No. 725,087. PATENTED APR. 14, 1903.

J. A. JENNEY.

OSCILLATING PISTON EXPLOSIVE ENGINE.

APPLICATION FILED SEPT. 18, 1902.

NO MODEL. 5 SHEETS—SHEET 1.

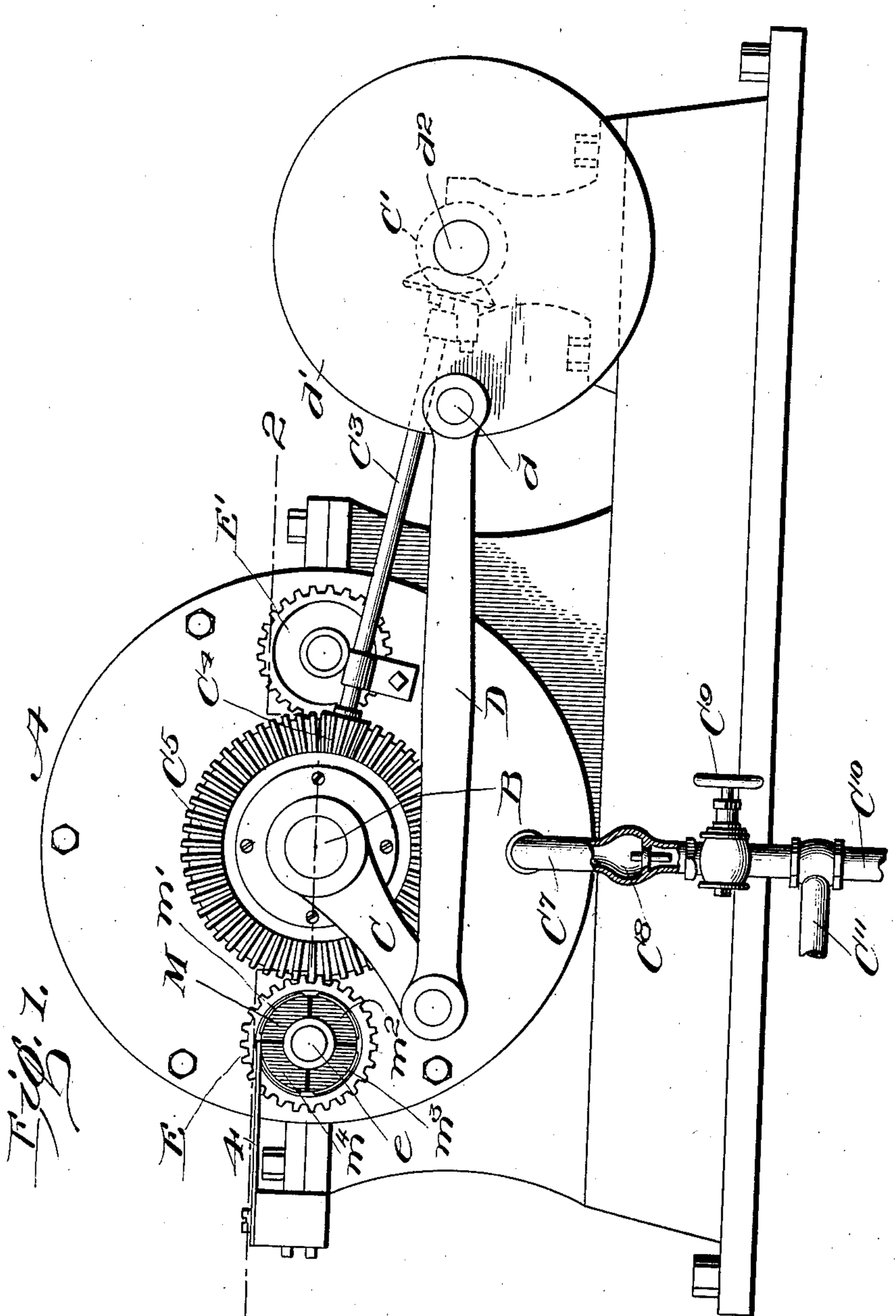


Fig. 1.

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NO MODEL. 5 SHEETS—SHEET 2.

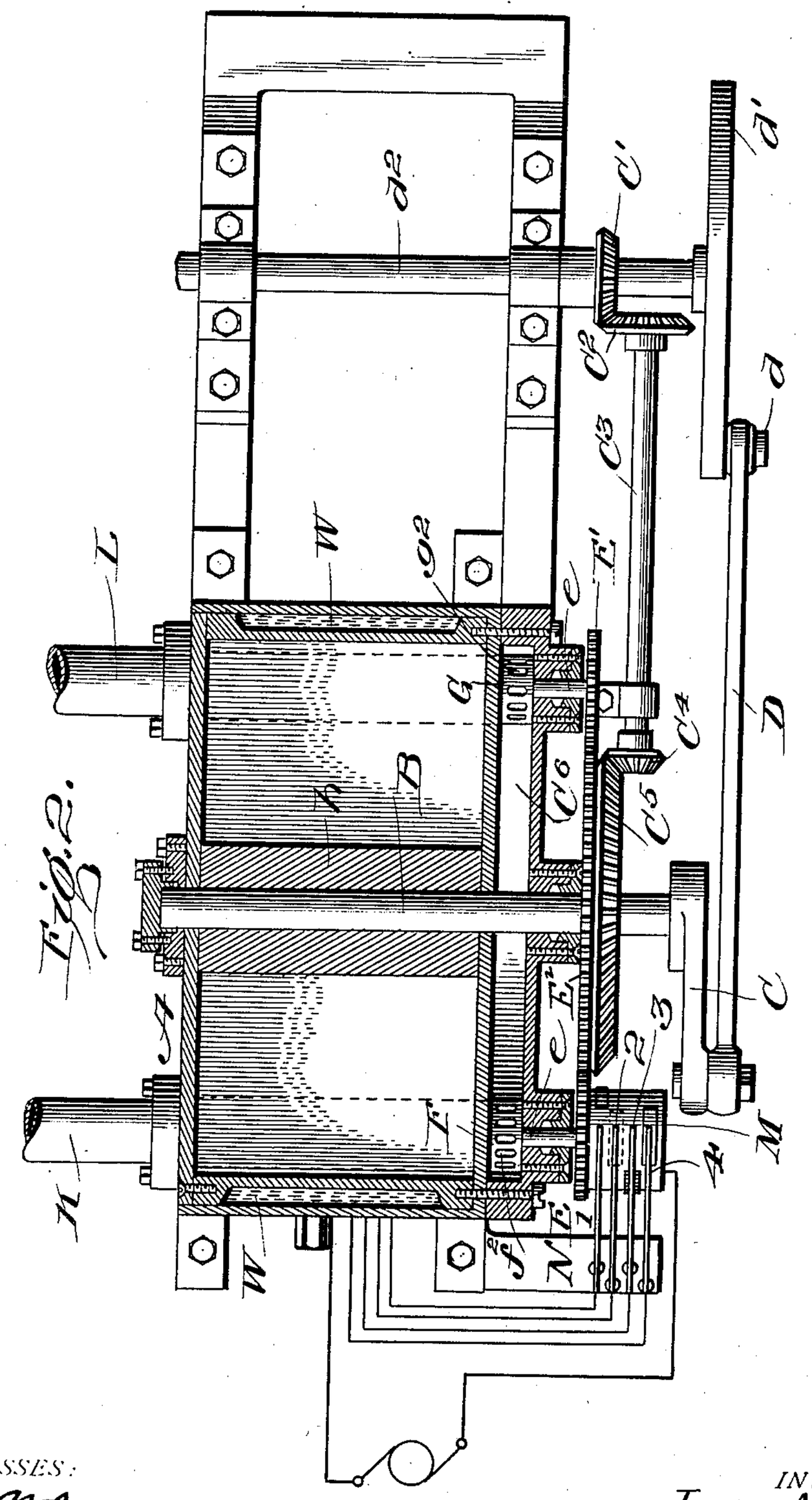


Fig. 2.

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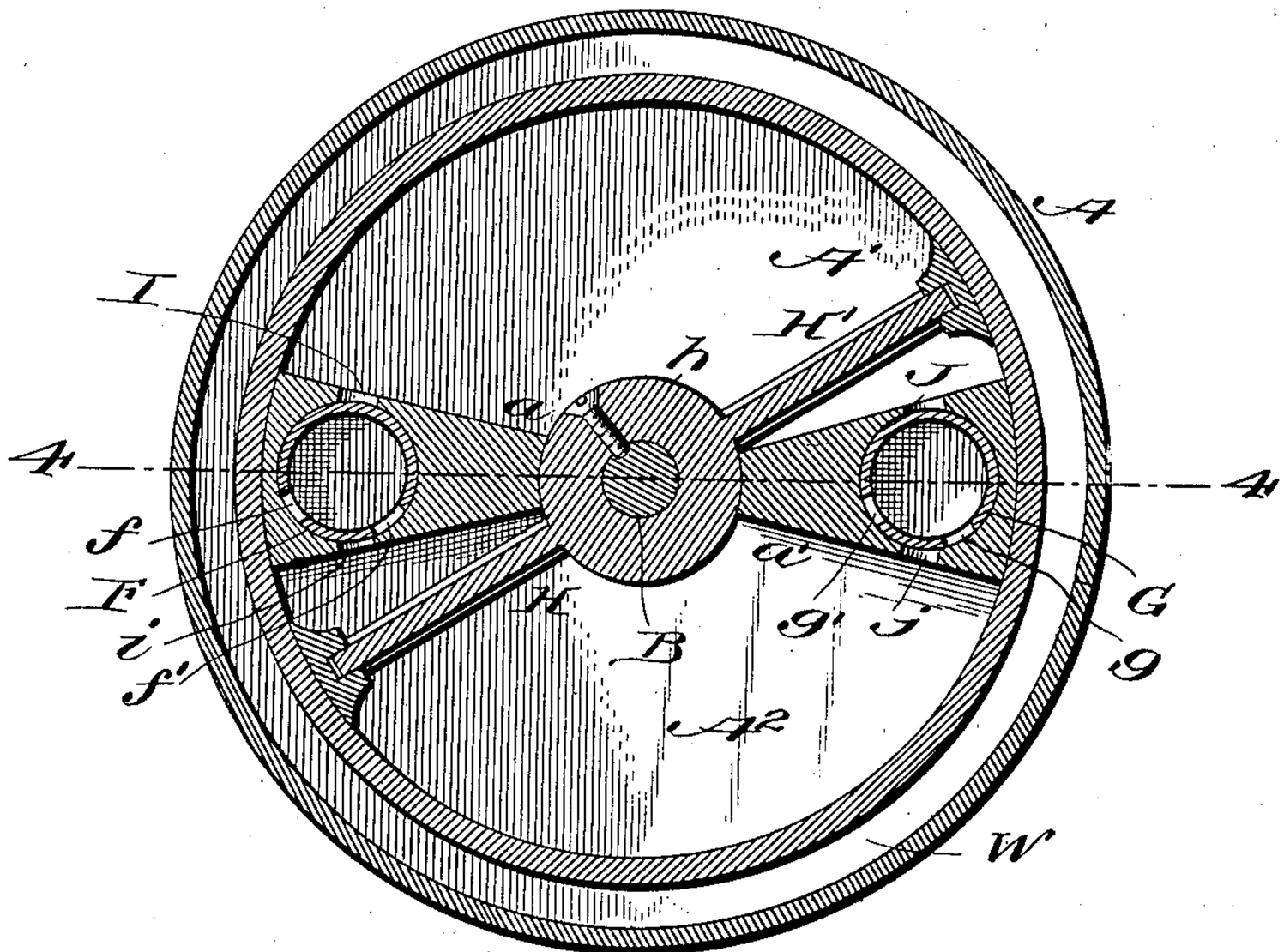
NO MODEL. 5 SHEETS—SHEET 3.

Fig. 3.


A
A'
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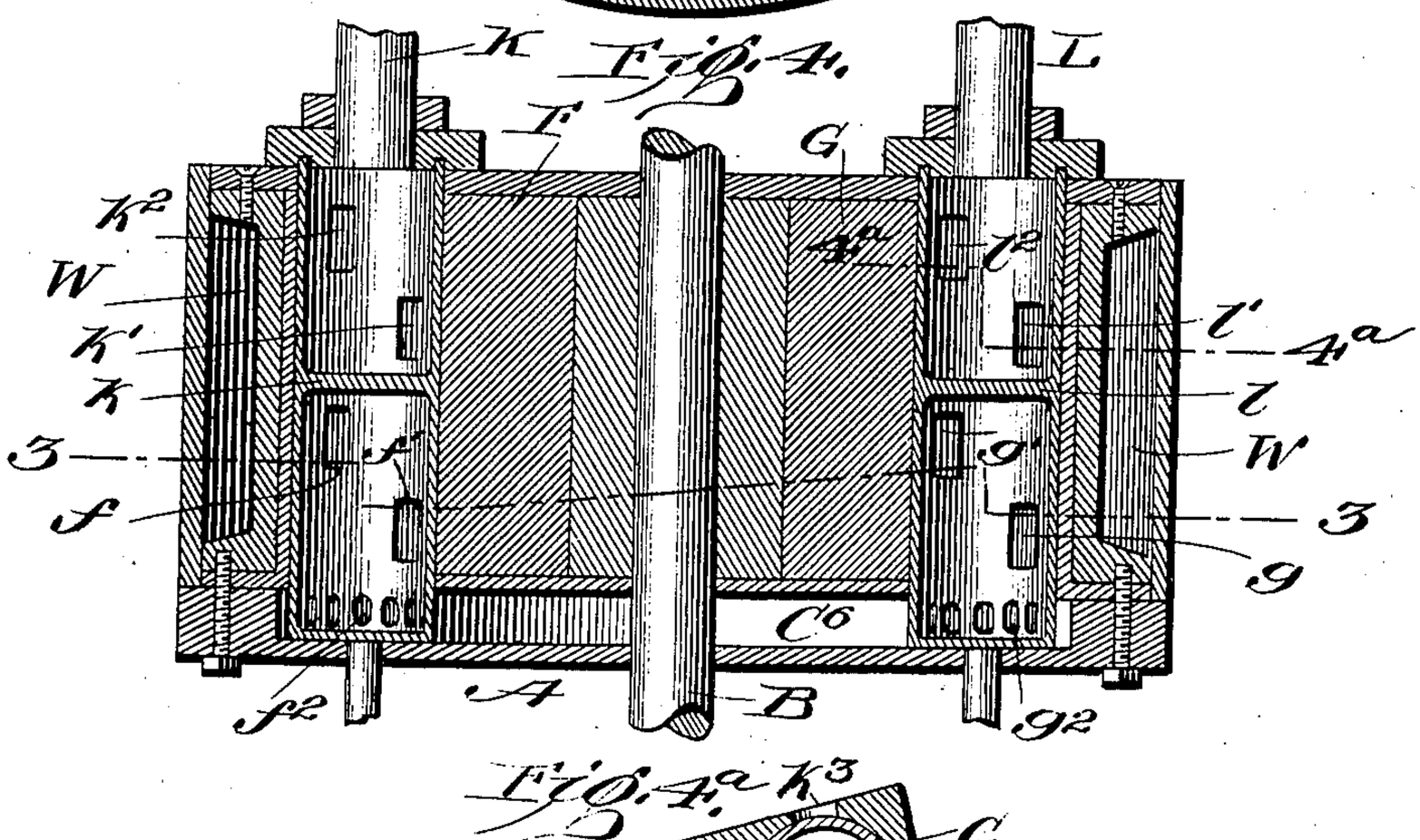
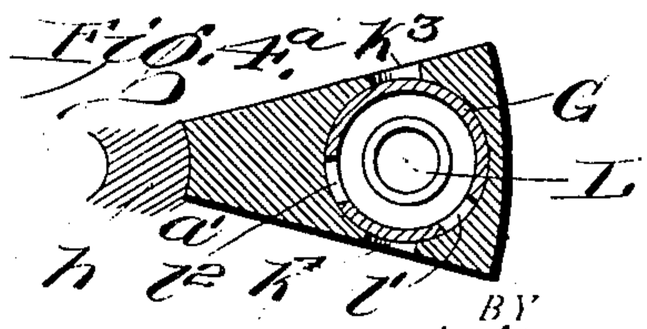



Fig. 4a.

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NO MODEL. 5 SHEETS—SHEET 4.

Fig. 6.

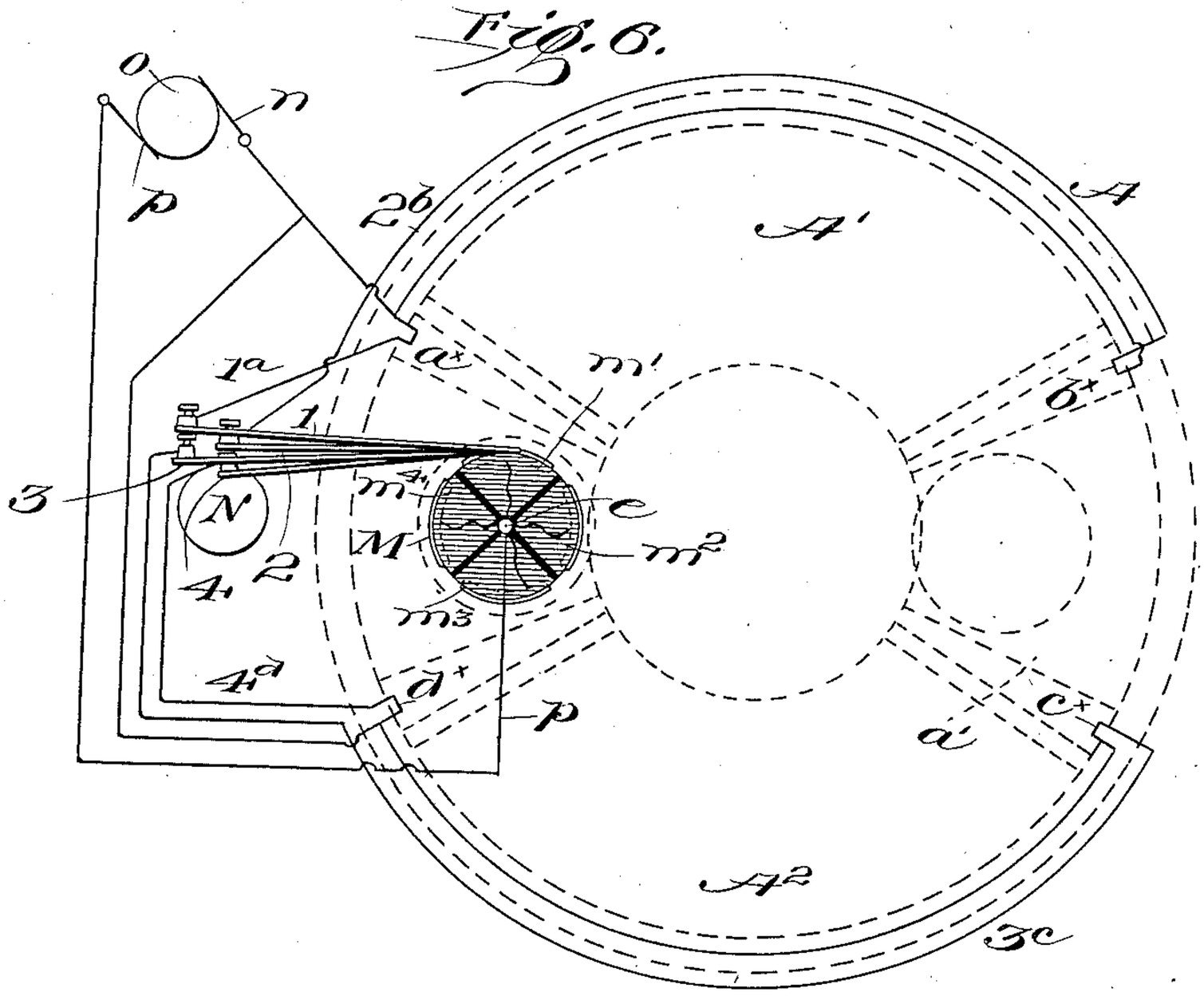
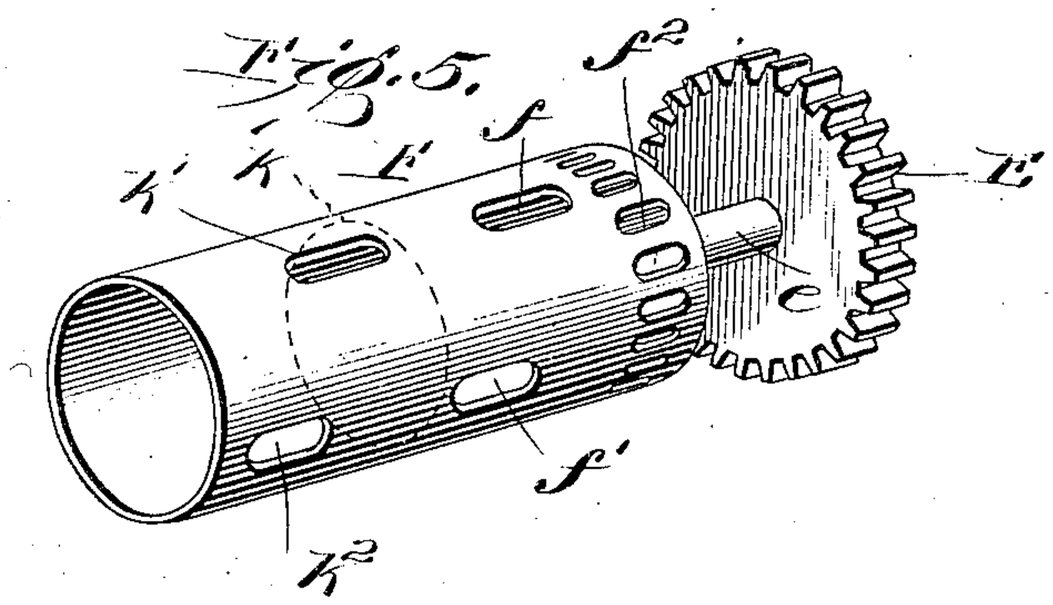



Fig. 5.

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## OSCILLATING PISTON EXPLOSIVE ENGINE.

APPLICATION FILED SEPT. 18, 1902.

NO MODEL. 5 SHEETS—SHEET 5.

Fig. 7.

First stroke

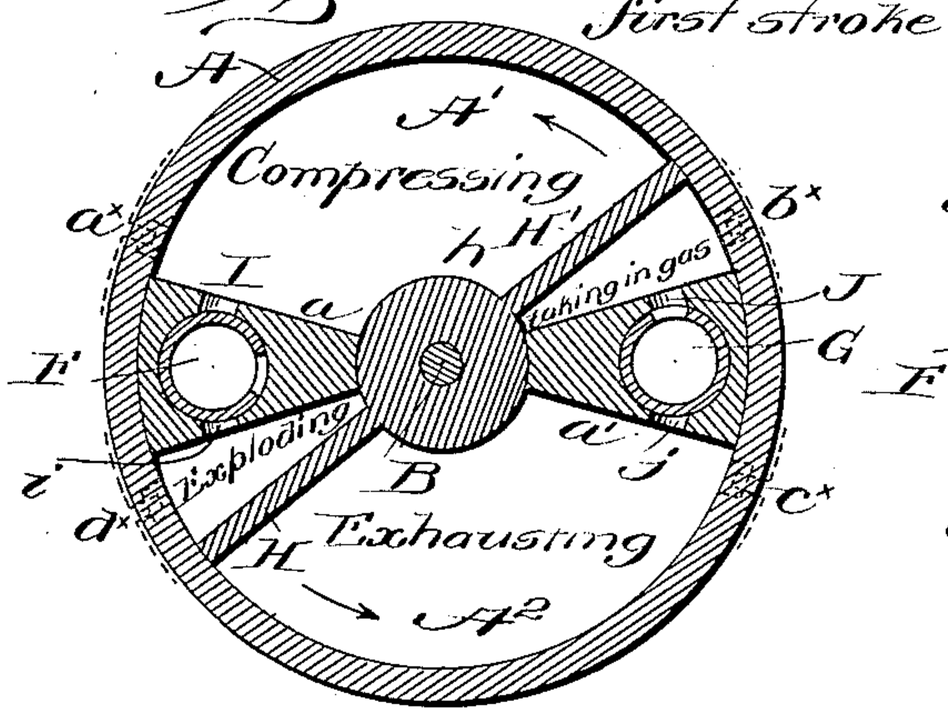



Fig. 8.

Second stroke

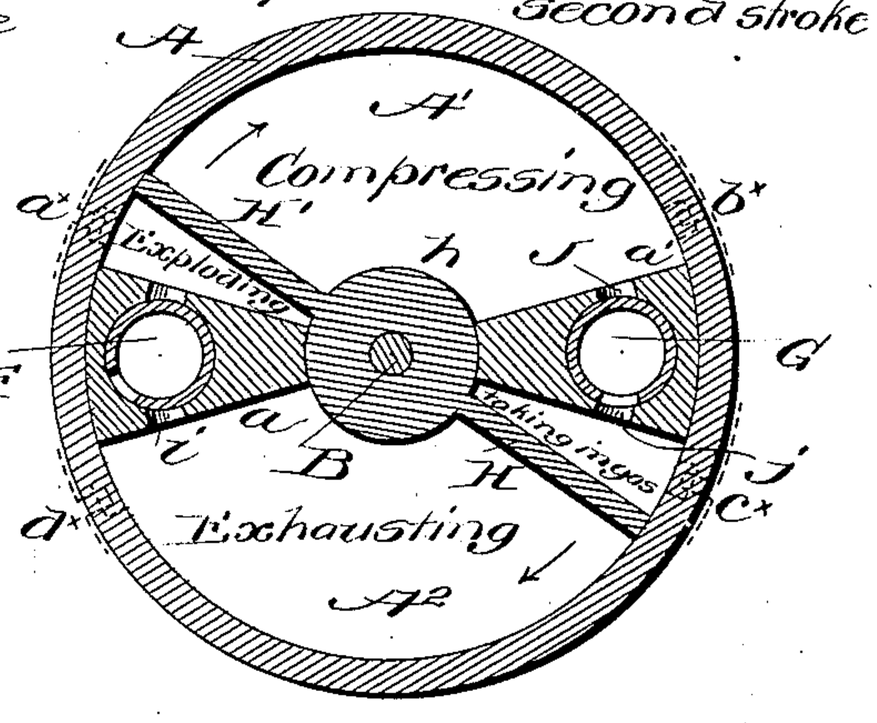



Fig. 9.

Third stroke

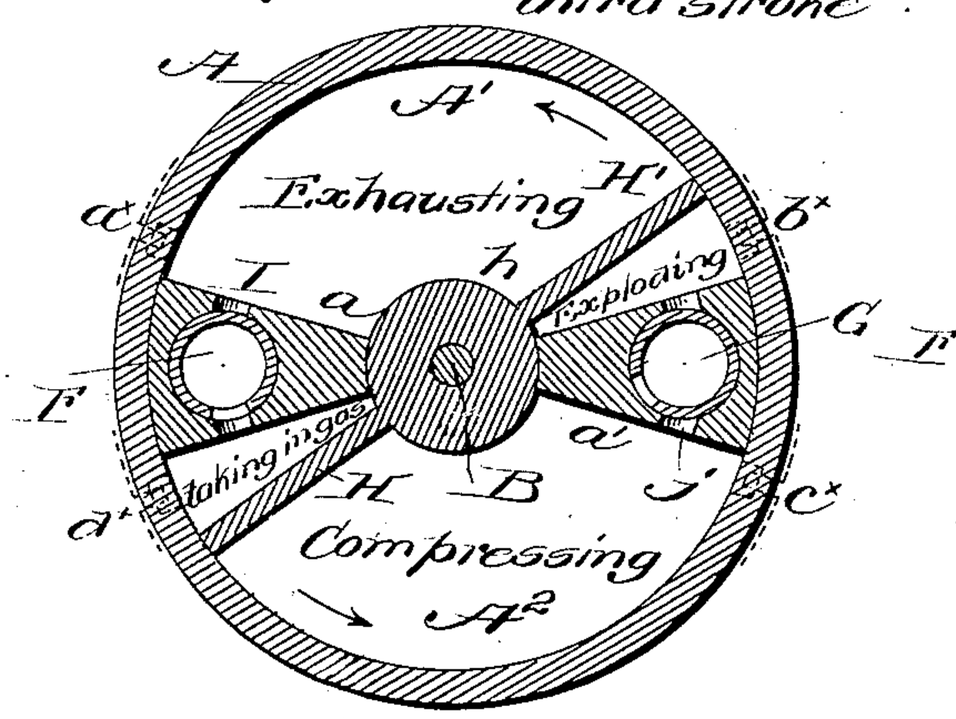
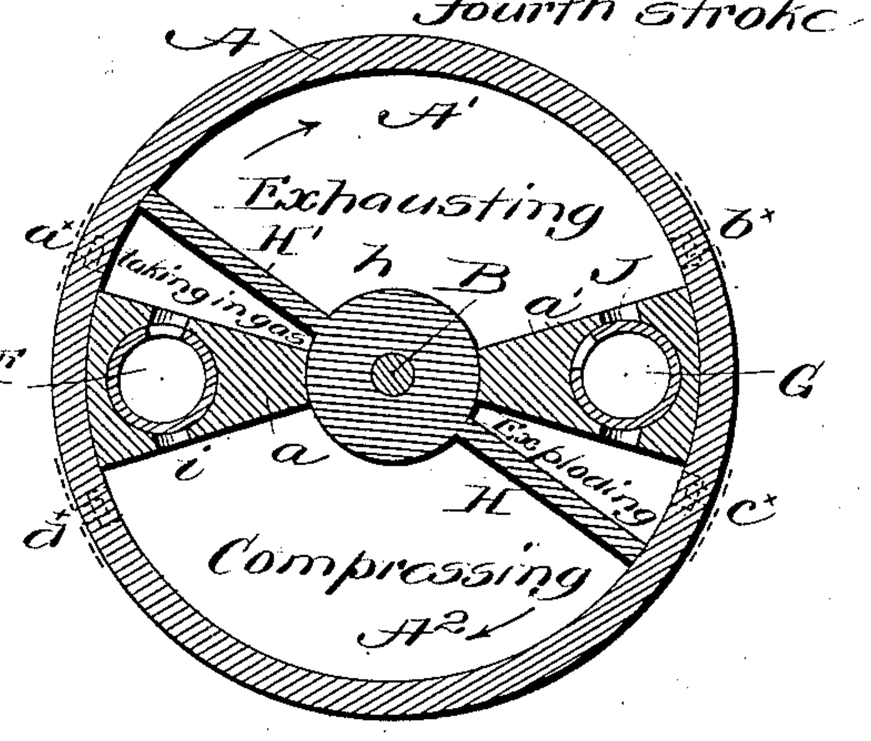



Fig. 10.

Fourth stroke

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# UNITED STATES PATENT OFFICE.

JAMES A. JENNEY, OF FAIRHAVEN, MASSACHUSETTS.

## OSCILLATING-PISTON EXPLOSIVE-ENGINE.

SPECIFICATION forming part of Letters Patent No. 725,087, dated April 14, 1903.

Application filed September 18, 1902. Serial No. 123,835. (No model.)

*To all whom it may concern:*

Be it known that I, JAMES A. JENNEY, a citizen of the United States of America, and a resident of Fairhaven, in the county of Bristol and State of Massachusetts, have invented certain new and useful Improvements in Oscillating-Piston Explosive-Engines, of which the following is a specification.

My invention relates to improvements in gas or explosion engines which may be operated with any gas or mixture of gases which will ignite and explode and when so exploded will act upon a movable part or piston to move it, together with connected parts, and thereby operate the engine.

The construction and operation of an engine embodying the invention will be hereinafter set forth and is illustrated in the accompanying drawings, and the novel features will be pointed out in the appended claims.

In the drawings, Figure 1 is a view in side elevation showing an engine embodying the invention. Fig. 2 is a top plan view, partly in horizontal section, along the line 2 2 of Fig. 1. Fig. 3 is a sectional elevation on line 3 3 of Fig. 4, showing the cylinder of my improved engine with one of the front plates or heads removed. Fig. 4 is a view in horizontal section on the line 4 4 of Fig. 3. Fig. $4^a$ is a detail in vertical section on the line $4^a$ $4^a$ of Fig. 4. Fig. 5 is an enlarged detail view of one of the combined inlet and exhaust valves of the engine. Fig. 6 is a diagram of the electrical connections for exploding the charges. Figs. 7, 8, 9, and 10 are similar diagrammatic views, in transverse sectional elevation, showing the interior of the cylinder with the piston in different positions to illustrate the operation of the engine.

The cylinder or exploding chamber of my improved engine is in the form of a drum A, through the center of which passes a main shaft B, to which crank C is attached. From this crank any desired mechanism may be operated. In the present instance, however, I have shown the crank C connected by a connecting-rod D with a wrist-pin $d$ in the crank-plate $d'$, attached to shaft $d^2$, which latter carries gears C', meshing with gear $C^2$ upon an intermediate shaft $C^3$, which is provided at its extremity with a beveled gear-pinion $C^4$, meshing with a bevel-gear $C^5$, which encircles and moves upon the same axis as but is independent of main shaft C. The bevel-gear $C^5$ is connected to a gear-wheel $E^2$ at its back or is formed with gear-teeth back of its level teeth, which gear-teeth engage and actuate the two oppositely-placed gear-wheels E E', which are attached to the shafts $e$ $e'$ of and impart rotary movement to the valves F G, by which the ingress of gas and the egress of the spent products of combustion are controlled, as indicated more clearly in Figs. 3, 4, 7, 8, 9, and 10.

The cylinder A is provided with a transverse stationary part or abutment dividing the interior of the cylinder into two equal chambers A' $A^2$, semicircular in form, but less in section than a true semicircle on account of the presence of the said abutment. This abutment is composed of two portions $a$ $a'$, which are secured to and extend from opposite sides of the cylinder to the central portion, being separated, and the space between their ends being occupied by the hub $h$ of the oscillating or swinging piston, which has two arms H H', which extend in opposite directions from said hub, which latter is carried upon the driving-shaft B. The abutment is formed of considerable thickness, and each half contains a cylindrical chamber or valve-seat, within which are rotatably mounted the double-ended tubular valves F G. The valves F G are divided at about their middle portion by transverse partitions $k$ $l$. One end of each valve is provided with supply-ports and their opposite ends with exhaust-ports. The supply ends of the valves F G extend into or communicate with a narrow chamber $C^6$, which is cut off from the main cylinder and serves as a mixing-chamber, and the ends of the said valves F G which extend into said chamber are provided with a number of relatively small perforations $f^2$ $g^2$, through which the mixture of air and gas enters the supply ends of the valves. The supply ends of the valves F G are provided with ports $f$ $f'$ and $g$ $g'$, which are adapted to register at desired times with ports I $i$ J $j$, extending into the chambers A' $A^2$, into which the said cylinder A is divided by the abutment $a$ $a'$. Other and similar ports are formed in the abutment $a$ and correspond to the exhaust-ports $k'$ $k^2$ in the exhaust end of the valve F, Figs. 4, 5,

which communicates with the exhaust-pipe K for removing the products of combustion at desired times. Similarly the other half of the abutment $a'$ is formed with exhaust-ports $k^3$ $k^4$, adapted to register with ports I' I² in the exhaust end of said valve and to communicate with the exhaust-pipe L, as indicated in Fig. 4ª. The piston H oscillates back and forth toward and away from the two valves of the abutment, and in so oscillating the crank C is caused to oscillate, but does not make a complete revolution, as it would be impossible for the piston to pass the abutment extending transversely of the cylinder. The oscillating movement of the crank C communicates rotary movement to the shaft $d^2$ and from there as may be desired, in addition to which the said rotary movement is conveyed back to the cylinder through the shaft C³ and connected parts, so that rotary movement is imparted to the two valves F G, which are embedded or seated in the abutment, whereby a most economical control is afforded over the motor fluids to be supplied to the cylinder and exhausted therefrom. The valves by which the motor fluids and products of combustion are admitted to and withdrawn from the cylinder are in the form of revolving cylinders F G, which are rotatably mounted in suitable cylindrical chests or receptacles therefor, one in each half of the abutment, which divides the cylinder on its central longitudinal axis. Means for imparting rotary movement to these valves has been referred to. The valves are transversely divided at about their central portion by diaphragms $k$ $l$, so that the ports $k'$ $k^2$ $l'$ $l^2$ on the exhaust side of the diaphragm connect with the exhaust-pipes K L, secured in the side of each chamber A' A² and leading thereinto, and act only as exhaust-ports, while the ports $f$ $f'$ $g$ $g'$ on the other sides of the diaphragm—that is, in the other ends of the valves F G—are the inlet or supply ports and communicate through a series of smaller openings $f^2$ $g^2$ with chamber C⁶ at one side of the cylinder, into which the supply ends of the said valves extend and which is the mixing-chamber for the air and gas and from which the explosive mixture passes through the said small holes $f^2$ $g^2$ into the ends of the valves and through the larger openings or ports $f$ $f'$ $g$ $g'$, through corresponding ports I $i$ J $j$ in the abutment, and into the chambers A' A³ of the cylinder, and the ports are so located that their registration will occur at desired intervals for producing the proper effect upon the piston H.

C⁷ is an inlet-pipe connecting with the mixing-chamber C⁶ and provided with a check-valve C⁸ and also with a stop-cock C⁹, and C¹⁰ is a pipe through which gas is supplied to the inlet-pipe, C¹¹ being another pipe through which air is supplied. In operation the gas and air pass through the inlet-pipe C⁷, Fig. 1, and into the mixing-chamber C⁶, Figs. 2 and 4, from which chamber it passes through the apertures $f^2$ $g^2$ into the supply ends of the valves F G, and thence through the said valves and their ports and the ports in the abutment into chambers A' A² of the cylinder as the said valves are rotated through the cycle of operation. The piston H oscillates or swings from the side of one-half of the abutment on one side of the cylinder to the other. The combination of gears and revolving valves, together with the openings in the valves and the ports in the abutment, are so arranged that the several operations of charging the several parts of the cylinder with an explosive mixture of gas and air, compressing the charge, exploding the compressed charge, and, lastly, exhausting the products of combustion from the cylinder proceed in regular successive order in the four divisions of the cylinder, as will be more clearly apparent from inspection of the illustrative diagrams Figs. 7, 8, 9, and 10, in which the different positions of the valves and the piston during the four different strokes comprising the cycle of operation are shown diagrammatically. In these views the letters of reference are omitted from the ports to avoid confusion, the different supply and exhaust ports being assumed to be in positions to admit of the inlet and egress of the gases, as indicated by descriptive matter occurring in the drawings.

In Figs. 7, 8, 9, 10 four different steps in the operation of the engine are shown, each representing a power-stroke of the piston and illustrating the cycle of the supply, compression, explosion, and exhaust in the several compartments of the cylinder. As in Fig. 7, the piston is swinging in the direction of the arrows, its arms moving away from the abutment on one side $a'$ and toward the other side $a$ thereof. At the moment illustrated in Fig. 7 the explosive mixture, which has been compressed into the lower left-hand part, is being exploded by loop $d^\times$. The force so applied will, acting upon arm H of the piston, cause it to swing, as indicated by arrows, away from the point of explosion. This will drive out the products of combustion on the other side of the said arm H of the piston through the exhaust-port on that side, it being then open. During the moment just described the other arm H' of the piston is compressing its explosive charge and taking gas into the space being formed between itself and the abutment. The next step is indicated in Fig. 8, in which the explosion occurs on the opposite side of the same part $a$ of the abutment as in Fig. 7, the loop $a^\times$ exploding the charge last compressed and reversing the direction of movement of the piston. This action results in taking in the explosive mixture from the opposite side of the other portion $a'$ of the abutment filling the space last exhausted. Meanwhile the products of combustion from the last explosion in the fourth division of the cylinder are being driven out through the appropriate exhaust-port. The third step

shifts the point of explosion to the opposite side of the cylinder, it taking place in the space occupied by the loop $b^{\times}$. At the same time the explosive mixture is compressed against the opposite side of the same abutment. In Fig. 10 the fourth and last step in the cycle of operation occurs, and the fourth explosion takes place from the firing-loop $c^{\times}$, completing the cycle. The next explosion will be as indicated in Fig. 7, the same cycle being followed as before, so that with each explosion there is a complete swing of the piston from one side to the other, the products of combustion are swept out of the last exploded chamber, the opposite side of said chamber is filled with an explosive mixture, and the charge of explosive mixture on the opposite side of the end of the piston against which the explosion is taking effect is thereby compressed to the desired point of subsequent firing. At the same time the compression of the gas cushions the piston and prevents damage thereto. Each movement of the piston is directly due to a separate explosion, so that the engine is not required to store up energy in a heavy fly-wheel sufficient to carry it for a number of strokes or for even a single stroke without the direct impetus or application of force, which application being directly upon the piston imparts the power-stroke thereto and compresses the gas on one side, while preparing the opposite side of the cylinder to perform a like function, since, as indicated in Figs. 7, 8, 9, 10, the point of compression, the point of charging with explosive mixture, and the point of exhausting the products of combustion follow each other around the central axis in the order named and in regular succession.

The igniting device is shown in Figs. 1, 2, and 6, and comprises a commutator M, which is divided into segments corresponding with the number of points in the cylinder at which the gas is to be exploded, in this instance four, $m'$ $m^2$ $m^3$ $m^4$, said commutator being conveniently mounted upon the end of the shaft $e$ which is connected with valve F. Commutator-brushes 1 2 3 4 are suitably supported at their rear ends by an arm N, with their outer or free ends bearing upon the periphery of the commutator, the segments of which engage the brushes 1 2 3 4 in succession as the commutator is rotated and produce incandescence or sparks at points around the cylinder A for the purpose of igniting the charges of gas and air in the several portions of the cylinder at the proper times to produce regular oscillations of the piston and of the crank C, whence motion is transmitted. The brush 1 is connected to conductor $1^a$, which is provided with a loop $a^{\times}$, entering the chamber A′ and desirably fitting into a suitable recess therein in order to escape destruction by the piston in its movement. The loop $a^{\times}$ may be of any desired or well-known construction whereby a spark or sufficient heat is produced by the passage therethrough of a current of electricity when the corresponding section of the commutator M passes under the brush 1. The brush 2 is connected to conductor $2^b$ and in like manner includes a loop $b^{\times}$, entering the other side of the chamber A′. The commutator-brush 3 is connected by conductor $3^c$ with a similar loop $c^{\times}$, which enters the chamber $A^2$ on the opposite side of the abutment, and commutator-brush 4 is connected by conductor $4^d$ to loop $d^{\times}$ on the other side of the same chamber $A^2$. With this construction igniting-sparks or incandescence will be produced in loops $a^{\times}$ $b^{\times}$ $c^{\times}$ $d^{\times}$ in succession as the conducting-strips on the commutator M successively engage the brushes 1 2 3 4. O represents a suitable source of current from which extend conductors $p$ $n$. The conductor $p$ is connected with all of the segments of the commutator, while the conductor $n$ is provided with four branches, which extend to and connect with the return ends of the circuits $1^a$ $2^b$ $3^c$ $4^d$, including the igniting-loops, and completing the circuit of said loops back to the source of current, each of the circuits being closed in turn upon the source of current as each successive segment passes under one of the commutator-brushes.

A water-jacket W is formed about the cylinder A in order to absorb a large proportion of the heat generated by the explosion.

While I have described a construction of my improved engine in detail, I do not limit myself to the precise details shown and described, since many minor modifications and changes may be made in view of the foregoing without departing from the invention, which is not limited to the particular arrangements shown.

Having described my invention, what I claim is—

1. The combination with a cylinder having a transverse stationary abutment dividing it into two equal chambers, a fuel-passage in each abutment and ports from each passage to both the chambers, a centrally-mounted swinging piston having arms, one extending into and dividing each chamber, a rotary admission-valve seated in each abutment-passage and connections operated by the piston for continuously rotating the valves, the valves being set so that an explosive mixture is supplied in succession to the four divisions of the cylinder formed by the pistons and abutments and means for exploding the charge in succession, whereby each charge being compressed serves as a cushion for a charge being exploded.

2. The combination with a cylinder having a transverse stationary abutment dividing it into two equal chambers, a centrally-mounted swinging piston having an arm extending into and dividing each chamber, rotary tubular valves seated one in each half of the abutment and each having a transverse partition, connections between one end of the valve and the supply of motor fluid and between the other end of said valve and the exhaust,

ports and passages between the two portions of the valve and the chambers on each side of the abutment, and means for continuously rotating the said valves and supplying the motor fluid to and exhausting the products of combustion from the chambers on opposite sides of the abutment in succession.

3. The combination with a cylinder having a transverse stationary abutment dividing it into two chambers, a centrally-mounted swinging piston having an arm extending into and subdividing each chamber, valves seated in each half of the abutment and connected with the several compartments by suitable inlet and outlet ports and passages and means for supplying an explosive mixture to the compartments of the cylinder in succession and for exploding the said charges in succession in the several compartments of the cylinder, whereby the power-stroke imparted to the piston by each explosion in one compartment coincidently compresses a charge in another compartment of the cylinder.

4. A gas-engine having a cylinder, a stationary abutment extending transversely and dividing it into compartments, a driving-shaft in the center of the cylinder and a swinging piston attached thereto having an arm extending into and subdividing each compartment, a continuously-rotating valve seated in each abutment, a plurality of ports extending into each compartment, a transverse division in each valve, ports in one end of each valve adapted to register only with part of the ports extending through the abutment and into the compartments and connected with an exhaust-pipe, and other ports in the other division of the valve registering with the remaining ports in the abutment and connected with a supply of explosive gases and means for turning the valves and supplying explosive mixture to the several divisions of the cylinder in succession and coincidently exhausting the products of combustion.

5. The combination with a cylinder having a transverse stationary abutment dividing it into two equal chambers, a centrally-mounted swinging piston having an arm extending into and dividing each chamber, a rotary valve seated in each part of the abutment, a rotating tubular valve seated in each half of the abutment, said valve having a transverse division, connections with one end of the valve and the exhaust and with suitable ports and passages extending into the chamber on each side of the abutment, and connections with the other end of said valve and a source of explosive gas, and ports and passages connecting said supply end of the valve with the chambers on each side of the abutment, the said ports and passages in the abutment and in the valve being so located that the said valve, in its revolution while supplying explosive mixture to the chamber on one side of the abutment is exhausting the products of combustion from the chamber on the other side thereof.

6. The combination with a cylinder having a transverse stationary abutment dividing it into two equal chambers, a centrally-mounted swinging piston having an arm in each chamber thereby dividing the cylinder into four compartments, a continuously-rotated double-ended valve in each abutment, and ports and passages connecting one end of each valve with a mixing-chamber and conveying a supply of explosive gas from said mixing-chamber to two of the compartments in succession, and similar ports and passages connecting the same compartments through the other end of the valve with the exhaust, a similar valve having corresponding ports and passages rotatably mounted in the opposite half of the abutment, mechanical connections operated by the piston for continuously rotating said valves whereby a supply of explosive mixture is delivered to each of the four divisions of the cylinder in succession, one of the said charges is exploded in each one of the four compartments in succession, and coincidently a charge is being compressed in one of the four compartments and an exploded charge is being exhausted.

Signed at New York, N. Y., this 16th day of September, 1902.

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