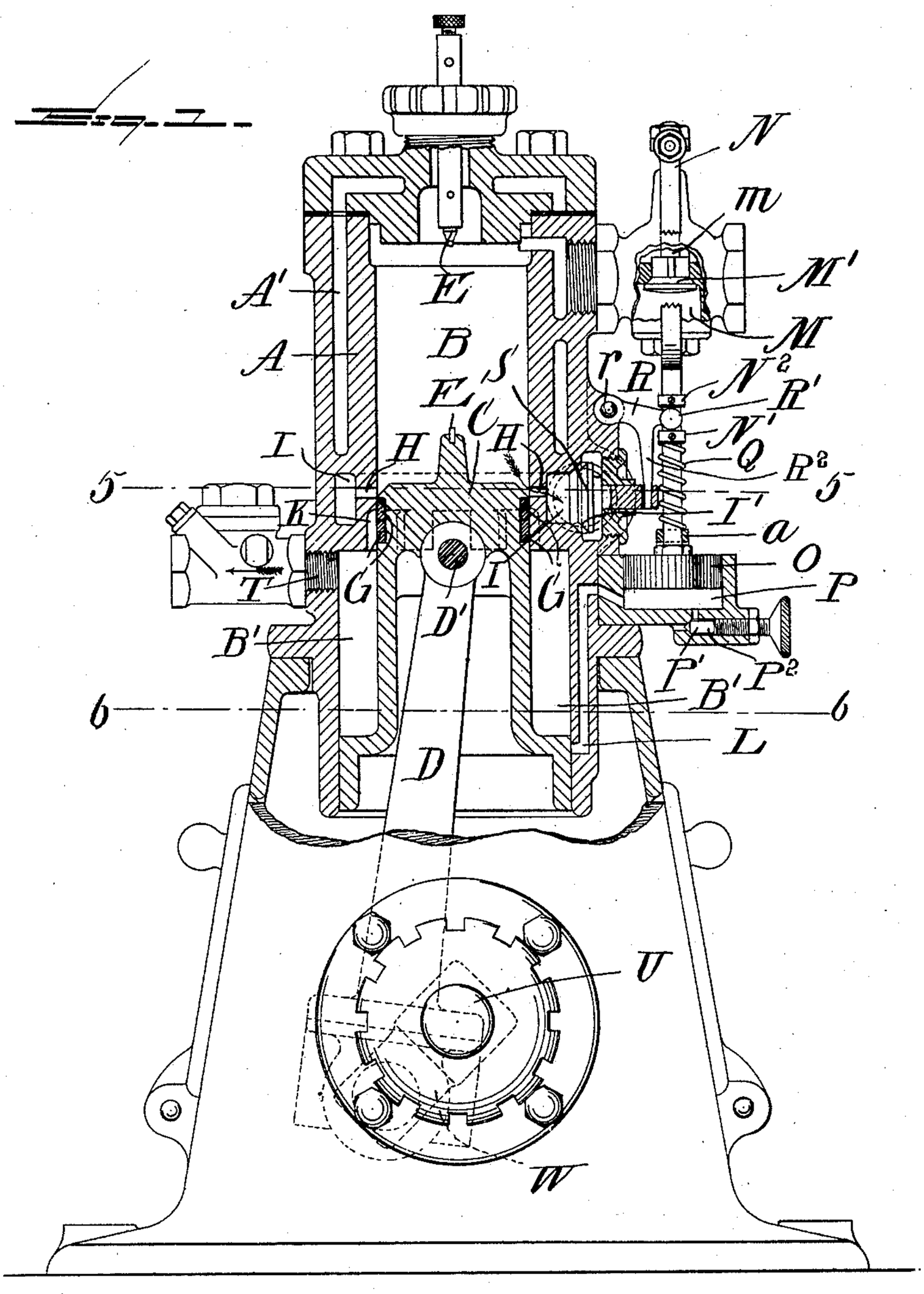
No. 711,235. Patented Oct. 14, 1902.

E. G. SHORTT.

GAS ENGINE.

(Application filed Oct. 5, 1901.)

(No Model.) 6 Sheets—Sheet 1.



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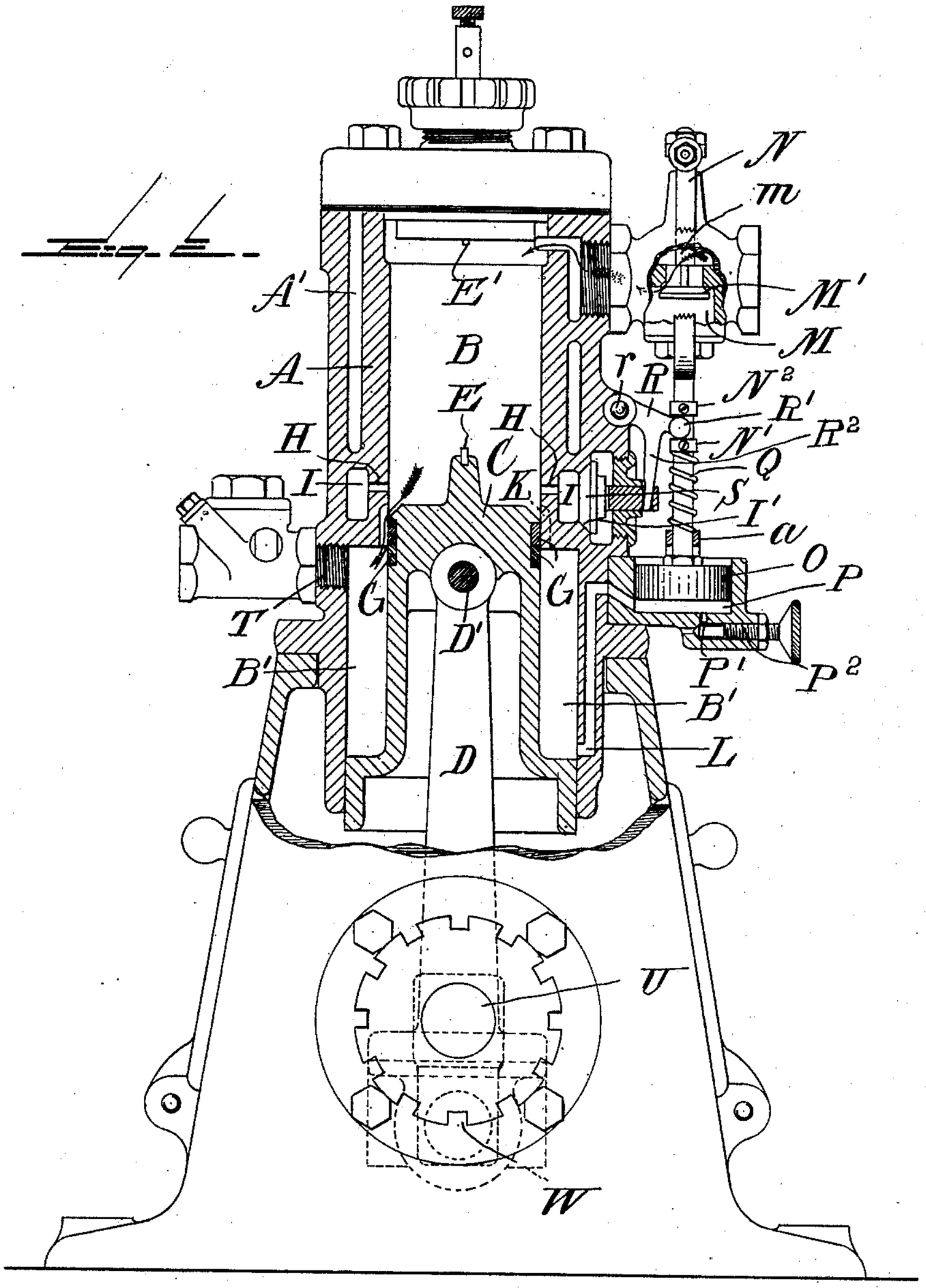
(No Model.) 6 Sheets—Sheet 2.



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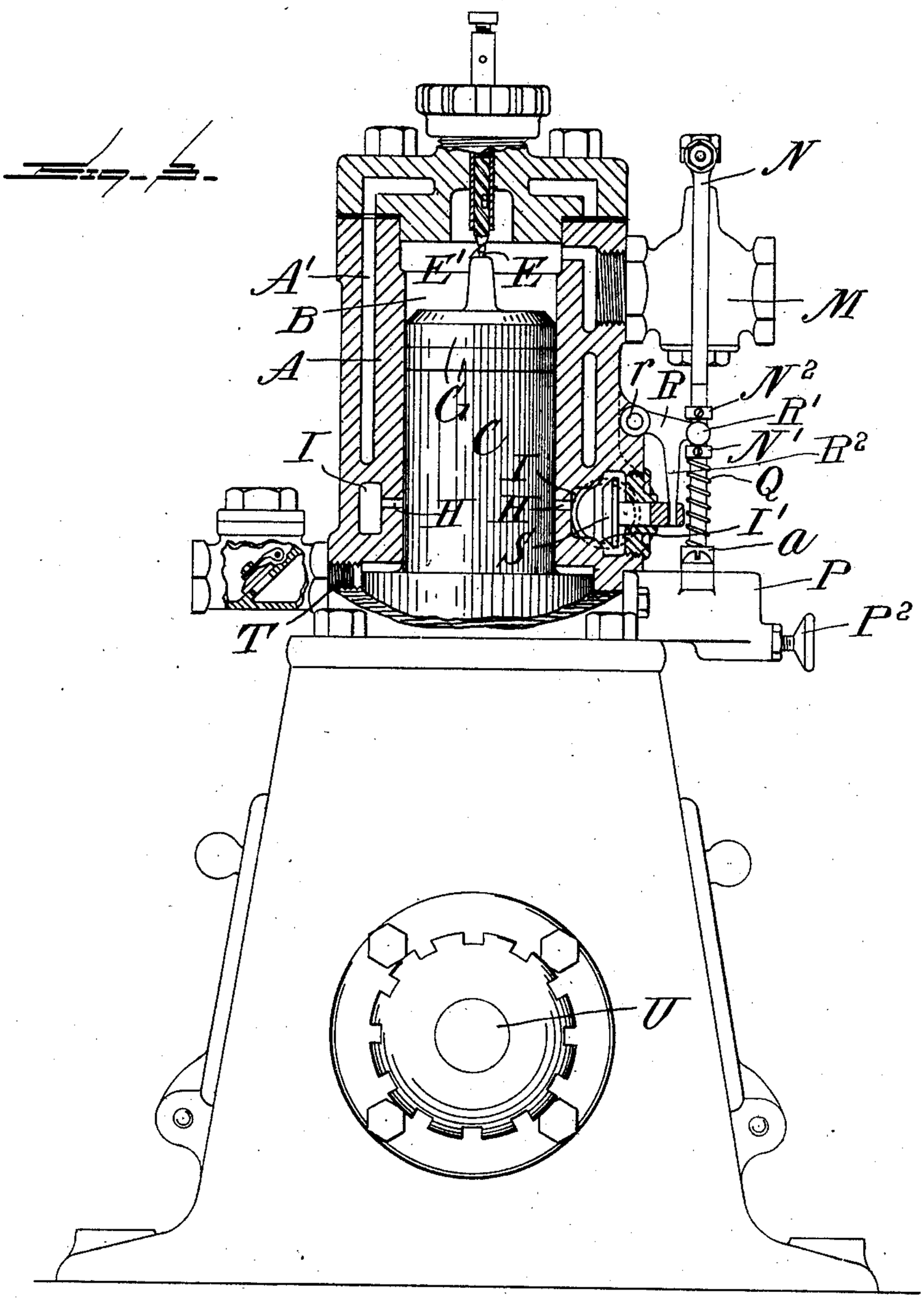
(No Model.) 6 Sheets—Sheet 3.

Fig. 5.



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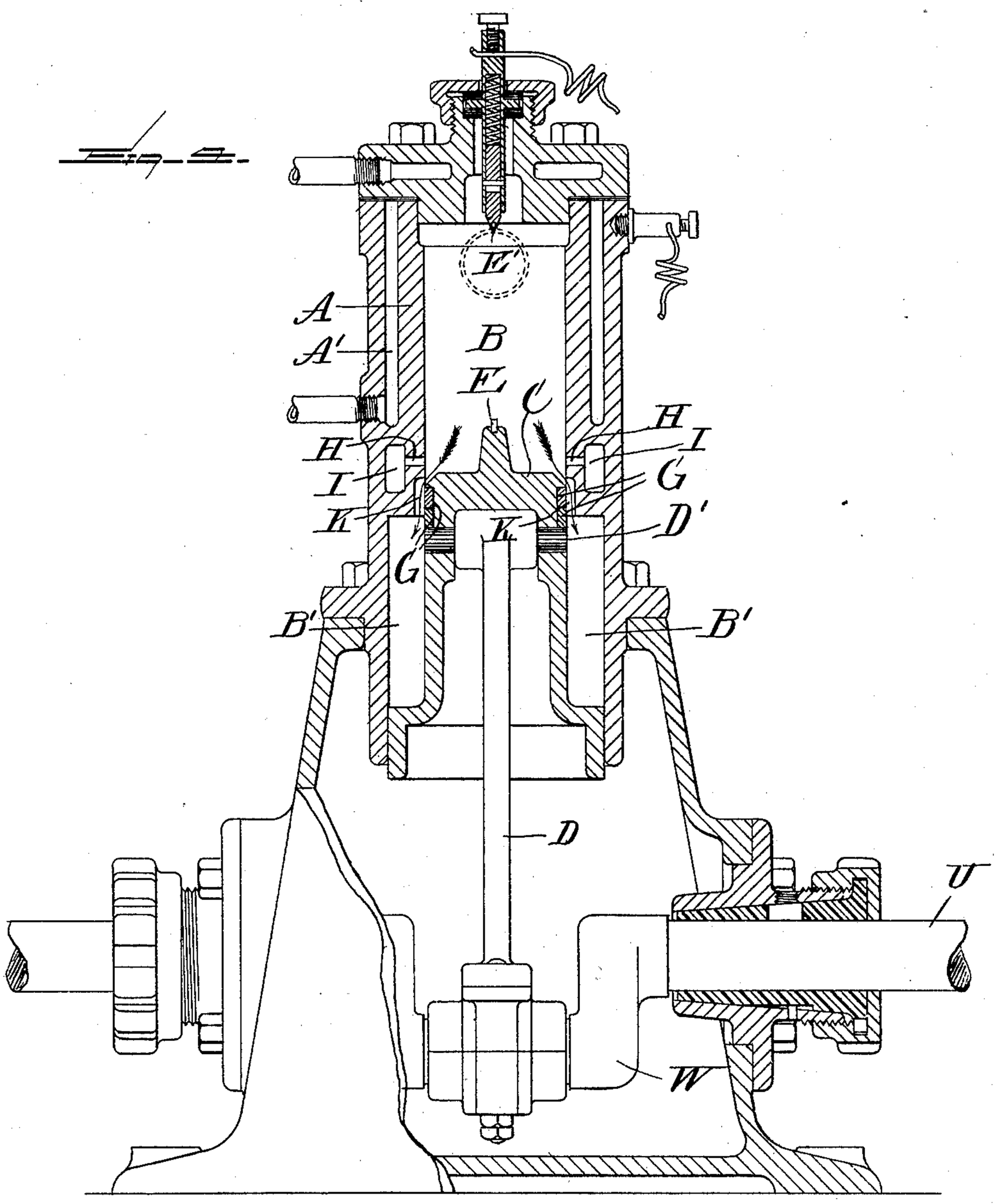
(No Model.) 6 Sheets—Sheet 4.

Fig. 4.



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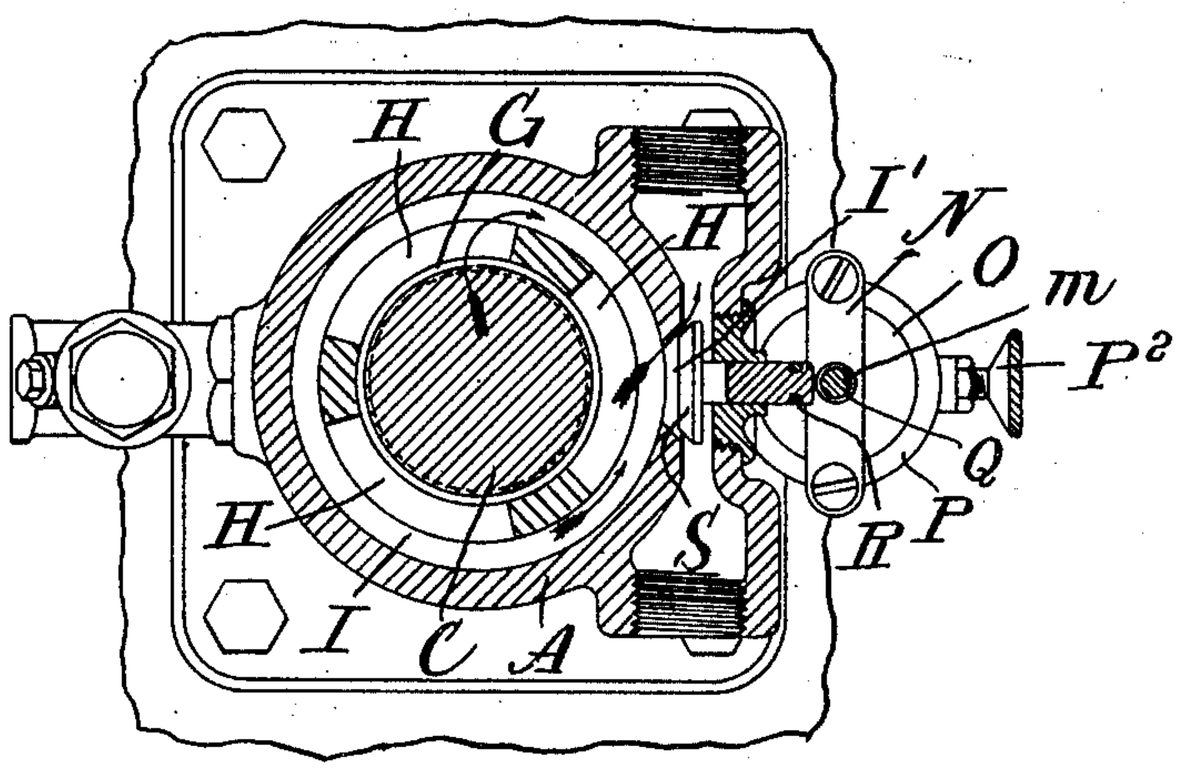
(No Model.) 6 Sheets—Sheet 5.

Fig. 5.



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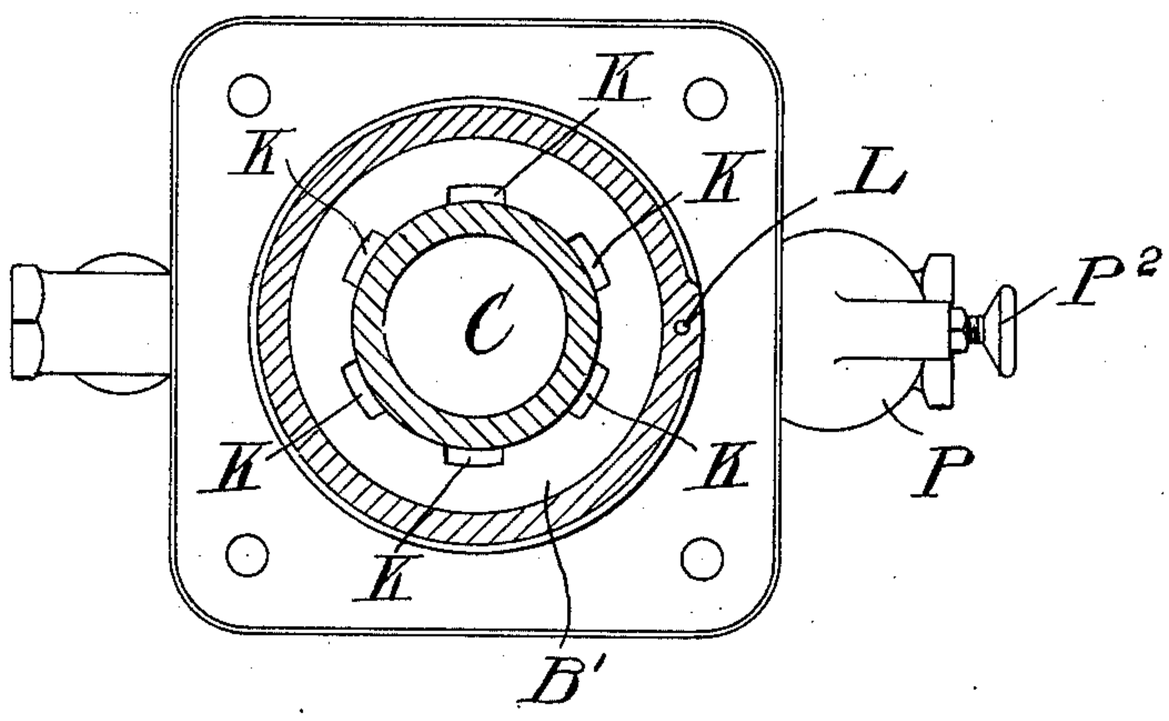
(No Model.) 6 Sheets—Sheet 6.

Fig. 5.



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UNITED STATES PATENT OFFICE.

EDWARD G. SHORTT, OF CARTHAGE, NEW YORK.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 711,235, dated October 14, 1902.

Application filed October 5, 1901. Serial No. 77,706. (No model.)

To all whom it may concern:

Be it known that I, EDWARD G. SHORTT, a citizen of the United States, residing at Carthage, in the county of Jefferson and State of New York, have invented certain new and useful Improvements in Gas-Engines; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, 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 improvements in gas-engines, and the object in view is to produce an explosive-gas engine in which the products of combustion are wholly removed from the combustion-chamber after an explosion, whereby the efficiency of the engine is greatly increased, the removal of the gaseous residue of combustion being effected by means of a vacuum, into which the residue is drawn from the combustion-chamber simultaneously with a secondary exhaust.

Another feature of the invention consists in the provision of means controlled by atmospheric pressure for closing an intercepting-valve in a passage-way communicating with the combustion-chamber while the gaseous residue of combustion is being withdrawn from the latter, said valve being normally in an open relation excepting at the moment of a secondary exhaust, thereby preventing a backflow simultaneously with the formation of a vacuum in the combustion-chamber.

The various details of the invention will be hereinafter more fully described, and specifically defined in the appended claims and clearly illustrated in the accompanying drawings, which, with the letters of reference marked thereon, form a part of this application, and in which drawings—

Figure 1 is a central vertical sectional view through the improved engine, the piston being shown in position to allow for the primary exhaust into the atmosphere, the intercepting-valve being shown as open. Fig. 2 is a central sectional view showing the piston lowered slightly from the position shown in Fig. 1 sufficiently to allow for the secondary exhaust, the intercepting-valve to the primary exhaust being shown as closed. Fig. 3 is a central sectional view through the upper portion of the engine, the piston being shown in elevation and at its highest throw. Fig. 4 is a vertical section of the engine at right angles to the plane of the section shown in Fig. 1. Fig. 5 is a cross-sectional view on line 5 5 of Fig. 1, and Fig. 6 is a cross-sectional view on line 6 6 of Fig. 1.

Reference being had to the details of the drawings by letter, A designates the cylinder of the engine, in which is an annular space A′, forming a water-jacket. Said cylinder has a contracted portion B, forming the combustion-chamber, in which the contracted portion C of the piston works, said piston in the present instance being shown as hollow and having a pitman D pivotally connected thereto by means of pin D′. Rising centrally from the upper end of the piston is a contact-point E, which, coöperating with the contact-point E′ with suitable electrical connections, forms a sparking apparatus for exploding the compressed charges of vaporized gasolene.

Seated in an annular groove in the circumference of the piston near its upper end are packing-rings G G. Leading through the wall of the cylinder near its lower end are ports H H, which communicate with the annular chamber I, into which the primary exhaust passes. Leading from the exhaust-chamber is a port I′, through which the gaseous residue of combustion passes to the atmosphere. In the inner wall of the cylinder and at its lower end is a series of ducts or channels K, through which communication is had between the contracted portion of the cylinder or combustion-chamber and the enlarged portion of the cylinder, forming the vacuum-space B′, when the upper end of the piston passes below the upper ends of said ducts or channels, as shown by the relative positions of the cylinder and piston shown in Fig. 2 of the drawings. The lower end of the piston, which is enlarged to fit the vacuum-space air-tight, serves to close communication between the vacuum-space B′ and the duct L, leading into said vacuum-space, during the primary exhaust through the ports H.

Communicating with the combustion-chamber near its upper end is a valve-cage M, in

which is mounted an intake or induction valve M′ to allow a mixed charge of gasolene and air to enter the combustion-chamber. Said valve M′ has a stem *m*, that is fastened to the yoke N, the shank portion of the latter passing through a guide *a*, which forms an abutment for spring Q, and to the lower end of the stem is fastened the piston or diaphragm, which is adapted to be depressed by atmospheric pressure in the suction-cup P, having communication through the duct L with the vacuum-space. As the piston or diaphragm is connected by said yoke and stem *m* with the induction-valve, it will be observed that the latter will operate positively each time the piston or diaphragm is actuated.

A duct P′, which is relatively of smaller diameter than duct L, leads into the cup P from the atmosphere, and a valve P^2 regulates the flow of air through said duct P′, accordingly as it may be desired to cause the vacuum-space to draw a greater or less volume of gas into the combustion-chamber. For instance, if it should be desired to feed a large charge of gas the valve P^2 would be closed, thus allowing the vacuum-space to draw to its fullest capacity from the mixing-chamber (not shown) into the combustion-chamber. If it should be desired to feed a lesser quantity of gas, said valve P^2 would be partially opened, thereby reducing the vacuum. If preferred, the duct P′ may be made to communicate direct with the vacuum-space through the wall of the cylinder, and the valve P^2, which is shown as adapted to be operated as a thumb-screw, may be actuated by any automatic means, as by a governor mechanism. Said piston O is held at its highest limit by means of a spring Q, which surrounds the shank portion of the yoke N and bears between the abutment *a* and a collar N′. A second collar N^2 is also provided, which is fastened to the shank portion of said yoke, and between the two collars N′ and N^2 is disposed the end of an arm R′ of the angle-lever R, said lever being pivoted at *r* to the cylinder. A second arm R^2 of said lever engages the stem of the intercepting-valve S. Said valve S is designed to seat over the port I′ only during a secondary exhaust and is held normally from seating by means of the spring Q for the purpose of allowing the bulk of the gaseous residue of combustion to exhaust to the atmosphere.

Leading away from the vacuum-space at its highest portion is an exhaust-port T, provided with a suitable outlet-valve through which the residue passes from the vacuum-space. The pitman D is connected to the crank W on the driving-shaft U, and by reason of the piston being hollow said pitman has ample room to work laterally without interference with the wall of the piston.

In operation a charge of vaporized gasolene having been drawn into the combustion-chamber, by rotating the operating-shaft and causing the piston to be driven to its outer limit the charge is compressed by the return throw of the piston and ignited by the sparking apparatus. The force of the explosion after driving the piston beyond the ports H will allow the gaseous products of combustion to pass through the primary exhaust-chamber and into the outside atmosphere. As the piston is driven outward by the explosion a vacuum is formed in the space B′, and the moment the upper portion of the piston traverses the upper ends of the ducts or channels K to allow of communication between the combustion-chamber and the vacuum-space the lower enlarged end on the piston will have passed the outlet end of the duct L, leading into the vacuum-space, thus allowing the vacuum to draw through the duct L, which will cause the atmosphere to depress the piston or diaphragm O in the suction-cup P, and through the connections of the shank portion of the yoke and angle-lever with the intercepting-valve the latter will be seated and any possible backflow prevented simultaneously with the withdrawal of the remaining residue of gaseous products of combustion from the combustion-chamber into the vacuum-space. As the gaseous residue after the explosion which remains in the combustion-chamber after the primary exhaust into the atmosphere is heavier than the atmosphere, being largely carbonic-acid gas, it will naturally settle to the lower portion of the combustion-chamber. Simultaneously with the closing of the intercepting-valve S the intake or induction valve M′ is opened, allowing the mixed gasolene and air to enter the combustion-chamber for the new charge, the latter being drawn into the combustion-chamber by the vacuum which is formed therein by the withdrawal of the remaining gaseous residue of combustion, which passes through the secondary exhaust into the vacuum-space and expelled therefrom through the duct T on the return throw of the piston C. The moment the pressure on the opposite sides of the piston C, controlling the intercepting-valve S, is equalized, which will be at the moment the remaining gaseous residue has been withdrawn from the combustion-chamber, the spring Q will return the piston or diaphragm O to its normal position and will open the valve S in readiness to allow for a primary exhaust to the atmosphere after the piston has been driven outward by the next explosion.

From the foregoing when taken in connection with the drawings it will be observed that the various parts are so arranged and operated at such predetermined moments that at the time of communication being had between the combustion-chamber and the vacuum-space the intercepting-valve will be seated as the secondary exhaust commences, thus preventing any backflow of the primary exhaust, and will be opened simultaneously with the commencing of the return stroke of

the piston and the closing of the intake or induction valve.

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

1. A gas-engine having a combustion-chamber having a primary exhaust to the atmosphere, a vacuum-space with secondary exhaust thereto from the combustion-chamber, an intercepting-valve controlling the primary-exhaust passage-way, and variable pneumatic means for seating said valve during a secondary exhaust, as set forth.

2. A gas-engine having a combustion-chamber with a primary exhaust to the atmosphere, a vacuum-space with secondary exhaust thereto from the combustion-chamber, an intercepting-valve controlling the primary-exhaust passage-way, an intake-valve, and variable pneumatic means for alternately seating and unseating said valves, as set forth.

3. A gas-engine having a combustion-chamber with a primary exhaust to the atmosphere, a vacuum-space with secondary exhaust thereto from the combustion-chamber, valves, actuated simultaneously by variable pneumatic means, for controlling the intake and primary exhaust.

4. A gas-engine having a combustion-chamber with primary exhaust to the atmosphere, an intercepting-valve for preventing a backflow of the primary exhaust, a power-piston in said chamber, a vacuum-space, secondary-exhaust passage-ways communicating between said chamber and the vacuum-space during a division of the cycle of said piston, and means actuated by variable atmospheric pressure for closing said intercepting-valve, as set forth.

5. A gas-engine having a combustion-chamber with a primary exhaust to the atmosphere, an intercepting-valve for preventing backflow of the primary exhaust, a vacuum-space, secondary-exhaust passage-ways communicating with said chamber and vacuum-space during a division of the cycle of the piston, a suction-cup communicating with the vacuum-space, a piston working therein actuated by atmospheric pressure, a stem on said piston, an intake-valve with stem thereto, connections between said piston and valve stems, a pivoted angle-lever actuated by said piston-stem and designed to seat said intercepting-valve during a secondary exhaust to the atmosphere, as set forth.

6. A gas-engine having a combustion-chamber with a primary-exhaust passage-way to the atmosphere, an intercepting-valve for preventing a backflow of the primary exhaust, a vacuum-space, secondary-exhaust passage-ways communicating between said chamber and vacuum-space during a division of the cycle of the piston, a suction-cup communicating with the vacuum-space, a piston working therein actuated by atmospheric pressure, a stem to said piston, an intake-valve with stem thereto, connections between said piston and valve stems, a pivoted angle-lever, collars on said piston-stem between which an arm of said angle-lever is oscillated to seat said intercepting-valve during a secondary exhaust to the atmosphere, as set forth.

7. In a gas-engine, a combustion-chamber with primary exhaust to the atmosphere, a power-piston in said chamber, an intercepting-valve for controlling a backflow of the primary exhaust, an intake-valve, a vacuum-space, secondary-exhaust passage-ways communicating between said chamber and vacuum-space during a division of the cycle of the piston, a suction-cup with duct communicating between same and said vacuum-space, a piston working in said cup and having a stem adapted to actuate the intake-valve, and seat the intercepting-valve, and means for regulating the quantity of fuel being fed to the combustion-chamber, as set forth.

8. In a gas-engine, a combustion-chamber with primary exhaust to the atmosphere, a power-piston in said chamber, an intercepting-valve for preventing a backflow of the primary exhaust, an intake-valve, a vacuum-space, secondary-exhaust passage-ways communicating between said chamber and vacuum-space during a division of the cycle of the piston, a suction-cup with duct communicating between same and said vacuum-space, a piston working in said cup and having a stem adapted to actuate the intake-valve, and seat the intercepting-valve, and pneumatic means for regulating the quantity of fuel being fed to the combustion-chamber, as set forth.

9. A gas-engine having a combustion-chamber with primary-exhaust passage-way to the atmosphere, a power-piston in said chamber, an intercepting-valve adapted to prevent a backflow of the primary exhaust, a vacuum-space, secondary-exhaust passage-ways communicating between said chamber and vacuum-space at one division of the cycle, a suction-cup, a duct leading from the latter to said vacuum-space, a piston working in said cup and actuated by atmospheric pressure, connections between said valves and piston for automatically seating the valve during the secondary exhaust, as set forth.

10. A gas-engine having a combustion-chamber with a primary-exhaust passage-way to the atmosphere, a power-piston in said chamber, an intercepting-valve for preventing a backflow of the primary exhaust, a vacuum-space, secondary-exhaust passage-ways communicating between said chamber and vacuum-space during a division of the cycle of the piston, a suction-cup and piston or diaphragm working therein and actuated by atmospheric pressure, a duct communicating between said cup and vacuum-space, an angle-lever engaging said intercepting-valve and actuated by the stem of the piston in said cup, as set forth.

11. A gas-engine having a combustion-

chamber with an intake passage-way leading therein, a power-piston in said chamber, a valve located in said passage-way, a suction-cup, a piston or diaphragm adapted to be depressed therein by atmospheric pressure, a spring for returning the piston to its normal position, connections between said valve and piston, a primary-exhaust passage-way, an intercepting-valve in said primary-exhaust passage-way, a pivoted angle-lever engaging said intercepting-valve and actuated by the piston-stem, a vacuum-space and secondary-exhaust passage-ways leading thereto from the combustion-chamber, and a duct communicating between said cup and vacuum-space during a secondary exhaust, as set forth.

12. A gas-engine having a combustion-chamber, a power-piston working therein, said chamber having a primary exhaust to the atmosphere, an intercepting-valve adapted to prevent a backflow of the primary exhaust, a vacuum-space, secondary-exhaust passage-ways communicating between said chamber and vacuum-space at one division of the cycle of the piston, a suction-cup, a piston working therein and actuated by atmospheric pressure, connections between said valve and piston for automatically seating the valve during a secondary exhaust, a duct leading from said suction-cup and designed as the power-piston is reciprocated, to alternately communicate between the vacuum-space and the atmosphere, as set forth.

13. In a gas-engine, a combustion-chamber with primary exhaust to the atmosphere, a power-piston in said chamber, an intercepting-valve for preventing a backflow of the primary exhaust, an intake-valve, a vacuum-space, secondary-exhaust passage-ways communicating between said chamber and vacuum-space during a division of the cycle of the piston, a suction-cup with duct communicating between same and said vacuum-space, a piston working in said cup and having a stem adapted to actuate the intake-valve, and said intercepting-valve, a port leading from said cup to the atmosphere, and a valve regulating the inflow of air through said port into the cup whereby the length of time the intake-valve is held open may be determined, as set forth.

In testimony whereof I hereunto affix my signature in presence of two witnesses.

EDWARD G. SHORTT.

Witnesses:
CHAS. E. NORRIS,
JOHN UNSER.