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POWER DOOR OPERATING SYSTEM WITH DOOR RETURN
ACTION UPON MANUAL DOOR MOVEMENT

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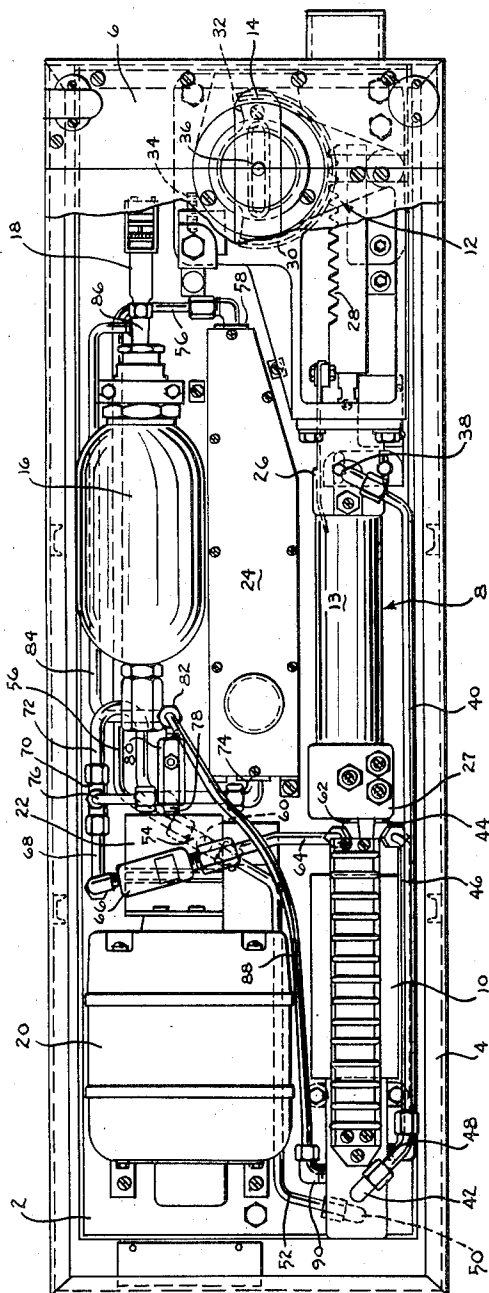


FIG. 1

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POWER DOOR OPERATING SYSTEM WITH DOOR RETURN ACTION UPON MANUAL DOOR MOVEMENT

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The present invention relates to a power driving system particularly adapted for the operation of doors and the like. A feature of the system is the employment of an accumulator as part of the power system which also provides force for returning the door to its proper position when it has been manually moved therefrom.

In power door operating systems and the like special provision has been made for causing the door to return to a given position, usually its closed position, when it is manually moved therefrom. Ordinarily, some form of mechanical spring arrangement has been favored because it will function even when power has failed or when, for any reason, the driving system is inoperative. Such arrangements are subject, however, to several major drawbacks. They constitute an appreciable item of expense not only because of the cost of the spring unit itself but also because of the resultant complexity of the linkages which must be employed. In many instances an increase in size of the operating unit is required when spring returns are employed, and yet space and weight considerations are quite important to the design of many door operators, such as those designed to be used in transportation vehicles, where space is a prime consideration. Moreover, spring returns have the undesirable inherent characteristic that as the door is opened and the spring is compressed, the force exerted by the spring increases markedly. This inhibits manual opening of the door to its fullest extent and it further provides the least amount of closing force when that force is most needed, that is to say, when the door is almost fully closed and appreciable force is required in order to cause the latch or keeper to engage. If the spring when extended (when the door is almost closed) provides sufficient closing force, then the force required to fully compress the spring (when the door is fully open) tends to be excessive. For example, a spring return system which provides fifteen pounds of closing force when the door is substantially fully closed will apply perhaps forty-five pounds of closing force when the door is almost fully open. In addition, spring returns make for inefficient operation, since the power system, each time that the door is to be opened, must compress the spring as well as provide the force necessary to move the door itself.

According to the present invention there is no necessity for employing any spring return mechanism or any mechanism other than the usual components of the power system itself. The arrangement of the system is such that a door closing action is obtained whether the power driving system is energized or not. In addition, a substantially constant door-closing pressure may be obtained no matter what the position of the door. In contradistinction to the 15-45 pound differential of a spring return system, a commercial embodiment of the present invention can provide a 15-17 pound differential in door closing force as between door closed and door opened positions. Because no components other than those usually associated with the hydraulic system itself need be employed, size, weight and expense are correspondingly

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minimized. In addition, because of the specific system connections by means of which the desired results are achieved, it is possible to utilize a hydraulic system which is simpler than has previously been thought feasible, and which lends itself in some embodiments to a construction which further reduces the size and weight of the overall assembly.

These results are achieved by utilizing the accumulator of the standard power system as the source of the door closing force. An accumulator is a container, usually of appreciable volume, into which the operating fluid under pressure is received, that fluid, as it fills the accumulator, compressing a gas or other element within a confined case, the pressure in that case therefore increasing as the volume of fluid in the accumulator is increased. The accumulator is employed in part to provide an ample supply of operating fluid under the desired pressure. In many instances it is provided with a pressure-sensitive switch which, when the pressure falls below a certain minimal value, causes a pump to operate to replenish the operating fluid in the accumulator, drawing upon a reservoir of fluid to that end, until the pressure has been once again restored to its desired value.

According to the present invention, here described in connection with an hydraulically powered piston-type motor, when the door is in closed position that side of the piston of the hydraulic motor which is most remote from its corresponding cylinder end is directly connected to the accumulator by a path through which hydraulic fluid may flow in both directions. Should the door be manually opened, the piston of the driving motor will be moved in such a direction as to force fluid out of that end of the cylinder toward which the piston is moved. Since the remainder of the hydraulic system is closed, that fluid will be forced into the accumulator via the aforementioned path. When manual opening force on the door is released, the hydraulic fluid under pressure in the accumulator will flow back into the cylinder of the driving motor, causing the piston to return to its initial position, and thus causing the door to close. The relationship between the normal volume of the accumulator and the volume of the hydraulic fluid displaced from the motor when the door is manually opened will determine the differential in door closing force as between door closed and door opened positions—the larger the accumulator, the smaller the differential.

In order to prevent the formation of a vacuum on one side of the piston when the door is manually moved to open position, the hydraulic connections are such that hydraulic fluid not under pressure is drawn into the cylinder as the piston is moved therealong. When the door is manually released this fluid is forced back into the reservoir and the resistance to its return flow as produced by the ports, lines and valves through which it must pass, limits the speed at which the piston can return to its original position and thus serves as a check on the door closing movement. In one form here specifically disclosed, provision is made to permit the hydraulic fluid not under pressure to enter the cylinder more readily than it can leave the cylinder, thus comparatively strongly checking the door closing stroke without correspondingly impeding the manually impelled door opening movement.

The invention is here described in terms of a system which will provide pressure-return of the door to closed position when manual opening force is released, this being the conventional situation. Of course, through a mere reversal of arrangements, the door could be returned to open position after being manually moved to closed position. While door control and closed and open door positions are specifically mentioned, it will be apparent that the invention is equally applicable to the control of the movement of any power-driven object be-

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tween whatever positions may be appropriate thereto.

To the accomplishment of the above, and to such other objects as may hereinafter appear, the present invention relates to a door operating mechanism and system as defined in the appended claims and as described in this specification, taken together with the accompanying drawings, in which:

Fig. 1 is a top plan view, with the cover partially broken away, of a door operating system embodying the present invention;

Fig. 2 is a schematic view of the hydraulic connections thereof; and

Fig. 3 is a partially schematic view of an alternative system incorporating the present invention utilizing a differential-piston type driving motor and disclosing a simplified structural arrangement of the motor and accumulator units.

Referring first to Figs. 1 and 2, a base plate 2 is mounted within a casing 4 having a cover 6. All of the operative parts of the door driving system are mounted within the casing 4, thus producing a compact unit of minimal size and weight which may be very readily installed. These operative elements include a hydraulic motor 8, a four-way valve 10 operatively connected thereto, a linkage generally designated 12 by means of which movement of the piston of the motor 8 is transformed into corresponding movement of an operating arm 14 connected in any appropriate manner to a door or other object to be moved, an accumulator 16 of any desired specific construction for receiving the hydraulic fluid and holding it under pressure, an adjustable pressure-actuated switch 18 thereon which controls the operation of motor 20 which drives hydraulic pump 22, and a reservoir 24 for the hydraulic fluid employed, in conjunction with the hydraulic connections the description of which will follow.

The piston 9 of the motor 8 is connected to a piston rod 11 which extends out through the right hand end 26 of the cylinder 13 and causes a geared rack 28 to reciprocate, the rack meshing with sector gear 30, one abutment edge 32 thereof being moved into engagement with adjustable screw 34 when the rack 28 is moved to the right, as viewed in Fig. 1, corresponding to an outward projection of the piston rod 11, the screw 34 functioning as a positive stop for the moving parts of the motor 8 and linkage 12. A shaft 36 is secured to the sector gear 30, extends up through the cover 6, and the operating arm 14 is connected thereto to rotate therewith. The right hand end 26 of the cylinder 13 has an inlet port 38 connected by means of line 40 to an outlet port 42 of the valve 10. The valve 10 has an exhaust port 50 connected by means of pipe 52, T-fitting 54 and pipe 56 to an inlet port 58 at the reservoir 24. A pipe 60 connects the T-fitting 54 to port 55 of the pump 22 and functions as a by-pass for the pump 22. The left hand end 27 of the cylinder 13 is provided with another port 62 connected by means of pipe 64, check valve 66, and pipe 68 to T-fitting 70. A pipe 72 extends from the T-fitting 70 to outlet port 74 of the reservoir 24. A pipe 76 connects the T-fitting 70 to suction port 78 on the pump 22. The outlet from the pump 22 passes through outlet port 79 and adjustable flow control valve 80 to T-fitting 82. Pipe 84 connects the T-fitting 82 to the interior of the accumulator 16 via pipe 86, the pressure sensitive switch 18 being also operatively connected thereto. Pipe 88 connects the T-fitting 82 to inlet port 90 of the valve 10. The motor 8 is so connected to the door or other moving object that when the piston thereof is moved all the way to the left hand end 27 thereof having the ports 44, 62, as shown in Figs. 1 and 2, the door will be closed.

The operation of this system can perhaps best be seen from a study of Fig. 2. A supply of hydraulic fluid not under pressure is drawn from the outlet port 74 of reservoir 24 via pipes 72 and 76 through suction port 78 of

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the pump 22 and is forced out therefrom via pump outlet port 79 into the accumulator 16 via lines 84 and 86, the communicating line 88 containing fluid at the same pressure. Port 90 of the valve 10 thus constitutes its pressure inlet port. Port 50 constitutes the exhaust port of the valve, and is connected by lines 52 and 56 to the inlet port 58 of the reservoir 24. Valve port 48 constitutes an outlet port connected by means of line 46 to the motor port 44 which communicates with the left hand side of the piston 9. Valve port 42 communicates via line 40 with the motor inlet port 38 at the right hand side of the piston 9. The left hand side of the piston 9 is also connected by a port 62, line 64, check valve 66, and lines 68 and 72 with the reservoir 24, the check valve 66 permitting fluid flow in the direction indicated by the arrow 67 in Fig. 2. The line 60, communicating with the line 56, constitutes a by-pass from the pump 22 controlled by any appropriate relief valve, which may be built into the pump 22 or separately supplied, as desired.

When the door is to be power-driven to and restrainingly retained in its closed position, the valve 10, actuated in any appropriate manner, either directly or by pneumatic, hydraulic or electrical remote control, will be positioned to connect the lines 88 and 40, thus applying pressure to the right hand side of the piston 9. The valve 10 will also connect line 46 with line 52, thus permitting the left hand side of the piston 9 to exhaust into the reservoir 24. Since pressure is exerted on the right hand side of the piston 9 and no pressure is exerted on the left hand side thereof, the piston will move all the way to the left hand end 27 of the cylinder 13 to close the door.

If the door is to be power-driven to open position, the valve 10 will be actuated to connect line 46 to the line 88 and line 40 to line 52. As a result hydraulic fluid under pressure will be applied to the left hand side of the piston 9 and, the hydraulic pressure on the right hand side of the piston will be relieved. Hence the piston will be forced to the right hand end 26 of the cylinder 13, thus extending the rack 28 and causing the sector 30 to rotate until the edge 32 thereof engages the screw 34, the arm 14 correspondingly rotating and opening the door.

When the door is closed and the valve 10 is in appropriate position, as previously described, and if the door be manually opened, the motor piston 9 will be pulled to the right toward the cylinder end 26. This will cause a positive displacement of hydraulic fluid out of the end 26 of the cylinder 13, corresponding to the right hand side of the piston 9. This fluid will flow through the lines 40, 88, 84 and 86 into the accumulator 16. The left hand end 27 of the cylinder 13, corresponding to the left hand side of its piston 9, will fill with hydraulic fluid not under pressure, that fluid being sucked into that side of the cylinder primarily through the line 68, the check valve 66 and the line 64 in the direction of the arrow 67, those lines being somewhat larger in diameter than the line 46 and hence causing the left side of the cylinder to fill with fluid without exerting any appreciable resistance to movement of the piston 9. When manual opening force is released from the door, the pressure of the hydraulic fluid acting on the right hand side of the motor piston 9 will cause that piston to return to its position all the way to the left, thus causing the door to close, the hydraulic fluid not under pressure at the left hand side of the piston 9 exhausting through lines 46, 52 and 56. This exhausting action through a path of flow restricted either by the port 44, the line 46, the valve 10, or some other element, provides a cushioning action which checks the return of the door to closed position. Even if there is no electric power to the hydraulic driving mechanism, so that the pump 22 cannot be driven, the system will still function to provide hydraulically urged closing force to the door, since the connections between the right hand side of the piston 9 and the accumulator 16 are such that no appreciable leakage of hydraulic fluid

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will take place. Because of the fully closed hydraulic system, no suction impediment to opening of the door will result, and checking of door closing movement will obtain.

In the system specifically disclosed in Fig. 2 hydraulic fluid from the reservoir 24, and hence hydraulic fluid not under pressure, enters the left hand end 27 of the cylinder 13 through two paths, one of which is the fairly wide line 72, 68, 64 and the fairly wide port 62. Thus the piston 9 is comparatively free to move to the right unimpeded by any suction effect on the trailing side thereof. However, when the piston 9 moves to the left hydraulic fluid can leave the left hand end 27 of the cylinder 13 only through the comparatively restricted port 44 and the comparatively restricted lines 46, 52, 56. Hence resistance to flow of the hydraulic fluid in this return path is comparatively great, and as a result a fairly strong checking action is obtained which limits the speed at which the door will be moved to closed position through the action of the pressure within the accumulator 16. This represents a desirable but not essential refinement, and the connection 72, 68, 66, 64, 62 could be eliminated if desired, the size of the port 44, the line 46 and the other lines communicating therewith being proportioned to provide a desired compromise between freedom of movement in door opening and checking of movement in door closing.

The system disclosed in Fig. 3 differs from the previously described system in that a three-way valve 10' is employed instead of the four-way valve 10 and a differential area-piston motor structure 8' is employed, the accumulator 16' being physically integrated therewith so as to produce an especially compact structure.

The motor 8' comprises axially aligned large and small cylinders 13a and 13b respectively within which large and small pistons 9a and 9b are respectively mounted, both being secured to a piston rod 11' the operating end of which extends out beyond the free end of the large cylinder 13a. End caps 92 and 94 are mounted on opposite ends of the cylinder assembly 13a, 13b and are held in place by rods 96. The accumulator 16' is secured in any appropriate way directly to the end cap 94, and preferably axially in line with the small cylinder 13b, a passage 98 through which hydraulic fluid is freely passable in both directions defining a communication between the accumulator 16' and the interior of the small cylinder 13b. The end cap 94 also includes a passageway 100 which communicates between passage 98 and a line 102 extending from the pump 22' driven by the motor 20'. A pipe 104 connects the pump 22' to the reservoir 24'. A pipe 106 connects the pump 22' to relief valve 108, and thence, by pipe 110, to speed control valve 112, pipe 114 connecting the valve 112 to the three-way valve 10'. Pipe 116 connects the exhaust port of the valve 10' to the reservoir 24', and pipe 118 acts as a bypass between the relief valve 108 and the pipe 116. A pipe 120 connects the outlet of the valve 10' to a passage 122 in the end cap 92 which communicates with the interior of the large cylinder 13a.

The mode of operation of the system disclosed in Fig. 3 is as follows: The motor 20', controlled by a pressure-sensitive switch operatively connected to the accumulator 16', drives the pump 22' so as to maintain hydraulic pressure in the pipes 102 and 106 and in the accumulator 16' at a predetermined value. When the door is closed, the valve 10' connects the pipes 120 and 116 and plugs off the pipe 114. Hence the pressure applied to the small-area piston 13b forces the piston rod 11' to the left, the hydraulic fluid in the large cylinder 13a exhausting into the reservoir 24'. When the door is to be power driven to open position, the valve 10' is actuated in any appropriate manner to plug off the exhaust pipe 116 and to connect the pipes 114 and 120. The same pressure will therefore be exerted on the left hand side of the large-area piston 9a and the right hand side of the small area piston 9b and, because of the differences in area thereof, the

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pistons 9a, 9b, and the piston rod 11' will be moved to the right to open the door. When the door is closed and the valve 10' is appropriately positioned, and if the door should be manually opened, the piston rod 11' and the pistons 9a and 9b will be moved to the right. The hydraulic fluid within the cylinder 13b will be forced into the accumulator 16', fluid being sucked into the cylinder 13a on the left hand side of the piston 9a from the reservoir 24' and through the pipe 116, the valve 10', the pipe 120 and the passage 122. When manual force on the door is released, the hydraulic fluid under pressure active on the right hand side of the piston 9b will force the pistons and the piston rod 11' back to their position in Fig. 3, thus returning the door to its closed position, the fluid in the cylinder 13a, which is not under pressure, being returned to the reservoir 24'. As previously described in connection with the embodiment of Fig. 2, the connection 116, 120, 122 could be of a size such as to produce a desired compromise between freedom of door opening movement and checking of door closing movement.

It will be appreciated from the above description that effective door return is produced without employing any elements other than those which normally form part of the hydraulic driving system. This return will function even if power to the motor 20 has been cut off. Through the use of the apparatus and system here disclosed, a much more simple and compact hydraulic door operating mechanism may be produced than has heretofore been thought feasible when a door return feature is incorporated therein.

While but two embodiments of the present invention have been here specifically disclosed, it will be apparent that variations may be made therein, all within the scope of the present invention as defined in the following claims.

I claim:

1. An hydraulic driving system for doors and the like comprising a piston-type hydraulic motor operatively connected to said door and capable of assuming first and second operative positions corresponding respectively to first and second door positions, hydraulic pressure applied to a given side of the piston of said motor causing it and said door to assume their first positions respectively, a reservoir of hydraulic fluid, an accumulator, an hydraulic connection between said accumulator and said reservoir including means for supplying said accumulator with hydraulic fluid from said reservoir until the pressure in said accumulator reaches a predetermined value and also including means to prevent fluid flow therethrough from said accumulator to said reservoir, a first fluid-tight connection between said accumulator and said given side of said motor piston, said connection being open in both directions whenever said door is to assume said first position, the pressure transmitted by said first connection constituting substantially the sole force urging said door to said first position, and a second fluid-tight connection between said reservoir and the other side of said piston permitting fluid flow in both directions whenever said door is to assume said first position, manual movement of said door from said first position while said connections are in the status set forth above causing fluid flow from said motor through said first connection to said accumulator and from said reservoir through said second connection to said motor, the consequent increased pressure in said accumulator tending to cause fluid flow in a reverse direction to urge said door to return to its first position.

2. The system of claim 1, in which said first connection is open in both directions for both positions of said door, and means controllably active on the other side of said motor piston for overcoming the pressure on said given side thereof when said door is to be power-moved to its second position.

3. The system of claim 1, in which said motor is of

the differential piston type, said first connection being between said accumulator and the small-area side of said piston and being open in both directions for both positions of said door, said piston being movable in the direction of its small-area side to cause said door to assume its second position, and a connection between said accumulator and said large-area side of said piston via a valve which connects said accumulator to said large-area side and disconnects said large-area side from said reservoir when said door is to be power-moved to and retained in its second position and which connects said large-area side to said reservoir when said door is to be power-moved to and retained in its first position.

4. The hydraulic driving system of claim 3, in which said second connection comprises two paths between said reservoir and said other side of said piston, one of said paths offering greater resistance to fluid flow than the other, the other of said paths permitting fluid flow substantially only from said reservoir toward said other side of said piston.

5. The hydraulic driving system of claim 3, in which said second connection comprises two paths between said reservoir and said other side of said piston, one of said paths offering appreciable resistance to fluid flow in both directions, the other of said paths resisting fluid flow toward said reservoir and permitting appreciable fluid flow from said reservoir.

6. The hydraulic driving system of claim 3, in which said second connection comprises two paths between said reservoir and said other side of said piston, one of said paths being of lesser minimal cross section than the other, the other of said paths having valving permitting fluid flow substantially only from said reservoir.

7. The hydraulic driving system of claim 3, in which said second connection comprises means offering greater resistance to fluid flow toward said reservoir than from said reservoir.

8. The system of claim 1, in which the motor is of the differential piston type, a valveless connection between said accumulator and said small-area side of said piston, and a second path of hydraulic flow between said accumulator and the large-area side of said piston and including a valve having an inlet from said accumulator, an outlet to said large-area side of said piston and an exhaust communicating with said reservoir, said valve in one operative position, corresponding to power-moving said door to and retaining it in its second position, connecting said inlet to said outlet, said valve in another operative position, corresponding to power-moving said door to and retaining it in its first operative position, connecting said outlet to said exhaust.

9. In the system of claim 1, a single valve between said accumulator on the one hand and both sides of said piston on the other hand, said valve in one operative position, corresponding to power-moving said door to and retaining it in its first position, connecting said accumulator to one side of said piston and connecting the other side of said piston to exhaust, said valve in another of said positions, corresponding to power-moving said door to and retaining it in its second operative position, connecting said accumulator to said other side of said piston and connecting said one side of said piston to exhaust, a fluid-tight connection between said reservoir and said exhaust, and an additional connection between said reservoir and said other side of said piston permitting fluid flow only toward said piston.

10. An hydraulic driving system for doors and the like comprising a differential piston type hydraulic motor operatively connected to said door and capable of assuming first and second operative positions corresponding respectively to first and second door positions, an accumulator mounted on said motor, a valveless hydraulic connection between said accumulator and the small-area side of said piston, said piston being movable in the direction of its small-area side to cause said door to

assume its second position, a reservoir of hydraulic fluid, a hydraulic connection between said reservoir and said accumulator including a pump for supplying said accumulator with hydraulic fluid from said reservoir until the pressure in said accumulator reaches a predetermined value and also including means to prevent fluid flow therethrough from said accumulator to said reservoir, and a connection between said accumulator and the large-area side of said piston via a valve which connects said accumulator and large-area side when said door is to be power-moved to and retained in its second position and which connects said large area side to said reservoir when said door is to be power-moved to and retained in its first position.

11. An hydraulic driving system for doors and the like comprising a differential piston type hydraulic motor operatively connected to said door and capable of assuming first and second operative positions corresponding respectively to first and second door positions, an accumulator mounted on said motor at the small-area side of the piston thereof and being longitudinally in line therewith, a valveless hydraulic connection between said accumulator and the small-area side of said piston, said piston being movable in the direction of its small-area side to cause said door to assume its second position, a reservoir of hydraulic fluid, a hydraulic connection between said reservoir and said accumulator including a pump for supplying said accumulator with hydraulic fluid from said reservoir until the pressure in said accumulator reaches a predetermined value and also including means to prevent fluid flow therethrough from said accumulator to said reservoir, and a connection between said accumulator and the large-area side of said piston via a valve which connects said accumulator and large-area side when said door is to be power-moved to and retained in its second position and which connects said large area side to said reservoir when said door is to be power-moved to and retained in its first position.

12. The hydraulic driving system of claim 1, in which said second connection comprises two paths between said reservoir and said other side of said piston, one of said paths offering greater resistance to fluid flow than the other, the other of said paths permitting fluid flow substantially only from said reservoir toward said other side of said piston.

13. The hydraulic driving system of claim 1, in which said second connection comprises two paths between said reservoir and said other side of said piston, one of said paths offering appreciable resistance to fluid flow in both directions, the other of said paths resisting fluid flow toward said reservoir and permitting appreciable fluid flow from said reservoir.

14. The hydraulic driving system of claim 1, in which said second connection comprises two paths between said reservoir and said other side of said piston, one of said paths being of lesser minimal cross section than the other, the other of said paths having valving permitting fluid flow substantially only from said reservoir.

15. The hydraulic driving system of claim 1, in which said second connection comprises means offering greater resistance to fluid flow toward said reservoir than from said reservoir.

16. A hydraulic driving system for doors or the like comprising a piston-type hydraulic motor operatively connected to said door and capable of assuming first and second operative positions corresponding respectively to first and second door positions, hydraulic pressure applied to a given side of the piston of said motor causing it and said door to assume their first positions respectively, an accumulator containing hydraulic fluid under pressure, a first fluid-tight connection between said accumulator and said given side of said motor piston, said connection being open in both directions whenever said door is to assume said first position, a reservoir of hydraulic fluid, and a second fluid-tight connection be-

tween said reservoir and the other side of said piston permitting fluid flow in both directions whenever said door is to assume said first position, manual movement of said door from said first position causing fluid flow from said motor through said first connection to said accumulator and from said reservoir through said second connection to said motor, the consequent increased pressure in said accumulator tending to cause fluid flow in a reverse direction to urge said door to return to its first position, said second fluid-tight connection comprising two paths between said reservoir and said other side of said piston, one of said paths offering greater resistance to fluid flow toward said reservoir than the other and offering lesser resistance to fluid flow from said reservoir than the other.

17. A hydraulic driving system for doors or the like comprising a piston-type hydraulic motor operatively connected to said door and capable of assuming first and second operative positions corresponding respectively to first and second door positions, hydraulic pressure applied to a given side of the piston of said motor causing it and said door to assume their first positions respectively, an accumulator containing hydraulic fluid under pressure, a first fluid-tight connection between said accumulator and said given side of said motor piston, said connection being open in both directions whenever said door is to assume said first position, a reservoir of hydraulic fluid, and a second fluid-tight connection between said reservoir and the other side of said piston permitting fluid flow in both directions whenever said door is to assume said first position, manual movement of said door from said first position causing fluid flow from said motor through said first connection to said accumulator and from said reservoir through said second connection to said motor, the consequent increased pressure in said accumulator tending to cause fluid flow in a reverse direction to urge said door to return to its first position, said second fluid-tight connection comprising two paths between said reservoir and said other side of said piston, one of said paths offering appreciable resistance to fluid flow in both directions, the other of said paths resisting fluid flow toward said reservoir and permitting appreciable fluid flow from said reservoir.

18. A hydraulic driving system for doors or the like comprising a piston-type hydraulic motor operatively connected to said door and capable of assuming first and second operative positions corresponding respectively to first and second door positions, hydraulic pressure applied to a given side of the piston of said motor causing it and said door to assume their first positions respectively, an accumulator containing hydraulic fluid under pressure, a first fluid-tight connection between said ac-

5 cumulator and said given side of said motor piston, said connection being open in both directions whenever said door is to assume said first position, a reservoir of hydraulic fluid, and a second fluid-tight connection between said reservoir and the other side of said piston permitting fluid flow in both directions whenever said door is to assume said first position, manual movement of said door from said first position causing fluid flow from said motor through said first connection to said accumulator and from said reservoir through said second connection to said motor, the consequent increased pressure in said accumulator tending to cause fluid flow in a reverse direction to urge said door to return to its first position, said second fluid-tight connection comprising two paths between said reservoir and said other side of said piston, one of said paths being of lesser nominal cross section than the other, the other of said paths having valving permitting fluid flow substantially only from said reservoir.

19. A hydraulic driving system for doors and the like comprising a differential piston type hydraulic motor operatively connected to said door and capable of assuming first and second operative positions corresponding respectively to first and second door positions, an accumulator, a valveless hydraulic connection between said accumulator and the small-area side of said piston, said piston being movable in the direction of its small-area side to cause said door to assume its second position, a reservoir of hydraulic fluid, a hydraulic connection between said reservoir and said accumulator including a pump for supplying said accumulator with hydraulic fluid from said reservoir until the pressure in said accumulator reaches a predetermined value and also including means to prevent fluid flow therethrough from said accumulator to said reservoir, and a connection between said accumulator and the large-area side of said piston via a valve which connects said accumulator and large-area side when said door is to be power-moved to and retained in its second position and which connects said large-area side to said reservoir when said door is to be power-moved to and retained in its first position.

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