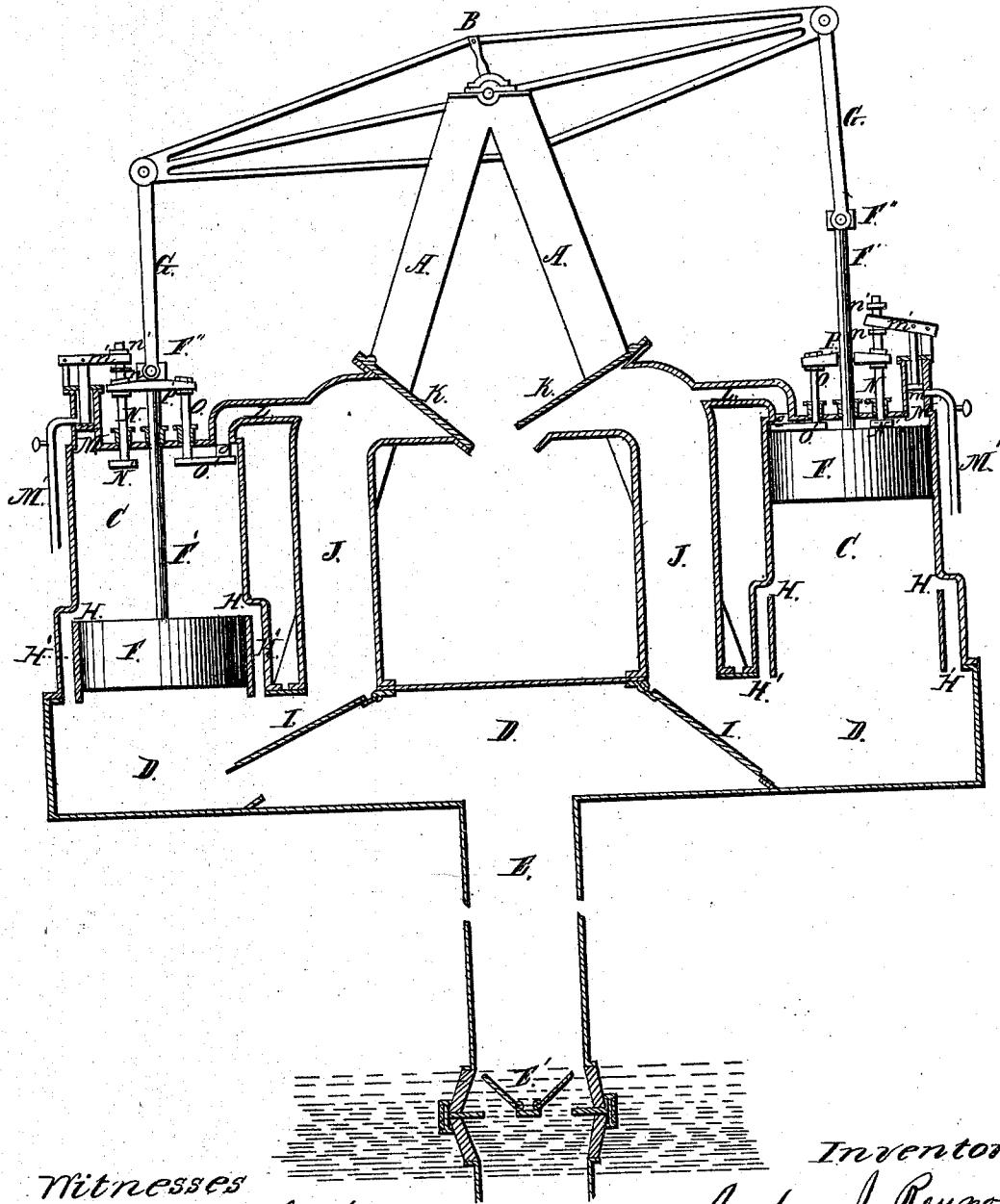


*A. J. Reynolds*  
*Hydraulic Engine.*

*N<sup>o</sup> 97,698.*

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# United States Patent Office.

ANDREW J. REYNOLDS, OF CHICAGO, ILLINOIS.

Letters Patent No. 97,698, dated December 7, 1869.

## IMPROVEMENT IN ATMOSPHERIC AND CONDENSING HYDRAULIC ENGINES.

The Schedule referred to in these Letters Patent and making part of the same.

### To whom it may concern:

Be it known that I, ANDREW J. REYNOLDS, of Chicago, in the county of Cook, and State of Illinois, have invented a new and useful Improvement in Atmospheric and Condensing Hydraulic Engines; and I do declare that the following is a true and accurate description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon; and being a part of this specification.

The nature of this invention relates to an improved construction of engines for raising water by atmospheric pressure, steam being used and condensed in said engines for the purpose of creating a vacuum therein, and thus utilize the pressure of the atmosphere for the purpose first mentioned.

It consists in the employment of two cylinders, surmounting and opening into a channel-plate. In each of said cylinders is a piston, connected, through its rod and links, to either end of a walking-beam, for producing a steady, continuous discharge of water. By means of a peculiar arrangement of valves and tappets, steam is alternately let into each cylinder on top of the piston, forcing it down, and expelling the water from its under side, through the channel-plate and discharge-pipe. As the piston approaches the bottom of the cylinder, the steam induction-pipe is automatically closed, and the piston uncovers the ports of side-pipes leading from the lower part of the cylinder down into the channel-plate, when the steam in the cylinder is condensed by contact with the cold water, and a vacuum established in the cylinder, when the piston is forced up by a column of water entering through the foot-valve, forcing down the other piston, and expelling the water from the other cylinder, by means of the walking-beam and its attachments. The steam, after the first stroke is completed, is chiefly used to fill the cylinders for creating a vacuum, after they are emptied of their water, which fills them by atmospheric pressure, as described.

It also consists in a new and peculiar arrangement of the air and steam-valves, and mechanism for operating them; also in the arrangement of the ports in the lower part of the cylinders, for opening communication between the steam in the cylinders and the water in the channel-plate, at the completion of the downward stroke, thereby rapidly condensing the steam and creating a vacuum, when a column of water raises the piston, and fills the cylinder in the manner described. The air and steam-valves are so arranged and operated, that but a very small amount of steam is required to be used in forcing down the pistons and expelling the water under the pistons, as it is greatly assisted by the upward pressure of the column of water raising the other piston.

In the drawings—

A represents a gallows-frame, in which is hung the walking-beam B.

C are cylinders, open at their lower ends, resting on and secured to the channel-plate D, communicating with the water-supply through a suction-pipe, E, having one or more check-valves, E', below the water-level. The suction-pipe should not be so long, nor the engines placed so high above the supply as to require more power than the natural pressure of the atmosphere to supply them with water.

Within each cylinder is a piston, F, attached to the piston-rod F', whose upper end terminates in a cross-head, F'', connected to the end of the walking-beam by links G.

Near the bottom of each cylinder, at the plane of the upper side of the piston, when it has completed its downward stroke are the ports H, connecting the cylinder with the channel-plate, through the side-pipes H'.

In the channel-plate are two foot-valves, I, one opening toward each cylinder.

J are the discharge-pipes, leading from the channel-plate, between the foot-valves and the cylinders. Their upper ends are furnished with ordinary clack-valves, K. An air-pipe, L, connects the top of the discharge-pipe with the top of the cylinder.

M is a cylindrical steam-chest, on top of each cylinder, to which steam is admitted through the steam-pipe M'.

Within the steam-chest is a piston-valve, *m*, whose stem is pivoted to a poppet-lever, *m'*. When this lever is raised, steam will enter the cylinder C, and when lowered, the steam will be shut off by the valve *m*.

Passing through a stuffing-box, in the head of the cylinder, is a lifting-rod, N, provided at its lower end with a follower, N', and at its upper, with adjustable tappets *n n'*, between which is inserted the free end of the lever *m'*.

Through another stuffing-box in the cylinder-head passes another lifting-rod, O, having a follower, O' on its lower end. This follower is elongated, and carries a plug-valve, *o*, which enters and closes the air-pipe L.

The upper end of the rod O is secured to one end of a yoke, P, whose other end embraces the rod N, so that when the piston descends nearly to the bottom of the cylinder, the cross-head F'' strikes and carries down the yoke P, closing the valve *m*, shutting off the steam, and opening the air-valve *o*.

When the piston rises to nearly the top of the cylinder, it strikes both followers, closing the air-valve, and opening the valve *m* for the admission of steam. The opening and closing of the steam-valve is effected by the tappets *n n'* striking and moving the poppet-lever; but any other suitable device may be employed in lieu thereof for operating the valve.

All the parts of each cylinder are alike in construction and operation.

The operation of this apparatus is as follows:

The channel-plate and cylinders are filled with water until the pistons stand at the same height in each cylinder; steam is then admitted in the right-hand cylinder, forcing down the piston, and driving the water up and out of the right discharge-pipe. At the same time the left piston rises, the water following it and filling the cylinder.

When the right piston gets to the bottom of the cylinder, the steam is shut off, and the steam in the cylinder, passing through the ports H into the channel-plate, coming into contact with the cold-water, is instantly condensed, the tendency of the steam being to follow the running-water; at the same time the air-valve *o* is opened, and, as the water is discharged the clack-valve K, at the end of the discharge-pipe, closes.

The vacuum being established in the upper part of the cylinder and discharge-pipe, the pressure of the external atmosphere causes a column of water to rush up the pipe E, raising the foot-valve, and filling the cylinder, forces up the piston, in which it is assisted by the downward pressure of the steam on the other piston. As the piston approaches the top of the cylinder, the air-valve is closed, and the steam-valve opened, to discharge the contents of the cylinder.

The operation of the other cylinder is the same, and by the employment of two cylinders, the discharge of water is continuous.

Where a large amount of water is to be raised, necessitating the employment of large cylinders, the great area of their internal surfaces, cooled at each stroke by the rising water, would tend to condense the steam early in the downward stroke. In such cases a smaller steam-cylinder, similar in construction to those described, may be placed on top of them, with

both their pistons secured to the one piston-rod. By this arrangement, no water can get into the upper cylinder to cool it down while in operation, to waste steam by condensation before a vacuum is required.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In combination with the devices employed for connecting together the pistons, the cylinder C, provided with the ports H, and side-pipes H', by means of which steam is admitted to the channel-plate, substantially as and for the purpose specified.

2. The arrangement of the air-valves *o*, the lifter-rods O, the followers O', the yoke P, with the cross-head P', the piston-rod F', and the piston F, to open and close the air-pipes before steam is admitted to the cylinders, and after it is cut off, substantially as set forth.

3. The arrangement of the piston-valves *m*, lifter-rods N, yokes P, poppet-levers *m'*, tappets *n n'*, followers N', steam-chests M, and piston-rods F', for admitting steam to and cutting it off from the cylinders C, substantially as described.

4. The channel-plate D, foot-valves I, discharge-pipes J, and clack-valves K', in connection with the pipe E, and check-valves E', arranged substantially as herein set forth.

5. An atmospheric and condensing hydraulic engine, wherein two cylinders are employed, with their pistons connected through a walking-beam, and so arranged that the surplus power of one piston is transferred to the other, so as to produce a continuous reciprocating motion, without the use of a crank and fly-wheel, substantially as and for the purpose set forth.

ANDREW J. REYNOLDS.

Witnesses:

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H. F. EBERTS.