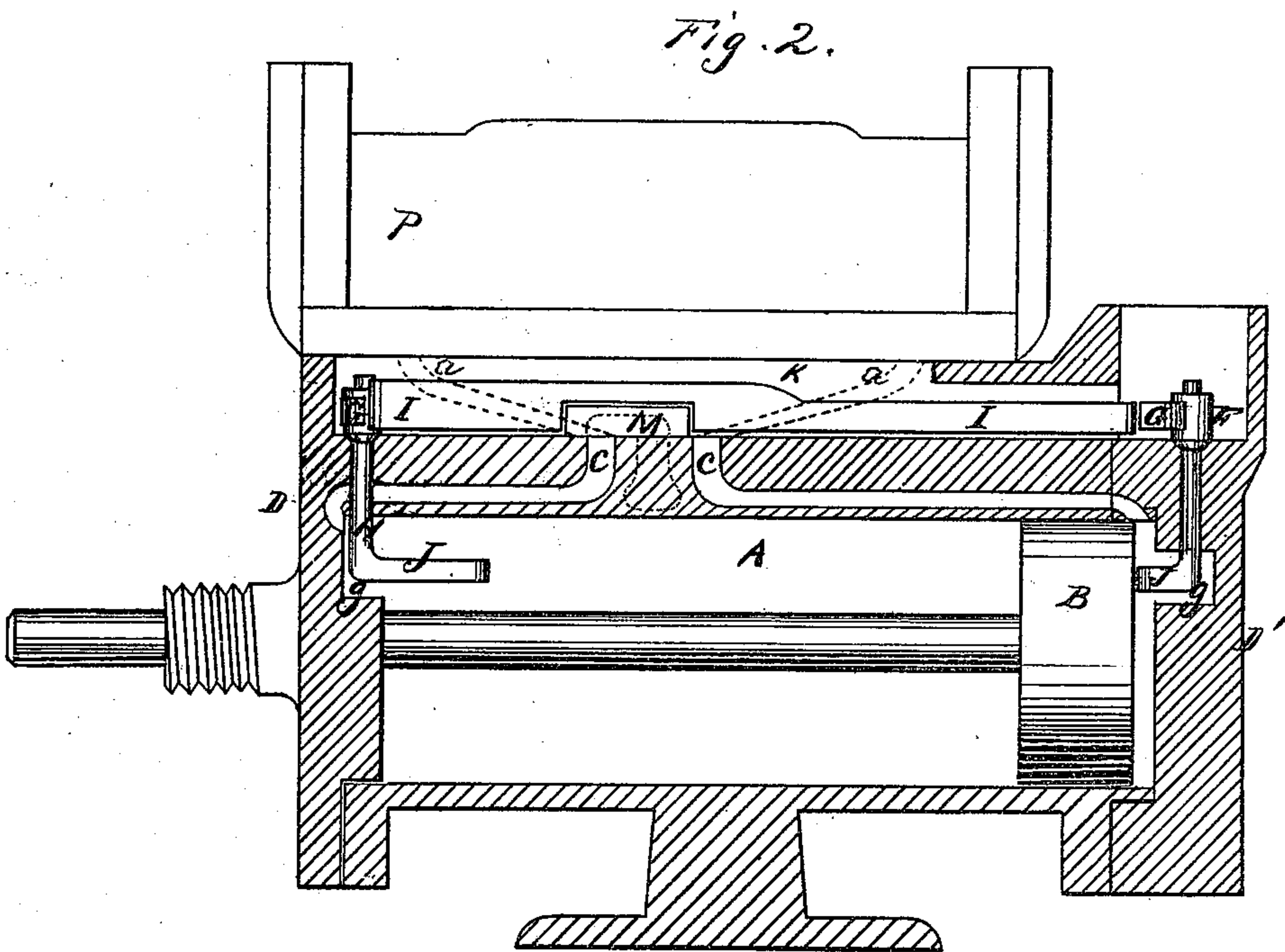
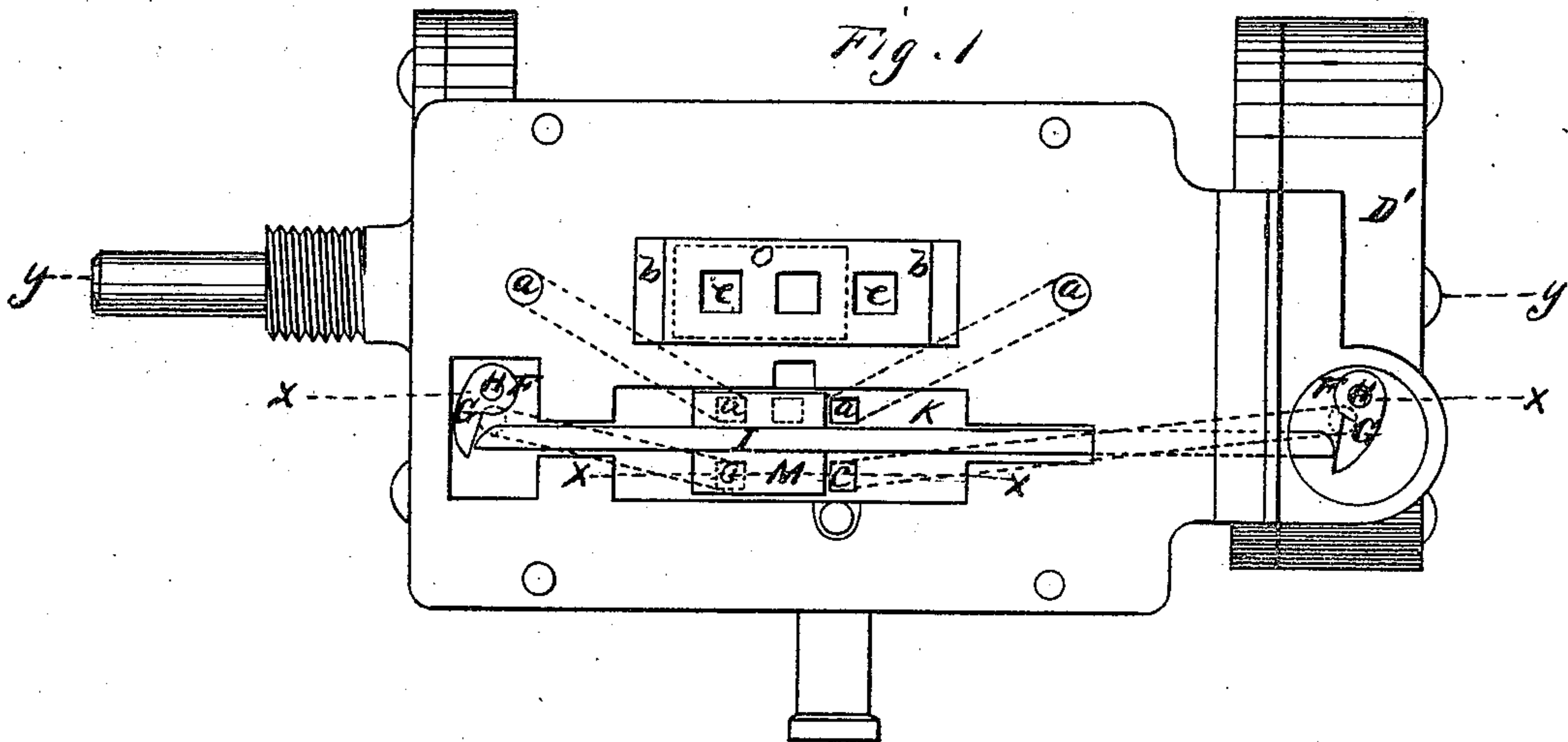


W. D. HOOKER.

Improvement in Direct-Acting Engines

No. 129,345.

Patented July 16, 1872.



Witnesses

*J. L. Boone*

*C. W. Richardson*

Inventor

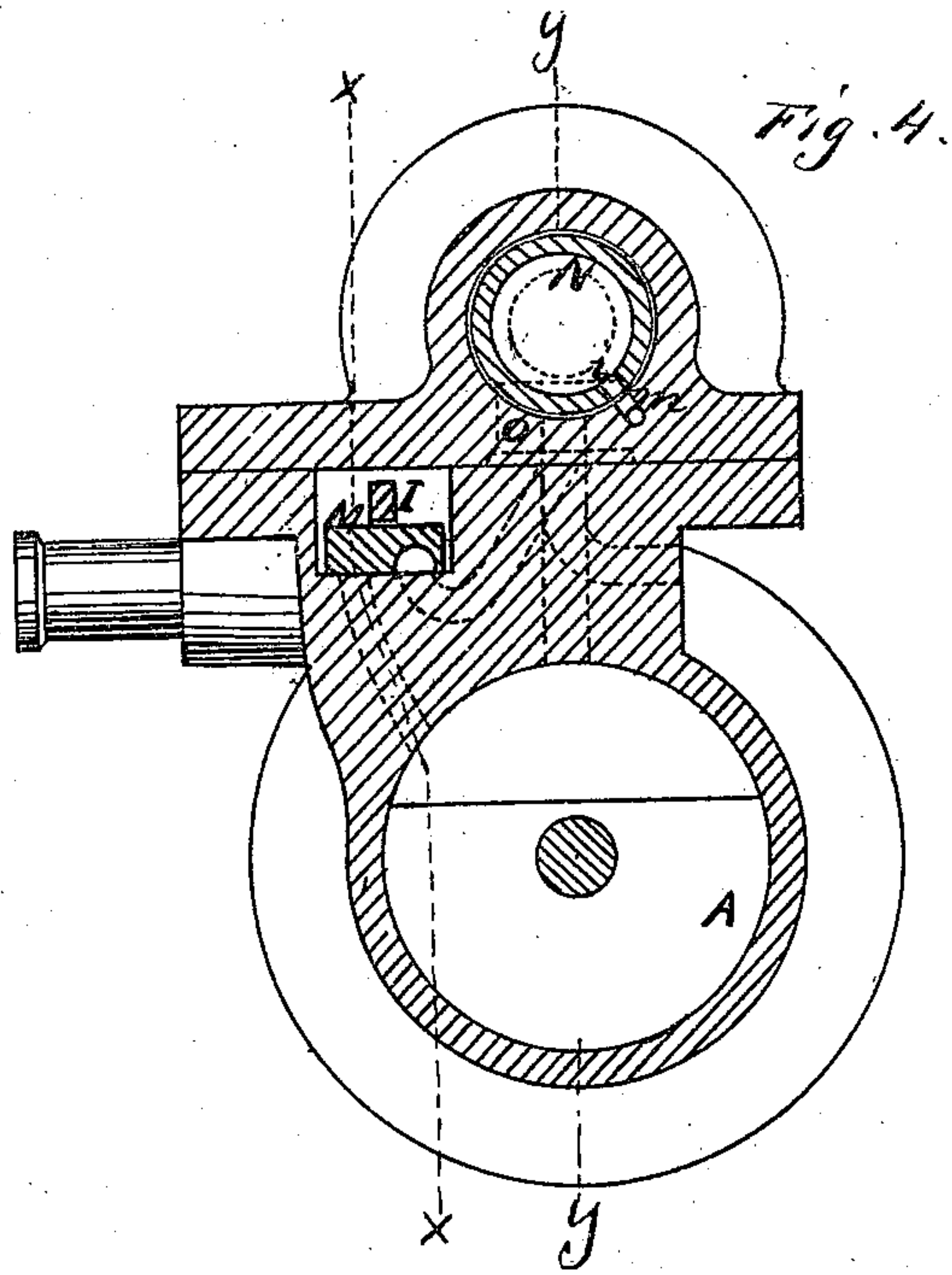
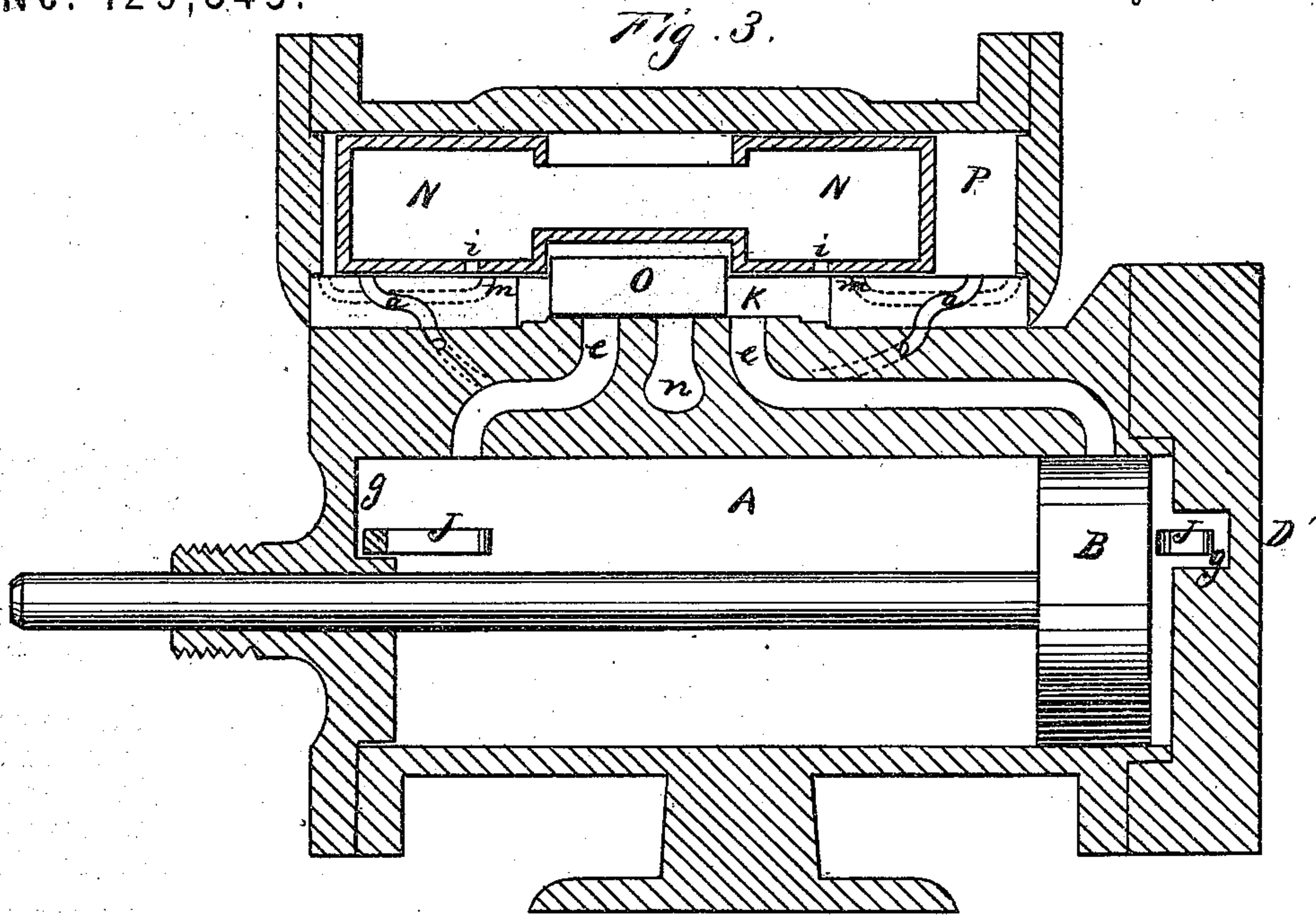
*William D. Hooker*  
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*Attys*

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# UNITED STATES PATENT OFFICE.

WILLIAM DAVIS HOOKER, OF SAN FRANCISCO, CALIFORNIA.

## IMPROVEMENT IN DIRECT-ACTING STEAM-ENGINES.

Specification forming part of Letters Patent No. 129,345, dated July 16, 1872.

### SPECIFICATION.

*To all whom it may concern:*

Be it known that I, WILLIAM DAVIS HOOKER, of the city and county of San Francisco, State of California, have invented an Improved Direct-Acting Steam-Engine; and I do hereby declare the following description and accompanying drawing are sufficient to enable any person skilled in the art or science to which it most nearly appertains to make and use my said invention or improvements without further invention or experiment.

The object of my present invention is to provide an improvement in that class known as direct-acting steam-engines; and it relates more particularly to an engine for which a patent was granted to me dated December 6, 1870, and numbered 109,904. My invention consists, first, in a novel construction and arrangement of ports in the supplemental piston in relation to ports leading to the end of said piston-chamber, and also ports leading to the auxiliary valve in such a manner that the live steam constantly contained in the said piston and supplied from the main valve-chamber shall drive the main valve for the first part of its stroke and be supplied behind the end of the piston at the last of its stroke to balance the valve, suitable provision being made to compress the live steam so supplied, so that it will be impossible for the piston to strike the end of its chamber. The office of the auxiliary valve is to exhaust the steam from said piston-chamber and supply steam to finish up the stroke of the main valve. The live steam which was compressed behind the end of the supplemental piston is always ready to drive it and the main valve the instant the auxiliary exhausts the steam from the chamber at the opposite end of the piston. My invention further consists in the use of recesses in the main cylinder-heads, within which the arms which are operated by the piston to move the auxiliary valve are protected from being broken by the piston. It also consists in constructing a valve-bar which moves in suitable slots and engages with the auxiliary valve, so that the valves shall always be in direct contact with the arm at starting, and so that the bar and valve can be removed with very little trouble.

Referring to the accompanying drawing for a more complete explanation of my invention,

Figure 1, Sheet 1, is a plan, showing the main valve-face and the auxiliary valve. Fig. 2, Sheet 1, is a longitudinal section of the cylinder passing through the auxiliary valve and chamber in the plane *xx*. Fig. 3 is a longitudinal section taken through *yy*. Fig. 4 is a transverse section.

A is the steam-cylinder, and B is the piston. D D' are the front and rear cylinder-heads. The front one may be made only sufficiently thick to allow of a recess or space, *g*, into which the arm J can lie above the hole through which the rod passes, so that when moved back by the piston it will be entirely protected and not liable to be broken, as might occur in my former construction, where there was no such protection. The rear head D' may be made of sufficient depth to receive the valve F, rod H, and arms G and J, as shown, so that the whole can be removed together and present no obstruction to the removal of the piston if it should be necessary or desirable. A similar recess, *g*, to the one described for the front head, receives the arm J at this end, and thus protects it. The valve F, with the arms G and J, are not different from those described in my former patent; but instead of two rods extending from the arms G to the auxiliary valve, one upon each side, I employ a continuous bar which moves in slots in the face, and is cut out or recessed so that it clasps the auxiliary valve M, as shown, and extends from one cam or arm G to the other. This is done in order to leave the valve and bar in direct contact with the cam G, toward which it was last moved by the action of the piston A; and there will thus be no lost motion and consequently wear of the valve at the points of contact, which would otherwise occur at the high rate of speed reached. It also renders it possible to remove the bar I and the auxiliary valve M whenever it is necessary, by simply exposing the main valve-face.

In my present construction the auxiliary valve M is a simple slide-valve moving upon its seat, and having two ports, *c*, leading to the ends of the main cylinder A, as shown. The same valve alternately opens and closes two ports, *a a*, which lead into the chamber P near each end, and a corresponding exhaust-port, as will be hereafter described. The main valve O moves upon the face *b*, alternately



opening and closing the ports *e* to the main cylinder and also the exhaust-port. The piston N is made, as shown, hollow for lightness, and also to contain the live steam which is supplied to the valve-chamber; but the ends of this piston must be closed so as to allow it to cushion at each end of its stroke, as will hereafter be shown. This piston is made smaller at its middle, and the upper part of the main valve extending into this diminished space, so that the movement of the piston carries the valve with it. A small port, *i*, is made in the lower part of the piston N at each side of the middle, and corresponding ports *m* are made in the chamber P, the ports leading to the extreme end of the chamber behind the piston.

The operation will be as follows: When the piston A arrives at one end of the cylinder it forces the arm or cam J back and rotates the shaft H and valve F with its arms G. This arm moves the bar I, and with it the auxiliary valve M, thus opening the ports *a* and *c*. The parts then being in the position shown, the steam which is admitted from the supply-pipe fills the chamber K, the space around the main valve, and the interior of the piston N, which is closed at both ends. This steam passes behind the piston N through the port *m*, and moves it so far as to open the port *a*, which is, as described, a short distance from the end, and allows live steam from the auxiliary valve to pass through it to the chamber P and finish the stroke of the piston. This is instantly moved to the opposite end of the chamber, thus moving the main valve *o* and opening the port *e*, which, with the port *c*, already opened by the auxiliary valve, admits steam to the main cylinder, arresting the main piston and forcing it back for the return-stroke. When the piston N reaches a point which brings the ports *i* and *m* together the live steam passes through them and is admitted behind the piston N. This instantly balances the pressure, but it does not stop the piston, which has immense velocity, and con-

tinues to move until the port *i* has just passed the port *m*, when the live steam will be imprisoned and compressed by any further movement of the piston, which is thus cushioned. The main piston has meanwhile finished its stroke, and by moving the arm J at that end, and through it the auxiliary valve, the exhaust-port *n* will be opened, thus allowing the steam to escape from the opposite end of the chamber P. The pressure, being thus removed, allows the compressed live steam just described to act and start the valve, moving it so far that the new steam can be admitted through the ports *a*, which, as before described, open a short distance from the end. By this arrangement I am enabled to obtain a quicker movement of the main valve than if the steam to start the piston were supplied by the auxiliary valve, and can consequently drive the main piston at a very great velocity without injury to the engine.

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

1. In combination with the valve F having the cams G and the auxiliary valve M, I claim the valve-bar I, notched, as shown, and the recess in which it moves and is guided, substantially as and for the purpose above described.

2. I claim the combination of the main piston B, the valves F with their arms J, and the recesses *g* in the cylinder-heads, constructed substantially as and for the purpose above described.

3. In combination with the valve *o*, the supplemental piston N, and ports *a a*, I claim the ports *i* in the supplemental piston N, and the ports *m* in the chamber P, arranged substantially as and for the purpose described.

In witness whereof I hereunto set my hand.

WILLIAM DAVIS HOOKER.

Witnesses:

C. M. RICHARDSON,  
I. L. BOONE.