(No Model.) 3 Sheets—Sheet 1.

F. M. COMSTOCK.

ENGINE.

No. 560,892. Patented May 26, 1896.

Fig. 1.

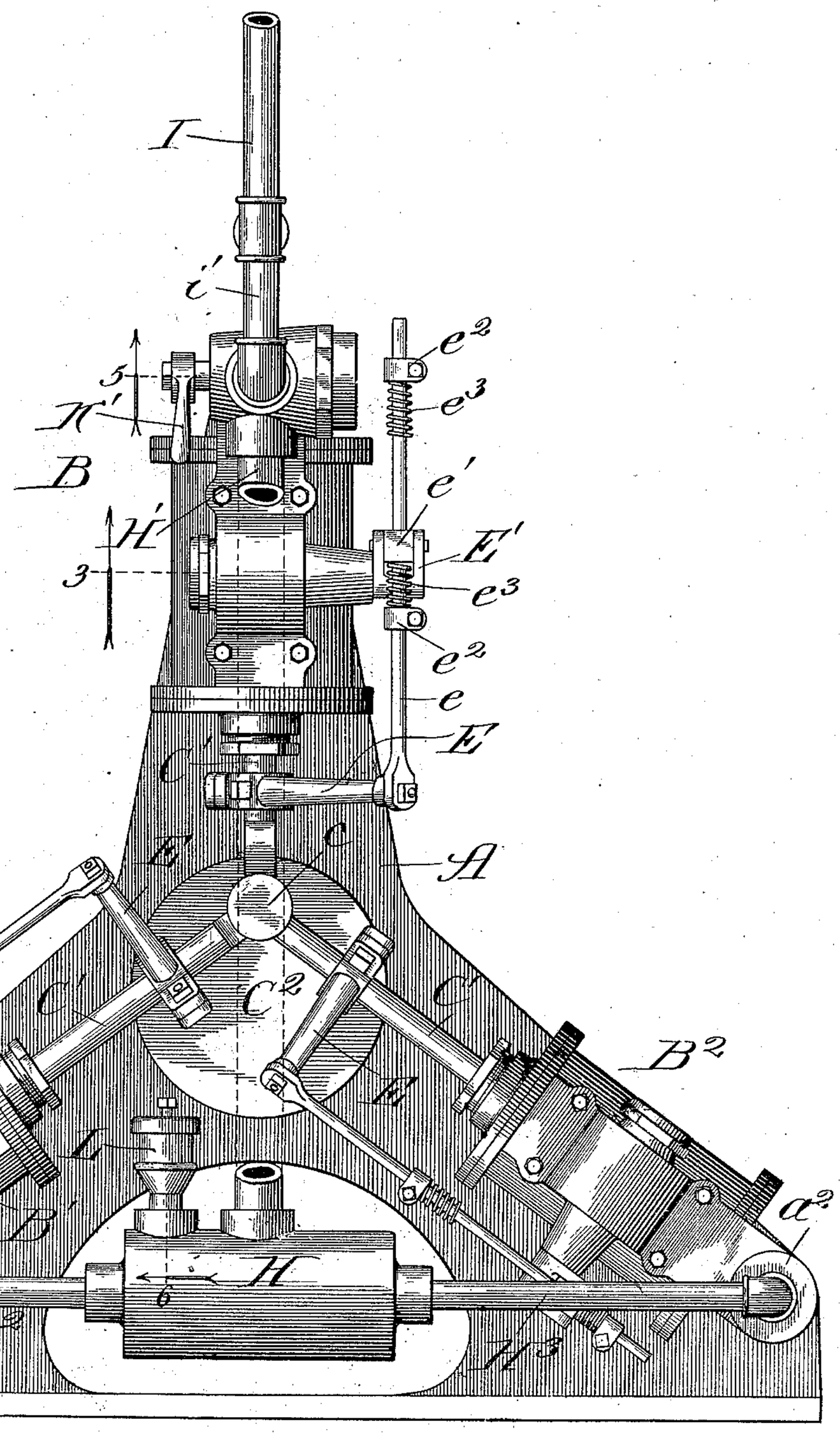

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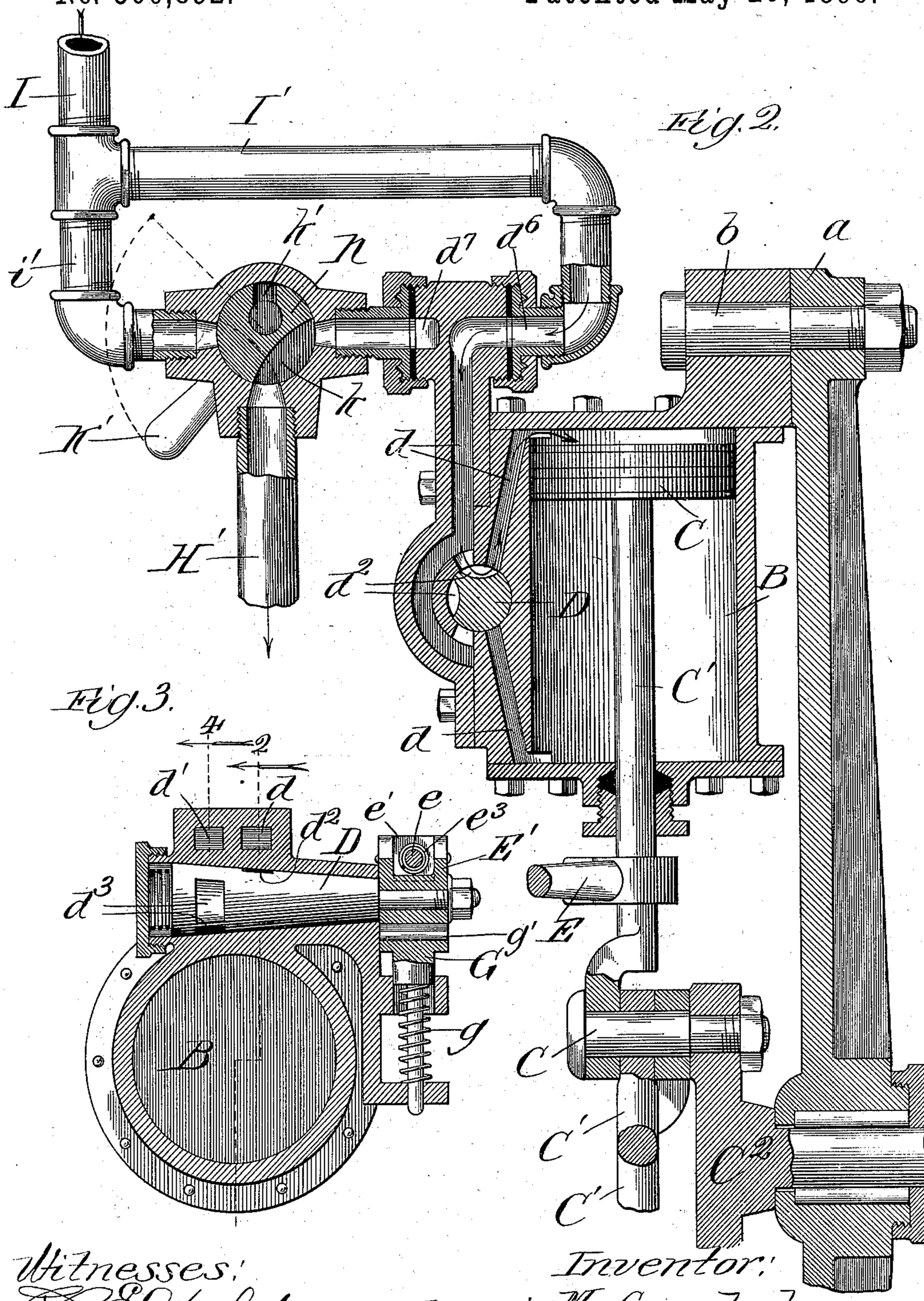
Fig. 2.



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3 Sheets—Sheet 3.

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Fig. 4.

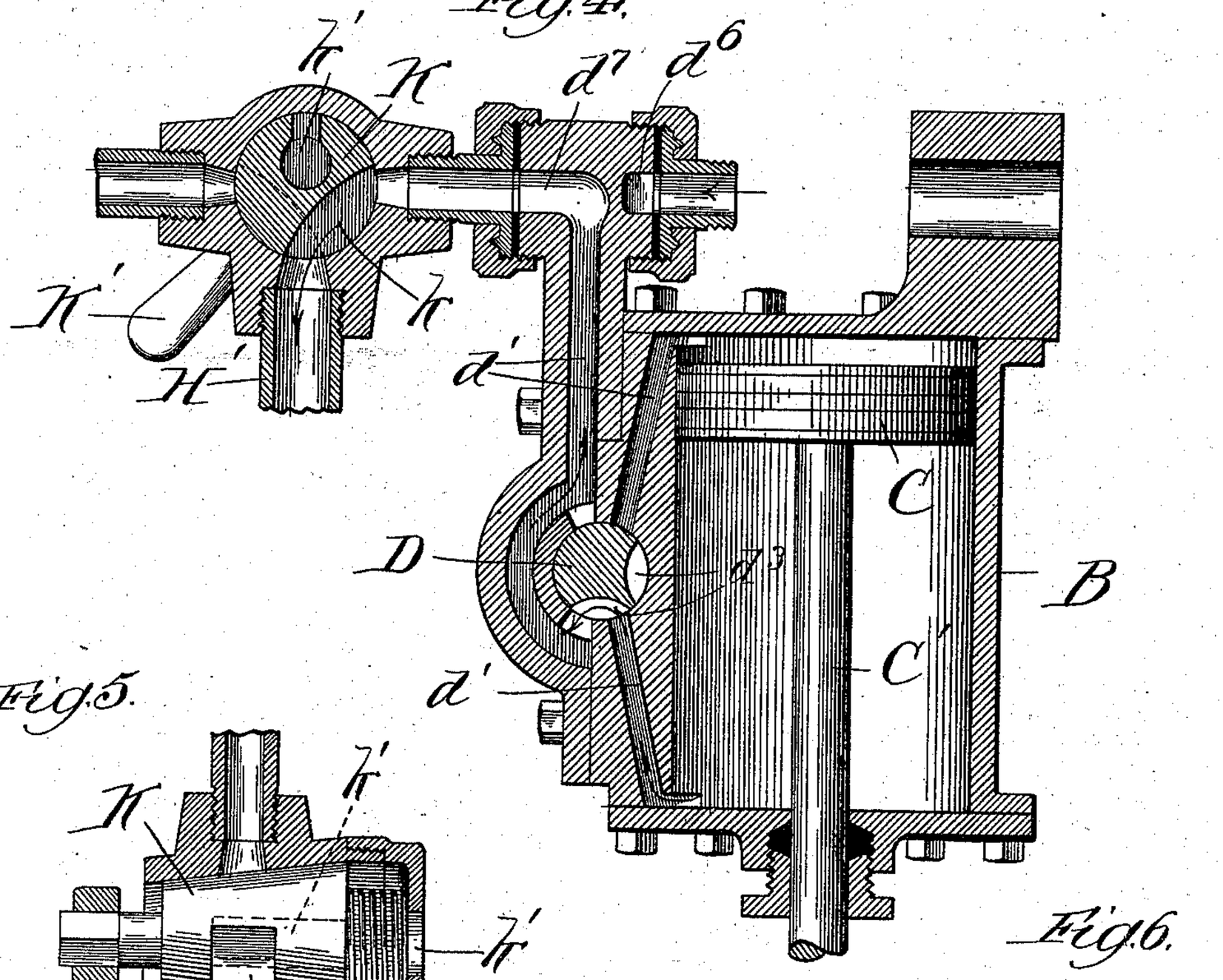


Fig. 5.

Fig. 6.

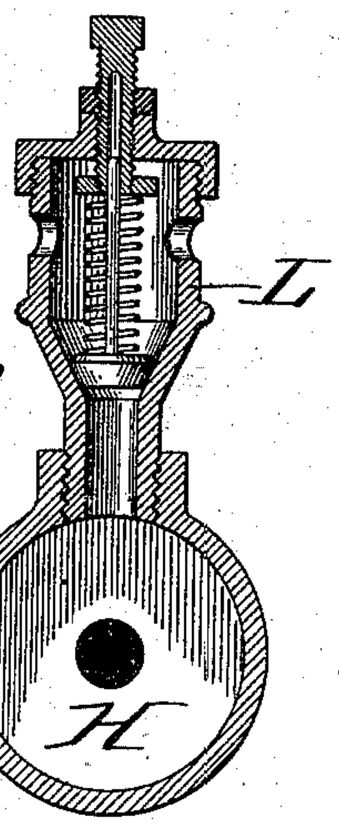


Fig. 8.

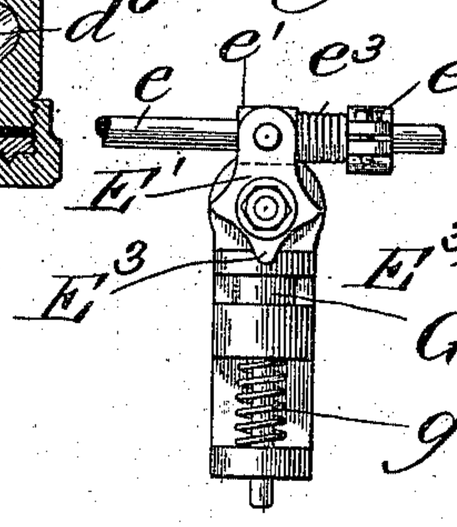
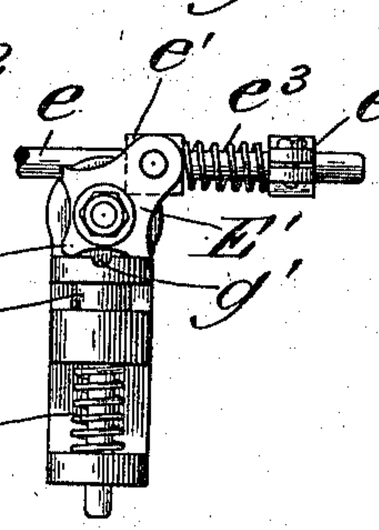


Fig. 7.



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UNITED STATES PATENT OFFICE.

FRANCIS M. COMSTOCK, OF TOPEKA, KANSAS, ASSIGNOR TO THE COMSTOCK MOTOR COMPANY, OF SAME PLACE.

ENGINE.

SPECIFICATION forming part of Letters Patent No. 560,892, dated May 26, 1896.

Application filed July 1, 1895. Serial No. 554,639. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS M. COMSTOCK, a citizen of the United States, residing at Topeka, Kansas, have invented certain new and useful Improvements in Engines, of which the following is a specification.

My invention relates particularly to engines or motors in which fluid-pressure is used as the force to operate the motor, and especially to triple engines that are adapted to be used either direct or in compound relation to one another.

The object of my invention is to provide a simple, economical, and efficient triple engine in which the cylinders are adapted to be used direct or in compound relations to each other; and the invention consists in the features and combinations hereinafter described and claimed.

In the drawings, Figure 1 is a front elevation of my improvement; Fig. 2, a longitudinal vertical section of the upper cylinder shown in Fig. 1, taken on line 2 of Fig. 3, looking in the direction of the arrow; Fig. 3, a transverse sectional view taken on line 3 of Fig. 1; Fig. 4, a similar view of a portion of the mechanism shown in Fig. 2, taken on line 4 of Fig. 3; Fig. 5, an enlarged view of a portion of the main valve shown in Fig. 1, taken on line 5 of the same figure; Fig. 6, an enlarged view of the puppet-valve shown in Fig. 1, taken on line 6; and Figs. 7 and 8 are enlarged views of the valve mechanism hereinafter described.

In constructing my improvement I use a frame portion A of the desired size and shape and adapted to hold three cylinders in their operative position. The frame is preferably triangular in shape—that is, provided with three portions a, a', and a^2, at the ends of which the cylinders are pivotally secured. Pivoted to each end portion of the frame by means of the shoulder-pins b are cylinders B, B′, and B², in such manner that they may oscillate to accommodate the movements of their respective piston-rods. Each cylinder is provided with a reciprocating piston C and piston-rod C′, that is secured to a common crank-pin c of a crank-plate C². The piston-rods are secured to this crank-pin in such a manner and by the location of their respective cylinders that but one piston at any one time is at the limit of its backward motion.

In order to admit fluid-pressure to operate the engine at the proper time and exhaust the same, each cylinder is provided with the usual port d and exhaust d', that are formed in a portion of the casting of the cylinder-frame. (See Figs. 2 and 4.) A rotary valve D, provided with passages d^2 and d^3, is inserted in the cylinder-frame for the purpose of cutting off and opening communication with the interior of the cylinder and the ports and exhausts. The description of one set of these ports and exhausts and rotary valve describes the same as are used on each cylinder, so that but one description is necessary for all.

In Fig. 2 it will be seen that the piston is at the backward limit of its motion and the rotary valve in such position as to admit fluid-pressure back of it, while in Fig. 4 a different sectional view is shown of the rotary valve and cylinder, which shows that portion of the cylinder in front of the respective pistons as open or in communication with the exhaust.

To actuate the rotary valves at the proper time, I secure to each piston-rod an arm E, to which is pivotally secured an actuating-rod e. Each of the valve-stems is provided with bifurcated arms E′, in which are pivoted blocks e', provided with transverse openings, through which the actuating-rods e operate and slide. Each of the actuating-rods is provided with a double set of split collars e^2 and helically-coiled springs e^3, that form cushioned tappets and which are arranged to strike the valve-arm.

In ordinary operation as the piston approaches its backward limit of motion (see upper cylinder in Fig. 1) the lower tappet strikes the slide-block, and the spring being compressed until sufficient force is stored the further movement of the actuating-rod throws the rotary valve toward the back and places the valve in the position shown in Figs. 2 and 4, in which position it remains until the piston-rod has nearly reached the forward limit of its motion, when the upper tappet strikes

the valve-lever and draws it to the opposite side of its motion to again reverse the movement of the piston.

In order to hold the rotary valves in their different positions, a platen or table G is arranged directly under the valve-arm and provided with a helical spring g, which is adapted to keep the platen normally in contact with the valve-arm, which is substantially flattened on two sides, so that when it is contacted by the movable platen it is held in either limit of its motions. The platen is also provided with a groove g' and the valve-arm with a projection E^3, adapted to fit in the groove and hold the valve for a desired length of time in a central position, as hereinafter described.

Assuming the valve to be in the position shown in Figs. 2 and 4 and the piston to have started on its forward motion, the helical coiled spring of the tappet contacts the block of the valve-arm, as shown in Fig. 7, and after compression moves the valve into the central position, as shown in Fig. 8. The piston has in the meantime performed about three-quarters of its stroke, and before the valve can be shut off completely or the exhaust opened completely the spring e^3 must be completely compressed, as shown in Fig. 8, when the further movement of the actuating-rod throws the valve-arm out of engagement with the notch in the platen, and by the assistance of the platen and the spring of the tappet the rotary valve is immediately and very quickly thrown to the opposite limit of its motion, thus opening the exhaust behind and admitting steam in front of the moving piston to form a small cushion of fluid-pressure.

In order to use the cylinders in compound relation to one another, I provide an expansion-chamber H and connect it with the exhaust of the primary cylinder B and the other or secondary cylinders B′ and B^2 by means of the pipes H′, H^2, and H^3. The inlet-pipe I is shown at the top of Figs. 1 and 2 and is connected, by means of a pipe I′, with the port-opening d^6 of the primary cylinder, while the pipe H′ is connected with the exhaust-opening d' of the same cylinder, so that the fluid-pressure from the primary cylinder as it is exhausted passes through the pipe H′ into the expansion-chamber H, and from thence, through pipes H^2 and H^3, into each of the secondary cylinders, to be used in them and afterward exhausted. The passages d in the secondary cylinder are the exhaust-passages and the passages d' are the supply or port passages, with which the pipes H^2 and H^3 are connected. It will thus be seen that the fluid-pressure from such secondary cylinders is exhausted through opening d^6 into the outer air.

In order to change the cylinders from compound to direct acting, I provide what I term a "transforming-valve" K, that is interposed in and between the inlet-pipe and pipe H′ and the exhaust of the primary cylinder. This valve is provided with two passages k and k' for the purpose of cutting off or opening communication between pipe H′ and the inlet-pipe or the exhaust of the primary cylinder, as hereinafter described. As shown in Fig. 2, the valve is in such position that the fluid-pressure of the primary cylinder can pass into the secondary cylinders. By turning the handle K′ of the transforming-valve to the opposite limit of its motion, as shown in dotted lines, communication is cut off between the exhaust of the primary cylinder and the secondary cylinders, and direct communication opened between the secondary cylinders and the inlet-pipe by means of the branch pipe i', so that such cylinders may be operated directly by the fluid-pressure. When the transforming-valve is placed in this position, the passage k' of the valve is brought in alinement with the exhaust-opening of the primary cylinder, (see Fig. 5,) and fluid-pressure may be exhausted through such opening, which is at the bottom of the valve, into the open air.

In experimenting with my engine I have found that the greatest efficiency has been obtained in compounding it when a certain amount of fluid-pressure was furnished the first cylinder. For instance, assuming that twenty pounds pressure is furnished the primary cylinder and exhausted into the expansion-chamber H and fed into the other cylinders, a certain pressure is indicated in such chamber and a certain number of revolutions of the crank-shaft obtained. By either lowering or raising the pressure furnished the first cylinder from this point the efficiency of the engine is impaired—that is, the velocity of the engine was not increased or decreased in proportion to the amount of power furnished, nor was the pressure indicated in the expansion-chamber proportionate to the power furnished or taken away. Therefore, in order to obtain an average pressure in the exhaust-chamber and maintain the maximum efficiency of the engine within certain limits, I provide a puppet-valve L, of any usual form of construction, and secure it to the expansion-chamber in any desired position. These puppet-valves are so well known that they need no detailed description here, and are made adjustable, so as to obtain any desired pressure in the expansion-chamber before any blowing off takes place.

In operation (see Fig. 2) fluid-pressure is furnished the inlet-pipe I and, by means of the pipe I′, passes through the port d and passage d^2 of the rotary valve back of the moving piston of the primary cylinder. By the mechanism hereinbefore described when the piston has reached the forward limit of its motion the rotary valve is turned so as to close the port back of the moving piston, opens the port in front of it, and opens the exhaust back of such piston. This reverses the main piston and starts it on its backward motion, thus forcing the pressure (see Fig. 4) out through the exhaust d', through the pas-

sage and transforming-valve into the pipe H′, which leads to the expansion-chamber H. The pressure is furnished from this expansion-chamber to the other cylinders, but in diminished pressure, and serves to operate the pistons of such cylinders to rotate the crank-plate and thereby the crank-shaft. (Not lettered.) The pressure from these cylinders as it is exhausted (see Fig. 2) is passed out through the passages d and opening d^6 into the outer air.

If it be desired to use pressure direct to all the cylinders, the transforming-valve (shown particularly in Fig. 2) is moved to the other limit of its motion, as shown in dotted lines, so that direct pressure is simultaneously furnished to all the cylinders and exhausted from all into the outer air.

The pressure should be applied gradually until the crank or "main" shaft, as it might be properly called, attains its maximum velocity, when the puppet-valve can be set to discharge any excess of pressure above that point in the expansion-chamber, so that when too much pressure is furnished to the primary cylinder warning is given to the engineer by the puppet-valve discharge and the pressure furnished the secondary cylinders lowered to the desired point.

The advantages of my construction are that I have provided a simple, economical, and efficient multiple engine which is adapted to be economically and easily transformed from a direct into a compound engine, or vice versa. By the use of an expansion-chamber and puppet-valve the maximum efficiency of the engine is obtained with the least amount of pressure. Further, by the use of the valve mechanism above described the rotary valve is operated in a predetermined manner and a cushion furnished the reciprocating piston immediately before it reaches the final limit of either of its motions.

I claim—

1. In a multiple engine, the combination of three oscillating cylinders, one of such cylinders arranged to take fluid-pressure primarily, a pipe for conveying and guiding the fluid-pressure as it is exhausted from the primary cylinder to the ports of the secondary cylinders, an expansion-chamber on such pipe to receive the exhaust of the primary cylinder before it enters the ports of the secondary cylinders, an inlet-pipe connected with such exhaust-pipe and with the port of the primary cylinder for supplying fluid-pressure to the same, and a transforming-valve interposed between the pipe leading to the secondary cylinders, the outlet-pipe and the exhaust of the primary cylinder to open communication between such pipes and between the exhaust of the primary cylinder and the outer air when in one position, and to close communication between such pipes and between the exhaust of the primary cylinder and the outer air and open communication between the exhaust of the primary cylinder and the ports of the secondary cylinders when in its other position, substantially as described.

2. In a multiple engine, the combination of three oscillating cylinders, one of such cylinders arranged to take fluid-pressure primarily, a pipe leading from the exhaust of the primary cylinder to the ports of the secondary cylinders, an inlet-pipe to furnish fluid-pressure to the primary cylinder, an expansion-chamber arranged on the pipe connecting the three cylinders to furnish a chamber for the expansion for the exhaust fluid-pressure as it leaves the primary cylinder and before it reaches the secondary cylinders, and a puppet-valve on such expansion-chamber to regulate any fluid-pressure contained therein, substantially as described.

3. In an engine provided with a reciprocating piston and rotary valve, a bifurcated lever-arm on such rotary valve, provided with two substantially flat portions and a projecting portion, a platen arranged adjacent to such lever-arm and provided with a notch to receive the projection and adapted to hold the valve-lever arm at each limit of its motion and the central portion of its motion, and a spring to normally keep the platen in contact with the valve-lever arm, substantially as described.

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