H. H. CUTLER.

COMBUSTION ENGINE.

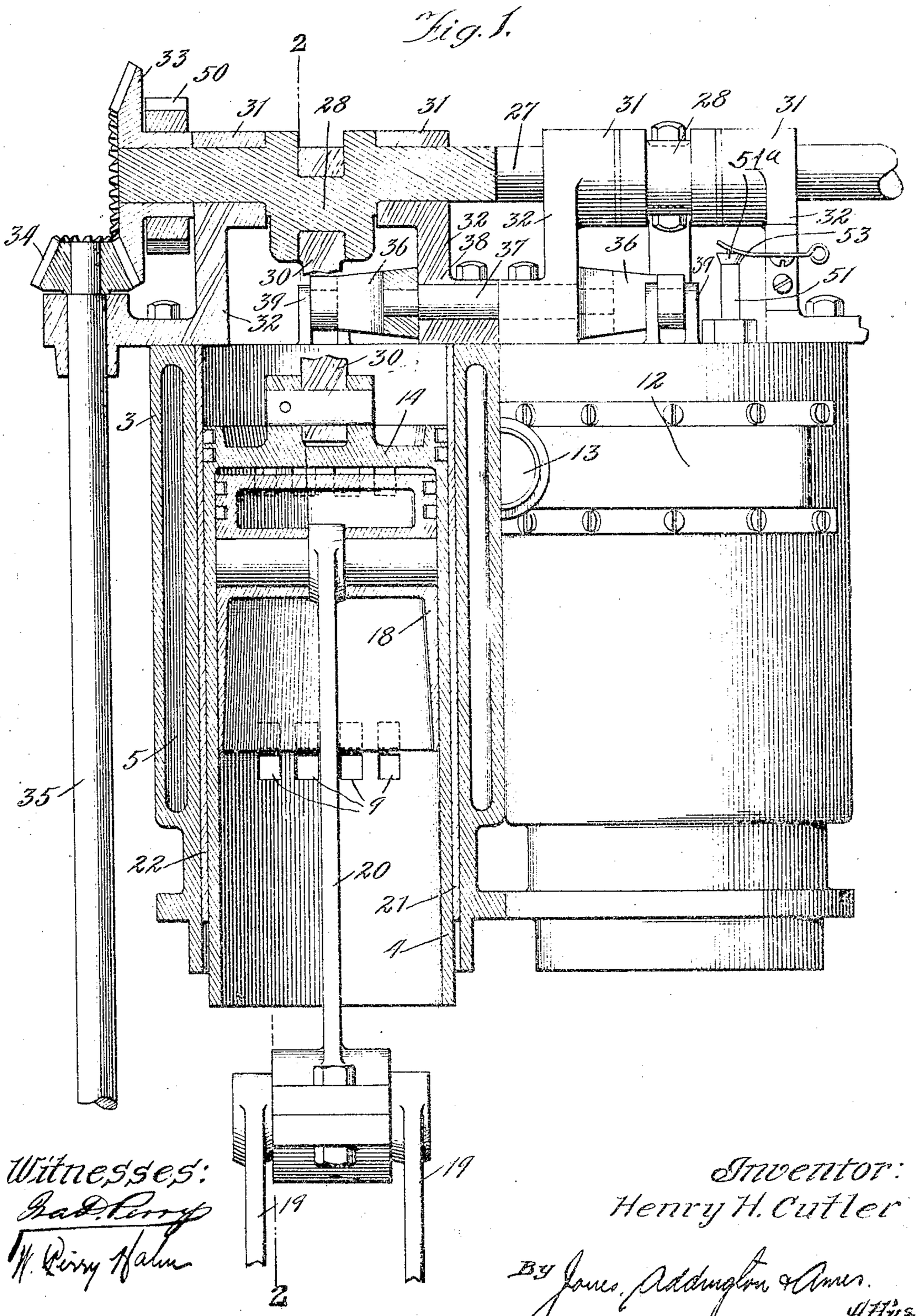
APPLICATION FILED MAY 13, 1907.

923,496.

Patented June 1, 1909

4 SHEETS—SHEET 1.

Fig. 1.



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4 SHEETS—SHEET 2.

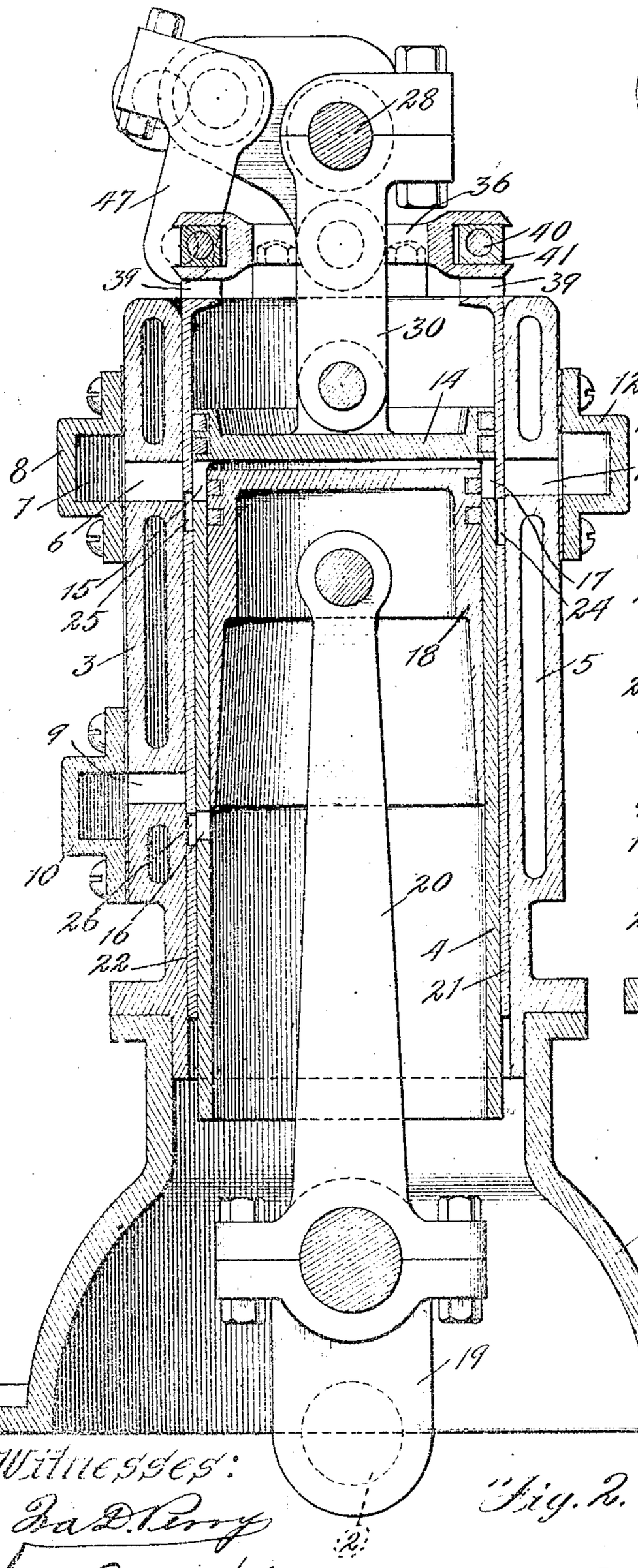

Fig. 2.

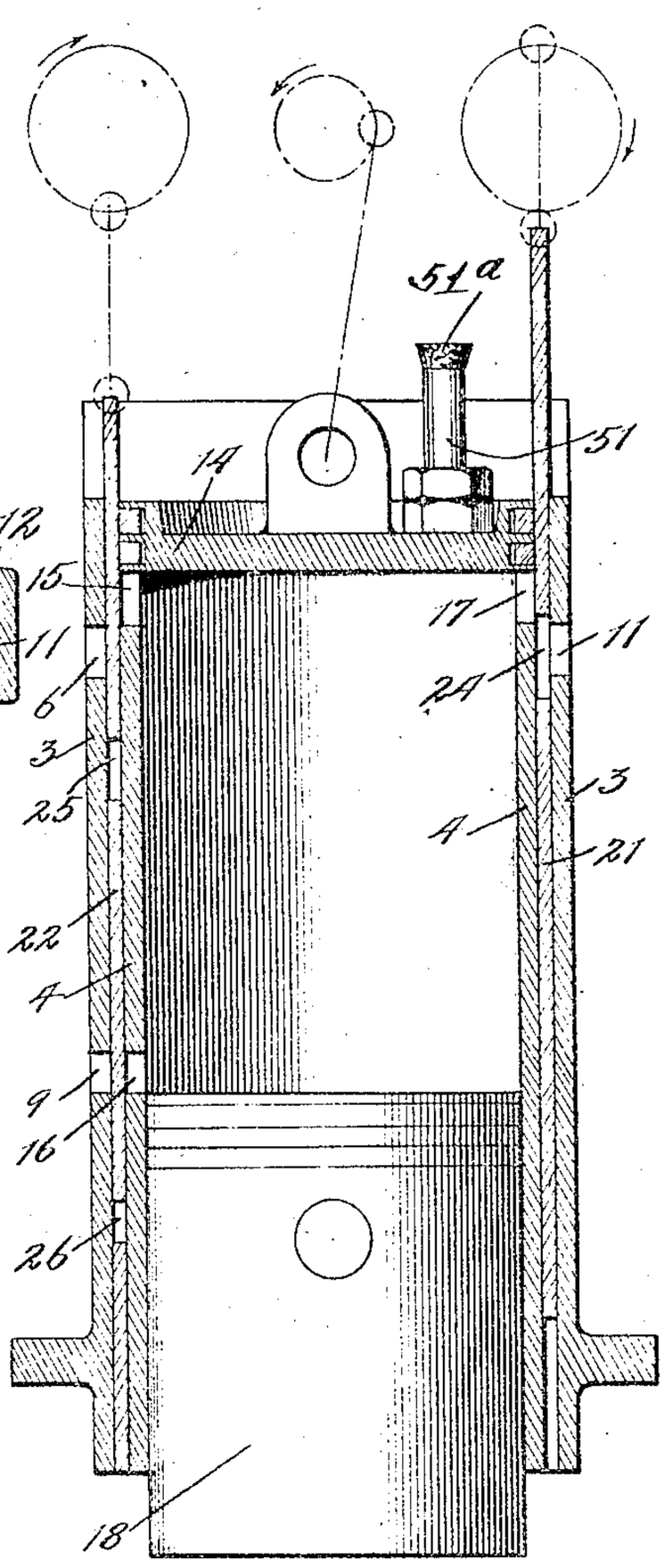

Fig. 3.

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4 SHEETS—SHEET 3.

Fig. 4.

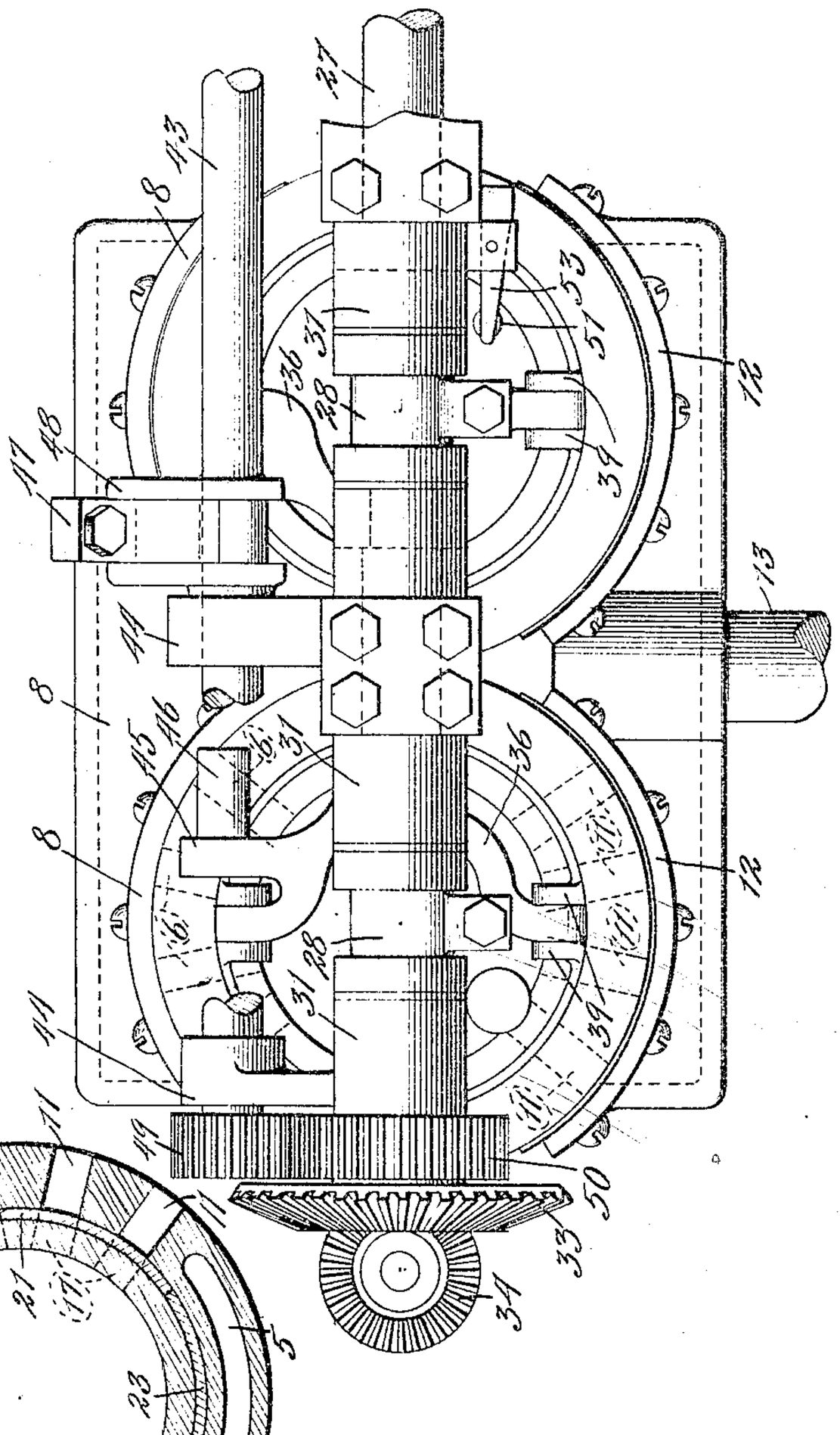
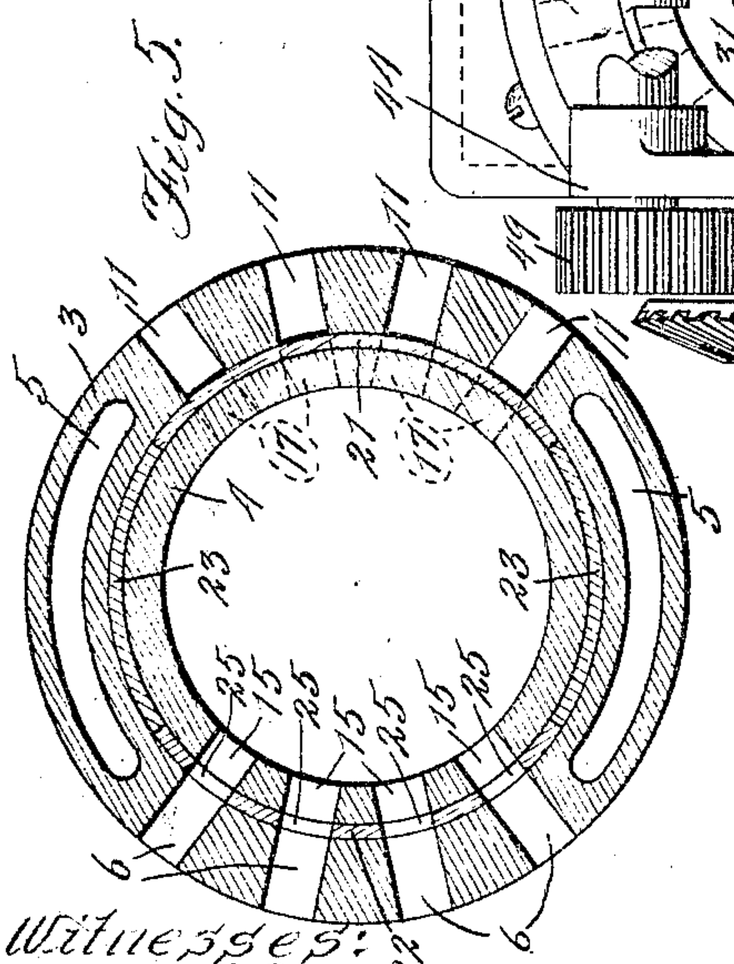


Fig. 5.



Witnesses:

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4 SHEETS—SHEET 4.

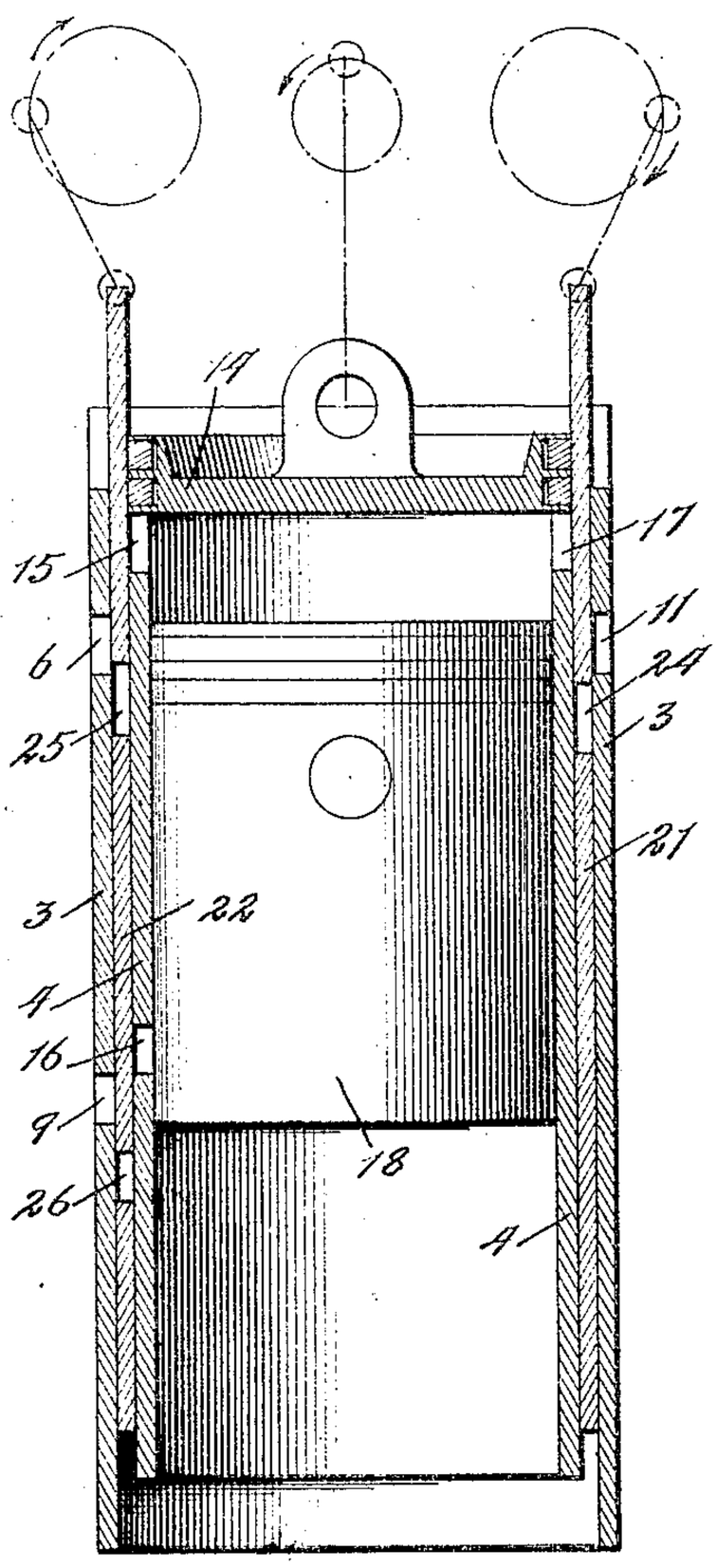

Fig. 6.

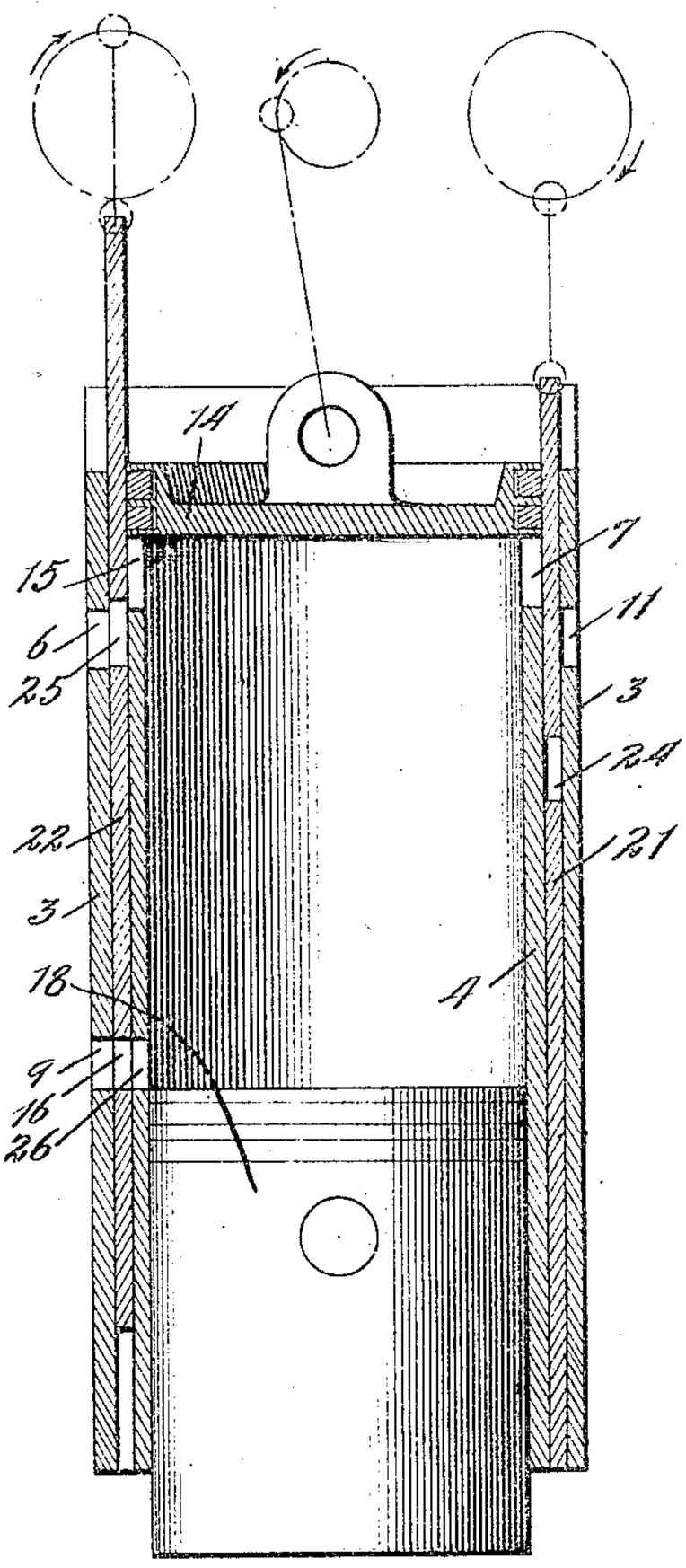

Fig. 7.

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UNITED STATES PATENT OFFICE.

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COMBUSTION-ENGINE.

No. 923,496. Specification of Letters Patent. Patented June 1, 1909.

Application filed May 13, 1907. Serial No. 373,329.

To all whom it may concern:

Be it known that I, HENRY H. CUTLER, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented new and useful Improvements in Combustion-Engines, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My invention relates to improvements in combustion engines, one of the objects of the same being to provide a combustion engine which is practically self scavenging.

Another object of my invention is to provide means for accomplishing the scavenging of the engine without undue multiplication or complication of parts.

In carrying my invention into effect I preferably provide a cylinder capable of reciprocating movement, a piston operating in said cylinder, inlet and exhaust controlling valves, and means for causing the cylinder to make one to and fro movement during every two such movements of the piston, the movements being so timed that the head of the cylinder is in close proximity to the top surface of the piston toward the end of the exhaust stroke, and distant therefrom to a sufficient extent to allow enough compression space at the end of the compression stroke, whereby perfect scavenging and compression are respectively obtained.

For the purpose of disclosing my invention I have illustrated in the accompanying drawings one form which the invention may take.

In said drawings Figure 1 is a side elevation of two cylinders of an explosive engine, one of the cylinders being shown in section; Fig. 2 is a transverse section on the line 2—2 of Fig. 1; Fig. 3 is a diagrammatic view of one of the engine cylinders; Fig. 4 is a plan view of two engine cylinders; Fig. 5 is a sectional view of one engine cylinder showing the arrangement of the ports; Figs. 6 and 7 are diagrammatic views showing the cycle of operation of one cylinder.

In the drawings I have shown two cylinders of a multiple cylinder engine but it will be understood that my invention is equally applicable to a single cylinder engine. In carrying out my invention each cylinder is mounted upon a crank casing 1 of the usual construction, the upper half of which is shown in Fig. 2 and in which operates the crank shaft 2. Each cylinder comprises an outer or stationary cylinder 3 and an inner and movable cylinder 4.

The stationary cylinder is open at the top and bottom and is provided with a water jacket 5 of the usual construction which surrounds the same. Suitable exhaust ports 6 are provided in the sides of the cylinder 3. These ports consist of a plurality of holes, preferably four, bored through the walls of the cylinder and adapted to communicate with the exhaust chamber 7 formed in the valve bonnet 8. The valve bonnet 8 is preferably formed of a single casting common to all of the cylinders, and bolted or otherwise secured to the sides of the stationary cylinders 3. One end of the bonnet may be suitably connected to the exhaust discharge through a suitable muffler as desired. A second or auxiliary exhaust 9 is also provided in the stationary cylinder in the form of a plurality of holes which are bored through the stationary cylinder at a point near its lower end and which communicate with the auxiliary exhaust valve bonnet 10 similar to the bonnet 8. Inlet ports 11, are also provided in the stationary cylinder which likewise take the form of a plurality of holes, preferably four, bored through the cylinder 3 and adapted to communicate with the inlet chamber formed in the inlet bonnet 12. The inlet bonnet like the exhaust bonnet preferably consists of a single hollow casting common to all the cylinders bolted or otherwise secured to the walls of the stationary cylinders. This inlet bonnet is connected to the admission pipe 13 extending from a suitable fuel supply.

The movable cylinder 4 constitutes the operating cylinder of the engine and is provided with a head 14. The head is provided with suitable packing rings which prevent any of the gases, from escaping upwardly between the movable cylinder 4 and the stationary casing 3. The cylinder 4 is provided with exhaust ports 15 and 16 which take the form of a plurality of holes bored through the side walls of the cylinder adapted to register, when the cylinder 4 is in its exhaust position, with the exhaust ports 6 and 9 in the stationary cylinder 3. Intake ports 17 are also provided in the side walls of the cylinder 4 which, when the cylinder is in its admission or intake position, are adapted to register with the intake ports 11 in the stationary cylinder 4. The piston 18 of the

cylinder operates in the movable cylinder 4 and is connected with the crank 19 of the crank shaft by the usual piston rod 20.

The valves for controlling the intake and exhaust of the engine preferably comprise a pair of arc shaped slides 21 and 22 interposed between the stationary cylinder and the movable cylinder. Each slide is about one third of the circumference of the cylinders so that there is left a short space between the stationary cylinder and movable cylinder. This space is preferably filled by two stationary segments 23 which may be separate from the cylinder 3 or may be formed integrally therewith. The intake valve 21 is provided with a plurality of ports 24 which, at the proper interval, are adapted to register with the inlet ports 11 in the stationary cylinder and the inlet ports 17 in the movable cylinder. Exhaust ports 25 and 26 are likewise provided in the valve 22 which, at the proper interval, register with the exhaust ports 6 and 9 in the stationary cylinder and the exhaust ports 15 and 16 in the movable cylinder.

In order that a proper compression space may be formed between the end of the piston 18 and the head 14 of the movable cylinder 4 and in order that after the explosion takes place and the piston moves to its exhaust stroke, the distance between the cylinder head and the piston may be reduced to a minimum to insure the discharge of all the burned gases, the movable cylinder is adapted to be moved away from and toward the piston as suitable intervals. This movement also causes the proper registering of the inlet and exhaust ports of the movable cylinder with the inlet and exhaust ports of the stationary cylinder.

The movement of each movable cylinder is accomplished by a rotating crank shaft 27, and cranks 28, the working length of which is approximately equal to half the distance which it is desired to have between the lower face of the head 14 and the upper face of the piston 18, when the gases are compressed to the greatest extent. I preferably provide a single shaft common to all the cylinders of the engine, provided with a crank for each movable cylinder adapted to be connected to the head of the cylinder by a pitman 30. The shaft is supported in journals 31 formed in brackets 32 secured upon the tops of the stationary cylinders 3 and is driven by a bevel gear 33 meshing with a bevel gear 34 of a vertical shaft 35 driven from the crank shaft of the engine, the gearing being such that the shaft 27 makes one revolution for every two revolutions of the shaft 2.

The valves 21 and 22 of each cylinder are reciprocated by a rocker arm 36, mounted upon a shaft 37. The shaft 37 is mounted in a bearing 38 formed in the brackets 32 and a single shaft may support the arms for two cylinders, an arm being mounted on each end of the shaft. One end of the arm is connected to the valve 21 by a pair of lugs 39 between which is adapted to fit the end of the arm and a pin 40 which extends through the lugs and through a block 41 fitting in a slot 42 in the end of the arm. The opposite end of the arm 36 in a like manner is connected with the valve 22.

The rocker arm is operated from a crank shaft 43 mounted in journals 44 formed in arms extending from the brackets 32. This shaft extends over all of the cylinders and operates all of the rocker arms, where a plurality of cylinders are used. Each rocker arm is provided with a short extension 45 which is connected, by a pin 46, to a pitman 47 extending from a crank 48 of the shaft 43 and, as the crank shaft 43 is rotated, by a gear 49 keyed thereon and meshing with the gear wheel 50 mounted on the shaft 27, the rocker arm is caused to reciprocate the valves 21 and 22.

The ignition of the charge in each cylinder is effected by the usual spark plug 51 fitted into the top of the cylinder 4. This plug, however, instead of being permanently connected with the spark coil is only connected during the ignition of the charge. This is accomplished by the provision of a carbon contact 51^a upon the spark plug which, when the plug is moved upwardly with the cylinder, 4 is adapted to engage the stationary contact 53 connected with the spark coil.

The operation of the engine is as follows: Assuming, for the purpose of describing the cycle of operation, that the charge has been exploded and the burned gases exhausted and that the piston is at the beginning of the intake stroke, then the parts are in the position illustrated in Fig. 2, with the movable cylinder 4 in its lowermost position and the rocker arm 36 in substantially a horizontal position. This leaves the exhaust valve 22 almost closed and the intake valve 21 about to open and exhaust ports 6 and 15 registering and the intake ports 11 and 17 registering. As the piston moves downwardly, the valve 22 moves downwardly completely closing the ports 6 and 15 and the valve 21 moves upwardly opening the intake ports 11 and 17. At the same time the cylinder 4 moves upwardly but as the movement of the valve 21 is more rapid it will have opened the ports 11 and 17 before the port 17 completely passes the port 11. When the valve 21 reaches its extreme upward movement the port 11 is open. At the moment the bottom of port 17 passes the top of the port 11 the valve 21 starts on its downward movement. The charge, however, has been taken in by this time and the piston starts on its compression stroke. During the above operation of the valve 21 the valve 22 has been moving downwardly. At the time the pis-

ton has reached the end of its intake stroke and is ready to start on its compression stroke the parts are in the position illustrated in Fig. 3 with the valve 22 at the limit of its downward movement, the valve 21 at the limit of its upward movement, and the cylinder 4 intermediate of the limit of its strokes and moving on the up stroke. The piston now commences to move on its compression stroke, the valve 21 commences to move downwardly and the valve 22 upwardly. When the piston reaches the end of its compression stroke the parts are in the position illustrated in Fig. 6, with the cylinder 4 at the end of its up stroke, leaving a compression chamber between the cylinder head and the piston, and the valves 22 and 21 intermediate of the limits of their strokes. The charge now being exploded drives the piston downward. The valve 22 continues to move upward, the valve 21 downward and the cylinder 4 starts on its downward travel. When the piston reaches the end of its operating stroke the parts are in the position shown in Fig. 7, with the valve 21 at the limit of its down movement, the valve 22 at the limit of its up movement and the cylinder 4 intermediate of the limit of its stroke and moving downwardly. The annular exhaust ports 9, 16 and 26 now register and part of the burned gases escape. As the cylinder 4 continues to move downward and the piston upward, the exhaust ports 6, 15 and 25 register and the remaining burned gases are exhausted. The exhaust ports 6, 15 and 25 remain open until the piston reaches the upper limit of its stroke and the cylinder 4 reaches the lower limit of its stroke, or in the position shown in Fig. 2. It will be noted that during the exhaust stroke of the piston the head of the cylinder 4 moves toward the piston and by the time the piston reaches the limit of its exhaust stroke the space between the end of the piston and the cylinder head has been reduced to a minimum and all of the burned gases have been forced out, leaving the cylinder perfectly clear and ready for a fresh charge.

In Figs. 3, 6 and 7 I have shown the valves 21 and 22 as each being connected with an eccentric and have illustrated the throw of the eccentric by a circle. I have also illustrated the throw of the eccentric for operating the removable piston 4 by a circle. I have adopted this method of illustration in order that the relative positions of the parts may be more fully and clearly understood.

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

1. In a combustion engine, a movable cylinder, a piston movable therein, and positively actuated means for moving the cylinder to vary the distance between its head and the upper surface of the piston at different periods in the operation of the engine, the movement of said cylinder being entirely effected by said means.

2. In a combustion engine, a movable cylinder, a movable piston operating therein, and means for moving the cylinder toward the piston as the latter moves on its exhaust stroke and away from the piston as the latter moves on its compression stroke.

3. In a combustion engine, a movable cylinder, a movable piston operating therein, and positively actuated means for moving the cylinder toward the piston as the latter moves on its exhaust stroke and away from the piston as the latter moves on its compression stroke.

4. In a combustion engine, a stationary cylinder, a movable cylinder, a movable piston operating therein, and positively actuated means for moving the movable cylinder to vary the distance between its head and the upper surface of the piston at different periods in the operation of the engine, the movement of the cylinder being entirely effected by said means.

5. In a combustion engine, a stationary cylinder, a movable cylinder therein, a movable piston operating in the movable cylinder, and positively actuated means for moving the movable cylinder toward the piston as the latter moves on its exhaust stroke and away from the piston as the latter moves on its compression stroke.

6. In a combustion engine, a movable cylinder, a piston movable therein, and means for moving the cylinder in the same direction as the simultaneous movement of the piston during a portion of the movement of the latter.

7. In a combustion engine, a stationary cylinder, a movable cylinder therein, a movable piston operating in the movable cylinder, positively actuated means for moving the movable cylinder, and intake and exhaust aperture controlling valves located between said movable cylinder and said stationary cylinder.

8. In a combustion engine, a stationary cylinder having inlet and exhaust ports therein, a movable cylinder in the stationary cylinder having inlet and exhaust ports therein, arc-shaped controlling valves located between the stationary cylinder and the movable cylinder and having apertures therein adapted to register with the inlet and exhaust apertures of the stationary and movable cylinders, a piston in the movable cylinder, and automatically actuated means for effecting the movement of the controlling valves.

9. In a combustion engine, a movable cylinder and a stationary cylinder having inlet and exhaust ports therein, a piston movable in the movable cylinder, positively actuated means for moving the cylinder to vary the

distance between its head and the upper surface of the piston at different periods in the operation of the engine, arc-shaped controlling valves located between the stationary cylinder and the movable cylinder and having apertures therein adapted to register with the inlet and exhaust apertures of the stationary and movable cylinders, and automatically actuated means for controlling the movement of the valves.

10. In a combustion engine, a movable cylinder, a spark plug carried thereby and having a contact member, a piston movable in the cylinder, positively actuated means for moving the cylinder to vary the distance between its head and the upper surface of the piston at different periods in the operation of the engine, and a fixed contact member adapted to engage the contact member of the spark plug during a portion of the movement of the movable cylinder.

11. In a combustion engine, a stationary cylinder, a movable cylinder therein, a spark plug carried by the movable cylinder and having a contact member, a movable piston operating in the movable cylinder, positively actuated means for moving the movable cylinder toward the piston as the latter moves on its exhaust stroke and away from the piston as the latter moves on its compression stroke, and a contact member supported by the stationary cylinder, adapted to engage the contact member of the spark plug during a portion of the movement of the movable cylinder.

12. In a combustion engine, a movable cylinder having inlet, exhaust and auxiliary exhaust ports therein, a piston movable in the movable cylinder, means for moving the cylinder to vary the distance between its head and the upper surface of the piston at different periods in the operation of the engine, and means for controlling the inlet, exhaust and auxiliary exhaust ports of the cylinder.

13. In a combustion engine, a movable cylinder having inlet, exhaust and auxiliary exhaust ports therein, a piston movable in the movable cylinder, positively actuated means for moving the cylinder to vary the distance between its head and the upper surface of the piston at different periods in the operation of the engine, and means for controlling the inlet, exhaust and auxiliary exhaust ports of the cylinder.

14. In a combustion engine, a stationary cylinder having inlet, exhaust and auxiliary exhaust ports therein, a movable cylinder operating therein and having inlet, exhaust and auxiliary exhaust ports adapted to register with the corresponding ports of the stationary cylinder, a movable piston operating in the movable cylinder, positively actuated means for moving the movable cylinder, and a valve for controlling the ports of the stationary and movable cylinders, located between said movable cylinder and said stationary cylinder.

15. In a combustion engine, a stationary cylinder having inlet, exhaust and auxiliary exhaust ports therein, a movable cylinder therein having inlet, exhaust and auxiliary exhaust ports adapted to register with the corresponding ports of the stationary cylinder, a movable piston operating in the movable cylinder, positively actuated means for moving the movable cylinder toward the piston as the latter moves on its exhaust stroke and away from the piston as the latter moves on its compression stroke, and valves, located between said movable cylinder and said stationary cylinder, for controlling the ports thereof.

16. In a combustion engine, a plurality of stationary cylinders, movable cylinders therein, movable pistons operating in the movable cylinders, positively actuated means for moving the movable cylinders to vary the distance between their heads and the upper surface of the pistons at different periods in the operation of the engine, intake and exhaust aperture controlling valves in said movable cylinders and said stationary cylinders, and a single means for operating all of said valves actuated from said cylinder moving means.

17. In a combustion engine, a movable cylinder, a movable piston, means for moving the cylinder toward the piston as the latter moves on its exhaust stroke and away from the piston as the latter moves on its compression stroke, and an auxiliary exhaust valve and main exhaust valve, said auxiliary exhaust valve being adapted to be automatically opened as the piston reaches the end of its explosion stroke, and said main exhaust valve being adapted to be opened as the piston moves on its exhaust stroke.

18. In a combustion engine, a movable cylinder, a movable piston, positively actuated means for moving the cylinder toward the piston as the latter moves on its exhaust stroke and away from the piston as the latter moves on its compression stroke, and an auxiliary exhaust valve and main exhaust valve, said auxiliary exhaust valve being adapted to be automatically opened as the piston reaches the end of its explosion stroke, and said main exhaust valve being adapted to be opened as the piston moves on its exhaust stroke.

19. In a combustion engine, a movable cylinder, a movable piston, means for moving the cylinder toward the piston as the latter moves on its exhaust stroke and away from the piston as the latter moves on its compression stroke, an auxiliary exhaust valve and a main exhaust valve, and positively actuated means for opening said auxiliary valve as the piston reaches the end of

its explosion stroke and for opening said main exhaust valve as the piston moves on its exhaust stroke.

20. In a combustion engine, a movable cylinder, a movable piston, positively actuated means for moving the cylinder toward the piston as the latter moves on its exhaust stroke and away from the piston as the latter moves on its compression stroke, a main exhaust valve and an auxiliary exhaust valve, and positively actuated means for moving said auxiliary exhaust valve as the piston reaches the end of its explosion stroke and for opening said main exhaust valve as the piston moves on its exhaust stroke.

21. In a combustion engine, a movable cylinder, a movable piston, means for moving the cylinder toward the piston as the latter moves on its exhaust stroke and away from the piston as the latter moves on its compression stroke, and positively actuated exhaust and intake valves.

22. In a combustion engine, a movable cylinder, a movable piston, positively actuated means for moving the cylinder toward the piston as the latter moves on its exhaust stroke and away from the piston as the latter moves on its compression stroke, and positively actuated exhaust and intake valves.

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses.

HENRY H. CUTLER.

Witnesses:
T. E. BARNUM,
F. S. WILHOIT.