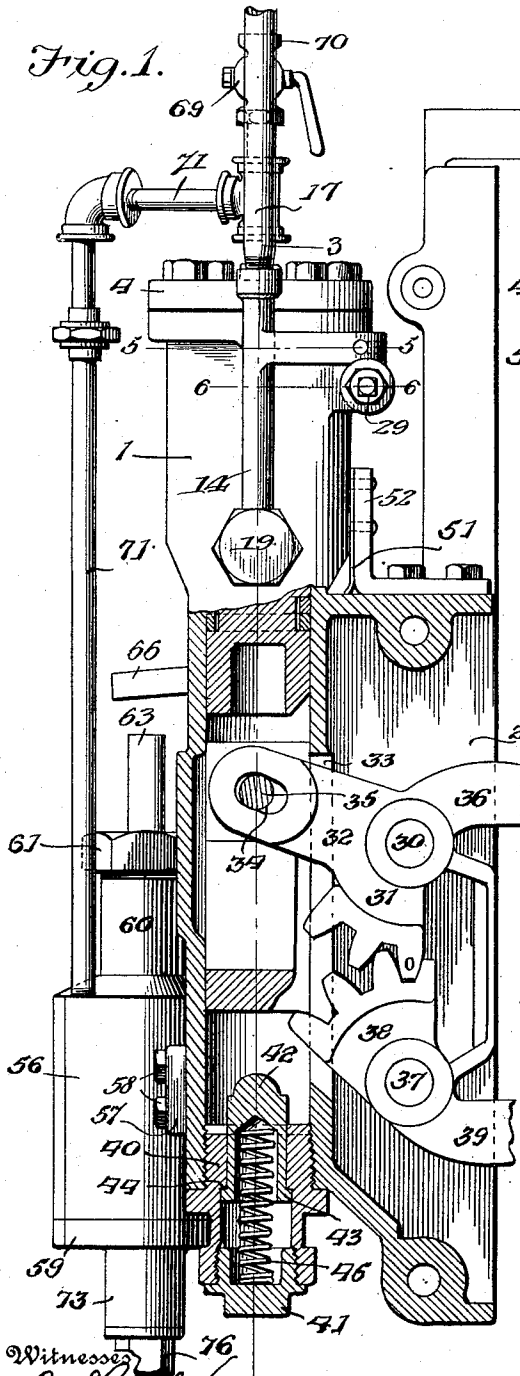


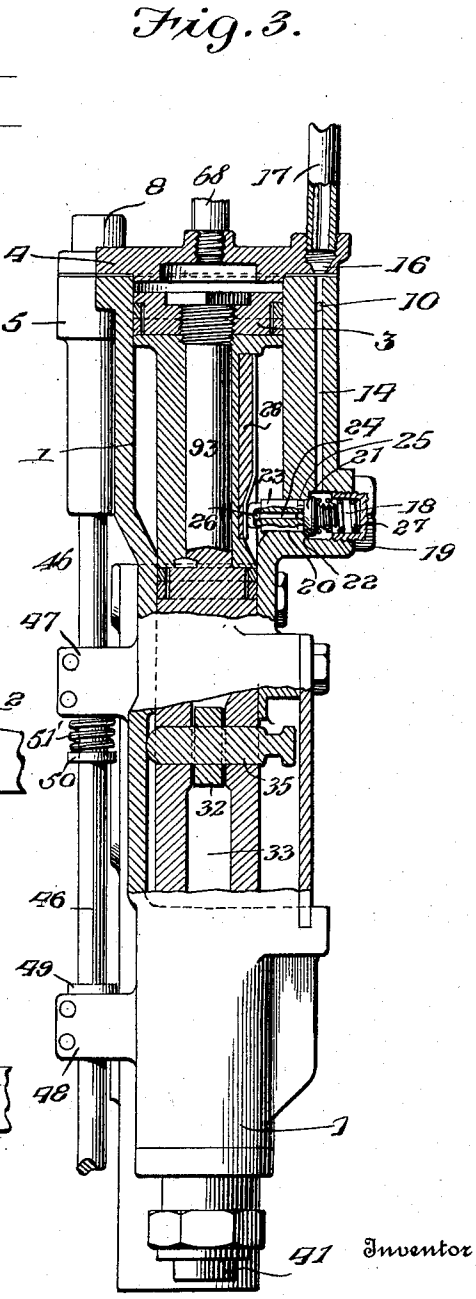
G. AKANS.
 FLUID ACTUATED MOTOR.
 APPLICATION FILED OCT. 21, 1914.

1,156,855.

Patented Oct. 12, 1915.
 5 SHEETS—SHEET 1.



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FLUID ACTUATED MOTOR,
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5 SHEETS—SHEET 2.

Fig. 2.

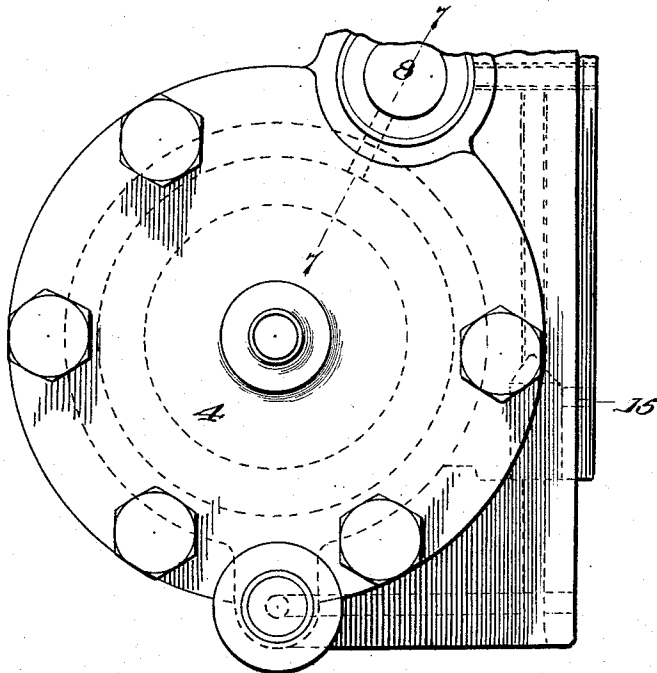
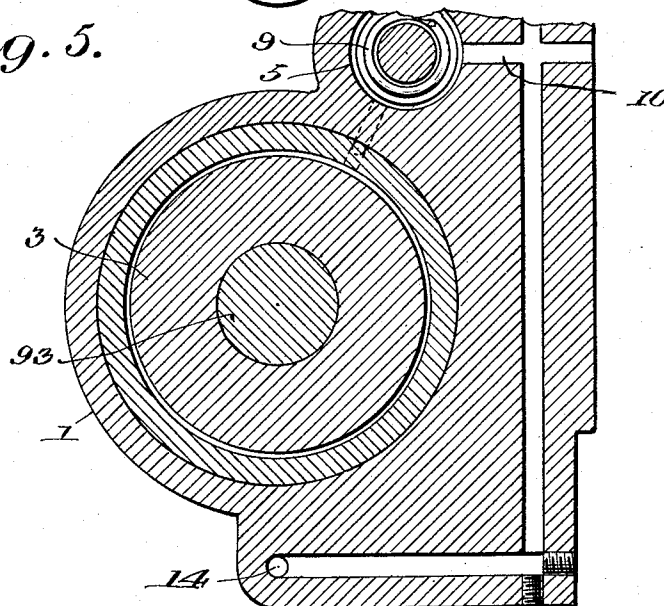


Fig. 5.



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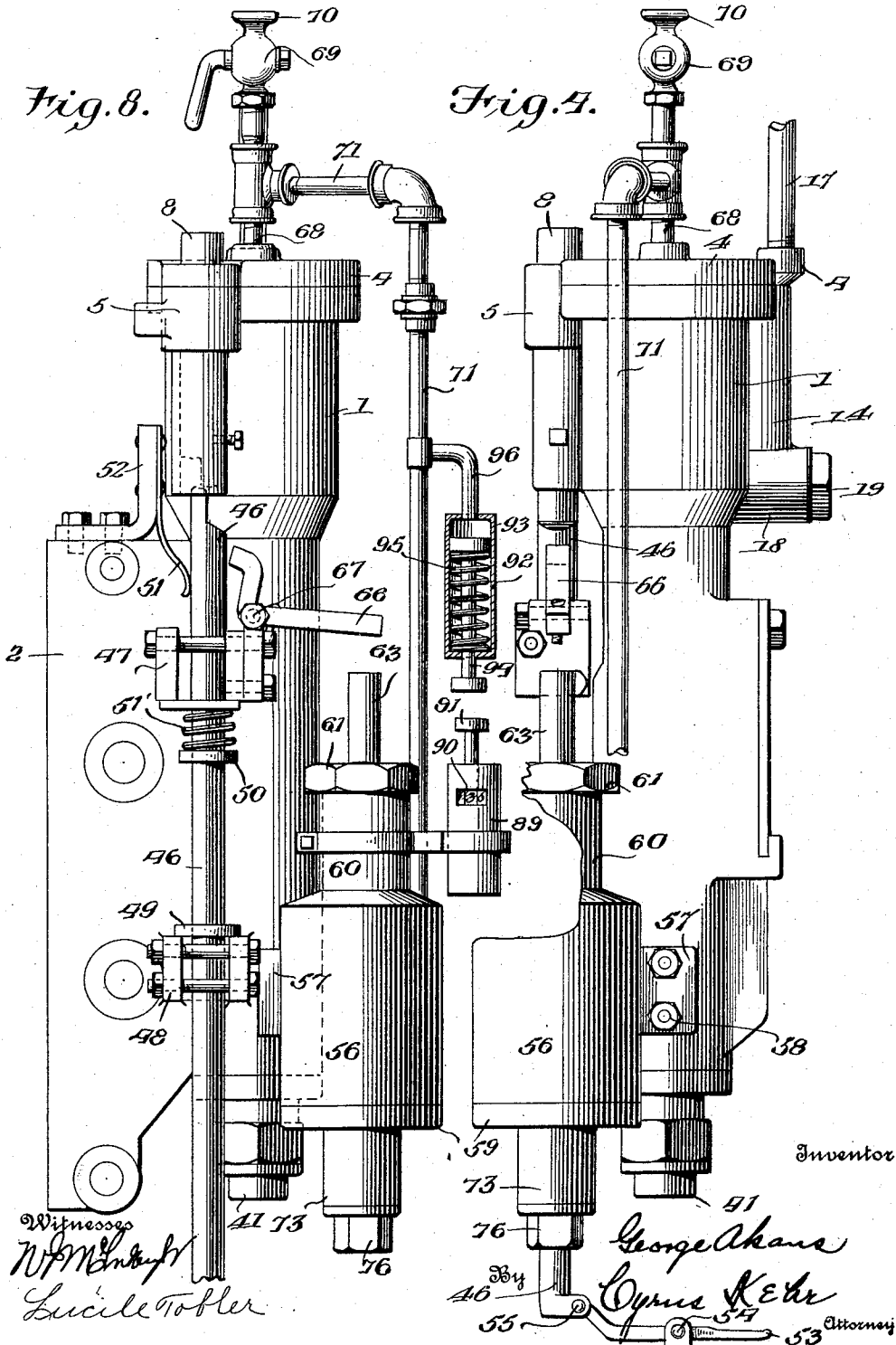
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5 SHEETS—SHEET 3.



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5 SHEETS—SHEET 4.

Fig. 6.

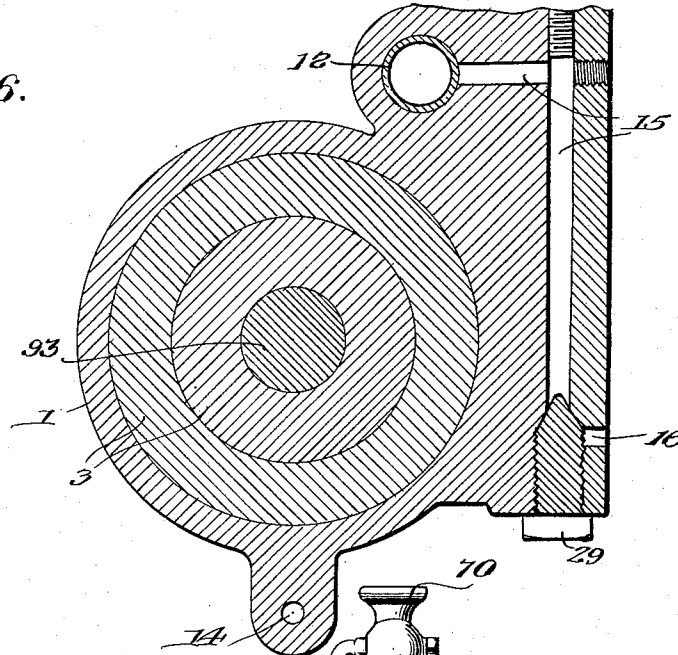
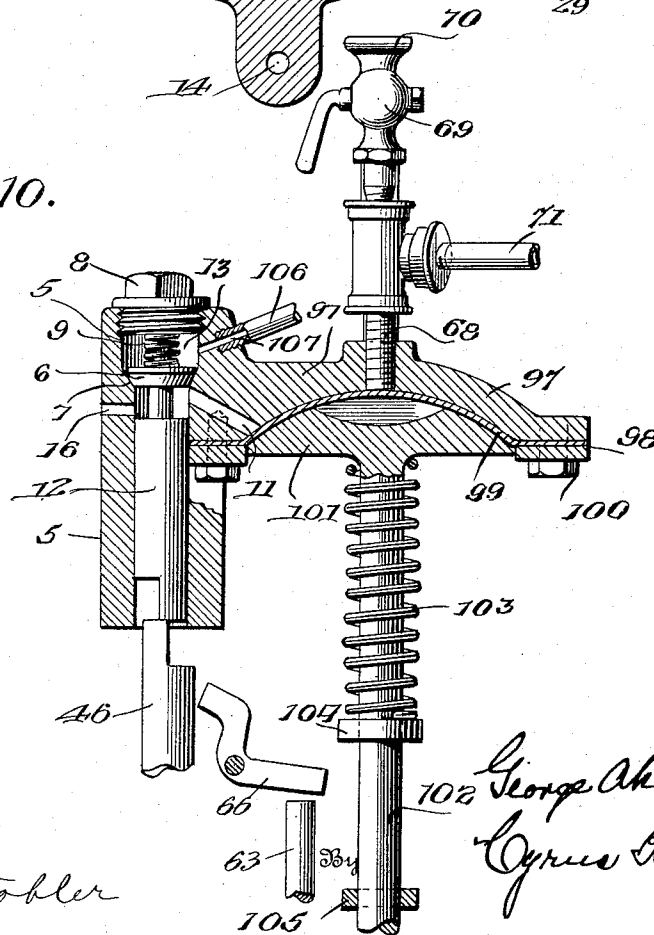


Fig. 10.



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Patented Oct. 12, 1915.
5 SHEETS—SHEET 5.

Fig. 9.

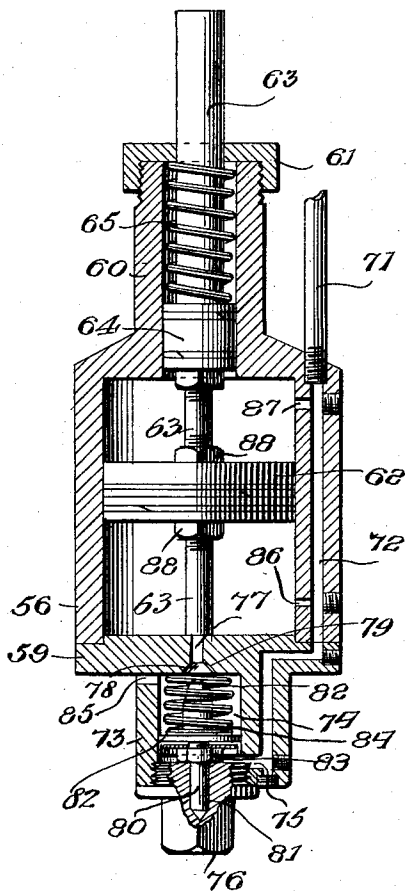
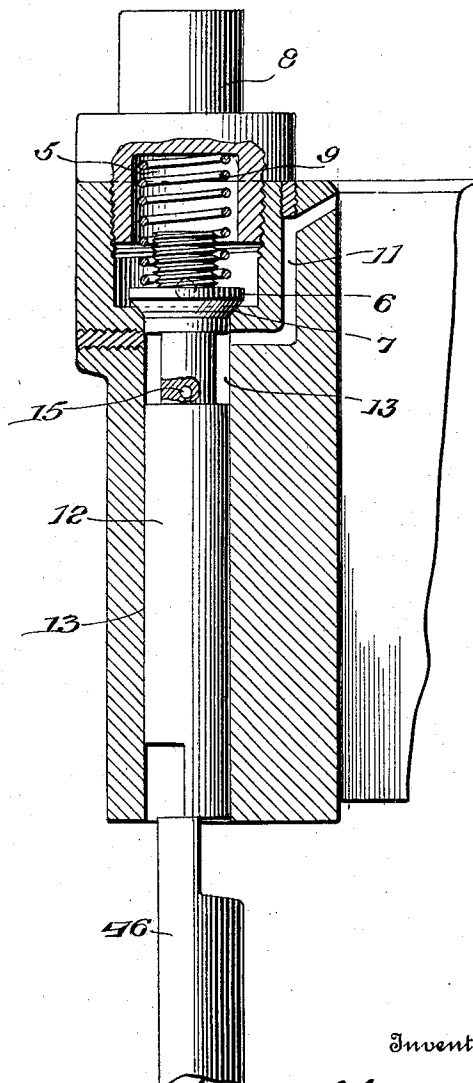


Fig. 7.



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UNITED STATES PATENT OFFICE.

GEORGE AKANS, OF ATLANTA, GEORGIA, ASSIGNOR TO SAID GEORGE AKANS, TRUSTEE.

FLUID-ACTUATED MOTOR.

1,156,855.

Specification of Letters Patent.

Patented Oct. 12, 1915.

Application filed October 21, 1914. Serial No. 867,825.

To all whom it may concern:

Be it known that I, GEORGE AKANS, a citizen of the United States, residing at Atlanta, in the county of Fulton and State of Georgia, have invented a new and useful Improvement in Fluid-Actuated Motors, of which the following is a specification, reference being had to the accompanying drawing.

My improvement relates particularly to fluid actuated motors comprising an expansion chamber which contains a piston or a similar reciprocatory member driven by fluid under pressure, the admission of such fluid for actuating the piston or similar member being under the control of an operator or of mechanism associated with the motor.

The object of my invention is to embody in the motor automatic fluid-actuated means for limiting the duration of the action of the fluid upon the piston or similar member after the operator or such associated mechanism has moved a member for establishing admission of fluid under pressure for moving said piston or similar member from its position of rest. As an example of use for such a motor, I mention the control of locomotive and other steam boiler fire box doors, the pressure fluid used being, usually, air, and the main piston of the motor being in its position of rest when the doors are closed, and being driven from its position of rest for the opening of the doors, and the valve by which air is admitted for driving the piston from its position of rest being normally closed and being opened by pressure of the foot of the fireman upon a pedal which is connected with transmission members leading to said valve.

My improved motor comprises means for automatically destroying operative relation between the pedal and the main valve after the valve has been open a chosen time; to the end that the doors may remain open only during a proportional period of time, although the fireman prolongs the pressure upon the pedal.

The various parts are to be so proportioned and adjusted as to cause the doors to be opened just long enough to allow the fireman to deliver a shovelful of coal through the door into the fire box. By limiting the period during which the door is open, the quantity of cold air rushing into the fire box through the door is limited. As

is known to those familiar with this art, the admission of an excessive quantity of cold air into the fire box of a steam boiler chills the fire and inner portions of the boiler, including flues; and such chilling interferes with combustion of fuel and reduces the production of steam and injures flues and other portions of the boiler. Furthermore, such control of the door prevents the fireman from feeding coal in excessive quantities at any one time. He is obliged to feed evenly during the time he is on duty. This leads to more complete and uniform combustion of the coal and tends to avoid wasting fuel and making smoke. It is to be noted that when such doors are thus operated, it is desirable that both the opening and closing movements be relatively rapid, in order that the doors may remain closed as long a time as possible.

The portion of the motor which comprises the above-mentioned piston or similar member may be of any desired form. This portion, as shown and described in this application, is already known in the art and has been used for the control of steam boiler fire box doors.

In the accompanying drawings, Figure 1 is a front view partially in section of a structure embodying my improvement; Fig. 2 is a top view; Fig. 3 is a partial section on the line, 3—3, of Fig. 1; Fig. 4 is a side view looking at the apparatus from the left as shown in Fig. 1; Fig. 5 is an enlarged section on the line, 5—5, of Fig. 1; Fig. 6 is an enlarged section on the line, 6—6, of Fig. 1; Fig. 7 is an enlarged fragmentary section on the line, 7—7, of Fig. 2; Fig. 8 is a rear elevation, portions being broken away; Fig. 9 is an upright section of the secondary cylinder; Fig. 10 is a sectional elevation of a motor embodying my invention and comprising a flexible diaphragm.

The main cylinder, 1, is shown upright and as having a plate, 2, by means of which the cylinder may be secured to any other structure. In the cylinder is the main piston, 3, which is in its position of rest when it is close to the head, 4, of the cylinder. The piston is to be driven downward by air entering the cylinder above the piston.

In the valve chamber, 5, is a main valve, 6, adapted to rest on a seat, 7. The upper portion of said chamber is formed by a cap, 8, which is screwed into the adjacent portion of the cylinder. Within said cap is an

expanding coiled spring, 9, bearing downward upon the valve and normally holding the latter against the seat, 7, which is the closed position of said valve. Air is admitted to said chamber through the port, 10. Below the valve seat, a port, 11, extends through the cylinder wall into the interior of the cylinder above the piston. A stem, 12, extends downward through a passage, 13. Immediately below the valve, said stem is of smaller diameter than said passage, whereby space is left around the stem within said passage. Below said contracted portion, said stem is made of the full diameter of said passage so as to prevent downward flow of air through said passage. At the lower end of said stem, one side thereof is cut away. The port, 10, leads from the port, 14. An exhaust port, 15, leads from the valve stem passage, 13, to the outside exhaust port, 16. A supply pipe, 17, containing air under pressure is screw-threaded into the cylinder head, 4, in communication with the port, 14. The lower portion of said port opens into a valve chamber, 18, the outer portion of which is formed by a cap, 19, which is screw-threaded into the side wall of the cylinder. In horizontal alinement with said chamber is a horizontal passage, 20. A valve, 21, is located within said chamber, 18, and bears normally against a seat, 22, and has a stem, 23, resting in said passage and extending into the interior of the cylinder. Next to the valve, said stem is contracted so as to form an open space around said stem within said passage. Said stem has a passage or duct, 24, along its axis, and next to the valve a duct, 25, intersects said duct, 24, and within the cylinder, a transverse duct, 26, intersects the axial duct, 24. An expanding coiled spring, 27, is located within the chamber, 18, and bears endwise against the cap, 19, and against the valve, 21, for normally pressing said valve to its seat.

Below the valve, 21, and at its stem, 23, the interior diameter of the cylinder, 1, is contracted to conform to the diameter of the neck or stem of the piston, whereby the stem is held to linear movement. The neck of the piston has a cam, 28, opposite the valve stem, 23, the lower portion of said cam permitting the valve, 21, to seat when the piston is in its upper or rest position. The portion of said cam which is above said stem when the piston is in its upper position extends outward toward the cylinder wall, so that when the piston is driven downward, said cam will push said stem outward and unseat the valve, 21. While the head is descending, the valve, 21, is open, so that air is driven out through that valve and up through the port, 14, into the supply pipe, 17, and through the duct, 10, into the space above the piston. The piston is differen-

tial, because the area on its lower face is less than the area of the upper face, the difference being the cross-sectional area of the piston neck. Hence the piston is driven downward when the main valve, 6, and the valve, 21, are both open.

When the valve stem, 13, is pushed upward by pressure on the pedal hereinafter described, the main valve, 6, is raised so that air may flow from the valve chamber, 5, downward into the passage, 13, and thence upward through the port, 11, into the interior of the cylinder above the piston head. By this means, this piston is started downward, the valve, 21, being at the time closed. Soon the cam, 28, forces the stem, 23, and the valve, 21, outward, so that air under pressure may communicate downward through the port, 14, the chamber, 18, and the valve, 21, and the stem, 23, into the interior of the cylinder below the piston head. The pressure of this air is the same as the air passing through the port, 10, into the upper portion of the cylinder; but since the piston is a differential piston, as above stated, the downward pressure over-comes the upward pressure, and the piston continues to move downward until it reaches its lower limit. During such descent of the piston, the air bearing against the piston from below is driven outward through the valve chamber slowly and, before it is thus expelled, it serves as a cushion or retarding medium to avoid such rapid movement as would cause jarring or slamming of the fire box doors or other part or parts connected with the piston to be operated by the latter.

When the main valve stem, 12, is pushed upward for opening the main valve, the portion of said stem which is of full diameter extends across the exhaust port, 15, so that air can not pass from the upper portion of the cylinder nor from the main valve chamber through said exhaust port. When the main valve stem is again released and allowed to descend through the action of the coiled spring, 9, said valve returns to its seat, and then the valve stem moves downward and uncovers the exhaust port, 15. Then air can no longer enter through the port, 10, and air may escape from the upper portion of the interior of the cylinder through the port, 11, and the port, 15. An adjusting screw, 29, is seated to extend into and vary the port, 15. By means of such variation, the flow of air from the upper portion of the cylinder during the upward movement of the piston may be varied and such air made to act in varying degrees as a retarding medium or cushion for avoiding objectionably rapid return of the piston to its upper position.

It will be observed that the cam, 28, is so arranged that the valve, 21, closes when the piston reaches its upper limit, pressure being

then cut off from both sides of the piston. On the plate, 2, is a journal, 30, which supports a segment gear, 31, on which is an arm, 32, which extends into a slot, 33, in the piston stem and has a slot, 34, which receives a pin, 35, which is seated in the piston stem. From said segment gear an arm, 36, extends outward horizontally away from the cylinder. A journal, 37, is supported by the plate, 2, below the journal, 30, and said journal, 37, supports a segment gear, 38, meshing with the segment gear, 31. On the segment gear, 38, is an arm, 39, extending away from the cylinder parallel to the arm, 36. When the piston is driven downward, the arm, 32, is driven downward and the segment gear, 31, rotated to lift the arm, 36, and the segment gear, 31, turns the segment gear, 38, upward to move the arm, 39, downward. Said arms may support fire box doors (not shown) or any other members.

A tube, 40, is screw-threaded into the lower end of the cylinder. A cap, 41, is screw-threaded into the lower end of said tube. A hollow cushion block, 42, rests slidably in the upper portion of the tube, 40, and projects upward out of said tube into the interior of the cylinder. The lower end of said block has a head, 43, adapted to bear upward against the shoulder, 44, in the tube, 40, said shoulder limiting the upward movement of said cushion block. An expanding coiled spring, 45, is located within the block, 42, the tube, 40, and the cap, 41, and normally presses said block upward to its upper limit. When the piston stem moves downward far enough to bear against the upper end of said cushion block, the latter bears yieldingly against the piston, and the downward movement of the piston is thus gradually arrested.

The portion of the mechanism thus far described has been heretofore used, and a pedal has been used to raise the main valve.

The mechanism whereby connection between the pedal or similar device and the main valve is destroyed automatically, after the lapse of a chosen period of time will now be described. The upper end of the valve bar, 46, normally rests just below and in approximate alinement with the lower end of the valve stem, 12, so that when said bar is pushed upward it will abut against the lower end of said stem and push the latter upward. Said bar is slidable in an upper bearing, 47, and a lower bearing, 48. The downward movement of said bar is limited by a collar, 49, fixed on said bar above the lower bearing, 48, and adapted to rest on said bearing. Below the upper bearing, 47, an annular shoulder, 50, supports said bar, and an expanding coiled spring, 51, surrounds said bar between said shoulder and said bearing and normally exerts such pressure against said bearing and said

shoulder as will cause the bar to move downward until the collar, 49, rests on the bearing, 48. The collar, 49, should be so placed as to bring the upper end of the valve bar a little below the lower end of the valve stem when the valve is seated. The bearings, 47, and 48, are large enough to allow the upper portion of the valve bar, 46, to move laterally in a plane parallel to the plate, 2. A blade spring, 51, is supported by a bracket, 52, which rests on the plate, 2. Said spring bears against the valve bar from the left, as viewed in Fig. 8, and the relative location of the parts is such as to bring the upper end of the valve bar approximately into alinement with the lower end of the valve stem when the valve bar has been pushed as far toward the right as the bearing, 47, permits. A pedal, 53, is fulcrumed on a support, 54, and has one end hinged to the lower end of the valve bar at 55.

When the foot of the fireman or other operator is pressed downward on the free end of the pedal, the opposite end rises and lifts the valve bar, pressing the upper end of said bar against the lower end of the valve stem, 12, and pushing said stem and the valve, 6, upward. This allows the air entering through the port, 10, to pass downward from the valve chamber around the valve and thence laterally through the port, 11, into the space between the piston, 3, and the head, 4, of the cylinder, 1. Pressure is thus exerted upon the piston and the latter is driven downward for the accomplishment of any work to be done by the motor. While the parts are in this relation, the valve remains open and the air pressure is maintained.

When the valve bar, 46, is pushed aside against the pressure of the blade spring, 51, the upper end of said bar is moved out of alinement and out of engagement with the main valve stem, whereby the main valve is made free to move downward in response to the pressure of the spring, 9. The valve bar is thus moved sidewise through the action of a secondary fluid-actuated expansion chamber which is put into action when air is admitted into the main expansion chamber for driving the main piston downward. The secondary expansion chamber is so constructed and arranged as to operate so slowly as to continue to be in action when the piston, or similar member, of the main expansion chamber has been from its position of rest the desired length of time. In other words, when my motor is applied for operating the doors of a fire box, the difference between the action of the two expansion chambers is made sufficient to allow the fire box doors to be separated from each other by fluid pressure in the main expansion chamber as long as may be desired, the movement of a portion of the secondary ex-

pansion chamber then acting to permit the seating of the main valve. The secondary expansion chamber, as will be hereinafter described, is adapted to adjustment for varying the time required for its action after the main valve has been opened.

In the form illustrated by the drawings, the secondary expansion chamber comprises a cylinder, 56, on which is a bracket, 57, which is bolted against the lower portion of the main cylinder by means of screw bolts, 58. On the lower portion of the cylinder, 56, is a head, 59. The upper portion of said cylinder is contracted to form a tubular neck, 60, on the upper end of which is a head, 61. Within the cylinder is a piston, 62, having a stem 63. Said stem extends through said neck and the head, 61, and a small piston, 64, surrounds said stem in said neck. Above the small piston is an expanding coiled spring, 65, which bears against said piston and the head, 61, and yieldingly resists the upward movement of the small piston, said spring constituting a yielding means for retarding the upward movement of the two pistons.

The stem, 63, projects upward through the head, 61, far enough to bear against the bell-crank form trigger, 66, when said stem is driven upward to its upper limit. Said trigger is hinged at 67 on the upper valve bar bearing, 47, and one arm of said trigger extends upward and approximately touches the valve bar, when the latter is in normal position, and the other arm extends horizontally into the path of the stem, 63. On the head, 4, of the main cylinder is a pipe, 68, which is tapped through said head so as to communicate with the space between said head and the main piston. On the upper end of said pipe is a cut off valve, 69, and above said valve is an oil cup, 70. By means of said cup and said cut off valve and said pipe oil may be admitted into the main cylinder, the cut off valve being normally closed. Between said valve and the cylinder head, 4, a pipe, 71, is connected with the pipe, 68, and leads thence downward into the wall of the secondary cylinder and is there made to communicate with a duct, 72, extending downward through said wall. On the cylinder head, 60, is a neck, 73, in which is a valve chamber, 74. The duct, 72, leads downward and communicates with said chamber through a port, 75, immediately above the cap, 76, which forms the bottom of the chamber, 74.

A port, 77, extends through the head, 59, above the chamber, 74. A valve, 78, is located within said chamber and is adapted to bear against the seat, 79, at the lower end of said port. Said valve has a stem, 80, extending slidably into a chamber, 81, in the cap, 76. The upper portion of said stem is surrounded by a piston, 82, which fits the

interior of the chamber, 74. A nut, 83, is threaded around the stem, 80, and bears upward against the piston, 82. Normally said nut rests upon the upper face of the cap, 76. An expanding coiled spring, 84, surrounds the valve between the piston and the head, 59, and normally presses said valve downward so as to leave the port, 79, open. In the wall of the chamber, 74, close to the head, 59, is a port, 85, making communication between the chamber, 74, and the outer atmosphere. Near the head, 59, a port, 86, in the wall of the secondary cylinder forms communication between the duct, 72, and the portion of the interior of the cylinder below the piston, 62; and above said piston a port, 87, forms communication between the duct, 72, and the interior of the cylinder. The port, 86, is smaller than the port, 87, in order that air may flow into the lower portion of the secondary cylinder more slowly than it flows into the upper portion of said cylinder. The lowest position is the position of rest of the piston, 62, the lower end of the stem, 63, resting on the head, 59, over the port, 77.

The operation is as follows: When the main valve, 6, is closed, there is no air pressure through the pipe, 71, into the duct, 72; for the pipe, 71, receives air from the interior of the upper portion of the main cylinder through the pipe, 68 (which is also used for delivering oil into the interior of the cylinder). When the main valve, 6, is opened, air is driven through the pipes, 68 and 71, and the duct, 72, and the port, 75, into the space below the piston, 82, in the chamber, 74, whereby said piston and the valve, 78, are driven upward until said valve is seated and closes the port, 77, air above said piston being exhausted through the port, 85. Thus the port, 77, is closed from below by the time the piston stem, 63, moves upward and uncovers the upper portion of said port. The space below the piston, 82, being less than the space in the lower portion of the cylinder, 56, the valve, 78, is seated before the piston, 62, is moved. At the same time the air enters the port, 75, air also enters the ports, 86 and 87. Since the port, 87, is larger than the port, 86, greater pressure is established in the portion of the cylinder chamber above the piston, 62, whereby downward pressure, additional to the downward pressure of the spring, 65, is exerted upon the piston, 62, to prevent the rising of said piston in response to upward pressure of air within the cylinder below said piston. But by continued flow or air through the port, 86, air pressure in the upper and lower portion of the cylinder becomes equalized. Then, on account of the larger net area of the lower side of the piston, 62, the piston is driven upward against the combined down-

ward pressure of the spring, 65, and the air pressure on the upper side of the piston. In this connection, it is to be observed that the effective or net area of the upper side of the piston is obtained by deducting the area of the small piston, 64. When the piston is thus driven upward, the upper end of the piston stem, 63, bears against the horizontal arm of the trigger, 66, and tilts the trigger so as to make it engage the valve bar, 46, and push it sidewise until it becomes disengaged from the stem, 12, of the main valve, 6, whereupon said valve is pushed downward to its seat by the action of the spring, 9, and the downward pressure of the air in the valve chamber, 5. As soon as the main valve is thus seated, pressure through the pipe, 71, is cut off. This allows the spring, 65, to drive the pistons, 64 and 62, downward. At the same time that pressure ceases through the pipe, 71, the spring, 84, drives the valve, 78, and the piston, 82, downward, the air beneath the piston, 82, being driven outward through the port, 75, and the duct, 72. During the downward movement of the piston, 62, the air below said piston is driven through the ports, 77, and, 85, into the atmosphere and also outward through the port, 86, and thence upward through the duct, 72, and then inward through the port, 87, into the upper portion of the cylinder chamber. The opening in the head, 61, is large enough for the easy outward and inward passage of air around the piston stem, 63, when the small piston moves up or down. The downward movement of the pistons and the piston stem is arrested when the lower end of said stem bears upon the lower head, 59, of the cylinder. When that occurs, said stem covers the port, 77; but that is immaterial, because the air need not pass through said port while said stem is in such position. Before said stem again rises to uncover said port, said port is closed from below by the seating of the valve, 77.

From the above description, it will be seen that the opening of the fire box doors is started or initiated by the fireman. When he has pressed the pedal, 53, the valve, 6, is raised, and then the cycle of movements already described starts and progresses until the door is again closed.

The length of time during which the door remains open depends upon the length of time consumed between the admission of air through the pipe, 71, into the cylinder, 56, and the driving of the piston, 62, to its upper limit. This again depends upon two factors; (1) the difference between the capacities of the ports, 86 and 87, (2) the difference between the space below the piston, 62, and the space above said piston when the piston is at its lower limit. In construction, the ports, 86 and 87, are made approxi-

mately in the right proportion, and provision is made for adjusting the piston, 62, up and down to change the relation of the spaces above and below the piston. For this purpose, the lower portion of the stem, 63, is screw-threaded and the bore of the piston is made large enough to be movable endwise on said stem. At each side of the piston is a nut, 88. By loosening either of said nuts, the other may be driven forward for moving the piston in the corresponding direction. The first nut may then be driven against the piston for binding the latter in its new position on the stem.

An apparatus which I have constructed and put into operation is adapted to hold the door open during a period ranging from 2 seconds to 7 seconds, according to adjustment; and I have adjusted it for a period of 3 seconds, which I have found by observation is a minimum time during which a fireman can conveniently insert a shovel of coal.

A register, 89, showing numbers through the opening, 90, is secured against the neck of the cylinder, 56. On the register is an upright stem, 91, which is pressed downward for making the registrations. The register may be of any desired form. Above the register is a cylinder, 92, in which is a piston, 93, having a stem, 94, extending downward through the lower head of said cylinder and abutting against the stem, 91, of the register. An expanding coiled spring, 95, surrounds said stem below the piston, 93, and normally bears said piston and the stem, 94, upward. A pipe, 96, leads from the upper ends of the cylinder, 92, into the pipe, 71, so that when air pressure is put into said pipe, as already described, air pressure will extend from the pipe, 71, into and through the pipe, 96, whereby the piston, 93, is driven downward. This causes the valve stem, 94, to press the register stem, 91, downward far enough to cause a registration. When air pressure in the pipe, 71, is released, air pressure in the pipe, 96, and the cylinder, 92, is also released. Then the expanding coiled spring, 95, forces the piston, 93, upward. This allows the stem, 91, of the register to be moved upward by the mechanism of the register. Then these parts are again ready to repeat downward movement to make another registration. Thus all the movements of the valve, 6, and the piston of the main cylinder and the parts depending upon the movement of said piston are registered. Hence the register will show how often the door was opened during any given period.

Fig. 10 shows another form of the main expansion chamber. A head, 97, resembling the head, 4, of the main cylinder already described, is concave on its inner side. The stem, 102, is slidable endwise in bearings, 130

104 and 105, and is axially in alinement with the concave portion of the head, 97. Adjacent the head, 97, the stem, 102, bears a head, 101. Between said head and the head, 97, is a flexible diaphragm, 99, having its edges extending outward beyond the concave portion of the head, 97, and between a ring, 98, and the adjacent face of the head, 97. Bolts, 100, extend through said ring and engage said head, whereby the edge of said diaphragm is sealed against the passage of air. An expanding coiled spring, 103, surrounds the stem, 102, between the guide, 104, and the head, 101, and serves as a constantly-acting means tending to move the head, 101, and the stem, 102, toward the diaphragm, 99, and the head, 97. The main valve chamber, 5, already described, is formed on the head, 97, and associated with said chamber are the valve, 6, seat, 7, cap, 8, spring, 9, stem, 12, passage, 13, and exhaust port, 16. And the port, 11, leads from the upper portion of the passage, 13, through the head, 97, into the space between said head and the diaphragm, 99. A pipe, 106, leading from a constant source of fluid pressure is tapped into the wall of the valve chamber, 5, and a duct or port, 107, leads from said pipe into said chamber. The pipe, 68, cut off valve, 69, an oil cup, 70, are applied at the middle of the head, 97, as already described with reference to the cylinder head, 4; and the pipe, 71, is joined to the pipe, 68, as already described with reference to the cylinder head, 4. The valve bar, 46, is applied below the valve stem, 12, as already described. The trigger, 66, is located beside the valve bar, 46, and the second expansion chamber is located adjacent the trigger, only the upper portion of the stem, 63, of said chamber being shown. When the bar, 46, is pushed upward and raises the stem, 12, and the valve, 6, said stem covers the port, 16, and air flows from the pipe, 106, through the port, 107, the chamber, 5, into the upper portion of the passage, 13, and through the port, 11, into the space between the head, 97, and the diaphragm, 99. The air presses the diaphragm against the head, 101, and thereby presses said head and the stem, 102, away from the head, 97, the chamber, formed by the head, 97, and the diaphragm being made larger and larger. Air passes through the pipes, 68, and 71, into the second expansion chamber, whereby the stem, 63, is driven upward to tilt the trigger, 66, and make the latter bear against the side of the valve bar, 46, for pushing said bar sidewise.

I claim as my invention,

1. In a mechanism of the nature described, the combination of a fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding

means tending to close said valve, transmission means (separate from said yielding means) for opening said valve, and automatic means for interrupting the action of said transmission means, whereby the valve is freed for closing, substantially as described.

2. In a mechanism of the nature described, the combination of a fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, transmission means separate from said yielding means and controlled by the operator for opening said valve, and automatic means for interrupting the action of said transmission means, whereby said valve is freed for closing, substantially as described.

3. In a mechanism of the nature described, the combination of a main fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, transmission means for opening said valve, and a second fluid-actuated expansion chamber for interrupting the action of said transmission means, whereby the main valve is freed for closing, substantially as described.

4. In a mechanism of the nature described, the combination of a main fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, transmission means controlled by the operator for opening the main valve, and a second fluid-actuated expansion chamber for interrupting the action of said transmission means, whereby the main valve is freed for closing, substantially as described.

5. In a mechanism of the nature described, the combination of a main fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, transmission means for opening said valve, and a second fluid-actuated expansion chamber communicating with the main expansion chamber for interrupting the action of said transmission means, whereby the main valve is freed for closing, substantially as described.

6. In a mechanism of the nature described, the combination of a main fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, transmission means controlled by the operator for opening the main valve, and a second fluid-actuated expansion chamber communicating with the main expansion chamber for inter-

rupting the action of said transmission means, whereby the main valve is freed for closing, substantially as described.

7. In a mechanism of the nature described, the combination of a fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, a valve bar (separate from said yielding means) for opening the main valve, and automatic means for interrupting the action of said valve bar on the main valve, whereby the main valve is freed for closing, substantially as described.

8. In a mechanism of the nature described, the combination of a fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, a valve bar separate from said yielding means and controlled by the operator for opening the main valve, and automatic means for interrupting the action of said valve bar on the main valve, whereby the main valve is freed for closing, substantially as described.

9. In a mechanism of the nature described, the combination of a main fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, a valve bar for opening the main valve, and a second fluid-actuated expansion chamber for interrupting the action of said valve bar on the main valve, whereby the main valve is freed for closing, substantially as described.

10. In a mechanism of the nature described, the combination of a main fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, a valve bar controlled by the operator for opening the main valve, and a second fluid-actuated expansion chamber for interrupting the action of said valve bar on the main valve, whereby the main valve is freed for closing, substantially as described.

11. In a mechanism of the nature described, the combination of a main fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, a valve bar for opening the main valve, and a second fluid-actuated expansion chamber communicating with the main expansion chamber for interrupting the action of said valve bar on the main valve, whereby the main valve is freed for closing, substantially as described.

12. In a mechanism of the nature described, the combination of a fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, pedal mechanism for opening the main valve, and automatic means for interrupting the action of said pedal mechanism, whereby the main valve is freed for closing, substantially as described.

13. In a mechanism of the nature described, the combination of a main fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, pedal mechanism for opening the main valve, and a second fluid-actuated expansion chamber for interrupting the action of said pedal mechanism on the main valve, whereby the main valve is freed for closing, substantially as described.

14. In a mechanism of the nature described, the combination of a fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, a valve bar and pedal for opening the main valve, and automatic means for interrupting the action of said valve bar on the main valve, whereby the main valve is freed for closing, substantially as described.

15. In a mechanism of the nature described, the combination of a fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, means for opening the main valve, and a fluid actuated motor comprising a cylinder, a differential piston in said cylinder, a spring for moving said piston in the direction of the larger area side of the piston, means for limiting the movement of the piston in said direction, ports leading into said cylinder at opposite sides of the piston, the port on the smaller area side of the piston being larger than the other port, means for simultaneously conducting a fluid to said ports whereby, when fluid is admitted to said ports, a pressure exceeding the pressure at the larger area side of the piston will be established at the smaller area side of the piston and maintained a limited time, substantially as described.

16. In a mechanism of the nature described, the combination of a fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, a valve bar for opening the main valve, and a fluid actuated motor comprising a cylinder

der, a differential piston in said cylinder, a spring for moving said piston in the direction of the larger area side of the piston, means for limiting the movement of the piston in said direction, ports leading into said cylinder at opposite sides of the piston, the port on the smaller area side of the piston being larger than the other port, means for simultaneously conducting a fluid to said ports whereby, when fluid is admitted to said ports, a pressure exceeding the pressure at the larger area side of the piston will be established at the smaller area side of the piston and maintained during a limited time, substantially as described.

17. In a mechanism of the nature described, the combination of a main fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, a valve bar for opening the main valve, pedal mechanism for moving said valve bar, and a fluid-actuated motor comprising a cylinder, a differential piston in said cylinder, a spring for moving said piston in the direction of the larger area side of the piston, means for limiting the movement of the piston in said direction, ports leading into said cylinder at opposite sides of the piston, the port on the smaller area side of the piston being larger than the other port, means for simultaneously conducting a fluid to said ports whereby, when fluid is admitted to said ports, a pressure exceeding the pressure at the larger area side of the piston will be established at the smaller area side of the piston and maintained during a limited time, substantially as described.

18. In a mechanism of the nature described, the combination of a fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, transmission means for opening the main valve, automatic means for interrupting the action of said transmission means on the main valve, whereby the main valve is freed for closing, and a register and a fluid-actuated expansion chamber in operative relation with said register and in communication with said first-mentioned expansion chamber, whereby each exertion of fluid pressure in the first-mentioned chamber will be registered on said register, substantially as described.

19. In a mechanism of the nature described, the combination of a main fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, transmission means for opening

the main valve, a second fluid-actuated expansion chamber for interrupting the action of the transmission means on the main valve, whereby the main valve is freed for closing, and a register and a fluid-actuated expansion chamber in operative relation with said register and in communication with said main expansion chamber, whereby each exertion of fluid pressure in the main chamber will be registered on said register, substantially as described.

20. In a mechanism of the nature described, the combination of a fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, transmission means for opening said valve, and automatic means operatively related with said transmission means to act within a chosen time after the opening of the main valve for interrupting the action of said transmission means, whereby the valve is freed for closing, substantially as described.

21. In a mechanism of the nature described, the combination of a fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, transmission means controlled by the operator for opening said valve, and automatic means operatively related with said transmission means to act within a chosen time after the opening of the main valve for interrupting the action of said transmission means, whereby said valve is freed for closing, substantially as described.

22. In a mechanism of the nature described, the combination of a main fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, transmission means for opening said valve, and a second fluid-actuated expansion chamber communicating with the main expansion chamber operatively related to act within a chosen time after the opening of the main valve for interrupting the action of said transmission means, whereby the main valve is freed for closing, substantially as described.

23. In a mechanism of the nature described, the combination of a main fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, transmission means controlled by the operator for opening the main valve, and a second fluid-actuated expansion chamber communicating with the main expansion chamber and operatively related to act within a chosen time after the opening of the

main valve for interrupting the action of said transmission means, whereby the main valve is freed for closing, substantially as described.

24. In a mechanism of the nature described, the combination of a fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, a valve bar for opening the main valve, and automatic means operatively related to act within a chosen time after the opening of the main valve for interrupting the action of said valve bar on the main valve, whereby the main valve is freed for closing, substantially as described.

25. In a mechanism of the nature described, the combination of a fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, a valve bar controlled by the operator for opening the main valve, and automatic means operatively related to act within a chosen time after the opening of the main valve for interrupting the action of said valve bar on the main valve, whereby the main valve is freed for closing, substantially as described.

26. In a mechanism of the nature described, the combination of a main fluid-actuated expansion chamber comprising fixed and removable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, a valve bar for opening the main valve, and a second fluid-actuated expansion chamber operatively related to act within a chosen time after the opening of the main valve for interrupting the action of said valve bar on the main valve, whereby the main valve is freed for closing, substantially as described.

27. In a mechanism of the nature described, the combination of a fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, pedal mechanism for opening the main valve, and automatic means operatively related to act within a chosen time after the opening of the main valve for interrupting the action of said pedal mechanism, whereby the main valve is freed for closing, substantially as described.

28. In a mechanism of the nature described, the combination of a main fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, pedal mechanism for open-

ing the main valve, and a second fluid-actuated expansion chamber operatively related to act within a chosen time after the opening of the main valve for interrupting the action of said pedal mechanism on the main valve, whereby the main valve is freed for closing, substantially as described.

29. In a mechanism of the nature described, the combination of a fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, a valve bar and pedal for opening the main valve, and automatic means operatively related to act within a chosen time after the opening of the main valve for interrupting the action of said valve bar on the main valve, whereby the main valve is freed for closing, substantially as described.

30. In a mechanism of the nature described, the combination of a fluid-actuated expansion chamber comprising fixed and movable portions, means forming a passage for admitting fluid into said chamber and a valve seat around said passage, a main valve normally seated on said seat, yielding means tending to hold said valve on said seat, means (separate from said yielding means) for moving the main valve from its seat, and means for relatively disengaging said moving means and the main valve, whereby the main valve is freed for seating, substantially as described.

31. In a mechanism of the nature described, the combination of a fluid-actuated expansion chamber comprising fixed and movable portions, means forming a passage for admitting fluid into said chamber and a valve seat around said passage, a main valve normally seated on said seat, yielding means tending to hold said valve on said seat, means separate from said yielding means and controlled by the operator for moving the main valve from its seat, and means for relatively disengaging said moving means and the main valve, whereby the main valve is freed for seating, substantially as described.

32. In a mechanism of the nature described, the combination of a main fluid-actuated expansion chamber comprising fixed and movable portions, means forming a passage for admitting fluid into said chamber and a valve seat around said passage, a main valve normally seated on said seat, yielding means tending to hold said valve on said seat, means for moving the main valve from its seat, and a second fluid-actuated expansion chamber for relatively disengaging said moving means and the main valve, whereby the main valve is freed for seating, substantially as described.

33. In a mechanism of the nature described, the combination of a fluid-actuated

expansion chamber comprising fixed and movable portions, means forming a passage for admitting fluid into said chamber and a valve seat around said passage, a main valve normally seated on said seat, yielding means tending to hold said valve on said seat, a valve bar for moving the main valve from its seat, and means for relatively disengaging said valve bar and the main valve, whereby the main valve is freed for seating, substantially as described.

34. In a mechanism of the nature described, the combination of a fluid-actuated expansion chamber comprising fixed and movable portions, means forming a passage for admitting fluid into said chamber and a valve seat around said passage, a main valve normally seated on said seat, yielding means tending to hold said valve on said seat, a valve bar controlled by the operator for moving the main valve from its seat, and means for relatively disengaging said valve bar and the main valve, whereby the main valve is freed for seating, substantially as described.

35. In a mechanism of the nature described, the combination of a fluid-actuated expansion chamber comprising fixed and movable portions, means forming a passage for admitting fluid into said chamber and a valve seat around said passage, a main valve normally seated on said seat, yielding means tending to hold said valve on said seat, pedal mechanism for moving the main valve from its seat, and means for relatively disengaging said moving means and the main valve, whereby the main valve is freed for seating, substantially as described.

36. In a mechanism of the nature described, the combination of a fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, transmission means for opening said valve, and automatic means for interrupting the action of said transmission means, whereby the valve is freed for closing, said interrupting means being adjustable to vary the time consumed by it in acting, substantially as described.

37. In a mechanism of the nature described, the combination of a fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, transmission means controlled by the

operator for opening said valve, and automatic means for interrupting the action of said transmission means, whereby said valve is freed for closing, said interrupting means being adjustable to vary the time consumed by it in acting, substantially as described.

38. In a mechanism of the nature described, the combination of a main fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, transmission means for opening said valve, and a second fluid-actuated expansion chamber for interrupting the action of said transmission means, whereby the main valve is freed for closing, said interrupting means being adjustable to vary the time consumed by it in acting, substantially as described.

39. In a mechanism of the nature described, the combination of a main fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, transmission means controlled by the operator for opening the main valve, and a second fluid-actuated expansion chamber for interrupting the action of said transmission means, whereby the main valve is freed for closing, said interrupting means being adjustable to vary the time consumed by it in acting, substantially as described.

40. In a mechanism of the nature described, the combination of a main fluid-actuated expansion chamber comprising fixed and movable portions, a normally-closed main valve for admitting fluid into said chamber, yielding means tending to close said valve, transmission means for opening said valve, and a second fluid-actuated expansion chamber communicating with the main expansion chamber for interrupting the action of said transmission means, whereby the main valve is freed for closing, said interrupting means being adjustable to vary the time consumed by it in acting, substantially as described.

In testimony whereof I have signed my name, in presence of two witnesses, this ninth day of October, in the year one thousand nine hundred and four-teen.

GEORGE AKANS.

Witnesses:

LON N. BATCHELOR,
D. C. ROBERTSON.