(No Model.)

3 Sheets—Sheet 1.

S. N. KNIGHT.

HYDRAULIC ENGINE.

No. 371,076. Patented Oct. 4, 1887.

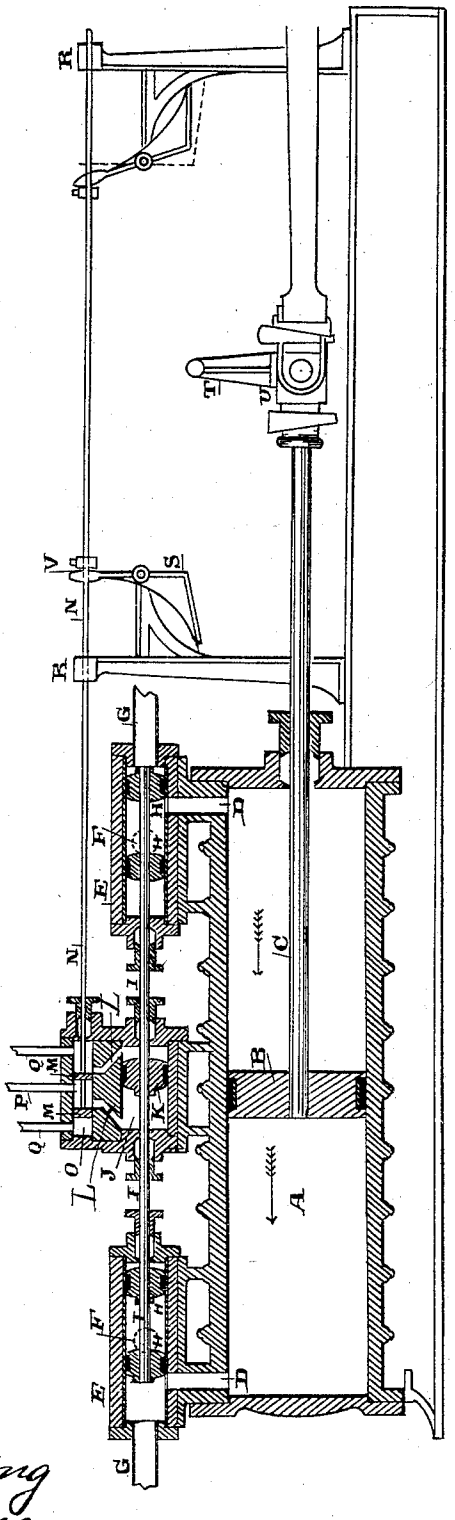


FIG. 1.

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(No Model.) 3 Sheets—Sheet 2.

S. N. KNIGHT.

HYDRAULIC ENGINE.

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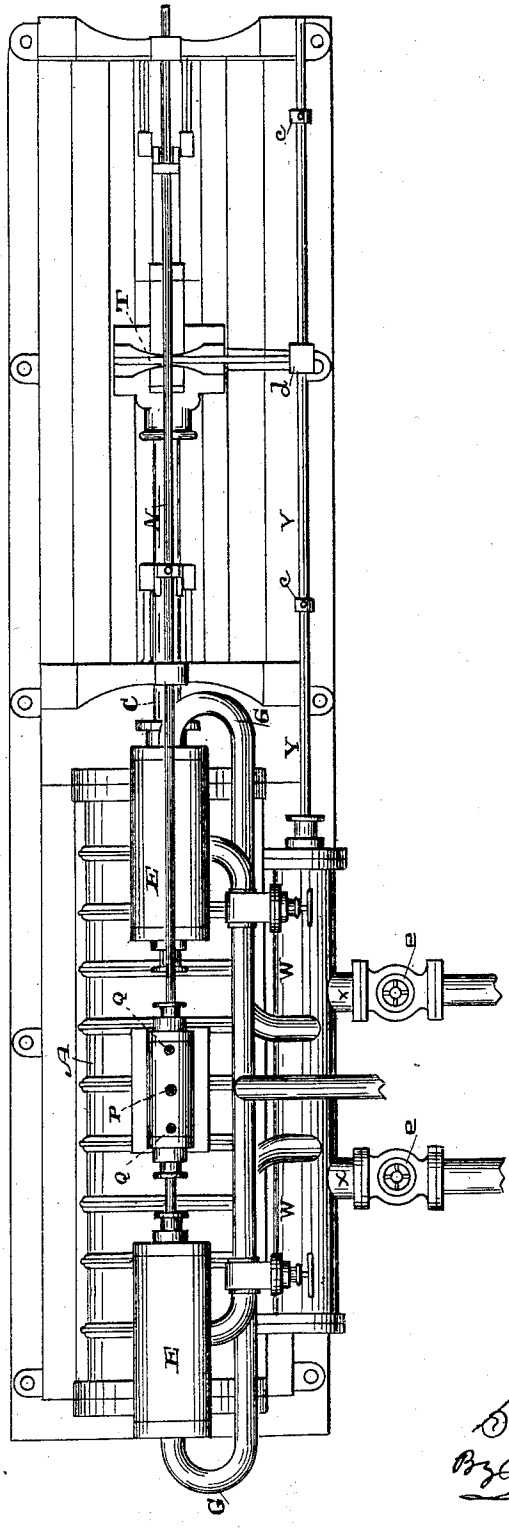


FIG. 2.

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(No Model.) 3 Sheets—Sheet 3.

S. N. KNIGHT.

HYDRAULIC ENGINE.

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FIG. 3.

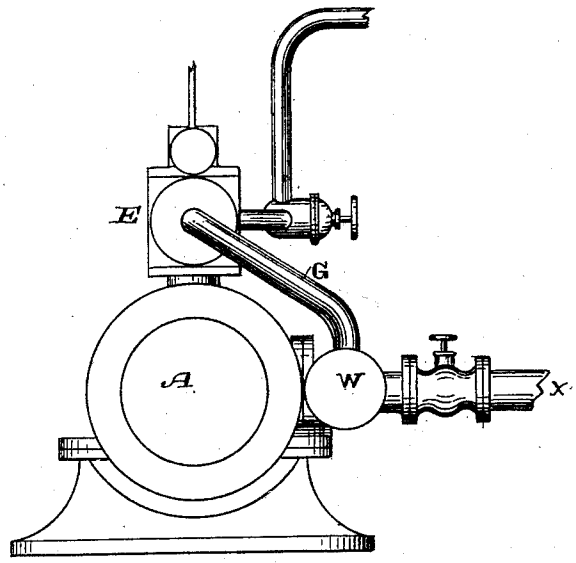
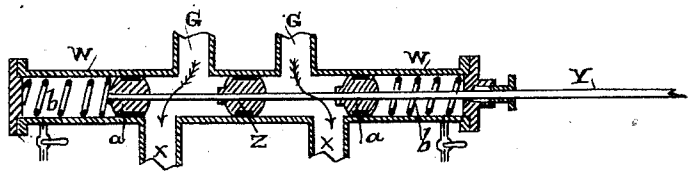


FIG. 4.



Witnesses,
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UNITED STATES PATENT OFFICE.

SAMUEL N. KNIGHT, OF SUTTER CREEK, CALIFORNIA.

HYDRAULIC ENGINE.

SPECIFICATION forming part of Letters Patent No. 371,076, dated October 4, 1887.

Application filed September 16, 1886. Serial No. 213,731. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL N. KNIGHT, of Sutter Creek, Amador county, State of California, have invented an Improvement in Hydraulic Engines; and I hereby declare the following to be a full, clear, and exact description of the same.

My invention relates to certain improvements in hydraulic engines.

It consists of a water-cylinder with a plunger moving therein, a piston-rod connected with the plunger and extending through one end, and having a tappet or shipper attached to a cross-head, balance-valves by which water is admitted and exhausted alternately from the opposite ends of the cylinder, and a mechanism by which the valves are actuated and balanced, supplemental safety exhaust-valves, and a means for actuating the same when the piston approaches to one end of the cylinder, and a check valve or valves in connection with this supplemental exhaust.

Referring to the accompanying drawings for a more complete explanation of my invention, Figure 1 is a longitudinal vertical section of my engine. Fig. 2 is a plan or top view of the same. Fig. 3 is an end view. Fig. 4 is a detail.

A is the cylinder, having the plunger B, moving within it, and C is the piston-rod, extending out through one end of the cylinder and connected with a cross-head, or in some cases connected with a pumping mechanism.

D are ports at each end of the cylinder A, through which water is admitted to drive the plunger alternately from one end to the other of the cylinder.

E E are valve chambers, which in the present case I have shown made cylindrical, having the feed or water-supply passages F opening into one side at the center, and the exhaust-passages G, which open from the outer ends of the cylinder.

H H are plungers secured to the valve-stem I, which extends through from one of the valve-chambers E to the other, these plungers or valves being secured to the stem I, so that when the rod is moved to one end of one of the valve-chambers the supply-opening F and the port D will lie between the two valves or plungers H H in that cylinder, and the supply will pass directly into the engine-cylinder and move the piston from that end. The valves H H in the other cylinder will be moved to the inner end, and the feed or supply passage still open between the two will be cut off from the cylinder-port D. The latter then being outside of the outer valve, H, will have free communication with the exhaust-passage G at that end of the cylinder, so that as the piston moves in that direction in the main cylinder it will exhaust the water through these passages. As the feed or supply passage is always open between the two valves or plungers H, whatever may be their position in the cylinder, it will be manifest that the valves are perfectly balanced, and they can be easily moved, whatever may be the pressure in the supply-pipe.

Midway between the two valve-chambers E is a cylinder, J, containing a piston or plunger, K, which is keyed to the rod I, this rod passing through this intermediate cylinder as well as the two valve-chambers E.

L are ports by which water is admitted to the cylinder J at each end, and M M are balance-valves secured to a rod, N, and moving within a valve-chamber, O.

P is a supply-pipe, by which water under pressure is admitted to the central portion of the valve-chamber O, and between the valves M, so that these valves are balanced.

Q Q are exhaust pipes or passages connecting with the ends of the valve-chamber O, and the valves M are so moved that when the one to the left, as shown in Fig. 1, has been moved beyond the ingress end of the cylinder-port L it allows water to pass directly from the supply-pipe P directly into the cylinder J to drive the piston K to the opposite end of its stroke, thereby moving the valves H in the valve-chambers E, as before described. At the same time the valve M at the right end of the valve-chamber O will have been moved so far toward the left as to pass the end of the cylinder-port L, and thus leave a free communication between it and the exhaust-passage Q at that end. By this mechanism the valves H, which supply the main cylinder, are operated. The valve-rod N extends through a guide or guides, R, which have brackets to which the valve-shipping devices S are fulcrumed, as shown in Fig. 1. These devices are formed of obtuse-angled triangles having a fulcrum-pin passing through the vertical side at a point between the lower angle and the upper acute angle.

T is an arm or shipper attached to the cross-head U or otherwise connected with the main piston-rod C, so as to partake of its motion.

The operation of the angular valve-shipper S is as follows: It hangs from its fulcrum so that the side through which the fulcrum-pin passes is nearly or quite vertical and the lower side of the triangle inclines downward from the meeting angle of the two sides. When the upper end of the shipper T strikes the angle of S, it causes the triangular shipper to swing about its fulcrum, and the upper end engaging with a collar, V, which is fixed to the valve-rod N, it will move the valve-rod, and with it the valves M in the valve-chamber O, so as to admit water to the opposite end of the cylinder. The movement of the triangle S about its fulcrum causes the vertical side to stand at an incline, and this raises the lower angle and the lower side sufficiently to allow the upper end of the shipper T to pass beneath it. The object of this is to change the valves M, and through them the piston K and the valves H; but as this action consumes some little time it is necessary that the valves M be moved before the piston B has reached the full end of its stroke. For this reason the upper end of the shipper T strikes the angle of S and shifts the valve before the piston has reached the end of its stroke, and it is then allowed to move beneath the horizontal side of the part S until the piston reaches the end of its stroke, or until the water-supply is reversed. The exhaust-pipes G are carried downward to the supplemental exhaust-chamber W, opening into it at points on each side of the center. Corresponding pipes, X, open out from this exhaust-chamber W, and these pipes are farther apart than the pipes G by a space equal to their full diameter. A rod, Y, passes through the valve-chamber W, and has secured to it the central plunger, Z, and the two exterior ones, *a*.

b b are springs fixed in the ends of the valve-chamber W and pressing against the ends of the valves *a*, the tension being such that these valves are ordinarily held just on the outer edges of the discharge-passages X, while the plunger Z remains midway between the two, and thus separates the two exhaust-passages G from each other. Each passage G, however, remains in full connection with its own discharge-passage X upon the opposite side of the chamber W, and the exhaust thus takes place through this chamber freely, first through one side and then through the other. If, however, by any accident the main piston should be moved too far in its cylinder, so that there would be danger of its striking the cylinder-head, this is prevented by means of a collar, *c*, which is fixed to the valve-stem Y of the supplemental exhaust-chamber.

d is an arm projecting from the cross-head, so that when the latter has reached a point in either direction as far as the piston should go this projection *d* strikes the collar *c*, and this moves the rod Y and the plungers *a* far enough so that the exhaust or discharge passage X upon that side is temporarily closed by the plunger *a*, which cuts it off. This prevents any further escape of the water from the cylinder and serves as a stop until the valve motion has again been reversed.

This engine is especially useful in connection with pumping mechanism, being operated horizontally and connected by a pitman with a pump-bob, or it may stand vertically in line with the pump-rod and connect directly therewith.

As the weight of the pump-rods is usually very considerable in a mine, and it is necessary to regulate the motion of the engine, especially before the pump-column is entirely filled with water, this I do by means of check-valves *e*, which are connected with the discharge-pipes X from the supplemental exhaust-chamber W. By closing these check-valves, so as to limit the escape of the water, the engine may be made to move as slowly as desired in either direction, and as fast as the pump-column becomes filled with water these valves may be opened until the exhaust is left free. This is important in such connection as I have described.

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

1. The main cylinder with its plunger, plunger-rod, independent valve-chambers connecting with opposite ends of the cylinder, and having valves arranged with relation to the inlet-passages, as shown, a central cylinder in line with the valve-chambers, and having a piston fixed to the valve-rod which passes through it, and a supplemental valve-chamber, O, with balance-valves M, fixed to the valve-stem, which extends out from this chamber parallel with the main plunger-rod, in combination with the triangularly-fulcrumed shippers S, by which the valve-rod is moved, and the arm T, fixed to the main cross-head, substantially as described.

2. The main cylinder with its balanced supply and exhaust valves and ports, in combination with a supplemental exhaust-valve chamber into which the exhaust-passages open, secondary passages opening out of this chamber, and the valves *a* and Z, fixed to a valve-rod within said chamber, together with the springs *b*, substantially as herein described.

3. The supplemental exhaust-chamber W, into which the main exhaust-passages G open, and the secondary discharge-passages X, the valve-stem with the plungers *a* and Z secured to it, and the springs *b*, within the cylinder, in combination with the collar *c*, secured to the valve-stem Y, and the shipper or arm *d*, connected with the main piston-rod, substantially as herein described.

In witness whereof I have hereunto set my hand.

SAMUEL N. KNIGHT.

Witnesses:
S. H. NOURSE,
H. C. LEE.