(No Model.)

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HYDRAULIC GAS PUMP.

No. 474,053. Patented May 3, 1892.

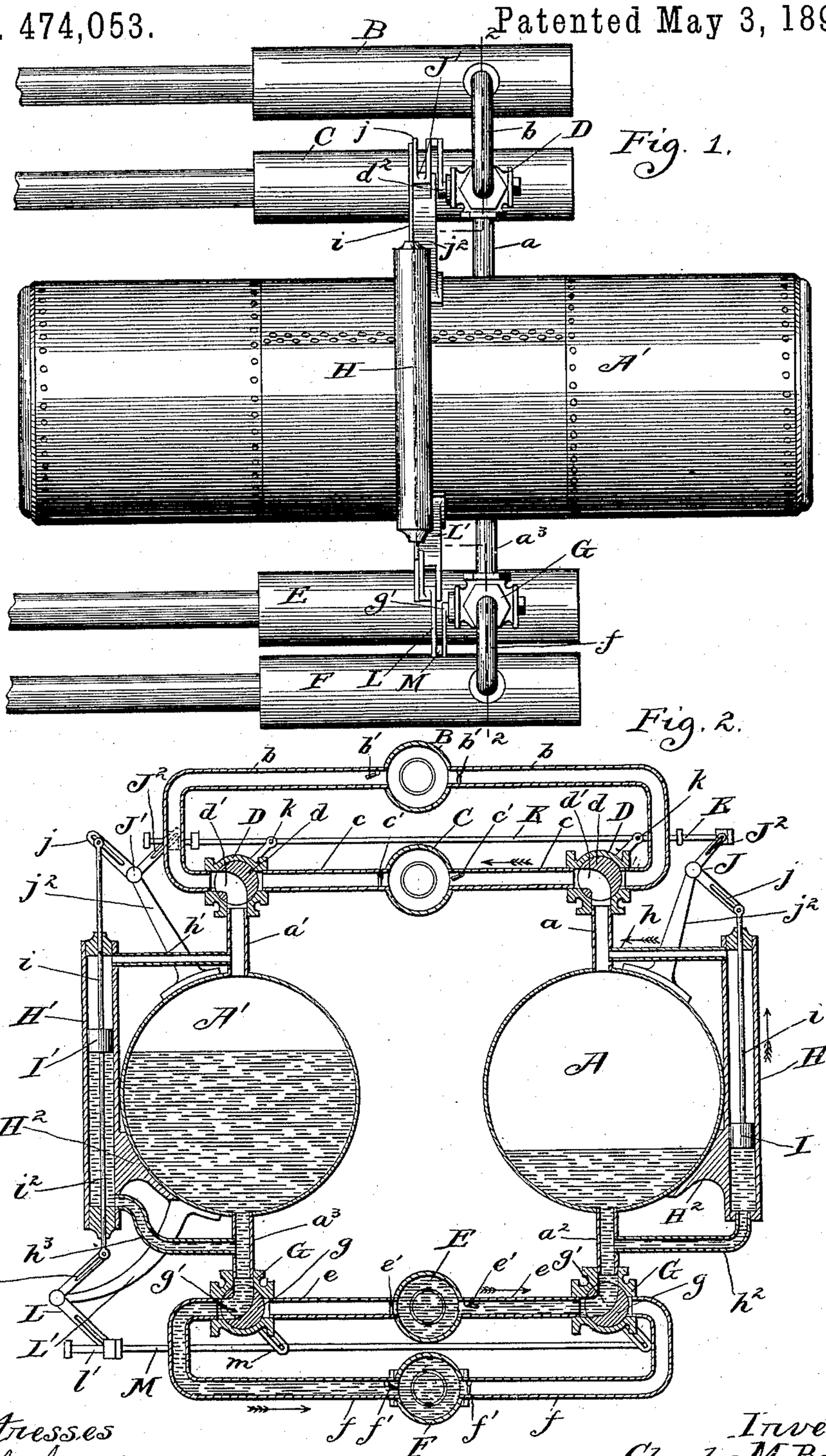

Fig. 1.

Fig. 2.

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HYDRAULIC GAS-PUMP.

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To all whom it may concern:

Be it known that I, CHARLES M. BENNETT, a citizen of the United States, residing at Logansport, in the county of Cass and State of Indiana, have invented certain new and useful Improvements in Gas-Pumping Apparatus, which are fully set forth in the following specification, reference being had to the accompanying drawings, in which—

Figure 1 represents a side elevation of a pumping apparatus embodying my invention; and Fig. 2, a cross-section of the same, taken on the broken line 2 2 of Fig. 1.

My invention relates to apparatus for pumping or forcing gas through the mains of a city system or through long-distance mains or pipes, being especially adapted for use in the latter case, where it is desired to pipe natural or other gas long distances.

The invention consists in an apparatus in which water-pressure is employed as the force for driving the gas forward through the conveying-pipes, the gas being conducted from the supply-source to a suitable receiver or receivers and thence expelled by water forced into the receiver under suitable pressure.

I will proceed to describe in detail an apparatus in which my invention is embodied in one practical form, and will then point out more definitely in the claims the particular improvements which I believe to be new and wish to secure by Letters Patent.

In the drawings, A and A′ represent two receivers or gas-holders, in which the gas is accumulated directly from the source of supply, either natural or artificial. These receivers are large strong cylinders, preferably of boiler-iron, and constructed after the manner of boilers. One or more of these gas-holders may be employed. In the drawings two are shown, and the apparatus connected and operating with this pair will be described. As shown in the drawings, these gas-holders are arranged side by side, and a supply-pipe B is connected with each, as will be presently described, this pipe being here shown arranged above the holders. The supply-pipe is of course connected with the supply-source, whether it be a natural-gas well or apparatus for the manufacture of gas. A delivery-pipe C is shown in the drawings just below the supply-pipe. Branch pipes *b* proceed from each side of the supply-pipe B, extending outward and then downward to valve-cases D, arranged over the respective holders. Branch pipes *c* also extend outward on each side of the pipe C and connect with the same valve-cases D, but on the sides opposite to the connections of the pipes *b*. Check-valves *b′* are arranged at suitable points in the respective branch pipes *b*, these valves being constructed to open outward, but not inward. Any known construction of check-valve may be here employed. Hence I do not show and describe any particular construction of this device. Similar check-valves *c′* are located in the branch pipes *c* at suitable points. These valves are, however, constructed and arranged to open inward, but not outward. The gas-holders are also connected, respectively, with the respective valve-cases D by short pipes *a a′*, the connection, as shown in the drawings, being at right angles to the connections of the branch pipes *b* and *c*. A two-way valve *d* is suitably mounted in each of the valve-cases D, being provided with an angular passage *d′*, adapted to connect either of the branch pipes *b c* with the pipes *a a′*, and through them with the respective gas-holders.

Two water-pipes are arranged below the gas-holders, the pipe E being a pressure-pipe leading from a pump, stand-pipe, or other device for forcing water through said pipe under pressure, while the pipe F, just below the pressure-pipe, is an exhaust-conduit for the discharge of water, after use in the gas-holders, into a reservoir or elsewhere, as may be desired. Branch pipes *e* connect with the pressure-pipe E and extend out on each side thereof to valve-cases G, and in these branch pipes are arranged suitable check-valves *e′*, constructed to open outward, but not inward. Branch pipes *f* also connect with the exhaust-pipe F and extend outward on each side of the latter, and are then bent upward to connect with the respective valve-cases G at the sides opposite to the connections with the branch pressure-pipes *e*. These branch pipes *f* are also provided with suitable check-valves *f′*, which are constructed and arranged to open inward, but not outward. The gas-holders A and A′ are also connected with the respective valve-cases G by short depending pipes a^2 a^3, the connection being at right an-

gles to those of the branch pipes *e f*, the same as in the valve mechanism described above. A two-way valve *g* is mounted in each case and is provided with an angular passage *g'*, adapted to connect the pipes a^2 a^3 with either of the branch pipes *e f*.

Now suppose the holder A has been filled with gas and the holder A' with water under pressure and that the valves *d* are adjusted, as seen in Fig. 2 of the drawings, so that communication is open between the holder A and the delivery-pipe C, while with the holder A' communication is made with the supply-pipe B, and the valves *g* are also adjusted, as seen in Fig. 2, so that communication is open between the pressure-pipe E and the holder A and between the exhaust-pipe F and the holder A'. It is evident that with the operation of the check-valves described above water will now be forced into the holder A, and the gas therein will thereby be driven out into the delivery-pipe C and forced along through said pipe to the required point of delivery. At the same time, through the operation of the exhaust, the water in the holder A' will be discharged and gas from the source of supply will be driven into this holder to take the place of the water expelled. The capacity of the two holders being the same, it is evident that when the holder A is finally filled with water the water in the holder A' will be entirely discharged and the said holder filled with gas. If, then, the valves are all reversed, it is evident that the same operation will take place as before, except that gas will now be forced from the holder A' into the delivery-pipe and water will be exhausted from the holder A, which at the same time is filled with gas, and so this operation may be continued, the two holders being alternately filled with gas and water. Of course in the operation of this pumping or forcing apparatus thus described, the supply of gas to the holders and the supply of water under great pressure to the same must be continuous, so long as the pumping apparatus is to be kept in operation.

It will be noted at once that it is desirable and important to have the valves operated automatically, so that the required reversal will be effected at the proper time by mechanical means without interruption, and I will now describe a mechanism for this purpose. At the sides of the apparatus are small upright cylinders H and H', the former at the outside of the holder A and the latter of A'. As shown in the drawings, these cylinders are supported by brackets H^2, attached to the respective holders. These cylinders are connected at their upper ends by pipes *h h'* with the respective gas connecting-pipes *a a'* and at their lower ends by similar pipes h^2 h^3 with the connecting water-pipes a^2 a^3. The cylinders are supplied, respectively, with pistons I and I', the rods *i i'* of which, projecting from the upper ends of the cylinders, are connected, respectively, with bell-crank levers J and J', which are mounted on brackets J^2, secured to the respective holders. The arms *j*, to which the piston-rods are attached, are provided with slots *j*, to accommodate the reciprocation of the pistons and their rods, and the other arms j^2 of these levers are connected to the respective ends of a connecting-rod K, to which crank-arms *k* are pivoted, while at their other ends they are fastened to the stems d^2 of the respective valves *d*. The piston I' in the cylinder H' is also provided with a rod i^2, which is extended out through the lower end of the cylinder and then connected to a bell-crank lever L, mounted on a bracket L', secured to the holder A'. The arm *l*, to which this piston-rod is connected, is slotted for the purpose stated above, and the other arm *l'* is pivoted to one end of a connecting-rod M, to which are connected the outer ends of crank-arms *m*, which are fastened at their other ends to the valve-stems *g'* of the valve *g*. Now it is obvious that as the cylinders *h h'* are connected with both the gas-pipes and the water-pipes, as described, the fluids in the respective cylinders will correspond to the fluids in the respective adjacent holders, and so one will be filled with water under pressure and the other with gas, and vice versa. The action of the water-pressure in these cylinders will of course reciprocate the pistons therein. As one is filled with water its piston will be driven up to the upper end of the cylinder, while the water being exhausted at the same time from the companion cylinder its piston will be driven down by the gas to its lower end. From the connection of the pistons with the valve, already described, it is evident that their movement in opposite directions, just mentioned, will effect a change of the valves, both those in the gas-pipes and those in the water-pipes. These parts are so constructed and arranged that the reversal of the valves is effected just at the proper time for changing the water-pressure from one holder to the other and reversing the connections between the holders and the gas supply and delivery pipes, as already explained. The valve mechanism is thus made automatic, so that the operation of the pumping apparatus is continuous without special attention.

The operation of this apparatus will be understood from a study of Fig. 2 of the drawings. In this figure it will be seen that the holder A is in communication with the delivery-pipe C and the pressure-pipe E, while the holder A' is in communication with the gas-supply pipe B and the exhaust-pipe F. Consequently the gas is being forced out of the holder A into the pipe-line and the holder is being filled up with water while water is being exhausted from the holder A' and gas is flowing in from the source of supply. The piston I will be carried up and I' down, and these pistons will reach the limit of their respective movements when the holder A is at length filled with water, at which time the valve mechanism will be entirely reversed and

the water-pressure thereby changed from the holder A to the holder A′, when the operation is continued by forcing the gas out of A′ and refilling with gas the holder A.

With this apparatus any practical pressure required is readily obtained for driving the gas through mains or other pipes for long distances. In accordance with the well-known laws regulating water-pressure the force exerted upon the gas to drive it into and through the pipes may be increased or diminished, as required, with great facility and an effective pressure obtained for conveying gas long distances with an apparatus comparatively cheap and simple.

In using this apparatus for pumping gas long distances it may be duplicated, of course, at such intervals as may be required, there being of course a practical limit to the distance through which a single pump can force the gas.

I have here shown and described a valve mechanism for the purpose of illustrating a practical mode of operating the valve automatically; but I do not wish to be understood as limiting my invention to this mechanism, for the variety of known devices for regulating and operating valves is so great that this mechanism may be changed for others or greatly modified in its construction and arrangement. I do not wish to be understood as restricting my invention to any particular valve mechanism. I also desire to make the same reservation as to the particular construction and arrangement of the several pipes and their connection with the gas-holders, which are here shown and described. These special features are not essentials of my invention, but may be modified in a great variety of ways for convenience and to facilitate the operation. It is also evident that this plan of operation may be applied to a single holder; but the action would then be intermittent—that is, the one holder would be alternately filled with gas and then emptied thereof, and of course during the filling there would be no flow of gas to the delivery-pipe. The apparatus then may be worked with single gas-holders or in pairs, and the pairs may be duplicated, if desired.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

In a gas-pumping apparatus, the gas-holders A A′, in combination with the valve-cases D and G, connected with both said holders, gas supply and delivery pipes B C, provided, respectively, with branches *b c*, connecting with the respective valve-cases D and having suitable check-valves, water pressure and exhaust pipes E F, provided with branches *e f*, connecting with the respective valves G and having suitable check-valves, the valves *d g*, mounted in the respective valve-cases, the cylinders H H′, connected with the water-pipes at one end and the gas-pipes at the other, the pistons I I′, the sliding rods K and M, connected, respectively, to arms on the valves *d* and *g*, the bell-crank levers J, J′, and L, and connecting-rods *i*, *i′*, and i^2, substantially as described.

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