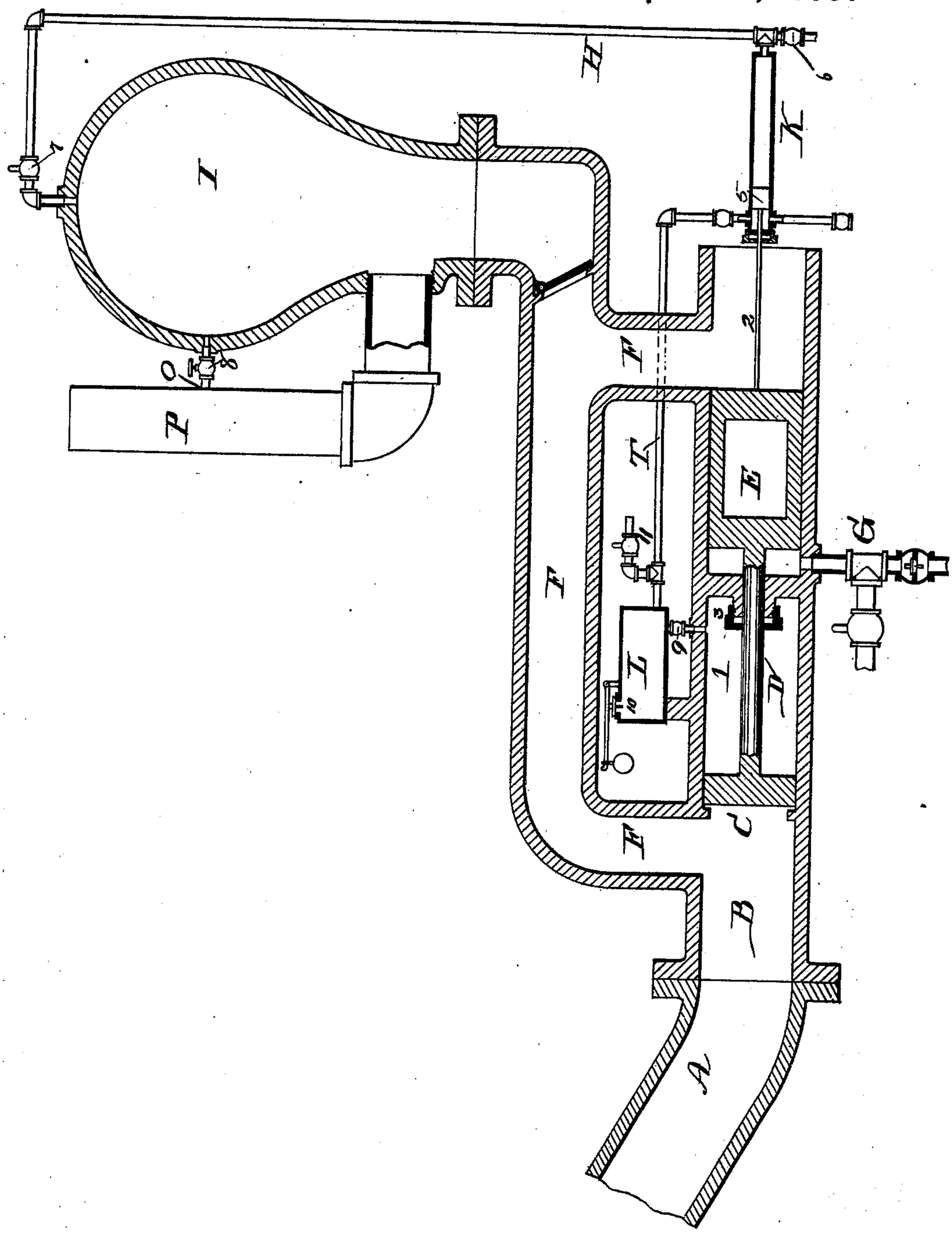
G. YELLOTT.

Hydraulic-Ram.

No. 214,979. Patented April 29, 1879.



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IMPROVEMENT IN HYDRAULIC RAMS.

Specification forming part of Letters Patent No. **214,979,** dated April 29, 1879; application filed January 24, 1879.

To all whom it may concern:

Be it known that I, GEORGE YELLOTT, of Towsontown, in Baltimore county and State of Maryland, have invented a new and Improved Hydraulic Ram, by the action of which water in large quantities for operating machinery, supplying towns and cities, and for other useful purposes, can be raised to a great elevation; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the annexed drawings, making a part of this specification, by which the whole machine is correctly represented, with an interior view of the pipes, cylinders, pistons, valves, and other appendages and parts connected and put together as when in operation.

The nature of my invention consists in dispensing with the use of the valve which opens and closes the orifice of discharge in the ram-pipe, and by so doing puts in motion and then suddenly stops the flow of water through said pipe in the ordinary hydraulic ram now in use, but which valve, by suddenly closing against a non-elastic and solid substance, causes a shock and jar to the machine proportionate to the momentum of the moving column of water, and substituting for said valve a piston moving against condensed air in a cylinder, the water in the ram-pipe being put in motion and stopped by the action of said piston in opening and closing the channel of escape without any jar or concussion caused by the collision of solid bodies coming in contact suddenly and with great force, which, in a large ram of the ordinary construction, would rupture the pipe and destroy the machine, by reason of which it has been found impossible to use these hydraulic motors for elevating water in large quantities.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and operation.

In the accompanying drawings, A represents a section of the ram-pipe conducting the water from the source of supply, which pipe, at its lower end, is attached to and opens into a cylinder, B, which cylinder is divided into two parts, (designated, respectively, by figures 1 and 2.) In that part of cylinder B which is designated by figure 1 is a piston, C, accurately fitted, so as to prevent the escape of air, and connected by a rod, D, which passes through a stuffing-box, figure 3, with another piston, E, in that part of said cylinder designated by figure 2. This part of said cylinder is open at its end, and its length is about double that of the other part of said cylinder, (designated by figure 1.)

The piston E is hollow, and is cylindrical in shape, with both ends closed, so as to present the exterior appearance of a solid body. It is of sufficient length to fill one-half of that portion of the cylinder designated by figure 2, in which it slides with the rims of its two ends accurately fitted, so as to prevent the passage of air.

F represents a pipe of less diameter than the pipe A, being, at one end, attached to and opening into that portion of the cylinder B immediately in front of the piston C. The other end of the pipe F is attached to and opens into that portion of the cylinder B designated by figure 2, immediately behind the piston E. G is a pipe opening into the part of the cylinder B designated by figure 2, in front of the piston E, and with a valve opening inward and another valve opening outward, so that either air or water can be drawn in and expelled when the piston E is in motion.

K is a small cylinder, with a piston and rod (designated by figure 5) working in said small cylinder by being connected with the piston E. H is a small pipe, by which air being admitted into the small cylinder K by the valve opening inward, and designated by figure 6, is driven through the valve designated by figure 7 into the air-chamber I, which air-chamber communicates with the pipe F by a valve, as represented in the drawings.

In order that there may be always a proper condensation of air in that portion of the cylinder B designated by figure 1, a receiver, L, is attached to said portion of the cylinder, and communicates therewith by a valve, 9, which opens into said cylinder. This receiver is connected by a pipe, T, with the small cylinder K. To the top of this receiver is attached a weighted valve opening outward, and designated by figure 10. This valve is so weighted that when the air in the cylinder is of the desired condensation it rises and lets the air forced into the receiver through the pipe T es-

cape; but if there has been an escape of air from the cylinder, then, when the piston C is at the extreme end of the cylinder, the air therein will exert a less pressure on the valve, figure 9, than will the weight on the loaded valve, figure 10, and air will be forced into the cylinder and supply the deficiency.

The small pipe, figure 11, can be conveniently attached to the receiver-pipe T and closed by a cap screwed on the end after the air in the cylinder has been condensed.

In order to operate this ram I condense the air in that portion of the cylinder B designated by figure 1, by pumping air through the small pipe designated by figure 11, which pipe has a valve opening inward and through the receiver and valve 9. This small pipe should then be closed by a cap screwed on its end.

The air in the cylinder is condensed until it is more than sufficient to overcome by its elasticity the weight and friction of the pistons in the cylinder and the static pressure of the water in the pipe A when the water is at rest in said pipe, which static pressure is dependent upon the height of the fall of water perpendicularly from the source of supply. The air being condensed, as aforesaid, and the two pistons being so placed that the piston E leaves the orifice at the end of the pipe F open, the water passes through the pipe F with a velocity due to the height of the fall, and escapes freely from the end of the cylinder B designated by figure 2.

The column of water in the pipe A is thus put in motion and acquires a momentum due to the weight of the whole number of cubic feet of water in the pipe A multiplied by the velocity of the moving column. This momentum can be easily and correctly estimated, and the mode of calculation should be perfectly understood when a ram is to be constructed, as it has an important bearing upon the strength of materials to be used in its construction.

If the height of the fall of water is ten feet, the water freely escaping through the pipe F will have a velocity in its passage through that pipe of twenty-five feet per second. If the pipe A is of a cubic capacity sufficient to pass four times as much water as the pipe F, the velocity of the water in A will be a little more than six feet per second. If A contains one hundred cubic feet of water the weight of the whole column will be more than six thousand pounds, and the whole column moving through A with a velocity of six feet per second, the momentum will be thirty-six thousand pounds. If the piston C presents a surface of one hundred square inches, and the air in the cylinder has been condensed to two atmospheres, or thirty pounds to the square inch, the resistance at first offered by the piston to the momentum of the moving column of water in A will only be three thousand pounds; but this will be continually increased by the additional condensation of the air as the piston is driven back in the cylinder.

It is thus seen that the momentum of the water in a large ram is immense, and in constructing the machine can be increased at pleasure by simply lengthening the ram-pipe, the height of the fall of water remaining the same.

This is a fact never to be lost sight of by those engaged in the construction of this ram, and it is deemed important to make it clearly appear. This momentum is directed against the head of the piston C, and driving back the two pistons connected by the rod D the piston E slides over and instantly closes the orifice of discharge of the pipe F, thus suddenly checking the moving column of water in F, which is then driven into the air-chamber I, when the entire momentum of the water in the pipe A is concentrated on the head of the piston C, and the two pistons are driven back until the air in that portion of the cylinder B designated by figure 1 acquires an enormous pressure, while at the same time water enters by atmospheric pressure through the pipe G and fills the space, which would otherwise be left vacant by the piston E when driven to the end of the cylinder B. There is also a supply of air driven by the small piston figure 5 through the pipe H into the air-chamber I, and replaces the particles of air absorbed and carried off by incorporation with the water by compression.

To guard against an excessive quantity of air being forced into the air-chamber, the one end of a very small pipe, O, opened and closed by a cock, figure 8, is inserted into the air-chamber at a point below which the water should never fall when the ram is in operation. The other end of the pipe O is inserted in the ascending pipe P, and after the ram is put in operation the cock figure 8 is opened, and water passes out and is discharged up the pipe P, unless the water falls below the point of insertion of the pipe O into the air-chamber, when air passes through the pipe O by the preponderating pressure, and is carried out in bubbles through the pipe P.

As the velocity of the water in the pipe A is diminished the condensed air in that portion of the cylinder B designated by figure 1 reacts, and, driving the water back by means of the piston C, causes it to enter the air-chamber I through the pipe F with a pressure equal to the sum of the two opposing forces—namely, the pressure of the condensed air in the cylinder and the remaining momentum of the moving column of water in the pipe A.

When the motion of the water in the pipe A has entirely ceased the water will no longer act by its momentum, but will act by static pressure alone, which, if the fall, as has been supposed, is ten feet, would be one-third of an atmosphere; and as the air in that portion of the cylinder B designated by figure 1 was originally condensed so as to be more than sufficient to overcome this static pressure, together with the weight and friction of the pistons in the cylinder B, the two pistons C and

E will be impelled forward by the air so condensed until the orifice in the end of the pipe F will be opened, when the water in the pipes F and A will be put in motion again and with a like result.

If the initial condensation of the air in that portion of the cylinder B designated by figure 1 has been made sufficient for the purpose, all waste-water which has entered through the pipe G can be utilized by a proper connection with the said pipe G, as the water, acting alternately by static pressure and by momentum, becomes weaker and stronger as it changes its mode of action; and when acting by momentum as a solid body of equal weight its power is only limited by the length and diameter of the ram-pipe and the strength of the materials, so that if a greater condensation of the air in the cylinder is desired for a given purpose it is only necessary to lengthen the ram-pipe and such additional condensation is obtained, while the static pressure when the water is at rest in the ram-pipe will remain unaltered.

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

1. In a hydraulic ram, a piston or pistons, or other solid body or bodies, resting against condensed air or other elastic fluid in a cylinder or other confined space, and by the action of said piston or pistons, or other solid body or bodies, when driven back by the momentum of the water in the ram-pipe against the said condensed air or other elastic fluid, closing the orifice through which the water, by its motion in escaping, gives velocity and momentum to the water in the ram-pipe, and by the reaction of said condensed air or other elastic fluid on said piston or pistons, or other solid body or bodies, opening said orifice, and thereby putting the water in the ram-pipe, communicating with said orifice by a proper connection therewith, in motion with a renewed velocity after said water has ceased to act by momentum and is acting by static pressure, and driving water into the air-chamber without any shock or concussion endangering the safety of the machine, substantially as herein specified.

2. In combination with an air-vessel and ascending pipe of a hydraulic ram, a small pipe provided with a controlling valve or cock, the said pipe connecting the air-vessel and ascending pipe at a point below the lowest level attained by the water in the air-vessel, substantially as and for the purpose specified.

GEORGE YELLOTT.

Witnesses:
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