J. C. Strode,

Hydraulic Ram.

No. 10,079. Patented Oct. 4, 1853.

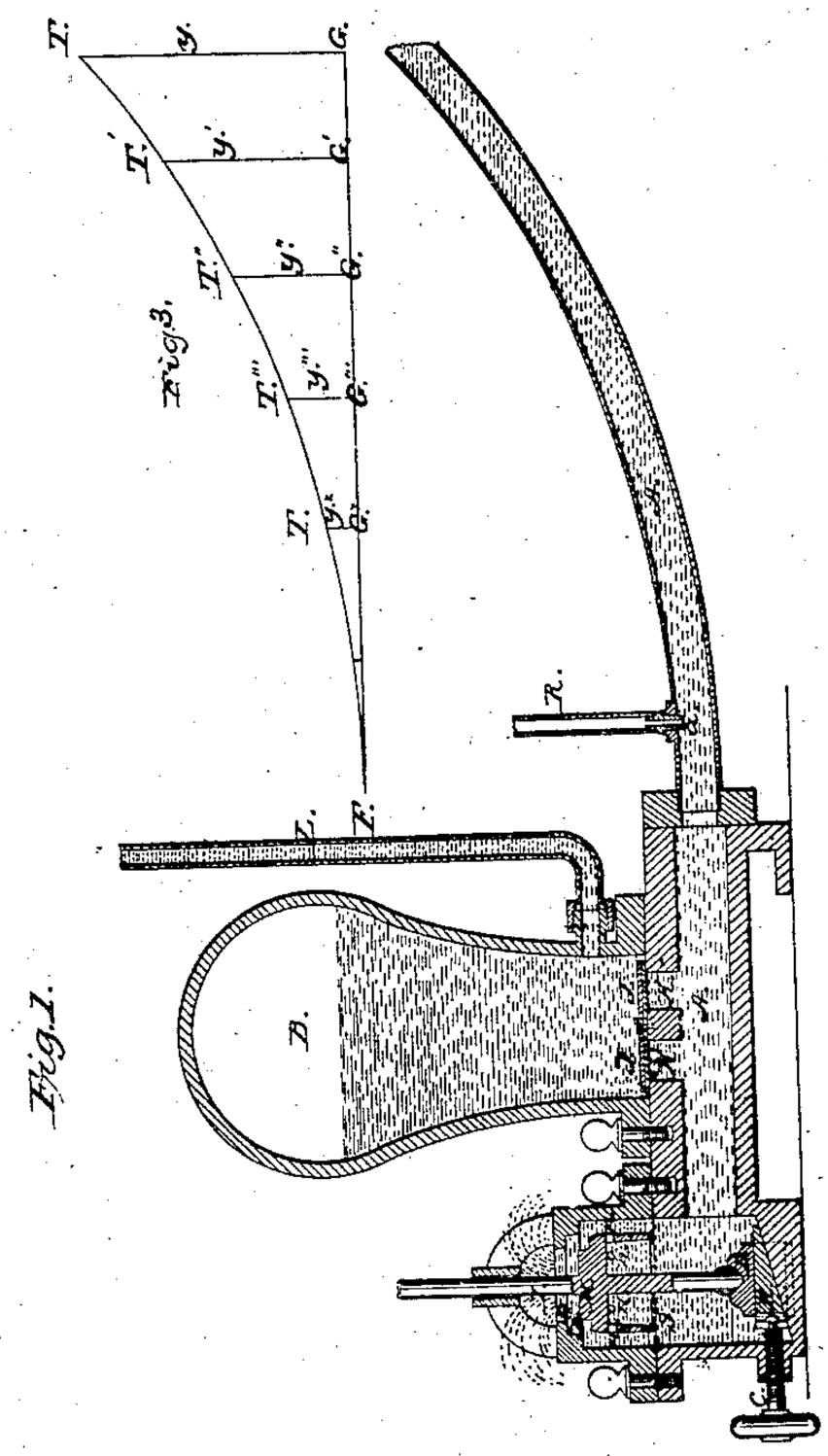

Fig. 1.

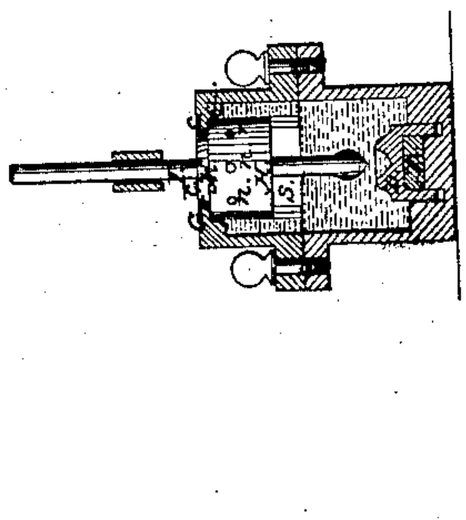

Fig. 2.

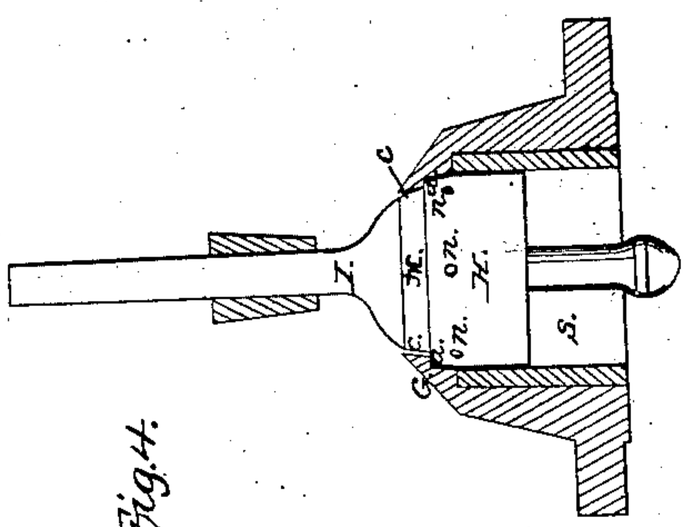

Fig. 4.

UNITED STATES PATENT OFFICE.

JOSEPH C. STRODE, OF EAST BRADFORD, PENNSYLVANIA.

HYDRAULIC RAM.

Specification of Letters Patent No. 10,079, dated October 4, 1853.

To all whom it may concern:

Be it known that I, JOSEPH C. STRODE, of East Bradford township, in the county of Chester and State of Pennsylvania, have invented certain new and useful Improvements in Hydraulic Rams; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1, is a longitudinal vertical section of a hydraulic ram constructed according to my improvements. Fig. 2, is a transverse vertical section of the same taken through the discharge valve-box. Fig. 3 is a diagram illustrative of the manner of laying out the curve of the driving pipe. Fig. 4 is a view of the discharge valve, showing the annular spaces above and below its seat.

Similar letters of reference indicate corresponding parts in each of the several figures.

The first part of this invention consists in laying the driving pipe which conveys the water from the head to the ram, in the brachistochrone curve, which is that curve in which a body will descend from one point to another point not in the same vertical line, in the shortest time and therefore with the greatest mean velocity. This property of the above curve will enable a greater quantity of water to be raised by a machine of a given size than can be raised with the driving pipe laid in any other direction, and will cause a greater reaction of the water to take place after the closing of the valves leading to the air chamber, and thus more perfectly insure the opening of the discharge valve.

The second part of the invention relates to the peculiar construction of the discharge valve and its seat for the purpose of forming vanishing waterways both above and below the valve seat for the purpose of making the valve come softly in contact with its seat, and for permitting a small quantity of air to pass through the upper annular recess or water way to the top of the valve, for facilitating the descent of the valve by preventing the formation of a partial vacuum between the valve and its seat.

My invention further consists in regulating the amplitude of the descent of the discharge valve, by placing the dash pot upon the horizontal upper surface of a wedge, which resting upon an inclined plane is raised and lowered by a screw working against the larger extremity of the wedge; thus rendering the position of the dash pot capable of an extremely nice adjustment in a vertical direction.

A, is the body of the ram, forming a continuation of the driving pipe A′, which is curved to the point where it connects with the ram.

B, is the air chamber which has communication with the pipe A, through openings K, K, furnished with hinged valves J, J.

S, is the chamber which contains the discharge valve, this is made deeper than usual in order that the dash pot D, wedge E, and screw C, for regulating the opening of the discharge valve may be brought in such a position as not to offer any obstruction to the water.

H, is the discharge valve which is in the form of an inverted cup; its spindle I, is made of conical shape at its lower end to fit a recess of similar form in the top of the dash-pot and thus cause its fall to be broken as it descends, by the resistance of the water escaping from the recess.

The valve seat G, is at the top of a recess N, in the upper part of the chamber, S, and the valve when up to its seat has a small annular space, *a*, around it below the seat, which is visible in Figs. 2, and 4. The upper part M, of the valve above the face is made smaller than the other part of the valve and enters the discharge opening, but fits the said opening in such a way as to leave a small annular space, *c*, within the opening; this is visible at the sides of the valve in Figs. 2, and 4. The annular spaces, *a*, and *c*, form vanishing or gradually contracting water-ways during the closing of the valve and by gradually checking the escape of the water make the valve close without a shock and the upper space *c*, above the valve serves to admit a small quantity of air which pressing on the top of the valve will facilitate its fall by preventing the formation of a partial vacuum between the valve and its seat after the closing of the valve.

The valve is perforated as closely as possible to the top, with small holes *n*, *n*, to allow the escape of any air that may be taken in during the time of the reaction of the water after the closing of the valves, J, J, when there is a tendency to form a partial vacuum in the ram. These holes are made oblique, so that the water escaping through them will turn the valve in the seat S.

L, is the ascension pipe in which the water is raised by the expansion of the compressed air in the air chamber B. In the driving pipe near the ram there is an air valve *d*, which may be of any known form but the simplest form will be a perforated nozzle screwed into the pipe and having its lower end covered with several thicknesses of oiled silk or any such material, similar to the valves sometimes used in air pumps. When the driving pipe is immersed in water a pipe R, must be placed above the valve *d*. The valve is for the admission of air to the driving pipe before the valve H, opens.

The brachistochrone curve or curve of quickest descent may be briefly described as follows. Let F, in Fig. 3, be the point where the driving pipe enters the ram, F G, a horizontal line, T the point where the said pipe enters the head; the curve line commencing at F and terminating at T will be that to be considered. If the whole length of the driving pipe or the distance from F to T measured on the curve be represented by T, the whole fall from where the pipe enters the head to the ram by *g*, and any other distances F T′, F T″ by T′ T″ and any other falls T′ G′, T″ G″ by Y′, Y″, then the following ratios will obtain, $T^2 : T'^2 :: Y : Y'$, and $T^2 : T'^2 :: Y : Y''$, &c. The whole length of pipe T, is sixty feet and the fall Y 20 feet, T′=50 T″=40 &c. Then the ordinates Y′ Y″, &c., calculated by the above formula as follows: $T^2\ (60^2) : T^2\ (50^2) :: Y\ (20) : Y'\ (13.88)$ and $T^2(60^2) : T''^2\ (40^2) :: Y\ (20) : Y''\ (8.88)$. In the same way will be found $Y^{III}=5$, $Y^{IV}=2.22$, $Y^{V}=.555$.

The above description of the curve is deemed sufficiently explicit to enable any person versed in the rudiments of mathematics to lay it out.

The same curve may be also demonstrated to be a portion of an inverted cycloid. It is not claimed that under a given head the water when at rest will press any harder than in a pipe otherwise formed, but when the water is in motion this curve has advantages belonging to no other curve or shape, among which are, 1st, that as it is the curve along which a body descends with the greatest mean velocity, and as the momentum of each stroke of the ram is proportional to the product of the weight of water in the driving pipe into the aforesaid velocity, this momentum will be greater than if the pipe were of any other shape; 2nd, this curve is known to be a portion of the inverted cycloid; now a known property of the inverted cycloid is that if a heavy body be allowed to move down it, the velocity it acquires at each point in its downward motion is proportional to the distance of the said point at the bottom at the same time, so that when the water is stopped by the closing of the discharge valve, the whole force of the water in the driving pipe is instantaneously concentrated at the ram in forcing water into the air chamber B. By this instantaneous concentration of the whole force of water in the driving pipe at the lowest point more water will be driven into the air chamber B, than when part of the force remains unexpended after the first instant, or after the valves J, J, are closed, as is the case when any other arrangement of the driving pipe is used.

By the increased quantity of water forced into the air chamber very important results are effected. The air in the said chamber is now condensed and reacts with greater force on the valves and in closing them gives greater force to the water below the said valves in the pipe A, causing said water to move back through the driving pipe with greater velocity and thereby creating a more perfect vacuum in the ram, causing the valve H, to open with more certainty and the valve *n*, to take a greater quantity of water to supply the air chamber.

Much damage is done to the discharge valves of hydraulic rams by the violence with which they are thrown against their seats. This is effectually remedied by making the narrow water ways above and below the seat of the valve so that as the valve closes the water displaced by it escapes upward and downward in small, and gradually decreasing quantities, by properly proportioning the width of the spaces *a*, *a*, and, *c*, *c*, the distance to the valve may be made just sufficient to make it close without violence. This arrangement forms what may be termed a "vanishing water cushion". The upper annular opening admits a supply of air to the "vanishing water cushion" chamber, preventing the formation of a partial vacuum and allowing the valve to drop with certainty.

The employment of the screw C attached to the wedge E for raising or depressing the dash pot D, furnishes a mode of governing the valve openings with the utmost precision and exactness; a slight turn of the screw serving to insert or withdraw the wedge, and consequently move vertically the dash pot D, which effects in a proportionate degree the opening of the discharge valve. This arrangement is entirely below

the flow of water and consequently offers no obstruction to the action of the apparatus.

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

The application of the brachistochrone curve to the conduit pipes of hydraulic rams, in the manner and for the purposes hereinbefore set forth.

JOSEPH C. STRODE.

Witnesses:
WM. WILLIAMSON,
JOHN HALL.