May 6, 1947. J. R. NEWKIRK 2,419,964

SPRING RETURN PUSH DOOR WITH DOOR LOCK

Filed Feb. 27, 1945 3 Sheets-Sheet 1

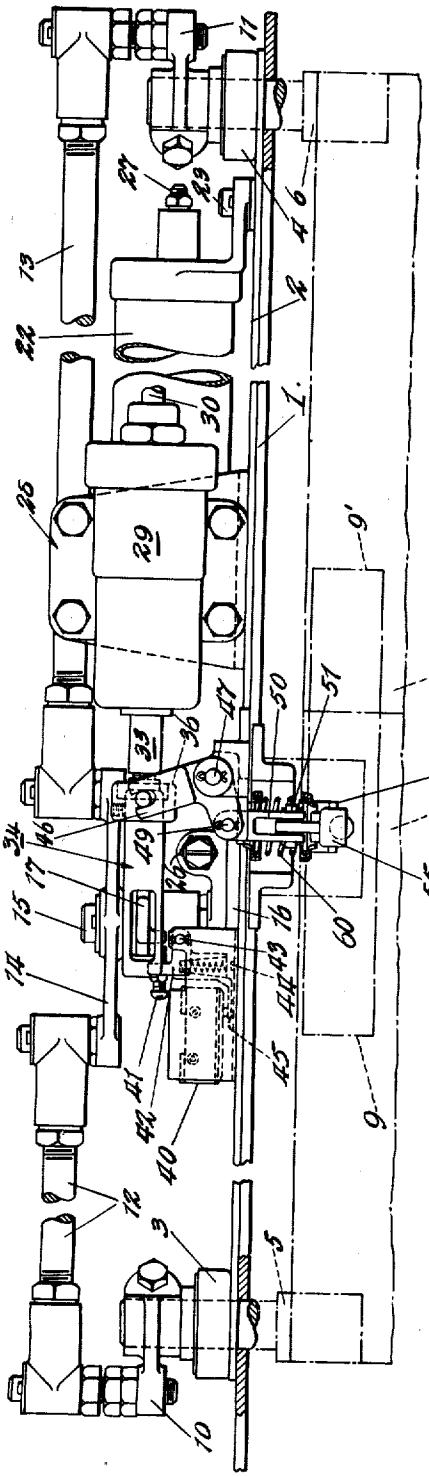


Fig. 1.

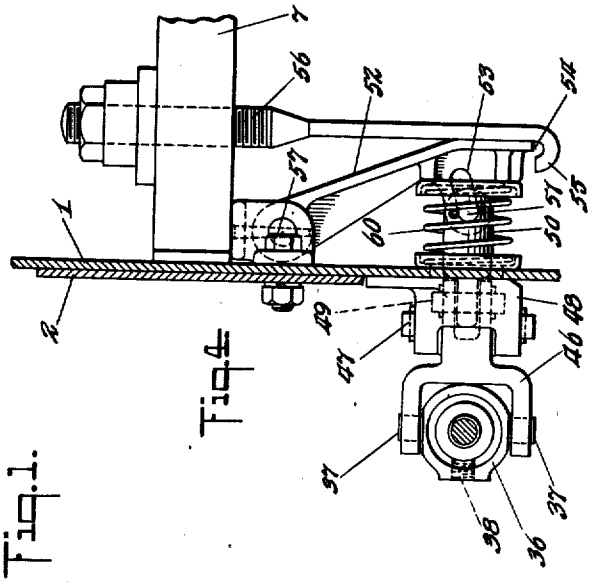


Fig. 4.

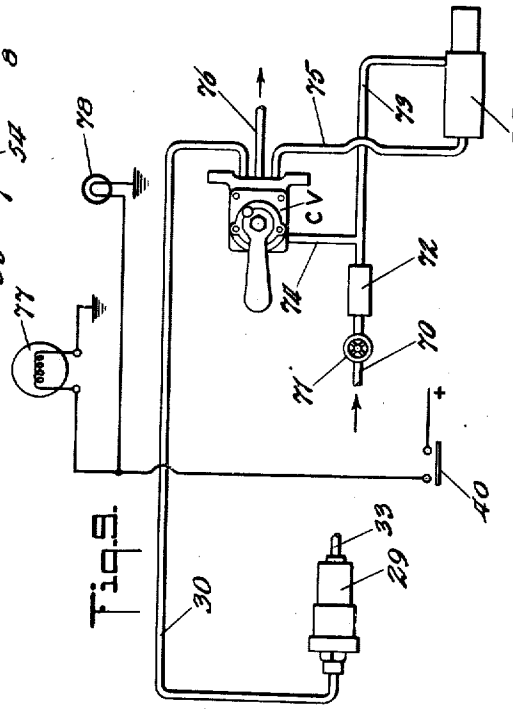


Fig. 3.

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Filed Feb. 27, 1945 3 Sheets-Sheet 2

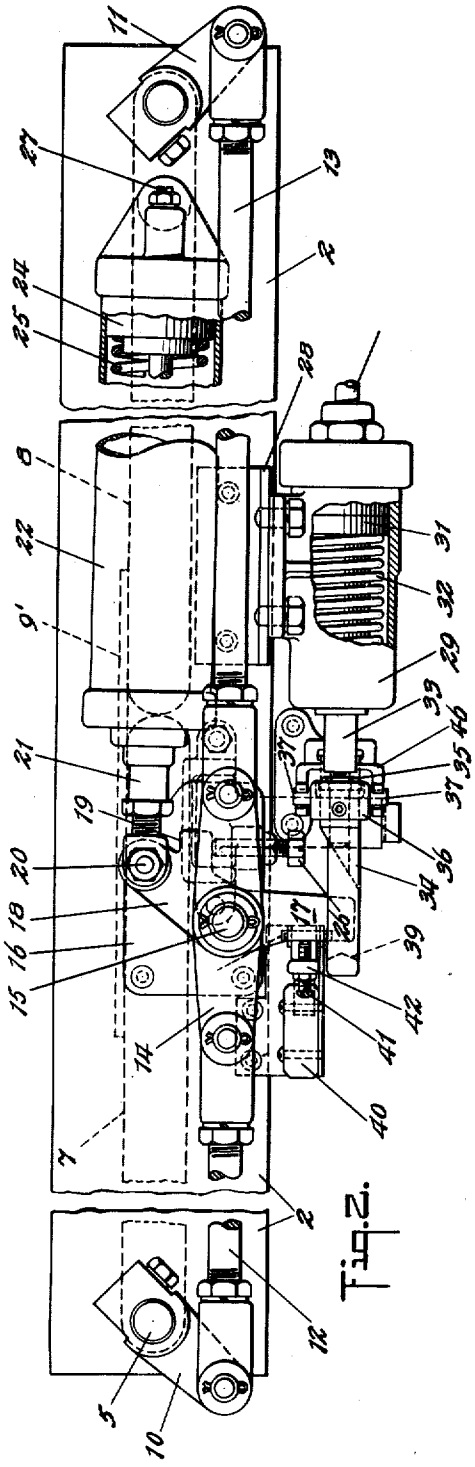


Fig. 2.

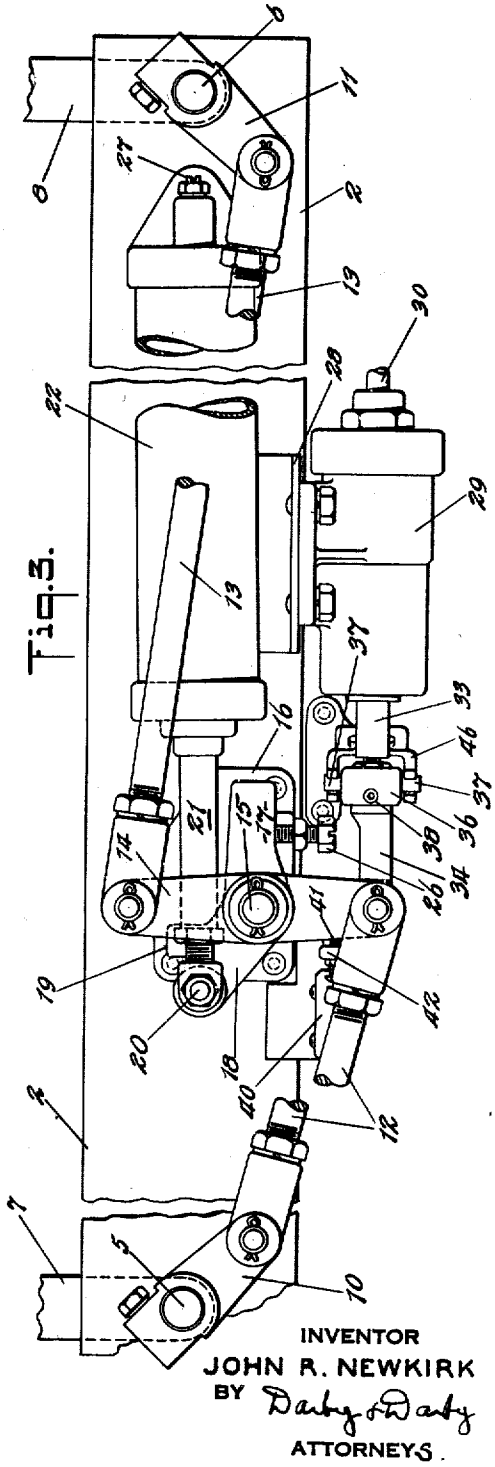


Fig. 3.

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SPRING RETURN PUSH DOOR WITH DOOR LOCK

Filed Feb. 27, 1945 3 Sheets-Sheet 3

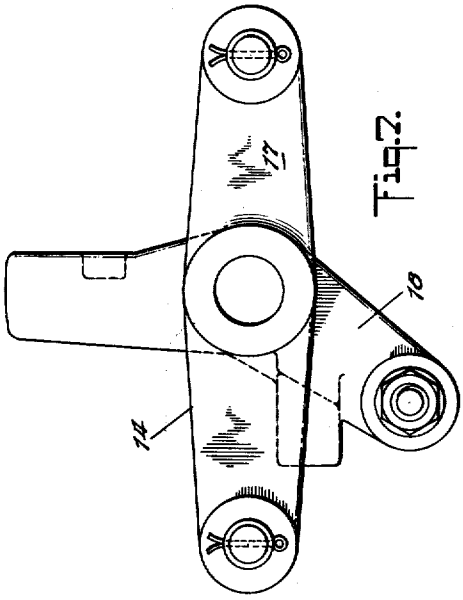


Fig. 2.

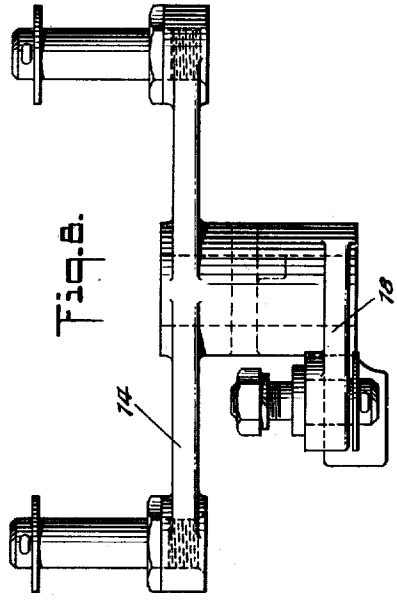


Fig. 4.

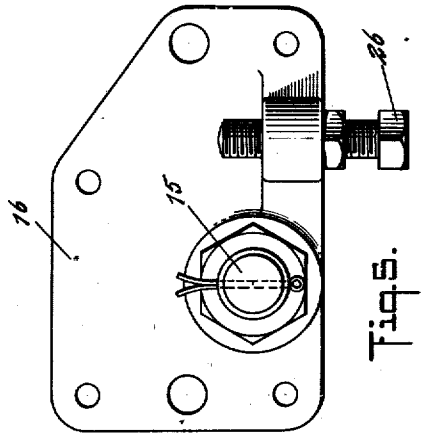


Fig. 5.

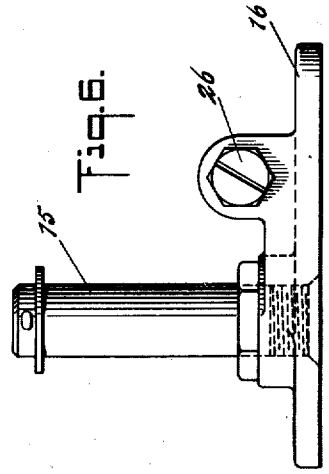


Fig. 6.

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UNITED STATES PATENT OFFICE

2,419,964

SPRING RETURN PUSH DOOR WITH DOOR LOCK

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Application February 27, 1945, Serial No. 579,971

14 Claims. (Cl. 292—1)

1

This invention relates to a door operating mechanism for the rear doors of motor buses, street cars and the like.

The main object of this invention is to provide an automatically operating lock for a door operating apparatus of the type disclosed in my United States Patent No. 2,259,579, granted October 21, 1941.

Other and more detailed objects of this invention will be apparent from the following description when taken in connection with the attached drawings, and as defined in the appended claims.

This invention resides substantially in the combination, construction, arrangement and relative location of parts, all as will be described in detail below.

In the accompanying drawings,

Figure 1 is an elevational view of the mechanism of this invention, showing the upper portion of a rear door, looking at the mechanism from the inside of the vehicle to which it is applied, with the apparatus in door closed position;

Figure 2 is a top plan view of this mechanism with the parts in door closed position;

Figure 3 is a top plan view of the mechanism with the doors in fully opened position, showing that the doors open outwardly of the vehicle;

Figure 4 is an enlarged end elevational view of the lock structure with some parts broken away;

Figures 5 and 6 are top plan and side elevational views of a structural detail comprising the mounting bracket for the lever of Figures 7 and 8;

Figures 7 and 8 are top plan and side elevational views of the lever mechanism for interconnecting the door shafts with the spring return motor for closing the doors; and

Figure 9 is a diagrammatic and schematic view illustrating one mode of operation of the apparatus.

The subject matter of this invention is for use on so-called one-man operated vehicles such as motor buses, street cars, and the like, on which boarding and alighting facilities are provided which include a so-called rear door exit remotely positioned with respect to the vehicle operator, and, therefore, not under his close observation. The subject matter of this invention is related to a door operating mechanism for the rear door of vehicles of this type, which makes provision for locking the doors in closed position and interlocking them with the operation of the front door of the vehicle, the motive power control for the vehicle and/or the brakes for the vehicle, so that

2

the door is locked in closed position and unlocked when the vehicle is at rest.

It is common practice today to employ, and the subject matter of this invention is concerned with, a rear door operating mechanism of the type by which, when the door is unlocked, the door may be pushed open by a person desiring to leave the vehicle. The act of pushing the door open loads a spring return motor which returns the door to closed position after the alighting passenger releases it. It is usual, in such a system, to provide a mechanism for automatically locking the doors in closed position, after they are returned to that state by the spring return motor.

Such a system is disclosed in my above mentioned patent, as here. However, the said patent does not include, as does this disclosure, a mechanism for preventing the doors from being inadvertently opened, and thereby creating the possibility of an accident should a person be leaning against the doors when they are unlocked by an act of the vehicle operator of the type above described. In the system of my patent, when the doors are unlocked by such an act of the vehicle operator, they can swing open if a passenger is leaning against them, tending to tumble him into the street. My herein disclosed improvement prevents the doors from opening if anyone is leaning against them, but leaves them free to be pushed open if, at the time they are unlocked, there is no pressure on them.

In order to have a full understanding of the improvement herein disclosed, a considerable portion of the mechanism of my above mentioned patent has been duplicated, although there is some rearrangement of the elements thereof.

The detailed embodiment of the invention as illustrated in the attached drawings will now be described. The mechanism of Figure 1 is in elevation as viewed from the inside of the vehicle. The support or plate 1 comprises a part of the vehicle body structure or a special support mounted therein above the rear door opening. Mounted upon this support is a plate 2 for in turn supporting the various elements of the combination of this invention. A pair of bearings 3 and 4 are mounted on the plate 2 and are positioned to provide rotatable supports for the upper ends of the pintles 5 and 6 attached to the upper corners of the door leaves 7 and 8 which are similarly supported at the bottom in the floor or doorstep well. Thus the door leaves 7 and 8 may rotate about their outer vertical edges, from the door closed position shown in Figure 2, to the

door open position of Figure 3, by swinging outwardly of the vehicle body. On the outer face of the door leaf 7 near the top edge, is a plate or bar 9 secured thereto so as to project beyond its free edge and overlie for a short distance the outer face of the door leaf 8, as indicated by the portion 9' thereof. If desired, a similar bar can be used at the bottom of the door leaves, attached to the leaf 7 and overlying the leaf 8. The function of this bar will be described later.

Secured to the upper ends of the pintles 5 and 6, in any suitable manner, are the short levers 10 and 11 respectively which in turn are pivotally connected to the links 12 and 13 respectively. The free ends of the links 12 and 13 are pivotally connected to the ends of a teetering bar 14 which forms part of a single casting clearly illustrated in detail in Figures 7 and 8. The teetering bar 14 is provided with pivot pins, as shown, on which the ends of the links 12 and 13 are pivotally mounted.

The compound lever structure or single casting of Figures 7 and 8 is pivotally mounted on a pivot pin 15, which is in turn mounted in a plate 16 attached to the base plate 2. This structure is clearly illustrated in Figures 5 and 6. The unitary lever casting includes in addition to the teetering bar 14 the lever 17 extending at right angles thereto, the lever 18 extending at an acute angle thereto and having a lateral projection 19. The lever 18 has mounted therein a pivot pin 20. These various levers are united by a hub which is rotatably mounted on the pivot pin 15.

The end of a piston rod 21 is pivotally connected with pin 20. Rod 21 extends into a cylinder 22 which is pivotally mounted, at one end, on a pivot pin 23 (see Fig. 1), in turn mounted on the base plate 2. Within the cylinder 22 is a piston 24, and between it and the end cap through which the piston rod 21 slides is a suitably proportioned compression spring 25. Spring 25 is related to piston 24 to move it in the door closing direction. The cap at the end of the cylinder 22 opposite the spring-retaining cap is provided with an adjustable air escape port 27 to cushion or control the rate of return movement of the piston 24 under the action of spring 25 in the door closing direction.

Mounted on the base plate 2 is a bracket 28 to which is secured a locking cylinder 29 within which, as shown, is a piston 31 attached to a piston rod 33. A spring 32 lies between the piston and the end of the cylinder to resist the movement of the piston in air operated direction. A compressed air supply pipe 30 from any suitable source supplies air to the locking cylinder 29, as will be described later.

Adjustably secured to the projecting end of the locking cylinder piston rod 33 is a clevis 34 on which in turn a collar 36 is mounted and locked thereon by means of a set screw such as an Allen screw 38. As is clear from Figure 2, the piston rod 33 has a reduced threaded end which is received in a threaded recess in the end of the clevis 34 and is locked in adjusted position by means of a lock nut 35. The collar 36 has a pair of radially opposed pivot pins 37 which cooperate with a yoke 46 which will be referred to later.

The clevis 34 has an opening therethrough shaped as indicated by the dotted lines in Figure 2; the lever 17, lies in the position of the parts in Fig. 2, and extends into that opening. In that position, a lateral projection 19 on the lever 18 cooperates with an adjustable stop screw 26 mounted on the plate 16 (see Figs. 5 and 6). Lever 17 has a vertical projection on its end face (see Fig. 1), which cooperates with an adjustable machine screw 41 mounted on a lever 42 pivotally mounted at 43 on a bracket on the base plate 2. Mounted adjacent this lever is a microswitch 40 with its operating member projecting downwardly (see Fig. 1) for cooperation with an L-shaped extension 45 forming part of the lever 42. A compression spring 44 normally urges the lever 42 in a clockwise direction, which is the direction to close the microswitch 40. When the door is in closed and locked position, however, the lip on the lower face of the lever 17, through engagement with the screw 41, holds lever 42 in retracted position, comprising spring 44 so that microswitch 40 is open.

The yoke 46 previously referred to is pivotally mounted on a pivot pin 47 in a support on the base plate 2. The yoke 46 includes a laterally extending lever which is pivotally connected at 49 to a link 50 (see Fig. 4), which in turn is pivotally connected by pivot pin 51 operating in elongated slot 53 formed in the lateral extension of the locking lever 52. The lever 52 is pivotally mounted at 57 on the underside of the support 1. At this point it may be noted that Figure 4 should be rotated in a clockwise direction through an angle of 90 degrees to position it in conformity with the other figures. Thus, in Figure 4, one is looking towards the free edge of the door leaf 7; and the locking lever 52 extends generally parallel to the floor or roof of the vehicle, that is, at right angles to the top edge of the door. A spring 60 lies between the lever 52 and the adjacent part of the vehicle body formed so as to normally urge the lever 52 in a counterclockwise direction (Fig. 4). Mounted near the upper right hand corner (Fig. 1) of door 7 is a rod 56 (Fig. 4) having the hooked end 55 for movement with the end 54 of the lever 52. It might be noted that Figure 4 shows the position of the parts with the doors closed, but with no pressure such as would result from a person leaning against the doors.

The structure of Figure 9 will be briefly described. It illustrates the use of the subject matter of this invention with the control system for the front door engine DE which is of the differential type. Pressure fluid from any suitable source is supplied through the pipe 70 which includes a shut-off valve 71 and an air strainer 72, to the engine DE at a point between the two pistons thereof in accordance with usual practice in this respect, and as illustrated in the above mentioned patent. Pressure fluid is also supplied from pipe 73 through a branch 74 to the door control valve CV. A pipe 75 extends from this valve to the larger cylinder on the engine DE. The pipe 76 is the exhaust pipe and the pipe 30 also extends from this valve to the door locking cylinder 29. The microswitch 40 is connected to the positive side of a suitably grounded current source, and to the brake interlock magnet valve 77 having one terminal grounded. The current supply lead for the magnet valve is also connected to a grounded signal light 78 which light is positioned adjacent the vehicle operator's station.

In order to understand a description of the operation of this system it will be understood that the mechanism as shown in Figure 2 will be in the position illustrated therein when the doors are closed and locked. The doors are locked in closed position by reason of the fact that the teetering bar 14 and the links 12 and 13 all lie in a straight line forming a locking toggle linkage

system. This position of these parts is assured by the fact that upon the previous closing of the doors the spring 25 acts to move the teetering bar 14 in a clockwise direction until the projection or lug 19 engages the adjustable stop screw 26, in which position it is shown in Figure 2. The compression spring 25 in the cylinder 22 is urging the parts in this direction so that the teetering bar 14 is held in locking position in cooperation with the stop screw 26. At this time pressure fluid is being supplied to cylinder 29 through the pipe 30, so that the clevis 34 is in the position shown in Figure 2.

Referring to Figure 9, pressure fluid is supplied from the source through pipe 70, branch 74 and through the valve CV to pipe 30, communication between branch 74 and pipe 30 being established when the valve is in the position shown. In this same position of the valve the left hand end of the large cylinder of the differential engine DE is connected through pipe 75 and valve CV to branch 74. Pressure fluid, of course, is supplied continuously from pipe 70 through the pipe 73 to the right hand end of the engine in accordance with usual practice, and under these conditions the front door of the vehicle is closed.

While the front door engine as herein described is of the differential type, it will, of course, be apparent to those skilled in the art that any other suitable type of air operated engine can be employed for the front door without affecting the rear push door operation.

When the vehicle operator brings the vehicle to a stop by applying the brakes, he moves the operator of valve CV to a position to disconnect pipe 75 from branch 74 so that pressure fluid is exhausted from the left hand end of the large cylinder of engine DE through pipe 76 to cause the front door to open. In this position of the valve, communication between branch 74 and pipe 30 is maintained, so that the rear door remains locked. In order to unlock the rear door, the vehicle operator moves the handle of valve CV to another position which does not disturb the connection between branch 74 and pipe 75, but does break the connection between branch 74 and pipe 30, connecting the latter to the exhaust pipe 76. Thus the front door remains open and the cylinder 29 is exhausted. Spring 32 in this cylinder pushes piston 31 to the right, carrying clevis 34 with it. This clevis engages the lever 17 and moves it in a counterclockwise direction a short distance, so that the teetering bar 14 is moved out of the straight line alignment with the links 12 and 13. The rear door leaves 7 and 8 are then normally free to be pushed open by hand so that a passenger may alight. As these door leaves are pushed open, spring 25 is compressed, and when the door leaves are released by the alighting passenger, spring 25 rotates the teetering bar 14 in a clockwise direction back to door closed position. This return movement is cushioned by the adjustable air exhaust port or speed plug 27.

It will be seen that if one or more passengers are leaning against the door leaves 7 and 8, when the locking cylinder 29 is open to exhaust so that the teetering bar 14 is moved out of alignment, without some provision for preventing it, the doors will push open and the passengers might easily fall out of the vehicle and be injured. This accidental operation is prevented by means of the locking arrangement shown in Figures 4 and 5.

At the time the cylinder 29 is open to exhaust

so that its piston 31 moves to the right, carrying piston rod 33 and clevis 34 with it, it will be seen (Fig. 1) that the L-shaped lever 46 extension 45 will be rotated in a clockwise direction, tending to rotate lever 52 (Fig. 4) in a clockwise direction, and move its end 54 out of the path of the hooked end 55 of the latching rod 56. However, it will be equally apparent that if someone is leaning against either of the door leaves 7 and 8, they will spring outwardly so that the hooked end 55 engages the end 54 of the lever 52. Thus the locking cylinder 29 cannot move far enough to cause the clevis 34 to engage the lever 17. Thus the door remains locked in closed position as long as this pressure is maintained on either of the leaves 7 and 8.

At this point it may be noted that pressure on leaf 8 has the same effect as pressure on leaf 7 because of the plates 9. If there is no pressure on either door leaf at the time that cylinder 29 is exhausted, the lever 52 will be moved in a clockwise direction out of the path of movement of the hooked end 55 (see Fig. 4), so that the operation of door opening as previously described may proceed in a normal manner. It will also be apparent that if there was pressure on the door at the time the cylinder 29 is exhausted, so that hooked end 55 engages end 54, that condition can be corrected simply by relieving the pressure on the door. The spring in the locking cylinder is continuing to tend to cause clockwise rotation of the lever 52, so that as soon as the pressure is taken off of either or both of the door leaves 7 and 8, they will spring back enough so that the hooked end 55 will release the cooperating end 54 of the lever 52 and it will be pulled to the left (Fig. 1). The doors may then be pushed open by hand.

As soon as the teetering bar 14 begins to move towards door open position the depending lug of lever 17 moves away from the adjustable screw 41, so that spring 44 can cause counterclockwise movement of lever extension 45 and close microswitch 40. As will be seen from Figure 9, the closing of microswitch 40 completes the circuit for the brake interlock magnet valve 77, so that air will be supplied directly to the brakes through the magnet valve to keep them applied even if the vehicle operator tries to release them. At the same time signal light 78 is energized, so that the operator knows the rear door is not closed and locked. It will be seen that the microswitch opens just as the rear door goes into fully closed and locked position, extinguishing the signal light and releasing the brake interlock, so that the vehicle is free to move.

The vehicle operator may close the front door at any time by moving the valve CV back to its original position, connecting pipe 75 to branch 74. At the same time air is applied to the cylinder 29 to return the connected parts to the position shown in Figures 1 and 2. This can occur even though the rear doors are still open, since lever 17 can swing into the position shown in Figure 2, with the clevis 34 in the position illustrated. At the same time, the mechanism, including the lever 52, returns to normal position shown in the various figures. This does not interfere with the closing of the rear doors because, as they move to closed position, the hooked or locking rod 56 engages the inclined face of lever 52 and forces it to the left (Fig. 4) against spring 60 so that the hooked end may pass back to the position shown in Figure 4. The slotted connection 53 is provided for this purpose, that is, to permit lever

52 to move to the left, even though the link 50 is held rigidly in the position shown in Figure 4, the assumption having been made, of course, that air is back on the locking cylinder 29. Spring 60 snaps the locking lever 52 back to normal position as the hooked end 55 passes off of the end of the locking lever.

Thus it will be seen that no condition can be created by the vehicle operator which will prevent the closing of the rear doors and the return of all parts to normal position. An important point, however, is that the rear doors may not inadvertently open under the weight of a passenger and throw him to the ground when the vehicle operator performs his normal operations of opening the front door and conditioning the rear door operating apparatus for opening these doors.

From the above description it will be apparent to those skilled in the art that the subject matter of this invention may be embodied in other physical forms, and I do not, therefore, desire to be strictly limited to the disclosure as given herein for purposes of illustration, but rather to the scope of the invention as defined in the appended claims.

What is claimed is:

1. In a door operating system, the combination including a door, a motive device for closing the door, a linkage system connecting the motive device with the door, said linkage system taking a position to lock the door when closed, motive means for moving the linkage system to unlocking position, said doors being then free to be pushed open, and means for preventing opening movement of the doors if they are under pressure when the linkage system is moved to unlocking position.

2. In the combination of claim 1, said means for preventing opening of the doors including a lever pivotally mounted adjacent the door and a cooperating member mounted on the door.

3. In the combination of claim 1, said means for preventing opening of the doors including a lever pivotally mounted adjacent the door and a cooperating member mounted on the door, and means interconnecting said pivotally mounted lever with said motive means to move it out of locking position if the doors are free of pressure when the linkage system is moved to unlocking position.

4. In a push door system of the type described, the combination including a pivotally mounted door, a motive device connected to the door for moving it to closed position while leaving it free to be pushed open, a linkage system connecting the motive device with the door and locking it in closed position, motive means for moving the linkage system out of locking position to release the door for opening movement, and means for preventing opening movement of the door if it is under pressure when so released.

5. In the combination of claim 4, said last means being actuated by said motive means to release the door for opening movement under its own pressure at that time.

6. In combination with a door, means tending to move the door to closed position, means for locking the door against movement out of closed position, and means for disabling the door locking means, the door, when the locking means is disabled, being movable by pressure directly thereagainst, and means for preventing such disabling if the pressure against the door was effective simultaneously with the energization of the disabling means.

7. In combination with a door, means tending to move the door to closed position, means for locking the door against movement out of closed position, and means for disabling the door locking means, the door, when the locking means is disabled, being movable by pressure directly thereagainst to open the door against the action of the means tending to move the door to closed position, and means for preventing such disabling if the pressure against the door was effective simultaneously with the energization of the disabling means.

8. In combination with a door, means tending to move the door to closed position including a linkage, the linkage including means for locking the door against movement out of closed position, and means for moving the linkage to disable it as door locking means, the door, when the locking means is disabled, being capable of being opened by pressure directly thereagainst and in opposition to the action of the means tending to move the door to closed position, and means for preventing such disabling if the pressure against the door was effective simultaneously with the energization of the disabling means.

9. In combination with a door, a lever for moving the door to open and closed positions, means for actuating the lever to move the door to closed position, the lever then assuming a position to lock the door against movement out of closed position, and means for moving the lever out of locking position, the door, when the lever is not in locking position, being capable of being opened by pressure directly thereagainst, and means for making the lever moving means ineffective if the pressure against the door was effective simultaneously with the energization of the lever moving means.

10. In combination with a vehicle having a door, control means for the vehicle, means tending to move the door to closed position, means for locking the door against movement out of closed position, and means for disabling the door locking means on actuation of the control means, the door, when the locking means is disabled, being movable by pressure directly thereagainst, and means for preventing such disabling if the pressure against the door was effective simultaneously with the actuation of the control means.

11. In combination with a door, means tending to move the door to closed position, means for locking the door against movement out of closed position, and means for disabling the door locking means, the door, when the locking means is disabled, being movable by pressure directly thereagainst, and means for preventing such disabling if the pressure against the door was effective simultaneously with the energization of the disabling means and until that pressure has first been removed.

12. In combination with a vehicle having a door, control means for the door, an auxiliary door, means tending to move the auxiliary door to closed position, means for locking the auxiliary door against movement out of closed position, and means for disabling the door locking means on actuation of the control means, the auxiliary door, when the locking means is disabled, being movable by pressure directly thereagainst, and means for preventing such disabling if the pressure against the auxiliary door was effective simultaneously with the actuation of the control means.

13. In combination with a vehicle having a door, control means for the door, an auxiliary

door, means tending to move the auxiliary door to closed position, means for locking the auxiliary door against movement out of closed position, and means for disabling the door locking means on actuation of the control means, the auxiliary door, when the locking means is disabled, being movable by pressure directly thereagainst, and means for preventing such disabling of the pressure against the auxiliary door was effective simultaneously with the actuation of the control means and until that pressure has first been removed.

14. In combination with a vehicle having a door, control means for the door, an auxiliary door, a lever for moving the auxiliary door to open and closed positions, means for actuating the lever to move the auxiliary door to closed position, the lever then assuming a position to lock the auxiliary door against movement out of closed position, and means for moving the lever out of locking position on actuation of the control means, the auxiliary door, when the lever is not in locking position, being capable of being opened by pressure directly thereagainst to open the auxiliary door against the action of the means tending to move the auxiliary door to closed position, and means for making the lever moving means ineffective if the pressure against the auxiliary door was effective simultaneously with the actuation of the control means and until that pressure has first been removed.

JOHN R. NEWKIRK.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,227,144	Krause	Dec. 31, 1940
2,259,579	Newkirk	Oct. 21, 1941

Certificate of Correction

Patent No. 2,419,964. May 6, 1947.

JOHN R. NEWKIRK

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows:

Column 4, line 15, for the word "comprising" read *compressing*; column 6, line 3, strike out the word and numeral "lever 46"; line 43, before the word "extension" strike out "lever";

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 26th day of April, A. D. 1949.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.