(No Model.)

5 Sheets—Sheet 1.

B. H. COFFEY.

GAS ENGINE.

No. 446,851. Patented Feb. 24, 1891.

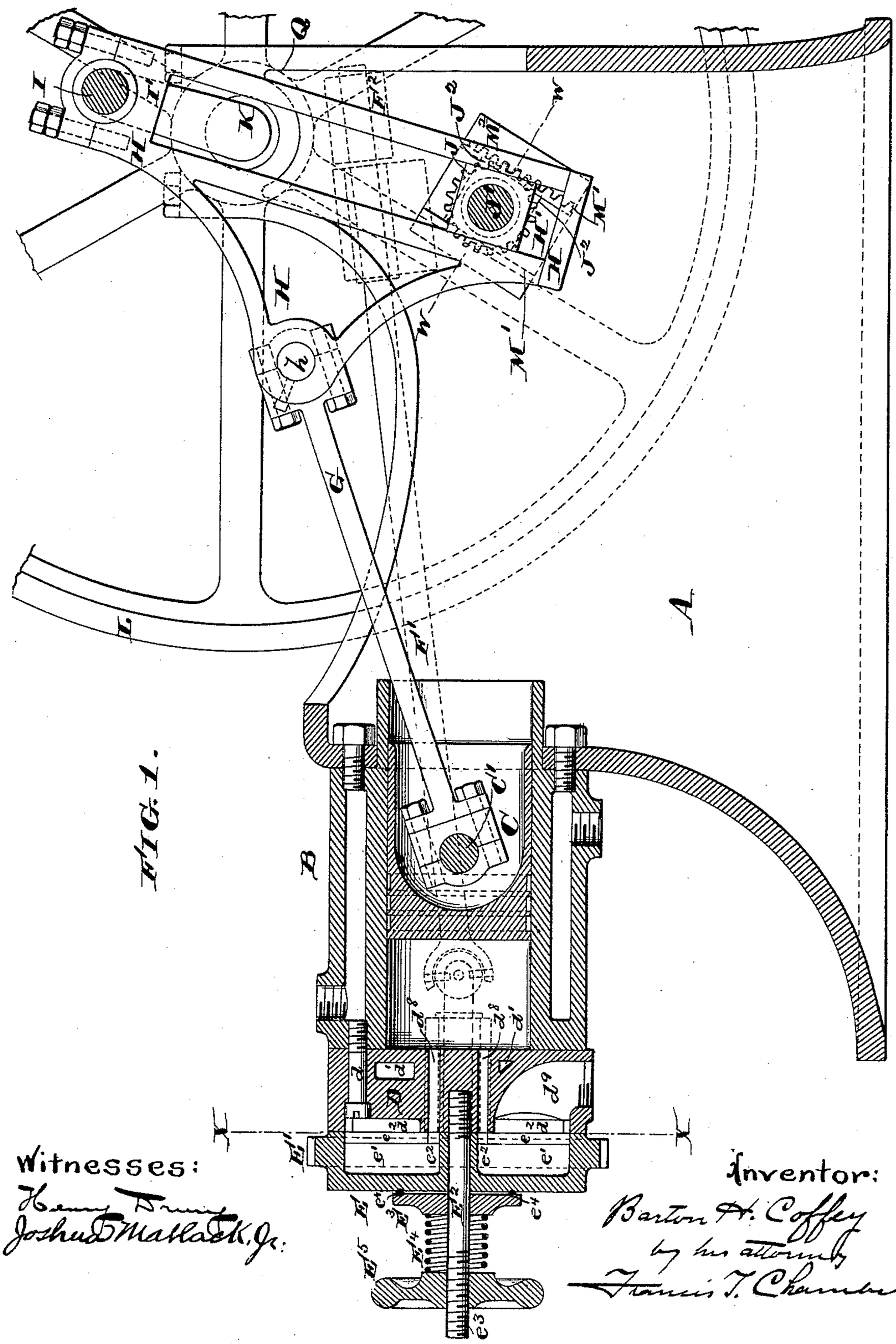


FIG. 1.

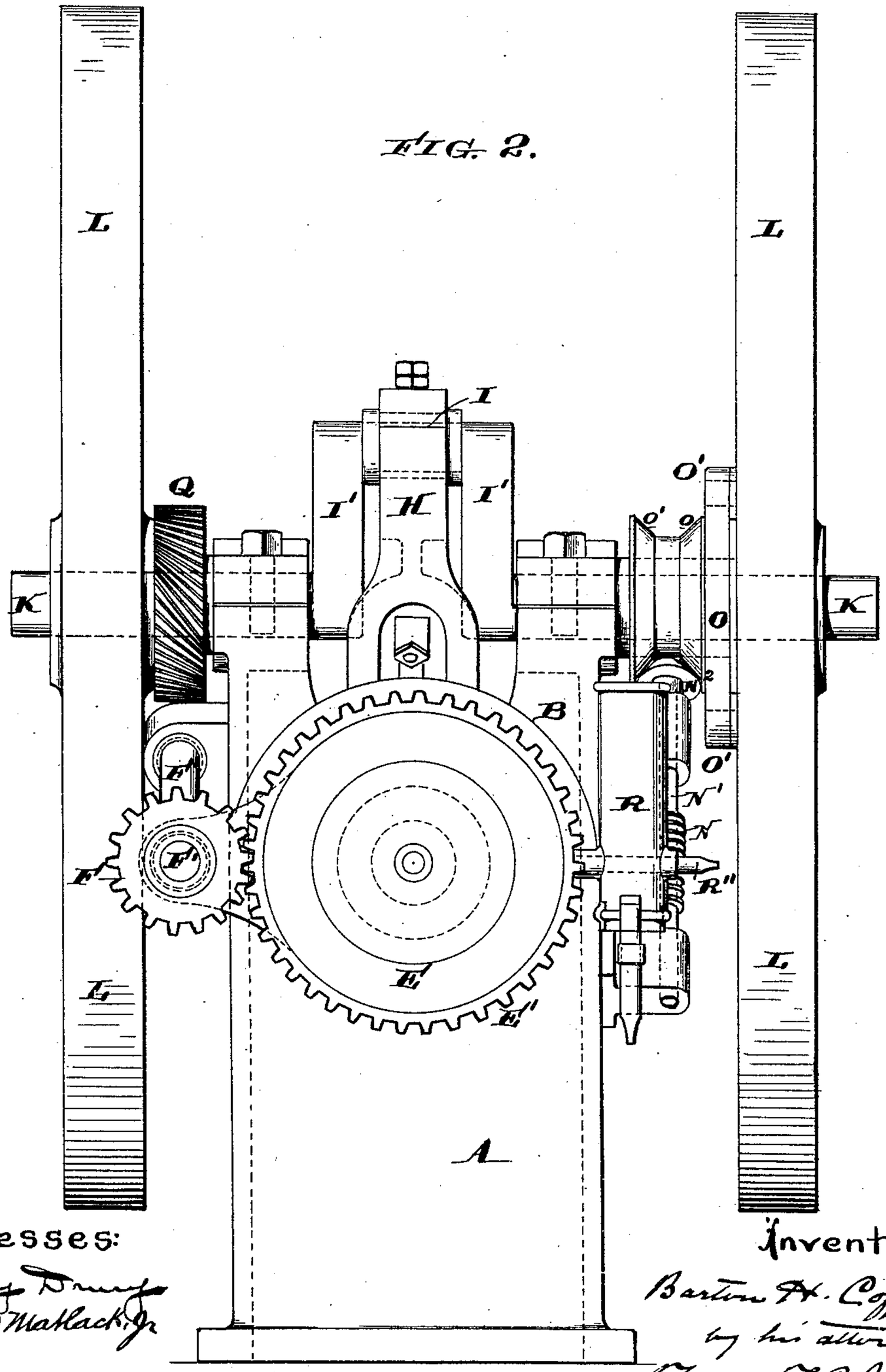
(No Model.) 5 Sheets—Sheet 2.

B. H. COFFEY.

GAS ENGINE.

No. 446,851. Patented Feb. 24, 1891.

FIG. 2.



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(No Model.) 5 Sheets—Sheet 3.

B. H. COFFEY.

GAS ENGINE.

No. 446,851. Patented Feb. 24, 1891.

FIG. 4.

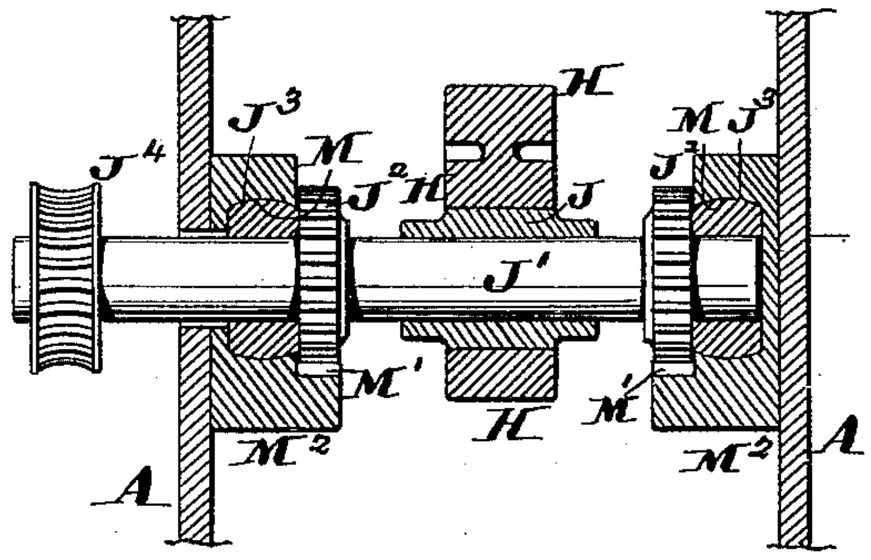
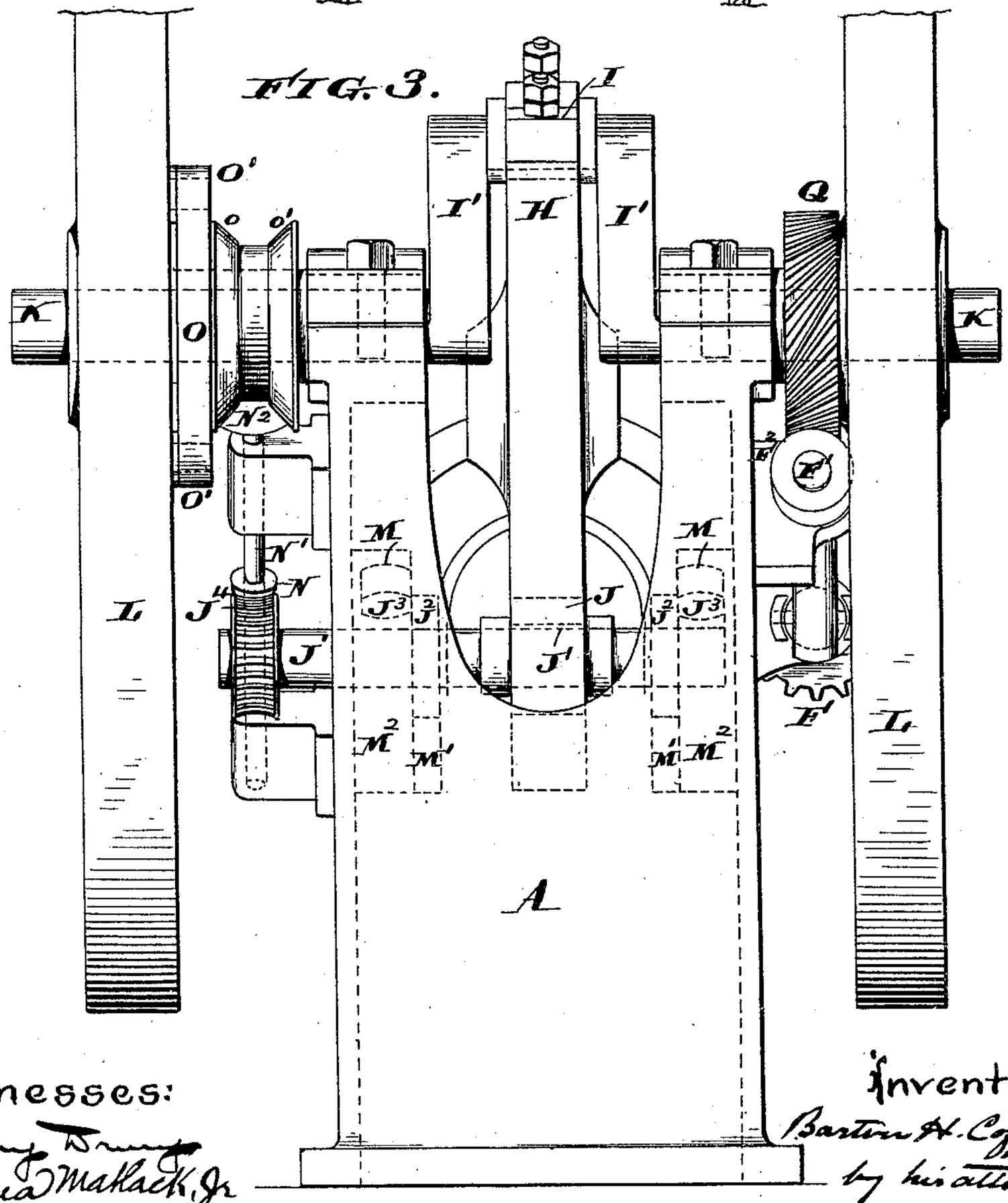


FIG. 3.



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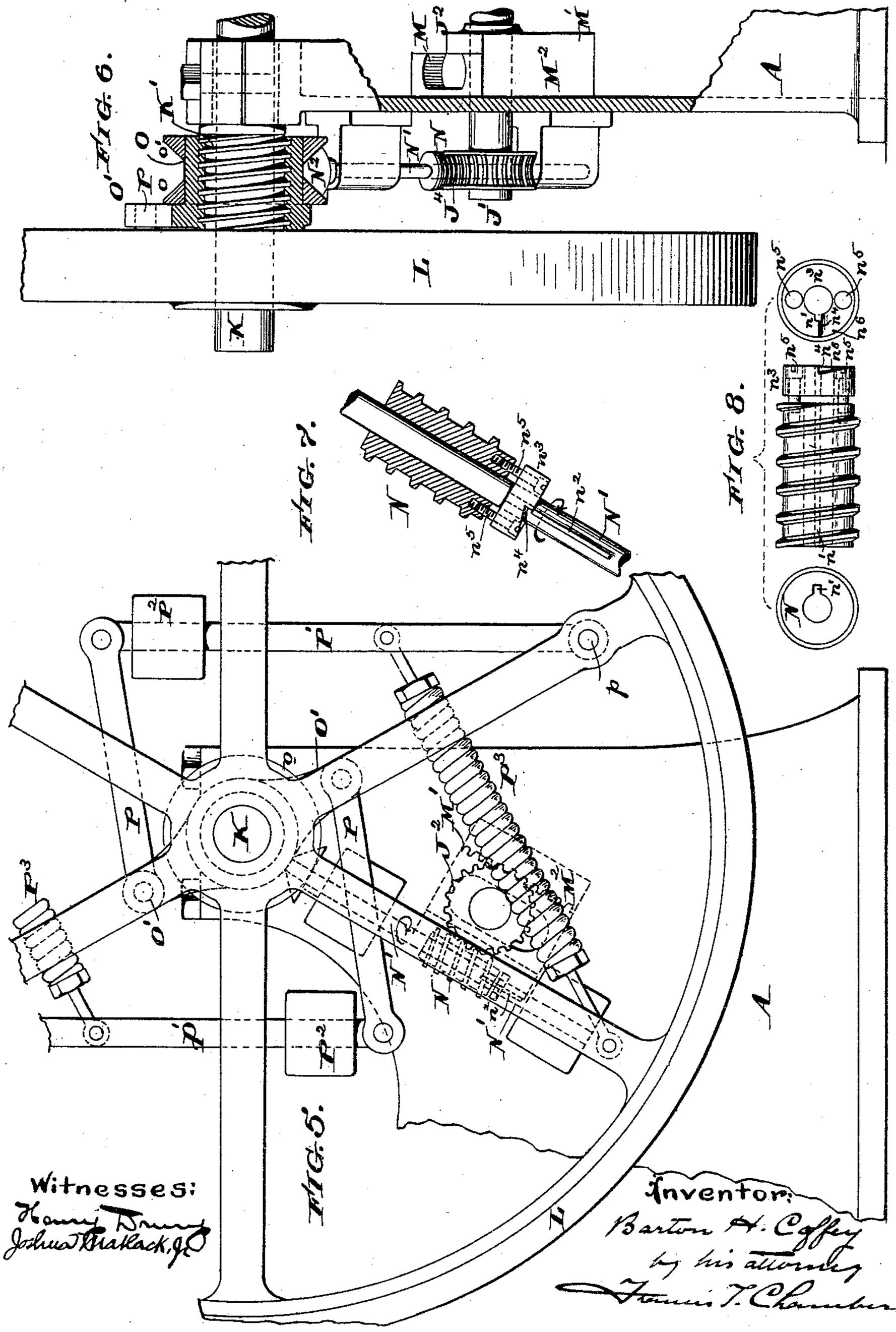
(No Model.) 5 Sheets—Sheet 4.

B. H. COFFEY.

GAS ENGINE.

No. 446,851. Patented Feb. 24, 1891.



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(No Model.) 5 Sheets—Sheet 5.

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GAS ENGINE.

No. 446,851. Patented Feb. 24, 1891.

FIG. 12.

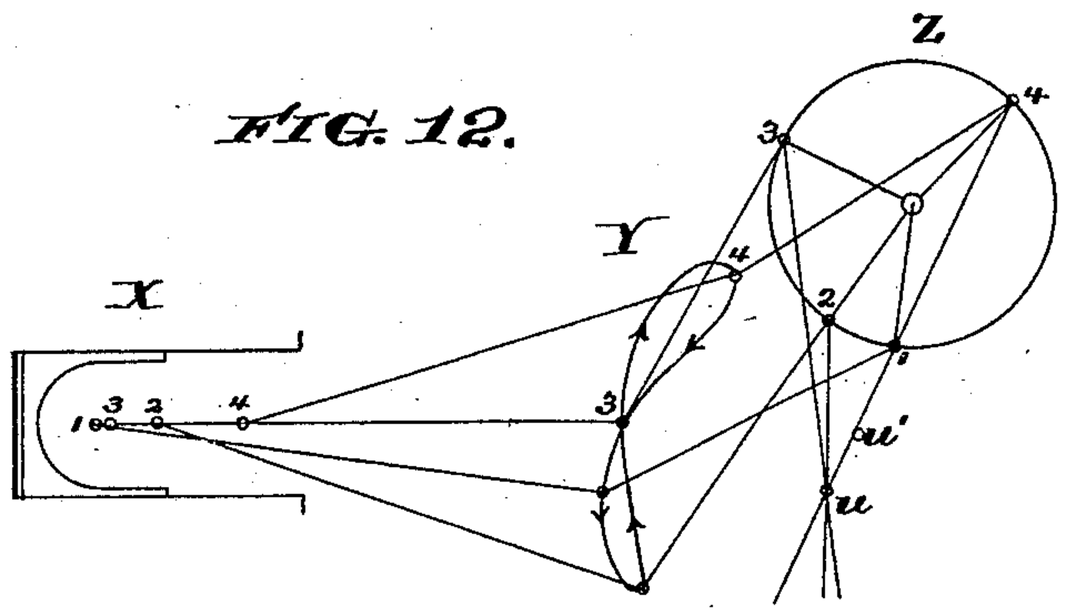


FIG. 13.

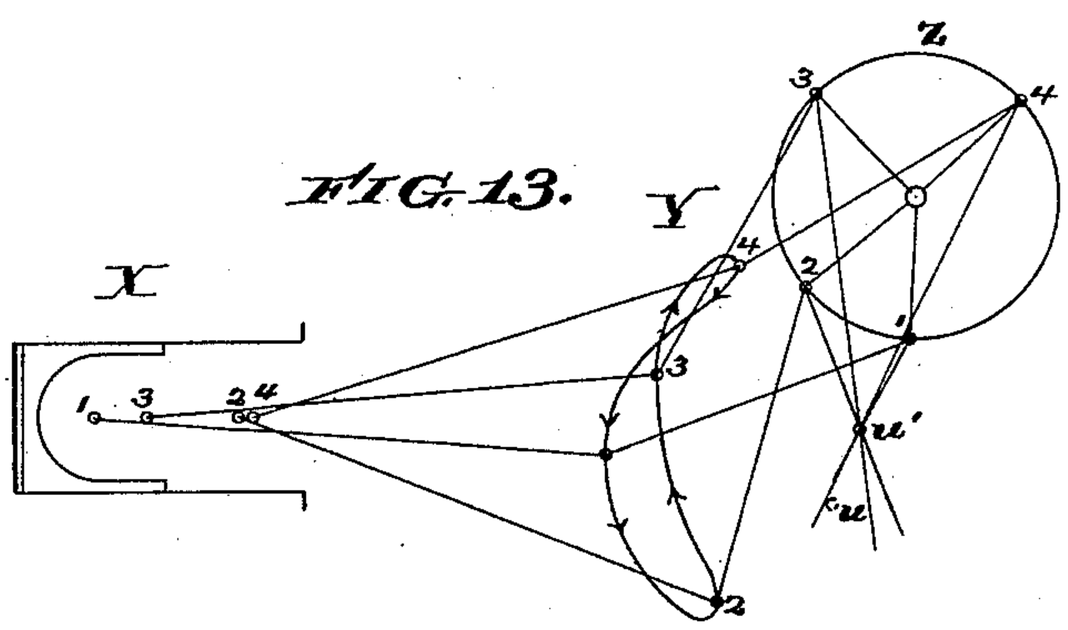


FIG. 9.

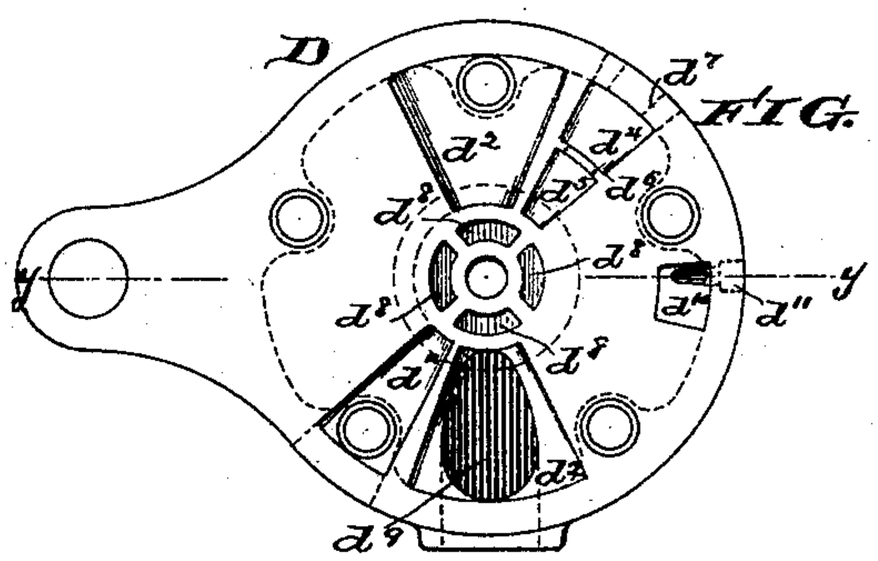


FIG. 10.

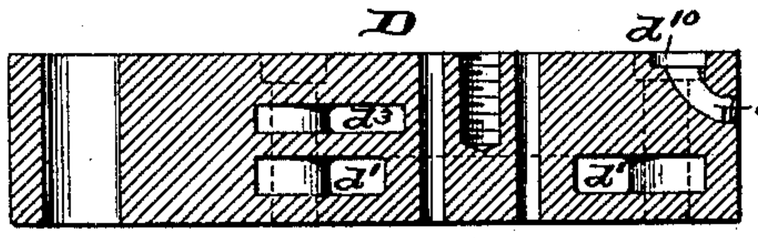
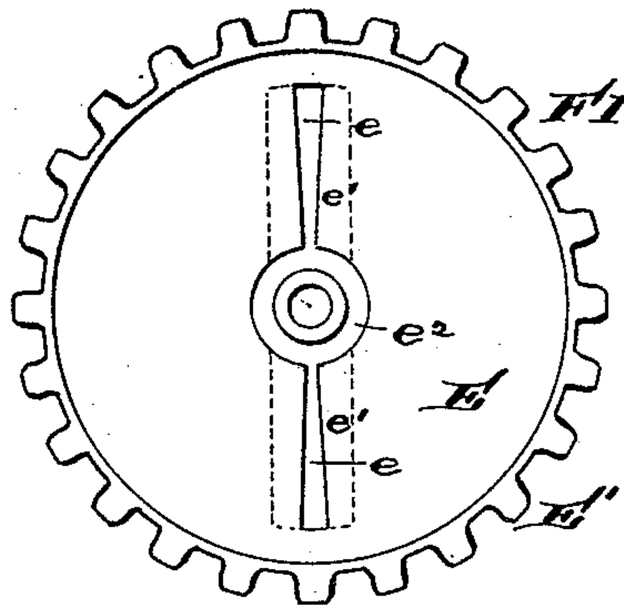


FIG. 11.



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UNITED STATES PATENT OFFICE.

BARTON H. COFFEY, OF PHILADELPHIA, PENNSYLVANIA.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 446,851, dated February 24, 1891.

Application filed January 27, 1890. Renewed December 1, 1890. Serial No. 373,128. (No model.)

To all whom it may concern:

Be it known that I, BARTON H. COFFEY, of the city and county of Philadelphia, State of Pennsylvania, have invented a new and useful Improved Gas-Engine, of which the following is a true and exact description, reference being had to the accompanying drawings, which form a part of this specification.

My invention relates to the construction of gas-engines, and has for its object to simplify and improve the construction and operation of the same.

The nature of my improvements will best be understood as described in connection with the drawings in which they are illustrated, and the novel features which I desire to protect by Letters Patent are hereinafter pointed out in the claims.

In the drawings, which represent a gas-engine constructed with my improvements, Figure 1 is a side elevation showing the cylinder and its valves in section. Fig. 2 is an end elevation of the cylinder end of the engine. Fig. 3 is an elevation of the other end of the engine. Fig. 4 is a view of the guiding-pivot shaft and its connections, taken on the line *w w* of Fig. 1. Fig. 5 is a face view of a fly-wheel, showing a governor and its connection with the guiding-pivot shaft. Fig. 6 is a side view of the same parts. Figs. 7 and 8 show details. Fig. 9 is a plan of the end plate of the cylinder, showing the ports formed in it. Fig. 10 is a section on line *y y* of Fig. 9. Fig. 11 is a plan view of the inner face of the valve acting on the end plate; and Figs. 12 and 13 are diagrams illustrating the action of the engine in two positions of the guiding-pivot shaft.

A is the frame of the engine; B, the cylinder; C, the trunk-piston; C′, the pin by which it is connected with the connecting-rod G.

D is the end plate of the cylinder; E, the valve-plate, having a circular rack E′ formed on its outer rim; F′, a shaft which actuates the valve E by means of the gear-wheel F engaging rack E′.

There are novel features in connection with the valve and valve-ports shown which I will describe hereinafter; but I may here state that my principal novel feature which I am about to describe can be employed in connection with any convenient valve system.

K is the main shaft of the engine; I′ I′, crank-arms secured to said shaft, and I the crank-pin.

J′ is a pivot, preferably made adjustable or movable, for reasons which I will state, and H is a link of substantially triangular form and provided with a slot H′, which may be straight, as shown, or, if desired, may have a curved outline. This link is pivoted to the crank-pin I, as shown, and to the connecting-rod G at *h*, and also to the guiding-pivot J′ by means of its slot H′, the connection being made in the plan shown by means of a block J sliding in slot H′ and turning on pivot J′. The effect of this combination of the connecting-rod, crank-shaft, guiding-pivot, and slotted link upon the motion of the piston is shown in the diagrams 12 and 13, the piston making two strokes for each revolution of the shaft and an explosion occurring for each revolution. For instance, in the diagrams X, 1 2 3 4 indicate the different extreme positions of the piston during each revolution of the main shaft; Y, 1 2 3 4 the corresponding positions of the pivot *h* at the end of the connecting-rod G, and Z, 1 2 3 4 the corresponding positions of the crank-pin I, while the position of the guiding-pivot is indicated in Fig. 12 at *u* and in Fig. 13 at *u′*. As the crank-pin moves from 1 to 2, the piston moves from 1 to 2, sucking in the charge of gas and air. As the pin moves from 2 to 3, the piston moves back to 3, compressing the charge. The explosion then occurs, forcing the piston to 4 and impelling the crank-pin from 3 to 4, and the rotation of the crank-pin from the piston back to 1, expelling the burned charge and completing the cycle. The curve described by the end of the connecting-rod is indicated at Y.

My device of the slotted link and its connection with the connecting-rod, crank, and guide-pivot is, I believe, entirely new, and it is a simpler and more convenient device for accomplishing the desired movements of the piston than any with which I am familiar, besides giving a capacity for regulating and altering the operation of the engine by making the guide-pivot adjustable. For instance, referring to Figs. 12 and 13, by making the guide-pivot adjustable between points *u* and *u′* the movements of the piston are changed in degree, so that when the pivot is at *u′* the

outward stroke of the piston which draws in the charge is longer than when the pivot is at *u* and the compression-stroke correspondingly altered. This adjustability of the guide-pivot is another important feature of my invention.

By connecting a governor with a movable guide-pivot by mechanism which will cause the said pivot to change its position as the load on the engine varies, I am enabled to regulate and govern the engine in the most effective way—that is, to shorten the suction-stroke as the load falls and lengthen it as it increases, and this also is an important feature of my invention.

Referring again to the drawings, I will describe the mechanism there shown for adjusting the guiding-pivot and for actuating it by the governor, the construction shown being, I believe, well adapted for its purpose, but being capable of almost indefinite change and modification in its details of construction. The guide-pivot J′ is formed as a shaft on which the sliding block J can turn freely, and to said shaft are secured bearing rings or wheels J^3 J^3 and spur-gears J^2 J^2, a worm-wheel J^4 being secured to one end.

M^2 M^2 are blocks in which are formed guide-bearings M M, to secure the wheels or rings J^3 and racks M′ M′, in which the gear-wheels J^2 engage. It is obvious that by this construction the rotation of shaft J′ will cause it to travel back or forward in the guiding-bearings M M.

N is a worm which engages worm-wheel J^4. It is secured to a shaft N′ by means of a slot *n*′, which engages a feather n^2 on said shaft, the worm being thus free to move along the shaft while it turns with it. On the lower end of worm N is secured by means of bolts n^5 an extension n^3, which is free to move to and from the worm for a short distance, being held normally at the greater distance from it by gravity, or, if desired, a light spring. A shoulder n^4, with gradual inclined slope n^6, is formed on its face. As the shaft N′ revolves in the direction indicated by the arrow in Fig. 7, the worm revolving with it rotates shaft J′ by engaging with worm-wheel J^4, and as the shaft moves up on racks M′ the worm moves up along the shaft N′ until the end of feather n^2 comes beneath the extension n^3 of the worm, when the worm ceases to turn, and the further revolution of the shaft simply causes the extension n^3 to move to and fro on its supporting-bolts; but as soon as the rotation of shaft N′ changes in direction the feather n^2 engages shoulder n^4 and rotates the worm, which immediately begins its backward movement along the shaft. The purpose of this construction is to provide a limit to the upward movement of the guiding-pivot when it is coupled with a governor in the way shown, and which I am about to describe.

On the upper end of shaft N′ is fixed a friction-cone N^2, fitting between beveled collars *o* *o*′ on a ring O, which ring is internally threaded and screwed upon a screw-threaded ring or collar K′ on shaft K. Extending from ring O are arms O′ O′, to which are pivoted at one end links P P, which at their ends are pivoted to links P′ P′, the other ends of which are pivoted, as at *p*, to the fly-wheel L. On links P′ are secured weights P^2, and springs P^3 are provided to hold the weighted links normally in their desired position and to act against the centrifugal force of the weights as the fly-wheel revolves.

The operation of the device shown is easily followed. As the fly-wheel revolves with increasing speed the centrifugal force of the weighted levers overcomes the springs and as they move outward they act upon the arms O′ of ring O, causing it to turn on shaft K, and by reason of its engagement with threaded ring K′ to move along it. This brings the ring *o*′ in contact with cone N^2, causing shaft N′ to revolve, as shown by arrow in Fig. 7, and by the connections described causing the pivot-shaft J′ to move up and shorten the suction-stroke of the piston. On the other hand the slowing down of the fly-wheel causes the springs to overcome the centrifugal force of the governor-weights and the ring O is rotated in the opposite direction on shaft K, the ring *o* being brought in contact with the cone N^2 and the guide-pivot J^2 caused to move downward, with the result of lengthening the suction-stroke of the piston.

Referring now to the engine, valves, and ports, the construction of the end plate D is shown in Figs. 1, 9, and 10. It is secured to the cylinder by a number of bolts, as *d*, and has a water-space *d*′ formed in it.

d^2 d^2 are exhaust-ports connected together by a passage d^3, and d^9 is a passage leading from one of them to the open air or exhaust-pipe.

d^4 d^4 are air-inlet ports, and d^5 a gas-inlet port. As shown, it is separated from an adjoining air-port d^4 by a partition d^6, and the gas-pipe d^7 leads through the air-port and the partition.

d^8 d^8, &c., are ports leading through plate D to the interior of the cylinder.

d^{10} is the ignition-port, into which leads a passage d^{11}, into which is fastened a closed tube R″, situated in a flue R, in which a Bunsen burner is situated in the usual way. The valve E is chambered out, as shown at *e*′ *e*′, said chambers connecting with the annular opening e^2 and being open on the face of the valve through slots *e* *e*. The valve is held in position by a bolt E^2, screwing into plate E and having a threaded end e^3, upon which screws a hand-wheel E^5.

E^3 is a plate which rests against the end of valve E, balls e^4 being preferably used to convert sliding into rolling friction. A spring E^4, situated between plate E^3 and wheel E^5, keeps the valve pressed against the end plate D with a force regulated by the compression of the spring.

The valve E is given a constant movement

of rotation by means of the gear-wheel F, meshing with its circular rack E′ and driven by shaft F′, which has at its end a spirally-toothed wheel F^2, engaging a spiral gear Q, the gearing being such as will cause the valve E to made a half-revolution for each complete revolution of the shaft K. The action of the valve is very simple. When its ports *e e* register with the air and gas ports d^4 d^4 d^5, the charge is drawn in, passing through openings e' e^2 to the ports d^8 and thence to the cylinder, the valve continuing to revolve. Its openings *e* are closed by the plain face of plate D during the compression of the charge, and one of said openings *e* registers with the firing-port d^{10} at the end of the compression-stroke, allowing the mixture in the cylinder to enter the heated tube R″ and become ignited, the ignition being freely communicated through passage d^{11}, port d^{10}, opening *e*, chamber *e′*, opening e^2, and ports d^8 to the cylinder. At the end of the explosion-stroke of the piston the openings *e* of the valve register with the exhaust-ports d^2 and the gases are freely expelled during the return-stroke of the piston.

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

1. In a gas-engine, the combination of the connecting-rod, the crank of the main shaft, and a guiding-pivot J′, with a link H, pivoted to the connecting-rod and crank at fixed points and to the pivot J′ by means of a slot H′, formed in said link, all substantially as and for the purpose specified.

2. In a gas-engine, the combination of the connecting-rod, the crank of the main shaft, and a movable guiding-pivot J′, with a link H, pivoted to the connecting-rod and crank at fixed points and to the pivot J′ by means of a slot H′ formed in said link, all substantially as and for the purpose specified.

3. In a gas-engine, the combination of the connecting-rod, the crank of the main shaft, and a movable guiding-pivot J′, with a link H, pivoted to the connecting-rod and crank at fixed points and to the pivot J′ by means of a slot H′ formed in said link, a governor and mechanism connecting said governor, and the movable guide-pivot arranged to change its position as the load of the engine varies.

4. In a gas-engine, the combination of the connecting-rod, the crank on the main shaft, a guiding-pivot shaft J′, having gear-wheels J^2 attached to it, racks M′, engaging gear-wheels J^2, mechanism for rotating shaft J′ and its gears J^2 to change its position on the racks, and a slotted link H, pivoted to the connecting-rod and crank at fixed points and to the shaft J′ by means of its slot, all substantially as and for the purpose specified.

5. In a gas-engine, the combination of the connecting-rod, the crank on the main shaft, a guiding-pivot shaft J′, having gear-wheels J^2 attached to it, racks M′, engaging gear-wheels J^2, mechanism for rotating shaft J′ and its gears J^2 to change its position on the racks, a governor connected with and controlling the movement of said mechanism, and a slotted link H, pivoted to the connecting-rod and crank at fixed points and to the shaft J′ by means of its slot, all substantially as and for the purpose specified.

6. In a gas-engine having the slotted link H and movable pivot J′, as described, and a shaft N′, actuated by the governor, the combination of the worm N, mounted on shaft N′ and connected with it by feather n^2, the movable extension n^3 of said worm having shoulder n^4, and the worm-wheel J^4 on shaft J′, all substantially as and for the purpose specified.

7. In a gas-engine, the combination of the cylinder end plate D, having induction-ports d^8, exhaust-ports d^2 d^2, air-ports d^4 d^4, and gas-port d^5, arranged substantially as specified, and a rotating valve E, having openings *e e*, chambers *e′ e′*, and passage e^2.

8. In a gas-engine, the combination of the cylinder end plate D, having induction-ports d^8, exhaust-ports d^2 d^2, air-ports d^4 d^4, gas-port d^5, and ignition-port d^{10}, with passage d^{11}, arranged substantially as specified, and a rotating valve E, having openings *e e*, chambers *e′ e′*, and passage e^2.

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