in detail. Referring more particularly to Fig. 6, a pair of twin leaf doors 1 and 2 hinged respectively at 3 and 4 with their free swinging edges along the line 5, are each mounted upon a door post 6 arranged at opposite sides of the doorway so that in swinging open, each twin door hinges along the hinge lines 3 and 4 with the outer panel folding back against the inner panel and the inner panel hinging on the post so that both doors or panels open flat against the respective sides of the doorway as shown in Fig. 5. The face of the outer panel which comes next to the inner panel of the door when the door is opened, is provided with rubber buttons 5' to engage the inner panel as shown in Figs. 1 and 5. The upper ends of these door posts 6 are arranged within the usual compartment found in street cars and busses above the doorway and secured to the upper end of the right hand post is a

double crank casting having crank arms 8 and 9 extending substantially diametrically therefrom on opposite sides of a straight line connecting the axes of the two posts. Secured to the upper end of the left hand post 6 is a crank casting 10 having a pair of crank arms 11 and 12 extending radially in the same direction to one side of said straight line as best appreciated from Figs. 5 and 6.

As both door operating mechanisms are identical, a description of one will suffice for both. The right hand of each door engine C is closed by closure 13 having a central threaded aperture 14 therein to receive the threaded end of a rod or link 15 terminating in a forked end, to pivotally straddle and be connected to the upper crank arm 8 by means of pivot pin 16. A piston head 17 operating in the cylinder C is packed as shown to hold a pressure at either side and is carried by a piston rod 18 of adjustable length and terminates at its outer end in a fork 19 to be pivotally connected to the upper crank arm 11 of the left hand twin door by means of the pivot pin 20 on the same side of the straight line connecting the post axes as the crank 8. To floatingly support the cylinder C and piston without sagging from a straight line connecting the posts, the piston rod passes through a packing in an extended bearing in head 21 at the left hand end of the door engine cylinder C and both heads 13 and 21 of each cylinder are provided with four laterally projecting apertured ears 22, through which extend clamping bolts 23 for securely fastening the heads to the cylinder. This disposes the axes of the piston and cylinder parallel with the straight line connecting the posts. A flat coiled buffer compression spring 24 of conical shape is disposed between the piston head 17 and one end of the cylinder to cushion door opening movements and to normally serve in urging the piston rod to door closed position. This spring 24 when completely uncoiled and relieved of all tension, as when the doors are closed, extends to a point substantially less than the medial portions of the cylinder so that its smaller end is in position to abut the piston as it moves to door opening position while the larger end of the spring abuts against the end head, to be compressed therebetween as the doors move to open position under the influence of compressed air entering the cylinder C at the right hand end thereof.

As the front doors open in and the rear doors open out, the stop springs 24 are disposed in corresponding ends of the front and rear door cylinders C so as to cushion and stop the front doors in their opening movements and the rear doors in their closing movements. To relieve the hinges 3 and door headers from excessive strains, stops are provided to stop or limit movements of the doors. A stop bracket 50 is arranged axially of each piston rod 18 and is secured to the end cap 21 with the same nuts which are positioned on the rods 23 for holding the end caps on the cylinder. An adjustable stop collar 51 with a rubber bumper is adjustably mounted on the threaded portion 52 of each rod 18 so that it can be adjusted lengthwise thereof to abut the bracket 50 when the front doors close and the rear doors open in order to limit movement of the doors.

Each head 13 and 21 as shown in Figs. 3 and 4 is provided with a pair of ports 25 and 26 communicating with the interior of the cylinder C. the uppermost port 25 also communicating with a ball check valve chamber 27 having a valve seat 28 upon which is normally seated a ball valve

29 urged to seating position by a coil spring 30. Beyond this seat is a threaded plug 31 adapted to be connected to the pipe leading from the control valve, and its inner end is provided with a longitudinal bore and a transverse opening 32 communicating with a passage 31 leading to the lower port 26 into the cylinder. A needle valve 34 is threaded into the head to control the extent of opening of passage 33 in order to control the speed of movement of the exhaust from the right hand end of the cylinder through port 26 into passage 33 and thence into the threaded plug 31 back to the exhaust passage of the control valve. With this arrangement, air entering the plug 31 will unseat the ball valve 29 to pass into the right hand end of cylinder C through both ports 25 and 26 but when this end of the cylinder exhausts, air from the cylinder seats the ball check valve 29 so that it can only escape from the cylinder through the passage 26 past the needle valve and thence into the plug and back into the control valve. By this means, the speed of opening and closing movements of the doors can be accurately controlled.

Since the door engine or power cylinder C of each door operating mechanism is totally suspended by the links 15 and 18, there is a possibility of one door sticking or moving slower than the other door of the pair. In order that the movements of both doors 1 and 2 will be simultaneous, an adjustable rod or link 35 has its ends pivotally connected to the lower cranks 12 and 9 of the door post castings so as to compel simultaneous movement of both of these doors.

The front and rear doors of the bus are normally held closed by the admission of air into the right hand ends of the door engines C, thereby causing these cylinders which are suspended, to move to the right of the figures while causing the piston rods 8 to move to the left of the Figs. 2, 5 and 6. To open the doors, the control valve is operated to admit air under pressure to the left hand ends of the cylinders C, thereby causing the piston rods 18 to move to the right, while the air in the right hand end of cylinders C is exhausting through the restricted needle valve opening and is conveyed back to the control valve to exhaust through the exhaust passages as will be evident.

From the foregoing, it will be apparent that a very simple mechanism has been provided for operating the front and rear doors of a motor vehicle with the minimum number of parts and without the necessity of providing a differential cylinder and piston construction as has heretofore been employed.

It will be understood that various changes in the shape, size and relation of parts may be resorted to without departing from the spirit of the invention or the scope of the appended claims.

We claim:

1. A door operating system including a doorway, a pair of hinged doors at opposite sides of the doorway, linkage connecting the doors, and a bodily movable cylinder and piston floatingly supported by the linkage for simultaneously a power opening and closing both doors, said linkage being rigid as a unit transversely thereof to prevent sagging of the cylinder relative to the linkage, and valve means for introducing pressure into or exhausting it from either end of said cylinder.

2. The combination with a pair of hinged doors, a pair of aligned rods connecting the doors and arranged in substantial alignment on one side of

a straight line connecting the axes of the hinged doors, a bodily movable cylinder rigidly connected to one rod, a piston in the cylinder rigidly connected to the other rod and serving to suspend the cylinder between the two rods, and a diagonal rod connecting the doors to cause their simultaneous positive movement in the same direction through 90 degrees, and valve means for introducing pressure into or exhausting it from either end of said cylinder.

3. A door operating system comprising a doorway, a pair of hinged doors, linkage connecting the same, a bodily movable cylinder and piston in self supporting floating suspension in the linkage for simultaneously operating both doors in the same direction, and means for normally supplying fluid under pressure to one end of the cylinder for closing said doors and holding the doors in closed position, for exhausting said end of the cylinder and for supplying the fluid under pressure to the opposite end of the cylinder for simultaneously opening both doors.

4. The combination of a pair of hinged doors mounted upon spaced vertical oscillatable posts, a crank arm secured to the upper end of each post and extending on the same side of a straight line connecting the axes of the posts, a link structure supported between the crank arms and including a cylinder having a rod fixed thereto and pivotally connected to one of said arms, a piston in said cylinder, and a piston rod slidably mounted in one end of the cylinder and pivotally connected to the other crank arm for suspending the cylinder and piston above the doors and between said arms in said link structure with the axes of the cylinder substantially parallel with said line to cause the doors to swing simultaneously in the same direction through 90 degrees, a second pair of crank arms secured to the upper ends of the two posts, one of said last named arms extending in a diametrically opposite direction to the first named crank arm and extending to the opposite side of said line, a link pivotally connected to said second pair of crank arms and extending in a horizontal plane below that of the cylinder and valve means for introducing fluid pressure to or exhausting it from either end of the cylinder for simultaneously operating the door posts in opposite directions to open or close the doors with fluid pressure.

5. The combination with a pair of hinged doors adapted to be swung simultaneously in the same direction on a pair of posts, a crank arm secured to each post for turning the same upon its axis, a rod connected with each crank, a bodily movable double acting operating fluid medium cylinder rigidly connected to one rod, a piston in said cylinder rigidly connected to the other rod, said rod connections with the cranks, cylinder and piston forming the sole support without other assistance to floatably suspend the cylinder and piston between the two rods and to cause their movement in a straight line without sagging tendencies between the cylinder and piston, and said cylinder being ported for the admission and exhaust of a fluid medium from opposite ends thereof, whereby the piston and cylinder are simultaneously relatively moved in opposite directions and the fluid medium constitutes the sole force for opening and closing the doors simultaneously in the same direction.

6. The combination with a pair of hinged doors adapted to be swung simultaneously in the same direction on a pair of vertical oscillatory posts, a crank arm secured to the upper end of each post

above the doors for turning the same upon their axes, a rod pivotally connected with each crank, a double acting operating fluid medium cylinder rigidly connected to one rod and closed at both ends, a piston in said cylinder rigidly connected to the other rod, said cylinder having a bearing in its end for slidably mounting the piston rod and assuring its axial movement relative to the cylinder, said rod connections with the cranks, cylinder and piston forming the sole support without other assistance to floatably suspend the cylinder and piston between the two rods and cause their relative movement without sagging tendencies between the cylinder and piston, and said cylinder being ported for the admission and exhaust of a fluid medium from opposite ends thereof whereby the piston and cylinder are simultaneously moved relatively in opposite directions and the fluid medium constitutes the sole force for opening and closing the doors simultaneously in the same direction.

7. The combination with a pair of hinged doors; of a bodily movable fluid medium cylinder and means for supplying fluid under pressure to either end thereof for opening and closing said doors, a pair of closure caps for opposite ends of said cylinder, a rod rigidly connected to one of said caps and pivotally connected with one of said doors, said other cap having an extended bearing, and a piston in said cylinder having a piston rod slidably mounted in said extended bearing and pivotally connected to the other door, said rods forming the sole support of the cylinder whereby it is caused to move bodily without sagging as the fluid medium under pressure is admitted to either end of the cylinder.

8. The combination with a pair of hinged doors; of a fluid medium cylinder and means for supplying fluid under pressure to either end thereof for opening and closing said doors, a pair of closure caps for opposite ends of said cylinder, each cap being provided with intake and exhaust ports, one of said caps having a threaded recess and the other having an extended bearing, a rod having one end threaded into said threaded recess and its other end pivotally connected with one of said doors, a piston in said cylinder having a piston rod slidably mounted in said extended bearing and pivotally connected to said other door, said rods forming the sole support of the cylinder whereby it moves bodily without sagging as the fluid medium under pressure is admitted to either end of the cylinder.

9. The combination with a pair of vertical oscillatory posts, a door secured to each post, means for simultaneously swinging both door posts and doors in the same direction to open and close the same, said means comprising a linkage extending substantially parallel to a straight line drawn through the axes of said posts and including a bodily movable fluid medium cylinder and piston rod with their common axis on the same side of said straight line, said cylinder being closed at both ends, crank arms secured to the posts and extending in the same direction toward said straight line, said linkage connecting the crank arms on the same side of said straight line, and valve means for normally supplying fluid under pressure to one end of the cylinder for closing and holding the doors in closed position and for exhausting said end of the cylinder and supplying the fluid under pressure to the opposite end of the cylinder for simultaneously opening both doors in the same direction, solely by means of said fluid pressure medium.

10. The combination of a pair of hinged doors mounted upon spaced vertical posts, a pair of horizontal arms secured to the posts and having their free ends extending on opposite sides of a straight line drawn through the post axes, a diagonal rod crossing said line and having connection with said arms, a fluid medium cylinder having a double acting piston connected to one of said arms for power operating said doors to open and close the same, and valve means for supplying fluid under pressure to the cylinder for simultaneously operating the doors in the same direction solely by means of said fluid pressure.

11. A door operating system comprising a doorway, a pair of hinged doors, a bodily movable fluid medium cylinder and piston, and means for

supplying and exhausting fluid under pressure to and from either end thereof for opening and closing said doors, a pair of closure caps for opposite ends of said cylinder, each cap provided with intake and exhaust ports, said floating cylinder having one end pivotally connected with one of said doors, a piston in said cylinder having a piston rod slidably mounted in the other cap and pivotally connected to said other door, and means for controlling the supply or exhaust of fluid medium to and from either end of the cylinder for simultaneously swinging both doors in opposite directions to simultaneously open or close both doors.

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