(No Model.) 2 Sheets--Sheet 1.

I. C. SMITH.

Hydraulic Engines.

No. 232,656. Patented Sept. 28, 1880.

Fig. 1.

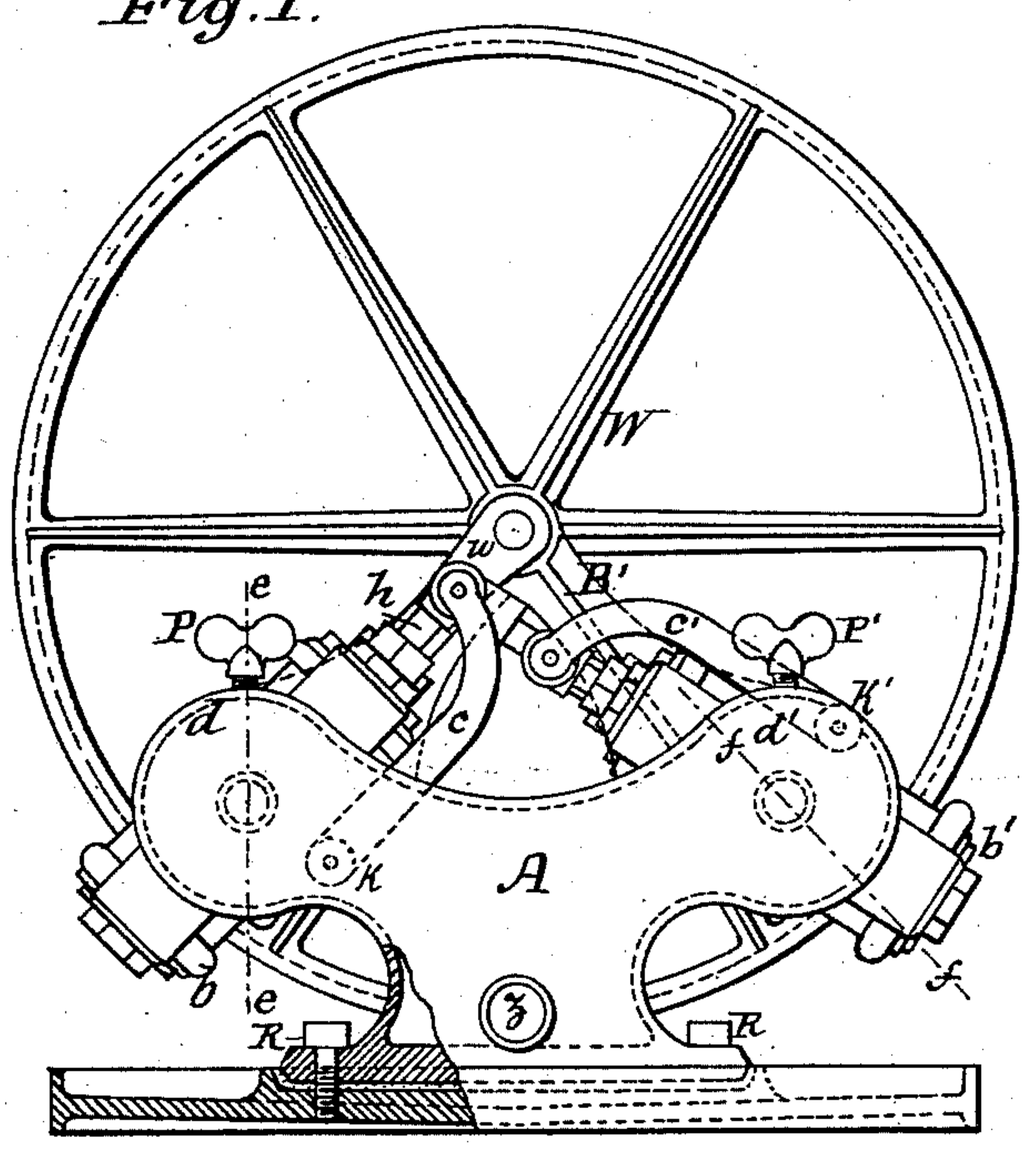


Fig. 2.

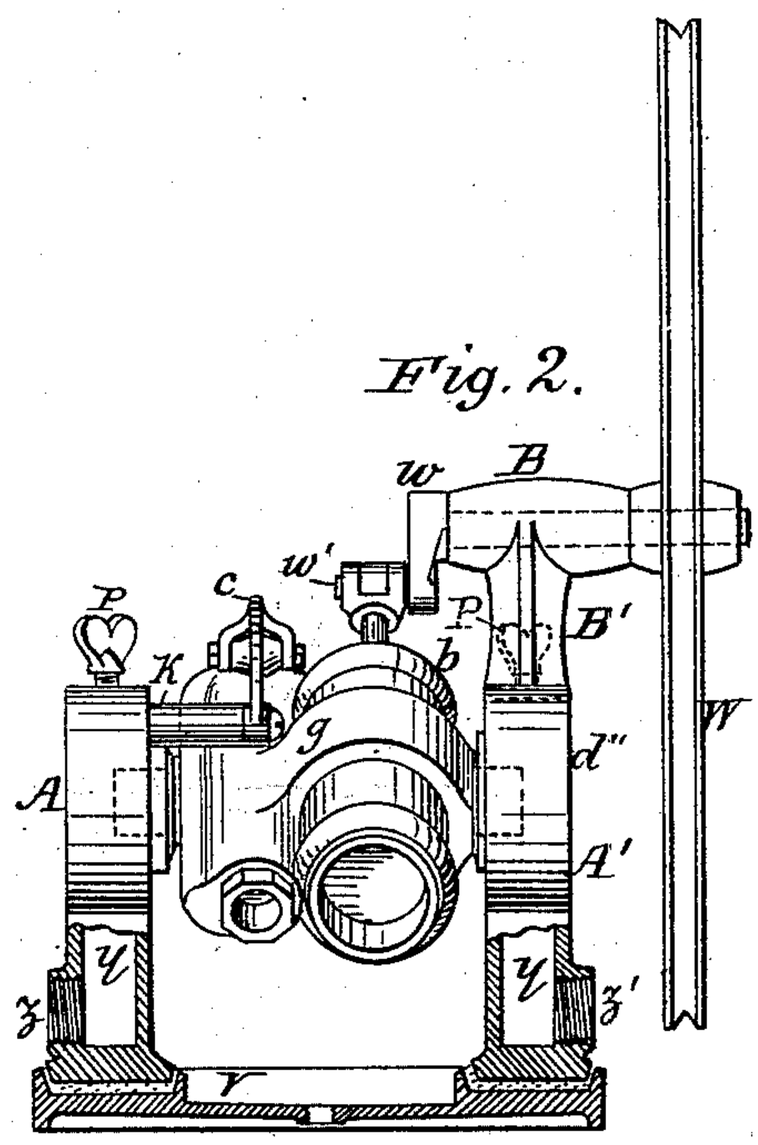


Fig. 3.

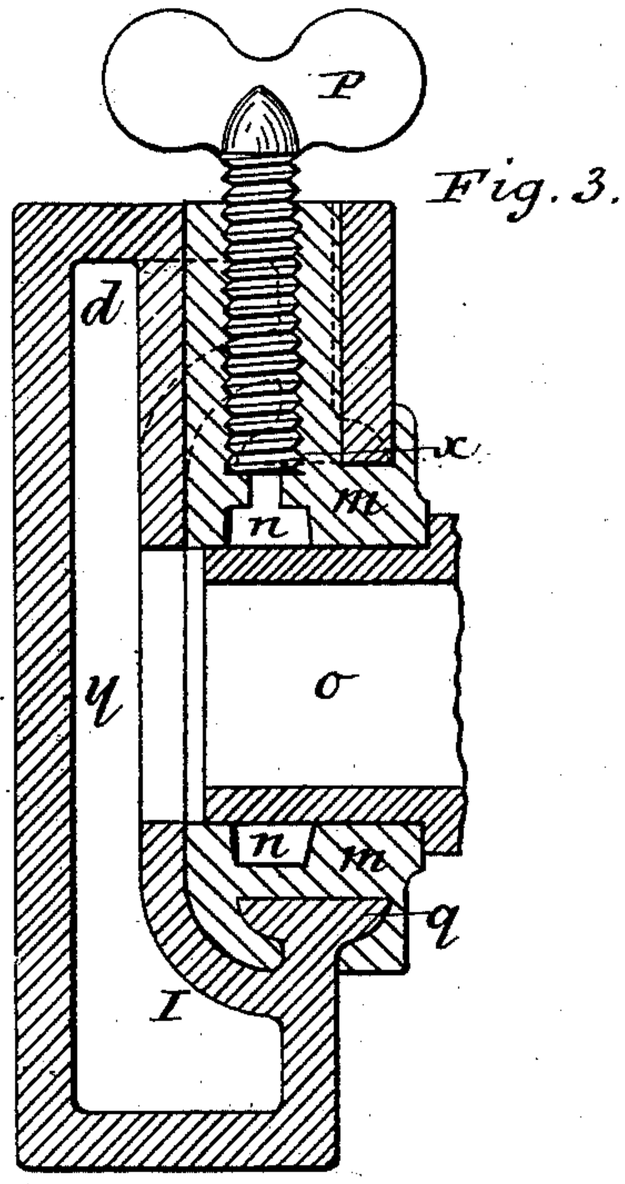
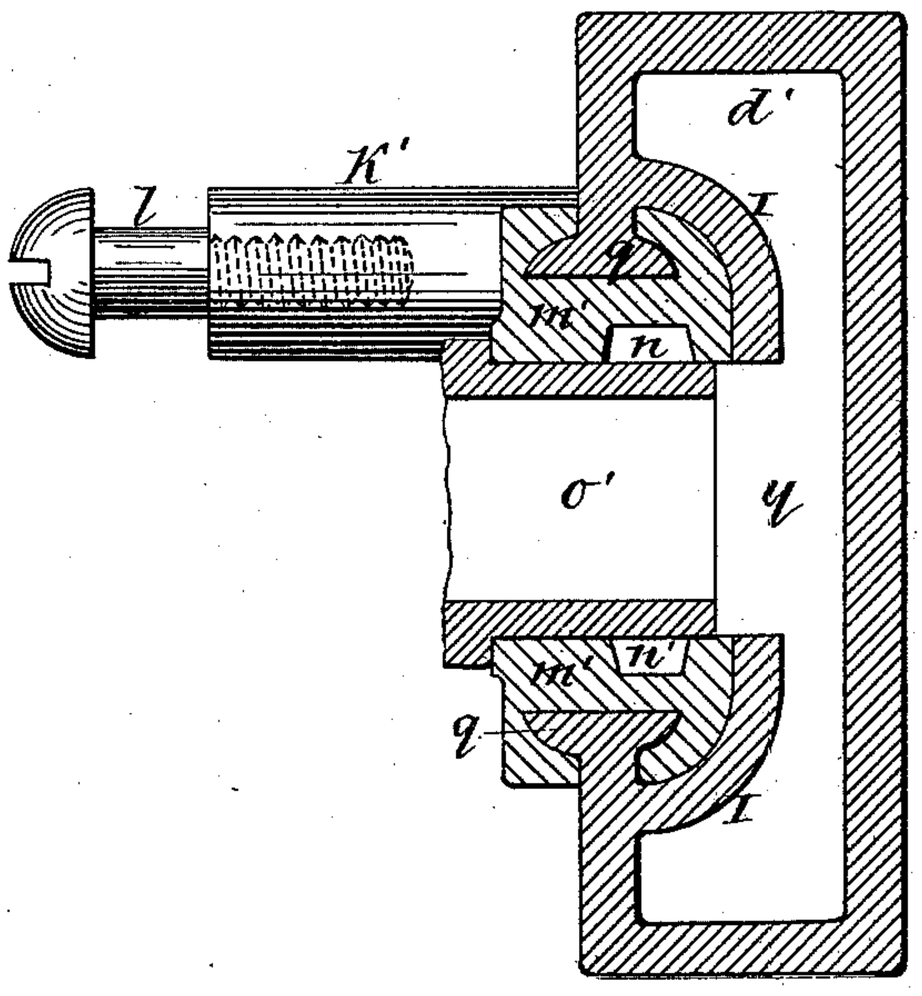


Fig. 4.



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(No Model.) 2 Sheets—Sheet 2.

I. C. SMITH.

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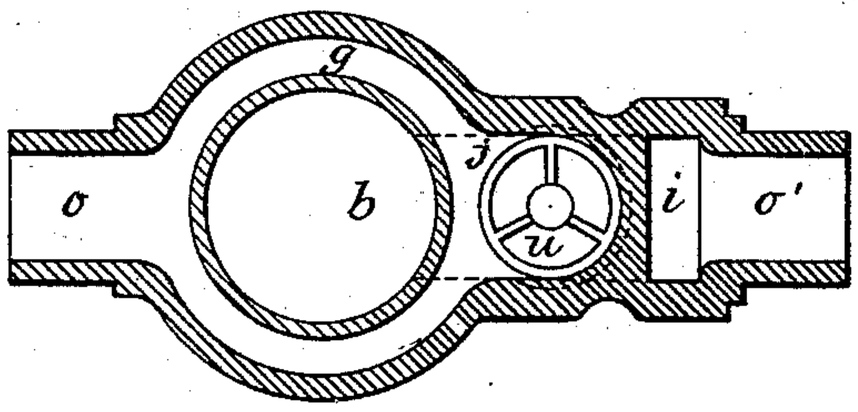
Fig. 5.



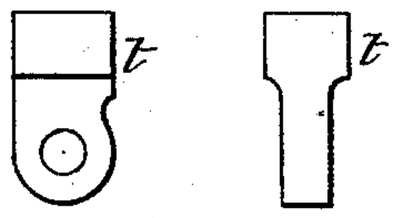
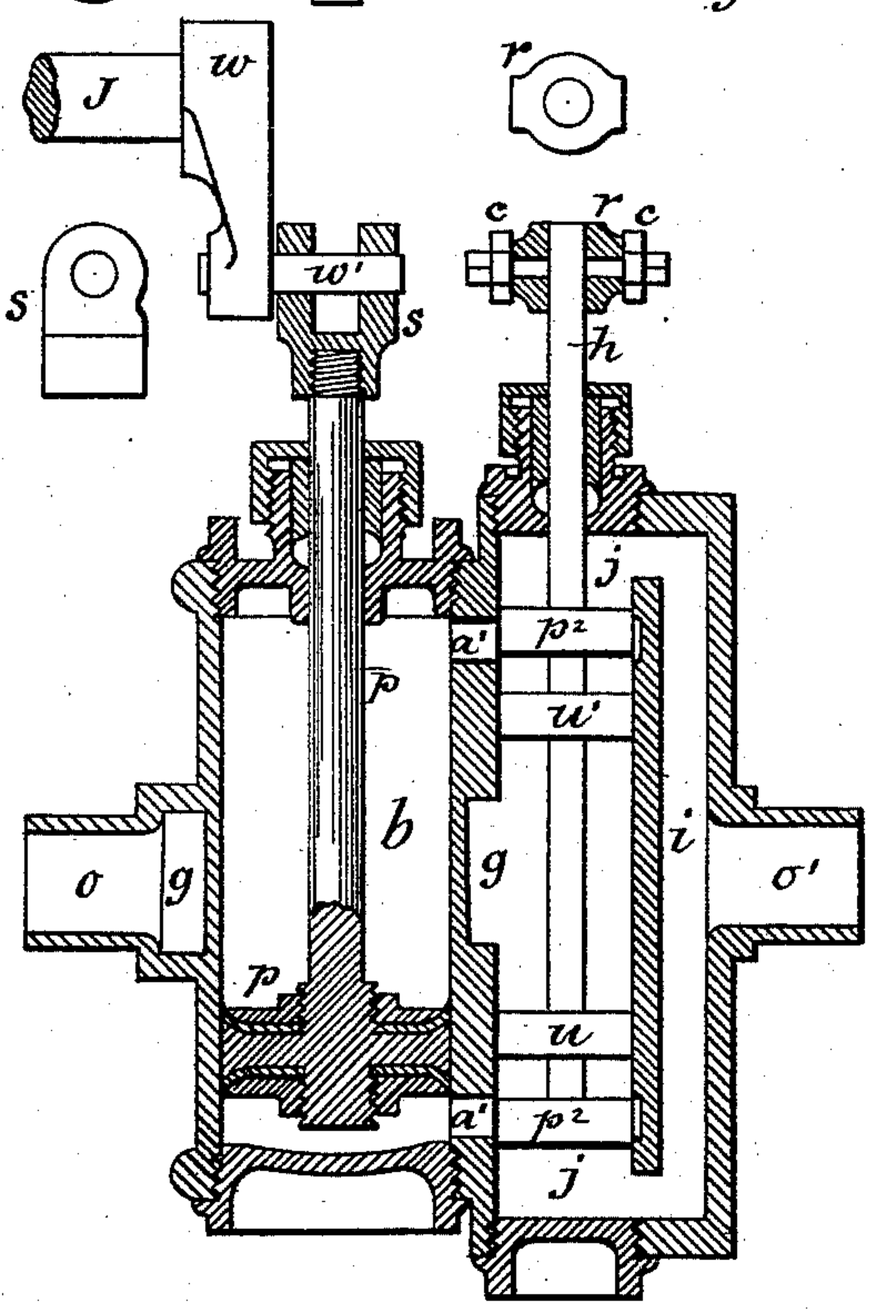


Fig. 6.



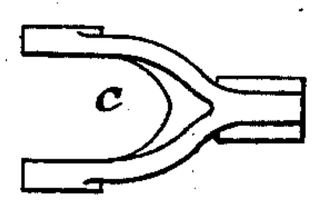
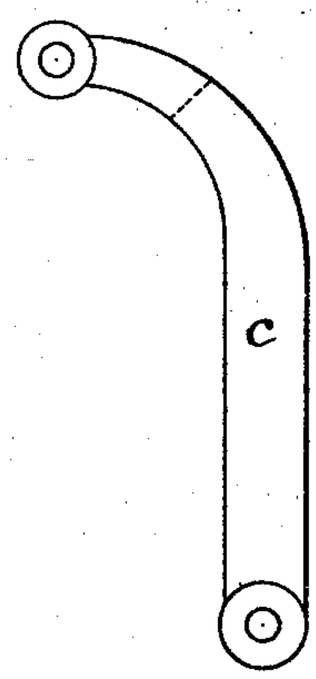


Fig. 7.



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UNITED STATES PATENT OFFICE.

IRVING C. SMITH, OF NEW YORK, N. Y.

HYDRAULIC ENGINE.

SPECIFICATION forming part of Letters Patent No. 232,656, dated September 28, 1880.

Application filed June 3, 1880. (No model.)

To all whom it may concern:

Be it known that I, IRVING C. SMITH, of the city, county, and State of New York, have invented new and useful Improvements in the Construction of Hydraulic Engines, of which the following is a specification.

My improvements relate mainly to details in the construction of hydraulic engines, so as to economize the labor and materials required in their construction, and thus enable inexpensive, durable, and efficient machines to be made. I attain these objects by mechanism illustrated in the accompanying drawings, in which—

Figure 1 represents a side view, partly in section, of the entire machine. Fig. 2 represents an end view of the same, with the frame partly in section. Fig. 3 is a vertical section, on an enlarged scale, of one side of the engine-trunnion, taken on line *e e* of Fig. 1. Fig. 4 is a sectional view of a portion of the same frame, on an enlarged scale also, on line *f f* of Fig. 1. Fig. 5, Sheet 2, represents a cross-section through the trunnions, cylinder, and valve-chamber of one of the pair of engines. Fig. 6 represents a longitudinal section through the center of the trunnions, cylinder, and valve-chamber of one of the engines, with details of pieces used therewith. Fig. 7 represents a side and end view of one of the arms used to operate the valve-stem.

Similar letters refer to similar parts throughout the several views.

The pressure-trunnion frame A, together with the exhaust-trunnion frame A′ on the opposite side of the cylinders, support the two oscillating cylinders *b b′* and rest upon the bed-plate V.

In order to secure the necessary surfaces for these frames to rest, and to avoid the ordinary expensive method of planing, two open boxes or cavities are formed on the upper surface of the bed-plate V, and the trunnion-frames A A′ are sustained in position over the bed-plate, with their feet partially inserted in the boxes, leaving a space between each foot and the upper surface of the bed-plate V, which is then filled with melted soft metal, *v*, which conforms itself to these surfaces, which metal, when set, makes the necessary joints to enable these frames to rest on an even foundation and be bolted immovably to the bed-plate.

The trunnion-frames A and A′ are each cast in one piece, hollow, forming a communicating channel, *y*, to each trunnion from the inlet-opening *z*, Fig. 1, and are alike, excepting that the frame A carries the two valve-arm studs K and K′, Fig. 1, and the frame A′ carries the shaft or plumber-block bearing B, supported by two arms, B′, inclined inward and reaching from the main portion of the frame to this bearing B, Figs. 1 and 2.

The trunnion-frames are cast with double-ribbed apertures *q*, Figs. 3 and 4, for the admission of the trunnion boxes or bearings *m*, which boxes are formed after the frames are placed in their proper positions by inserting smooth cores of steel or other suitable material in these apertures in the positions the trunnions are to occupy, said cores extending through the saucer-shaped shells I on the inside of the frames. These saucer-shaped shells form half-molds, as it were, while the other halves of the molds are separate from the frames. They can be secured on the cores and shaped to form the other ends of the boxes. These separate half-molds on the cores, when the outer surfaces of the frames are pressed against them, form inclosures around the double ribs *q* of the frame.

On the cores thus placed in position are segment-rings previously put in the position of the packing-grooves *n*, Figs. 3 and 4, and on these segment-rings core-screws are resting in the position of pressure-screw P, Fig. 3, the heads of which pressure-screws (there being four in all) are also shown in Fig. 1. Melted soft metal is poured down around these core-screws and into the molds or inclosures before described, and is caused to run around each of the ribs *q*, which metal, in cooling and setting, clinches on the two ribs of each aperture and forms water-tight joints between the trunnion-boxes *m* or *m′* and the ribs *q*, and by withdrawing the trunnion-cores finished bearings are thus left for the trunnions, and by extracting the several segments of the rings inwardly and out of these trunnion-bearings the packing-grooves *n* remain, and by extracting the core-screws the packing-reservoirs *x* remain also, one of which is shown in Fig. 3 occupied by pressure-screw P. These screws, when withdrawn, leave packing-reservoirs, into which is put tallow or other

suitable material for packing, and the pressure-screws are reinserted in the top of the reservoirs. By turning down these screws the tallow packing or other suitable material is forced against and around the trunnions in the annular packing-grooves *n*, which open inwardly, and water-tight joints are thus formed, preventing any leakage through the trunnion-bearings. By this arrangement it will be seen that the frames A A′ are closed in front of the ends of the trunnions, and that the trunnions open into the water-channel *y*.

On the pressure-trunnion frame A are cast two stationary valve-arm studs, K K′. (Shown in dotted circles in Fig. 1.) An enlarged view of one of these studs, K, is shown in Fig. 4, in which studs are fastened pins *l*. These pins pass through one end of each of the valve-arms C C′, Figs. 1, 4, and 7. The other or forked ends of these valve-arms are connected to the valve-stems *h*, Figs. 1 and 6, by pins passing through the ears of the valve-arms C C′ and screwed into the cross-head *r* and against the valve-stems *h*, forming bearings where the pins pass through the ears of the valve-arms, and acting as set-screws at the same time against the valve-stems *h*, whereby the valves p^2 may be properly set and the valve-stems *h* held to the valve-arms C C′. Now, as the cylinders *b b′*, Fig. 1, oscillate the piston, valves p^2 will reciprocate, so as to admit and discharge water to and from the cylinders, and thus communicate, through piston-rods *p*, cross-heads *s* and *t*, crank-pin *w′*, crank *w*, and shaft J, a rotary motion to the driving-wheel W. The extent of motion or throw of the valves will be determined by the position of the stationary valve-arm studs K K′ on the pressure-trunnion frame A, Fig. 1. The farther these studs are set from the center of motion the greater will be the throw or motion of the valves. It will be seen that these piston-valves p^2 are placed on the sides of the cylinders and move in a direction parallel to them on a line passing through the center of motion.

In Fig. 5 the skeleton valve-guide *u* is shown in the water-chest *j*, and it is also shown in Fig. 6. This valve-guide, it will be seen, is cylindrical on its periphery, and connected to the valve-stem *h* by three wings, permitting water to pass through the skeleton-guide *u* in its passage to and from the cylinder.

Water is admitted to the engine through the opening *z*, Fig. 1, and passes to either pressure-trunnion *o′* through the channel *y*, and enters either end of the water-chest *j* by passing in through the trunnion *o′* and passage-way *i*, Fig. 6, and is admitted into cylinder *b*, at the outer ends of the piston-valves p^2, as these valves reciprocate with the oscillations of the cylinder, the admission of the water to either end of the cylinder being almost coinstantaneous with the discharge of the water from the other end of the cylinder by reason of the valves having but very slight lap on the admission side, with a negative lap on the exhaust side. The valves at the same time, being a little wider on their faces than the widths of the ports *a′*, prevent what is technically termed "blowing through." After the water has driven the piston within a fraction of the end of its stroke its further admission into the cylinder *b* is stopped by the piston-valve p^2, when the water that is in the cylinder is allowed to pass out through the skeleton valve-guide *u u′* into the exhaust-belt *g*, and out of the trunnion *o* through the channel *y* in the exhaust-trunnion frame A′, and out of an opening, *z′*, in that frame opposite to *z*, Fig. 1.

In Fig. 6 the section shows the cylinder *b* with the water-chest *j* on the side of the cylinder, the two trunnions *o o′*, water-passage *i*, and exhaust-belt *g* passing entirely around the cylinder *b*, (see Fig. 5,) all cast in one piece, thus avoiding the expense of making any joints to connect these parts. Annular recesses are turned in the water-chest *j* in order to define the edges of the ports *a′*, and these ports are made large to facilitate the ingress and egress of water to and from the cylinder, and to prevent the possibility of the piston-valves p^2 catching in the ports or recesses, the skeleton valve-guides *u u′* are placed on the valve-stem between the two piston-valves p^2, and are made to slide against the inner surface of the water-chest *j*, thereby guiding the piston-valves p^2 safely by the ports and recesses. This mode of construction, while it provides almost frictionless and balanced valves which are easily fitted up in a lathe, also reduces the cost of manufacture by dispensing with all joints by means of the single casting above referred to.

Water being a compact incompressible substance, in making use of it to operate engines the current or column is alternately changing from one end of the cylinder to the other, which tends to cause throbs or beats by the sudden checking or stopping of its momentum. Hence the trunnion-frames A A′, or those parts of them more particularly designated *d d′*, are raised above the trunnions to form air chambers or cavities for the air, which is more or less mingled with the water, to rise up and collect in, thereby allowing the water to cushion against the air that collects in these chambers, and thus permitting the engine to work smoothly as the water is admitted and discharged from the cylinders. These air-chambers can be enlarged by increasing the spaces at *d d′* above the trunnions, as may be desired.

I am aware that prior to my invention oscillating hydraulic engines have been made in which the oscillation of the cylinder has caused the valves to operate. I therefore do not claim such a combination, broadly.

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

1. In combination with the oscillating cylinder and valve-chamber of a hydraulic engine, its hollow frame, and a pin, *l*, secured to said frame eccentrically to its trunnions, the valve-arm *c*, pivoted to said pin, and valve-stem *h*, whereby a reciprocating motion parallel with

the axis of the cylinder is imparted to the valves by the oscillation of said cylinder, substantially as set forth.

2. The combination of the cylinder, valve-chamber, and hollow trunnion of an oscillating hydraulic engine with a valve-stem and skeleton valve-guides *u*, placed thereon between two piston-valves, substantially as and for the purpose described.

3. In combination with the inner sides of the double-chambered frame of a hydraulic engine and the circular double rib *q* projecting therefrom, the soft-metal trunnion-boxes *m*, cast around said rib, substantially as and for the purpose described.

4. In combination with the inner side of the double-chambered frame of a hydraulic engine and the double rib *q* projecting therefrom, the soft-metal trunnion-boxes *m*, provided with annular packing-grooves *n*, packing-reservoirs *x*, and pressure-screws P, substantially as and for the purpose set forth.

5. The combination of the double-chambered frame of a hydraulic engine with the cylinder *b*, valve-chest *j* on the side of the cylinder and parallel therewith, exhaust-belt *g*, and hollow trunnions *o* and *o'*, cast in one piece, substantially as and for the purpose described.

6. The combination, with two pairs of hollow trunnion-frames having flanges *q* and half-mold shells I, to retain soft-metal trunnion-boxes, and water-chambers *y* under said trunnions, of air-chambers *d d'* above said trunnions, substantially as and for the purpose set forth.

7. The combination of the hollow frames A A', carrying trunnion-boxes of a hydraulic engine, with a bed-plate, V, having inclosed depressions for the reception of soft metal, *v*, and screws R, substantially as and for the purpose described.

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