J. F. WOOLF.

EXPLOSIVE ENGINE.

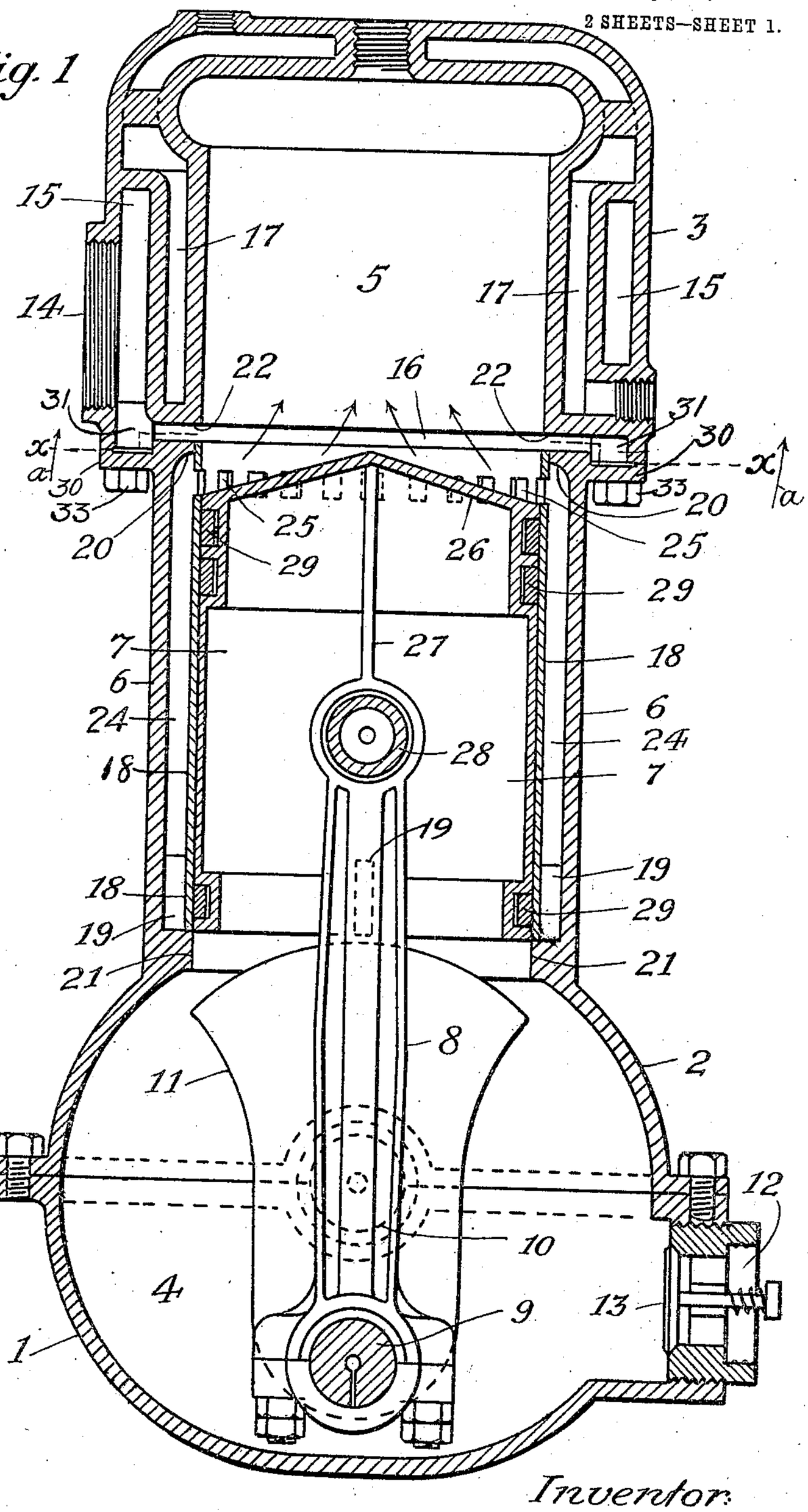
APPLICATION FILED FEB. 16, 1909.

959,905.

Patented May 31, 1910.

2 SHEETS—SHEET 1.

Fig. 1



Witnesses:
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H. A. Bowman.

Inventor:
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2 SHEETS—SHEET 2.

Fig 3

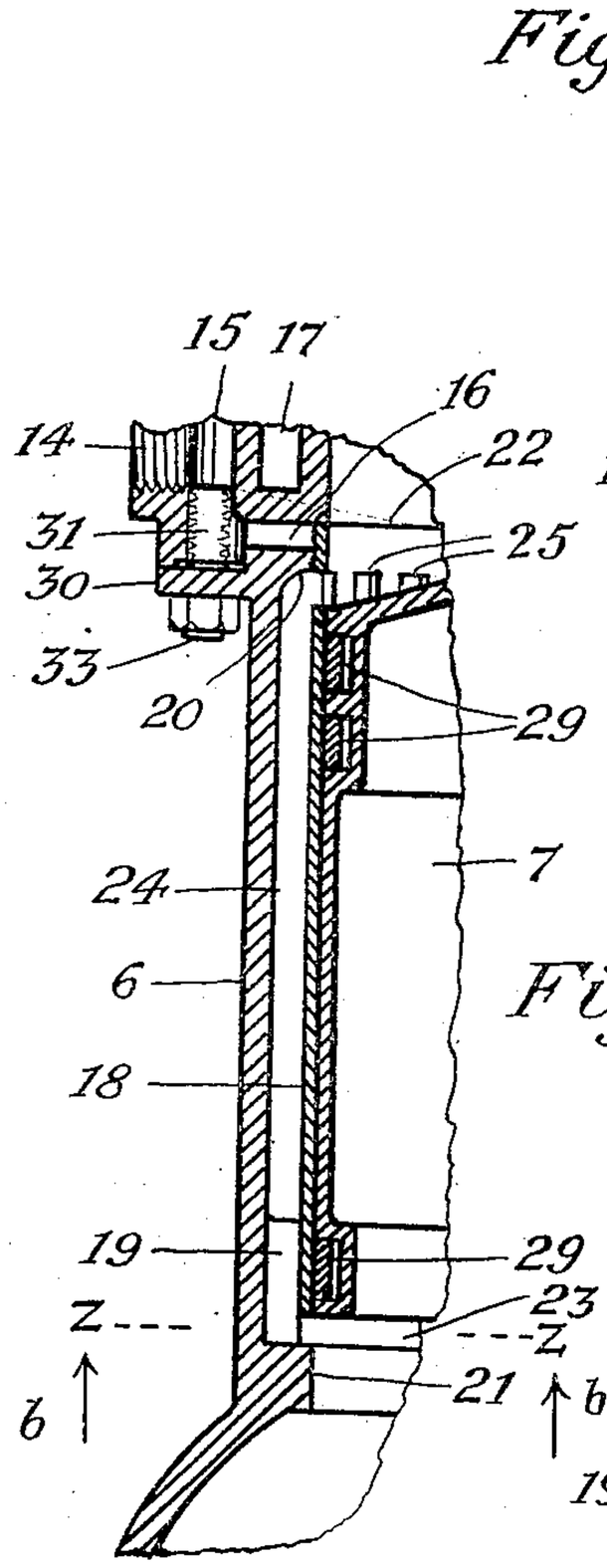


Fig 2

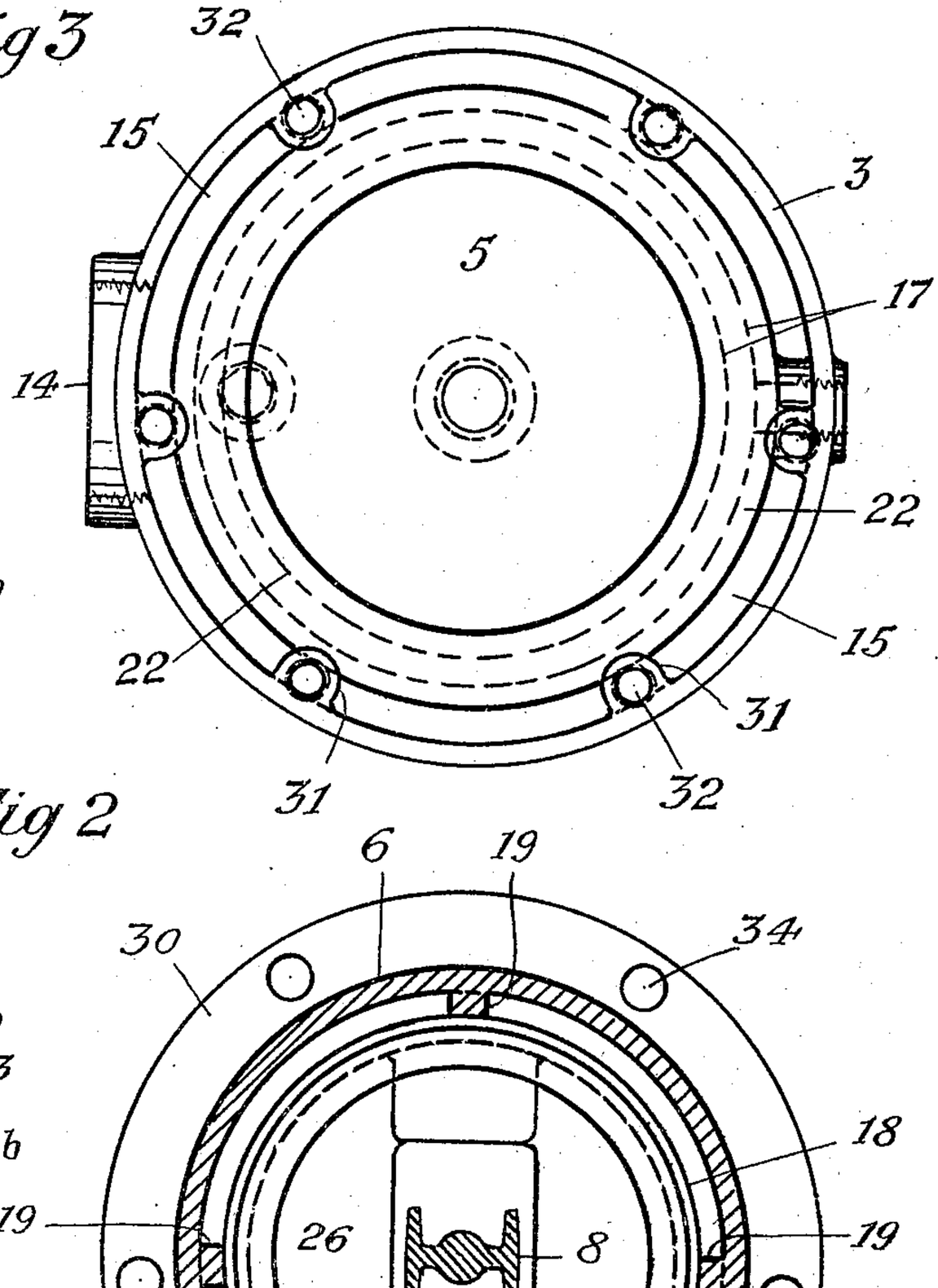
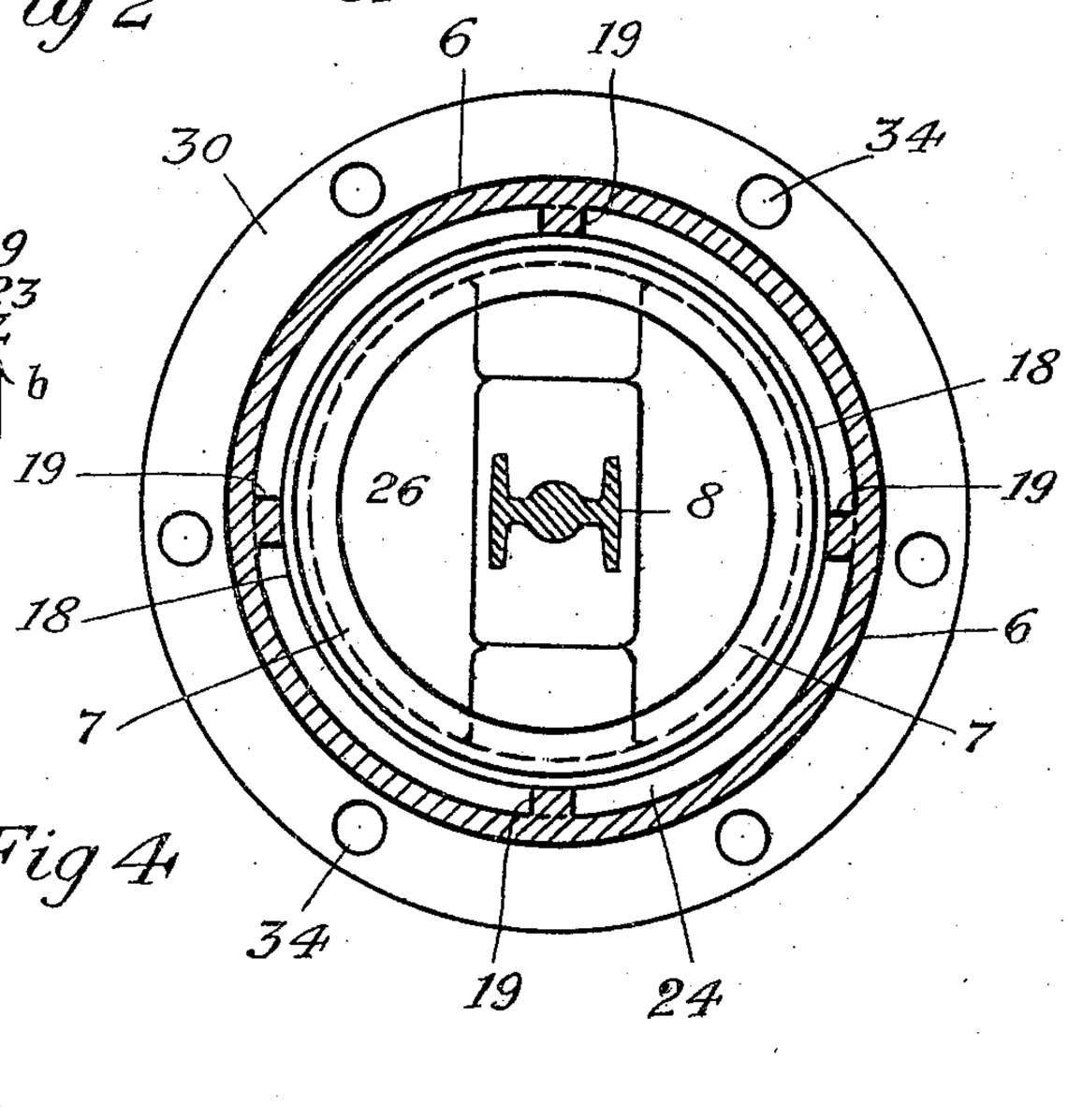


Fig 4



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UNITED STATES PATENT OFFICE.

JAY F. WOOLF, OF MINNEAPOLIS, MINNESOTA, ASSIGNOR OF ONE-HALF TO ELLIS J. WOOLF, OF MINNEAPOLIS, MINNESOTA.

EXPLOSIVE-ENGINE.

959,905. Specification of Letters Patent. Patented May 31, 1910.

Application filed February 16, 1909. Serial No. 478,198.

To all whom it may concern:

Be it known that I, JAY F. WOOLF, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Explosive-Engines, of which the following is a specification.

My invention relates to explosive engines, and its principal object is to connect the compression and explosion chambers by a direct annular passage-way and to so construct and arrange the piston and connections that the piston movements will control the ports to such passage-way and also control the exhaust ports.

My improvements are illustrated in the accompanying drawings, in which—

Figure 1 is a central vertical section of an explosive engine embodying my improvements, showing the piston at the limit of its inward movement and showing the port between the charging chamber and transfer passage-way closed; Fig. 2 is a similar view of a portion of the engine showing the piston in position to open such port to permit the flow of fluid from the compression chamber through the annular passage-way to the explosion chamber. Fig. 3 is a transverse section on the irregular broken line *x*—*x* viewed in the direction of the arrows *a*, showing a bottom view of the casting or casing member that provides the explosion chamber. And Fig. 4 is a transverse section on the line *z*—*z* of Fig. 2 viewed in the direction of the arrows *b*, the port between the charging chamber and transfer passage-way being open.

In the drawings 1, 2, and 3, respectively, represent the parts constituting a suitable casing, providing a compression chamber 4 and an explosion chamber 5, and an intermediate cylinder 6 in which the piston 7 operates. The piston is connected by a rod 8 to the crank-pin 9 of the crank-shaft 10 and the usual counterbalance 11 for the crank is provided. An inlet port 12 in the wall of the chamber 4 is controlled by an ordinary spring-actuated check-valve 13; and an exhaust port 14 is provided in the casing member 3 which is in communication with an annular passage-way 15 which is open to a circular exhaust chamber 16 formed by a space left between the casing members 2 and 3. The usual water-jacket space 17 is provided around the walls of the upper chambers.

The base of the casting or casing member 3 being wider than the cylinder 6 the latter is provided near its outer end with a flange 30 upon which the base of the outer portion of the casting 3 is seated. Stud lugs 31 formed within the casting have threaded openings 32 to receive bolts 33 that are entered from below through holes 34 in the flange 30 for securing the parts together. The exhaust space 16 is thus provided between the top of the cylinder 6 and the lower end of the inner portion of the casting 3.

Within the cylindrical portion 6 of the casing is arranged a concentric cylinder or sleeve 18 that is slidable longitudinally, being guided near the lower end by lugs 19 formed on the inner walls of the casing, and at the top by a rim 20 projecting inwardly from the top of the casing member 2. The downward movement of the sleeve 18 is limited by a stop 21 which may be a shouldered inward projection from the casing; its upward movement is also limited by a suitable stop 22, which may be the lower wall of the upper casing member 3; and the length of the sleeve is such that when seated on the lower stop 21 (as shown in Fig. 1) its upper end is flush with the top of the casing member 2, thus leaving the exhaust chamber 16 open to the outlet, and when its upper end is in contact with the stop 22 and the exhaust chamber is closed (as shown in Fig. 2), its lower end will be sufficiently removed from the seat 21 to provide an opening or port 23 between the chamber 4 and the annular space 24 intermediate the casing 6 and sleeve 18. This space 24 provides the passage-way for the fluid from the chamber 4 to the chamber 5, and to permit the flow from the passage-way to the latter chamber. The upper portion of the sleeve 18 is provided with numerous openings or ports 25. These openings or ports are provided at points in the sleeve immediately above the location of the head of the piston when the latter is at its lower limit of travel.

The piston 7 consists of a cylindrical

shell open at the bottom and closed at the top by a head 26 from which the hanger 27 for the connecting rod pin 28 is suspended. The outer walls of the piston body may be in frictional contact with the inner walls of the sleeve 18, but to insure sufficient friction to adequately move the sleeve packing rings 29 are provided near both ends of the piston. The arrangement adapts the piston when reciprocated to move the sleeve correspondingly between the stops 21 and 22, and enables the piston to slide beyond the sleeve when the latter engages the stop 22.

In operation, the charging mixture is admitted to the chamber 4 through the intake 12 during the upward stroke of the piston, and then during the return stroke of the piston the valve 13 is seated by the combined action of its spring and the fluid pressure in the chamber 4, and the compression of the fluid continues until the piston reaches the limit of its return stroke, shown in Fig. 1. In that position the chamber 5 is free to exhaust the products of combustion through the chamber 16 and discharge outlet 14. The first effect then of the next piston reciprocation is to lift the sleeve 18 from its seat and open the port 23 between the annular passage-way 24 and the chamber 4 and to move the upper end of the sleeve to its stop 22 and thereby close the exhaust passage-way 16, as shown in Fig. 2. When in the latter position the fluid is free to flow from the chamber 4 through the passage-way 24 and the valve openings 25 into the chamber 5, and such flow continues until the piston slides within the sleeve far enough to close the inlet openings or ports 25. The further movement of the piston serves to compress the fluid in the chamber 5, and when compressed and the piston has reached the limit of its stroke the compressed gaseous charge is exploded in the usual way.

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

1. In an explosive engine, the combination with casing members providing compression and explosion chambers and an intermediate cylinder, of a piston therein separating the compression chamber from the explosion chamber, a sleeve separated from the cylinder by an annular space and slidable on and with the piston and having ports past which the piston head reciprocates to control the flow of gas through said ports from said annular space to the explosion chamber, and stops provided on the casing members for limiting the sleeve reciprocations to permit the piston head to open said ports near the end of its down-stroke and close them during its up-stroke, substantially as set forth.

2. In an explosive engine, the combination with casing members providing compression and explosion chambers and a cylinder connecting said casing members and providing a circular exhaust outlet between its upper end and the base of the casing of the explosion chamber, of a piston located within the cylinder and casing members and separating the compression chamber from the explosion chamber, a sleeve slidable thereon and therewith and provided in its upper portion with ports past which the piston reciprocates, the sleeve being separated from the body of the cylinder by an annular fluid passage-way and serving, at times, to connect the compression chamber with said passage-way and the sleeve ports being in communication with the annular passage-way in position to be uncovered by the piston near the end of its down-stroke to connect the explosion chamber with said passage-way, and a stop provided on the casing below said passage-way for limiting the movement of the sleeve and coöperating therewith to shut off the passage-way from the compression chamber on the down-stroke of the piston, substantially as set forth.

3. In an explosive engine, the combination with casing members providing compression and explosion chambers and a cylinder connecting said casing members and providing a circular exhaust outlet between its upper end and the base of the casing of the explosion chamber, of a piston located within the cylinder and casing members and separating the compression chamber from the explosion chamber, a sleeve slidable thereon and therewith and provided in its upper portion with ports past which the piston reciprocates, the sleeve being separated from the body of the cylinder by an annular fluid passage-way and serving, at times, to connect the compression chamber with said passage-way and the sleeve ports being in communication with the annular passage-way in position to be uncovered by the piston near the end of its down-stroke to connect the explosion chamber with said passage-way, a stop provided on the casing below said passage-way for limiting the downward movement of the sleeve, and a stop provided on the casing above the exhaust outlet for limiting the upward movement of the sleeve and coöperating therewith to close the exhaust outlet at the beginning of the up-stroke of the piston, substantially as set forth.

4. In an explosive engine, the combination with casing members providing compression and explosion chambers and a cylinder connecting said casing members and providing a circular exhaust outlet between its upper end and the base of the casing of the explosion chamber, of a piston, a sleeve slid-

able thereon and therewith to and from contact with the base of the casing of the explosion chamber, and a rim on the cylinder for guiding the sleeve, whereby the sleeve is adapted to open and close the exhaust outlet, substantially as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses this 6th day of February 1909.

JAY F. WOOLF.

Witnesses:
JOHN P. MARTIN,
CHAS. H. DIXON.