

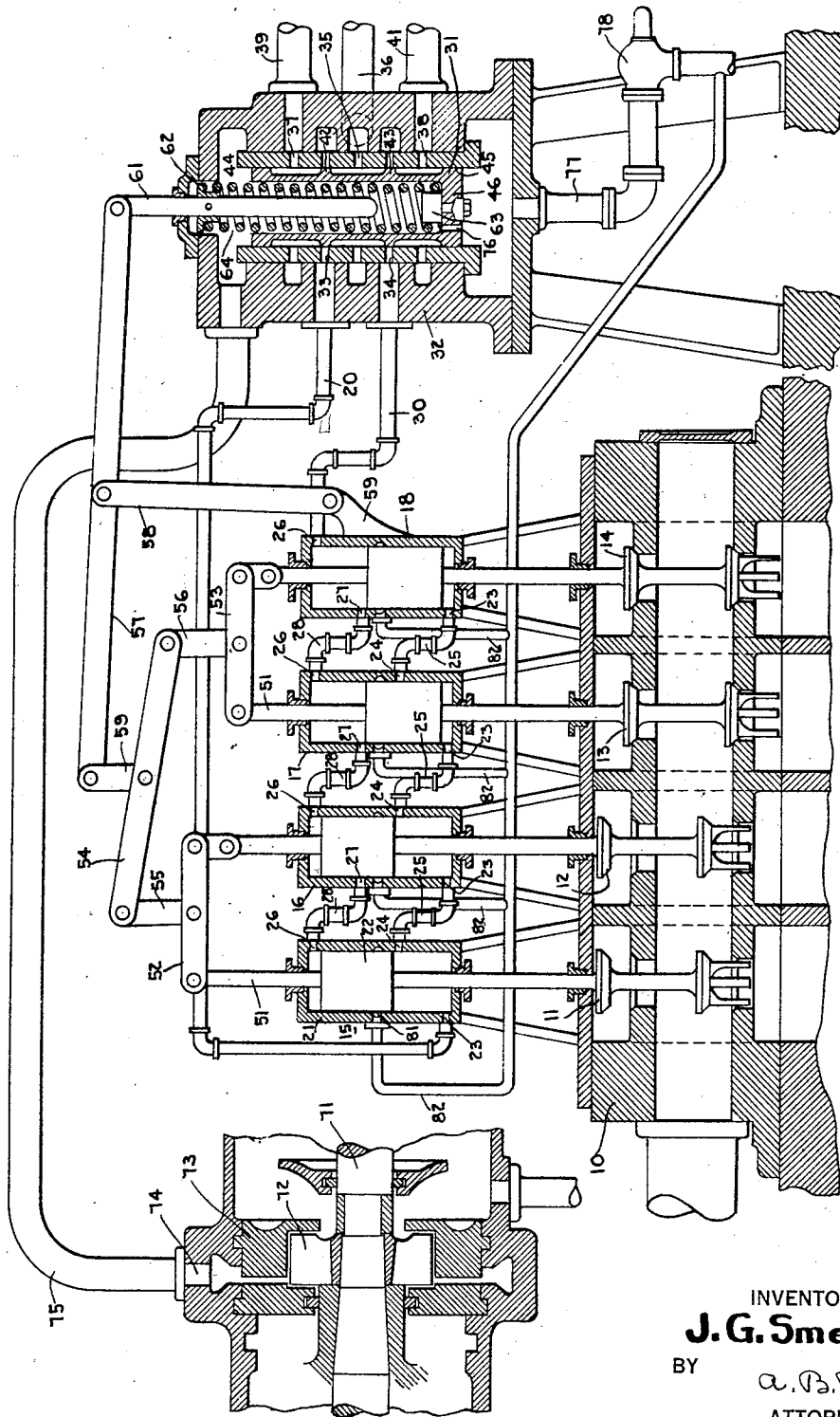
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VALVE OPERATING MECHANISM

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VALVE-OPERATING MECHANISM.

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My invention relates to a valve-operating mechanism for actuating a series of valves, and it has for its object to provide a valve-operating mechanism which will operate said 5 valves successively.

More specifically, my object is to provide a valve-operating mechanism for a steam chest embodying a plurality of valves under control of a governor, whereby said valves 10 are opened and closed in succession, and whereby a definite valve opening may be obtained for a given position of said governor.

In accordance with my invention, I provide a fluid-pressure motor for each valve, 15 and connect the motors in series in such manner that the fluid pressure, under control of the pilot valve, must pass through the motors in the order in which they are to be moved and must complete actuation of each motor before it can pass to the next motor. A follow-up mechanism connected to each motor 20 is provided for returning the pilot valve to closing position when a valve opening corresponding to the control of the governor is obtained. This mechanism includes a lever 25 connected to a motor at each end and to the pilot valve intermediate the ends. If more than two valves are to be operated, a plurality of such levers are provided.

Apparatus exemplifying my invention is illustrated in the accompanying drawing, in which:

The single figure is a diagrammatic view, with parts in section, of one embodiment of 35 my invention.

A steam chest 10 contains a plurality of valves designated 11, 12, 13 and 14, respectively. These valves are controlled by motors 15, 16, 17 and 18, respectively, each motor 40 consisting of a cylinder 21 and a piston 22. Each cylinder 21 is provided with a port 23 disposed at or near the lower end thereof, through which fluid pressure for operating the piston upwardly is admitted.

The cylinders of motors 15, 16 and 17, are each provided with a port 24, communicating with the port 23 of the adjacent cylinder shown to the right thereof, through a conduit 25. Each cylinder 21 is provided with 50 a port 26 at or near the upper end thereof for admitting fluid pressure to move the piston 22 downwardly. Each cylinder 21 of the motors 16, 17 and 18 is provided with a port 27 communicating with the port 26 of the 55 adjacent cylinder shown to the left thereof,

through a conduit 28. Each port 24 is so disposed that it will be immediately below the piston 22 when said piston is in its uppermost position, and each port 27 is so disposed that it will be just above the piston 22 when 60 said piston is in its lowermost position. The ports 24 and 27 are both covered by the piston 21 in all intermediate positions thereof.

The admission of fluid pressure to this series of motors is controlled by a pilot valve 65 31, operating in a valve casing 32. The casing 32 is provided with ports 33 and 34, the port 33 communicating with the port 23 of motor 15, through a conduit 20, and the port 34 communicating with the port 26 of the 70 motor 18 through a conduit 30. The casing is further provided with a port 35 communicating with a source of fluid pressure as through a conduit 36, and with ports 37 and 38 communicating with discharge conduits 75 39 and 41, respectively.

The pilot valve 31 is provided with piston portions 42 and 43, which normally cover the ports 33 and 34, respectively. The pilot valve 31 is also provided with piston portions 80 44 and 45 at opposite ends thereof. The pilot valve 31 is formed with a hollow interior, the upper end thereof being open and the lower end being closed as indicated at 46.

A follow-up mechanism is provided to re- 85 turn the pilot valve 31 to closed position, or the position in which the piston portions cover the ports 33 and 34, when the valves have assumed the desired opening. Each piston 22 is provided with a rod 51 extending 90 through the upper end of the cylinder 21. The ends of rods 51 of the motors 15 and 16 are pivotally connected to the opposite ends of a lever 52 and the rods 51 of the motors 17 and 18 are pivotally connected to the oppo- 95 site ends of a lever 53. The levers 52 and 53 are connected at points intermediate their ends to the opposite ends of the lever 54, preferably by links 55 and 56, respectively. A lever 57 is fulcrumed intermediate its ends 100 at the upper end of the link 58, the lower end of the link being pivoted to a stationary member such as bracket 59 carried by the motor 18. The lever 54 is connected intermediate its ends to one end of the lever 58, as by 105 a link 59. The other end of the lever 57 is pivoted to the outer end of a rod 61 which extends through the upper end of the valve casing 32.

The rod 61 is provided with a spring-hold- 110

ing member 62, and a second spring-holding member 63, disposed within the hollow interior of the pilot valve, is secured to the closed end 46 of the pilot valve. The opposite ends of a tension spring 64 are secured to the spring-holding members 62 and 63, respectively.

The prime mover to which the steam chest 10 is applied, has a rotor shaft 71 carrying an impeller 72 rotating within a casing 73. The casing 73 is provided with a discharge opening 74, communicating with the upper end of the valve casing 32 through a conduit 75.

The closed end 46 of the pilot valve 41 is provided with a restricted opening 76 through which a small quantity of fluid may pass from the upper side of the pilot valve to the lower side thereof. The lower end of the valve casing 32 is closed and communicates with a conduit 77 returning to a fluid reservoir, and interposed within the conduit 77 is a relief valve 78 which may be adjusted to provide any desired back-pressure on the fluid in the lower end of the valve casing.

The operation of the above described apparatus is as follows: Assume the prime mover which is being governed, to be carrying an intermediate load. The valves 11 and 12 are fully open and supply the necessary amount of motive fluid to carry the load. The impeller 72 rotating with the shaft 71 develops a fluid pressure which is a function of the speed of the prime mover. This pressure, which is communicated to the upper end of the valve casing, is applied to the pilot valve 31, and acts thereon in a downward direction. A portion of this fluid under pressure passes through the restricted opening 76 and passes through the conduit 77. The fluid below the pilot valve 31, however, has a back pressure imposed thereon by the relief valve 78. The pilot valve 31 is therefore urged downwardly by the resultant of the fluid pressures acting thereon, and the spring 64 is deflected until its force balances the resultant fluid pressure.

Assume now that the load imposed upon the prime mover is increased, resulting in a reduced speed thereof. The pressure developed by the impeller 72 is reduced, and the spring 64 moves the pilot valve 31 upwardly a distance corresponding to the decrease in speed; in other words, until the decreased deflection provides a decreased pressure balancing the decrease in fluid pressure. The port 33 is now placed in communication with the fluid pressure port 35 and fluid pressure flows through the conduit 20 to the port 23 of motor 15. It flows from the lower end of motor 15 through ports 24 and 23 to the lower end of motor 16, and from there through the next ports 24 and 23, to the lower end of motor 17, and moves the piston 22 therein upwardly. The port 24 of the motor 17 is covered by the piston 22 during its upward movement, and

therefore no fluid pressure is communicated to the motor 18. Upon completion of the upward movement of the piston 22, the port 24 is uncovered and the fluid pressure then flows through the next conduit 25 to the port 23 of the motor 18, and moves the piston 22 therein upwardly in the same manner.

During the above-mentioned upward movement of the piston in the motor 17, the fluid above the piston is discharged through port 26, and flows through conduit 28 to the upper end of motor 18 and thence through conduit 30 to the pilot valve.

During the upward movement of the piston 22 in motor 17, the corresponding end of the lever 53 is moved upwardly. The lever 53, in turn, moves one end of the lever 54 upwardly through the link 56, and the lever 54 moves the connected end of the lever 57 upwardly through the link 59. The rod 61 is thereby moved downwardly, permitting the pilot valve 31 to move downwardly until the piston portions 42 and 43 cover the ports 33 and 34, respectively, when movement of the valve motors ceases. The valves have now been moved to provide a definite opening corresponding to the speed of the prime mover, and, as will be clear, according to a definite deflection of the spring 64.

Assume now that the valves are again in the position shown on the drawing, and that the load on the prime mover is reduced, resulting in an increased speed. The pressure developed by the impeller 72 and imposed on the pilot valve 31, is increased correspondingly. The spring 64 is deflected until the force thereof again balances the difference in pressure above and below the pilot valve, resulting in downward movement of the pilot valve.

The port 34 is now in communication with the fluid pressure port 35, and the port 33 is in communication with the discharge port 37. The fluid pressure passes from port 34 through conduit 30 to the port 26 of the motor 18. It flows through the upper end of motor 18, through the conduit 28 to the upper end of motor 17, and thence through the next conduit 28 to the port 26 of motor 16. The fluid pressure acts on the piston 22 of motor 16 to move the same downwardly. When the piston 22 has moved downwardly the full length of its travel, the port 27 is uncovered and fluid pressure flows through the conduit 28 to the upper end of motor 15 and acts on the piston 22 therein.

As each piston 22 moves downwardly, the fluid therebeneath flows out through port 23, and the remaining conduits 25 and cylinders, to the conduit 20 and the port 33 of the pilot valve. It is then discharged through port 37 to conduit 39.

Downward movement of the pistons 22 in succession proceeds until the follow-up mechanism returns the pilot valve 31 to closing position, when the ports 33 and 34 are

covered. The valves now again provide a total valve opening corresponding to the deflection of the spring 64.

In order to prevent leakage of fluid from one end of the cylinder 21 to the opposite end, I provide an annular groove 81 in each cylinder intermediate the ports 24 and 27. In this position the groove is at all times covered by the piston 22. Any fluid which leaks between the piston and the cylinder is collected in this groove and flows by gravity to one of the drain conduits 82. This leak-off drain is important for the reason that if it were not provided the fluid would slowly leak from the high pressure end of the cylinder to the opposite end and interfere with the operation of the piston. For example, the fluid beneath the piston 22 in motor 15 would slowly leak by the piston to the top thereof, and permit the piston 22 to slowly drop by force of gravity. Upon sufficient downward movement, the piston 22 would cover the port 24 and interfere with the proper operation of the mechanism.

From the above description, it will be seen that I have provided a valve operating mechanism for a plurality of valves each having a fluid pressure motor, wherein fluid pressure is applied to the motors one at a time and wherein a total valve opening corresponding to the deflection of the spring 24, or to the speed of the prime mover, is obtained.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. The combination with a plurality of valves to be opened and closed successively, of a fluid-pressure motor connected to each valve, a pilot valve controlling the admission of fluid pressure to said motors, means for successively placing said motors in communication with said fluid pressure when admitted by said pilot valve, and means for returning said pilot valve to closing position upon movement of a motor or motors.

2. The combination with a plurality of parts to be moved successively, of a fluid-pressure motor connected to each part, a pilot valve controlling the admission of fluid pressure to said motors, means for successively placing said motors in communication with said fluid pressure when admitted by said pilot valve, and means for returning said pilot valve to closing position upon movement of a motor or motors.

3. The combination with a plurality of valves to be opened and closed successively,

of a fluid-pressure motor connected to each valve, a pilot valve controlling the admission of fluid pressure to said motors, speed-responsive means for controlling said pilot valve, means for successively placing said motors in communication with said fluid pressure when admitted by said pilot valve, and means for returning said pilot valve to closing position upon movement of a motor or motors.

4. The combination with a steam chest for a prime mover comprising a plurality of valves, of a fluid-pressure motor connected to each valve, a pilot valve for controlling the admission of fluid pressure to said motors, means for successfully placing said motors in communication with said fluid pressure when admitted by said pilot valve, and means controlling said pilot valve whereby said valves will provide a total admission opening corresponding to the speed of the prime mover.

5. The combination with a plurality of valves to be operated in a predetermined order, of a fluid-pressure motor connected to each valve, a pilot valve controlling the admission of fluid pressure to said motors, means for successively placing said motors in communication with said fluid pressure when admitted by said pilot valve, and means for returning said pilot valve to closing position upon movement of a motor or motors.

6. The combination with a plurality of parts to be moved successively, a piston connected to each part, a cylinder for each piston, a pilot valve, means providing communication between the pilot valve and one end of one cylinder, a conduit providing communication between said cylinder and one end of a second cylinder, the flow of fluid through said conduit being controlled by the piston in said first cylinder, a second conduit providing communication between the other end of the first cylinder and the second cylinder, the flow of fluid through said second conduit being controlled by the piston in said second cylinder, means providing communication between the other end of said second cylinder and the pilot valve, and means for returning the pilot valve to closing position upon movement of a piston or pistons.

7. The combination with a plurality of valves to be opened and closed successively, of a fluid-pressure motor connected to each valve, a pilot valve controlling the admission of fluid pressure to said motors, means for successively placing said motors in communication with said fluid pressure when admitted by said pilot valve, and means providing connection between each motor and the pilot valve whereby movement of the motor in response to fluid pressure moves the pilot valve in a direction to closed position.

8. The combination with a plurality of

valves to be opened and closed successively, of a fluid-pressure motor connected to each valve, a pilot valve controlling the admission of fluid pressure to said motors, means for
5 successively placing said motors in communication with said fluid pressure when admitted by said pilot valve, and a lever connected at one end to one motor, at the other end to another motor, and between its ends to the
10 pilot valve.

9. The combination with a plurality of valves to be opened and closed successively, of a fluid-pressure motor for each valve, a pilot valve controlling the admission of fluid
15 pressure to said motors, means providing communication between said pilot valve and one motor, means responsive to movement of said one motor for placing another motor in communication with said pilot valve, and
20 means for returning said pilot valve to closing position upon movement of a motor or

motors.

10. The combination with a plurality of admission valves for a prime mover, of a fluid-pressure motor for each valve, a pilot
25 valve controlling the admission of fluid pressure to said motors, means providing communication between said pilot valve and one motor, means responsive to movement of said one motor for placing another motor in com-
30 munication with said pilot valve, means controlling said pilot valve in response to speed of the prime mover, and means returning said pilot valve to closing position upon
35 move of a motor or motors.

In testimony whereof, I have hereunto subscribed my name this eleventh day of April, 1927.

JUSTIN G. SMEBY.