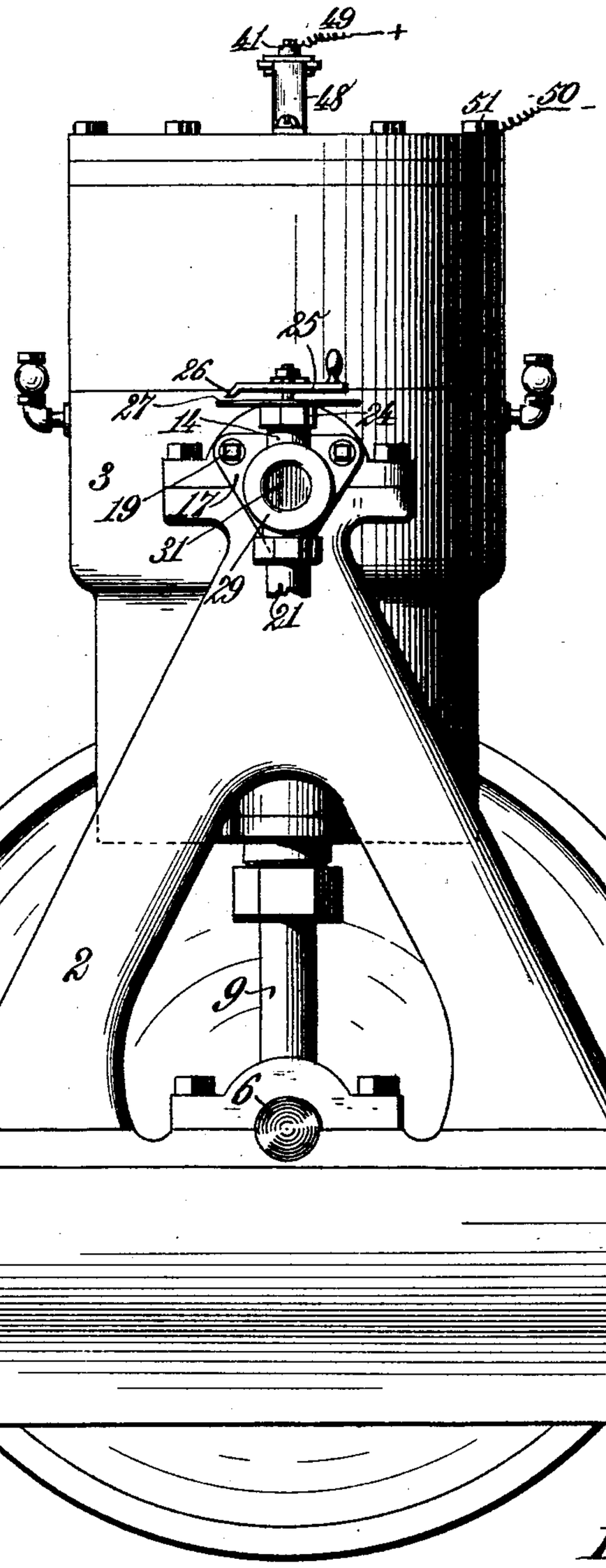
(No Model.) 3 Sheets—Sheet 1.

# C. I. CUMMINGS & J. C. HILTON.

## EXPLOSIVE ENGINE.

No. 591,952. Patented Oct. 19, 1897.

*Fig. 1.*




Witnesses.
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Vinton Coombs

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(No Model.) 3 Sheets—Sheet 2.

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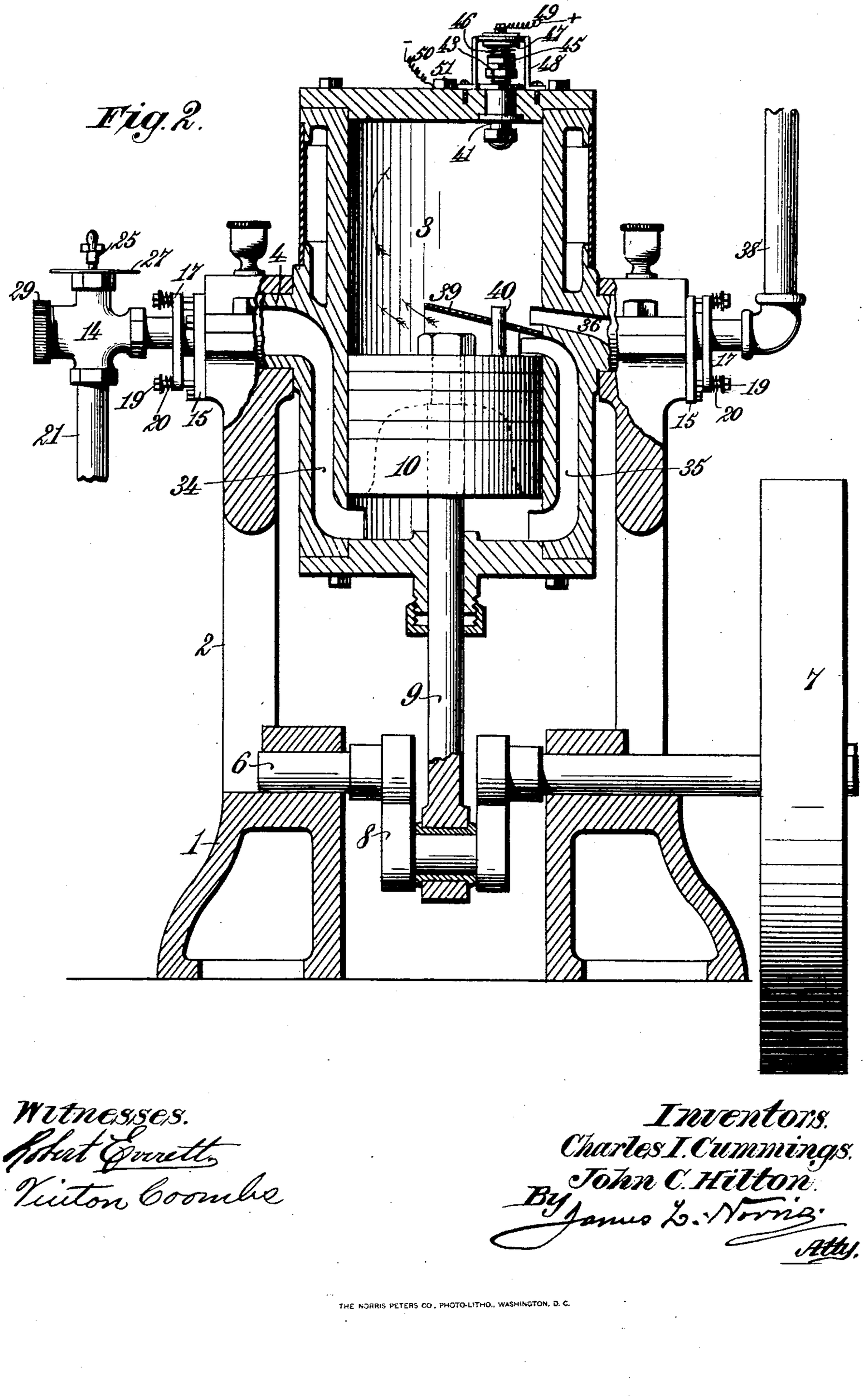
## EXPLOSIVE ENGINE.

No. 591,952. Patented Oct. 19, 1897.

*Fig. 2.*

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(No Model.) 3 Sheets—Sheet 3.

# C. I. CUMMINGS & J. C. HILTON.

## EXPLOSIVE ENGINE.

No. 591,952. Patented Oct. 19, 1897.

*Fig. 3.*

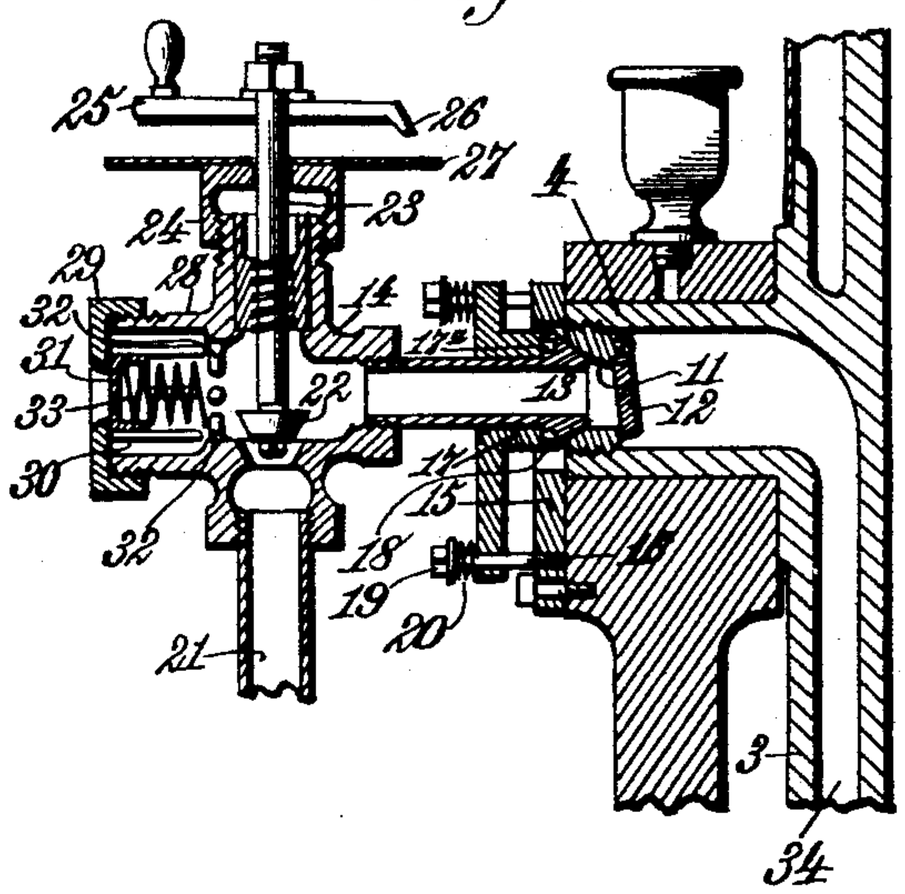



*Fig. 4.*

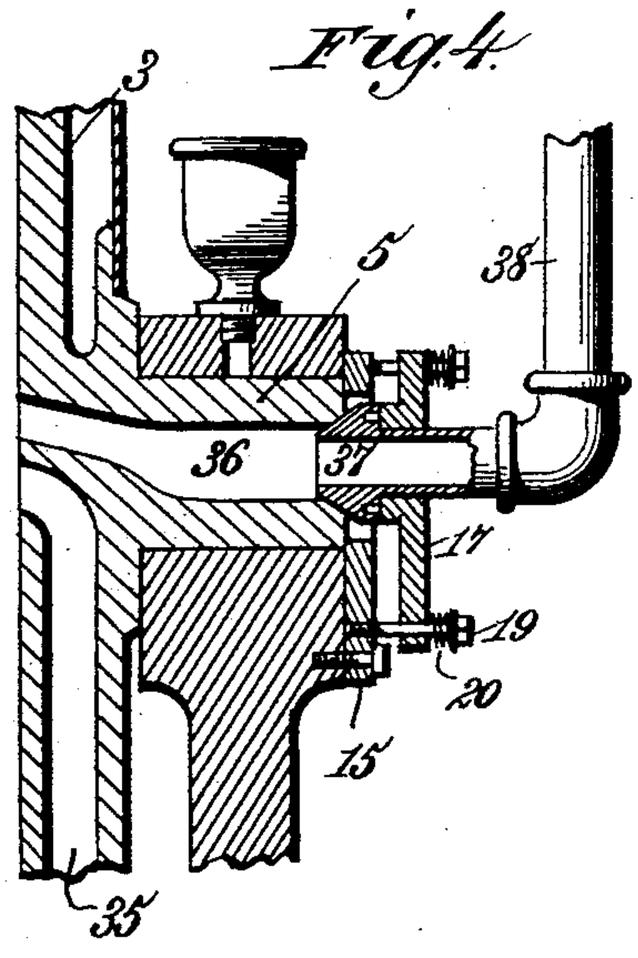



*Fig. 5.*

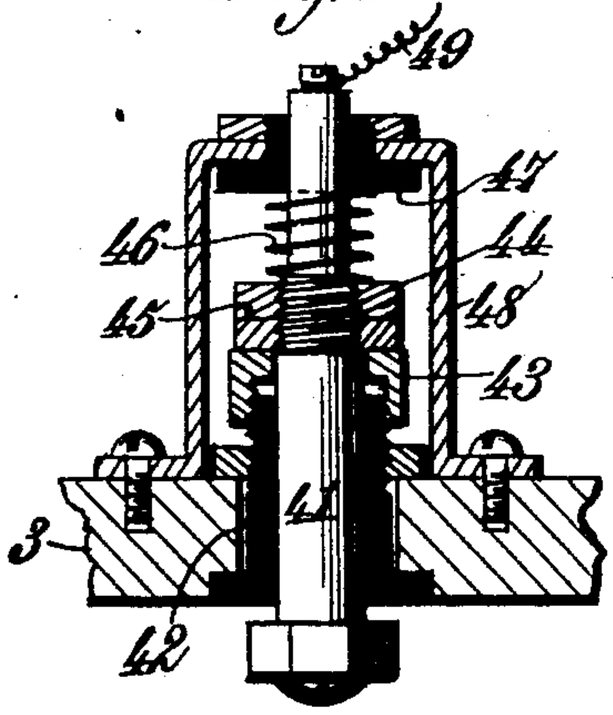
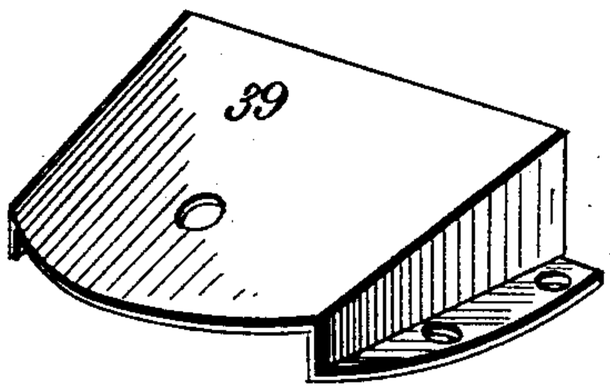



*Fig. 6.*

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# UNITED STATES PATENT OFFICE.

CHARLES I. CUMMINGS AND JOHN C. HILTON, OF ERIE, PENNSYLVANIA.

## EXPLOSIVE-ENGINE.

SPECIFICATION forming part of Letters Patent No. 591,952, dated October 19, 1897.

Application filed December 19, 1896. Serial No. 616,274. (No model.)

*To all whom it may concern:*

Be it known that we, CHARLES I. CUMMINGS and JOHN C. HILTON, citizens of the United States, residing at Erie, in the county of Erie and State of Pennsylvania, have invented new and useful Improvements in Explosive-Engines, of which the following is a specification.

This invention relates to explosive-engines, and particularly to oscillating engines adapted to be operated by gas.

It has for its object to provide an engine of the character stated wherein the gas is given an initial pressure in one end of the cylinder and is then transferred to the opposite end of the cylinder, where it is further compressed and then exploded.

It also has for its object to improve, simplify, and render more efficient this class of engines generally.

To these ends our invention consists in the arrangement, construction, and combination of parts hereinafter described, and definitely pointed out in the claims following the description, reference being had to the accompanying drawings, forming a part of this specification, wherein—

Figure 1 is a side elevation of our improved engine. Fig. 2 is a vertical central section of the same. Fig. 3 is a detail sectional view illustrating the check-valve and packing and the gas and air supply valve. Fig. 4 is a similar view of the exhaust. Fig. 5 is a detail sectional view of a part of the igniting device, and Fig. 6 is a detail perspective view of the deflector.

Referring to the drawings, the numeral 1 indicates the frame or bed of our improved engine on which are supported the standards 2.

The numeral 3 indicates the cylinder, on the opposite sides of which are formed the hollow trunnions 4 and 5, which are journaled in the standards 2.

The numeral 6 indicates the engine-shaft, having mounted thereon a fly-wheel 7, and cranked, as at 8, where it is engaged by the piston-rod 9 in the usual and ordinary manner. Fixed on the opposite end of the piston-rod and adapted to reciprocate back and forth in the cylinder is a piston 10.

Fitted in the outer end of the hollow trunnion 4 is a thimble 11, to the inner end of which is hinged a check-valve 12, adapted to open to permit the entrance of gas into the cylinder, but closing under pressure during the downstroke of the piston to prevent the escape of the gas from the cylinder through the trunnion 4. The outer end of the thimble 11 is interiorly beveled, as most clearly shown in Fig. 3, forming a seat in which is seated the tapered end of a nipple 13, the other end of said nipple being tapped into a valve-casing 14. A plate 15 is bolted to the outer face of the standard 2 around the nipple 13 and is provided with threaded bolt-holes 16, as shown. A flanged collar 17 is arranged on the nipple and engages and bears against a shoulder 18, formed on the tapered end of the nipple. The collar 17 is provided with projecting studs $17^a$ that engage corresponding recesses formed in the shoulder 18. The studs prevent the nipple turning with the trunnion. Headed bolts 19 are passed through suitable bolt-holes formed in the collar 17 and are tapped into the bolt-holes 16 in the plate 15. Arranged upon said bolts and between their heads and the collar 17 are spiral springs 20, which force said collar into engagement with the shoulder 18 on the nipple 13 and hold the tapered end of the latter closely to its seat in the thimble 11. The trunnion 4 is thus permitted to freely oscillate in its bearing and a gas-tight joint is at the same time maintained.

A gas-supply pipe 21 is tapped into the valve-casing 14 and its communication with the valve-casing is controlled by a reciprocating valve 22, operated by a stem 23, passing through a stuffing-box 24, and provided at its upper end with a handle 25. The handle 25 is provided with an index-hand 26, adapted to point to a dial 27, fixed on the upper end of the stuffing-box, and thus indicate the position of the valve 22 and consequently the quantity of gas being supplied to the engine. The valve-casing 14 is also provided with an air-inlet valve constructed as follows: Over the threaded end of the hollow nipple 28 of the valve-casing is fitted the centrally-apertured cap 29, provided with inwardly-projecting guide-fingers 30. Arranged between the guide-fingers 30 is a reciprocating cup-shaped valve 31, between which and inwardly-projecting flanges 32,

formed on the interior of the valve-casing, is disposed a coiled spring 33, which operates to normally hold the valve 31 to its seat over the central aperture in the cap 29, and prevent the ingress of air. When, however, the piston is on its upstroke, the valve 31 opens automatically and admits the entrance of air, which mixes with the incoming gas, and the mixed air and gas pass into the cylinder in the manner more fully hereinafter set forth.

The hollow trunnion 4 communicates with one end of an inlet-port 34, formed in the wall of the cylinder 3, and which extends to and discharges into the lower end of the cylinder. A similar port 35 is formed in the opposite wall of the cylinder and extends from the bottom of the latter to a point nearly midway between its ends, where it opens into the cylinder. The trunnion 5 is made hollow to form an exhaust-port 36, which communicates with the interior of the cylinder at one end and at its other end with a nipple 37, which is held to its seat in the trunnion 5 in the same manner as nipple 13 before described. An exhaust-pipe 38 is coupled to the nipple 37 and may discharge at such point as may be preferred.

Fixed on the upper side of the piston 10 is a deflector-plate 39, consisting of a funnel-shaped plate bolted to the piston with its smaller end so arranged that it will register with the upper end of the port 35 when the piston has nearly reached the limit of its downstroke.

The igniting device is constructed as follows: In the upper end of the piston 10 is fixed a contact 40, which is adapted to make electric connection with a movable contact arranged in the upper end of the cylinder as follows: The movable contact consists of a bolt 41, formed at its lower end with a collar 42, which limits the upward movement of the bolt. The bolt 41 passes through a bushing 42 of insulating material fixed in the cylinder-head and threaded at its upper end, over which is fitted a stuffing-box 43. The bolt 41 is threaded, as at 44, and has secured on said threaded portion two nuts 45, forming in effect a jam-nut. Resting on the nuts 45 is a coiled spring 46, which is held under compression by a washer 47, fitted to a bracket 48, bolted to the upper end of the cylinder. One terminal of an electric circuit is connected to the upper end of the movable contact 41, and the other terminal 50 of said circuit is connected to the cylinder by a bolt or binding-post 51, as shown. When the piston approaches the completion of its upstroke, the contact 40 strikes and raises the movable contact 41, thus completing the circuit from the battery or other suitable source of electricity, through the wire 50 to the cylinder and piston, through contacts 40 and 41, and by wire 49 back to the battery or other generator. When the piston starts on its downstroke, the contacts 40 and 41 are separated, causing a spark which ignites the explosive charge in a well-known manner. By making the electrode 41 yielding, injury to the igniting device through the impact of the electrode carried by the piston is prevented and electrical contact between the electrodes is insured.

The operation of our improved engine is as follows: Let it be assumed that the valve 22 is open and that the piston is on its upstroke. The gas then, mixed with air entering past the valve 31, will pass to the lower end of the cylinder through the hollow trunnion 4 and port 34, and upon the return or down stroke of the piston the pressure will close the check-valve 12 and the gas and air will be compressed below the piston. When the piston has performed about eight-tenths of its downstroke, the exhaust-port 36 is uncovered, putting the upper end of the cylinder into communication with the exhaust-pipe 38. When the piston has completed about nine-tenths of its downstroke, the upper end of the port 35 is uncovered, and the air and gas previously compressed beneath the piston escape through the port 35, and passing through the deflector 39 are introduced into the cylinder above the piston in a circular path, as indicated by the arrows, and force out the burned gases and smoke through the exhaust-port 36. When the piston has made one-tenth of its upstroke, it closes the upper end of the port 35, and when it has performed two-tenths of its upstroke it closes the exhaust-port, and during the remaining eight-tenths of its upstroke the air and gas are compressed in the upper end of the cylinder. When the piston commences its downstroke, the igniting device forms a spark which explodes the compressed mixture and forces down the piston, which in its descent compresses the air and gas taken into the cylinder on the upstroke of the piston, as before described. The piston is raised by the acquired momentum of the fly-wheel, and the cycle of movements is repeated.

Instead of gas, gasolene may be employed as the motive power—as, for example, in marine and portable engines.

Having described our invention, what we claim is—

1. In a gas-engine, the combination of an oscillating cylinder having hollow trunnions mounted in bearings, a gas-supply pipe connected to one of said trunnions, a port leading from said trunnion to the bottom of the cylinder, a corresponding port communicating with the cylinder near the bottom thereof and intermediate its ends, an exhaust-port, and a piston, substantially as described.

2. In a gas-engine, the combination of an oscillatory cylinder provided with hollow trunnions mounted in bearings, a check-valve arranged in one of said trunnions and opening inwardly, a gas-supply pipe communicating with said trunnion at its outer end, a port leading from the inner end of said trunnion to the

bottom of the cylinder, a similar port communicating at its opposite ends respectively with the bottom of the cylinder and at a point intermediate its ends, a piston and an exhaust, substantially as described.

3. In a gas-engine, the combination of an oscillatory cylinder provided with hollow trunnions mounted in bearings, a gas-supply pipe communicating with one of said trunnions at its outer end, a port leading from the inner end of said trunnion to the bottom of the cylinder, a corresponding port leading from the bottom of the cylinder to a point intermediate the ends of the cylinder, an exhaust-port arranged immediately above the upper end of said port, and a piston arranged in the cylinder, substantially as described.

4. In a gas-engine, the combination of an oscillatory cylinder provided with hollow trunnions mounted in bearings, a gas-supply pipe communicating with one of said trunnions at its outer end, a port leading from the inner end of said trunnion to the bottom of the cylinder, a corresponding port leading from the bottom of the cylinder to a point intermediate the ends of the cylinder, an exhaust-port extending through the other trunnion and opening into the cylinder immediately above the upper end of the said port, and a piston arranged to open and close said port and exhaust-port, substantially as described.

5. In a gas-engine, the combination of an oscillatory cylinder provided with hollow trunnions mounted in bearings, a gas-supply pipe communicating with one of said trunnions at its outer end, a port leading from the inner end of said trunnion to the bottom of the cylinder, a corresponding port leading from the bottom of the cylinder to a point intermediate its ends, an exhaust-port extending through the other trunnion, a piston, and an electric sparking device arranged to produce a spark when the piston starts on its downstroke, substantially as described.

6. In a gas-engine, the combination of an oscillatory cylinder provided with hollow trunnions mounted in bearings, a check-valve arranged in one of said trunnions and opening inwardly, a valve-casing communicating with said hollow trunnion and provided with a gas-regulating valve, a gas-supply pipe, an inwardly-opening air-valve for supplying air to said valve-casing, a port leading from the inner end of the said trunnion to the bottom of the cylinder, a similar port communicating at its opposite ends respectively with the bottom of the cylinder and at a point intermediate its ends, a piston, and an exhaust, substantially as described.

7. In a gas-engine the combination of an oscillatory cylinder having hollow trunnions mounted in bearings, a gas-supply pipe connected to one of said trunnions, a port leading from said trunnion to the bottom of the cylinder, a corresponding port communicating with the cylinder near the bottom and intermediate its ends, an exhaust-port arranged above the upper end of said port, a piston, and a funnel-shaped deflector arranged on the upper end of the piston, substantially as described and for the purpose specified.

8. In a gas-engine, the combination of an oscillatory cylinder 3 provided with hollow trunnions 4 and 5 mounted in bearings, the inwardly-beveled thimble 11 fitted in the outer end of the trunnion 4, a check-valve 12 hinged to said thimble, a tapered nipple 13 seated in said thimble and connected with a valved gas-supply pipe, and means for yieldingly holding said nipple to its seat, substantially as described.

9. In a gas-engine, the combination with the cylinder thereof, of a valve-casing 14 connected with a gas-supply pipe and with the cylinder, a valve 22 for controlling the passage of the gas through said cylinder, and an air-valve for periodically admitting air to the valve-casing, said air-valve consisting of a centrally-apertured cap 29 fitted over the nipple 28 and provided with inwardly-projecting guide-fingers 30, a reciprocating valve 31 arranged between said fingers and adapted to seat against the cap 29 over the central aperture, and a coiled spring 33 disposed between the valve 31 and a fixed support on the interior of the valve-casing and operating to normally hold the valve closed, substantially as described.

In testimony whereof we have hereunto set our hands in presence of two subscribing witnesses.

CHARLES I. CUMMINGS.
JOHN C. HILTON.

Witnesses:
WM. P. HAYES,
H. OPPENHEIMER.