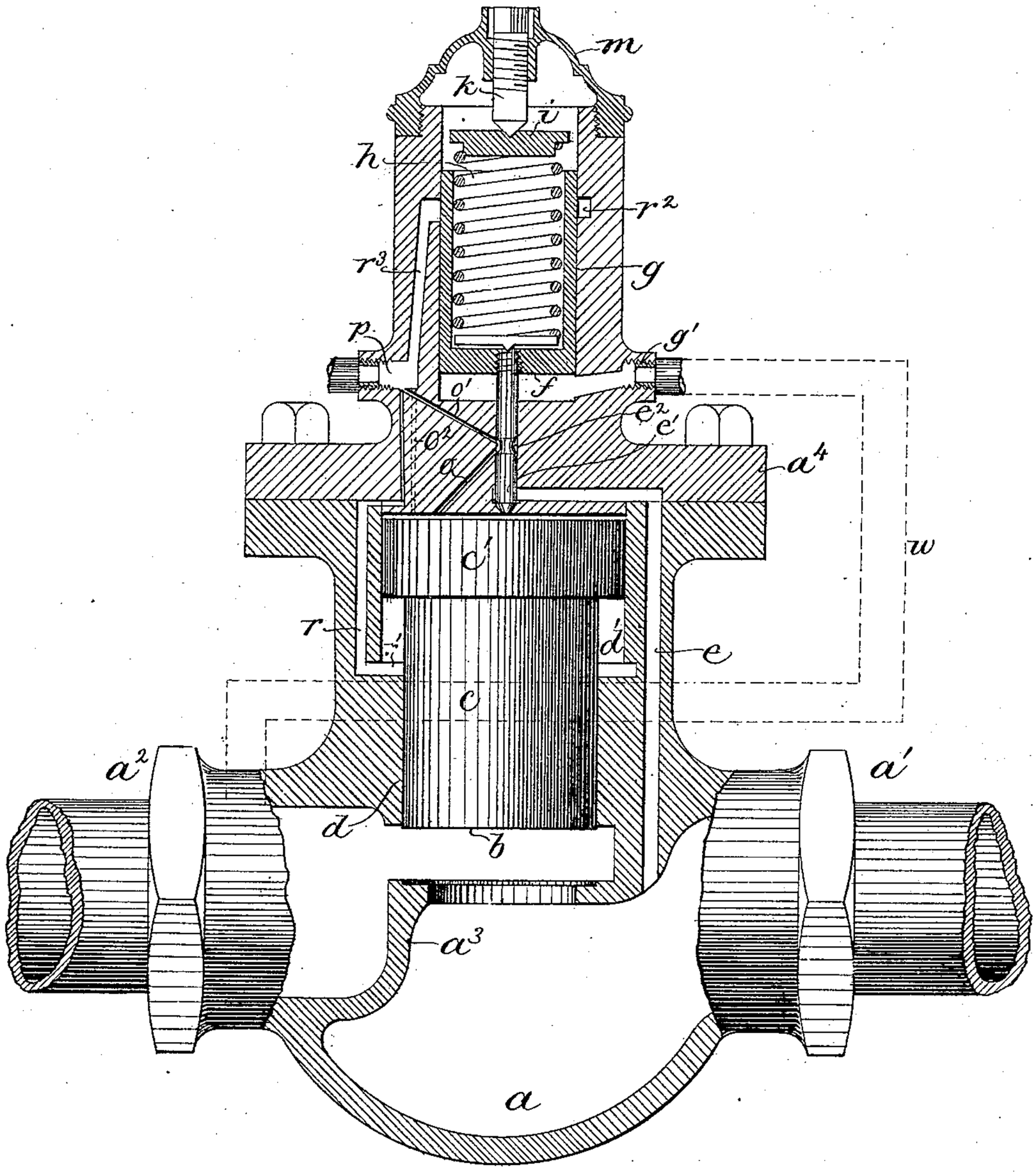
(No Model.)

W. B. MASON.

STEAM PUMP PRESSURE REGULATOR.

No. 334,080. Patented Jan. 12, 1886.



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UNITED STATES PATENT OFFICE.

WILLIAM B. MASON, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO THE MASON REGULATOR COMPANY, OF SAME PLACE.

STEAM-PUMP-PRESSURE REGULATOR.

SPECIFICATION forming part of Letters Patent No. 334,080, dated January 12, 1886.

Application filed September 28, 1885. Serial No. 178,348. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM B. MASON, of Boston, county of Suffolk, State of Massachusetts, have invented an Improvement in Steam-Pump-Pressure Regulators, of which the following description, in connection with the accompanying drawing, is a specification.

My invention relates to a pressure-regulator by which the operation of a valve, damper, or other device is governed in accordance with the pressure of a fluid.

The invention is shown embodied in an apparatus arranged and adapted to control the operation of a steam-pump or fluid-forcing apparatus in accordance with the pressure of the fluid forced by it, the pump remaining in operation until the said pressure rises to a definite predetermined point when the operation of the pump will be automatically stopped.

The apparatus comprises a main valve, which controls the admission of steam or motive fluid to the engine of the pump or forcing apparatus, and a main or valve actuating piston which operates the said valve, and is itself actuated by the motive fluid controlled by the main valve and a secondary or controlling piston or equivalent, working in a pressure-chamber and acted upon by the fluid forced or pumped by the engine, and controlling the action of the motive fluid on the piston that operates the main valve. The valve-actuating piston is differential, having a smaller area constantly exposed to the pressure of the motive fluid independently of the position of the main valve and a larger area working in a cylinder having an inlet-passage governed by the controlling-piston, which is acted upon in one direction tending to close the inlet-port by a predetermined governing force derived from a weight or spring, and in the other direction by the fluid forced by the pump which operates, as soon as its pressure overcomes the predetermined governing force, to move the controlling-piston, so as to open the inlet-port, admitting the motive fluid to the larger area of the valve-actuating piston, so that the fluid acts positively on both sides of the said piston, and, owing to the difference in areas, moves it in the direction to close the main valve. The secondary or controlling valve operated by the controlling or pressure piston, which controls the inlet-port, may also govern an exhaust-passage from the cylinder in which the larger portion of the valve-actuating piston works, opening the exhaust-passage when the inlet-passage is closed, and the reverse; or the said cylinder may have a very small constantly-open exhaust-passage, so small as not to reduce the pressure when the much larger inlet is open, but sufficient to quickly remove the fluid from the chamber when the inlet is closed.

The drawing shows in longitudinal section a pressure-regulator embodying this invention.

The apparatus illustrated is suitable for controlling a steam-pump, and comprises a main valve in the steam-pipe or other duct, through which the motive fluid is conveyed to the engine. The main-valve shell *a* has the usual inlet and outlet openings, a' a^2, separated by a partition, a^3, having an opening, the edges of which form the valve-seat. The main valve proper, *b*, controlling this opening and governing the flow of fluid through the valve-shell from the inlet to the outlet thereof, is shown in this instance as forming a part of the main-valve-actuating piston *c* c', working in a cylindrical chamber, *d* d', in the upper part of the valve-shell. The said piston *c* c' and cylinder *d* d' are differential, the lower portion being preferably of half the area of the upper portion, so that when both areas are acted upon by an equal pressure per unit of area the force tending to move it in one direction will be the same as the force tending to move it in the opposite direction derived from the pressure of the same amount per unit of area acting on the smaller area alone. The smaller portion *d* of the cylinder is open, so that the smaller area of the piston is always acted upon by the whole pressure of the motive fluid entering the valve-shell, whether the valve is seated or not, and when there is no pressure on the larger area of the piston it will be moved upward and in the said movement will open the main valve. The portion d' of the cylinder of larger area is connected by an inlet-port, *e*, with the interior of the valve-shell *a* at the inlet side of the partition a^3, so that

when the said port is open the larger area of the piston will also be acted upon by the pressure of the motive fluid, which will overcome that on the smaller area and move the piston in the direction to close the main valve. The inlet-port *e* is controlled by a secondary or controlling valve, *e'*, shown as a rod connected with a pressure or controlling piston, *f*, working in a chamber, *g*, shown in this instance as made integral with the bonnet a^4, of the main valve, and provided with an inlet-passage, *g'*, communicating with the delivery-pipe or reservoir for the fluid forced by the pump the operation of which is to be controlled. The said controlling or pressure piston *f* is acted upon in one direction—namely, tending to seat the valve *e'*—by a substantially constant predetermined governing force, shown in this instance as derived from a spring, *h*, the force of which may be adjusted by a suitable follower, *i*, and adjusting device, *k*, shown as a screw working in a threaded passage in the cap or cover *m* of the chamber *g* and bearing on the spring *h*. The pressure of the forced fluid entering the pressure-chamber *g* and acting on the piston *f* therein will produce no effect as long as its force on the piston *f* is less than that of the predetermined governing force; but the moment that it becomes greater than the said governing force it will produce a movement of the piston *f*, which will open the controlling-valve *e'* in the inlet-port *e* to the larger part *d'* of the cylinder, so that the piston *c c'* will be exposed to equal pressure per unit of area at both ends, and, owing to the greater area at the larger end, will move in the direction to close the main valve, and will thus immediately stop the operation of the pump or forcing apparatus, so that it will no longer tend to increase the pressure of the forced fluid, and the said parts will remain in this condition until the pressure of the forced fluid is reduced in some manner, as by the consumption of the said fluid. When such reduction in the pressure of the forced fluid takes place, the governing force, acting on the piston *f*, will prevail, moving it in the direction to close the controlling-valve *e'* and cut off admission of motive fluid to the larger area of the cylinder *d d'* and piston *c c'*, so that the fluid, acting unbalanced on the smaller area of the said piston, will move it in the direction to open the main valve *b*, thus permitting the pump to operate again until the pressure of the fluid forced by it again prevails over the constant governing force and causes the main valve to be closed, as before described.

The motive fluid is exhausted from the portion *d'* of the cylinder of larger area through an exhaust-passage, *o o'*, leading to an outlet or escape passage, *p*. This exhaust-passage may be controlled by the piston *f* or the stem of the valve *e'*, as shown, the said passage passing into the guide-passage of the said valve-stem, and being closed by the said stem when the valve *e'* is open, but the said stem having an annular groove e^2, which completes the exhaust-passage when the valve *e'* is closed. If desired, the larger portion *d'* of the cylinder may have a continuously open exhaust-passage, as shown in dotted lines at o^2, of much smaller area than the inlet-passage *e*, so that when the latter is open the escape of fluid through the exhaust-passage o^2 will not appreciably lower the pressure of the motive fluid in the portion *d'* of the cylinder, the said passage o^2 being merely a small leak, permitting only a trifling amount of fluid to escape, but being sufficient to empty the cylinder with sufficient rapidity when the inlet-passage *e* is wholly closed by the valve *e'*.

The fluid which may leak around the different portions of the piston *c c'* has a free escape through a leak-passage, *r*, opening from an annular groove, *r'*, at the lower end of the larger bore of the cylinder, so that no pressure can be brought upon the annular area at the junction of the larger and smaller portions of the piston. In a similar manner the fluid which may leak around the pressure-piston *f* will enter the groove r^2 in the inner surface of the chamber *g* and pass off through an escape-passage, r^3, this provision making it possible to have the piston *f* fit somewhat loosely in the chamber *g*, so as to work with but very little friction, and thus respond to an exceedingly small change in the pressure of the forced fluid when just about equal to the governing force.

The main valve is controlled in its operation by the variations in the pressure of the forced fluid; but is not actuated by that pressure as in apparatus used for this purpose as heretofore generally constructed, and, furthermore, the main valve is actuated by the motive fluid which it controls, and this is believed to be a novel principle of operation in apparatus for controlling the operation of pumps in accordance with the pressure of the fluid forced by them.

The apparatus or portions thereof may be applied to a variety of uses besides controlling steam-pumps. The main piston is actuated by a fluid, and the said main piston is governed in its operation by a fluid having variable pressure. The variable fluid might be the same that flows through the main valve. For instance, if the outlet side of the main-valve shell were connected with the pressure-chamber, as by the pipe or duct *w*, shown in dotted lines, (it might be a port in the valve shell,) the valve would be controlled in accordance with the pressure of fluid flowing out from it, thus constituting a pressure-reducing valve; or the piston, actuated by a fluid and controlled by the variable pressure of a fluid, need not actuate a valve at all, but might actuate the damper or draft-controller of a steam-generator in accordance with the pressure of the generated steam, closing the damper when the pressure rises to the predetermined point and opening it when below that point.

In another application for Letters Patent

I have shown a pressure-regulator in which the pressure-chamber forms a part of the differential cylinder in which the valve-actuating piston operates, the said piston being necessarily actuated by the fluid having a variable pressure. In the present invention, however, the pressure-chamber is wholly independent of the cylinder or chamber containing the fluid by which the main piston is actuated, and consequently the said piston may be actuated by a fluid the same as or different from the fluid the variable pressure of which controls the operation, as may be required.

I propose in some cases to use a diaphragm in the pressure-chamber to operate the secondary or controlling valve instead of the piston shown, these devices being well-known mechanical equivalents for one another.

I claim—

1. The combination of a differential cylinder and piston therein having its smaller area constantly exposed to a motive fluid and the larger portion of the cylinder having an inlet for the motive fluid, with a valve controlling the said inlet and a pressure-chamber and actuating device for the said valve therein acted upon in one direction by a variable fluid-pressure and in the other direction by a predetermined governing force, the pressure-chamber being independent of the differential cylinder and adapted to receive the same or a different fluid, substantially as and for the purpose described.

2. A main valve comprising a valve-shell having inlet and outlet openings, and a movable valve controlling the flow of fluid from one to the other, and a differential cylinder included in the said shell, having two portions of different bore or sectional area, and a piston therein composed of two parts of different diameter, each having a working fit in the corresponding part of the cylinder, the said piston having its smaller area constantly exposed to the pressure of the fluid entering the valve-shell, the larger portion of the cylinder being provided with an inlet-port, combined with a controlling-valve governing the flow of fluid through the said inlet-port, and a pressure-chamber and device therein governing the said controlling-valve, substantially as described.

3. A main valve comprising a valve-shell having inlet and outlet openings, and a movable valve controlling the flow of fluid from one to the other, and a differential cylinder included in the said shell having two portions of different bore or sectional area, and a piston therein composed of two parts of different diameter, each having a working fit in the corresponding part of the cylinder, the said piston having its smaller area constantly exposed to the pressure of the fluid entering the valve-shell, the larger portion of the cylinder being provided with inlet and exhaust ports, combined with a controlling-valve governing the flow of fluid through the said ports and a pressure-chamber and device therein governing the said controlling-valve, substantially as described.

4. The main-valve shell having inlet and outlet openings and a partition between them provided with an opening and valve-seat, and a differential cylinder above the valve-seat, having two portions of different bore or sectional area, and piston therein composed of two parts of different diameter, each having a working fit in the corresponding part of the cylinder, the said piston co-operating with the valve-seat to control the flow of fluid through the opening therein, and a port leading from the inlet portion of the valve-shell to the larger part of the cylinder, and an exhaust-port from the larger part of the cylinder, combined with a controlling-valve governing the flow of fluid through the said inlet-port and a pressure-chamber and actuating device therein for the said controlling-valve, substantially as described.

5. A valve-shell having inlet and outlet openings and a partition between them provided with an opening and valve-seat, and the differential cylinder above the valve-seat having two portions of different bore or sectional area, and a port leading from the inlet portion of the valve-shell to the larger part of the cylinder, combined with a piston composed of two parts, each having a working fit in the corresponding part of the differential cylinder, the said piston co-operating with the valve-seat to control the flow of fluid through the valve-shell, and a controlling-valve governing the flow of fluid through the port leading to the larger portion of the differential cylinder, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WM. B. MASON.

Witnesses:
JOS. P. LIVERMORE,
H. P. BATES.