Sheet 1- 2 Sheets.

Birdsill, Holly,

Supply Regulator for Water Works.

No. 87,413. Patented Mar. 2. 1869.

Fig 1

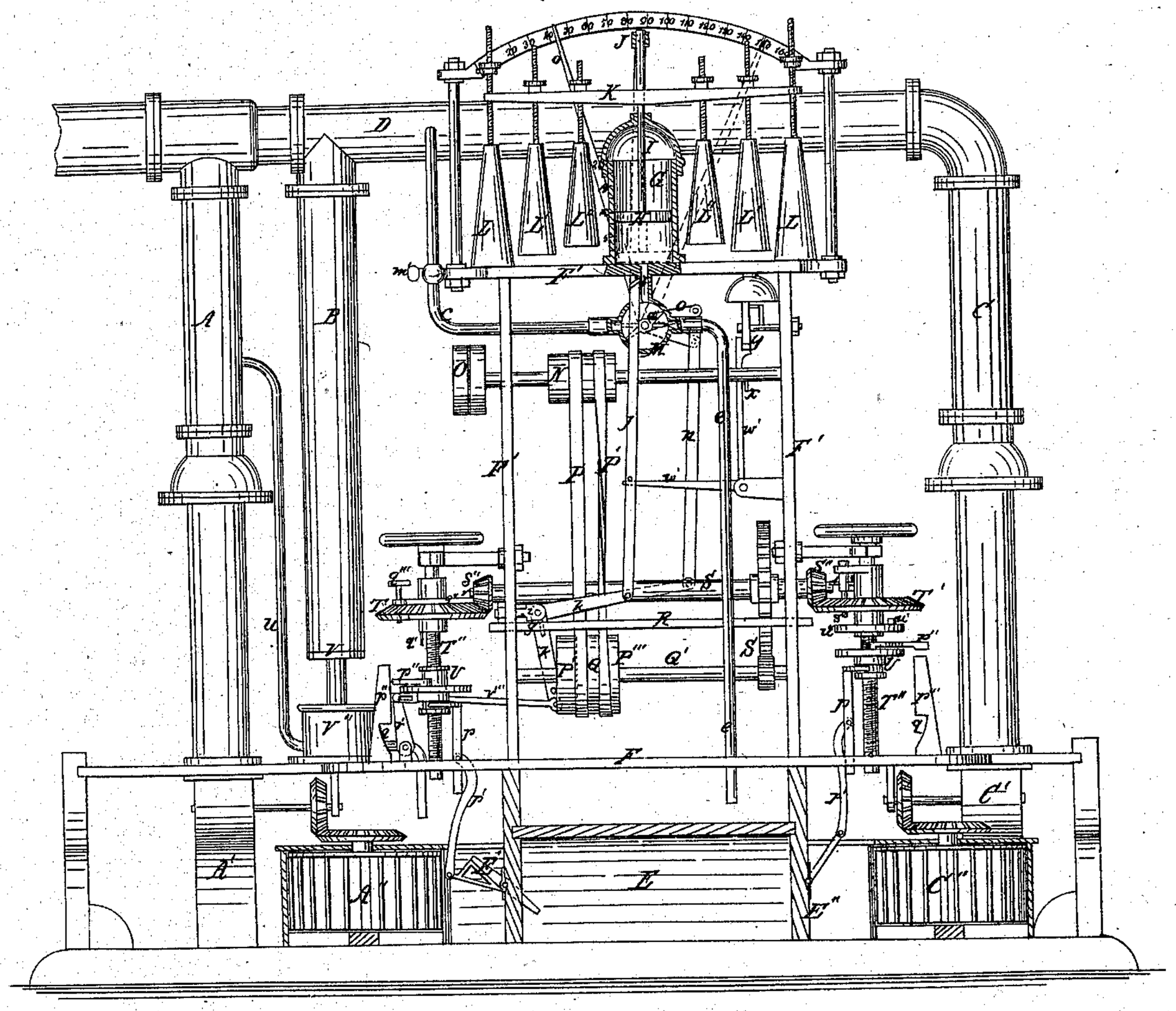


Fig 2

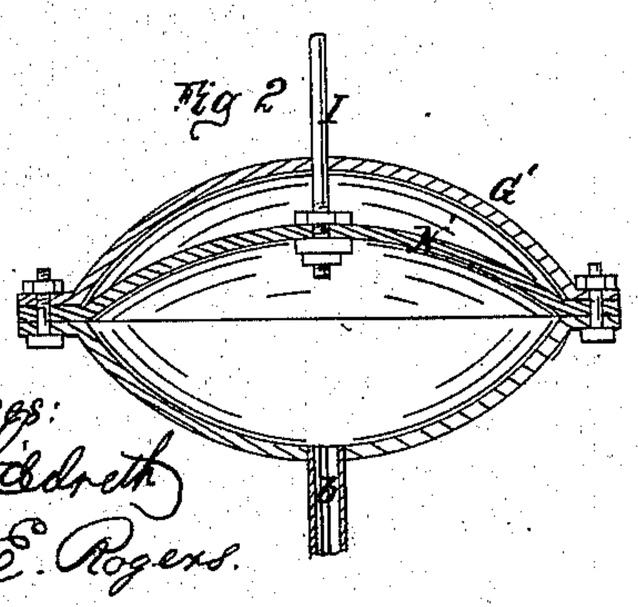
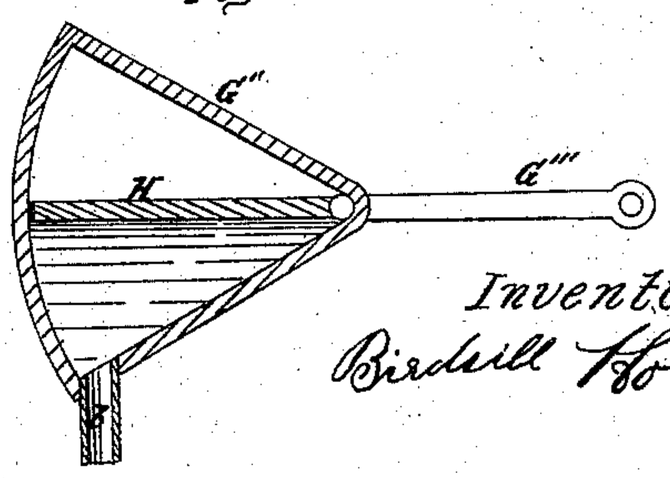


Fig 3.



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F. E. Rogers.

Inventor
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Sheet 2 2 Sheets.

Birdsill Holly,

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Fig 4.

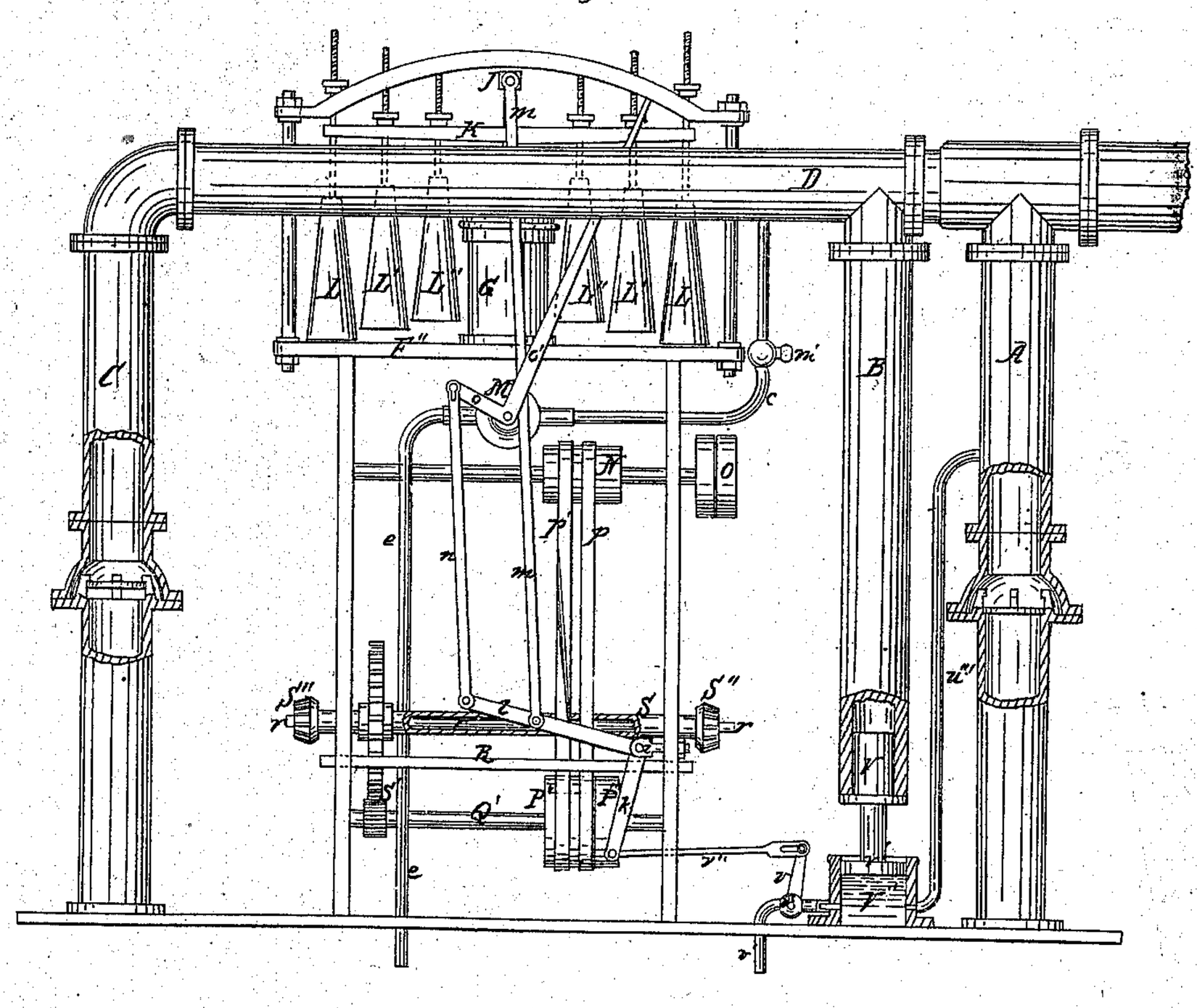

Fig 5.

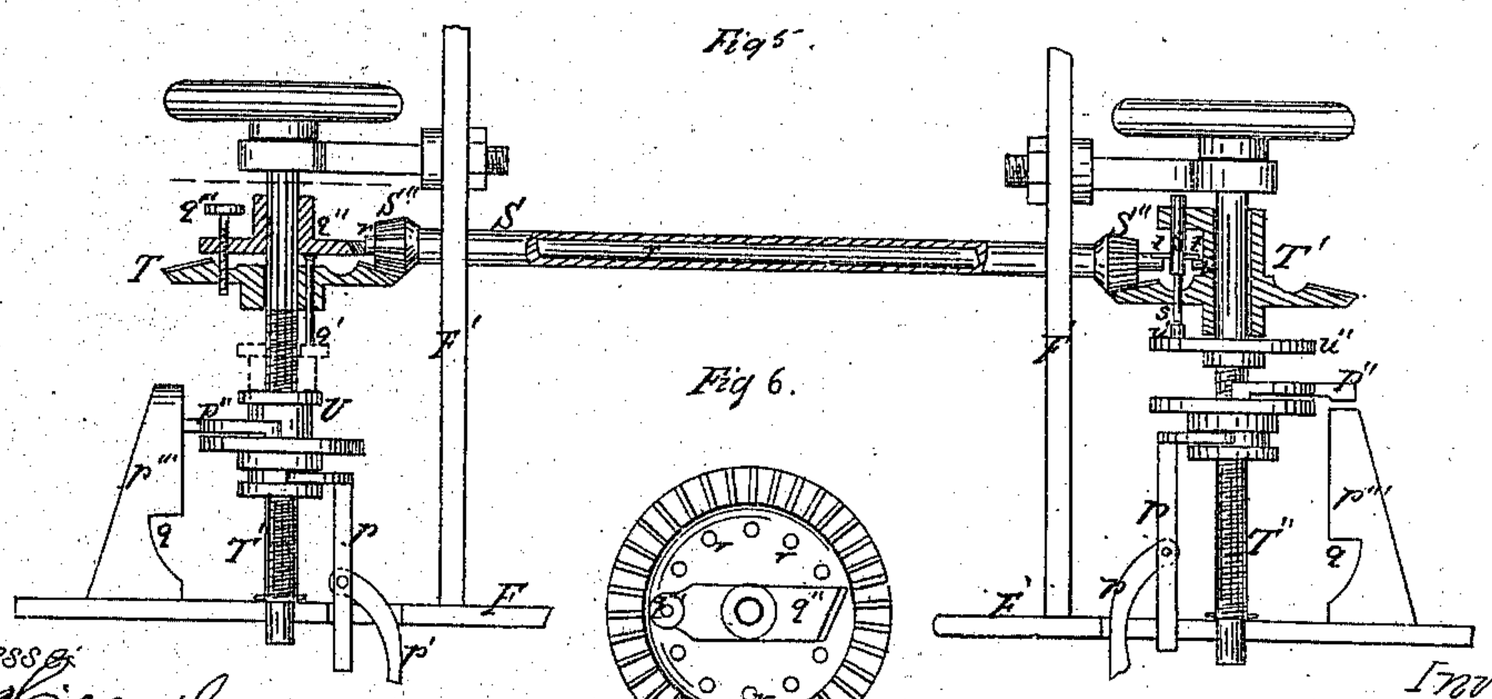

Fig 6.

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UNITED STATES PATENT OFFICE.

BIRDSILL HOLLY, OF LOCKPORT, NEW YORK.

IMPROVEMENT IN WATER-SUPPLY REGULATOR FOR WATER-WORKS.

Specification forming part of Letters Patent No. **87,413**, dated March 2, 1869.

To all whom it may concern:

Be it known that I, BIRDSILL HOLLY, of Lockport, in the county of Niagara and State of New York, have invented a new and Improved Water-Supply Regulator for Water-Works; and I do hereby declare that the following is a full, clear, and exact description thereof, which will enable those skilled in the art to make and use the same, reference being had to the accompanying drawings forming part of this specification, in which—

Figure 1 is a front elevation of my invention. Fig. 2 is a detailed section, showing a modification of the piston-chamber. Fig. 3 is a second modification of the piston-chamber. Fig. 4 is a rear elevation of the invention, a reverse view of Fig. 1, and having the gate-operating mechanism removed, to exhibit more clearly the more important features of the apparatus. Fig. 5 is a detail front elevation of the gate-operating mechanism, with certain parts of the same shown in section. Fig. 6 shows a detail top view of the wiper for setting the auxiliary gate mechanism in operation.

Similar letters of reference indicate corresponding parts.

The object of this invention is to provide an effective and reliable means for governing or regulating the supply of water in the street-mains of town water-works. It is designed more particularly for those towns and cities where there is no natural head to give the requisite pressure for carrying the water into the upper stories of the buildings, and where the water is forced into the street-mains by water or steam power pumps, but is also applicable solely as a fire apparatus in any city, whether supplied with artificial water-works or otherwise. Its office, more particularly expressed, is to regulate the admission of water to the motors which drive the forcing-pumps supplying water to the street-mains and pipes by the timely opening or closing of the water-gates.

When steam-power is employed the same apparatus operates, in the same automatic manner, to open or contract the steam-passages leading to the pump-engines by acting upon any suitable throttle valve or valves in a similar manner to that by which it operates the water-gates.

In those towns or cities which are unprovided with a natural head of water of suitable height, the proper pressure to force the water into the street-mains and upper parts of buildings must be obtained by artificial power, as steam or water power; and for this purpose steam-engines or turbines are commonly used to drive any suitable forcing-pumps, as rotary or reciprocating pumps. A set of such pumps are kept constantly running to maintain a constant supply in the pipes for domestic and other ordinary purposes; but when from any cause, as that of fire, a larger supply and increased pressure are required, additional pumps must be put into operation, or those already working must be driven with greater velocity, and it is the office of my invention to accomplish automatically the regulation of the supply and pressure when occasion arises for such regulation. For this purpose the pressure of the water (in the street-mains and the accessory pipe connecting them with the apparatus) is made use of as a means of communicating with the regulator and setting it in motion, after which it performs its regulating functions automatically, as will be shown.

Figure 1 is a front elevation of the apparatus complete.

A B C are vertical pipes, and D a horizontal pipe communicating with them. The pipes A and C receive the water from the rotary pumps A′ C′, which are driven by the turbines A″ C″. (Shown in red color.) The pipe D leads to some main pipe, from whence the street-mains branch off and ramify throughout the town or city. E is a sluiceway or waterway, having gates E′ E″, which admit water to the turbines driving the pumps.

As the gates are opened or closed, so will the speed of the turbines and pumps be accelerated or retarded, and the quantity of water forced into the pipes, and the consequent pressure of the same, be increased or diminished.

The ordinary pressure for domestic purposes and other daily uses will be, in most cases, about forty pounds per square inch, and this pressure may be kept up by driving a sufficient number of pumps at a slow rate of speed; but should a fire break out, greater pressure and quantity of water will be required for the time in the street-mains, and the increase of the speed of the pumps then running, or the setting in motion of other auxiliary pumps, will be accomplished by the regulator.

F is a bed-plate, having uprights F′ F′ and cross-plate F″, upon which latter a piston-chamber is affixed. This chamber is provided

with a piston, H, the rod I of which passes up through the top or dome of the chamber, as shown. Above the dome the piston-rod bears two cross-heads, J and K. From the cross-head K an equal number of weights, L L′ L″ L″, &c., are suspended, in such a manner that when the piston rises the weights will not be raised at once, but successively, so that the impulse which raises them will be expended in a succession of resistances, thereby preventing the piston from rising with a sudden jerk or jump. The cross-head J is a means by which the piston is connected with the mechanism which is dependent upon it for action, and will be hereinafter duly explained. M is a water-gage, having a radial valve, *a*, within a circular chamber, which chamber connects with the piston-chamber, below the piston of the same, by a pipe, *b*, and with any one of the pipes A B D, &c., by a pipe, *c*, and is further provided with a waste-water pipe, *e*. The radial valve *a* is on a shaft, which is connected with the cross-head J, and the valve is placed in such relation with the orifices of the pipes *c* and *e* that, as the piston rises, the valve will be moved, so as to offer less obstruction to the water passing through its chamber, and when the piston falls the valve will be also moved to a position where the passage of the water through the chamber will be more obstructed. The object of this arrangement is to maintain a constant and uniform pressure in the piston-chamber, (except during the moments of the change in such pressure,) irrespective of the pressure in the pipe D and its connections. The valve *a* is, therefore, arranged to partially obstruct the water entering and leaving the chamber through the pipes *c* and *e*, respectively, and the water, being so obstructed, will be forced into the piston-chamber, and exert an upward pressure on the piston H.

Now, if for any cause the pressure within the pipe D should be raised, the same pressure will exist in the pipe *c*, and will be consequently felt by the piston, raising the same, and lifting its weights from the cross-plate on which they rest; but the movement of the piston causes the valve in the chamber M to open or make a wider aperture for the egress of the water passing through the chamber, so that notwithstanding the pressure has been raised in the pipe D, the pressure in the piston-chamber remains constant.

To illustrate it with definite pressures: Suppose that there is a pressure of forty pounds per square inch in the pipes A B C D, and in all the street-mains, and that suddenly the pressure in said pipes is increased to one hundred and fifty pounds per square inch, this latter pressure will be felt in the pipe *c* and in the piston-chamber, causing the piston to rise a short distance, and in doing so the radial valve is opened, and a greater egress for the water provided, so that the greater pressure is compensated by a greater discharge, and the pressure within the valve-chamber and piston-chamber kept a constant quantity.

The weights L L′ L″, &c., are provided with reference to the constant pressure to be maintained in the piston-chamber, and the aggregate force of these weights just balances the pressure against the piston, or rather will slightly exceed that pressure, so that the two external weights will rest lightly on the cross-plate, thus leaving the piston free to respond to the slightest increase or decrease of pressure in its chamber.

I will now describe the mechanism which is set in motion by the piston to regulate the supply of water to the turbines. N is a drum on a shaft, which is continually turning it, being driven by the power which keeps up the ordinary supply of water in the pipes. This shaft is provided with a pulley, O, or other means for rotating it, the belt or other means connecting with any one of the turbines which is constantly running. The drum N bears two belts, P P′, which latter run on loose pulleys P‴ P⁗ on each side of the fast pulley Q on the shaft Q′. The belt P′ is crossed, so as to drive the fast pulley Q in a different direction from the straight belt P for the shifter R, which changes the belts from the loose to the fast pulleys, is movable in two directions, and in whichever direction it may be moved one of the belts will be shifted to the fast pulley Q, and the shaft Q′ revolved in one or the other direction.

The shifter is merely a bar sliding in suitable guides, and provided with loops encircling the belts, to shift them to or from the fast pulley. This shifter is operated by means of a stud on the shaft to which the arm *h* is affixed. This stud is shown dotted at *g*, and works loosely in a hole in the shifter, so that when the arm *h* is moved by the rod *j*, which connects it with the cross-head J of the piston-rod, the shifter will be also moved to shift the belts to or from the fast pulley Q. One of the two belts will, therefore, be shifted onto the fast pulley when the piston is raised or lowered from its normal position.

The shaft of the arm *h* is hung in bearings *i*, and this shaft bears another arm, *l*, (see Fig. 4,) to which is pivoted a rod, *m*, which latter is again pivoted to the cross-head J, and thus assists the rod *j* in oscillating the shaft to which the stud *g* and arms *k*, *h*, and *l* are affixed.

The radial valve *a* is operated by means of a rod, *n*, pivoted to the arm *l*, and to an arm, *o*, on the shaft of the valve, so that when the piston rises and falls the movement is transmitted, by the rod *m*, to the arm *l*, which latter communicates the motion, through the rod *n*, to the arm *o* on the valve-shaft. When the shaft Q′ is set in motion it communicates the same to the shaft S by means of gearing S′. The shaft S bears bevel-pinions S″, which engage with the bevel-wheels T T′ on the threaded shafts T″, which, in being turned, raise the hollow threaded bosses U, which work thereon, and which are connected with the water-gates by means of the clutch-rod and link *p p′*. As

[redacted]

the threaded shafts T″ are revolved the bosses U are kept from turning by means of the projections p'', which slide in contact with the standards p''', and, when raised beyond the end of the standards, pass over them, and by revolving with the threaded shafts cease to raise the gates. The same result takes place when these projections descend to the notches q in the standards. The wheel T is not keyed on its shaft, but turns loosely thereon when not coupled to the wiper p'', in a manner to be described hereinafter. The wheel T′ also works loosely on its shaft, so that its respective gate may not be opened until the opposite one has been fully opened, and the supply of water found insufficient to raise the pressure to the degree for which the apparatus was adjusted. When such is the case the boss U, in rising, strikes against a pin, q', projecting down from the wiper q'', and lifts the latter, bringing its beveled end in position to impinge against the projecting end of the rod r, which fits loosely within the hollow shaft S. The opposite end of the said rod is thereby protruded from the end of the hollow shaft, and the said protruded end encounters a tripping device, which arrests the loose motion of the wheel T and causes it to turn the threaded shaft. This tripping device consists of a small rod, s, having arms t t, one of which is set upon a slotted projection, u, on the hub of the wheel T′, and being so set the lower end s' of the rod will pass clear of the stud u', which is on the collar u'', which latter is keyed on the threaded shaft. The wheel T′ may thus be revolved indefinitely without turning its shaft; but when the rod r is protruded by the action of the wiper q'', the protruding end encounters one of the arms t, and dislodges the opposite arm from its seat on the stud-rest u, when the rod s, no longer supported, drops its end s', which encounters the stud u' on the collar n'' as the wheel T′ revolves. Connection is thus established between the wheel T′ and its shaft, and the second gate is raised in a manner similar to the first gate. The wiper q'' rises on its shaft, being kept from turning by a set-screw, q''', fitting loosely in any one of the holes v in the wheel T.

In operation the first gate or gates are partially open to one or a sufficient number of turbines to supply water for domestic and other purposes, which will be, as the pointer o' indicates in Fig. 1, about forty pounds per square inch; but should a fire break out in any part of the town, any properly-authorized person unlocks a hydrant and lets the full discharge of water escape therefrom. The sudden decrease of pressure in the pipes consequent upon the escape of a large volume of water is felt throughout the entire system of street-mains, and also in the pipes of the regulator; and this decrease of pressure being also felt in the piston-chamber the piston thereof falls to the bottom in a few seconds, and in so falling shifts the crossed belt P′ to the fast pulley, thus setting the shaft Q′ in motion, which revolves the threaded shaft T″, and the first gate is opened, admitting a greater volume of water to the turbines, and increasing the speed of the latter. The pointer o' having moved (as shown in red color) to indicate the prearranged pressure to be maintained for fire purposes, the pumps are driven to keep the water in the pipes at that pressure, and the valve a being moved to permit the water from the pipe c to pass through the gage-chamber with sufficient rapidity to maintain the pressure in the piston-chamber at its original degree, (say ten pounds per square inch) the pumps will then be kept running to keep the pressure up to the increased degree (say one hundred and fifty pounds per square inch,) while the piston remains raised higher, but balanced, as before, and in readiness to respond to any change of pressure in the street-mains and pipes A B D C. If the opening of the first gate does not admit sufficient water to raise the pressure to one hundred and fifty pounds, or any other prearranged pressure, the second gate is opened, as before described—that is to say, the boss U encountering the pin q'' just before the projection p'' passes over the end of the standard p''' and raises the wiper q''. The wiper q'', being thus raised, encounters the rod r, pushing it to protrude its opposite end and trip the rod s, which couples, in the manner before described, the loose wheel T′ with the fixed collar u'', thus setting in motion the threaded shaft, and raising the second gate, as before set forth. A number of streams having been taken from hydrants in the vicinity of the fire, the pressure in the mains remains uniform, for if the said pressure be suddenly increased by the sudden shutting-off of all or many of such streams a relief-valve is provided, the operation of which is dependent upon the movement of the piston, as any sudden increase of pressure would produce an impulse which would raise the piston, and this act of raising would open the relief-valve and permit the escape of a portion of the water, and readily lower the pressure throughout all the street and other pipes. This valve is shown at V, and is seated in the lower end of a pipe, as B. The valve is connected by a stem with a piston, V′, which fits in a water-chamber, V″, which is supplied by a pipe, u''', from the pipe B itself, or one of the adjacent pipes. The effective area of the piston being greater than the effective area of the valve, the latter will be always closed by the excess of pressure on the piston as long as there is no outlet for the water in the chamber V″, but an outlet is provided by a cock in the escape-pipe v'', leading from the chamber.

This cock is operated by an arm, v', to which is pivoted a slotted rod, v''', which latter is pivoted to the arm k, affixed on the same shaft as the arm l, the latter being connected with the piston cross-head J, as before described. The escape-cock w is arranged to open as the piston rises to its highest point, the rod v''' being slotted to permit any ordinary move-

ment of the piston without opening the cock, and in so doing reduces the sustaining pressure in the chamber V″, and the said pressure falling below the pressure acting downward upon the valve V, the latter is pressed down, thus permitting a volume of water to escape from the pipe B, and thus relieve it from bursting pressure. The escape-cock again closes when the piston recovers its normal position, and the pressure in the chamber V″ again closes the valve V.

As the pressure in the street-mains is at one hundred and fifty pounds per square inch during the fire, it is requisite that the same should be reduced automatically when there is no longer need of such pressure, and this is accomplished through the shifting of one or other of the belts, as may be arranged, for if the straight belt turns the shaft Q in a direction to open the gates, the crossed belt will turn it in the contrary direction, and close the gates; but in the latter case the two gates are both closed simultaneously to contract their combined openings sufficiently for running the pumps at the ordinary slow speed for the daily supply.

The method of reducing the pressure when the fire is over is to first open a hydrant and close it suddenly. The sudden obstructing of the pressure will produce an impulse which raises the piston to the top of the cylinder, thus placing the pointer *o* back to forty pounds on the dial, and causes the opening of the cock of the relief-valve chamber, whereby the relief-valve will open and discharge water until the regulator has partially shut both gates to the required opening, for when the piston was raised the crossed belt was shifted to the fast pulley, and the gates actuated to shut off a portion of the flow. Again, when a hydrant is opened and left running the sudden decrease of pressure is felt in the piston-chamber, and for a few seconds the piston falls to the bottom, as shown in red color, Fig. 1, and in so doing shifts the straight belt to the fast pulley, when the opening of the gates follows. The piston remains at the bottom of the cylinder until the additional pressure is felt, when the piston is raised again; but the valve *a* now permits a greater passage of water through its chamber, and the pressure supporting the piston is still ten pounds per square inch.

Should the many streams of water which had been playing on the fire be successively taken off, the increased pressure resulting therefrom will be felt by the piston, and it will rise in obedience to it, and in so doing open the relief-valve V, which will lower the pressure, and will also shift the crossed belt, and through it shut off the gates. *w′ w′* is a bell-crank lever, which supports a pivoted bell-clapper, and when the piston descends a stud on the rod *j* encounters the bell-crank, and trips it from under the clapper, thus leaving the lower end of the same to be struck by a stud, *x*, on the shaft of the drum N as it revolves.

By this means the attendant is notified that an increase of pressure is taking place. This apparatus requires no skilled attendant, one person of ordinary intelligence being required to inspect it occasionally, as the water may be supplied and regulated through both gates at once, and without employing the tripping-rod *r* and its accessory devices, this part of the apparatus being only desirable to avoid the constant running of both sets of turbines. After the said tripping device has been tripped it must be again set by the attendant, who then has no further duties in operating the apparatus. While the pumps are making the ordinary pressure of forty pounds, the piston automatically controls and regulates the action of the gates to maintain that pressure, for should the pressure in the pipes fall to thirty-nine pounds, the piston falls a short distance, and shifts the crossed belt, which opens the gate until the pressure under the piston rises to the standard pressure of ten pounds. Should the pressure in the pipes rise to forty-one pounds, the piston, in responding to this excess, will shift on the straight belt, which closes the gates until the pressure falls to forty pounds, at which pressure both belts are running on the loose pulleys, and the gate is stationary. In Fig. 4 the pipes C and A are partially broken away to exhibit check-valves to prevent the pressure from reacting against the pumps. The projections *p″* are springs to enable them to pass over the beveled ends of the standards, so as to catch against them when revolved in the opposite direction, thus preventing the standards and projections from losing their relative connection in the operation of raising or lowering the bosses U. The rod *n* has a slotted eye where it connects with the stud of the arm *o* of the valve-shaft, so that a slight motion of the piston is admissible without altering the position of the valve *a*. This is requisite to keep the valve *a* from being moved while the piston is responding to slight changes of pressure in maintaining the pressure at forty or one hundred and fifty pounds, or other pressure to which the same is adjusted to operate. The piston-chamber may be variously constructed. The modification shown at Fig. 2 is a diaphragm, H′, supporting the piston-rod. The diaphragm acts in a manner similar to the piston, and is inclosed in a chamber, G′. That shown at Fig. 3 is a vibrating piston, H″, in a sector-shaped chamber, G″, the piston having an arm, G‴, to which the rod *j*, or its equivalent, may be attached.

I desire to be understood as not limiting myself to the precise arrangement or construction herein set forth, for the mechanism by which the gates are immediately operated may be variously modified, or completely substituted by other different mechanism, in combination with the piston-chamber and piston or diaphragm shown in red. Nor do I desire to be understood as limiting myself to the form or construction of the valve *a* and its

chamber M, as that may also be substituted by a cock, or conical or screw valve, or a slide or stop valve, without any especial inventive effort. Neither do I wish to be understood as limiting myself to the use of weights L L′, &c., for I have found chains suspended from the bar *k* suitable substitution.

The cock *m′* on the pipe *c* is for the purpose of regulating the flow through the said pipe, when the valve *a* is being adjusted to its proper relation to the piston H with respect to different pressures in the pipe D.

When starting the apparatus the first gate is hoisted by means of a hand-wheel on the threaded shaft. The street-mains and other pipes are thereby soon filled with water. The screw *q‴* of the wiper *q″* is then turned down to enter any one of the holes *v* in the wheel T, whereby the said wheel is coupled to the shaft T″, and revolves it, thus controlling the gate. The wiper *q″* is permitted to rise, without turning on the shaft T″, by means of a slot and projection device, so that the wiper and its screw may serve as a means of changing the wheel T from a loose to a fast wheel, and also to permit the wiper to rise to a position for actuating the rod *r*.

I claim as new and desire to secure by Letters Patent—

1. The combination of the piston-chamber G, piston H, weights L to L″, valve *a*, chamber M, and the pipes *c*, *e*, and D, substantially as described, for the purpose specified.

2. The belts P P′, shifter R, gate-operating mechanism S S′ S″ T T′ U T″ Q *p‴ p″*, substantially as described, in combination with a piston-chamber, G, a piston, H, a valve, *a*, and a pipe, *c*, all as set forth.

3. The pipes A B C D, having check-valves and a relief-valve, V, substantially as described, in combination with a piston-chamber, G, piston H, weights L to L″, valve *a*, and belts P P′, running on loose and fast pulleys, all as described, for the purpose of operating the gate-raising mechanism, all as set forth.

4. The gate-raising mechanism of water-works, operated by means of a piston-chamber and piston, or its equivalent, the weights L to L′, and gage-valve *a*, operating substantially as described, for the purpose specified.

5. The hydrostatic relief-valve V, constructed and operating substantially as described, in combination with a pipe, B, piston H, and valve *a*, for the purpose of making its operation dependent upon the movement of the governing-piston, all as set forth.

6. The gate-operating mechanism, as shown at Fig. 5, all substantially as described, and for the purpose set forth, when in combination with the governing-piston and valve *a*, all as set forth.

7. The combination of a hydrostatic valve, *a*, substantially as described, with a pressure-chamber and piston, H, substantially as described, when so connected that the valve and piston are dependent upon each other, and act by the pressure of the water to maintain an equable pressure against the said piston, all as set forth.

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