(No Model.) 3 Sheets—Sheet 1.

W. D. HOOKER.

PUMPING ENGINE.

No. 262,228. Patented Aug. 8, 1882.

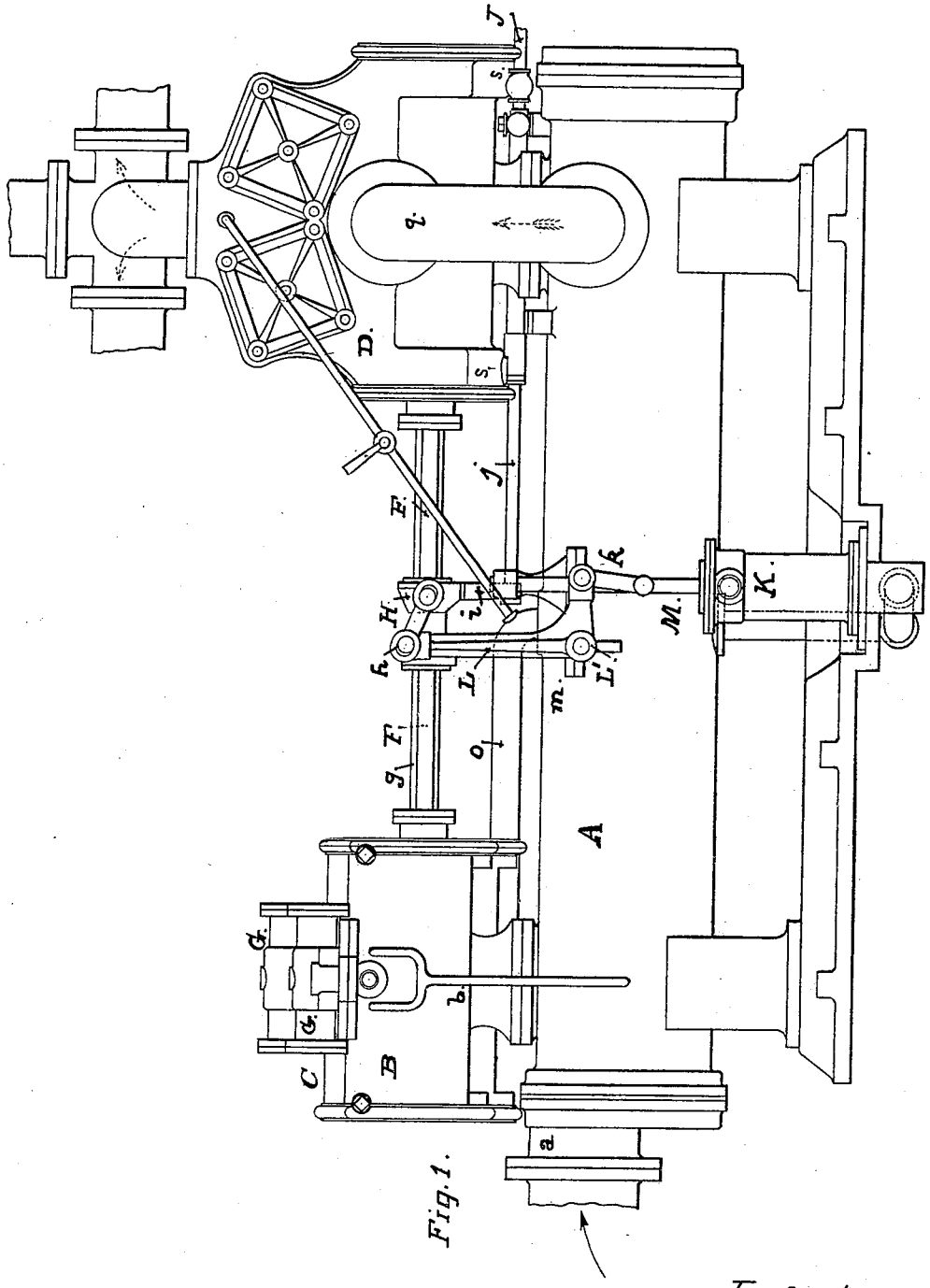

Fig. 1.

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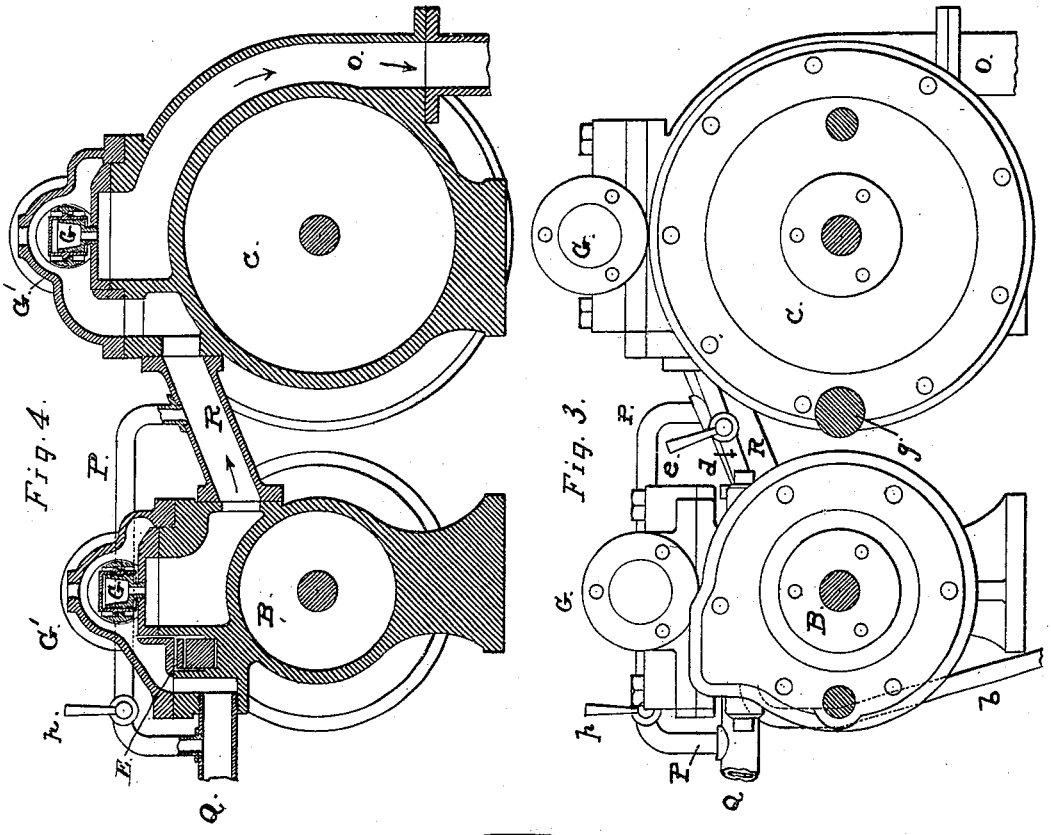

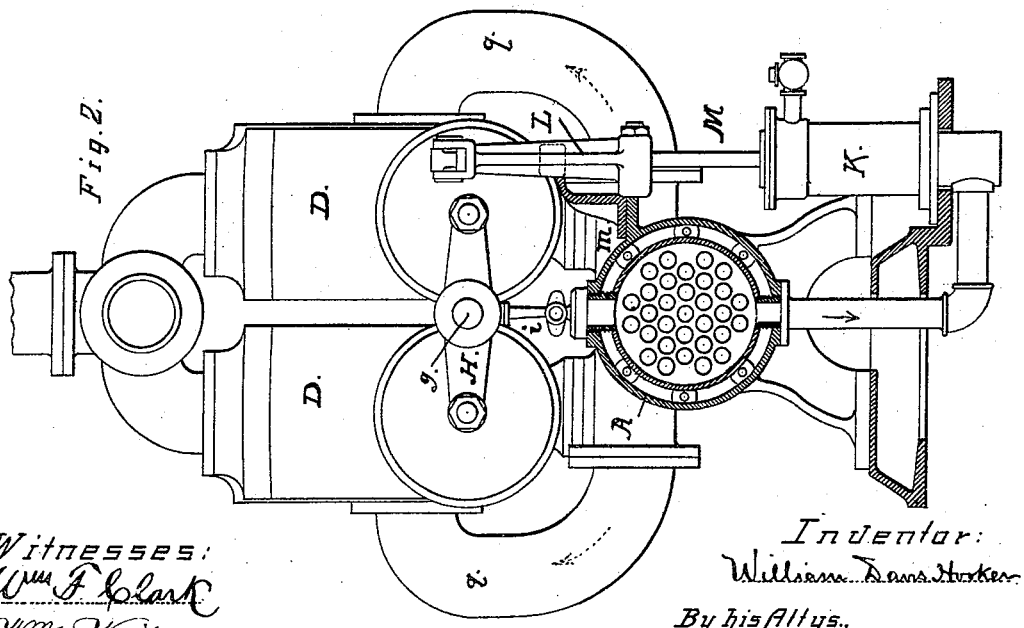

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(No Model.) 3 Sheets—Sheet 3.

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Fig. 5.

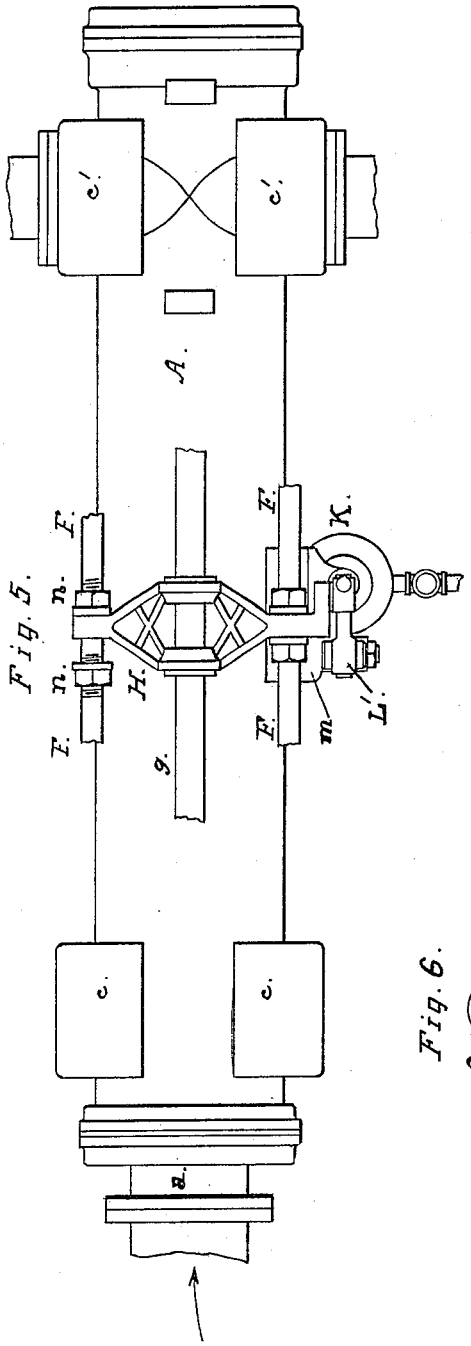


Fig. 7.

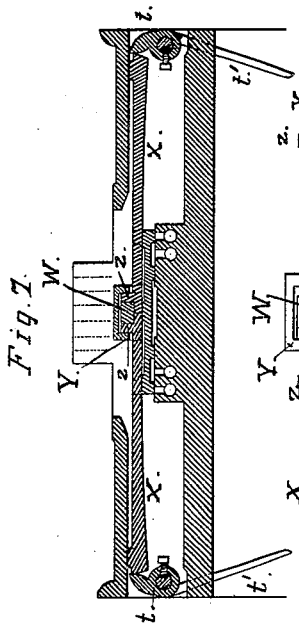


Fig. 8.

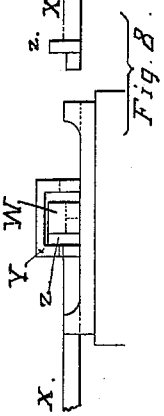
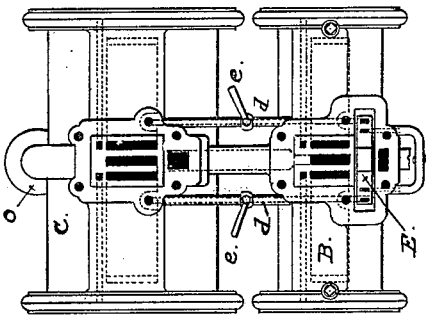


Fig. 6.



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UNITED STATES PATENT OFFICE.

WILLIAM D. HOOKER, OF OAKLAND, CALIFORNIA.

PUMPING-ENGINE.

SPECIFICATION forming part of Letters Patent No. 262,228, dated August 8, 1882.

Application filed September 21, 1881. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM D. HOOKER, of Oakland, county of Alameda, in the State of California, have invented certain new and useful Improvements in 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.

My invention relates to steam pumping-engines; and my improvements consist, first, in mounting a pump or pumps upon one end of a condenser and an engine or engines upon the other end of the same condenser to drive the pump or pumps by direct action. The condenser is made the bed-plate of the pumping-engine, and direct connection is had of the engine-exhaust with the condensing-space and of the pump or pumps with the water-way of the condenser, so that the water raised is taken into and drawn through the condenser, and a vacuum is produced in the water-way to counteract the vacuum formed by condensation in the steam-space of the condenser. By drawing the water through the condenser by the pump or pumps a circulation of cold water through the water-way is maintained, and no circulating-pump is required, and the vacuum in the water-space and that in the tube-space being equal, or nearly so, all liability of the tubes or other parts to leak at the joints is thereby prevented.

It consists, secondly, in mounting a high-pressure and one or more low-pressure engines upon one end of a condenser, to drive by direct action the pumps mounted on the other end of the same condenser, with which the exhausts of the engine and the suction of the pump are connected, as herein specified, and in operating the valves of all the engines simultaneously by steam supplied and controlled by a valve moved by the main piston. By this construction I am enabled to provide a compact simple pumping-engine having very great working capacity. I am also enabled to utilize the expansion and the vacuum of the low-pressure engine or engines.

It consists, thirdly, in driving the valve and the piston of the low-pressure engine by means of steam from the high-pressure engine and the vacuum formed in the condenser, and in supplying live steam directly to the low-pressure engine through a secondary pipe or passage controlled by a cock and leading from a source of supply into the exhaust-passage between the high and the low pressure engines, the valves of all the engines being operated simultaneously by steam supplied and controlled by a valve actuated by the high-pressure piston. By means of this part of my invention the speed of the low-pressure engine can be increased when desired, as in case of fire and other emergency. It also enables the low-pressure engine to be set in motion at the same time with the high-pressure engine in starting the pumps, to assist in moving the column of water resting in the discharge-pipe, and thereby relieve the main or high-pressure engine until the vacuum is sufficiently established.

It consists, fourthly, in connecting the piston-rods together by a cross-head or yoke, which is fixed to the rod of the high-pressure piston, but has a play or longitudinal movement between stops upon the rod of the low-pressure engine, so that a lost motion is obtained, which allows the low-pressure piston to have an independent movement and to operate to finish its stroke in advance of the piston of the high-pressure engine. This permits the low-pressure piston to "cushion" and the pump-valves to seat quietly without jar or shock while waiting for the piston of the main engine to finish its stroke, so that the engines reverse smoothly and work quietly.

Referring to the accompanying drawings, Figure 1 is a side elevation of my improved pumping-engine. Fig. 2 is a cross-section taken through Fig. 1 at a point just in front of the cross-head, showing the arrangement of the pump end of the engine and the connection of the suction with the water-way of the condenser. Fig. 3 is a vertical cross-section taken through Fig. 1 on a line just behind the inner heads of the steam-cylinder, showing the connection and relation of the two cylinders, their pipes, and valves. Fig. 4 is a vertical cross-section taken through the center of Fig. 6. Fig. 5 is a top view of the condenser that forms the bed-plate of the engine, the pump and steam-cylinders being removed. Fig. 6 is a plan view of the two steam-cylinders, with the valve-chamber and valves removed to show the arrangement of the ports and passages and their connection in the two engines. Fig. 7 is a vertical longitudinal section through the

auxiliary valve and its valve-chamber, showing the means for attaching the valve-rods. Fig. 8 is a view showing the same device in detail.

A represents a condenser, having suitable supporting brackets or surfaces, *c c*, at one end to receive the pumps D D, and similar supports, *c' c'*, on the opposite end for mounting the engine-cylinders B C thereon in line with the pump-cylinders, so that each engine is applied to drive a pump by direct action. Where two pumps and a compound engine are employed, as in forming a pumping-engine of increased capacity, the pumps and engine-cylinders will be disposed upon each side of the condenser for distributing the weight of the parts as equally as possible upon each side; but if a single pump and engine be used they can be mounted directly upon its top. The condenser thus forms the bed-plate of the pumping-engine, and the parts are all brought into close and compact relation and position together with great economy of space. There is a vacuum in the water-way of the condenser equal to the vertical lift of the water required before the water can be raised to the pump. The steam exhausted into the condenser between the tubes, tube-sheets, heads, and shell is condensed, such a vacuum is formed, and as long as the exhausting continues it will be maintained.

When the engine is a compound one, or composed of a high and a low-pressure cylinder, I connect the exhaust of the low-pressure directly with the condenser, while the high-pressure cylinder is connected with the valve-chamber of the low-pressure cylinder in the usual manner. This direct communication with the condenser brings the full effect of the vacuum upon the low-pressure cylinder, and then, by employing the auxiliary valve for supplying steam to the main valves G of both engines, I am enabled to operate both pistons uniformly and rapidly without employing any valve-mechanism for the low-pressure engines.

In many cases the engines could be run together without having any yoke or connection between the two piston-rods; but I find it desirable to couple the rods together by a yoke, H. This yoke H is supported and works on a guide-rod, *g*, between the piston-rods, that is fixed to and supported between the heads of the steam-cylinders at one end and the heads of the pump-cylinder at the other end along the top of the condenser, as seen in Figs. 1, 5, and 8. Its yoke serves also to work the hot-water pump J and the air-pump K, for which purpose it is provided with the depending arm *i* on its under side, to work the pump-rod *j*, and is connected by a link, *k*, at one side to the upper end of a rocking lever, L, pivoted at L' to the brackets *m*, just over the air-pump, the pump-rod M being connected at *k* to the shorter end of the right-angle lever, and working up and down in a bearing in the bracket *m*.

The manner of operating the valves of a high and one or several low pressure engine-cylinders by steam supplied by a valve actuated by the main piston of one engine is contained in a separate invention, on which I have made application for Letters Patent, and is not of itself claimed as a part of this invention; but in connection and combination therewith I find it highly useful and desirable to provide the low-pressure cylinder with a supply of live steam, so that when the engines are started the power of the low-pressure piston is obtained at once to assist the piston of the high-pressure cylinder without waiting for the vacuum to be sufficiently formed to work the low-pressure in the usual way from the exhaust-steam. By leading a pipe, P, Figs. 6 and 7, from the steam-supply of the high-pressure cylinder directly into the exhaust R, I can turn a small supply of live steam into the steam chest or supply of the low-pressure, and the valve, when set in motion by the main piston, will start both engines together. This supply of live steam for the low-pressure cylinder is also useful in regulating the speed of the piston in that engine, where the valve is not driven or controlled directly by a valve mechanism, for by letting into its cylinder a greater or less quantity of live steam the low-pressure piston can be accelerated more or less, as required, and both engines can then be brought up to a uniform speed.

The cylinder B or high-pressure side of the pumping-engine, as shown in Fig. 9, has the auxiliary valve E arranged and operated after the manner described in the Letters Patent issued to me on the 6th day of December, 1870. My present improvement upon the mechanism for driving this auxiliary valve on a pumping-engine from the movements of the main piston is shown in the detail view, Figs. 10 and 11. The valve E is moved in the usual way by the cams *t t* and arms *t' t'*, that project into the cylinder-space; but to connect the valve-rods X X, I now provide a lug, W, on top of the valve with a hole or slot, into which the ends of the rods are inserted, and then held in place by the cap Y. These rounded ends of the rods fit into the lug W; but they do not come quite in contact at the ends when inserted from opposite sides. Behind them, on the rod, is formed a shoulder, *z*, and over it the cap Y is dropped, a slot in each end of the cap allowing it to fit closely over each rod behind the shoulders *z*, and to embrace and cover the lug W and the two shoulders, so that the two stems are securely locked to the top of the valve. By simply lifting off the cap Y each rod X can be readily loosened and lifted out of place through the opening in the upper side of the valve-chamber, and through the same opening, after the rods X are removed, access can be had to the valve and the cams *t t* and their arms for taking them out for repairs. This is a very simple and effective mode of securing the valve to the rods X, and it enables the parts to be easily detached and the valve-cams and tappets taken out for inspection and repairing, as no pins, bolts, or other fastenings

are used. This auxiliary valve supplies steam to the valves G of both cylinders, B C, for moving them simultaneously, as described in the pending application for Letters Patent above referred to; and in that construction these pipes are crossed, and the valve then supplies steam to opposite ends of the valves G to move the engine-pistons simultaneously in opposite directions; but in my present invention each pipe *d*, that leads steam to the chamber G′ to move its valve, is carried directly across on the same side of both valve-chambers, so that these valves work back and forth together and the pistons move in the same direction. In each of these pipes I now provide a cock, *e*, for the purpose of regulating the movements of the valves of the low-pressure engine, as this enables me to perfectly control the supply of steam to the low-pressure-engine valve, so that I can regulate and exactly adjust its motion.

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

1. The combination, with a pumping-engine, of a condenser through which the water raised by the pump is drawn and caused to circulate before entering the suction-inlet of the pump.

2. In a pumping-engine, the combination, with a pump and its operating-engine, of a condenser so connected with the exhaust of the engine and the suction of the pump that a vacuum is formed and maintained in the interior of the condenser on both sides of the tubes, tube-sheets, and other partitions that separate the condensing-space from the water-way of the condenser, substantially as described.

3. In a pumping-engine, a condenser having a pump or pumps mounted on one end, with the suction connected with the water-way of the condenser, in combination with an engine or engines mounted upon the other end of the same condenser in a position to drive the said pump or pumps by direct action, and having the exhaust thereof connected directly with said condenser, substantially as described.

4. The combination of the pumps D D, engine-cylinders B C, each having its valve-chamber and valve G, the condenser having the exhaust of the engine and the suction of the pump respectively connected thereto, as described, and the auxiliary valve E, all applied to operate together substantially as and for the purpose described.

5. In combination with the low-pressure engine having its valve G moved by steam-pressure derived from the high-pressure engine, the secondary steam-supply P, having a cock, *p*, substantially as and for the purpose described.

6. The combination, with the two piston-rods F F, of a yoke or connection which is fixed to and carried by one rod, but is loosely connected with the other rod, so that the piston thereof can have a motion at the termination of its stroke independently of the movement of the piston of the other rod, substantially as described.

7. In combination with the piston-rod F, having the yoke H fixed to it, the rod F′, loosely connected to the yoke, and having the adjustable stops *n n*.

8. In combination with the low-pressure cylinder having its valve G moved by steam-pressure derived from the high-pressure engine, the auxiliary valve E and the pipes *d d*, connecting the ends of the valve-chamber G′ with the auxiliary valve, and provided with cocks *e*, substantially as set forth.

9. In combination with the valve E, having the lug W, the valve-rods with their shouldered ends, and the removable cap Y, substantially as described.

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