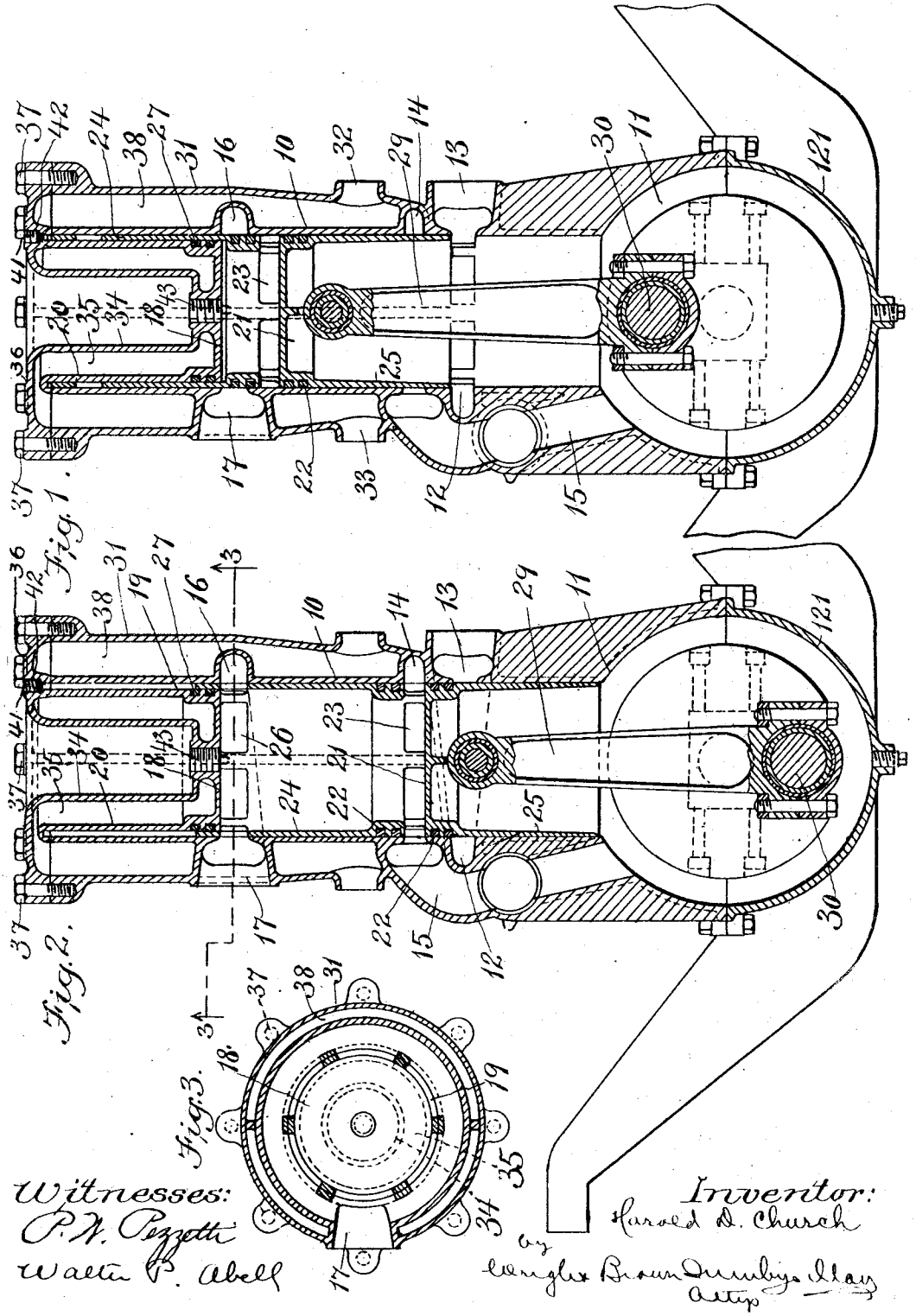
H. D. CHURCH.

GAS ENGINE.

APPLICATION FILED JAN. 27, 1908.

1,066,887. Patented July 8, 1913.



Witnesses:
P. F. Pezzetti
Walter B. Abell

Inventor:
Harold D. Church
by Langley Brown Dunlop & Mays
Attys

UNITED STATES PATENT OFFICE.

HAROLD D. CHURCH, OF NEWTON, MASSACHUSETTS, ASSIGNOR OF ONE-HALF TO LOUIS S. ROSS, OF NEWTON, MASSACHUSETTS.

GAS-ENGINE.

1,066,887. Specification of Letters Patent. Patented July 8, 1913.

Application filed January 27, 1908. Serial No. 412,754.

To all whom it may concern:

Be it known that I, HAROLD D. CHURCH, of Newton, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Gas-Engines, of which the following is a specification.

This invention has relation to internal combustion engines, and more particularly to those of the "two-cycle" type, and it has for its object to provide certain improvements therein for insuring a quicker and more perfect charging and scavenging of the cylinder than has heretofore been possible with engines of this type.

Referring to the accompanying drawings, Figure 1 represents in section a gas engine embodying the invention. In this figure the piston is at the inner end of its stroke. Fig. 2 represents a similar section with the piston at the outer end of its stroke. Fig. 3 represents a section on the line 3—3 of Fig. 2 looking in the direction of the arrow.

On the drawings, which illustrate one embodiment of the invention to the details of construction of which the invention is not limited, the cylinder is indicated at 10. At its lower or outer end, the cylinder communicates with a crank case indicated at 11, which has the removable portion 121.

12 indicates an annular port which encircles the cylinder, said port having a receiving mouth 13 for the combustible mixture which is admitted thereto for passage into the crank case. 14 indicates an annular port encircling the cylinder, this port communicating with a conduit 15 leading from the interior of the crank case so as to permit the passage of the combustible mixture from the crank case into the cylinder. 16 indicates a third annular port encircling the cylinder and communicating therewith, and through which port the products of combustion pass after combustion has taken place in the cylinder, said port having the discharge mouth 17. These three ports 12, 14 and 16 may be formed in any suitable way, and each communicates with the cylinder through a bridged slot or opening. When the cylinder is cast, these ports are formed by beads which are cast with the walls thereof. In the transverse plane with the upper edge of the port 16 is a transverse wall 18 of a reëntrant cylinder head. This transverse wall is separated from the annular wall of the cylinder by an annular space 19, the cylinder being projected somewhat beyond the wall 18 which is formed on the inner end of a reëntrant cylinder 20, whereby the area of the compression space is limited.

The piston is indicated at 21. It is of the trunk type and is equipped with the usual packing rings 22. Immediately above the diaphragm or head of the piston, it is provided with an annular extension 24 having the same diameter as said head and also having ports 23 which are adapted to register simultaneously with the port 14 and ports 26 adapted to register simultaneously with the port 16, when the piston is at the end of its outward or downward stroke as shown in Fig. 2. The piston is also provided with the usual annular flange or extension 25. The ports 26 consist of a bridged slot or elongated slots, the ends of which are close together, and are separated by narrow bridges. The ports 26 as stated, are adapted to register simultaneously with the discharge port 16 when the piston is at the end of its outward or downward stroke, said port 16 being closed as soon as the piston has completed the first part of its upward or inward stroke. The end of the inward flange or extension 24 fits in the annular space 19 at the upper end of the cylinder, said cylinder head 18 being provided with packing rings 27 to engage the interior wall of said flange or extension. The lower or outer extension 25 of the piston is adapted to open and close the port 12 which leads into the crank case. When the piston is at the end of its inward stroke, as shown in Fig. 1, the end of the flange or extension 25 has passed beyond the port 12 so as to open the said port and permit the passage of the explosive mixture into the crank case. At this time the said extension 25 closes the port 14 so as to cut off the passage of the mixture through the conduit 15. At the same time the piston has closed the discharge port 16, and the ex-

plosive mixture in the cylinder is compressed between the piston and the cylinder head. Assuming that the explosion takes place and that the piston moves outwardly, the first outward movement thereof causes the flange 25 of the piston to close the port 12 so as to cut off the entrance of the explosive mixture to the crank case. The continued outward movement of the piston compresses the mixture in the crank case, and as the piston approaches its limit of outward movement, the ports 16 and 14 are opened successively by the ports 26 and 23 of the flange or extension 24 registering therewith. Since the said ports 16 and 14 open into the cylinder through a slot which is practically continuous, and since the ports 26 and 23 form a practically continuous slot (consisting, as previously stated, of elongated apertures which are separated a short distance at their ends) the inrush of the explosive mixture into the inner end of the cylinder effects the immediate scavenging of the cylinder and the filling of the cylinder with the explosive mixture. It will be seen that, by this construction, the cylinder may be completely scavenged of the dead products of combustion in a very small space of time. The mixture flows into the cylinder from substantially every point in its periphery and the products of combustion are discharged outwardly in practically the same way. The products of combustion leaving the combustion chamber in a solid body and with little change in direction, tend to stratify, lessening the liabilities of dilution of the incoming charge, and because of the relative exhaust and inlet port location, it is practically impossible if the ports are of the proper relative heights for any of the incoming charge to escape through the exhaust ports, before the products of combustion have entirely left the combustion chamber.

It will of course be understood that the inner end of the piston is connected by a pitman 29 with the crank 30, any approved connections being used for this purpose. The cylinder may be water jacketed as illustrated. The water jacket 31 incloses the wall of the cylinder and is connected with the inlet and outlet ports 32 33. There is also a jacket at 34 to form a chamber 35 for cooling the reëntrant ring or wall 20 of the cylinder head. As a matter of construction the said wall 20 and the water jacket 34 may be cast in one piece with the flaring end wall 36 which is secured in place by bolts or the like as indicated at 37. By this means, the water chamber 35 may communicate with the water chamber 38 formed by the jacket 31. The water jacket is partitioned on opposite sides, as shown in Fig. 3, all the way from top to bottom on the cylinder, and on opposite sides of the cylinder head, to register with the jacket partition from the top of said cylinder head, to a point in the water jacket a predetermined distance above that portion of the head forming the upper end of the combustion chamber, so that all the water entering the cylinder jacket at opening 33, passes over the heated portion of said cylinder head before leaving the said cylinder jacket at opening 32. The extension 24 of the piston moves between two concentric water cooled walls so that it is not liable to be overheated. The combustion chamber in the engine is formed by the plate or head 21 of the piston, the flange or extension 24 thereof, and the cylinder head 18, and the gas and the flame do not come into contact with the cylindrical wall of the cylinder itself, except through the ports 23. The displacement of the crank case end of the piston being greater than that of the upper, or combustion chamber end, the volume of incoming gases when the piston is at the downward or lower end of its stroke, as shown in Fig. 2, is sufficient to fill not only that portion of the combustion chamber between the upper and lower extremities of the piston stroke, but also that portion of the said combustion chamber known as the compression space, said compression space being the space between the piston head and that portion of the cylinder head 18, when the piston is at the top of its stroke as shown in Fig. 1.

For the purpose of oiling the parts, it will be seen that there is, in line with the annular space 19 at the end of the cylinder, an aperture 41 through which oil may be introduced. This aperture may be normally closed by any kind of a plug such as that indicated at 42. There is also a suitable spark plug 43 in the compression space, though any other means may be employed for the ignition of the explosive mixture.

Having thus explained the nature of my said invention and described a way of constructing and using the same, although without attempting to set forth all of the forms in which it may be made or all of the modes of its use, I declare that what I claim is:—

1. In a two-cycle engine, a crank case, a cylinder of unvarying diameter from end to end, said cylinder having a reëntrant head surrounded by an annular space, and having in different planes in the cylindric wall between the inner end of the cylinder head and crank case inlet and exhaust ports of which each extends substantially entirely around the circumference of the cylinder, and a piston slidable in said cylinder and having an extension to project into said annular space, said piston and extension having a substantially unvarying diameter from

end to end, and said extension having two series of ports in different transverse planes, each series forming a substantially continuous opening extending entirely around the circumference of the extension, the ports of said series being adapted to register respectively and exclusively with said inlet and exhaust ports at the same time to effect a rapid scavenging of the cylinder, said cylinder having fuel supply ports between the crank case and said inlet ports, which supply ports are arranged to be closed by the piston when the latter is toward the crank case, said piston being movable beyond said supply ports, and means for conducting the fuel from the crank case to said inlet ports.

2. A two-cycle gas engine comprising a cylinder, a crank case, and a piston, said cylinder having a circular series of exhaust ports, a circular series of supply ports between said exhaust ports and the crank case, a circular series of inlet ports between said exhaust ports and supply ports, and a head of smaller diameter than the cylinder space, the effective surface of said head being flat and disposed in the transverse plane tangent to the outer edges of the exhaust ports, said piston having an annular extension beyond its head and surrounding the cylinder head, said extension having two circular series of ports in different transverse planes adapted to register respectively with said inlet and exhaust ports when the piston is nearest the crank case, the distance between the inlet ports and exhaust ports being greater than the piston stroke, the piston head being flat and disposed to occupy the transverse plane which is tangent to the inner edges of the inlet ports when the piston is nearest the crank case, the piston being adapted to cover said supply ports throughout the greater part of its stroke and uncover them when nearest the cylinder head, and means for conducting the fuel from the crank case to said inlet ports.

3. In a two-cycle gas engine, a crank case, a cylinder of unvarying diameter having in its cylindric wall an inlet between the cylinder head and crank case, an exhaust between the cylinder head and said inlet, and a trunk piston of unvarying diameter which respectively opens and closes said inlet and exhaust substantially simultaneously, said cylinder having a supply port between said inlet and the crank case, said piston being movable beyond said supply port to admit fuel to the crank case, said piston being adapted to close said supply port when moving toward the crank case, and means for conducting fuel from the crank case to said inlet.

4. A two-cycle gas engine, comprising a crank case, a cylinder, and a piston, said cylinder having a circular series of fuel supply ports in its cylindric wall substantially entirely surrounding the cylinder chamber, said piston being adapted to cover said supply ports when moving toward the crank case and to uncover them when at or near its outer extreme position, said cylinder having a reëntrant head surrounded by an annular space, and a circular series of exhaust ports between said head and said supply ports, said cylinder having also a circular series of inlet ports between said exhaust ports and said supply ports, the distance between said inlet and exhaust ports being greater than the piston stroke, means for conducting fuel from the crank case to said inlet ports, said piston having an annular extension extending outwardly from its head, said extension occupying said annular space around said reëntrant head, and having two circular series of ports in different transverse planes disposed to register respectively with said inlet ports and said exhaust ports when the piston is nearest the crank case.

5. In a two cycle gas engine, a cylinder and a crank case, there being three bridged ports arranged in different planes, and each extending entirely around the cylinder, one for the admission of the combustible mixture to the crank case, an intermediate one for the passage of said mixture to the cylinder, and the third at the inner or upper end of the cylinder for the discharge of the products of combustion, in combination with a piston having on its outer or lower end a portion to open and close the first-mentioned port, and on its inner or upper end a portion to open and close the second and third-mentioned ports.

6. In a two-cycle gas engine, a cylinder and a crank case, there being three ports arranged in different planes, one for the admission of the combustible mixture to the crank case, an intermediate one for the passage of said mixture to the cylinder, and the third at the inner or upper end of the cylinder for the discharge of the products of combustion, in combination with a piston having on its outer end a portion to open and close the first-mentioned port, and on its inner end a flange or extension with ports to register with the intermediate and discharge ports respectively.

7. In a two-cycle gas engine, a cylinder having a reëntrant head encircled by an annular space, an annular discharge port at the inner or head end of the cylinder, a crank case in open communication with the outer end of the cylinder, and an inlet port leading into the crank case through the cylindric wall of the cylinder, said cylinder having an intermediate port near the inlet port to receive the mixture from the crank

case, and a piston having ports to register with the intermediate port of the cylinder, an outer extension to open and close said inlet port, and an inner extension adapted to slide in said annular space and adapted to open and close the discharge port of the cylinder.

In testimony whereof I have affixed my signature, in presence of two witnesses.

HAROLD D. CHURCH.

Witnesses:
P. W. PEZZETTI,
E. BATCHELDER.