No. 808,210. PATENTED DEC. 26, 1905.

E. S. PALMBLA.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED DEC. 14, 1904.

4 SHEETS—SHEET 1.

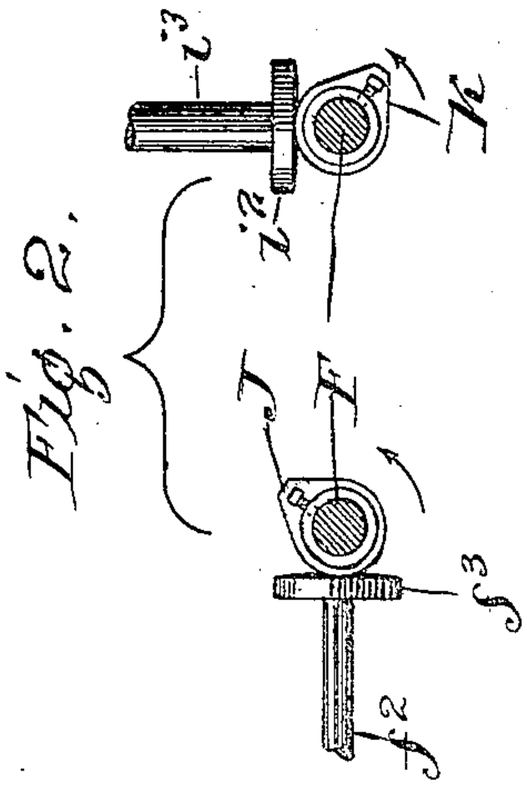

Fig. 2.

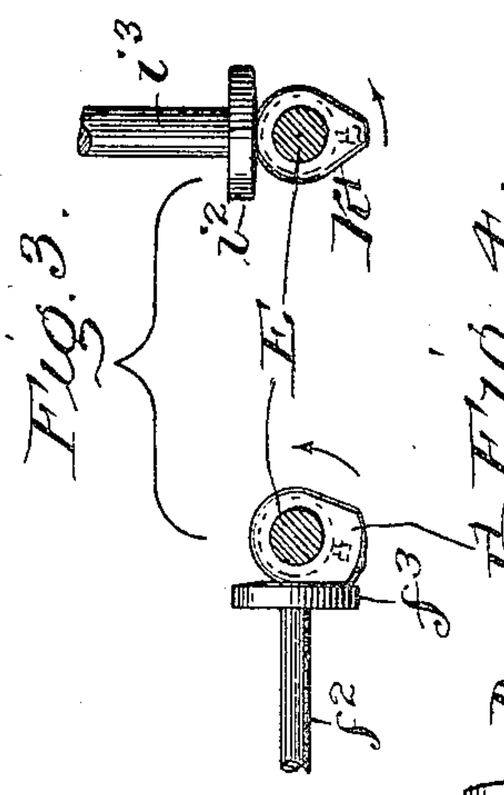

Fig. 3.

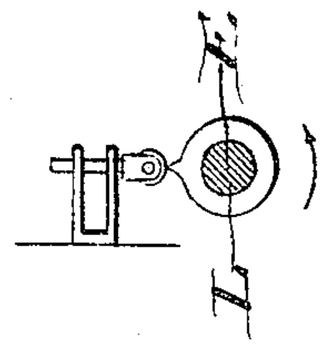

Fig. 4.

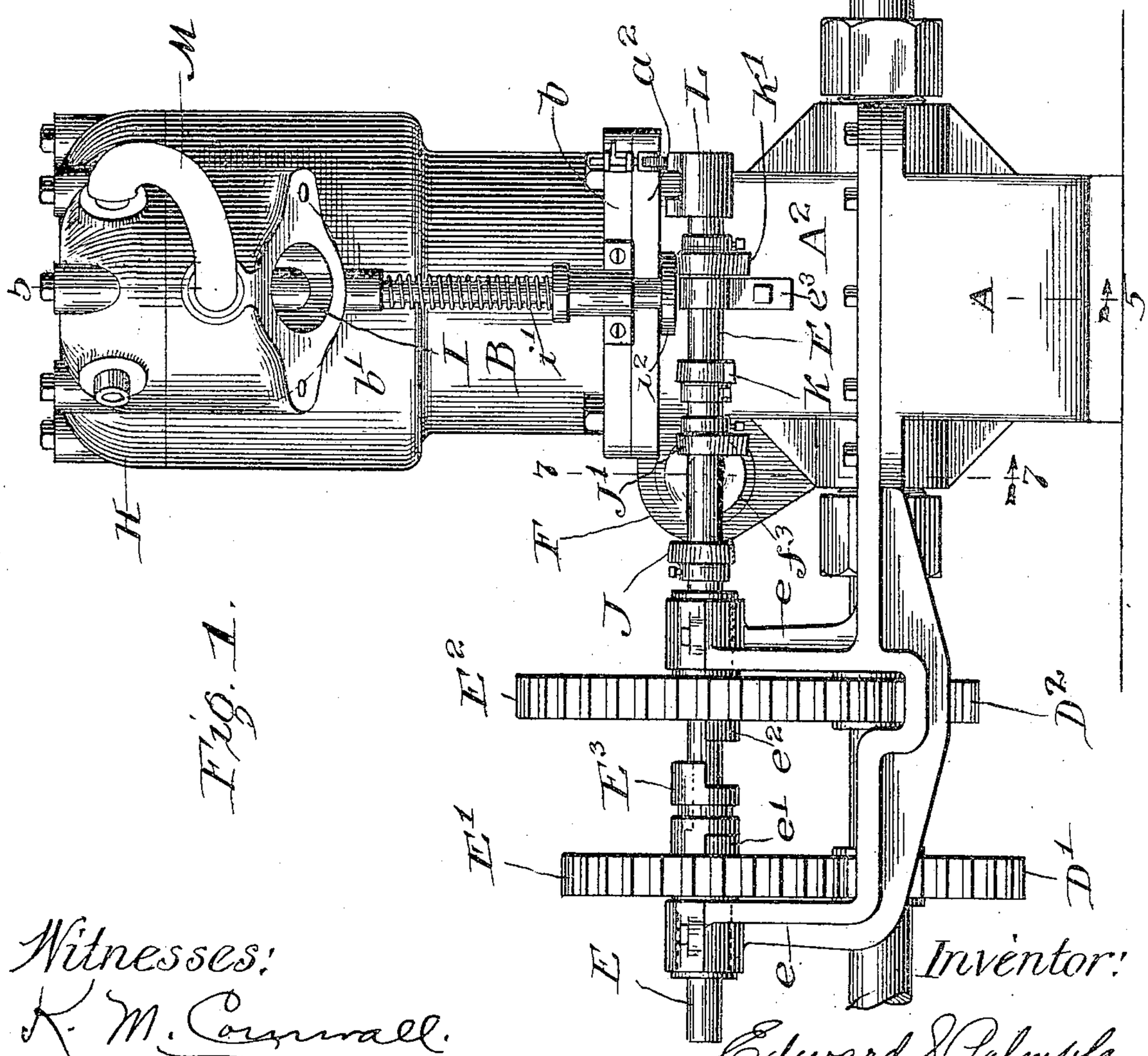

Fig. 1.

Witnesses:
K. M. Cornwall.
J. E. Shervey.

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4 SHEETS—SHEET 2.

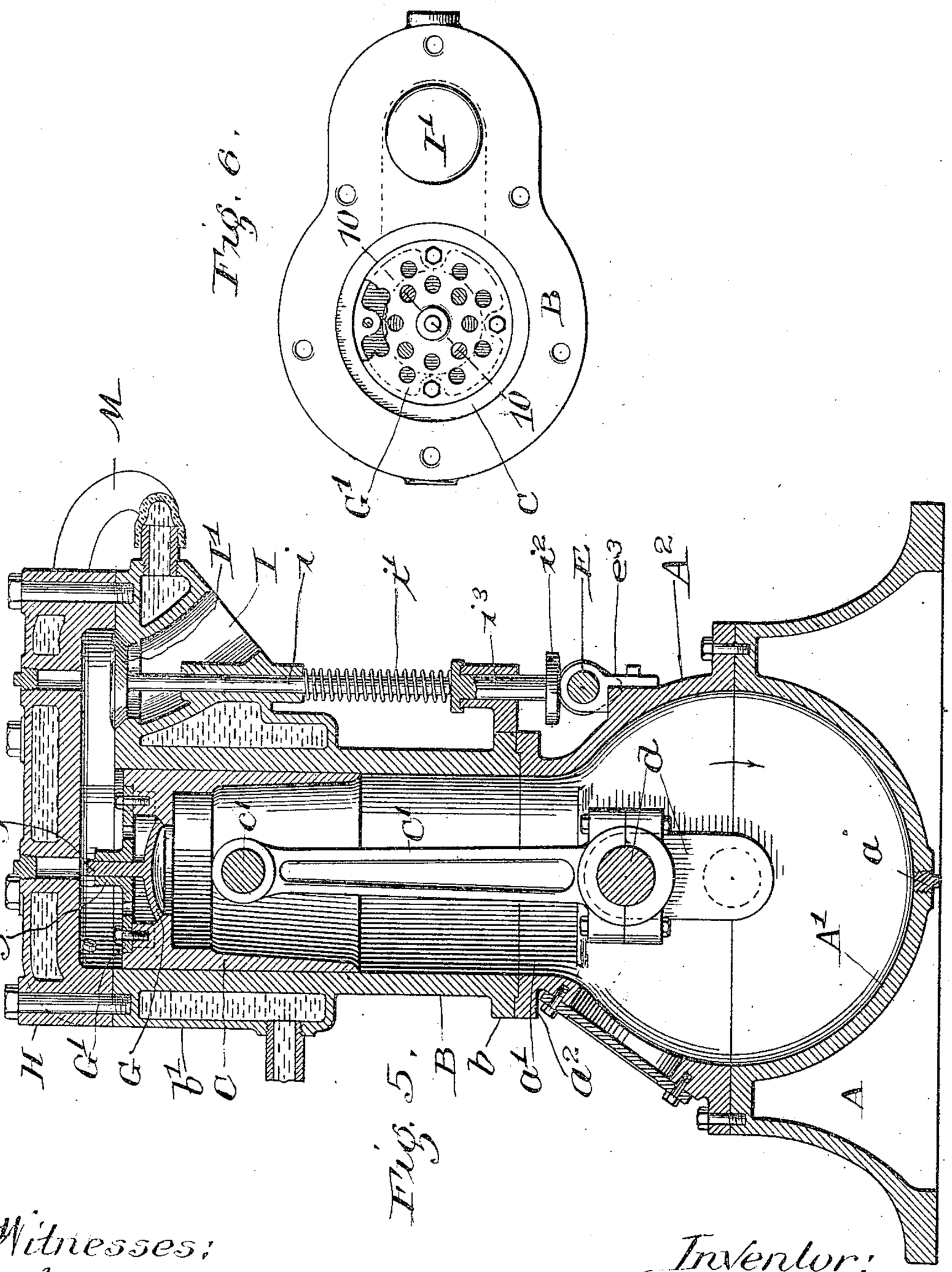

Fig. 5.

Fig. 6.

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4 SHEETS—SHEET 3.

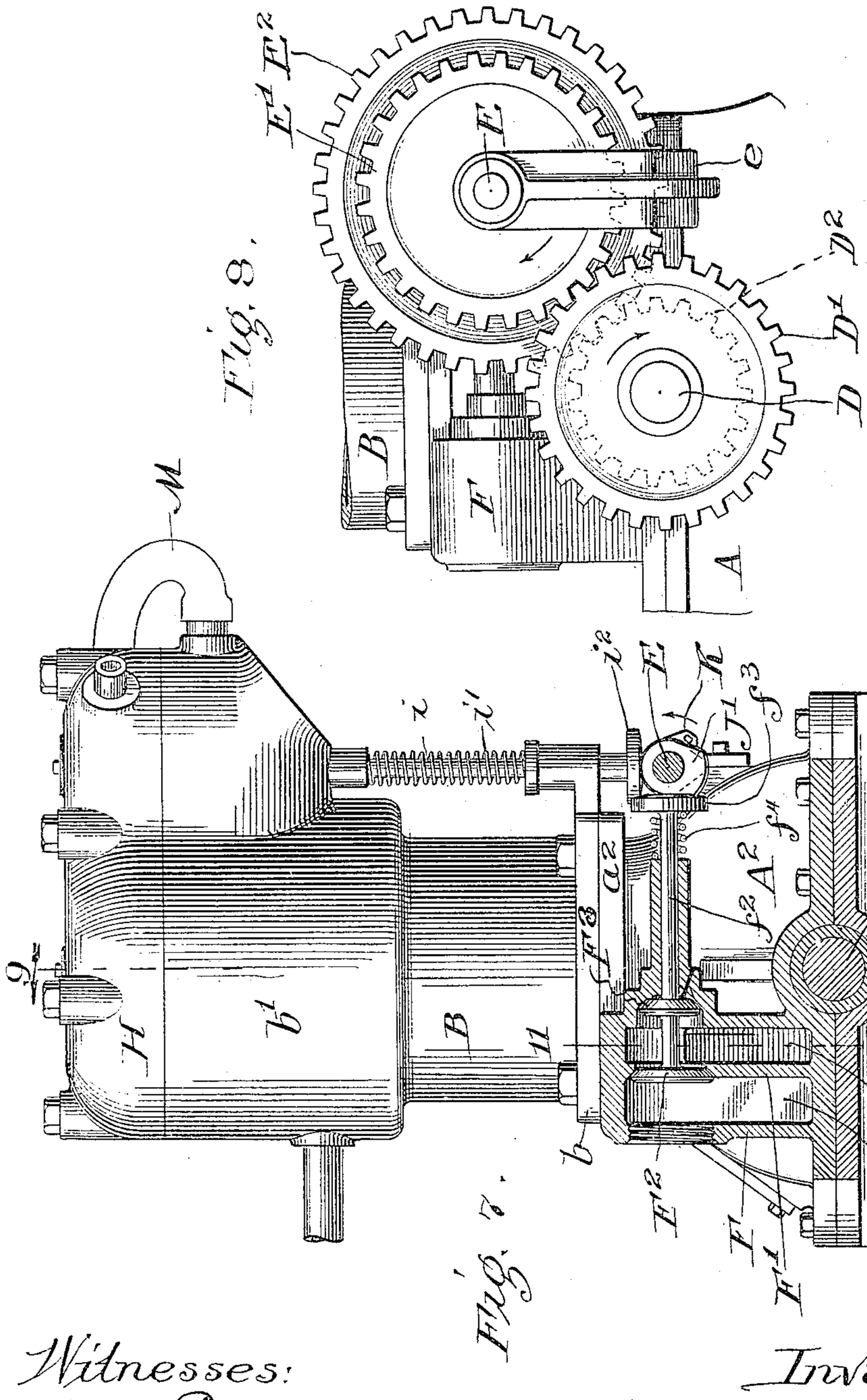

Fig. 8.

Fig. 7.

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4 SHEETS—SHEET 4.

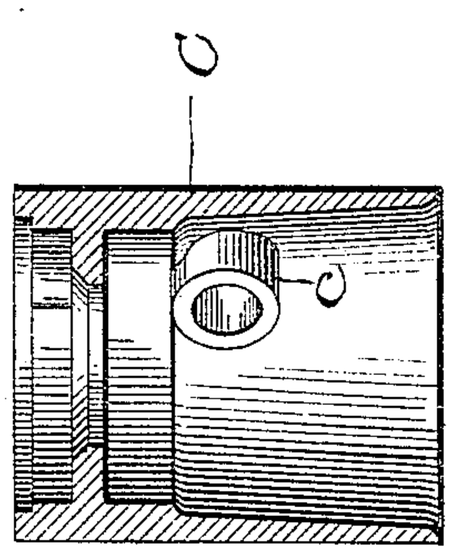

Fig. 10.

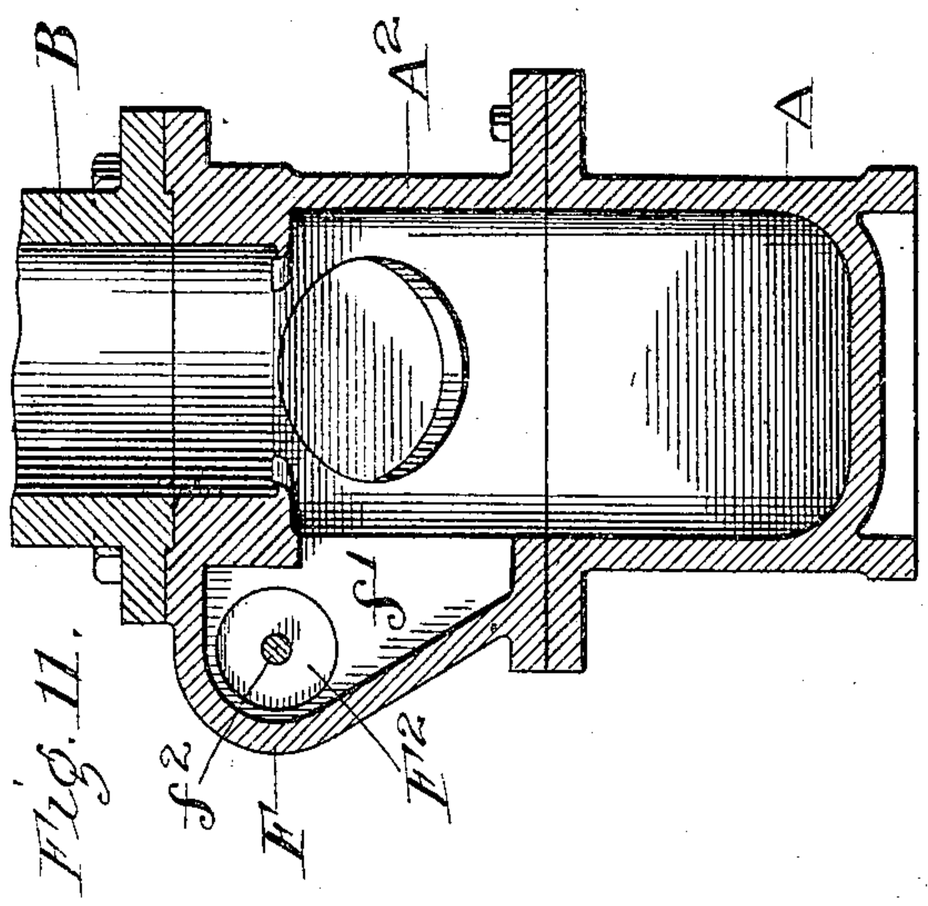

Fig. 11.

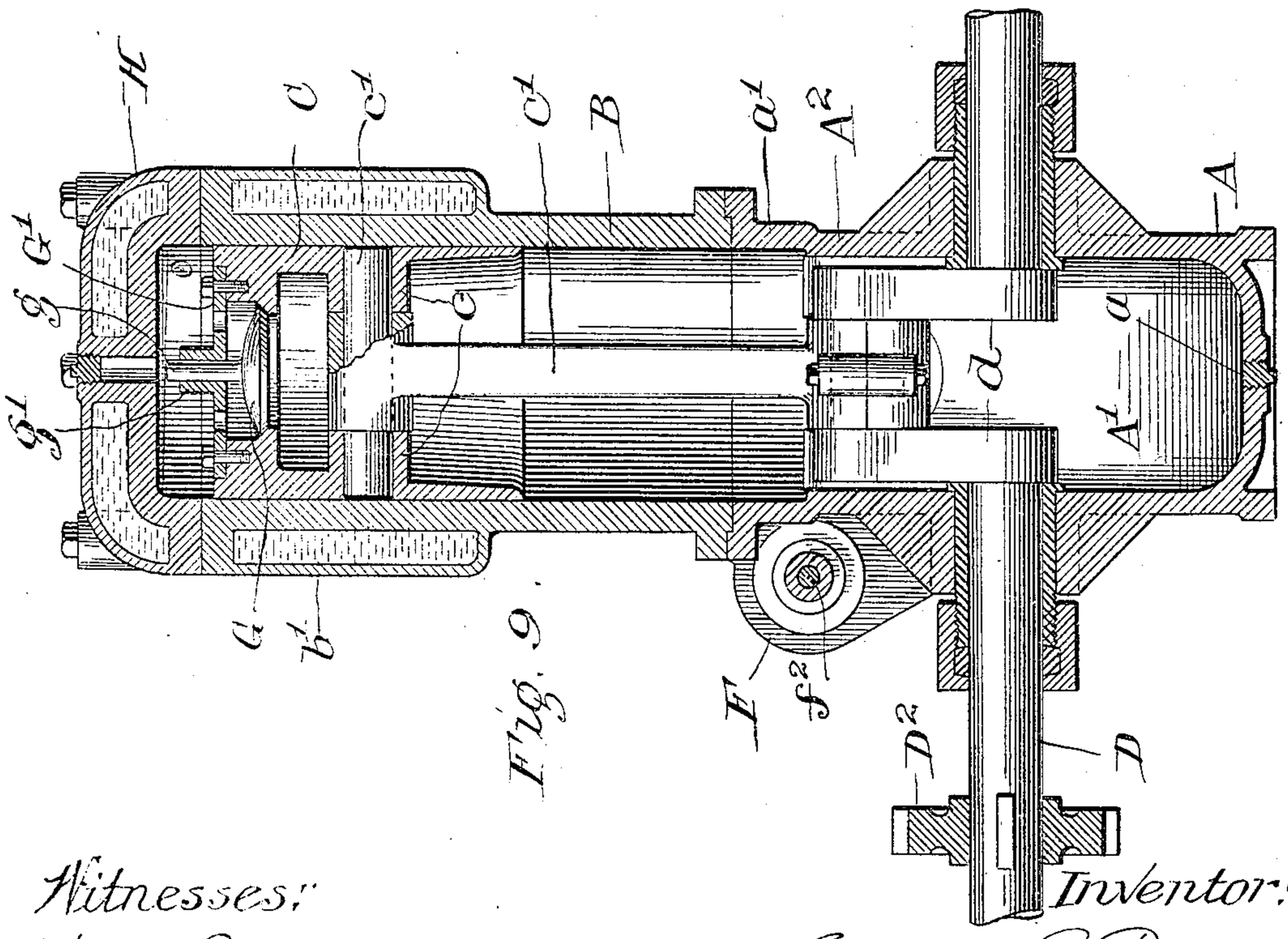

Fig. 9.

Witnesses:
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UNITED STATES PATENT OFFICE.

EDWARD S. PALMBLA, OF WAUKEGAN, ILLINOIS.

INTERNAL-COMBUSTION ENGINE.

No. 808,210. Specification of Letters Patent. Patented Dec. 26, 1905.

Application filed December 14, 1904. Serial No. 236,784.

To all whom it may concern:

Be it known that I, EDWARD S. PALMBLA, a citizen of the United States of America, residing at Waukegan, in the county of Lake and State of Illinois, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

My invention relates to certain new and useful improvements in internal-combustion engines; and its object is to produce a device of this class which shall have certain advantages which will appear more fully and at large in the course of this specification.

To this end my invention consists in certain novel features which are shown in the accompanying drawings as embodied in my preferred form of construction.

In the aforesaid drawings, Figure 1 is an elevation of my improved engine. Fig. 2 is an illustrative view of the four-cycle cams, showing their relative positions when the piston is at the top of its stroke and at the point of ignition. Fig. 3 is a similar view of the two-cycle cams at the moment of explosion. Fig. 4 is a similar view of the igniter-cam at the moment of explosion. Fig. 5 is a vertical transverse section in the line 5 5 of Fig. 1. Fig. 6 is a plan view of the cylinder with the cylinder-head removed. Fig. 7 is a section in the line 7 7 of Fig. 1, looking in the direction of the arrow. Fig. 8 is an end view of the lower part of the machine, looking from the left-hand end of Fig. 1. Fig. 9 is a section in the line 9 9 of Fig. 7, looking in the direction of the arrow. Fig. 10 is a longitudinal section through the piston in the line 10 10 of Fig. 6, and Fig. 11 is a longitudinal vertical section in the line 11 11 of Fig. 7.

Referring to the drawings, A is the base of my improved device, the same being cast with a semicylindrical recess A′, adapted to form half of the crank-case. This recess A′ is provided at its bottom with a plug *a*, by which the contents of the crank-case may be removed. To the base A is bolted an upper crank-case section A^2, which is semicylindrical in form and has at its upper end a cylindrical neck *a′*, having a laterally-projecting flange a^2, to which is secured a cylinder B, having a laterally-projecting flange *b* at its lower end. The cylinder B is provided with a water-jacket *b′*, of the ordinary type, within which is reciprocable hollow piston C. This piston C has inwardly-projecting bosses *c*, through which extends a pin *c′*, to which is pivotally secured a pitman C′, the lower end of which engages a crank *d* on a main shaft D, extending longitudinally through the journal-box in the crank-case.

Upon the shaft D are rigidly secured two pinions D′ D^2, which are in mesh with the pinions E′ E^2, respectively, running loose on a counter-shaft E, parallel with the shaft D. The counter-shaft E is mounted in brackets *e* e^3, and the pinions E′ E^2 are provided with bosses which extend through the journal-boxes on the bracket *e* and are each provided with a head on the opposite sides of said journal-boxes, whereby the pinions are prevented from longitudinal movement. Rigidly secured to the shaft E is a grooved clutch member E^3, having a single clutch-tooth on each side adapted to engage similar teeth *e′* e^2 on the adjacent faces of the pinions E′ E^2, respectively. It will be obvious that when the shaft D is rotated the pinions D′ D^2 will be rotated and that the shaft E can be driven through the medium of either of said pinions E′ E^2, depending upon which of said pinions is engaged by the clutch member E^3. The pinions D′ E′ are the same size, and the pinion D^2 is provided with half as many teeth as the pinion E^2, so that the shifting of the shaft E longitudinally will throw the clutch member into engagement with either of said pinions E′ E^2, and the counter-shaft can be made to rotate at or half the speed of the main shaft D.

The upper crank-case section A^2 is provided with a longitudinal extension F, Figs. 7, 8, and 11, divided by a vertical partition F′ into two spaces *f f′*. The space *f* is provided with a screw-threaded opening through which an inlet-pipe for gas can be attached, and the space *f′* opens into the crank-case, serving as an inlet-port. An inlet-valve F^2 on a valve-stem f^2 closes a perforation in the partition F′ and seats on the outside of the same, and a similar valve F^3, mounted on the same valve-stem, seats against an opening in the outer wall of the port *f′*, thereby forming a balanced inlet-valve, which has but little tendency to open when pressure reaches it from the inside of the crank-case. The valve-stem f^2 is provided with a beveled disk-shaped head f^3, against which a spring f^4 bears, the said spring holding the valve normally closed.

The piston C is formed with an opening in its head, and a check-valve G seats on the upper side of said opening and is held in place upon its seat by its stem g, which is guided in a boss g', formed on a perforated plate G', which is secured to the top of the piston.

H indicates the cylinder-head, the same being water-jacketed, as illustrated. The cylinder-head, it will be seen, incloses the entire upper end of the cylinder and directs all vapor contained therein to an exhaust-port I, closed by a valve I' on a valve-stem i. The said valve-stem is guided in a sleeve on the cylinder and is normally held down by a spring i'. The lower end of the valve-stem i^3 is separated from the upper part and is guided in a bracket supported by the cylinder. A beveled disk-shaped head i^2, like the head f^3, above referred to, is provided upon the lower end of the stem i^3.

This completes the description of so much of the machine as is necessary to give a general idea of its operation, and the construction of the operating-cams will be best understood if the cycles of operation of the engine are first made clear. My improved engine is designed to be used interchangeably as a two-cycle and four-cycle engine. As shown in the drawings, the cam-shaft is set for a two-cycle mode of operation.

When the engine is run as a two-cycle engine, the operation is as follows, starting with the piston at the upper end of its stroke and at the moment of explosion, which of course takes place once every revolution: At this time the crank-case is full of the explosive mixture and the inlet and outlet valves are both closed and remain closed until the crank reaches a point about fifteen or twenty degrees from the dead-center in its downstroke, and the gas in the crank-case is thus compressed. The exhaust-port is then opened to permit of the escape of the burned charge, and the compressed gas in the crank-case raises the piston check-valve and forces out the burned gas. The exhaust-port is closed when the crank reaches a point about fifteen degrees past the center, thus preventing escape of the fresh mixture, and the inlet-valve to the crank-case is opened as the exhaust-valve closes. During the remainder of the rise of the piston the gas in the cylinder is compressed and the crank-case is filled with fresh gas. When running as a four-cycle engine, the operation is as follows, starting with the piston up after the exhaust-stroke and the crank-case full of gas: At this time both the inlet and exhaust valves are closed, and as the piston comes down the piston check-valve opens and the gas in the crank-case passes up into the space above the piston. The piston then moves up, compressing the gas in the upper part of the cylinder and rarefying that in the crank-case. The gas is exploded in the ordinary way at or near the time when the piston reaches the upper part of its stroke and the piston moves down under the force of the explosion, the gas in the crank-case returning to its original pressure. Very little loss of energy is attended by the rarefaction of the gas in the crank-case, because the same is returned immediately to its original pressure, and whatever energy may be absorbed by the rarefying gas is returned by the suction which it exerts upon the piston during the explosion-stroke. Approximately at the end of the explosion-stroke the inlet and outlet valves are both opened and the crank-case is sucked full of fresh gases, and at the return of the piston the burned gases are expelled through the exhaust-port. These various movements of the valves are accomplished by the use of two sets of cams on the counter-shaft E and by running said counter-shaft at the same speed as the main shaft for the two-cycle engine and half the speed thereof for the four-cycle.

J J' are the inlet-valve cams for the four and two cycle operations, respectively, and K K' are the exhaust-valve cams for the same operations, respectively.

It will be seen that when the counter-shaft E is moved to the left, as seen in Fig. 1, it is driven through the pinions D' E' at the same speed with the main shaft D and that the cams J' K' are in position to engage with the disk-shaped heads of the valve-stems of the inlet and exhaust valves. These cams are shaped as illustrated in Fig. 3 and operate the valves as set forth above for the two-cycle operation. If now the shaft be shifted to the right, as seen in Fig. 1, its speed will be reduced to one-half the speed of the crank-shaft, and the cams J K will be brought into engagement with the corresponding valve-stems, when the four-cycle operation will commence.

L indicates a cam-block which operates the igniter. No special description of this igniter will be necessary, as the igniting portions of my improved device embody no novel features.

It is to be noted that the valve-cams engage the heads of the valve-stems near their peripheries, so that as the cam is operated the valve-stems and valves are slowly rotated, whereby they are evenly worn and to a certain extent self-ground. The disks are made slightly beveled, so that the cams will slip over them readily when the shaft is moved. It is also to be noted that the water-jacket of the cylinder-head and of the cylinder itself are made entirely separate and connected by a hose M, so that the cylinder-head can be removed without in any way interfering with the water in the cylinder itself.

I realize that considerable variation is possible in the details of this construction without departing from the spirit of my invention, and I do not intend to limit myself to the specific form herein shown and described.

I claim as new and desire to secure by Letters Patent—

1. In a device of the class described, the combination with a cylinder of an engine having an inclosed crank-case, of a piston movable in the cylinder and opening between the cylinder-head and crank-case, a check-valve closing said opening, an exhaust-port opening from the cylinder-head and an inlet-port opening into the crank-case, valves controlling said ports and means for operating said valves to produce two-cycle and four-cycle movements of the piston.

2. In a device of the class described, the combination with a cylinder having an inclosed crank-case and a piston movable in the cylinder, of a check-valve controlling an opening through the piston, exhaust and inlet ports opening respectively into the cylinder-head and crank-case, valves controlling said ports and means for operating said valves to produce two-cycle and four-cycle movements of the piston.

3. In a device of the class described, the combination with a cylinder having an inclosed crank-case, a piston movable in the cylinder and a valve-controlled opening between the crank-case and cylinder-head, of exhaust and inlet ports opening respectively into the cylinder-head and crank-case, valves controlling said ports, a main shaft driven by the piston, a counter-shaft driven by said main shaft, two sets of cams on said counter-shaft adapted to operate the valves to produce two-cycle and four-cycle movements of the piston, means for connecting the counter-shaft with the main shaft to move at the same speed or half the speed of the main shaft and for simultaneously automatically shifting from one set of cams to the other.

4. In a device of the class described, the combination with a cylinder having an inclosed crank-case, a piston movable in the cylinder and a valve-controlled opening from the crank-case into the cylinder-head, of inlet and exhaust ports opening respectively into the crank-case and cylinder-head, valves controlling said ports, two independent sets of cams adapted to operate said valves to produce two-cycle and four-cycle movements of the piston and means for bringing said cams into engagement with the valves.

5. In a device of the class described, the combination with a cylinder having an inclosed crank-case, a piston movable in the cylinder and a valve-controlled opening from the crank-case to the cylinder-head, of an exhaust-port in the cylinder-head, a valve controlling said port, an inlet-port in the crank-case, a balanced valve controlling said inlet-port and means for alternatively operating said valves to produce two-cycle and four-cycle movements of the piston.

6. In a device of the class described, the combination with a cylinder having an inclosed crank-case, a piston movable in the cylinder and a valve-controlled opening from the crank-case to the cylinder-head, of inlet and exhaust ports in the crank-case and cylinder-head respectively, a main shaft driven by the piston, a counter-shaft, two pinions loose on the counter-shaft and driven, one at the same speed as the main shaft and the other at half the speed of the main shaft, two sets of valve-operating cams on the counter-shaft, a single tooth-clutch member on the counter-shaft adapted to engage with similar clutch members on the two pinions and means for shifting the counter-shaft longitudinally to bring it into engagement alternatively with either of said pinions and to shift simultaneously one set of cams out of and the other into engagement with the valves, the cams which are in engagement when the counter-shaft is moving at half-speed operating the valves to produce four-cycle movement and the cams which are in engagement when the counter-shaft is moving at equal speed operating to produce two-cycle movement.

In witness whereof I have signed the above application for Letters Patent, at Chicago, in the county of Cook and State of Illinois, this 9th day of December, A. D. 1904.

EDWARD S. PALMBLA.

Witnesses:
CHAS. O. SHERVEY,
K. M. CORNWALL.