No. 670,803. Patented Mar. 26, 1901.

T. McMAHON.

GAS ENGINE.

(No Model.) (Application filed Apr. 28, 1900.)

2 Sheets—Sheet 1.

fig. 1.

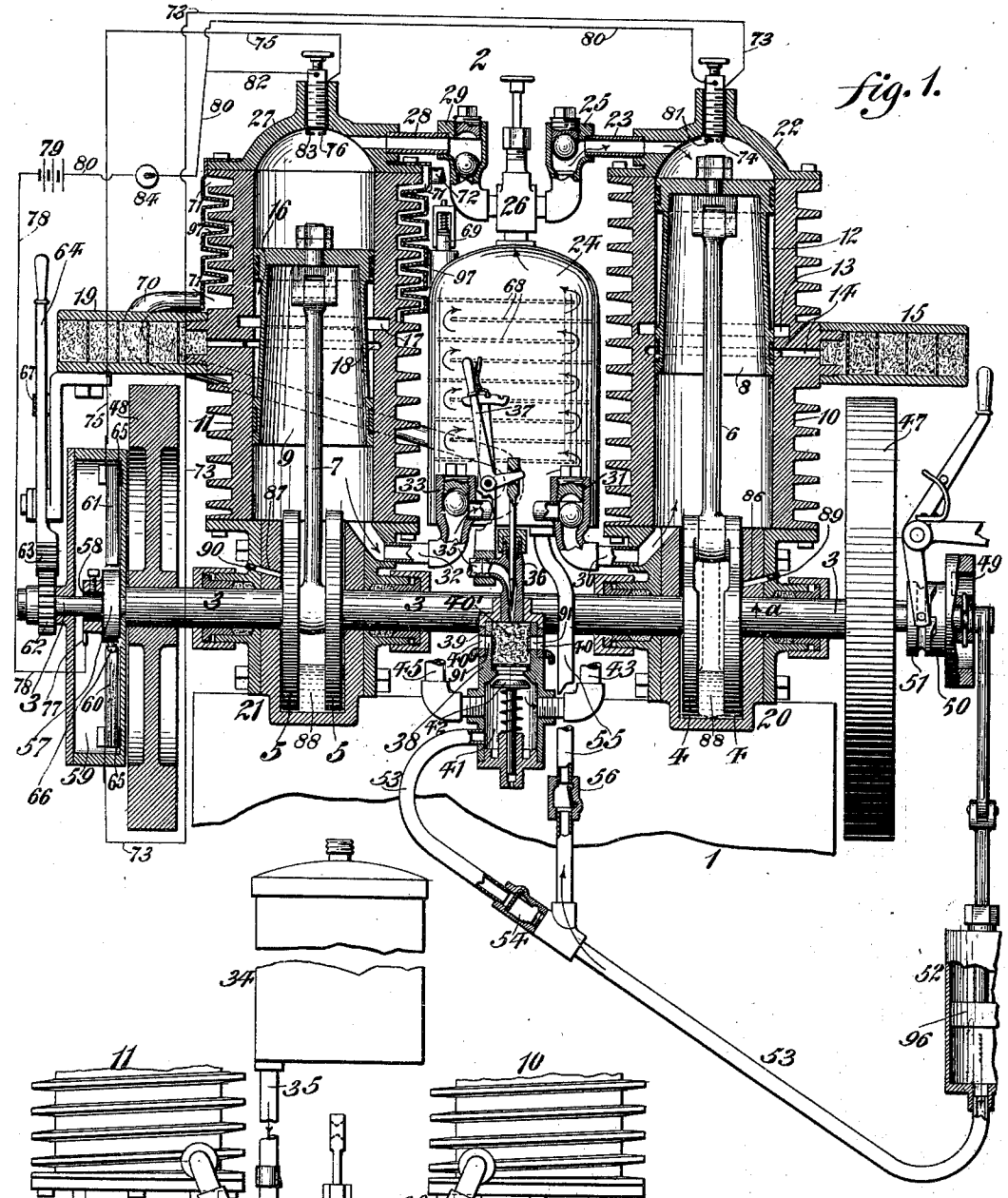


fig. 2.

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Fig. 3.

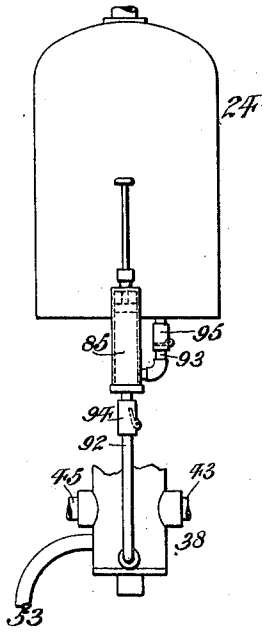


Fig. 5.

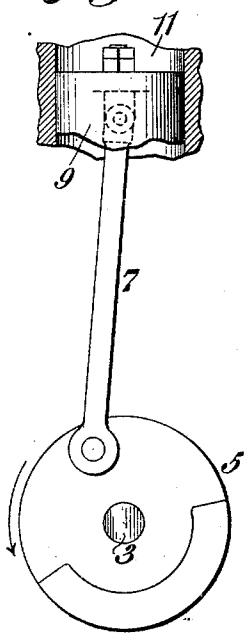


Fig. 6.

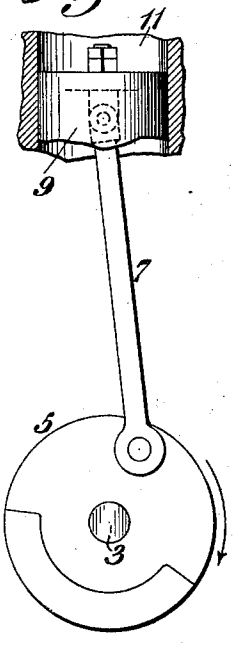
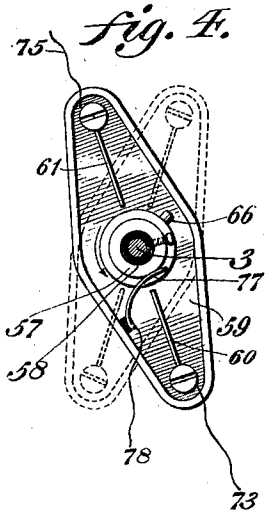


Fig. 4.



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UNITED STATES PATENT OFFICE.

THOMAS McMAHON, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR OF THREE-FOURTHS TO WILLIAM M. BUNN, OF SAME PLACE, AND ROYER LUCKENBACH, OF COLWYN, PENNSYLVANIA.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 670,803, dated March 26, 1901.

Application filed April 28, 1900. Serial No. 14,659. (No model.)

To all whom it may concern:

Be it known that I, THOMAS McMAHON, a citizen of the United States, residing in the city and county of Philadelphia, State of Pennsylvania, have invented a new and useful Improvement in Gas-Engines, which improvement is fully set forth in the following specification and accompanying drawings.

My invention consists of an improved construction of gas-engine, the novel features of which will be hereinafter set forth, and particularly pointed out in the claims.

Figure 1 represents a partial side elevation and partial vertical section of a gas-engine embodying my invention. Figs. 2, 3, and 4 represent side elevations of certain detached portions of the engine. Figs. 5 and 6 represent partial side elevations and partial vertical sections of certain detached portions of the engine.

Similar numerals of reference indicate corresponding parts in the drawings.

Referring to the drawings, 1 designates the bed-plate of the engine, and 2 designates the engine mounted thereon.

3 designates the main shaft, which latter has secured thereto the crank-wheels 4 and 5, to which are coupled the connecting-rods 6 and 7, respectively, the rod 6 being coupled to the piston 8 and the rod 7 to the piston 9, it being apparent that when motion is imparted to said pistons the same will transmit motion to the crank-wheels 4 and 5, and consequently to the shaft 3.

The pistons 8 and 9 are fitted in the cylinders 10 and 11, respectively. The piston 8 is provided with an annular groove 12, and the cylinder 10 is provided with annular grooves 13 and 14, for purposes to be hereinafter described. The cylinder 10 is provided with a muffler 15 to prevent noise when the waste product (after an explosion of gas) escapes into the atmosphere. The piston 9 is provided with an annular groove 16, and the cylinder 11 is provided with annular grooves 17 and 18, for purposes to be hereinafter described. The cylinder 11 is provided with a muffler 19 for a similar purpose to that described in connection with the muffler 15. Secured to the lower portions of the cylinders 10 and 11 are the housings 20 and 21, respectively, in which are located the crank-wheels 4 and 5. The head 22 of the cylinder 10 has connected thereto a pipe 23, which leads from a gas-reservoir 24, said pipe 23 being provided with a check-valve 25, for a purpose to be hereinafter described.

26 designates a throttle-valve for opening and closing the communication between the gas-reservoir 24 and the cylinders 10 and 11, it being noted that the head 27 of the cylinder 11 is provided with a pipe 28, which leads from the gas-reservoir 24, said pipe being provided with a check-valve 29, for a purpose to be hereinafter described.

30 designates a pipe which leads from the lower portion of the cylinder 10 to the lower portion of the gas-reservoir 24 and is provided with a check-valve 31, for a purpose to be hereinafter described.

32 designates a pipe which leads from the lower portion of the cylinder 11 to the lower portion of the gas-reservoir 24 and is provided with a check-valve 33, for a purpose to be hereinafter described.

34 designates a tank adapted to contain hydrocarbon, said tank being provided with a pipe 35, which leads therefrom to a valve 36, which latter may be operated by a lever 37, so as to either open or close said valve 36. The valve 36 controls the communication with a mixing-chamber 38, which latter is provided with a rotatable collar 39, with openings 40 therein, which serve to regulate the quantity of air admitted into said mixing-chamber 38. The mixing-chamber 38 is also provided with a fibrous material 40', through which the mixture of oil and air is caused to pass in order to thoroughly mix the two before the same enters the compartment 41 in the mixing-chamber 38.

42 designates a spring-actuated valve adapted to normally close the communication between the compartment 41 and the upper portion of the mixing-chamber 38. The compartment 41 has connected thereto a pipe 43, which leads therefrom to the cylinder 10, said pipe 43 being provided with a check-valve 44, for a purpose to be hereinafter described. The compartment 41 has connected thereto a

pipe 45, which leads therefrom to the cylinder 11, said pipe 45 being provided with a check-valve 46, for a purpose to be hereinafter described.

The shaft 3 has secured thereto the balance or fly wheels 47 and 48, around which may be passed a belt, chain, &c., for transmitting motion therefrom to any suitable point.

The shaft 3 is provided with a crank-wheel 49, loosely mounted thereon and provided with a clutch member 50, with which engages, when so desired, the clutch member 51, which slides on the shaft 3, so as to be caused to either engage with or be removed from the member 50, it being apparent that since the clutch member 51 rotates with the shaft 3 it will cause the crank-wheel 49 to rotate when both clutch members are engaged, and thus operate the pump 52, whose object is to supply an extra quantity of gas to the reservoir 24 when the engine is required to perform work in excess of the normal amount.

It is to be noted that the pump 52 has a pipe 53 connected thereto, said pipe 53 leading from the compartment 41 in the mixing-chamber 38 to the pump 52, and that said pipe 53 is provided with a check-valve 54 and a branch pipe 55, the latter serving as a means of communication between the pipe 53 and gas-reservoir 24, it being noted that said pipe 55 is provided with a check-valve 56, for a purpose to be hereinafter described.

The shaft 3 has firmly secured thereto a collar 57, it being noted that said collar is insulated from the shaft 3, as indicated at 58 in Figs. 1 and 4.

The shaft 3 has loosely mounted thereon a box 59, in which are secured the metallic strips 60 and 61, it being noted that said box 59 is provided with a pinion 62, with which engages a segment 63, operated by a lever 64, so as to turn said box 59 on the shaft 3 in order to change the positions of the strips 60 and 61, for a purpose to be hereinafter described. It is to be noted that the strips 60 and 61 are insulated, as at 65, from the box 59 and that the collar 57 is provided with a projecting pin 66, which rotates with said collar 57 and is adapted to contact with the strips 60 and 61, due to the rotation of the shaft 3, and for a purpose to be hereinafter described.

The lever 64 is retained in its adjusted position in any well-known manner—for instance, by frictional contact with a spring 67, as seen in Fig. 1.

The gas-reservoir 24 is provided with plates 68 in staggered order, so that the gas which is fed to said reservoir in the lower portion thereof will be retarded in its upward flow within the reservoir 24, and thus become gasified to a still greater extent, due to the heat imparted to said gas while passing through the reservoir on its way to the cylinders 10 and 11.

The reservoir 24 is provided with a relief-valve 69 to permit a portion of the gas within said reservoir to escape therethrough when the same exerts a pressure within said reservoir in excess of the safety limit.

It will be apparent that, if desired, a pipe 70 (seen in Fig. 1) may be led from the check-valve 33 to the hot-air space 71, formed by using a jacket 97, which surrounds the upper portion of the cylinder 11, so as to utilize the heat emitted by said cylinder to still further improve the quality of the gas, which may then be directed by a pipe 72 to the gas-reservoir 24. It is evident that the heat of the cylinder 10 may likewise be utilized.

The strip 60 has connected thereto one end of a wire 73, which leads to an electrode 74, located in the upper portion of the cylinder 10, and the strip 61 has one end of a wire 75 connected thereto, the opposite end of said wire being connected to an electrode 76, located in the upper portion of the cylinder 11.

The collar 57 has contacting therewith a metallic or other brush 77, to which is connected a wire 78, which leads therefrom to the battery 79 and from thence over the wire 80 to the electrode 81 in the cylinder 10, said wire 80 being tapped at 82, so as to connect the brush 77 with the electrode 83 in the cylinder 11.

84 designates a switch for turning on and shutting off of the electric current in the igniting device.

85 designates a hand-pump employed for charging the reservoir 24 with gas when the engine has remained inoperative for a considerable length of time.

86 and 87 designate openings in the housings 20 and 21, respectively, through which lubricating-oil 88 may be supplied to the chambers within said housings for oiling the working parts located within the same and the cylinders 10 and 11, it being apparent that when the engine 2 is in operation the rotation of the crank-wheels 4 and 5 and connecting-rods 6 and 7 will cause the oil 88 to splash, and thus reach all the parts that require to be oiled. The openings 86 and 87 are closed by plugs 89 and 90, respectively.

The operation is as follows: The tank 34 is supplied with hydrocarbon and the valve 36 is opened and the hydrocarbon will flow from said tank 34 into the mixing-chamber 38, which commingles it with the air which enters said mixing-chamber through the openings 40 in the collar 39 and openings 91 in the mixing-chamber 38, thereby producing gas to be employed to drive the engine 2. The hand-pump 85 is then operated in order to cause the gas to leave the mixing-chamber 38 and to flow through a pipe 92 and enter the reservoir 24 through a branch pipe 93, it being noted that the pipes 92 and 93 are provided with check-valves 94 and 95, respectively, for evident purposes. When the reservoir 24 is sufficiently charged with gas, the shaft 3 is rotated by any suitable means, whereupon the crank-wheels 4 and 5 will be caused to rotate. Assuming the several parts

of the engine to be in the positions seen in Fig. 1 and the shaft 3 to be rotated in the direction indicated by the arrow *a* in said figure, it will be apparent that the piston 9 in moving downwardly will force the gas contained within the cylinder 11 through the pipe 32 and valve 33 into the reservoir 24, it being assumed that the piston 9 has been before this in its lowermost position and in moving upwardly produced a suction within the cylinder 11 on the under side of the piston 9 wherefrom the gas within the mixing-chamber 38 was drawn therefrom through the pipe 45 and valve 46 and caused to enter the cylinder 11 beneath the piston 9, as hereinafter stated. The valve 26 is now opened, and the piston 9 in descending will force the gas from the reservoir 24 through the valves 26 and 25 and pipe 23 into the upper portion of the cylinder 10. The switch 84 is then operated, so as to close the electric circuit at this point, whereupon when the pin 66 is brought in contact with the strip 60 an electric flash will be produced between the electrodes 74 and 81, thereby causing an explosion of the gas within the upper portion of the cylinder 10, the force of which will cause the piston 8 to lower, whereupon motion will be imparted thereby to the shaft 3. When the top portion of the piston 8 has reached a point below the groove 13 in the cylinder 10, the waste products of the explosion will enter said groove 13, so that when the piston 8 moves upwardly and the groove 12 reaches the groove 13 the waste products which are in the latter can reach the groove 14 and escape into the atmosphere through the muffler 15, while a portion of said product may remain in said groove 12, and thus act as a packing for the piston. The piston 8 in moving upwardly will produce a suction in the pipe 30, thereby closing the valve 31 and permitting the gas in the reservoir 24 to flow in the direction stated—that is to say, in the upper portion of the cylinder 10, due to the downward movement of the piston 9. The piston 8 in moving upwardly will produce a suction in the pipe 43, and thereby cause the gas within the mixing-chamber 38 to flow therefrom and enter the cylinder 10 below the piston 8, it being apparent that when the piston 8 descends it will open the valve 31 and cause the gas on the under side of said piston 8 to flow through the pipe 30 and valve 31 and enter the reservoir 24 and pass therefrom through the valves 26 and 29 and pipe 28 into the upper portion of the cylinder 11. The pin 66 is brought in contact with the strip 61, whereupon an electric flash will be produced between the electrodes 76 and 83 and cause an explosion of the gas within the cylinder 11 and above the piston 9, thereby causing said piston to move downwardly, and thereby transmit motion to the shaft 3, it being noted that two distinct impulses are imparted to the shaft 3 in each revolution thereof. The groove 16 in the piston 9 and the grooves 17 and 18 in the cylinder 11 and the muffler 19 are intended to perform functions similar to those described in connection with the cylinder 8.

Referring to Figs. 4, 5, and 6, assuming the strips 60 and 61 to be in the positions seen in full lines in Fig. 4, it will be apparent that when the piston 9 (seen in Fig. 5 and a trifle below its uppermost position) is subjected to the impulse due to an explosion of gas resulting from the contact of the pin 66 and the strips 61 the crank-wheels 5 and also the crank-wheels 4 will be caused to rotate in the direction indicated by the arrow in Fig. 5. When, however, it is desired to reverse the direction of rotation of the shaft 3, the box 59 is turned by operating the lever 64 so as to assume the position seen in dotted lines in Fig. 4, whereupon the strip 61 will be in a position to contact with the pin 66 sooner than when in the position seen in full lines, thereby causing an explosion of gas in the upper portion of the cylinder 11 at a time when the crank-wheels 5 are in the position seen in Fig. 6, the impulse of which will drive the crank-wheels 5 and also the crank-wheels 4 in the direction indicated by the arrow in Fig. 6.

The pump 52 may be thrown out of action by removing the clutch member 51 from engagement with the clutch member 50.

It will be apparent that when the plunger 96 in the pump 52 ascends it will open the valve 54 and close the valve 56, thereby supplying the pipe 53 with gas from the mixing-chamber 38, and that when said plunger is lowered it will close the valve 54 and open the valve 56 and force the gas within a portion of the pipe 53 into the reservoir 24.

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

1. In a gas-explosive engine, a main shaft, a plurality of cylinders, pistons in said cylinders connected with said shaft, a gas-reservoir located intermediately of said cylinders, means for supplying gas to said cylinders, connections from the lower portion of each cylinder to the lower portion of said reservoir, and valved connections from the upper portions of said cylinders to the upper portion of said reservoir.

2. In a gas-explosive engine, a main shaft, a plurality of cylinders, pistons in said cylinders connected with said shaft, a gas-reservoir, located intermediately of the cylinders, means for supplying gas to the cylinders, baffle-plates in said reservoir for retarding the progress of the commingled air and gas therethrough, connections from the lower portion of each cylinder to the lower portion of the reservoir, and valved connections from the upper portions of said cylinders to the upper portion of the reservoir.

3. In a gas-explosive engine, a main shaft, a plurality of cylinders, pistons in said cylinders connected with said shaft, a mixing-chamber for air and fuel, an auxiliary fuel-

supply connected with said chamber, a gas-reservoir, connections between the same and the cylinders, and connections between the mixing-chamber and said cylinders.

4. In a gas-explosive engine, a main shaft, a plurality of cylinders, pistons in said cylinders connected with said shaft, a gas-reservoir, located intermediately of the cylinders, means for supplying gas to said cylinders, connections from the lower portion of each cylinder to said reservoir, valved connections from the upper portions of said cylinders with the upper portion of said reservoir whereby said shaft has motion imparted thereto by a plurality of explosions during each revolution of said shaft, and an auxiliary fuel-supply for said reservoir.

5. In a gas-explosive engine, a main shaft, a plurality of cylinders, pistons in said cylinders connected with said shaft, a gas-reservoir located intermediately of the cylinders, means for supplying gas to said cylinders, connections from the lower portion of each cylinder to said reservoir, valved connections from the upper portions of said cylinders with the upper portion of the reservoir, a mixing-chamber connected with said cylinders, and an auxiliary fuel-supply connecting with said chamber.

6. In a gas-explosive engine, a main shaft, a plurality of cylinders, pistons in said cylinders and connected with said shaft, a gas-reservoir, located intermediately of said cylinders, means for supplying gas to said cylinders, connections from the lower portion of each cylinder to the lower portion of the reservoir, a valved outlet leading from the upper portion of said reservoir, connections leading from said valved outlet to the upper portions of said cylinders, and check-valves in said connections.

7. In a gas-explosive engine, a main shaft, a plurality of cylinders, pistons therein connected with said shaft, a gas-reservoir, means for supplying gas to said cylinders, connections from the lower portions of each cylinder to the lower portion of the reservoir, valved connections from the upper portions of the cylinders to the upper portion of said reservoir whereby an initial supply of fuel is obtained for said cylinders, and an auxiliary fuel-supply leading to said reservoir.

8. In a gas-explosive engine, a main shaft, a plurality of cylinders, pistons in said cylinders connected with said shaft, a gas-reservoir, means for supplying gas to said cylinders, connections from the lower portion of each cylinder to the lower portion of said reservoir, valved connections from the upper portions of said cylinders to the upper portion of said reservoir whereby an initial supply of fuel is obtained for said cylinders, an auxiliary fuel-supply leading to said reservoir, and means actuated by said main shaft for controlling said auxiliary fuel-supply.

9. In a gas-explosive engine, a main shaft, a cylinder, a piston therein, a gas-supply reservoir for said cylinder, a mixing-chamber for supplying said supply-reservoir with charges through the suction of the piston, and auxiliary means driven by the main shaft for drawing charges from the mixing-chamber and forcing them into the said supply-reservoir.

10. In a gas-explosive engine, a main shaft, a plurality of cylinders, pistons in said cylinders, connections from said pistons to the main shaft, a gas-reservoir, means for conducting an initial supply of fuel to and from said cylinders, and means actuated by said main shaft for forcing an auxiliary supply of fuel to said gas-reservoir through means independent of the initial supply.

11. In a gas-explosive engine, a main shaft, a plurality of cylinders, pistons for said cylinders, a reservoir, pipes leading from the lower portion of said reservoir to the lower portion of said cylinders, and pipes leading from the upper portion of said reservoir to the upper portion of said cylinders, means for supplying gas to said cylinders, means for controlling said supply, valves in said pipes being so arranged as to permit gas to be forced from the lower portion of one cylinder into the upper portion of the other cylinder through said reservoir.

12. In a gas-explosive engine, a tank for hydrocarbon, a connection from said tank to a mixing-chamber, a plurality of cylinders, connections from said mixing-chamber to said cylinders, a main shaft, pistons in said cylinders connected with said shaft, a storage-reservoir, connections from said cylinders to said reservoir, means for causing gas to pass from one cylinder to the other through said reservoir and means for causing an explosion at the proper time in said cylinders.

13. In a gas-explosive engine, a main shaft, a plurality of cylinders, pistons in said cylinders, connected with said shaft, annular grooves in the inner walls of said cylinders, an annular groove in each of said pistons adapted to register at certain different times with the grooves in said cylinder, and means for permitting the escape of gas from one of said grooves, in the walls of said cylinders forming an exhaust.

14. In a gas-explosive engine, a main shaft, a plurality of cylinders, pistons in said cylinders, connected with said shaft, annular grooves in the inner walls of said cylinders, an annular groove in each of said pistons adapted to register at certain different times with the grooves in said cylinders, means for permitting the escape of gas from one of said grooves in the walls of said cylinders forming an exhaust, and a muffler at said exhaust.

15. In a gas-explosive engine, a main shaft, a plurality of cylinders, and pistons in said cylinders connected with said shaft, a gas-reservoir, a mixing-chamber for supplying said reservoir with charges through the suc-

tion of said pistons, means for conducting an auxiliary supply of fuel from said mixing-chamber to the reservoir, and means actuated by the revolution of said main shaft for controlling said auxiliary fuel-supply.

16. In a gas-explosive engine, a main shaft, a plurality of cylinders, an initial fuel-supply to said cylinders, an auxiliary fuel-supply to said cylinders, means actuated by said main shaft for operating said auxiliary fuel-supply, and clutch mechanism on said shaft for controlling said means.

17. In a gas-explosive engine, a main shaft, a plurality of cylinders, an initial supply to said cylinders, an auxiliary fuel-supply to said cylinders, means as a pump for controlling said auxiliary fuel-supply, pump-operating means actuated by the main shaft, and a clutch mechanism for controlling said operating means.

18. In a gas-explosive engine, a main shaft, a plurality of cylinders, a gas-reservoir located intermediately of said cylinders, a mixing-chamber for supplying said reservoir with charges, pistons in said cylinders for causing such supply of charges by their suction, means for conducting an auxiliary supply of fuel from said mixing-chamber to said reservoir, means actuated by the main shaft for controlling said auxiliary fuel-supply, and clutch mechanism interposed between said shaft and said means for controlling the latter.

19. In a gas-explosive engine, a main shaft, a plurality of cylinders, pistons therein, connected with said shaft, a gas-reservoir, means for supplying gas to said cylinders, connections from the lower portion of each cylinder to the lower portion of the reservoir, valved connections from the upper portion of said reservoir to the upper portions of the cylinders, a mixing-chamber, a pipe leading therefrom, a branch leading from said pipe, and means controlled by the main shaft for conducting an auxiliary fuel-supply through said pipe and branch to the reservoir.

20. In a gas-explosive engine, a main shaft, a plurality of cylinders pistons in said cylinders, connections from said pistons to the main shaft, a gas-reservoir, a mixing-chamber for supplying said reservoir with charges through the suction of the pistons, a pipe leading from said mixing-chamber, a pump connected therewith, a branch from said pipe to the reservoir, and means actuated by the main shaft for controlling the auxiliary fuel-supply through said pipe and branch.

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