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**2,606,022**

## DOOR OPERATION AND CONTROL

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3 Sheets-Sheet 1

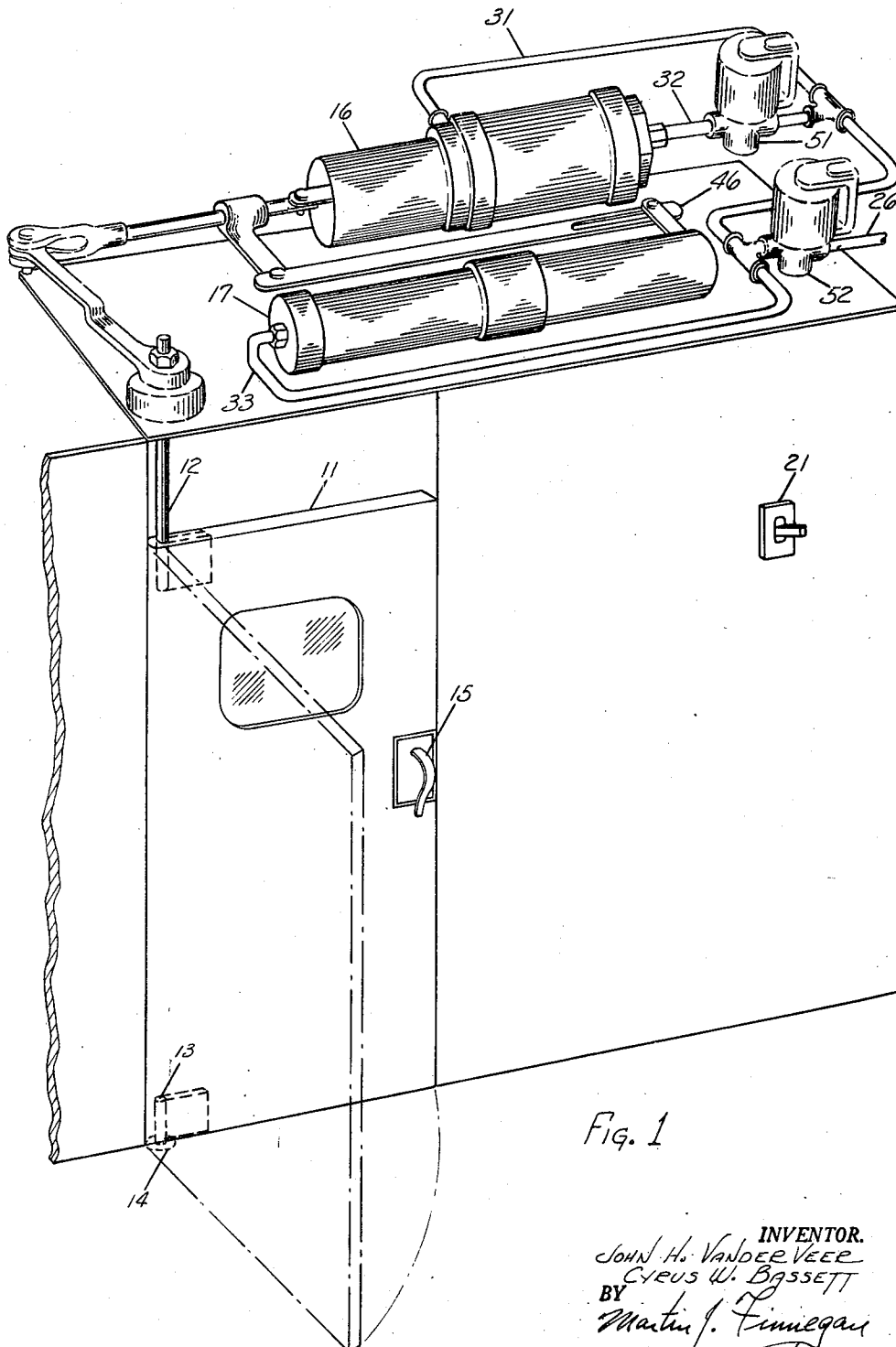


Fig. 1

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3 Sheets-Sheet 2

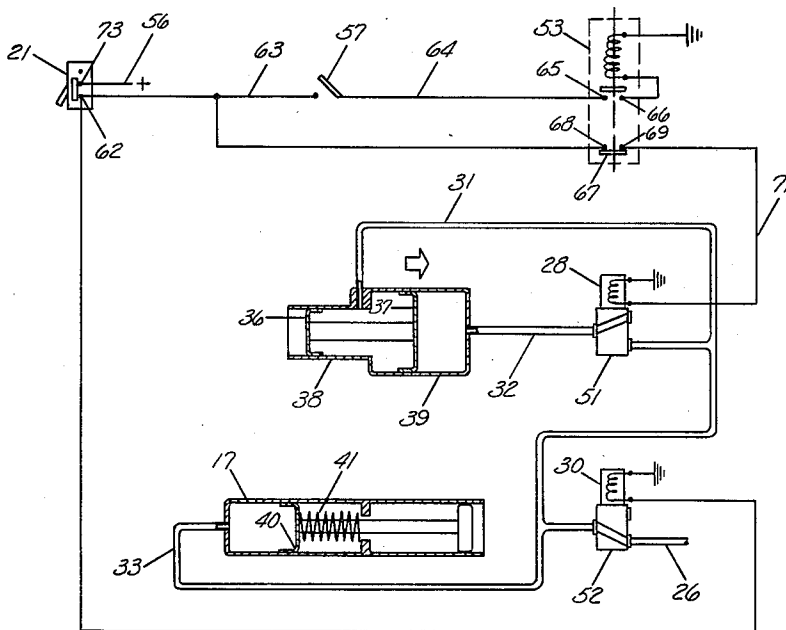


Fig. 2

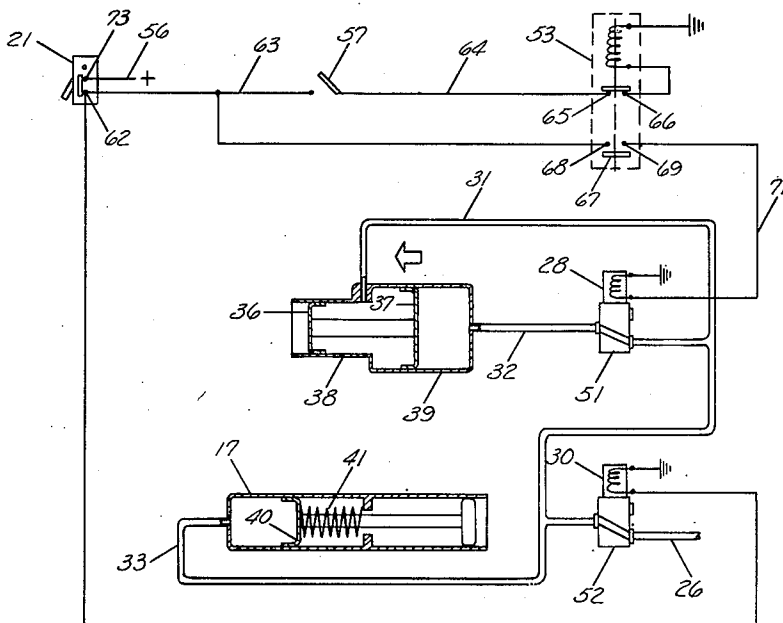


Fig. 3

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3 Sheets-Sheet 3

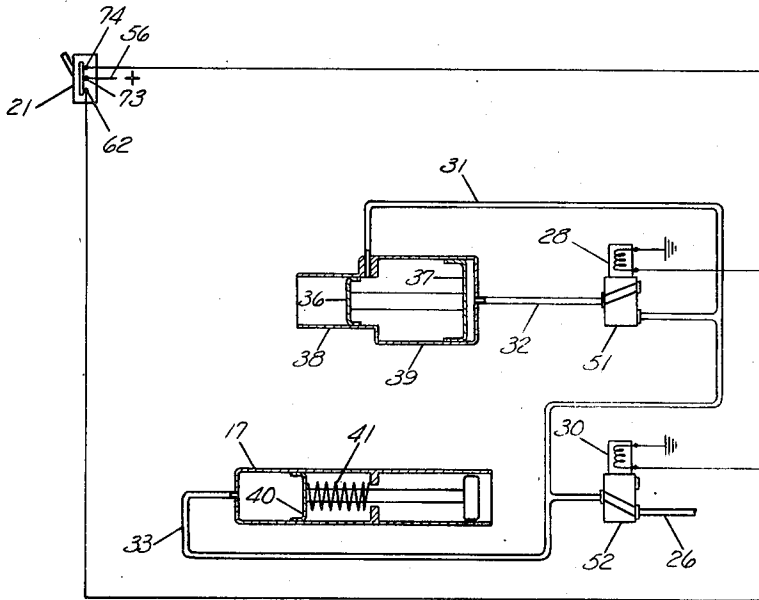


Fig. 4

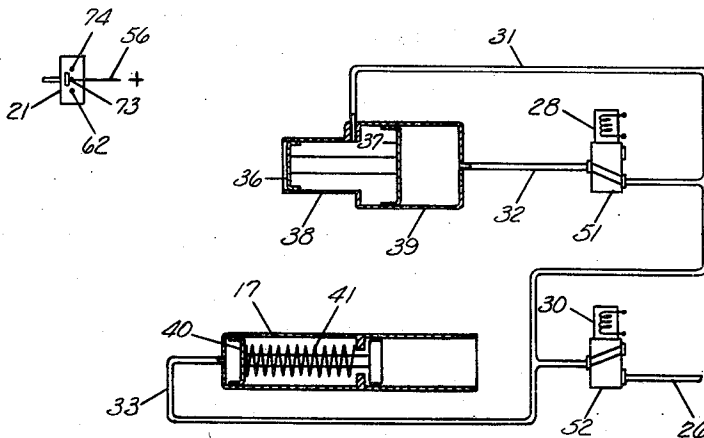


Fig. 5

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## UNITED STATES PATENT OFFICE

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## DOOR OPERATION AND CONTROL

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4 Claims. (Cl. 268—66)

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This invention relates to door operation and control, and particularly to a system providing a plurality of control methods applicable to a door, to cause it to move from a closed to an open position, to remain in such open position for a selected definite interval or for a selected indefinite interval, and to cause it to return to the closed position after such interval.

One object of the invention is to provide a novel method of controlling the operation of a door, which novel method involves the utilization of three power applying agencies individually or conjointly, according to the choice of the operator or depending upon prevailing conditions, one power applying agency being a fluid motor (in the embodiment chosen for exemplification herein), a second power applying agency being a spring motor, and the third power applying agency being the operator himself.

Such operator may be a regularly assigned attendant of the door, on one occasion, and a mere transient user of the door on other occasions. Thus, for example, when the invention is applied to the operation of a door controlling passage from one railway car to the succeeding car, in a train of cars, the controls may be manipulated by train passengers, successively, to facilitate their passage through the train, and also by a train porter, or other attendant, who may desire to have power applied to hold the door open (independently of continuous effort on his own part) for an interval of indefinite duration, so that a number of pieces of baggage can be carried through the door-way successively, before application of door closing effort by the first-named power applying agency.

A second object of the invention is to provide novel elements, and a novel inter-relationship of elements to establish the operations and controls outlined above, and further described below, with reference to the accompanying drawings wherein:

Fig. 1 is a perspective view of a swing door and operating and control mechanism for such door, functioning in accordance with the present invention; and

Figs. 2 to 5, inclusive, are schematic illustrations showing how the mechanism of Fig. 1 responds differently to different situations, according to the particular power applying agency selected for use.

While the invention is illustrated and described in a form of embodiment particularly efficacious for solution of problems arising in connection with the operation of through-doors

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of railway cars, commonly of the "swing" type, it will be apparent that the invention may be applied with equal efficacy to the operation of sliding doors, and to doors in other situations; also that portions of the disclosed invention may be employed independently of other portions, and that re-arrangements and modifications of parts are possible, and are intended to be embraced herein, insofar as they are within the spirit of the invention as herein defined.

Referring first to Fig. 1, the door 11 is shown as carrying two short shafts, 12 and 13, in vertical alignment along the axis of swing of the door; the lower shaft 13 being adapted to pivot in a stationary bearing plate 14 at the floor level, while the upper shaft 12 receives the turning effort applied thereto by the selected one of three power applying agencies, namely, the fluid motor 16, the spring motor 17, or the hand of the person desiring passage through the door-way. The determination of which agency is to be effective on any given occasion depends, first, upon the setting of a three-position control switch 21, and secondly, upon the availability of energizing power for the two motors 16 and 17. The manner in which these two factors determine the functioning of the system will become apparent as the description progresses.

The motors 16 and 17 are illustrated as adapted to receive compressed air or other operating fluid from a common feed line 26, the feeding and exhausting of such fluid being under the control of a pair of valves 51, 52; the former being spring-biased to a fluid feeding position upon energization of solenoid winding 28, and the valve 52 being spring-biased to a fluid exhausting position and shiftable to a fluid feeding position upon energization of solenoid winding 30. Two conduits 31, 32 lead to motor 16, and a single conduit 33 leads to motor 17; the motor 16 having two mechanically connected pistons 36, 37 reciprocable in connected cylinders 38, 39, respectively, and the motor 17 having a single piston 40 reciprocable in a cylinder which also houses a coiled compressible spring 41, on the side of the piston opposite to that which receives fluid from conduit 33. Conduit 32 supplies cylinder 39, and the fluid thus entering cylinder 39 operates on one side of the larger piston 37, while the fluid entering by way of conduit 31 between the two pistons 36 and 37 (the former being smaller than piston 37) operates on the inner faces of both pistons, the combination being such as to produce a pressure

differential first in one direction and then the other, in response to successive valve operations, as will be further described.

In order to make it possible to use fluid motor 16 to the exclusion of spring motor 17, when use of the latter is not desired, we provide a novel method and means of control of the spring motor and of the connections between the two motors, which control arrangement operates to hold the spring motor 17 in an "idling" position, so to speak, throughout periods of utilization of the fluid motor 16 exclusively; the spring motor, however, being instantly shiftable to working relationship to the door whenever desired, by the mere act of reversing the setting of the remote control switch 21; and being also automatically shiftable to said working relationship whenever, for any reason, fluid pressure is absent from the feed line 26.

This novel control arrangement includes the use of the pressure feeding conduit 33, above described, to maintain sufficient pressure against the piston 40 of the motor 17 to hold its spring fully compressed throughout all periods of exclusive control by the fluid motor 16, also the use of a slotted link 46 as part of the mechanical transmission between the said piston 40 and the door shaft 12; the length of the slot in link 46 being sufficient to permit a full stroke of the pistons 36 and 37, under fluid power, without exerting any reverse pressure on the piston 40 which therefor remains in an "idle" position; it being noted, however, that this idling relationship will automatically be converted to a working relationship whenever fluid pressure is removed from line 26.

The application of pressure fluid to motors 16 and 17 is under the direction of a pair of solenoid valves 51, 52, and a delayed-action 53; the solenoid windings 28, 30 of valves 51, 52, and the winding of relay 53 being supplied with current from a source 56, under the joint control of door latch switch 57 and the three-position control switch 21, previously referred to. The multiple operating possibilities are as follows:

**Operation A.**—Opening and closing of the door by power applied to motor 16. (Control switch 21 in "Automatic" position, bridging contacts 62, 73 (Figs. 2 and 3).)

With control switch 21 in the "Automatic" position bridging contacts 73, 62 a circuit is completed from source 56 to the winding 30 of "pressure" magnet valve 52; to direct pressure fluid through the valves 52 and 51 in succession, and into cylinder 39, through conduit 32, and also through conduit 34 to the working chamber between the two pistons 36, 37 and at the same time through conduit 33 to motor 17, thus placing the system in condition for successive automatic opening and closing movements of the door 11; the door being now in the closed position, as the differential of pressure on pistons 36 and 37 is such as to hold said pistons in their extreme leftward positions. (See Fig. 2). Moreover, piston 40 of motor 17 is held at its extreme rightward position (Fig. 2) by reason of the pressure fluid entering the motor by way of conduit 33.

Let it be supposed that, with the parts in the positions just indicated, a person desiring passage through the closed door 11 takes hold of the door handle 15 in the normal manner to withdraw the door latch. This withdrawal of the latch causes switch 57 to close, thus producing a flow of current to the winding of relay 53, by way of conductors 63 and 64, and its own normally

bridged contacts 65 and 66. Energization of the relay winding, though only momentary, is sufficient to snap the bridging member 67 of the relay into bridging relationship to contacts 68 and 69, which bridging relationship continues for three, four, five, or more seconds, according to the adjustment (not shown) of the delayed action dash-pot or other mechanism governing the return of bridging member 67 to its normal (non-bridging position).

During the continuance of this bridging relationship of part 67 to contacts 68, 69 current flows from source 56 to the winding 28 of "exhaust" magnet valve 51, the path of flow being by way of said parts 67, 68, 69, and conductor 71. The result of this activation of valve 51 is to exhaust pressure fluid from cylinder 39, by way of conduit 32, whereupon pistons 36, 37 move from left to right (the pressure on the left side of piston 37 being now dominant) and causes the door 11 to swing from the closed position to the open position.

When the pre-set time delay has run its course (three or more seconds) member 67 drops away from contacts 68, 69, thus de-energizing exhaust magnet valve 51. Pressure fluid instantly re-enters the line 32 and the cylinder 39, to the right of piston 37, moving the piston assembly 36, 37 to the left and thus returning the door 11 to its closed position.

**Operation B.**—Causing the door to be held in the open position. (Control switch 21 in "Remain Open" position, bridging contacts 62, 73, 74 (Fig. 4).)

When a train porter, or other person desires to have the door open, and remain open for a period of unmeasured duration, the switch 21 can be thrown to the "Remain Open" position, thus establishing a circuit from source 56 to the exhaust valve magnet winding 28, by way of bridged contacts 73, 74 of said switch 21. As this circuit maintains the valve 51 in a position which continuously vents cylinder 39 to the atmosphere, by way of conduit 32, it will be apparent that once the door has been opened (as previously described) it will remain open because of the absence of any closing pressure fluid in cylinder 39; the piston 40 of motor 17 being concurrently held in its inner position by the continuing pressure of the pressure fluid acting against said piston 40.

**Operation C.**—Closing the door by power stored in the spring motor 17. (Control switch 21 in "manual opening" position, separating contacts 62 and 74 from 73). See Fig. 5.

Placing control switch 21 in its third position breaks the normally closed circuit from source 56 to the winding 30 of "pressure" magnet valve 52; by way of contacts 62, 73 of switch 21. This causes a shift of valve 52 to the fluid exhausting position, whereupon spring 41 of spring motor 17 expands and moves piston 40 to the left, carrying with it the link 46 and the pistons 36 and 37, all of which are now free of fluid pressure influences. As a result of this working stroke of piston 40, the door is moved back to the closed position, automatically and without any fluid pressure assistance following any opening thereof manually, so long as switch 21 remains in this third position.

The spring 41 will also function as an automatic power closing agency for the door during any absence of effective fluid pressure, or during any absence of effective electric current, for in either of these situations there will be no restric-

tion on the free expansion of spring 41, following each compression thereof.

What we claim is:

1. Mechanism for operating a door comprising a cylinder and piston, said piston having less effective area on one face than on the other, a linkage connecting the piston to the door to cause motion of the piston to be transmitted to the door, to move the door in one direction or the other, according to the direction of motion of the piston, a source of fluid pressure, a pair of fluid conduits leading from said source to said cylinder, one conduit terminating in said cylinder on one side of said piston, and the other conduit terminating in said cylinder on the other side of said piston, a valve in one of said conduits, namely, the conduit leading to that end of the cylinder toward which faces that side of the piston having the greater effective area, said valve having fluid admitting and fluid-exhausting positions, means for shifting said valve to said fluid-exhausting position to cause the piston to move in the door-opening direction, and settable control means for (a) causing said valve to remain indefinitely in said fluid-exhausting position, following operation of said shifting means, or (b) to shift back to said fluid-admitting position after lapse of a predetermined time interval, measured in seconds, and thereby cause the door either (a) to remain in the open position indefinitely, or (b) to return to closed position at the end of the said time interval, according to the setting selected for said settable control means.

2. Mechanism for operating a door comprising a cylinder and piston, said piston having less effective area on one face than on the other, a linkage connecting the piston to the door to cause motion of the piston to be transmitted to the door, to move the door in one direction or the other, according to the direction of motion of the piston, a source of fluid pressure, a pair of fluid conduits leading from said source to said cylinder, one conduit terminating in said cylinder on one side of said piston, and the other conduit terminating in said cylinder on the other side of said piston, a valve in one of said conduits, namely, the conduit leading to that end of the cylinder toward which faces that side of the piston having the greater effective area, said valve having fluid-admitting and fluid-exhausting positions, means for shifting said valve to said fluid-exhausting position, and settable control means for (a) causing said valve to remain indefinitely in said fluid-exhausting position, following operation of said shifting means, or (b) to shift back to said fluid-admitting position after lapse of a predetermined time interval, measured in seconds, and thereby cause the door either (a) to remain in the open position indefinitely, or (b) to return to closed position at the end of the said time interval, according to the setting selected for said settable

control means; said valve shifting means including a source of electric energy, a solenoid whose plunger operates said valve, and a pair of parallel circuits from said source to said solenoid and said settable control means including a switch movable to close one or the other, alternatively, of said parallel circuits.

3. Mechanism as defined in claim 2, wherein one of said parallel circuits includes time-delay means operating to re-open the circuit within a measured interval following closure thereof.

4. Mechanism for operating a door comprising a cylinder and piston, said piston having less effective area on one face than on the other, a linkage connecting the piston to the door to cause motion of the piston to be transmitted to the door, to move the door in one direction or the other, according to the direction of motion of the piston, a source of fluid pressure, a pair of fluid conduits leading from said source to said cylinder, one conduit terminating in said cylinder on one side of said piston, and the other conduit terminating in said cylinder on the other side of said piston, a valve in one of said conduits, namely, the conduit leading to that end of the cylinder toward which faces that side of the piston having the greater effective area, said valve having fluid-admitting and fluid-exhausting positions, electro-magnetic means for shifting said valve to said fluid-exhausting position, settable control means for (a) causing continuous energization of said electro-magnetic means, and thereby causing said valve to remain indefinitely in said fluid-exhausting position, following operation of said shifting means, or (b) causing only brief energization of said electro-magnetic means, according to the setting selected for said electro-magnetic means, and means for returning said valve to the fluid-admitting position following such brief energization of said electro-magnetic means.

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