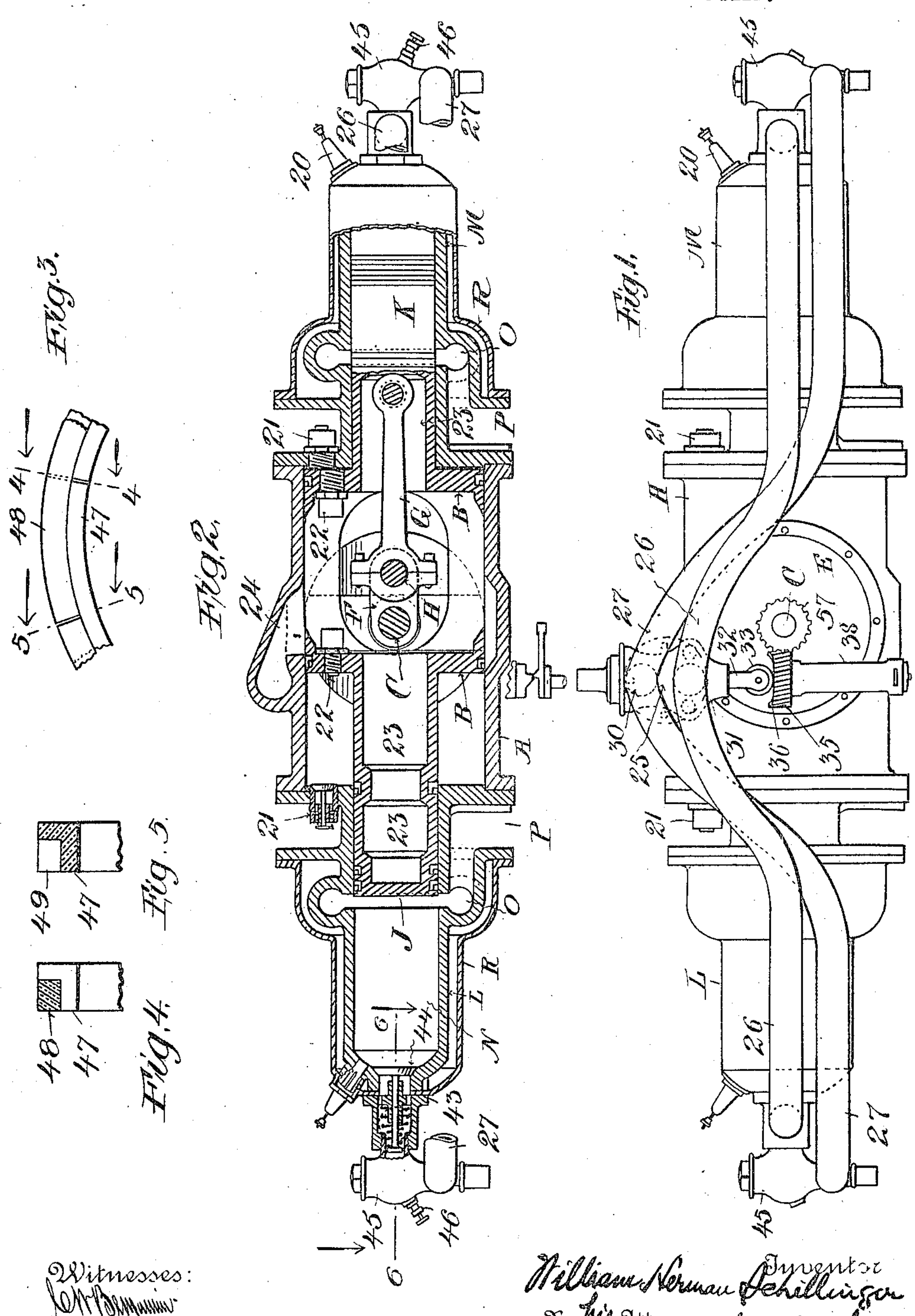
W. H. SCHILLINGER.
EXPLOSIVE ENGINE.
APPLICATION FILED JUNE 4, 1910.

1,069,480.

Patented Aug. 5, 1913.

3 SHEETS—SHEET 1.



Witnesses:

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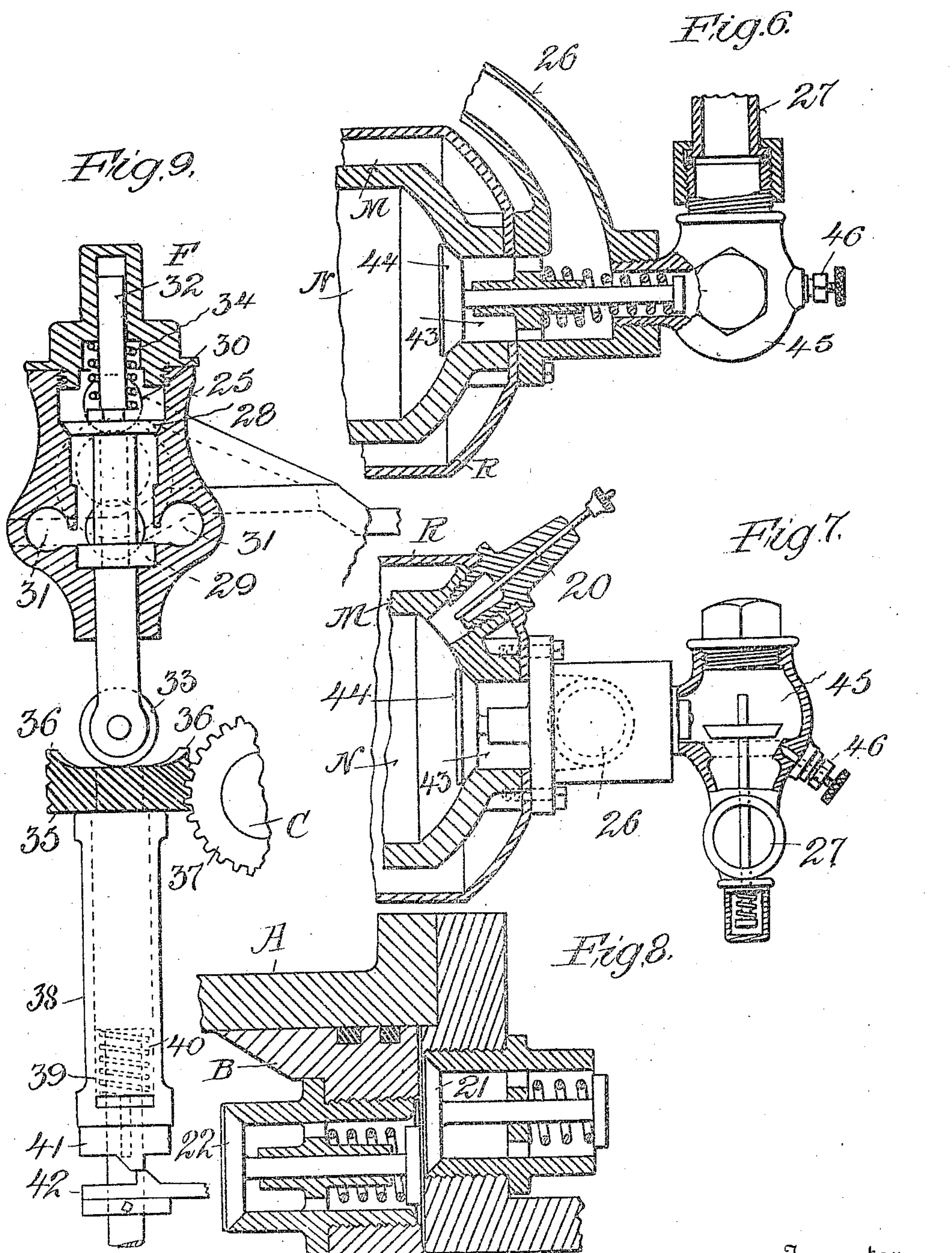

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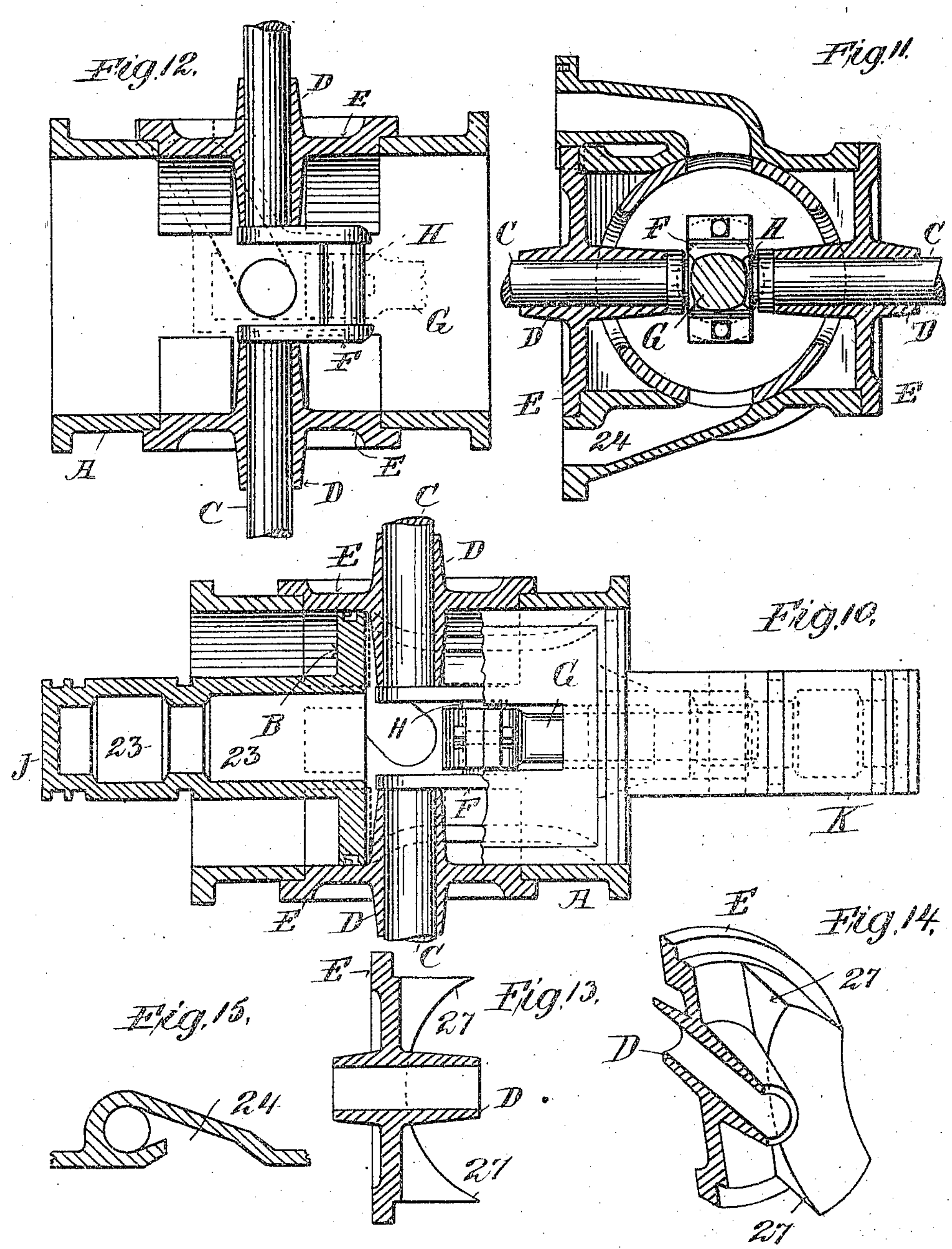

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UNITED STATES PATENT OFFICE.

WILLIAM HERMAN SCHILLINGER, OF ROCK ISLAND, ILLINOIS.

EXPLOSIVE-ENGINE.

1,069,480. Specification of Letters Patent. Patented Aug. 5, 1913.

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To all whom it may concern:

Be it known that I, WILLIAM HERMAN SCHILLINGER, a citizen of the United States, residing at Rock Island, county of Rock Island, State of Illinois, have made a certain new and useful Invention in Explosive-Engines, of which the following is a specification.

This invention relates to explosive engines.

The object of the invention is to provide an engine of the explosive type which is simple in construction, economical to manufacture and efficient in operation.

A further object is to provide an engine of the type referred to wherein the explosive charge is supplied automatically and under pressure.

A further object is to provide means for completely evacuating the engine cylinder of the gases and other products of combustion following an explosion of a charge before the next charge of explosive material is admitted to the explosive chamber.

A further object is to discharge the gases of each explosion by the use of compressed air, thereby preventing pre-ignition of the succeeding charge, retarding carbonization, increasing the efficiency of the fresh charge and promoting economy in the fuel required.

A further object is to provide means which are simple and efficient for cooling the engine, increasing the compression space, increasing the amount of the explosive charge, thereby increasing the power developed, and securing two explosions against the piston at each revolution of the engine, thereby doubling the propulsive energy of a two-cycle and quadrupling that of a four-cycle engine.

A further object is to provide means for compressing air at each stroke of the engine and utilizing the compressed air to clean out the explosion chamber after each explosion, and also to inject the fresh charge into the cleaned out compression and explosive chamber.

Other objects of the invention will appear more fully hereinafter.

The invention consists substantially in the construction, combination, location and relative arrangement of parts, all as will be more fully hereinafter set forth, as shown in the accompanying drawings, and finally pointed out in the appended claims.

Referring to the accompanying drawings, and to the various views and reference signs appearing thereon, Figure 1 is a view in side elevation of an engine embodying the principles of my invention. Fig. 2 is a vertical, central, longitudinal section of the same. Fig. 3 is a detached, detail, broken view of a portion of the piston packing rings. Figs. 4 and 5, are broken views in transverse section on the lines 4, 4, and 5, 5, respectively, of Fig. 3. Fig. 6 is a broken view in section, showing the inlet for the compressed air to clean out the explosion chamber of the gases and other products of explosion. Fig. 7 is a similar view showing the ignition plug. Fig. 8 is a similar view of the air compressor piston. Fig. 9 is a view in vertical section of the valve mechanism and its operating connections for controlling the cleaning out or scavenging charge and the fuel supply charge of compressed air to the explosion chamber. Fig. 10 is a view partly in section and partly in elevation of the piston. Fig. 11 is a view in vertical transverse section of the crank case. Fig. 12 is a view in horizontal section of the same. Fig. 13 is a detached detail view in section of the crank shaft bearing side plate of the crank case. Fig. 14 is a sectional view in perspective of the same. Fig. 15 is a broken detail view in section showing the communication between the crank case and the control valve casing.

The same part is designated by the same reference sign wherever it occurs throughout the several views.

In the construction and operation of engines of the explosive type, it is important to secure as large an area of compression space as possible so as to accommodate as large a volume of the explosive charge of proper mixture as possible, thereby securing a maximum of propulsive force at each explosion. It is equally desirable and important to completely clean out the explosion chamber of all gases, deposits and other products of each explosion so that the fresh charge of explosive mixture may not be weakened by admixture with the exploded gases.

It is among the special purposes of my present invention to secure these and other desirable objects in internal combustion or explosive engines, and in carrying out my invention, I propose to so construct the operating piston as to form a reservoir in the interior thereof to receive and store up charges of compressed air and to supply the same in the form of released blasts into the explosion chamber after each explosion to clear the same of the gases and other products of the explosion, and also, from which reservoir the compressed air may be supplied to inject the fresh charge of explosive mixture into the explosive chamber after said chamber has been cleaned out. I also propose to compress the air into the reservoir afforded by the piston, as above indicated by the operation of the piston itself, and to control, automatically, and in suitably timed relation, the supply of charges of the compressed air for cylinder scavenging and fuel supply purposes, said control being effected by the operation of the piston itself, and I propose to so construct and operate the piston that these results may be accomplished without employing exterior or auxiliary air compressing means or storage tanks, and without employing piston rod packings, or stuffing boxes.

In the drawings I have shown an operative embodiment of my invention as illustrative of the principles thereof, and as the best form in which I at present contemplate applying those principles, and I have shown my invention as applied to a double two cycle engine, but in this respect my invention, as defined in the claims, is not to be limited or restricted.

Reference sign A, designates that portion of the engine which forms the crank case and the chamber in which the air compression takes place. This portion of the machine is in the form of a cylinder in which works the air compressing piston heads B, B, respectively arranged on opposite sides of the crank shaft C. This shaft is journaled in bearings D, formed in the side plates, E of the crank case. If desired, and in order to secure an equally and evenly balanced operation of the engine, the crank F, is arranged centrally of the cylinder A, and is connected between the inner ends of two sections of the shaft C, one extending outwardly through a bearing side plate E, on each side of the cylinder A, as shown. This arrangement, however, is a detail which may be widely varied without departure from the spirit and scope of my invention as defined in the claims. The connecting rod G, is connected at one end to the pin H, of the crank, and at the other end extends into the interior of a hollow piston. As shown the piston is double ended with piston faces presented in opposite directions, the two ends J, K, of the piston being arranged on opposite sides of the crank shaft C, and respectively operating in a cylinder portion L, M, of smaller diameter than the cylinder portion A, in which the piston heads B operate, said piston heads B, however, being formed with or connected to the double ended piston to move therewith. The extreme end portion of each cylinder portion L, M, in which the piston ends J, K, respectively operate, forms a chamber N, which constitutes the compression and explosion chamber, into which the explosive charge is delivered and where the explosion of the mixed air and oil takes place. These cylinder portions L, M, are provided intermediate their ends with an encircling channel O, which is open to atmospheric exhaust through the passage P, and the stroke of the piston ends J, K, is so regulated that when said piston ends are in their extreme inner positions they uncover these exhaust channels O. As shown in Fig. 2 the piston end J has uncovered the exhaust channel O, of cylinder portion L, while the piston end K, is at the outer limit of its stroke in cylinder portion M, and ready to be acted upon by the compressed explosive charge in that cylinder portion. If desired, the cylinder portions L, M, may be jacketed, as indicated at R, for cooling purposes. The compressed charge may be exploded in any suitable manner, as, for instance, by means of a spark plug 20, in the usual way, and at the proper time.

In each end wall of cylinder A, is arranged an inwardly opening valve 21, controlling openings through said walls to the outer air, and in each piston head B is arranged an inwardly opening valve 22. With this arrangement it will be seen that as the piston heads B, move with the piston toward one end of the cylinder A, the air inlet valve 21, at that end of the cylinder toward which the piston heads move is closed while air is drawn into the cylinder through the inwardly opening valve 21, at the other end of the cylinder. At the same time the air contained in that end of the cylinder toward which the piston heads are moving, that is, in the space between the advancing piston head and the cylinder end, is compressed and eventually causes the inwar[illegible]y opening valve 22, in the advancing piston head to unseat thereby admitting the compressed air to the space between the piston heads and to the interior of the crank case, and to the interior piston chambers 23, which thus form a storage reservoir for the compressed air. Of course the same operation of air intake and compression into the reservoir takes place during the movement of the piston and piston heads in the opposite direction.

The compressed air accumulated and stored, as above described is utilized to expel the gases and other products of explosion from the explosion chambers N, following each explosion therein, and also is employed to force a fresh charge of fuel or explosive mixture into the explosion chamber following each expulsion of the gases and other products of the preceding explosion. At the same time the air which is compressed into the hollow piston is being constantly changed by the successive compressions of fresh air therein, thereby materially aiding in maintaining the pistons cool under constant working conditions.

I will now describe means for utilizing the stored up compressed air for clearing the explosion chambers of the gases following each explosion, and for supplying fresh charges of the explosive mixtures thereto.

The compressed air reservoir comprising the interior of the cylinder A, the crank case, and the hollow pistons is in communication, through passage 24, see Figs. 2 and 11, with a governor valve casing 25, from which deliver pipe connections 26, 27, to both ends L, M, of the engine cylinder. The communications of the pipes 26, 27, with the compressed air reservoir through the governor valve casing are controlled by suitable valves 28, 29, respectively controlling openings or ports 30, 31, from the governor valve casing to the pipe connections 27, 26. The valves 28, 29, are carried by a stem 32, which carries a roller 33, held by spring 34, pressed against the face of a gear disk 35, having cam projections 36, thereon, arranged to periodically move the valve stem 32, to operate the valves 28, 29. The gear 35, may be driven in any suitable manner. I have shown a simple arrangement wherein said gear 35, is driven from a gear 37, on the crank shaft C. The cam projections 36, and the operations of the gears 37 and 35, are so arranged and timed as to secure the desired and timely cycle of operation according to the design of the engine. If desired, and in order to regulate and adjust the operation of the governor valves, I mount the cam gear 35, upon a sleeve 38 the position of which may be adjusted. A simple arrangement for accomplishing this is shown, wherein the sleeve 38, is carried by a stud 39, and is held by a spring 40, against a cam collar 41, with which coöperates an adjustable cam sleeve 42. By adjusting the position of the cam sleeve 42, the gear sleeve 38, and with it, the cam gear 35, may be adjusted to vary and regulate the time of opening of the governor valve chamber to the pipe connections 26, 27. Of course it will be understood that when one of these pipe connections is open to the compressed air reservoir the other one is closed to the same. As above noted the pipe connections 26, 27, deliver to both ends of the engine cylinder. The pipe connection 26, is shown as employed to deliver the compressed air into the explosion chambers N, after each explosion therein, to clean out the same. To this end each end of said pipe connection delivers to a passage 43, which is controlled by an inwardly opening valve 44, and which delivers into the explosion chamber N. The operation is so timed that just as the piston end J, or K, as the case may be, begins to open the exhaust channel O, following an explosion in the chamber N, the lower governor valve 29, is opened to admit air pressure to the pipe connection 26, from the compressed air reservoir, whereupon a blast of the compressed air is delivered through pipe connection 26, and passage 43, causing valve 44 to open, and into the explosion chamber, thereby efficiently driving the gases and other products of the explosion out of the chamber N, through the exhaust O, P. Since a fresh charge or blast of compressed air is thus used after each explosion, it will be readily seen that not only are the gases and other products of the explosion efficiently expelled from the explosion chamber without danger of becoming mixed with the next charge of fuel but the compressed air thus used while filling the cylinder with air and eliminating vacuum, also serves to maintain the explosion chamber cool. By the time the piston end, in its movement in the reverse direction, has closed the exhaust opening O, P, the explosion chamber will have been completely cleaned out of the gases of the previous explosion and filled with clear air. The governor valve will also then have operated to close communication between the governor valve chamber and the pipe connection 26, and opened the communication between said chamber and the pipe connection 27. The pipe connection delivers at its ends into the generator chamber 45, with which also communicates the oil or fuel supply connection 46. The blast of compressed air thus delivered to the generator chamber 45, also causes the fuel oil to also be forced into said chamber, and the mixture of oil and air under pressure then passes through the passage 43, causing valve 44, to unseat, and on into the chamber N, until the governor valve cuts off the communication between the air reservoir and the pipe connection 27. Thereafter the mixed explosive charge in chamber N, is compressed and exploded, thereby repeating the cycle of operation above described.

The piston ends and heads may be packed in any suitable or convenient manner and by any desired arrangement of packing. A simple and convenient form of packing is shown in Figs. 3, 4 and 5, wherein packing rings 47, 48, are used, the ring 47, being rabbeted, as indicated at 49, to receive the ring 48. Preferably the rings are lap jointed. The packing rings are inserted in channels or grooves formed in the peripheral surfaces of the piston ends and piston heads as shown.

In an internal combustion or explosion engine embodying the principles of construction and having the mode of operation above described, I am enabled to increase the power developed by the engine by increasing the charge. I also keep the engine cylinders and pistons cool, expel the products of each explosion before the next charge is admitted, increase the compression space for the explosive charge. I also utilize the crank case and the interior space of the hollow pistons as a storage reservoir for compressed air and I control the supply of the compressed air for expelling the gases of each explosion and also for injecting fresh charges of explosive mixture under pressure into the explosion chamber. I also control the delivery of the compressed air for cleaning out the explosion chamber and for injecting the fuel charges, automatically and adjustably. These and other advantages are attained in the arrangement shown and above described.

An engine embodying in its construction the principles of my invention is well adapted for use in any situation where a motor of this character is desired, and may be operated with any suitable gas or liquid fuel to supply the explosive charge.

Many variations and changes in the details of construction and arrangements of parts would readily suggest themselves to persons skilled in the art and still fall within the spirit and scope of my invention. I do not desire, therefore, in the broadest scope of my invention as defined in the claims, to be limited or restricted to the details of structure and arrangement shown and described. But

Having now set forth the objects and nature of my invention, and a construction embodying the principles thereof, and having described the same, and the purposes functions and mode of operation of the same, what I claim as new and useful and of my own invention, and desire to secure by Letters Patent is,—

1. In an internal combustion engine, a casing having an interior chamber, a cylinder, a piston working in the cylinder, means arranged in said chamber and operated by the piston for compressing air into said chamber, fuel supply connections to the cylinder, independent pipe connections intermediate the cylinder and said interior chamber, said fuel supply connections communicating with one of said pipe connections, and valves arranged in said respective connections and controlled by said piston for controlling the delivery of a scavenging blast of compressed air from said chamber through the cylinder and to the atmosphere after each explosion therein and also controlling the delivery of air and the supply of fuel to the cylinder after the delivery of each scavenging blast.

2. In an internal combustion engine, a casing having a chamber, a cylinder, a hollow piston working in the cylinder, said chamber communicating freely with the interior of said piston, means actuated by the piston for compressing atmospheric air into said chamber, independent pipe connections between said chamber and the explosion chamber of the cylinder, a fuel supply connection communicating with one of said pipe connections, a valve controlled by the piston for delivering air from said chamber and fuel from the fuel supply connection to the explosive chamber of the cylinder to form an explosive charge, and valve mechanism also operated by the piston for controlling the other pipe connection between the casing chamber and explosion chamber for controlling the delivery of a scavenging blast of air from said casing chamber through said pipe connection to and through the cylinder to the outer air after each explosion in the explosion chamber.

3. In an internal combustion engine, a cylinder having an explosion chamber, a hollow piston working in the cylinder, means actuated by the piston for compressing atmospheric air into the interior of the hollow piston, fuel and air supply connections to the explosion chamber, said air supply connections being independent of each other and respectively communicating with the interior of the hollow piston, and valve mechanism operated by the piston for controlling said air pipe connections to control the supply of compressed air from the hollow piston to said explosion chamber, and operating to alternately deliver an explosive charge to the explosion chamber, and then a scavenging charge of air through said chamber.

4. In an internal combustion engine, a pair of cylinders having each an explosion chamber, connected hollow pistons respectively operating in said cylinders, means for compressing atmospheric air into the hollow pistons, independent fuel and air supply connections to each explosion chamber, and valve mechanism operated by the piston for controlling the supply of compressed air from the hollow pistons to said respective connections, and operating to alternately deliver an explosive charge to each explosion chamber through one of said connections, and then a scavenging charge of the air through the other of said connections and through each explosion chamber.

5. In an internal combustion engine, a pair of cylinders arranged in line with each other, each having an explosion chamber, connected hollow pistons respectively operating in said cylinders, means operated by the pistons for compressing the atmospheric air into the interior of said pistons, and valve mechanism operated by the pistons for alternately controlling the delivery of compressed air from the hollow pistons to both of the explosion chambers following

the explosions therein to expel the gases of the explosion and to form the explosive charge.

6. In an internal combustion engine, a cylinder having an explosion chamber, air inlet and fuel supply connections to said chamber, a casing having an interior chamber, independent pipes delivering from said interior chamber to said inlet and fuel supply connections, a piston operating in said cylinder, means operated by the piston for compressing atmospheric air into the interior chamber of the casing, a valve mechanism arranged in said pipe connection, and mechanism operated by the piston for actuating said valve mechanism to control alternately the supply of compressed air from said casing chamber to and through said explosion chamber following each explosion therein and to said chamber to form the explosive charge.

7. In an explosive engine, a cylinder having an explosion chamber, a hollow piston operating in said cylinder, air inlet and fuel supply connections to the explosion chamber, independent pipes connected thereto, means for compressing air into the hollow piston, and a valve mechanism for alternately controlling the communication of said pipes with the interior of the hollow piston.

8. In an explosive engine, a cylinder having an explosion chamber, a hollow piston operating in said cylinder, independent air inlet connections, and a fuel supply connection to said chamber, said fuel supply connection communicating with one of the air inlet connections, means operated by the pistons for compressing air into the interior thereof, and a valve mechanism for effecting the alternate communication between the interior of the hollow piston and said inlet and supply connections.

9. In an explosive engine, a cylinder having an explosion chamber, a hollow piston operating in said cylinder, independent air inlet connections to said chamber, a fuel supply connection with one of said air inlet connections, means operated by the piston for compressing air into the interior thereof, and a valve mechanism operated by the piston for effecting the alternate communication between the interior of said piston and said inlet connections.

10. In an explosive engine, a cylinder, a casing having an interior chamber, a valve in the end wall of said chamber, to control communication into said chamber from the outer air, a piston operating in the cylinder and having a head working in said chamber, a valve in said head to control a communication to the interior of said chamber, whereby when said piston is moved atmospheric air is compressed into said chamber, pipe connections from said chamber to the cylinder and valve mechanism operated by the piston and controlling said pipe connections, for utilizing the compressed air to first supply the cylinder with an explosive charge to operate the pistons and then to scavenge the same.

11. In an explosive engine, a cylinder having an explosion chamber, and also an interior chamber, a piston having a head operating in said interior chamber; coöperating valves in the end wall of said interior chamber and in said head, whereby when the piston is operated atmospheric air is compressed into said interior chamber, and a valve mechanism operated by the piston for controlling the supply of the compressed air from said interior chamber to the explosion chamber to expel the gases therefrom following each explosion therein.

12. In an explosive engine, a cylinder having an explosion chamber at each end thereof, a piston working in said cylinder, an air reservoir, means operated by the piston for compressing air into the reservoir, a valve chest, independent pipes delivering therefrom to each of both explosion chambers, said valve chest also in communication with said reservoir, valves for controlling the communication of said pipes with the chest, and means for operating said valves.

13. In an explosive engine, a cylinder having an explosion chamber at each end thereof, a piston working in said cylinder, said piston being hollow, means for compressing air into said hollow piston, a valve chest communicating with the interior of the piston, valves operating in said chest, independent pipes communicating between said chest and each of said chambers, and means for operating said valve to alternately open said pipes to said respective chambers.

14. In an explosive engine, a cylinder having an explosion chamber, a hollow piston, means operated thereby for compressing air thereinto, a valve chest communicating with the interior of said piston, and having independent communications with said chamber, valves for controlling said respective communications, and means for operating said valves alternately.

15. In an explosive engine, a cylinder having an explosion chamber, a hollow piston, means operated thereby for compressing air thereinto, a valve chest communicating with the interior of the hollow piston and with said chamber, valves for controlling said communications, and adjustable means for operating said valves.

16. In an explosive engine, a casing, a cylinder and piston, said casing having an interior chamber, means operated by the piston for compressing air into the casing chamber, independent pipes communicating

between said chamber and cylinder, a valve mechanism for controlling the supply of compressed air through said pipes from said chamber to the cylinder, and a shaft operated by the piston for actuating the valve mechanism to admit the compressed air alternately to said pipes.

17. In an explosive engine, a casing, a cylinder and piston, said casing having an interior chamber, means operated by the piston for compressing air into the casing chamber, independent pipes communicating between said chamber and cylinder, a valve mechanism for controlling the supply of compressed air through said pipes from said chamber to the cylinder, and including a valve stem, a cam for operating said stem and gearing operated by the piston movements for actuating the cam.

18. In an explosive engine, a casing, a cylinder and piston, said casing having an interior chamber, means operated by the piston for compressing air into the casing chamber, independent pipes communicating between said chamber and cylinder, a valve mechanism for controlling the supply of compressed air through said pipes from said chamber to the cylinder, and including a valve stem, a cam for operating said stem, means for adjusting the cam relative to the stem, and gearing operated by the piston for actuating the cam.

In testimony whereof I have hereunto set my hand in the presence of the subscribing witnesses, on this 18th day of May A. D., 1910.

WILLIAM HERMAN SCHILLINGER.

Witnesses:
JOHN T. MARRON,
JAMES F. MURPHY.