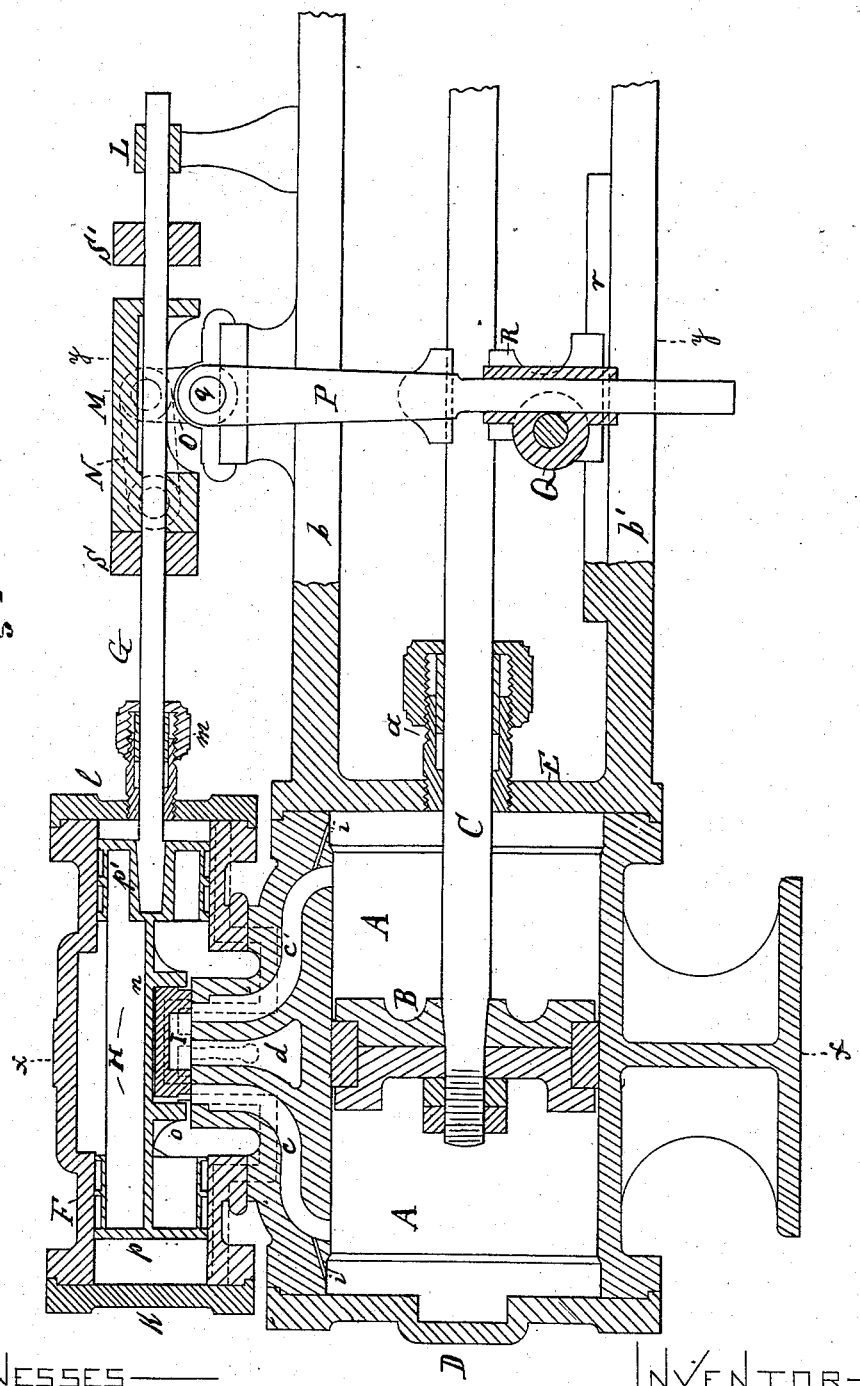
(No Model.) 2 Sheets—Sheet 1.

E. R. HUBBARD.

STEAM PUMPING ENGINE.

No. 263,785. Patented Sept. 5, 1882.

Fig. 1



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

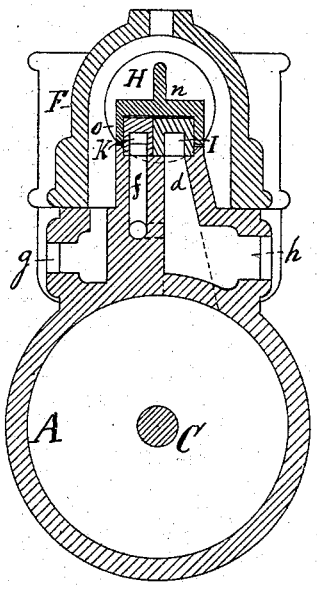


Fig. 3.

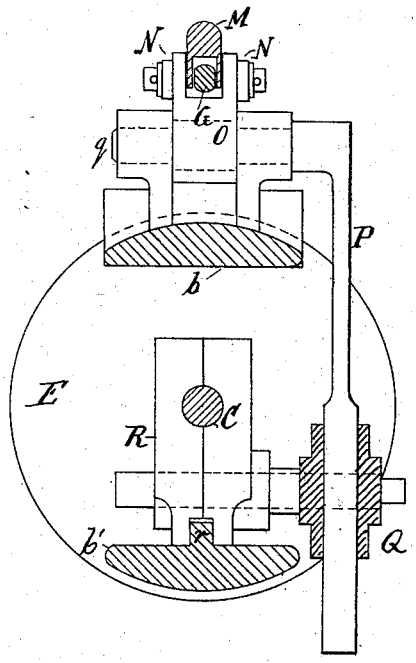


Fig. 4.

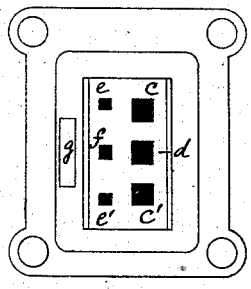


Fig. 5

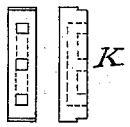
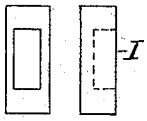


Fig. 6.



WITNESSES—
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UNITED STATES PATENT OFFICE.

EDWARD R. HUBBARD, OF CHICAGO, ILLINOIS, ASSIGNOR TO FREDERICK C. WELLS, OF SAME PLACE.

STEAM PUMPING-ENGINE.

SPECIFICATION forming part of Letters Patent No. 263,785, dated September 5, 1882.

Application filed May 9, 1882. (No model.)

To all whom it may concern:

Be it known that I, EDWARD R. HUBBARD, of Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Steam Pumping-Engines; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to direct-acting steam pumping-engines that operate without a fly-wheel.

In such engines it is essential that at the end of each stroke the piston should gradually reduce its speed until arriving at its limit, and then to gradually increase its speed again for its return-stroke, for the purpose of providing sufficient time for the suction and discharge valves of the pump to open and close without pounding, while during the intermediate portion of its stroke such plunger or piston should be propelled at a uniform velocity that will raise and force water in uniform quantities. To bring about such motions of the piston depends entirely upon the construction and arrangement of the steam-valve relative to the steam-ports of the engine, and upon the driving mechanism for the same; and it is the object of this my invention to produce a valve-gear that will admit and cut off the steam to the cylinder at the respective positions of the steam-piston by simple devices, and thus control the motion of such piston in the most effective manner for the intended purposes.

To this end my invention consists in certain improvements in the construction and combination of parts, as hereinafter described and claimed.

In the accompanying drawings, Figure 1 represents a longitudinal vertical section of the main and auxiliary parts of the steam-cylinder; Fig. 2, a vertical transverse section on line *x x* in Fig. 1; Fig. 3, a similar section on line *y y* in Fig. 1; Fig. 4, a plan view of the valve-face of the cylinder; Fig. 5, a bottom view and side elevation of the auxiliary slide-valve, and Fig. 6 a bottom view and side elevation of the main slide-valve.

Corresponding letters in the several figures of the drawings designate like parts.

A denotes the steam-cylinder; B, the piston, and C the piston-rod that forms a direct connection with the plunger of the pump.

D is the rear cover, and E the head, of the cylinder, having stuffing-box *a*, through which the piston-rod passes, and bars or braces *b*, that connect with the pump-cylinder.

The cylinder A is bored out and counterbored at its ends, in the usual manner, and has cast to its upper side the valve-face projection with the main steam-ports *c c'* and the main exhaust-port *d*, and parallel therewith and sideward thereof the auxiliary steam-ports *e* and *e'* and the auxiliary exhaust-port *f*, also the steam-inlet port *g*, which by a pipe is to connect with the steam-generator and the exhaust-outlet *h*.

As will be noticed in Fig. 1, the entrances of the steam-ports *c c'* are a sufficient distance off the ends of the cylinder that the packing-ring of the piston B will close such port before such piston will arrive at the end of its stroke, so as to cut off the passage of the exhaust-steam through such main steam-port opening entirely, and only allowing the remaining steam to escape through a small vent, *i*, that forms a communication between each port and the counterbored portion in each end of the cylinder. By this device the piston in its motion is not only checked and cushioned at the end of each stroke, but live steam is admitted by the motion of the valve in small quantities through the same vent *i*, that will start and move the piston slowly for its return-stroke until the main port-opening begins to be cleared by the packing-ring of such piston moving from under it.

F is the steam-chest, cylindrical at both ends, where it is bored out, and semi-cylindrical in its central portion, with a vertical extension that forms the joint with the cylinder A around its valve-seat, and with tubular side lugs for the connecting-studs. This steam-chest F is closed at its rear by a cover, *k*, and at its front by a head, *l*, which latter has a stuffing-box, *m*, for the valve-rod G to pass through and connect with the valve-yoke H. This valve-yoke H consists of a T-bar, *n*, having on its under side a rectangular box, *o*, that carries the valves, and having on each end a piston, *p* and *p'*, turned to fit snugly into the

bore of the cylindrical ends of the steam-chest F. The steam-ports *e* and *e'* communicate with the exterior ends of the bore in the cylindrical portions of the steam-chest, as shown by dotted lines in Fig. 1, so as to admit steam between one of the pistons *p* or *p'* and the cover *k* or head *l* of the steam-chest.

The main valve I, Fig. 6, that controls the inlet and escape through ports *c c'*, is of common construction, with its end faces made to close both steam-ports when the valve is at the center of its stroke, and with its cavity covering the exhaust-port *d* during its entire stroke.

The auxiliary valve K, Fig. 5, consists of a rectangular block having three ports that are connected by a channel inside of the valve, so as to communicate with each other. The end faces of valve K exterior to the ports are of just the width and a distance apart to cover the ports *e* and *e'* when such valve is on its half-stroke, while the central port of such valve will then be a continuation of exhaust-port *f*. This valve, however, may be made of the common D construction.

These valves I and K are placed side by side in box *o* of valve-yoke H, so as to move therewith, and while the auxiliary valve K is fitted longitudinally to form close joints in and with said box, and to travel the entire length of its stroke with the valve-yoke H, the main valve I is made sufficiently shorter to allow a certain amount of lost motion longitudinally that will reduce its stroke in either direction. By this arrangement, as will be readily seen, the auxiliary valve will always travel in advance of the main valve, and will open its port before the main valve has reached a point at which live steam can enter the main cylinder-port that is to be opened next and while the exhaust-port is still open. As soon as the auxiliary valve has thus admitted steam into the ports *e* or *e'* such steam will rush behind one of the pistons *p* or *p'*, pushing the valve-yoke H forward, and thus throw the main steam-port *c* or *c'* quickly and entirely open.

The valve-rod G is guided at its opposite end in a bracket, L, which is secured upon the brace *b*, and upon this valve-rod is loosely fitted a sleeve, M, that is connected by links N with a crank, O, mounted upon a shaft, *q*. This shaft *q* is journaled in bearings upon one of the braces *b*, and has secured upon its overhanging end a pendent lever, P. This lever P has a cylindrical end, which is projected through a guide-block, Q, pivoted to a cross-head, R, that is clamped upon the piston-rod C, and is guided on a rib, *r*, of lower brace, *b'*. The proportional lengths of crank O and lever P are such that the entire stroke of the piston-rod C will move the valve-rod G about or a little more than one-half of the entire stroke the valves will have to travel. Upon the valve-rod G are adjustably mounted two loose collars, S and S', that will come in contact alternately with the sleeve M, so as to move the slide-valves the desired distance with each stroke to a point where steam is to enter the port under the auxiliary valve K for shifting the valves the balance of their stroke by steam-pressure.

The operation of the valve movements is as follows, to wit: The steam-piston being at the end of its stroke, and steam being admitted by the valve I through port *c*, such steam can enter the cylinder only in a small jet through vent *i*, the main port being closed by the packing-ring of the piston. In consequence the piston will move slowly until such port *c* is opened fully, after which such piston will move with a uniform speed until arriving at the opposite end of the cylinder, where the main outlet for the exhaust-steam will be closed by the packing-ring of the piston closing port *c'*, and will thus again check the speed of the piston by only allowing the balance of the steam to escape through vent *i*. When the piston B begins its motion in the direction from port *c* to *c'* the collar S is in close proximity with sleeve M, which sleeve M being shifted with the motion of the piston-rod C by lever P and crank O, the valve-yoke H is pushed forward until the auxiliary valve K, which travels slightly in advance of the main valve I, as already explained, will open the port that admits steam behind the piston *p'*, so as to push the valve-yoke the balance of its stroke with rapidity, and thus throw the steam-port wide open for the reverse movement, when the next stroke will begin in the same manner, as before explained.

The collars S and S' should be so adjusted that the piston B is at or near the end of its stroke before steam is admitted behind the piston *p* or *p'*, so as to get the full benefit of the working capacity of the pump with each single reciprocation.

With the motion of the valve-yoke H by the steam-pressure the steam entering behind one piston, *p*, through port *e*, and exhausting from behind the other cylinder, *p'*, through port *e'*, the steam-port *e'* is closed by such valve before all the steam can exhaust, thus imprisoning a certain amount of steam, that will form a cushion to the valve-yoke piston.

With the above arrangement, whereby the valve-yoke H is started by positive connection with the piston-rod, and is kept thus in motion until carried forward by steam-pressure to the end of its stroke, such valve-yoke will never get a chance to bind or stick, and thereby to resist such steam-pressure when brought behind it, but will insure a reliable and never-failing movement of the valves.

Another great advantage is that a single pumping-engine thus constructed has no dead-center, where all the steam-ports would be closed, but may be started again from any point of the stroke of the piston in either direction at which it was stopped.

A further advantage is that the valve motion is regulated by the adjustable collars S S', which are always in reach and will not necessitate the opening of the steam-chest for such purpose, and that by the whole device it

is utterly impossible to make a mistake with such adjustment that could be destructive to any part of the engine, since a wrong adjustment of the collars will either shorten the stroke of the piston or will cause the engine to stop entirely, but never will lengthen such stroke to any sufficient extent beyond the designed limits in the cylinder that would cause the piston to strike with force against the cylinder head or cover, because the exhaust-steam port being shut by the packing-ring of the piston before such piston arrives at the end of its stroke, the remaining exhaust-steam forms a cushion which will break the momentum of the piston and will stop its motion gradually.

It is obvious that the main slide-valve may be constructed to cut off the steam at any desired point of the stroke of the piston for working such steam expansively by providing such valve with more or less lap, in the usual manner.

What I claim is—

1. In an engine for pumping and similar purposes, the main valve and auxiliary valve, arranged side by side and carried in a yoke having auxiliary pistons that move in cylinders within the steam-chest, such main valve, that opens and closes the main steam-ports, being allowed longitudinal end-play within the yoke, for the purpose that the auxiliary valve admitting steam behind the auxiliary pistons will travel in advance of such main valve in either direction, such valve-yoke being moved about one-half its entire stroke by the piston-rod through crank O, lever P, sleeve M, and collars S and S′, and the balance of its stroke by the pressure of steam admitted behind one of its auxiliary pistons, the whole being constructed and arranged to operate substantially in the manner set forth.

2. In an engine for pumping and similar purposes, the yoke H, having pistons *p p′*, and carrying valves I K, the valve-rod G, and adjustable collars S S′, in combination with the sleeve M, connected with piston-rod C by crank O and lever P, substantially in the manner and for the purpose set forth.

In testimony that I claim the foregoing as my invention I affix my signature in presence of two witnesses.

EDWARD R. HUBBARD.

Witnesses:

EDWARD BAUMANN,

RICHARD G. SCHMID.