S. MARSDEN.

HYDRAULIC ENGINES.

No. 195,033. Patented Sept. 11, 1877.

FIG. 1.

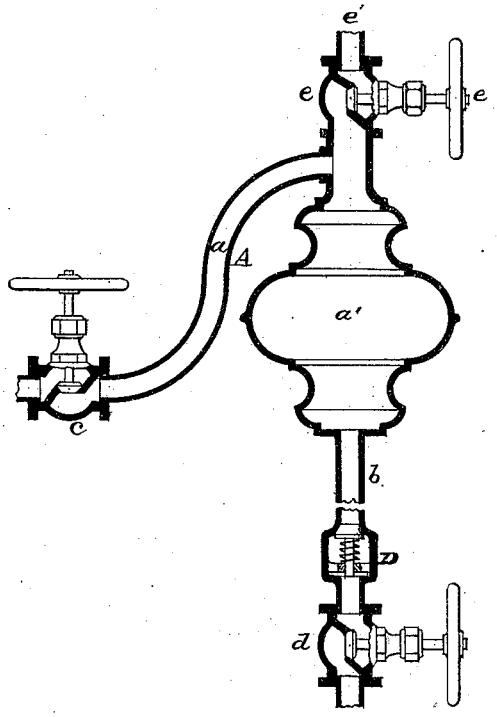
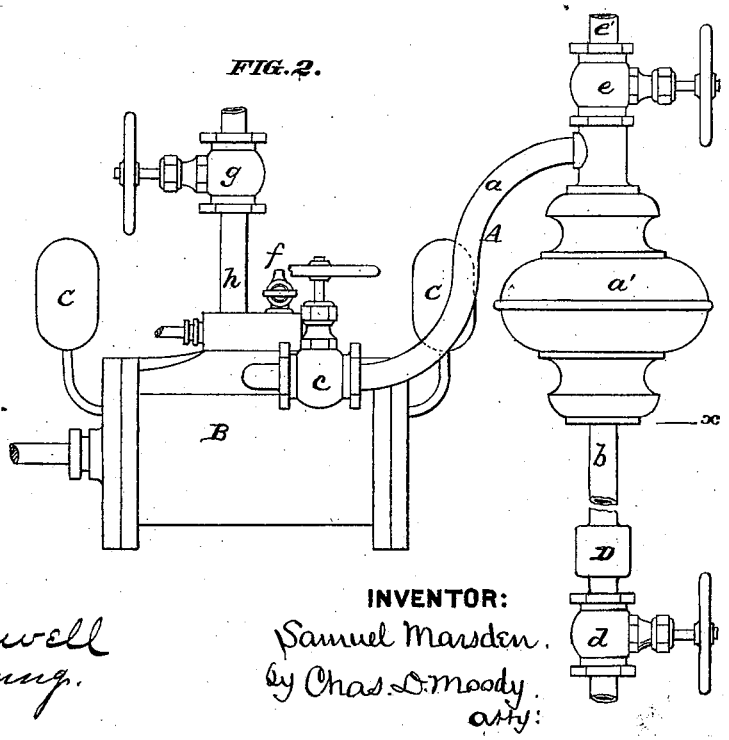


FIG. 2.



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IMPROVEMENT IN HYDRAULIC ENGINES.

Specification forming part of Letters Patent No. **195,033**, dated September 11, 1877; application filed July 19, 1877.

To all whom it may concern:

Be it known that I, SAMUEL MARSDEN, of St. Louis, Missouri, have made a new and useful Improvement in Water-Engines, of which the following is a full, clear, and exact description, reference being had to the annexed drawing, making part of this specification, in which—

Figure 1 is a sectional view of what I term the "low-pressure device," and Fig. 2 an elevation showing an engine with the improvement attached.

Similar letters refer to similar parts.

This improvement relates more especially to that class of water engines wherein the pressure of a head of water acts upon a piston or vane.

To thoroughly utilize the power of the head of water, it has been necessary hitherto to locate the engine at the bottom of the water-fall, and when the engine could not be thus arranged, but had to be placed at a higher level, that portion of the water-fall that was below the level of the engine was not turned to account.

By means of the present improvement the engine, if the water-fall be thirty-two feet and over, can be arranged at any desirable level between the bottom of the fall and a point thirty-two feet above it, and the entire power of the fall be utilized. If the fall is less than thirty two feet the engine can be located at any point between the top and bottom of the fall, and if the fall is more than thirty-two feet, and it is unnecessary to use all the power, the engine can be arranged at any point between the top of the fall and the thirty-two foot level, according to the power needed—that is, if the power of but thirty-two feet of water is desired the engine can be put at the top of the fall; if more power is required the engine can be put farther down, and so on until the thirty-two foot level is reached.

The improvement consists mainly in what I term a low-pressure device that is attached to any water-engine of the class referred to, and by means of which a vacuum is produced in the exhaust-pipe of the engine, enabling the atmospheric pressure to be exerted upon the engine-piston. It further relates to the means used in cushioning the engine-piston.

In the annexed drawing, A represents the low-pressure device. As shown, it is arranged as when the engine is located below the thirty-two foot level. In this case the device consists chiefly of a pipe, *a*, leading from the exhaust-pipe of the engine B upward to a level, *x*, thirty-two feet above the bottom of the water-fall, and a pipe, *b*, connected with the pipe *a* at the outer end thereof, and leading thence to the level of the bottom of the water-fall. The pipe *a*, just above the point of its connection with the pipe *b*, is preferably enlarged for the purpose hereinafter stated. There are three valves in the device, arranged as follows: One, *c*, in the pipe *a*, and, preferably, near the point of its connection with the engine; another, *d*, at the bottom of the pipe *b*; and a third, *e*, at the uppermost point of the device, as shown. There is also a cock, *f*, in the top of the valve-chest of the engine.

The operation of the invention is as follows: The valves *c* and *d* are closed, and the cocks *e* and *f* are opened. The supply-valve *g* is then opened, preferably gradually, admitting the water through the pipe *h* to the engine B. The air is expelled from the cylinder through the cock *f*, and the engine is filled with water. The air-cock *f* is then closed. The low-pressure device A is filled with water admitted through the pipe *e'* past the cock *e*. The water is introduced gradually, allowing the air that is in the device to escape through the pipe *e'*. When the device A is filled and the air expelled, the cock *e* is closed and the foot-valve *d* opened.

The additional weight of water in the device above that sustained by atmospheric pressure, and which is contained in the pipe *a* above the pipe *b*, and in that part of the device termed the "vacuum-chamber," forces the water below out of the device, creating a vacuum in the pipe *a*. The valve *c* is then opened, allowing the water to flow from the cylinder or engine B into the vacuum into the pipe *a*. This enables the atmospheric pressure to be exerted upon the front of the engine-piston in addition to the hydrostatic pressure of what-

ever head of water that may be above the engine, and the latter is worked with as much efficiency as if it were located at the bottom of the water-fall. In this manner the engine is set in motion.

Whenever it is desired to stop the engine the valves *g* and *d*, or the latter only, is closed, and the vacuum is maintained in the device until the engine is started again, which is effected by reopening the valves *g* and *d*.

The object of enlarging the pipe *a* at *a'* is to provide space to readily receive the water from the engine.

The same result can substantially be reached by enlarging the pipe *a* throughout its length.

The latter may be termed the "waste-pipe," the outer or upper portion of which constitutes the vacuum-chamber.

The pipe *b* may be styled the "balance-pipe," for containing a column of water in height equal to the pressure of the atmosphere.

It is evident that the pipes *a* and *b* virtually form a continuous pipe shaped to act as a siphon, and if the pipe *b* exceeds thirty-two feet in height, and the supply of water be cut off by closing the valve *c*, a vacuum will be formed in the pipe *a*.

When the engine is located at a level, at or more than thirty-two feet above the bottom of the fall, the pipe *a* extends either horizontally or downward. In such case the air-cock *e* is arranged suitably at the uppermost part of the pipe *a*.

The engine B may be a double one, both of its parts connecting with the vacuum-chamber of the device A, either by waste-pipes uniting just at the vacuum-chamber, or between the latter and the cylinder.

It is evident that when the engine is located more than thirty-two feet above the foot of the fall the vacuum-chamber may be formed directly within the engine itself; but in all cases the air-cock *e* must be at the highest part of the pipe or air-chamber *a*. When the vacuum-chamber is within the engine the valve *c* is dispensed with.

C C represent air-chambers, arranged above the engine, and connecting, respectively, with each end of the interior of the cylinder. They serve to cushion the piston, and are especially useful in connection with the low-pressure device A.

D represents a check-valve, seating upward, arranged in the balance-pipe *b*. It serves to prevent the variation in the weight of the atmosphere from interfering with the action of the device A.

When the atmosphere is sufficiently heavy to balance a column of water more than thirty-two feet high—say thirty-four feet—the vacuum-chamber in the device A must be suitably adjusted to correspond therewith.

I claim—

1. In combination with a water-engine, a waste-pipe having a vacuum-chamber therein, substantially as described.

2. In combination with a water-engine, a waste-pipe having a vacuum-chamber therein, and a discharge-pipe leading out of the vacuum-chamber, the latter being in height sufficient to contain a column of water that balances the weight of the atmosphere, substantially as described.

3. The combination of the low-pressure device A and the water-engine B, substantially as described.

4. The combination of the engine B, the pipes *a* and *b*, and the valves *c* and *d*, substantially as described.

5. The combination of the engine B, pipes *a* and *b*, and the valves *c*, *d*, and *e*, substantially as described.

6. The enlargement *a'* in the pipe *a*, substantially as and for the purpose set forth.

7. The combination of the water-engine B, the low-pressure device A, and the chambers C C, substantially as described.

8. The combination of the water-engine B, device A, and check-valve D, substantially as described.

9. The combination of the water-engine B, device A, and air-cock *e*, substantially as described.

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Witnesses:
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