Sept. 29, 1931. H. ROWNTREE 1,825,129

DOOR OPERATING MECHANISM

Filed July 20, 1929 5 Sheets-Sheet 1

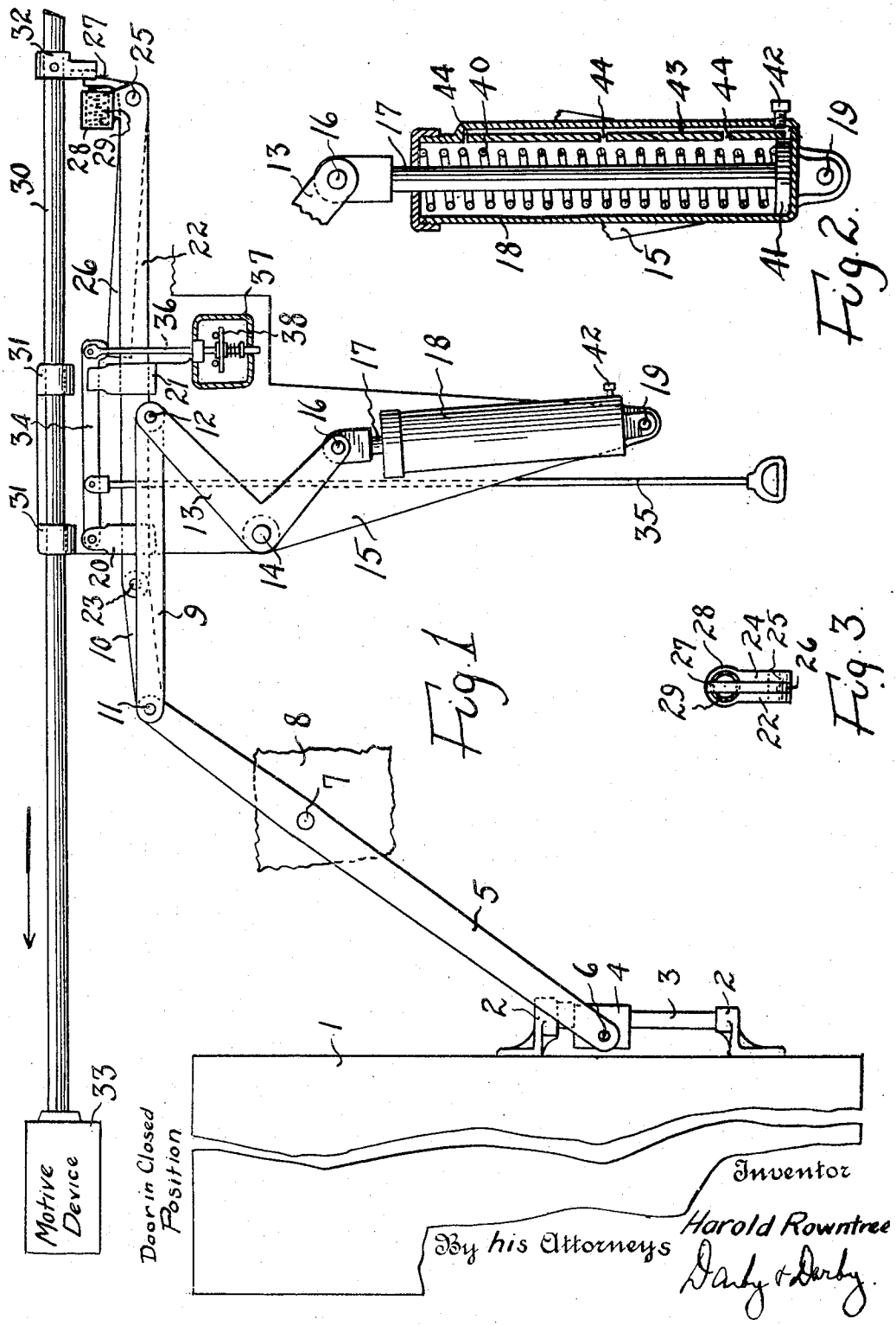


Fig. 1

Fig. 2.

Fig. 3

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DOOR OPERATING MECHANISM

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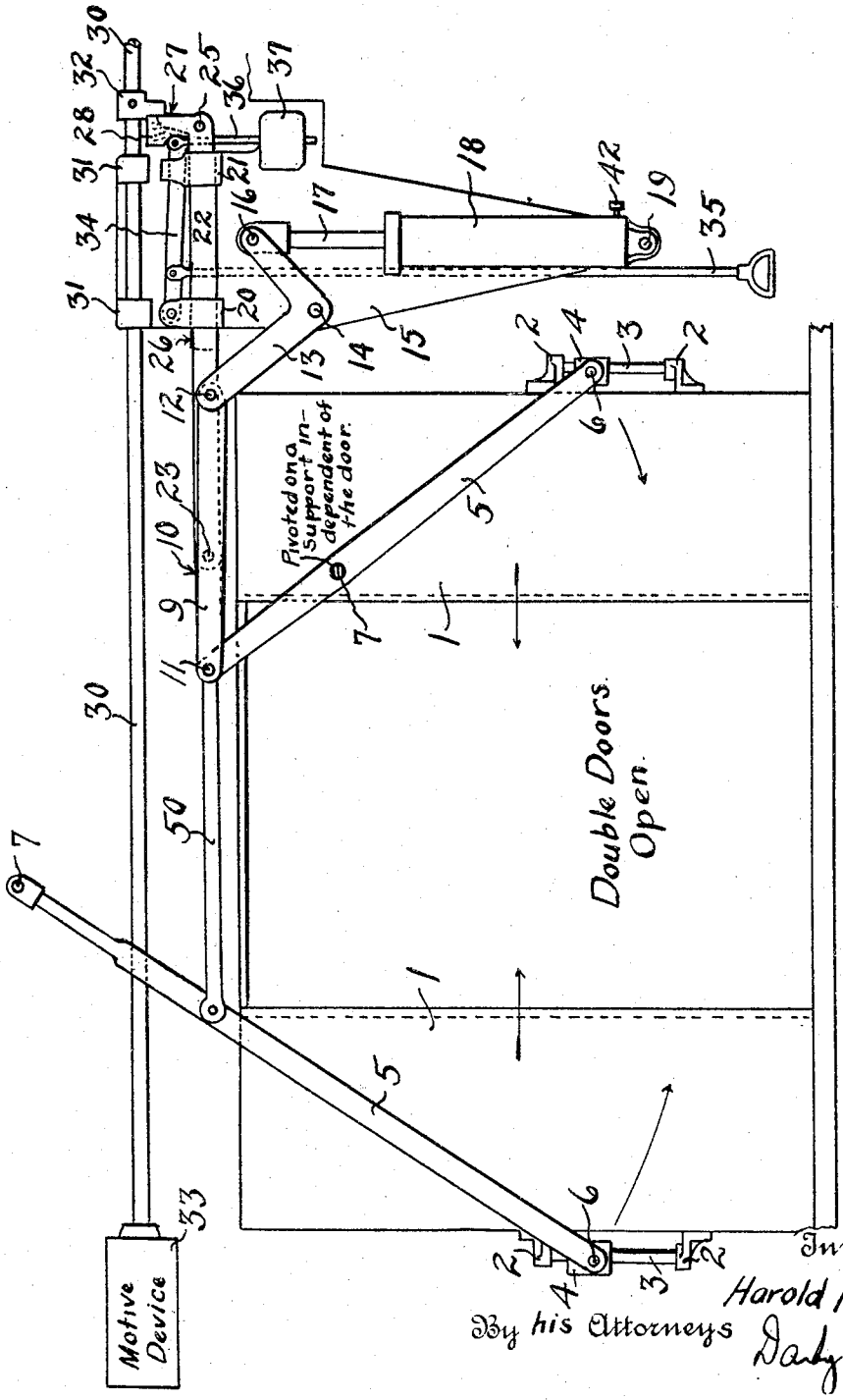


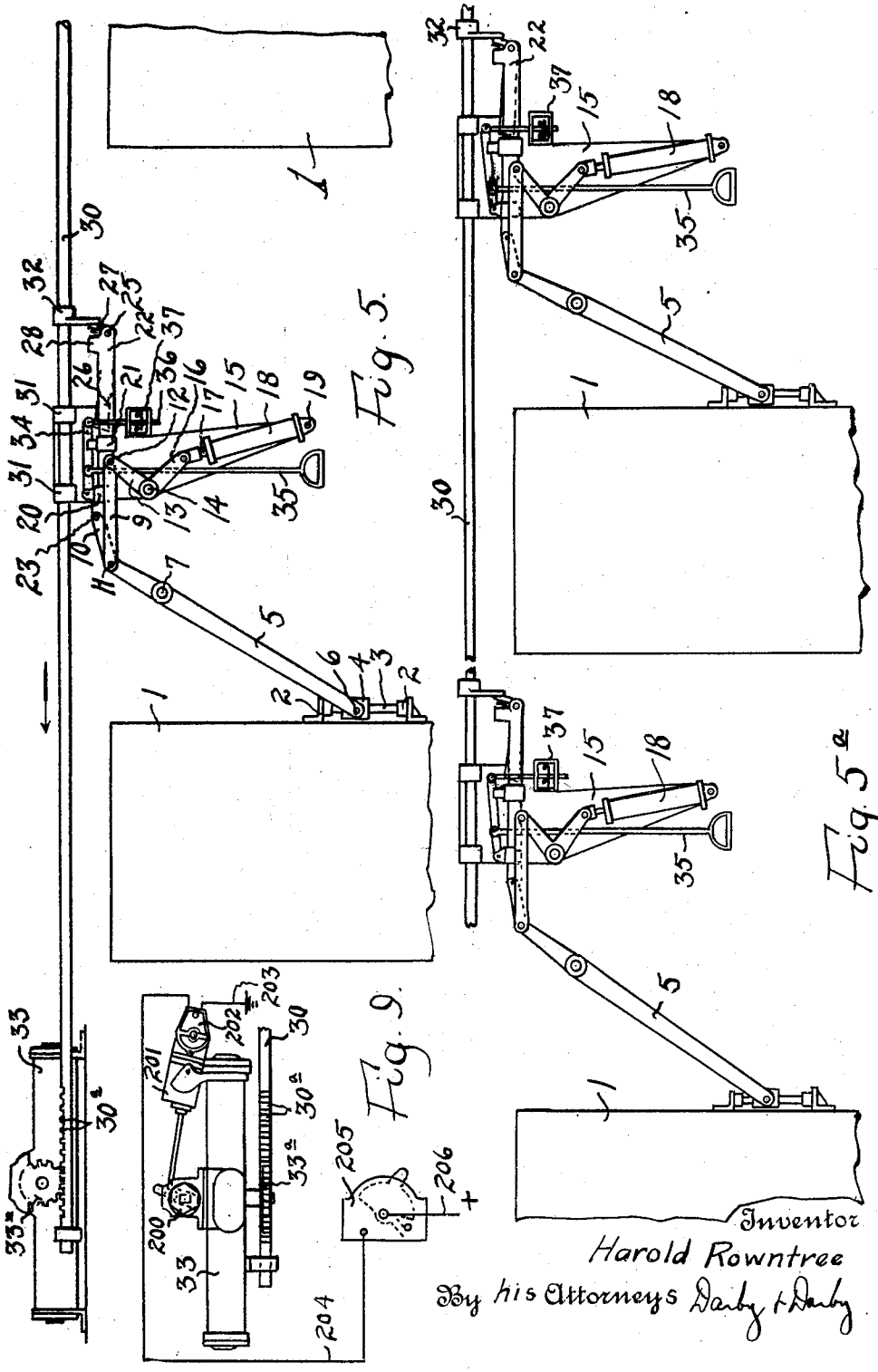
Fig. 4

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DOOR OPERATING MECHANISM

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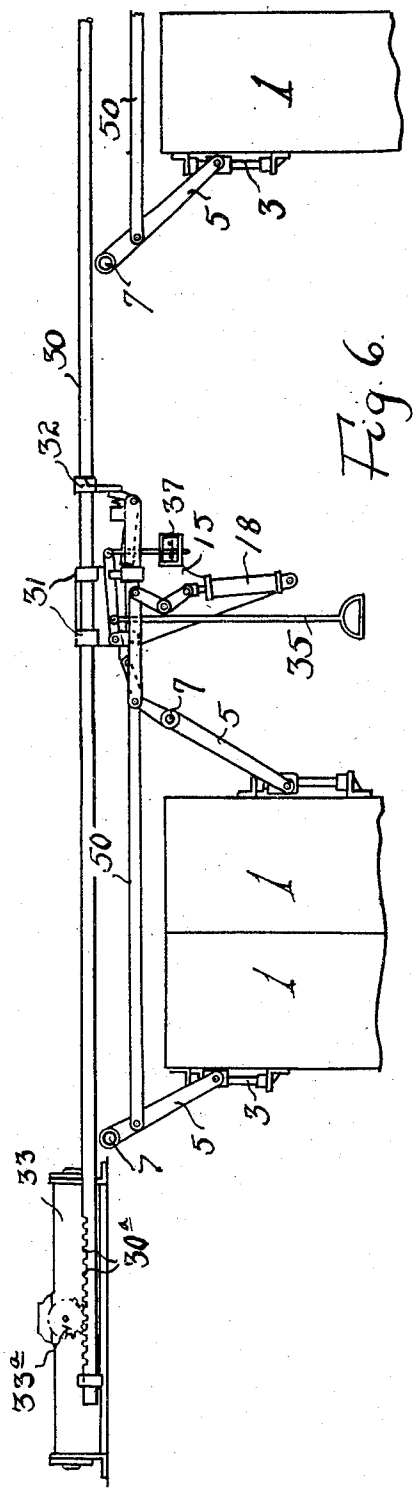


Fig. 6.

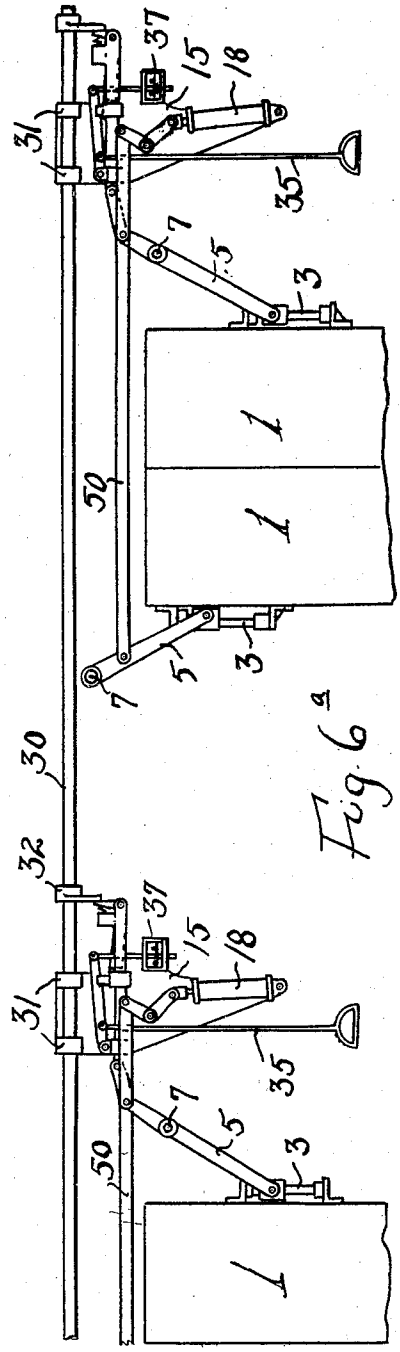


Fig. 6a

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DOOR OPERATING MECHANISM

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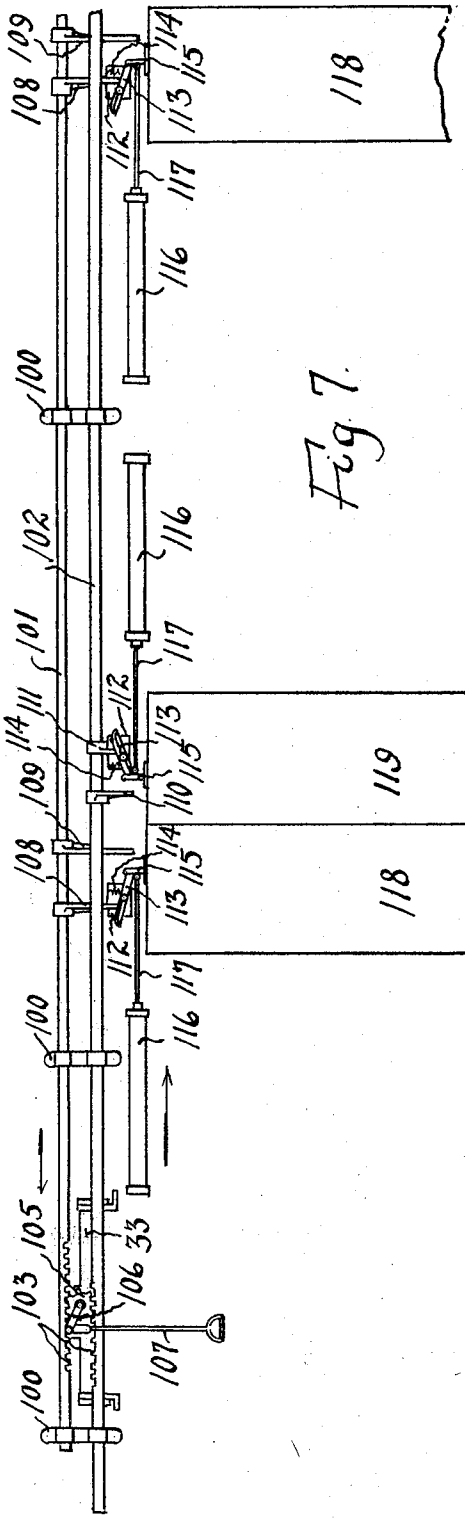


Fig. 7.

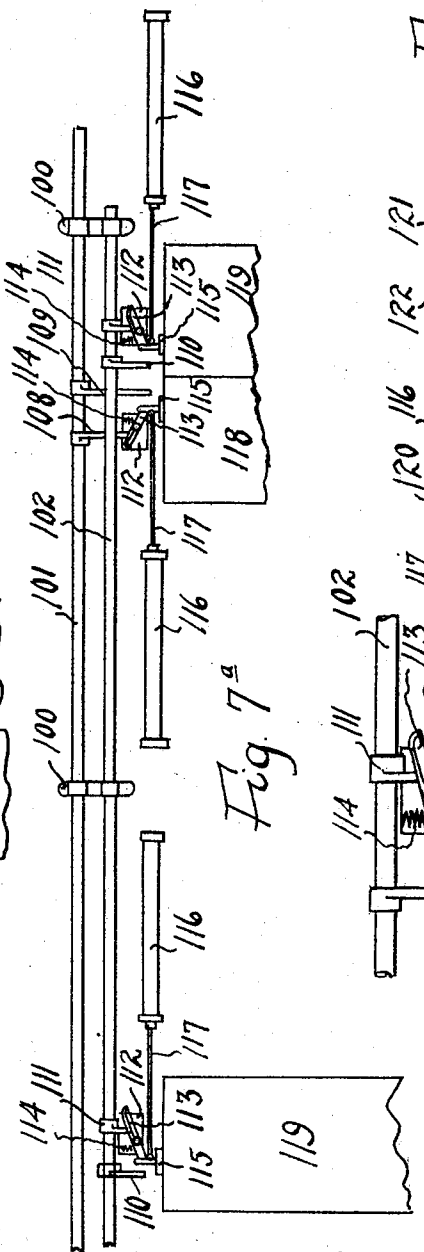


Fig. 7a.

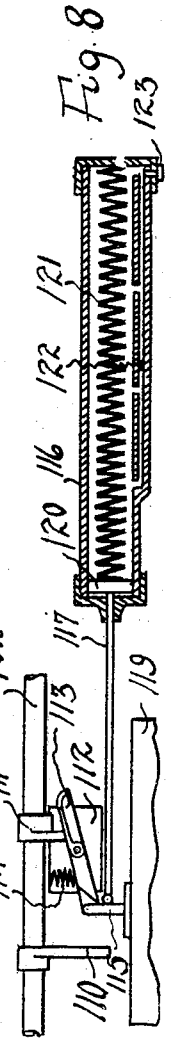


Fig. 8.

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UNITED STATES PATENT OFFICE

HAROLD ROWNTREE, OF SCARSDALE, NEW YORK, ASSIGNOR TO NATIONAL PNEUMATIC COMPANY, OF NEW YORK, N. Y., A CORPORATION OF WEST VIRGINIA

DOOR OPERATING MECHANISM

Application filed July 20, 1929. Serial No. 379,649.

This invention relates in general to the combination of a motive device, doors to be operated thereby, connecting mechanism therebetween, and means independent of the motive device for effecting closure of the doors.

One of the objects of this invention is the provision of a combination of the above type which is particularly adapted for operating doors on transportation vehicles of all kinds.

Another object of the invention is the provision of motive means for operating the doors in one direction and an additional motive means for operating them in the opposite, preferably the closing, direction.

Another object of the invention is the provision of a power actuated rod or the like adapted to extend throughout the length of the vehicle on both sides thereof by means of which all the doors on each side of the vehicle are operated to opened position by the adjacent rod.

A further object of the invention is the provision in a mechanism of the above type of a spring pressed plunger having cushioning or retarding means in conjunction therewith for closing the doors and preventing too rapid closing thereof and slamming at the end of the closing stroke.

A still further object of the invention is the provision of mechanism of the above type which may readily operate to permit the opening of the door by manual force exerted by a person in the path of the door who has been struck thereby.

A still further object is the provision of mechanism in apparatus of this type by means of which the doors may be locked in closed position arranged so that the lock is released during the initial movement of the mechanism before the door begins to move.

These and other objects as will appear from the following disclosure are successfully secured by means of this invention.

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

Referring to the drawings—

Figure 1 discloses in elevation, with some parts broken away, one form of this invention;

Fig. 2 is a vertical, longitudinal, cross-sectional view through the motive device for closing the door;

Fig. 3 is a detail view showing an end elevation of the lock member and its association with the links by means of which the mechanism is operated;

Fig. 4 is an elevational view of another form of the device as applied to double sliding doors moving in opposite directions;

Figs. 5 and 5A taken together show a plurality of single sliding doors operated in one direction by a common means and in the other by individual means;

Figs. 6 and 6A taken together show a similar combination for double sliding doors;

Figs. 7 and 7A taken together show a modified arrangement for operating double sliding doors;

Fig. 8 is an enlarged detail view of the closing cylinder, locking arrangement, and operating parts employed in connection with the apparatus of Figs. 7 and 7A; and

Fig. 9 is a diagrammatic view showing one well known method of controlling the motive device.

There are now known many forms of apparatus by means of which doors of all types are operated through the agency of a motive device. The present invention is directed to this field and comprises a new form of mechanism employing a number of features which distinguish it from the old forms now used. A clearer picture of the invention will be had by specific reference to the drawings, which will now be made.

As shown in Fig. 1 a door 1 of the sliding type is employed. The mechanism of this form of device is adapted for use in connection with a single sliding door. It may be pointed out here that other objects, rather than a door, can be operated by this mechanism and if a door is operated it need not necessarily be a sliding door. The illustrations of the drawings are merely given to help in explaining the principles embodied in the invention. Secured to the rear edge of the door are the spaced brackets 2 between which

extends the short shaft 3 on which is slidably mounted a collar 4. Pivotally secured to the sliding collar 4 at 6 is a link bar 5 which is pivotally supported at 7 on any fixed support 8. The other end of the link bar 5 is pivotally secured at 11 to the links 9 and 10. Link 9 is pivotally secured at 12 to the bell crank lever 13 which in turn is pivotally supported at 14 on the supporting plate 15. The other end of the bell crank lever 13 is pivotally secured at 16 to the piston rod 17 of the closing device 18. The closing device 18 is pivotally supported at 19 on the plate 15. Brackets 20 and 21 are secured to the plate 15 in which is slidably mounted the link 22 which is pivotally secured at 23 to the link 10. As shown in Fig. 3 a similar link 24 is provided extending parallel to the link 22 and likewise pivotally secured at 23 to the link 10. Pivotally supported at 25 between links 22 and 24 is the latch bar 26 having the extension 27. The outer ends of the links 22 and 24 are provided with enlarged recessed portions providing the casing 28 within which is mounted a spring 29 pressing against the end 27 of the latch bar 26. Slidably supported in the bracket 31 secured to plate 15 is a rod or shaft 30 which is intended to extend throughout the length of the vehicle or far enough so that as many doors as is desired may be operated thereby conjointly. For each door adjacent the end 27 of the latch bar 26 there is provided a short arm 32 rigidly secured to the rod 30. Each rod 30 is provided with a motive device which has been diagrammatically illustrated at 33. This, of course, may be any of the well known types either of the electric or the pneumatic type adapted to operate the rod 30 in either direction. Pivotally supported on the bracket 20 is a lever 34 provided with a rod and handle 35 for manual operation. The free end of the lever 34 contacts with the free end of the latch bar 26. Pivotally supported on the free end of the lever 34 and depending therefrom is a rod 36 on which is resiliently supported the contact disc 38 within a casing 37. This switch comprises a door switch connected in a signalling circuit in the usual manner to control a signalling device to indicate when the doors are opened and closed. The door closing device 18 comprises a cylinder within which operates a piston 41 connected to the piston rod 17. A spring 40 lies between one end of the cylinder and the piston 41. One wall of the cylinder is provided with a passage 43 having a number of spaced openings 44. The lower end of the passage 43 likewise opens into the cylinder and an adjusting screw 42 is provided to vary the area of the passage 43. This cylinder is provided with oil or other suitable cushioning means, the action of which will be described later.

The operation of this mechanism is as follows. The motive device 33 is, of course, controlled by a switch or valve depending upon its nature. When energy is supplied thereto it operates to slide the rod 30, if the door is to be opened, in the direction of the arrow. It is being assumed for the purposes of this description that the door is in closed position as illustrated in Fig. 1. As the rod 30 moves to the left (in the direction of the arrow) the first thing that happens is that the short arm 32 strikes the extension 27 of the latch bar 26. This causes the latch bar to rotate in a counter-clockwise direction against the action of spring 29 and moves the left hand end thereof down between the links 22 and 24 so that the upper edge thereof is in the same plane as the upper edges of the links 22 and 24. As the short arm 32 continues to move to the left it strikes the casing 28 and causes links 22 and 24 to likewise slide with it to the left. The movement of these links through the action of link 10 causes the link bar 5 to rotate in a counter-clockwise direction about its pivot 7 and the bell crank lever 13 to likewise operate in a counter-clockwise direction about its pivot 14. The result is that the door 1 moves to the right and piston 41 moves upwardly in its cylinder compressing spring 40. At the same time the oil above the piston escapes through the ports 44 and passage 43 around the piston and into the lower end of the cylinder. This action continues until the door is fully opened. It is, of course, apparent that the latch bar 26 has a lock which prevents the opening of the doors by hand as soon as the end thereof strikes the bracket 21 if it is in raised position. The initial movement of rod 30, however, moves this latch bar to a position where the motive device can open the door. Of course a number of doors may be operated by the same rod 30 by merely duplicating the mechanism for each door. When it is desired to close the door the motive device is energized to operate it in a reverse direction forcing shaft 30 to the right for its full stroke. The door then begins to close under the action of spring 40. It is prevented in too rapid movement by the cushioning action of the oil below the piston 41 which must escape through the ports 44 and finally through the lowermost port 44 near the end of the stroke of the door. As soon as the end of latch bar 26 is past bracket 21 spring 28 forces it upwardly so that the door is locked against manual opening. One feature of this arrangement is that during the closing movement should the door strike an obstruction, such as a person passing therethrough, the force of the blow on the person is reduced by reason of the fact that it is being closed by the spring 40 solely. In addition, the door may be moved manually by that person by merely pushing it against the action of spring 40. Whenever desired the mecha-

nism may be manually operated by pulling down on the rod 35 to move the latch bar 26 into unlocking position when the door may then be opened by hand. In this arrangement it is apparent that a number of doors may be simultaneously opened by means of a single motive device and left free to be closed independently of each other by means of each door closing device associated therewith. Since the force exerted by the spring 40 is not very great persons caught in the door can easily release themselves and the doors will immediately continue on their closing stroke as soon as the doorway is cleared and lock themselves shut when fully closed.

In place of the door closing mechanism disclosed a differential engine can be employed, one for each door, with the usual swinging arm in place of the spring dash pot shown. No control valves or switches would be needed for the differential engine except a check valve to allow free access of pressure to the small cylinder and only allow a restricted egress of pressure from it, thereby placing a minimum of restriction upon the door as it is opening, and giving it a constant speed in closing.

The modified form shown in Fig. 4 is particularly adapted for double sliding doors which move in opposite directions. The doors are shown at 1 and are arranged to move in opposite directions when they open and towards each other when they close. Most of the mechanism in this form of the device is similar to that shown in Fig. 1 and has been given the same reference numerals. Where any divergence occurs the differences will be described in detail. A second link bar 5 is provided for the added door 1 which is connected thereto in the same manner as the link bar 5 on the other door and the link bar 5 on the door in Fig. 1. This second link bar, however, is pivotally supported at 7 on some fixed support and at a point between the pivotal connection 6 and the pivotal support 7 link 50 is pivotally secured thereto at one end and at the other end to the links 5, 9 and 10 at 11.

The operation of this mechanism is substantially similar to that of the mechanism in Fig. 1. Thus, as shaft 30 moves to the left, the short arm 32 after releasing the latch 26 forces the links 22 and 24 to the left causing the link bar 5 to rotate in a counter-clockwise direction and the link bar 5 on the other door through the agency of the link 50 to operate in a clockwise direction. This is during the opening movement of the doors. The closing movement is effected, as before, by means of the spring operated device 18 after shaft 30 has been moved to the right by the motive device 33. In the closing movement the right hand link bar 5 moves in a clockwise direction and the left hand link bar 5 moves in a counter-clockwise direction. As before, during closing if a person is caught between the doors he can release himself by forcing them apart against the action of the spring in the cylinder of the device 18. When the doors are fully closed the latch bar 26 is raised by a spring to lock the doors in closed position.

In order that the basic thought of this invention may be more fully understood there has been shown in the drawings several arrangements in which a plurality of doors are operated in one direction by a common means and are individually operated in the opposite direction by its own operating device. For example, in Figs. 5 and 5A, which are to be taken together, there is shown a duplication of the parts shown in Fig. 1 for illustrating and emphasizing the feature of a common operating means for a plurality of doors in one direction and individual means for independently operating the doors in the other direction.

For the most part the elements in Figs. 5 and 5A do not need to be described in detail since they are an exact duplicate of the elements in Fig. 1. These figures show the apparatus arranged for operating three doors simultaneously. The main operating shaft 30, by means of which all the doors are operated to "open" position, is shown provided at one end with a rack 30^a meshing with the gear 33^a on the shaft of a fluid pressure operated motor 33. The circuit connections for such a motor are shown in Fig. 9 which will be described generally since this combination is old and well known in the art and only given here for purposes of permitting complete understanding of this invention. The fluid pressure operated device 33 is of the double piston type and has a valve 200 mounted thereon which in one position permits of the operation of the motor in one direction and in the other position permits of the operation of the motor in the opposite direction. Also supported on the motor is a valve puller 201 of well known construction which is connected to the valve for operating it to either of its positions. The valve puller is controlled by an electromagnet valve 202 which has a solenoid winding grounded at 203. The other terminal of this winding is connected by wire 204 to one of the contacts of a single-pole, single-throw switch 205. The other contact of this switch is connected by wire 206 to the positive side of the current source. It may be pointed out that the electromagnet valve 202, when energized, supplies fluid pressure to the valve puller 201 causing it, through its connection, to operate the valve 202 to its other position. In this position of valve 202 fluid pressure would be admitted to motor 33 at the right hand end, looking at Fig. 5, so as to cause gear 33^a to operate in a clockwise direction pulling shaft 30 to the left. This movement of the

shaft 30 to the left operates all of the doors 1 to "open" position in a manner carefully described in connection with Fig. 1. When switch 205 is opened it energizes magnet valve 202. The valve puller returns valve 200 to its other position to that shown in Fig. 9 admitting fluid pressure to the left hand end of the engine and permitting it to exhaust from the right hand end. At this time the motor operates to return rod 30 to the right to its normal position. This movement of rod 30 does not, however, operate the doors in the reverse direction but merely leaves them free to be each operated independently of the other to the "closed" position by means of the motive device 18. It will be remembered in connection with the description of Figs. 1 and 2 that when the doors open the spring in the motive device 18 is compressed. Hence when shaft 30 moves back to normal position each door is moved to "closed" position by the spring in the motive device 18.

In the arrangement of Figs. 6 and 6A, which are to be taken together to give a complete device, we find a duplication of the parts disclosed in Fig. 4. The motive device 33 would be the same as that disclosed in Fig. 9 and controlled in the same manner. The purposes of these figures is to again demonstrate the important point that a common operating means actuates all of the doors in one direction and they are free to be actuated in the other direction by independent means.

The main distinction between the arrangement in Figs. 6 and 6A and that of Figs. 5 and 5A is that the invention has been applied to double sliding doors which move away from each other in opposite directions when they open and towards each other when they close. As before, the shaft 30 is provided with a rack 30^a meshing with gear 33^a driven by the motive device 33. When the rod 30 moves to the left all of the doors are opened in the manner explained in connection with Fig. 4. When it is returned to normal position in the opposite direction the doors are left free to be operated to "closed" position by the motive device 18, each independently of the other.

A somewhat modified arrangement is shown in Figs. 7 and 7A which are to be taken together to show the complete device. This arrangement is shown as applied to double sliding doors and employs two rods 100 and 102 which are operated in opposite directions. As before, any suitable motive device 33 is employed which drives a gear 105 meshing with the racks 103 formed on rods 101 and 102. These rods are slidably supported in the brackets 100 and upon rotation of gear 105 move in opposite directions. A lever 106 is shown connected to the same shaft on which gear 105 is located and arranged to be operated manually by a handle 107 when desired. Rod 101 is provided with arms 108 and 109 and rod 102 is provided with arms 110 and 111. Supported over each section 118 and 119 of the doors is a support 112 on which is pivotally secured a lever 113. A suitable spring 114 is provided for holding the lever in the position shown in the drawings.

This construction is more clearly shown in Fig. 8. Secured to the top of each door section is a projecting arm 115 connected to a motive device 116 by the rod 117. As shown in Fig. 8 the motive device 116 comprises a cylinder having therein a piston 120 connected to the rod 117. A compression spring 121 lies between the piston and one end of the cylinder. A by-passage 122 is formed in the wall of the cylinder and is provided with an adjusting screw 123 to form a restricted opening to effect a dashpot arrangement, as is well known in the art. This dashpot arrangement prevents too rapid movement of the piston in its movement to the left.

The operation of this arrangement will now be given. When the motive device is energized to cause rod 101 to move to the left and rod 102 to move to the right arms 108 and 111, respectively, on their initial movement in view of their contact with levers 113 cause the levers to operate in a counter-clockwise direction to raise them above the arms 115 and compress springs 114. It may be pointed out that levers 113 operate as latch bolts or locks to hold the doors locked in "closed" position. This initial movement of rods 101 and 102 releases the locks and continued movement thereof causes arms 109 and 110 to move over and engage the arms 115 which are securely fastened to the upper edges of the door. Further movement of these rods then causes the door sections 118 and 119 to move in opposite directions to cause the doors to fully open.

When the motive device 33 is operated in the reverse direction rods 101 and 102 move back to normal position freeing the door sections for independent movement to closing position by means of the motive devices 116. This is effected by the potential energy of compression springs 121 acting on pistons 120. Too rapid movement of these pistons is prevented by the trapped air in the cylinders which must pass back of the piston through the passage 122 and its restriction. The same results may be secured by rotating the gear 105 by the handle 107.

It may be pointed out that in each case shown the doors may be hand operated, operated by pneumatic motors of any type of which one example is given, or they may be operated by electric motive devices of any suitable construction.

From the foregoing disclosure it will be apparent that I have embodied certain principles of construction and operation in a door operating mechanism of which several embodiments have been disclosed for purposes of

illustration. I am, of course, aware that many changes in the details of construction and relative arrangement of parts will readily occur to those skilled in the art without departing from the spirit and scope of this invention and I do not, therefore, desire to be limited except as required by the appended claims.

What I seek to secure by United States Letters Patent is:

1. In a door operating system of the type described, the combination comprising at least one movable rod, power means for moving said rod, a plurality of doors, connections between said rod and said doors whereby they are all operated simultaneously in the opening direction, independent spring actuated power devices connected to each door for operating each door in the closing direction independently of the other doors when freed by return movement of said rods and connections between said connections and power device whereby the power devices store energy during the opening of the doors for use in closing the corresponding doors independently.

2. In a door operating system the combination comprising a plurality of doors, a movable rod mounted adjacent the doors for operating all of them in opening direction, a movable bar for each door, supports for the bar, a lever normally projecting in the path of one of the supports, a lug on said rod one for each door, said lug being movable into contact with each lever to move it out of the path of the guiding support upon the initial movement of said rod, a power device for moving the rod, means for connecting each door to its corresponding bar, and independent means for each door attached thereto for operatitng each door independently in the closing direction.

In testimony whereoef I have hereunto set my hand on this 18th day of July, A. D. 1929.

HAROLD ROWNTREE.