R. RAGAN.

EXPLOSIVE ENGINE.

APPLICATION FILED JULY 24, 1911.

1,048,095.

Patented Dec. 24, 1912.

3 SHEETS—SHEET 1.

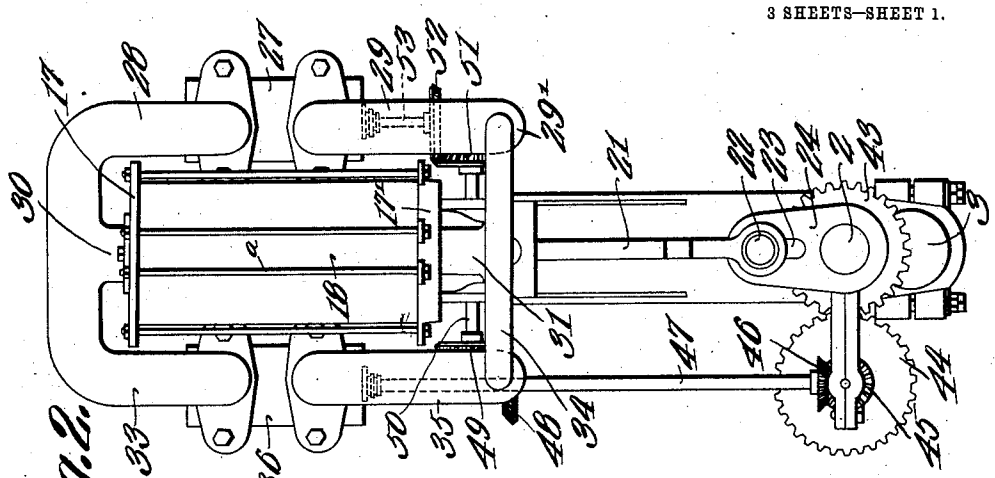

Fig. 2.

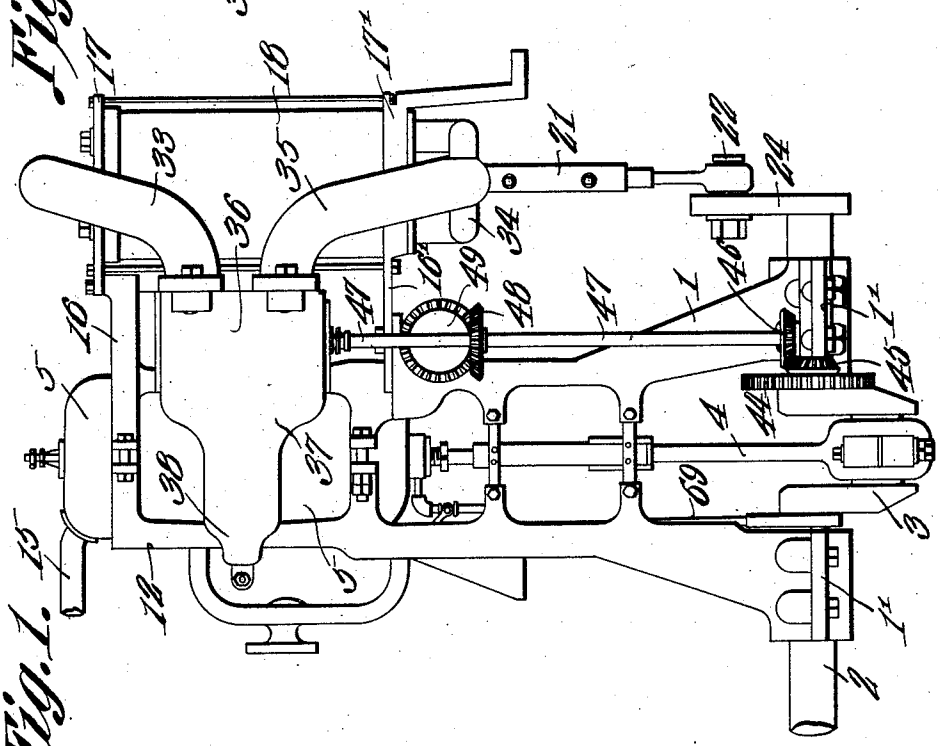

Fig. 1.

Witnesses

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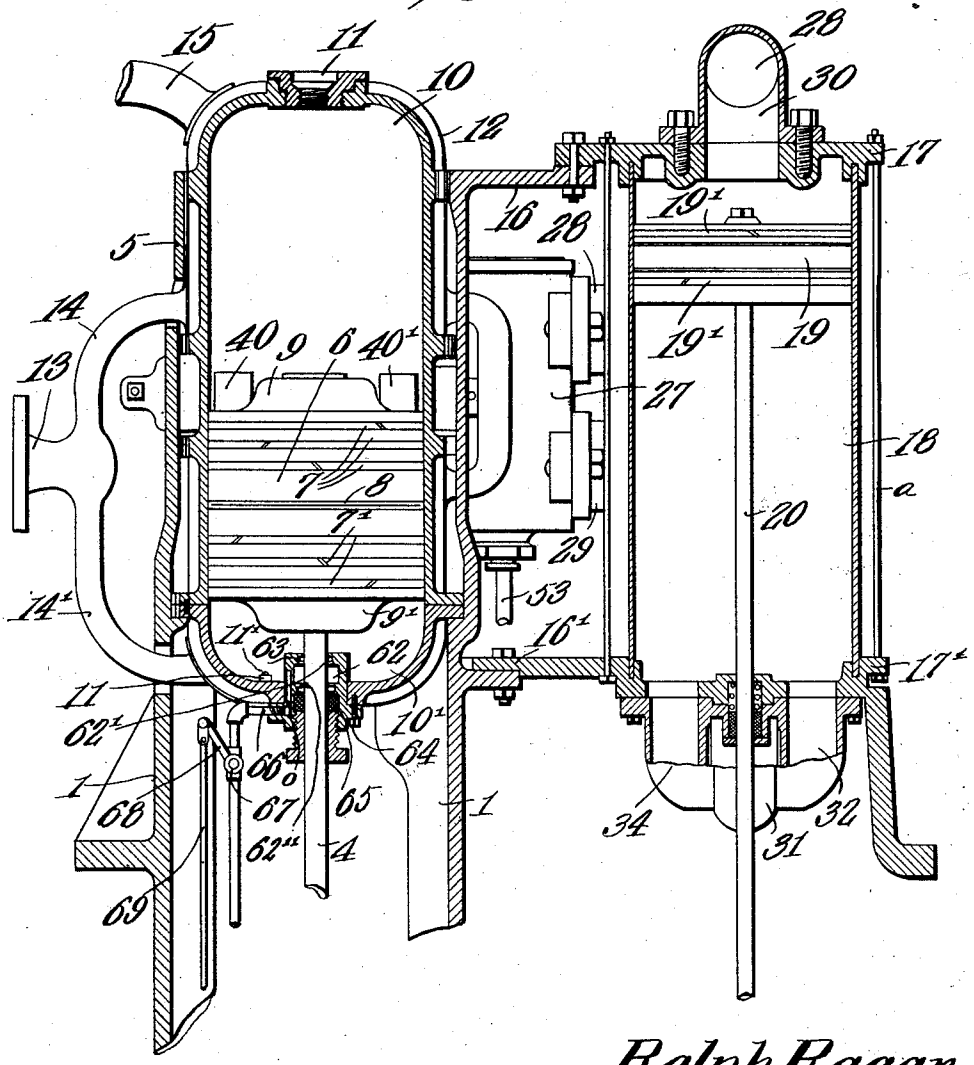
3 SHEETS—SHEET 2.

Fig. 3.



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3 SHEETS—SHEET 3.

Fig. 4.

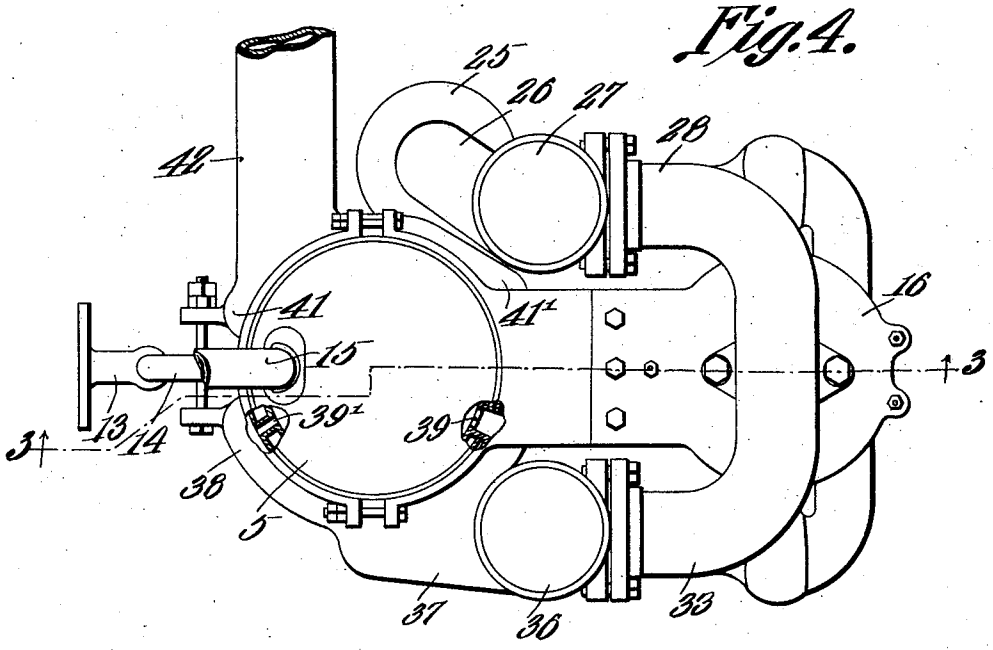


Fig. 5.

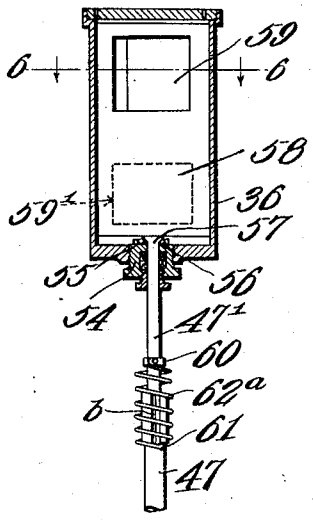
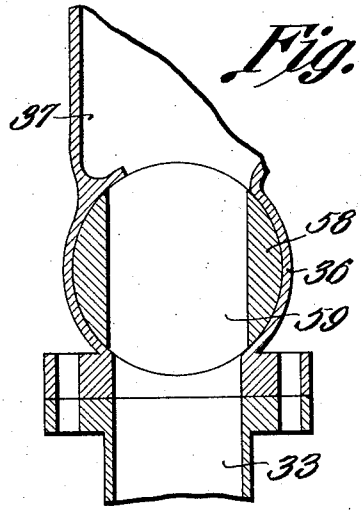


Fig. 6.



Witnesses

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UNITED STATES PATENT OFFICE.

RALPH RAGAN, OF ATLANTA, GEORGIA.

EXPLOSIVE-ENGINE.

1,048,095. Specification of Letters Patent. Patented Dec. 24, 1912.

Application filed July 24, 1911. Serial No. 640,267.

To all whom it may concern:

Be it known that I, RALPH RAGAN, a citizen of the United States, residing at Atlanta, in the county of Fulton and State of Georgia, have invented a new and useful Explosive-Engine, of which the following is a specification.

This invention relates to improvements in explosive engines, and the primary object of this invention is the provision of a supplemental air and gas mixing and compressing cylinder disposed in parallel with the main or engine cylinder of a reciprocating explosive engine, the same being provided with an explosive chamber at each end thereof, and adapted to explode at every stroke, a series of rotary valves interposed between the carbureter and the gas and air compressing and mixing chamber and between the gas and air mixing chamber and the explosive cylinder of the engine.

A further object of this invention is the provision of an explosive engine and air mixing and compressing cylinder so disposed with relation to the explosive cylinder as to feed thereto, in alternation, the desired quantity of carbureted and mixed air under pressure, so that the compression stroke of the explosive engine will be to a great extent reduced, and whereby the efficiency of the explosive charge or pressure exerted upon the piston of the cylinder will be greatly increased.

A still further object of this invention is the provision of an explosive engine having a carbureter, a double acting gas mixing and supplying cylinder disposed to receive the carbureted air from the carbureter, a valve interposed therebetween to regulate the flow of carbureted air from the carbureter to the respective ends of the said cylinder, an explosive cylinder provided with two explosive and compression chambers in opposed ends adapted to receive the compressed and mixed carbureted air from the compression cylinder, with a valve interposed therebetween for permitting the entrance of the carbureted air at the desired end of the cylinder to obtain from the said compressed carbureted air the maximum amount of explosive force.

A still further object of this invention is the provision of an explosive engine having a reciprocating piston mounted therein and adapted to be acted upon by explosive charges at the ends thereof, the exhaust therefrom being near the central portion and carried away from the cylinder, so as to in no way affect the heating of the charge delivered thereto, or the adjacent parts of the machine for delivering said explosive charge to the cylinder.

A still further object of this invention, is the provision of means operably connected to the drive shaft of the engine, whereby the carbureted air mixing and compressing cylinder, the piston in the explosive cylinder and the two sets of rotary valves for delivering the carbureted air to the compression cylinder and from the compression cylinder to the explosive cylinder may be operated in train or time.

With the foregoing and other objects in view which will appear as the description proceeds, the invention resides in the combination and arrangement of parts and in the details of construction hereinafter described and claimed, it being understood that changes in the precise embodiment of the invention herein disclosed can be made within the scope of what is claimed, without departing from the spirit of the invention.

In the drawings:—Figure 1 is a side elevation of the complete engine. Fig. 2 is an elevation looking from the compression cylinder side thereof. Fig. 3 is a longitudinal sectional view taken on line 3—3 of Fig. 4. Fig. 4 is a top plan view of the complete engine. Fig. 5 is a detail sectional view of one of the rotary valves and its casing. Fig. 6 is an enlarged detail sectional view on the line 6—6 of Fig. 5.

Referring to the drawings, the numeral 1 designates the main frame of the engine provided at its lower end with the shaft bearings or journals 1′ for the reception of the shaft 2, the same being provided with the crank 3 disposed between the lower members of the frame at the base of the engine. Operably connected to the crank 3 is a piston rod 4 and disposed in the upper end of the frame-work of the engine is an explosive cylinder 5, said rod 4 entering said cylinder at the lower end thereof and carrying reciprocatingly within said cylinder or rather the bore thereof, a piston 6, which is provided with the two series 7 and 7′ of split packing rings, and the central oil receiving groove 8 being provided circumferentially of said piston. Carried by and disposed upon opposite ends of the said piston are the baffle plates 9 and 9′ respectively, which are

adapted to convey the explosive charge to the respective explosive engine while the burned charge enters the exhaust outlet 40 or 40′, as will later appear.

The cylinder 5 as clearly shown in Fig. 3 is provided at its opposite ends with the explosive compartments or chambers 10 and 10′, in the outer walls of which are mounted the spark plug receiving means 11 for the spark plugs 11′, whereby the charge compressed within the respective ends of the cylinder may be exploded at the proper time to give the maximum power to the stroke of the piston.

Surrounding the complete cylinder 5 is a copper jacket 12 which provides a water space for cooling the cylinder and in order to feed water thereto a supply pipe 13 is provided with the two branches 14 and 14′ in communication with the space within said jacket and exhausts through the outlet pipe 15, as clearly shown in Fig. 3.

Properly supported from the upper portion of the framework 1 by means of the two arms 16 and 16′ are the heads 17 and 17′ of the air compressing and supplying cylinder 18, the diameter and length of which are identical with the diameter and length of stroke of the cylinder 5, the tie rods *a* being employed to retain the heads 17 and 17′ upon the respective ends of the cylinder or tube 18. Mounted for reciprocation within the cylinder 18 is a plunger or piston head 19 provided with a series of packing rings 19′ and connected for operation to the piston rod 20, said head 19 being adapted to be operated to assume the opposite position to the piston head 6 within the cylinder 5, so that explosive mixture is compressed and delivered to the cylinder 5 at the proper time, that is as clearly shown in Fig. 3 the lower end 10′ of the cylinder 5 having the fully compressed explosive charge and ready for exploding the same whereas the compartment 10 has had its charge exploded propelling the piston 6 downwardly to the exhausting position, where the baffle plate 9 has conducted the exhaust charge to the port 40 and the piston 19 has delivered its charge to the upper portion of the cylinder 5, to be compressed and exploded upon the upward stroke of the piston 6 and in the compartment 10, as the piston 19 is moved down in an opposite direction to the piston 6. In order to accomplish the proper reciprocation of the piston 19 within the air compressing and feeding cylinder 18, the piston rod 20 is provided with the adjusting sleeve 21 whereby the same may be lengthened or shortened and its pin 22 carried in the lower end thereof, is mounted for a sliding movement within the slot 23 of the crank 24 carried upon the end of the shaft 2, said crank 24 being disposed in opposite direction to the crank 3 of the shaft, the slot 23 permitting a slight sliding retarding motion to the piston 19, the purpose of which will presently appear.

Disposed to one side of the frame is the carbureter 25, having a manifold 26 leading therefrom to the casing 27 from which lead, in the opposite direction from the manifold, the two carbureted air conducting conduits or pipes 28 and 29, respectively, the conduit or pipe 28 leading to the pipe 30 into the upper end of the gas and air compressing cylinder 18, while the conduit or pipe 29 leads to the branch pipe 29′ and to the inlet pipe 31 to the lower end of the cylinder. Leading from the conduit 30 in opposite direction to the conduit 28 is a conduit 33, while leading from the conduit 31 at the lower end of the cylinder 18 is a branch 34 which leads to the conduit 35, said conduits 33 and 35 being in communication with the cylinder 36 on the same side thereof so that the carbureted and mixed air compressed and fed by the cylinder 18 and its piston 19 is supplied to the casing 36 and from there through the inlet conduits 37 and 38 to the ports 39 and 39′ of the cylinder 5.

As before mentioned leading from the cylinder 5, are the two exhaust ports 40 and 40′, which as shown in Fig. 4, are covered by the branch conduits or exhaust manifolds 41 and 41′ which lead to the exhaust pipe 42, thereby conducting the explosive discharges away from the cylinder of the engine so that the heat conducted thereby will not interfere with the parts thereof.

Keyed upon and rotatable with the shaft 2 is a gear 43 which meshes with a gear 44 whose small beveled pinion 45 meshes with and transmits motion to the beveled pinion 46 carried upon the lower end of the vertical shaft 47, which has connected thereon intermediate of its ends a beveled pinion 48, which meshes with a beveled pinion 49 upon the horizontal and transverse shaft 50, whose pinion 51 meshes with a pinion 52 and whereby the rotation of the shaft 2 will convey simultaneous motion and in time to the vertical shafts 53 and 47′ of the respective rotary valves, as shown in detail in Figs. 5 and 6, and which are mounted within the respective cylinders or chambers 27 and 36. As both of these valves are of the same construction, the description of one will be sufficient, and therefore by referring to Figs. 5 and 6 of the drawings it will be seen that the rotary valves mounted within said cylinders 27 and 36 will accomplish the desired result by operating in time to permit the carbureted air to be first admitted to the respective ends of the cylinder 18 and therein to be delivered at the proper time to the cylinder 36, whose valve will dispense the carbureted air at the proper time to the bore of the cylinder 5 to be exploded at the desired stroke of the piston 6 within the bore

of the cylinder 5, the actuation thereof operating the crank shaft and the various mechanisms operable therefrom.

In Fig. 5 the cylinder 36 is illustrated and the bore thereof is slightly tapered and has mounted therein a tapered rotary valve 58, the shaft 47 having slidably connected thereto the small shaft 47′, passing through a stuffing box 54 whose upper end has mounted thereupon as at 55, a ball race for the reception of the balls 56, the cone bearing 57 being provided at the upper end of the shaft 47′ and carrying the rotary valve 58 provided with the ports 59 and 59′, therein adapted to aline with the respective gas inlet 33 or 35 and thereby permit the induction of the explosive charge to the bore of the cylinder 5. Shaft 47′ is connected to the shaft 47 by means of a flexible coupling as at *b* and in order to retain the rotary valve 58 on its ball bearing seat, the collar 60 and pin 61 and the coil spring 62ª are provided, said coil spring 62 exerting a tension to pull the shaft 47′ and the rotary valve 58 downwardly.

As clearly shown in Fig. 3 a novel form of stuffing box and lubricating device is provided for the piston rod 4 as it enters the cylinder 5, the same being so constructed as to withstand the great force of the explosion as the piston 6 is driven upwardly, and at the same time prevent the escape of oil from the chamber 62 provided within the casing 63 which is formed or inserted in the lower end of the cylinder 5, and in this casing 63 is mounted the packing material 64 and the stuffing box 65, an oil lead 66 entering the casing 65 so that the oil is admitted to flow through the channel *o* into the chamber 62 and properly lubricate the piston rod 4 as the same is reciprocated. Two split metallic packing rings 62′ and 62″ having a tendency to contract around the piston rod 4, are mounted in the casing 63 at the upper and lower ends thereof. In order to admit the oil upon the down stroke of the piston 6, a valve 67 is mounted within the conduit or pipe 66 and has its arm 68 connected to a link 69, which is operably connected to the crank shaft, (not shown), at a proper time so as to permit the oil to flow from a pump system to the chamber 62 at the desired time and be checked by the valve 67 at the proper time to prevent escape of oil to the explosive charge within the bore of the cylinder 5.

As clearly illustrated, the rotary valves are so mounted and connected for operation as to act as check valves during the explosion at each explosive stroke of the piston 6, and at the proper time to permit either port 59 and 59′ to admit carbureted air to the cylinder 5, thus providing a combined double check and admission valve in each cylinder 27 and 36.

From the foregoing description taken in connection with the drawings, it is evident that by constructing an engine according to this invention the carbureted air delivered thereto is thoroughly mixed and compressed before the same is compressed within the cylinder 5 and the explosion from the explosive charge increased to a maximum; and by providing an engine which will explode at each stroke, or twice during the full reciprocation thereof, the maximum amount of power is secured. Further by employing the rotary valves and disposing them as shown, the heat from the explosive charge in no way affects the same nor is the compression cylinder 18 in any way affected, thus making it only necessary to provide a cooling or jacketing means for the cylinder 5 of the engine.

What is claimed is:—

1. The combination with an explosive engine, having two parallel cylinders, one of which is a power cylinder and the other of which is a pumping cylinder, a piston mounted in the power cylinder to compress an explosive mixture at the end of each stroke, means for exploding such mixture to propel the piston, said power cylinder being provided with centrally disposed intake and exhaust ports, and a piston in the pump cylinder mounted to be reciprocated in consonance with the power piston, of a carbureter, a cylindrical casing interposed between said carbureter and the pump cylinder, a slightly tapered valve provided with two superposed oppositely disposed ports mounted in said casing to control the admission of carbureted air to the respective ends of said pump cylinder, another cylindrical casing interposed between the intake ports of the power cylinder and the pump cylinder, and a slightly tapered rotary valve provided with two superposed oppositely disposed ports mounted in said casing to control the admission of the explosive charge from either end of the pump cylinder to the power cylinder.

2. An explosive engine, having four vertically disposed cylinders, one of said cylinders being a power cylinder, another of said cylinders being a carbureted air pumping cylinder, while the other two cylinders are valve cylinders, one being disposed to control the supply of carbureted air to the pumping cylinder while the other is disposed to control the supply of carbureted air from the pumping cylinder to the power cylinder, a carbureted air manifold leading to one valve cylinder, a conduit leading from said cylinder to the carbureted air pumping cylinder, another conduit leading from said carbureted air pumping cylinder to the remaining valve cylinder, and a conduit leading from said last mentioned valve cylinder to the power cylinder.

3. An explosive engine, having four vertically disposed cylinders, one of said cylinders being a power cylinder, another of said cylinders being a carbureted air pumping cylinder, while the other two cylinders are valve cylinders, one being disposed to control the supply of carbureted air to the pumping cylinder while the other is disposed to control the supply of carbureted air from the pumping cylinder to the power cylinder, a conduit leading from each end of the pumping cylinder and having two branches one connected to the valve cylinder to lead the carbureted air to the pumping cylinder and the other leading to the other valve cylinder to convey the carbureted air to the power cylinder, a piston mounted for reciprocation within the pumping cylinder, another piston mounted for reciprocation within the power cylinder, a valve mounted in each one of said valve cylinders, and a crank shaft, operably connected to the respective pistons and valves for operating them consonantly.

4. An explosive engine, having four vertically disposed cylinders, one of said cylinders being a power cylinder, another of said cylinders being a carbureted air pumping cylinder, while the other two cylinders are valve cylinders, one being disposed to control the supply of carbureted air to the pumping cylinder while the other is disposed to control the supply of carbureted air from the pumping cylinder to the power cylinder, a conduit leading from each end of the pumping cylinders and having two branches one connected to the valve cylinder to lead the carbureted air to the pumping cylinder and the other leading to the other valve cylinder to convey the carbureted air to the power cylinder, a piston mounted for reciprocation within the pumping cylinder, another piston mounted for reciprocation within the power cylinder, a valve mounted in each one of said valve cylinders, and a crank shaft operably connected to the respective pistons and valves for operating them consonantly, each of said valves being composed of a tapered circular in cross section member having two superposed oppositely disposed ports for registration with the branch conduits leading to and from the pumping cylinder.

In testimony that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

RALPH RAGAN.

Witnesses:
C. F. BARNWELL,
L. R. VAUGHN.