J. B. HIRST.

GAS PRESSURE REDUCING AND REGULATING MECHANISM.

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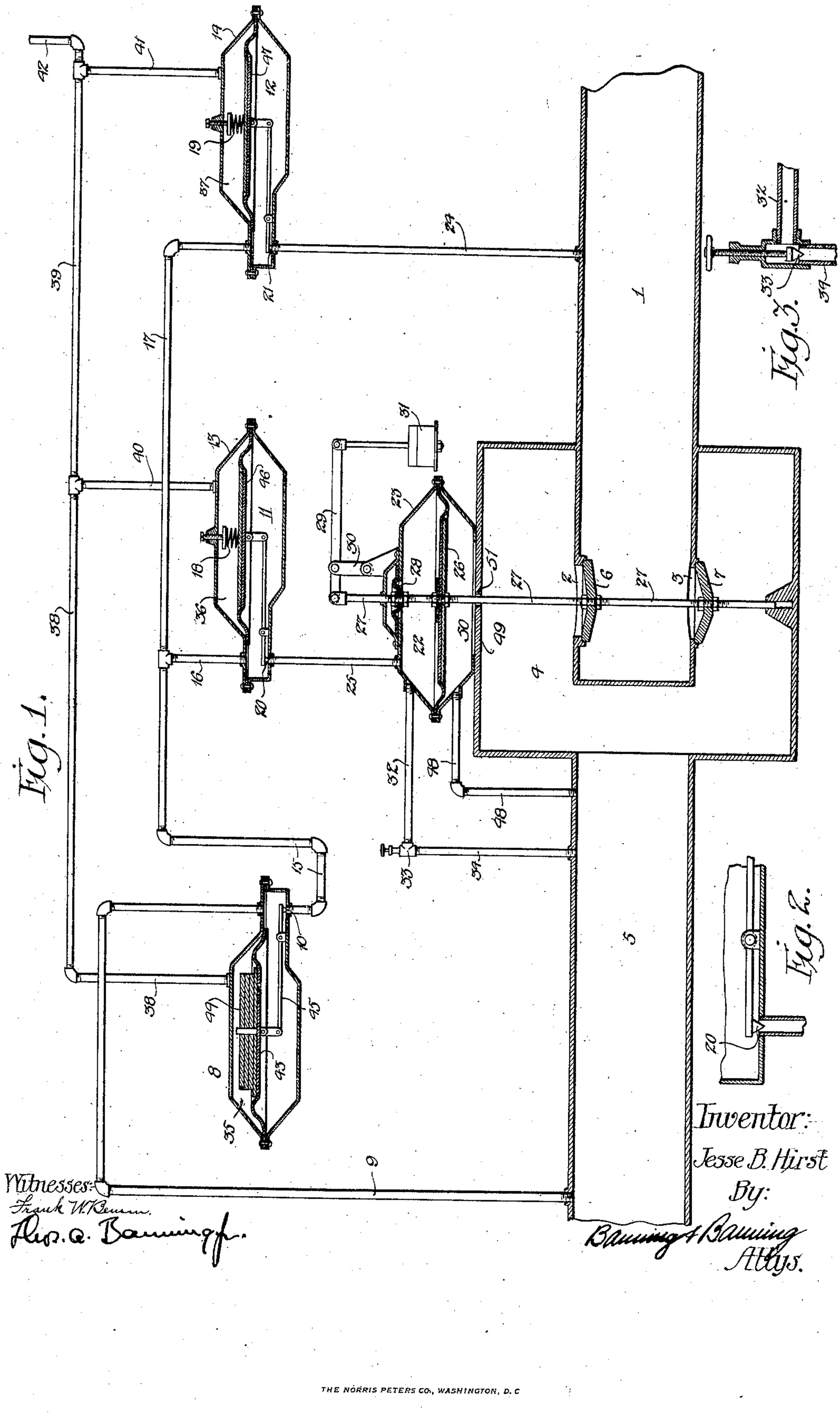

Fig. 1.

Fig. 2.

Fig. 3.

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GAS-PRESSURE REDUCING AND REGULATING MECHANISM.

985,175. Specification of Letters Patent. **Patented Feb. 28, 1911.**

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To all whom it may concern:

Be it known that I, JESSE B. HIRST, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Gas-Pressure Reducing and Regulating Mechanisms, of which the following is a specification.

Certain gas pressure-reducing and regulating mechanisms, as now constructed, involve the use of auxiliary diaphragms or other means for controlling the main reducing valve, actuated by the low pressure gas, so that when the lower pressure falls below a certain predetermined value, the main valve will be opened and high pressure gas will be allowed to pass from the high pressure to the low pressure main until the lower pressure has been raised to its proper value. Then the main reducing valve is closed by the auxiliary mechanism and the further admission of high pressure gas to the low pressure main is cut off. These mechanisms, as now made, are subject to several important defects, among which are, that the accumulation of water or mud in the manholes where they are placed affects the operation of the auxiliary devices by affecting the pressure acting on the diaphragms, thus throwing them out of adjustment and causing them to act at other than the desired gas pressures; that the failure of one of these auxiliary diaphragms, either by puncture or bursting, will admit high pressure gas directly to the low pressure main without control, thus endangering meters, house regulating mechanisms, and even the health of the gas users themselves; and that the main valve for the admission of high pressure gas to the low pressure main is subjected constantly to the opening tendency of a weight, so that the failure of low pressure gas to overcome this opening tendency might also allow excess of pressure to accumulate in the low pressure main.

This invention relates to an improved design and construction of mechanisms for reducing the gas from a higher to a lower pressure and the maintaining of a practically constant pressure in the low pressure main regardless of the rate of consumption of low pressure gas and of the fluctuations of pressure of the high pressure gas, as well as regardless of outside disturbing influences, such as the accumulation of water in the vault or manhole, where the regulating and reducing mechanism is placed; and also the provision of an auxiliary mechanism, the failure of any of whose parts will automatically cut off the supply of high pressure gas to the low pressure main. And the invention consists in the features of construction and combination of parts hereinafter described and claimed.

In the drawings, Figure 1 shows diagrammatically the arrangement of parts in my improved reducing and regulating mechanism; and Figs. 2 and 3 are enlarged details of the type of auxiliary and control valves which I use, respectively.

Referring to Fig. 1, gas from a high pressure main 1 passes through ports 2 and 3, when open, into a chamber 4, and from there into a low pressure main 5. The passage of gas from the main 1 to the main 5 through the ports 2 and 3 is controlled by valves 6 and 7, acting in unison to open or close the above mentioned ports. An auxiliary regulator 8 is operated by the pressure of gas from the low pressure main, acting through a pipe 9 to open or close a valve 10, thus establishing or cutting off communication of chambers 11 and 12 of auxiliary regulators 13 and 14 with the low pressure main 5, through pipes 9, 15, 16 and 17. Springs 18 and 19 of the auxiliary regulators 13 and 14 respectively, are so adjusted that these regulators will act to open or close valves 20 and 21 at the same gas pressure in the chambers 11 and 12, this pressure being equalized at all times through the pipes 16 and 17. The opening of the valves 20 and 21 places a chamber 22 of a main valve-actuating mechanism 23 in communication with the high pressure main 1, through pipes 24, 17, 16 and 25. A diaphragm 26 of the main valve-actuating mechanism 23 connects with a stem 27, the lower end of which carries the main valves 6 and 7, and the upper end of which passes from the chamber 22 by means of a small diaphragm 28, and is attached to one end of a lever arm 29, which is pivoted to a fulcrum arm 30. A weight 31, acting through the lever arm 29, tends always to close the ports 2 and 3 against the pressure acting down on the diaphragm 26, due to any excess of gas pressure in the chamber 22 over that in the chamber 50 of the main valve-actuating mechanism 23, and is of such

magnitude as to normally overcome the combined weight of the valves 6 and 7, the stem 27, the diaphragm 28, and the maximum water pressure which might have to come upon the diaphragm 28, due to flooding of the manhole or vault containing the mechanism. The chamber 22 of the main valve-actuating mechanism 23 is connected through a pipe 32, a needle valve 33, and a connection 34, with the low pressure main 5, so that when the high pressure gas is cut off from this chamber by the closing of the valves 20 and 21, the gas in it will escape into the main 5, thus allowing the weight 31 to raise the stem 27 and close the valves 6 and 7. Upper chambers 35, 36 and 37 of the auxiliary regulators 8, 13 and 14, respectively, communicate with the atmosphere through pipes 38, 39, 40, 41 and 42 at a point where water collected in the vault or manhole cannot enter them and thus affect their operation.

The low pressure chamber 50 of the main valve-actuating mechanism 23 is connected with the low pressure main 5 by the pressure-equalizing connection 48. The chamber 50 is separated from the chamber 4 by means of a baffle wall 49, which has in it a hole 51 just large enough to easily pass the stem 27. This baffle wall is for the purpose of preventing the accumulation of dynamic pressure in the chamber 50 due to the rushing of gas through the port 2 when it is opened.

In practice, the operation of the mechanism is as follows: Low pressure gas communicates from the main 5 through the pipe 9 to the lower face of a diaphragm 43 of the regulator 8. The upward pressure on the diaphragm 43, caused by the low pressure gas, is resisted by a weight 44, and the valve 10 is opened or closed by the action of the gas pressure through the medium of a lever 45. When the pressure of the gas in the main 5 falls the valve 10 is slightly opened, and some gas is allowed to pass from the pipe 15 and the mechanisms connected with it, thereby reducing the pressure acting on the lower face of the diaphragms 46 and 47 of the auxiliary regulators 13 and 14, respectively. The gas pressures on the diaphragms 46 and 47 are resisted by the springs 18 and 19, which springs, as above stated, are so adjusted that the diaphragms will act in unison, the gas pressures in the auxiliary regulators 13 and 14 being equalized through pipes 16 and 17. Therefore, the reduction of pressure in the main 5 will allow the regulator 8 to open the valve 10, thereby reducing the gas pressure under the diaphragms 46 and 47 and allowing the springs 18 and 19 of these regulators to open the valves 20 and 21. The instant these valves open, some high pressure gas will be admitted from the main 1 through the pipe 24, the valve 21, the pipes 17 and 16, and the valve 20, through the pipe 25, to the upper face of the diaphragm 26 of the main valve-actuating mechanism 23. Thereupon, this higher pressure gas, acting on the large upper surface of the diaphragm 26, will overcome the upward pressure of the low pressure gas acting on the bottom surface of this diaphragm, the small upward gas pressure on the diaphragm 28, the upward force due to the high pressure gas acting on the surfaces of the closed valves 6 and 7, and the excess upward force due to the weight 31; and the diaphragm 26 will be forced down, carrying with it the stem 27 and the valves 6 and 7, thus opening the ports 2 and 3 and allowing gas to pass from the main 1 to the chamber 4 and thence to the main 5.

As soon as the gas pressure in the low pressure main has been raised to its normal value, the auxiliary regulator 8 will close the valve 10, whereupon the pressure in the pipes 15, 16 and 17 will rise until the pressures on the diaphragms 46 and 47 become sufficient to close the valves 20 and 21, respectively. These valves will then shut off the supply of high pressure gas to the main valve-actuating mechanism. When this has been accomplished, the weight 31 will force up the stem 27, carrying with it the diaphragm 26, the diaphragm 28, and the valves 6 and 7, thus closing the ports 2 and 3. And the gas in the chamber 22 will escape through the pipe 32, the needle valve 33, and the connection 34, into the low pressure main 5.

It is seen that this improved mechanism overcomes the first of the above enumerated objections, for the flooding of the main valve-actuating mechanism 23 by the accumulation of water or mud in the manhole or vault where it is placed will merely serve to throw a downward pressure upon the small diaphragm 28; but we have above stated that the weight 31 is of a magnitude sufficient to overcome the maximum water pressure which might ever come upon the diaphragm 28 through flooding, so that flooding cannot actuate the mechanism 23, and thus abnormally raise the gas pressure in the main 5. Also the chambers 35, 36 and 37 of the auxiliary regulators 8, 13 and 14 are, as above stated, suitably connected through pipes to the atmosphere at a point where they cannot be flooded by the accumulation of water in the manhole. Therefore, their action can in no wise be affected by such flooding. Also the failure of the regulators 8, 13 and 14 to operate will merely prevent the admission of high pressure gas into the chamber 22 of the main valve-actuating mechanism, so that the weight 31 will maintain the valves 6 and 7 in the closed position, thus merely allowing the pressure in the

main 5 to fall below its normal value, and in no wise endangering the apparatus connected with it.

Those familiar with the present state of the art of regulating gas pressure will appreciate the fact that the devices used in this improved system can be made of simple and durable construction, and that the increased safety above mentioned, attainable through the use of it, will in itself constitute a large advance in the art.

I claim:

1. In a gas pressure-reducing and regulating system, the combination, with auxiliary regulators, of a main valve-actuating mechanism comprising a shell, a relatively large diaphragm dividing said shell, a relatively small diaphragm placed in one side of said shell and symmetrically with respect to said larger diaphragm, a needle valve connection connecting the space between said diaphragms with the low pressure main, a stem suitably attached to said larger and smaller diaphragms and carrying main valves adapted to open and close the ports for the passage of gas from the high pressure to the low pressure main, said smaller diaphragm suitably attached to a weight acting upon the smaller diaphragm and stem normally to keep the main valves in the closed position, substantially as described.

2. In a gas pressure-reducing and regulating system, the combination, with auxiliary regulators, of a main valve-actuating mechanism comprising a shell, a relatively large diaphragm dividing the inner space of said shell, a relatively small diaphragm placed in the upper side of said shell symmetrically with respect to said larger diaphragm, a connection from said auxiliary regulators for the admission of high pressure gas to the space between said larger and smaller diaphragms, a needle valve connection connecting the space between said diaphragms with the low pressure main, a stem suitably attached to said larger and smaller diaphragms and carrying main valves adapted to open and close the ports for controlling the passage of gas from the high pressure to the low pressure main, said smaller diaphragm suitably attached to a weight acting upon the smaller diaphragm and stem normally to keep the main valves in the closed position, substantially as described.

3. In a gas pressure-reducing and regulating system, a main valve-actuating mechanism, comprising a shell, a relatively large diaphragm dividing the inner space of said shell, a relatively small diaphragm placed in one side of said shell symmetrically with respect to said larger diaphragm, said larger diaphragm attached to a stem, said stem carrying the main valves for opening and closing the ports between the high pressure and low pressure mains, said stem connected to said smaller diaphragm, said smaller diaphragm connected through a lever mechanism with a weight, said weight exerting a force on said lever mechanism and stem in a direction tending normally to maintain the main valves in the closed position, the high pressure chamber of said main valve-actuating mechanism communicating through a needle valve with the low pressure main, in combination with an auxiliary regulating mechanism actuated by the pressure of the gas in the low pressure main, for controlling the admission of high pressure gas to the space between said larger and smaller diaphragms of the main valve-actuating mechanism, substantially as described.

4. In a gas pressure-reducing and regulating system, a main valve-actuating mechanism adapted to be operated by high pressure gas admitted thereto under the control of an auxiliary regulating mechanism, composed of a control auxiliary regulator comprising a shell, a diaphragm dividing the inner space of said shell, a weight tending normally to depress said diaphragm against a pressure thereon due to the pressure of low pressure gas, and an auxiliary control valve connected to said diaphragm, said auxiliary control valve connecting the pressure chambers of a main auxiliary regulator and a secondary auxiliary regulator with the low pressure main, the diaphragms of said main auxiliary regulator and said secondary auxiliary regulator acting at equal gas pressures to operate a main control valve and a secondary control valve, said secondary control valve, when open, placing the pressure chambers of the secondary auxiliary regulator and the main auxiliary regulator in communication with the high pressure main, and said main control valve, when open, admitting high pressure gas to operate the main valve-actuating mechanism, substantially as described.

5. In a gas pressure-reducing and regulating system, a main valve-actuating mechanism adapted to be operated by high pressure gas under the control of an auxiliary regulating mechanism, said auxiliary regulating mechanism composed of a control auxiliary regulator, comprising a shell, a diaphragm dividing the inner space of said shell, a weight tending normally to depress said diaphragm against a pressure thereon due to the pressure of low pressure gas, and an auxiliary control valve connected to said diaphragm, said auxiliary control valve, when open, placing the pressure chambers of a main auxiliary regulator and a secondary auxiliary regulator in communication with the low pressure main, the diaphragms of said main auxiliary regulator and said secondary auxiliary regulator acting at equal gas pressures against the force of springs to close a main control valve and a secondary

control valve respectively, said secondary control valve, when open, placing the pressure chambers of the main auxiliary regulator and the secondary auxiliary regulator in communication with the high pressure main, and said main control valve, when open, admitting high pressure gas to operate the main valve-actuating mechanism, substantially as described.

6. In a gas pressure-reducing and regulating system, a control auxiliary regulator, comprising a shell, a diaphragm dividing the inner space of said shell, a weight tending normally to depress said diaphragm against a pressure thereon due to the pressure of low pressure gas, and an auxiliary control valve connected to said diaphragm, said auxiliary control valve connecting the pressure chambers of a main auxiliary regulator and a secondary auxiliary regulator with the low pressure main, the diaphragms of said main auxiliary and said secondary auxiliary regulators acting at equal gas pressures against the force of springs to operate a main control valve and a secondary control valve, said secondary control valve, when open, placing the pressure chambers of the secondary auxiliary regulator and the main auxiliary regulator in communication with the high pressure main, and said main control valve, when open, admitting high pressure gas to the pressure chamber of a main valve-actuating mechanism, substantially as described.

7. In a gas pressure-reducing and regulating system, a control auxiliary regulator, comprising a shell, a diaphragm dividing the inner space of said shell, a weight tending normally to depress said diaphragm against a pressure thereon due to the pressure of low pressure gas, and an auxiliary control valve connected to said diaphragm, said auxiliary control valve connecting the pressure chambers of a main auxiliary regulator and a secondary auxiliary regulator with the low pressure main, the diaphragms of said main auxiliary and said secondary auxiliary regulators acting at equal gas pressures against the force of springs to operate a main control valve and a secondary control valve, said secondary control valve, when open, placing the pressure chambers of the secondary auxiliary regulator and the main auxiliary regulator in communication with the high pressure main, and said main control valve, when open, admitting high pressure gas to a main valve-actuating mechanism, comprising a shell, a relatively large diaphragm dividing the inner space of said shell, a relatively small diaphragm in one side of said shell, a stem attached to said larger and smaller diaphragms and carrying main valves adapted to open and close ports for regulating the flow of gas from the high pressure to the low pressure main, said smaller diaphragm connected by means of a lever mechanism with a weight, the tendency of said weight acting upon said stem being to keep the main valves normally in the closed position, substantially as described.

8. In a gas pressure-reducing and regulating system, a control auxiliary regulator, comprising a shell, a diaphragm dividing the inner space of said shell, a weight tending normally to depress said diaphragm against a pressure thereon due to the pressure of low pressure gas, and an auxiliary control valve connected to said diaphragm, said auxiliary control valve connecting the pressure chambers of a main auxiliary regulator and a secondary auxiliary regulator with the low pressure main, the diaphragms of said main auxiliary and said secondary auxiliary regulators acting at equal gas pressures against the force of springs to operate a main control valve and a secondary control valve, said secondary control valve, when open, placing the pressure chambers of the secondary auxiliary regulator and the main auxiliary regulator in communication with the high pressure main, and said main control valve, when open, admitting high pressure gas to a main valve-actuating mechanism, comprising a shell, a relatively large diaphragm dividing the inner space of said shell, a relatively small diaphragm in one side of said shell placed symmetrically with respect to said larger diaphragm, a needle valve connection connecting the space between said diaphragms with the low pressure main, a stem suitably attached to said smaller and larger diaphragms and carrying main valves adapted to open and close the ports for the passage of gas from the high pressure to the low pressure main, said smaller diaphragm connected by means of a lever mechanism with a weight acting normally to keep the main valves in the closed position, substantially as described.

9. In a gas pressure-reducing and regulating system, a control auxiliary regulator, comprising a shell, a diaphragm dividing the inner space of said shell, a weight tending normally to depress said diaphragm against a pressure thereon due to the pressure of low pressure gas, and an auxiliary control valve connected to said diaphragm, said auxiliary control valve connecting the pressure chambers of a main auxiliary regulator and a secondary auxiliary regulator with the low pressure main, the diaphragms of said main auxiliary and said secondary auxiliary regulators acting at equal gas pressures against the force of springs to operate a main control valve and a secondary control valve, said secondary control valve, when open, placing the pressure chambers of the secondary auxiliary regulator and the main auxiliary regu-

lator in communication with the high pressure main, and said main control valve, when open, admitting high pressure gas to a main valve-actuating mechanism comprising a shell, a relatively large diaphragm dividing the inner space of said shell, a relatively small diaphragm placed in one side of said shell symmetrically with said larger and smaller diaphragms, said larger diaphragm attached to a stem, said stem carrying the main valves for opening and closing the ports between the high pressure and the low pressure mains said smaller diaphragm and stem connected by means of a lever mechanism with a weight, said weight tending normally to maintain the main valves in the closed position, the space between said larger and smaller diaphragms communicating through a needle valve with the low pressure main, substantially as described.

10. In a gas pressure-reducing and regulating system, a main valve-actuating mechanism adapted to be operated by high pressure gas admitted thereto by means of an auxiliary regulating mechanism, composed of a control auxiliary regulator comprising a shell, a diaphragm dividing the inner space of said shell, a weight tending normally to depress said diaphragm against a pressure thereon due to the pressure of low pressure gas, and an auxiliary control valve connected to said diaphragm, said auxiliary control valve connecting the pressure chambers of a main auxiliary regulator and a secondary auxiliary regulator with the low pressure main, the diaphragms of said main auxiliary regulator and said secondary auxiliary regulator acting at equal gas pressures to operate a main control valve and a secondary control valve, said secondary control valve, when open, placing the pressure chambers of the secondary auxiliary regulator and the main auxiliary regulator in communication with the high pressure main, and said main control valve, when open, admitting high pressure gas to operate the main valve-actuating mechanism, the chambers on the low pressure sides of the diaphragms of said control auxiliary, main auxiliary, and secondary auxiliary regulators, being connected to atmosphere at a suitable point, substantially as described.

11. In a gas pressure-reducing and regulating system, a control auxiliary regulator, comprising a shell, a diaphragm dividing the inner space of said shell, a weight tending normally to depress said diaphragm against a pressure thereon due to the pressure of low pressure gas, and an auxiliary control valve connected to said diaphragm, said auxiliary control valve connecting the pressure chambers of a main auxiliary regulator and a secondary auxiliary regulator with the low pressure main, the diaphragms of said main auxiliary and said secondary auxiliary regulators acting at equal gas pressure against the force of springs to operate a main control valve and a secondary control valve, said secondary control valve, when open, placing the pressure chambers of the secondary auxiliary regulator and the main auxiliary regulator in communication with the high pressure main, and said main control valve, when open, admitting high pressure gas to the pressure chamber of a main valve-actuating mechanism, the chambers on the low pressure sides of the diaphragms of said control auxiliary, main auxiliary, and secondary auxiliary regulators, being connected to atmosphere at a suitable point, substantially as described.

12. In a gas pressure-reducing and regulating system, a control auxiliary regulator, comprising a shell, a diaphragm dividing the inner space of said shell, a weight tending normally to depress said diaphragm against a pressure thereon due to the pressure of low pressure gas, and an auxiliary control valve connected to said diaphragm, said auxiliary valve connecting the pressure chambers of a main auxiliary regulator and a secondary auxiliary regulator with the low pressure main, the diaphragms of said main auxiliary and said secondary auxiliary regulators acting at equal gas pressures against the force of springs to operate a main control valve and a secondary control valve, said secondary control valve, when open, placing the pressure chambers of the secondary auxiliary regulator and the main auxiliary regulator in communication with the high pressure main, and said main control valve, when open, admitting high pressure gas to a main valve-actuating mechanism, the chambers on the low pressure sides of the diaphragms of said control auxiliary, main auxiliary, and secondary auxiliary regulators, being in communication with atmosphere at a suitable point, said main valve-actuating mechanism comprising a shell, a relatively large diaphragm dividing the inner space of said shell, a relatively small diaphragm placed in one side of said shell symmetrically with said larger diaphragm, said larger and smaller diaphragms attached to a stem, said stem carrying the main valves for opening and closing the ports between the high pressure and the low pressure mains, said smaller diaphragm and stem connected by means of a lever mechanism with a weight, said weight tending normally to maintain the main valves in closed position, the space between said larger and smaller diaphragms communicating through a needle valve with the low pressure main, substantially as described.

13. In a gas pressure-reducing and regulating system, the combination, with auxiliary regulators adapted to be operated by changes of pressure of the gas in the low

pressure main from its normal value, of a main valve-actuating mechanism having within it a relatively large diaphragm adapted to be operated by high pressure gas admitted against said diaphragm by the auxiliary regulators, a stem attached to said larger diaphragm, main valves attached to said stem and arranged to open and close ports for the passage of gas from the high pressure to the low pressure main, a relatively small diaphragm placed in one side of said shell symmetrically with respect to said larger diaphragm, said stem attached to said smaller diaphragm, said smaller diaphragm and stem attached to a weight adapted to exert force on said stem in a direction constantly tending to maintain said main valves in closed position, a baffle wall for the separation of the low pressure chamber of said main valve-actuating mechanism from the low pressure main, and a connection between said low pressure chamber and the low pressure main, substantially as described.

14. In a gas pressure-reducing and regulating system, a control auxiliary regulator, comprising a shell, a diaphragm dividing the inner space of said shell, a weight tending normally to depress said diaphragm against a pressure thereon due to the pressure of low pressure gas, and an auxiliary control valve connected to said diaphragm, said auxiliary control valve connecting the pressure chambers of a main auxiliary regulator and a secondary auxiliary regulator with the low pressure main, the diaphragms of said main auxiliary and said secondary auxiliary regulators acting at equal gas pressures against the force of springs to operate a main control valve and a secondary control valve, said secondary control valve, when open, placing the pressure chambers of the secondary auxiliary regulator and the main auxiliary regulator in communication with the high pressure main, and said main control valve, when open, admitting high pressure gas to a main valve-actuating mechanism, the chambers on the low pressure sides of the diaphragms of said control auxiliary, main auxiliary, and secondary auxiliary regulators being in communication with the atmosphere at a suitable point, said main valve-actuating mechanism comprising a shell, a relatively large diaphragm dividing the inner space of said shell, a relatively small diaphragm placed in one side of said shell symmetrically with said larger diaphragm, said larger and smaller diaphragms attached to a stem, said stem carrying the main valves for opening and closing the ports between the high pressure and the low pressure mains, said smaller diaphragm suitably attached by means of a lever mechanism with a weight, said weight tending normally to maintain the main valves in closed position, the space between said larger and smaller diaphragms communicating through a needle valve with the low pressure main, the low pressure chamber of said main valve-actuating mechanism being separated from the low pressure main by means of a baffle wall, and a connection between the low pressure chamber and the low pressure main, substantially as described.

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