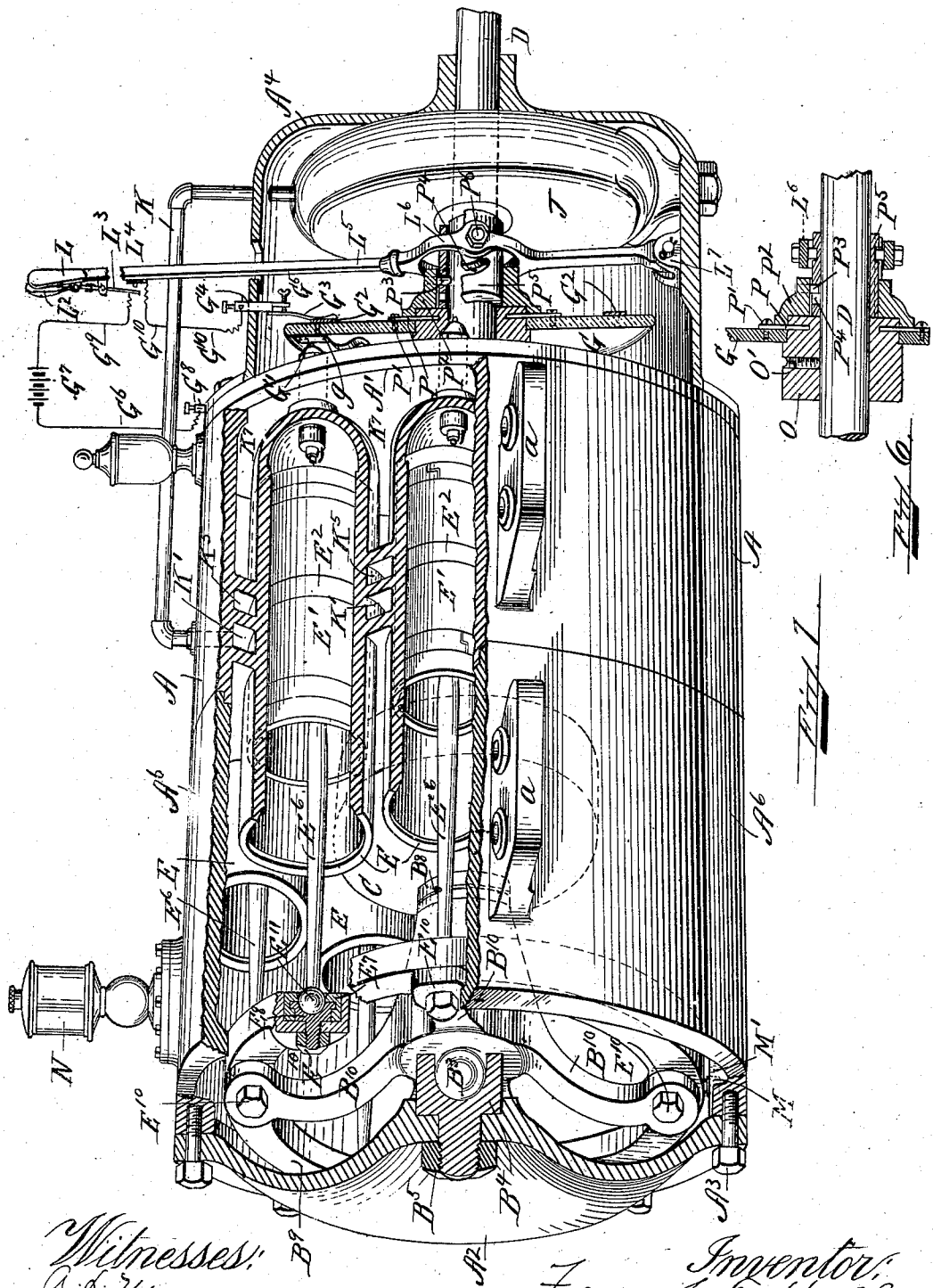
No. 773,206. PATENTED OCT. 25, 1904.

F. E. HALL.

GAS ENGINE.

APPLICATION FILED JUNE 10, 1903.

NO MODEL. 3 SHEETS—SHEET 1.



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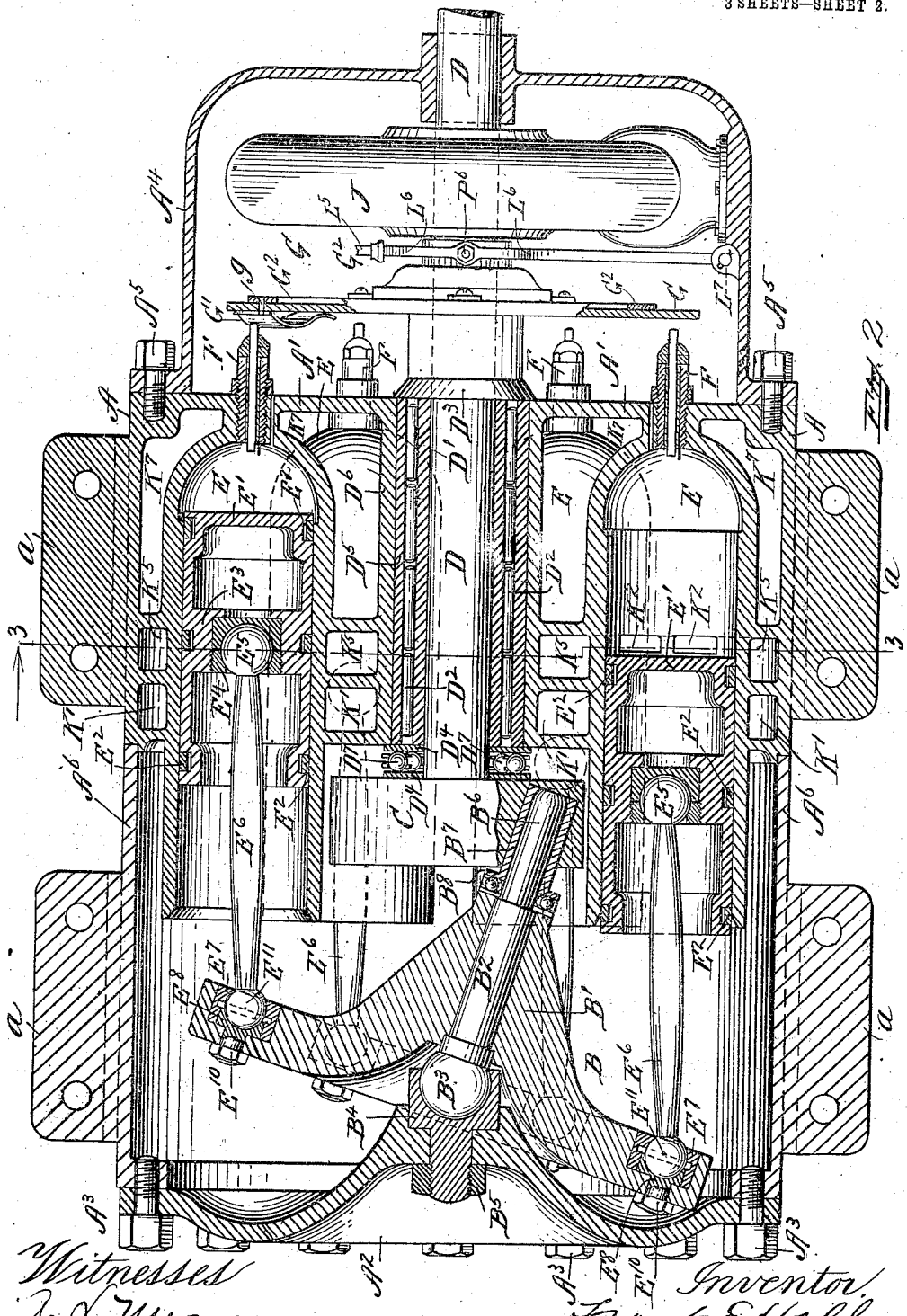
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APPLICATION FILED JUNE 10, 1903.

NO MODEL. 3 SHEETS—SHEET 2.



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NO MODEL. 3 SHEETS—SHEET 3.

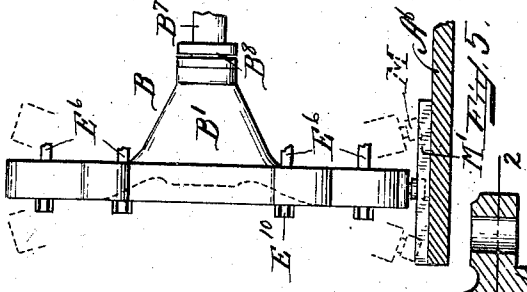


Fig. 5.

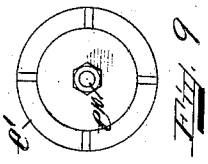


Fig. 9.

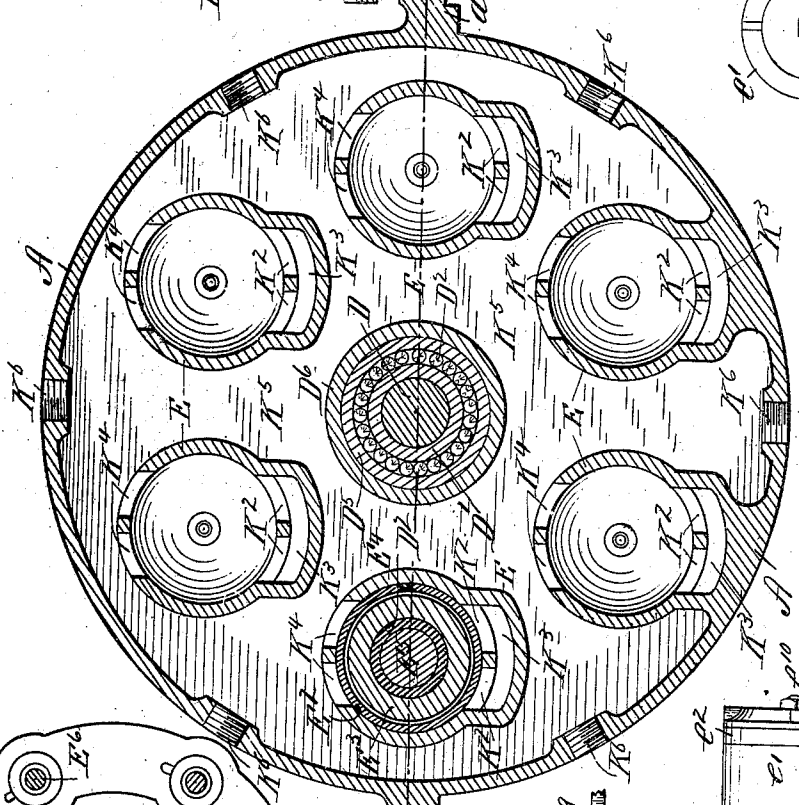


Fig. 3.

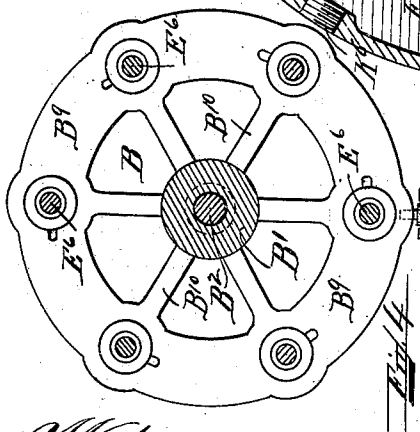


Fig. 4.

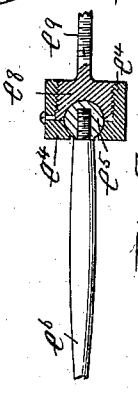


Fig. 7.

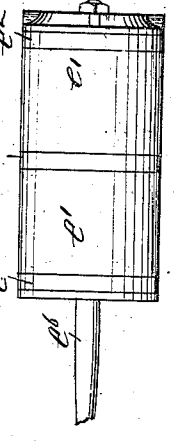


Fig. 8.

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No. 773,206. Patented October 25, 1904.

UNITED STATES PATENT OFFICE.

FRANK E. HALL, OF QUINCY, MASSACHUSETTS, ASSIGNOR TO HALL GASOLENE ENGINE COMPANY, OF PORTLAND, MAINE, A CORPORATION OF MAINE.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 773,206, dated October 25, 1904.

Application filed June 10, 1903. Serial No. 160,842. (No model.)

To all whom it may concern:

Be it known that I, FRANK E. HALL, of Quincy, in the county of Norfolk and State of Massachusetts, have invented certain new and useful Improvements in Gas-Engines, of which the following is a specification.

My invention relates to new and useful improvements in explosive-engines; and its object is to produce an explosive-engine simple of construction and efficient in operation.

My invention consists of certain novel features hereinafter described, and particularly pointed out in the claims.

In the accompanying drawings, which illustrate a construction embodying my invention, Figure 1 is a perspective view of my engine, partly in section. Fig. 2 is a top plan view taken on the line 2 2, Fig. 3, through the engine. Fig. 3 is a vertical cross-section taken on the line 3 3, Fig. 2, through the engine. Fig. 4 is a detail view of the rocking disk hereinafter described. Fig. 5 is a side elevation of the rocking disk. Fig. 6 is a detail view of the reversing mechanism hereinafter described. Figs. 7, 8, and 9 are modified constructions of the connection between the piston and the piston-rod.

Like letters of reference refer to like parts throughout the several views.

The exterior of the engine consists of three cylindrical sections A^6, A, and A^4. The outer end of the casting A^6 is closed by the base-plate A^2, secured in place by the bolts A^3, and the opposite end of said casting A^6 fits into the inner end of the casting A, as shown in Figs. 1 and 2. To the other end, A′, of the casting A is secured the casting A^4 by the bolts A^5. Secured in the center of the base-plate A^2 is the bearing B^4, held firmly in place by the nut B^5, and in said bearing is located the end B^3 of the shaft B^2, which extends through the center B′ of the rocking or oscillating disk B, and the upper end B^6 of said shaft B^2 fits into the sleeve B′, between which and the center portion B′ of the rocking disk B are located antifriction-balls B^8 to take up the thrust. The sleeve B^7 is located in the disk C, fast on the shaft D and to one side of its center. Surrounding the shaft D is the sleeve D′, and between said sleeve and another sleeve, D^5, are located a number of antifriction-rolls D^2 within the ring D^6 of the casting A. Between the disk C and the sleeves D′ and D^5 are two plates D^4, between which are suitable antifriction-rolls D^7 to take up the thrust. The opposite ends of the sleeves D′ D^5 are held in position by the disk D^3. Around the outer ends of the rocking disk B are secured the ball ends E^{11} of the piston-rods E^6 by a universal joint formed by the sleeve E^7, bearing E^8, and nut E^{10}, and each of said piston-rods (of which six are shown, forming a multiple-cylinder engine) extends into a cylinder E, and each has a ball end E^5 secured by the universal joint E^4 in the center E^3 of the piston E′, which piston is provided with suitable packing-rings E^2. This rocking disk B cannot revolve, as it is held against such movement by the pin M, reciprocating in the guide M′ in the side of the casting A^6, (see Figs. 1, 4, and 5,) so that the piston-rods are all held in positive relation to the pistons and oscillating rocking disk. A suitable pump J, secured to the main shaft D, keeps up a constant supply of air (and any mixture of crude oil, gasolene, or any other material which makes an explosive mixture when mixed with air) through the pipe K into the chamber K′, located around the cylinders and around the main shaft and communicating with each cylinder through the ports K^2 through the passage K^3, so that when each piston moves to the lower end of its stroke and uncovers the ports K^2 the explosive mixture passes from the chamber K′ into the cylinder through said ports, and the piston being moved to the head of the cylinder by the universal connection previously described the charge is compressed up to from sixty to seventy pounds to the square inch. The pressure in the supply-chamber K′ is kept constant to about one pound pressure per square inch, which pressure causes the mixture to flow into each cylinder when the ports K^2 are uncovered by the piston. On the opposite side of each cylinder are two ports K^4, opening into the exhaust-chamber K^5, which also surrounds the cylinder and the main shaft. From said ex-

haust-chamber K^5 are a number of exhaust-outlets K^6, which, if desired, may be connected by any suitable pipe connection and led to one main exhaust. The cylinders and the shaft are kept cool by suitable water-jacket K^7. The charge entering as described and compressed is exploded by a jump-spark through the sparking plug F (of any suitable construction) in the head of each cylinder. The electric circuit for this sparking is obtained from the battery G^7, which is connected by the wire G^6 to the engine through the binding-post G^8, and the other wires, G^9 G^{10}, (when the circuit is closed) are connected, through the binding-post G^4 and spring G^3, to the metallic ring G^2, secured to one side of the disk G, of insulating material. This disk G has on its face the metallic ring G^2, and connected with this ring is the pin *g* through the disk to make the connection through the flat spring G′ as this spring G′ contacts with each sparking plug, thereby exploding the charges one after another and keeping up the revolution of the main shaft D through the disk C and oscillating or rocking disk B.

The engine is reversed by mechanism consisting of the bushing O, secured fast on the shaft D by a suitable screw O′, and to said bushing is secured the disk G by gibs P, held in place by screws P′. To said disk G is secured fast the sleeve P^2, provided with an inwardly-extending pin P^3, adapted to work in the slot P^4 of the cam P^5. To said cam P^5 there is pivotally connected at P^6 the lever L^5, pivoted at its lower end at L^7 in the casting A^4 and having at its upper end a suitable handle L. When the lever is pushed in to its full limit and the engine started, it may be reversed by pulling the lever out to its full extent, and, as has been arranged in practice, this reversing mechanism causes a turn in either direction of about one-third of a revolution. In its reversing operation the disk G is turned on the shaft by the cam to throw the connecting-pin of one cylinder to where it has been sparking, exploding the charge on the upcoming of the piston, which puts the pressure on the oscillating disk B to make it oscillate in the opposite direction, which will turn the shaft D in the opposite direction. Then reversing the disk with the cam back to its original position the engine will run as first described.

The construction of this engine does away with all valves, and the engine being cast in one piece all packing and ground joints are done away with, and as the engine is perfectly balanced, having, preferably, six or more pistons, it can be run steadily without a fly-wheel.

In the ordinary engine the momentum of the fly-wheel is used to compress the charges in the cylinders; but with this disk motion the explosive in one cylinder is directly compressed by the charge in the opposite cylinder. There will always be three cylinders working down and three compressing charges, all in different positions to the stroke. It is preferable to use a rotary pump connected to the main shaft to keep up a constant supply of air and any mixture of gas, crude oil, and gasolene or any other material to make an explosive mixture when mixed with air. The circulation of the water around the cylinders can be kept up either by gravity or direct pressure from a pump or any other water-pressure. By means of suitable side plates *a a* the engine may be supported as desired. An oil-cup N supplies a lubricant to the working parts of the engine.

In the modified constructions shown in Figs. 7, 8, and 9 the piston-rod e^6 has its ball end e^5 within the sleeve e^4 and nut e^8, and said nut is provided with an extension e^9, which extends through the head of the cylinder e', and on the end thereof is connected the screw-bolt e^{10}. The packing e^2, similar to the packing E^2, is provided on the periphery of the piston E′.

I do not limit myself to the arrangement and construction shown, as the same may be varied without departing from the spirit of my invention.

Having thus described the nature of my invention and set forth a construction embodying the same, what I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In an explosive-engine, a main shaft, a series of cylinders surrounding said shaft and each provided with a piston, connecting mechanism between said pistons and said shaft for communicating motion to said shaft, means independent of the piston in each chamber for forcing air or explosive mixture under pressure to each cylinder, and means for igniting said explosive mixture in said cylinders.

2. In an explosive-engine, a main shaft, a series of cylinders surrounding said shaft and each provided with a piston, connecting mechanism between said pistons and said shaft for communicating motion to said shaft, means independent of the piston in each chamber for forcing air or explosive mixture under pressure to each cylinder, means operated by the movement of the main shaft for igniting said explosive mixture in said cylinders.

3. In an explosive-engine, a main shaft, a series of cylinders surrounding said shaft and each provided with a piston, connecting mechanism between said pistons and said shaft for communicating motion to said shaft, means independent of the piston in each chamber for forcing air or explosive mixture under pressure to each cylinder, and means mounted on the main shaft and operated thereby for igniting the explosive mixture in said cylinders.

4. In an explosive-engine, a main shaft, a series of cylinders surrounding said shaft and each provided with a piston, connecting mech-

anism between said pistons and said shaft for communicating motion to said shaft, means independent of the piston in each chamber for forcing air or explosive mixture under pressure to each cylinder, a sparking plug in each cylinder, a source of electricity, a disk of insulating material mounted on said driving-shaft and operated thereby, means controlled by the operator for closing the electric circuit, means on said disk engaging with said sparking plugs for closing the electric circuit therethrough successively.

5. In an explosive-engine, a main shaft, a series of cylinders surrounding said shaft and each provided with a piston, an oscillating disk for operating said shaft, piston-rods for said pistons connected thereto and to said oscillating disk, means independent of the piston in each chamber for forcing air or explosive mixture under pressure to each cylinder, a sparking plug in each cylinder, a source of electricity, a disk of insulating material mounted on said driving-shaft and operated thereby, means controlled by the operator for closing the electric circuit, and means on said disk engaging with said sparking plugs for closing the electric circuit therethrough successively.

6. In an explosive-engine, a main shaft, a series of cylinders surrounding said shaft and each provided with a piston, connecting mechanism between said piston and said shaft for communicating motion to said shaft, means for preventing rotation of said connecting mechanism, means independent of the piston in each chamber for forcing air or explosive mixture under pressure to each cylinder, and means for igniting said explosive mixture in said cylinders.

7. In an explosive-engine, a main shaft, a series of cylinders surrounding said shaft and each provided with a piston, an oscillating disk for operating said shaft, piston-rods for said pistons connected thereto and to said oscillating disk, means for preventing the rotation of said oscillating disk, means independent of the piston in each chamber for forcing air or explosive mixture under pressure to each cylinder, a sparking plug in each cylinder, a source of electricity, a disk of insulating material mounted on said driving-shaft and operated thereby, means controlled by the operator for closing the electric circuit, and means on said disk engaging with said sparking plugs for closing the electric circuit therethrough successively.

8. In an explosive-engine, a main shaft, a series of cylinders surrounding said shaft, and each provided with a piston, connecting mechanism between said pistons and said shaft for communicating motion to said shaft, a chamber for the air or explosive mixture surrounding said cylinders and communicating therewith, means independent of the piston in each chamber for forcing air or explosive mixture under pressure into said chamber, and means for igniting said explosive mixture in said cylinders.

9. In an explosive-engine, a main shaft, a series of cylinders surrounding said shaft, and each provided with a piston, connecting mechanism between said pistons and said shaft for communicating motion to said shaft, a chamber for the air or explosive mixture surrounding said cylinders and communicating therewith, means independent of the piston in each chamber for forcing the air or explosive mixture under pressure into said chamber, means for igniting said explosive mixture in said cylinders, and a chamber surrounding said cylinders for the exhaust from said cylinders.

10. In an explosive-engine, a main shaft, a series of cylinders surrounding said shaft and each provided with a piston, connecting mechanism between said pistons and said shaft for communicating motion to said shaft, means independent of the piston in each chamber for forcing air or explosive mixture under pressure to each cylinder, a sparking-plug in each cylinder, a source of electricity, a disk of insulating material mounted on said driving-shaft and operated thereby, means controlled by the operator for closing the electric circuit, means on said disk engaging with said sparking plugs for closing the electric circuit therethrough successively, and a movable cam on said main shaft for holding said insulating-disk in different positions on the shaft.

11. In an explosive-engine, a main shaft, a series of cylinders surrounding said shaft and each provided with a piston, connecting mechanism between said pistons and said shaft for communicating motion to said shaft, means independent of the piston in each chamber for forcing air or explosive mixture under pressure to each cylinder, a sparking plug in each cylinder, a source of electricity, a disk of insulating material mounted on said driving-shaft and operated thereby, means controlled by the operator for closing the electric circuit, means on said disk engaging with said sparking plugs for closing the electric circuit therethrough successively, a movable cam on said main shaft for holding said insulating-disk in different positions on the shaft, and an air-pump operated by said main shaft for forcing the air or explosive mixture into said supply-chamber.

12. In an explosive-engine, a main shaft, a series of cylinders each provided with a piston, an oscillating disk provided with a rear central bearing for operating said shaft, piston-rods for said pistons connected thereto and to said oscillating disk, means for preventing the rotation of said oscillating disk, means for causing an explosion in each cylinder upon each complete revolution of the main shaft, and means independent of the piston in each cylinder for forcing air or explo-

sive mixture into each cylinder under pressure.

13. In an engine, a main shaft, a series of cylinders each provided with a piston, an oscillating disk provided with a rear central bearing for operating said shaft, a disk on said shaft to which said oscillating disk is connected, piston-rods for said pistons connected thereto and to said oscillating disk, means for preventing the rotation of said oscillating disk, means for causing an explosion in each cylinder upon each complete revolution of the main shaft, and means independent of the piston in each cylinder for forcing air or explosive mixture into each cylinder under pressure.

14. In an explosive-engine, a main shaft, a series of cylinders surrounding said shaft and each provided with a piston, connecting mechanism between said pistons and said shaft for communicating motion to said shaft a supply-chamber under pressure for supplying air or explosive mixture located around said shaft and communicating with said cylinders, and an exhaust-chamber surrounding said cylinders for the exhaust therefrom.

15. In an explosive-engine, a main shaft, a series of cylinders surrounding said shaft and each provided with a piston, connecting mechanism between said pistons and said shaft for communicating motion to said shaft, a supply-chamber under pressure for supplying air or explosive mixture located around said shaft and around said cylinders and communicating with said cylinders, and an exhaust-chamber surrounding said cylinders for the exhaust therefrom.

16. In an explosive-engine, a main shaft, a series of cylinders surrounding said shaft and each provided with a piston, connecting mechanism between said pistons and said shaft for communicating motion to said shaft, a chamber for air or explosive mixture communicating with said cylinders, means independent of the piston in each cylinder for forcing air or explosive mixture into said chamber, means for igniting said explosive mixture in said cylinders, and a chamber surrounding said cylinders for the exhaust from said cylinders.

17. In an explosive-engine, a main shaft, a series of cylinders surrounding said shaft and each provided with a piston, connecting mechanism between said pistons and said shaft for communicating motion to said shaft, a chamber for air or explosive mixture communicating with said cylinders, means independent of the piston in each cylinder for forcing air or explosive mixture into said chamber, means for igniting said explosive mixture in said cylinders, a chamber surrounding said cylinders for the exhaust from said cylinders, and an exhaust-port in each cylinder controlled by said pistons.

18. In an explosive-engine, a main shaft, a series of cylinders surrounding said shaft and each provided with a piston, connecting mechanism between said pistons and said shaft for communicating motion to said shaft, a chamber for air or explosive mixture communicating with said cylinders, means independent of the piston in each cylinder for forcing air or explosive mixture into said chamber, means for igniting said explosive mixture in said cylinders, a chamber for the exhaust from said cylinders, and an exhaust-port in each cylinder controlled by said pistons.

19. In an explosive-engine, a main shaft, a multiple of cylinders surrounding said shaft and each provided with a piston, connecting mechanism between said pistons and said shaft for communicating motion to said shaft, means independent of the piston in each cylinder, for supplying air or explosive mixture to said cylinders, and means for igniting said explosive mixture in all of said cylinders during each complete revolution of the main shaft.

20. In an explosive-engine, a main shaft, a multiple of cylinders surrounding said shaft and each provided with a piston, connecting mechanism between said pistons and said shaft for communicating motion to said shaft, means independent of the piston in each cylinder, for supplying air or explosive mixture to said cylinders, means for igniting said explosive mixture in all of said cylinders during each complete revolution of the main shaft, and a port in each cylinder through which the exhaust passes from each cylinder during each complete revolution of the main shaft.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 29th day of May, A. D. 1903.

FRANK E. HALL.

Witnesses:
A. L. MESSER,
E. L. HARLOW.