No. 890,643. PATENTED JUNE 16, 1908.

H. S. HART.

TWO CYCLE INTERNAL COMBUSTION ENGINE.

APPLICATION FILED JULY 13, 1907.

2 SHEETS—SHEET 1.

Fig. 1.

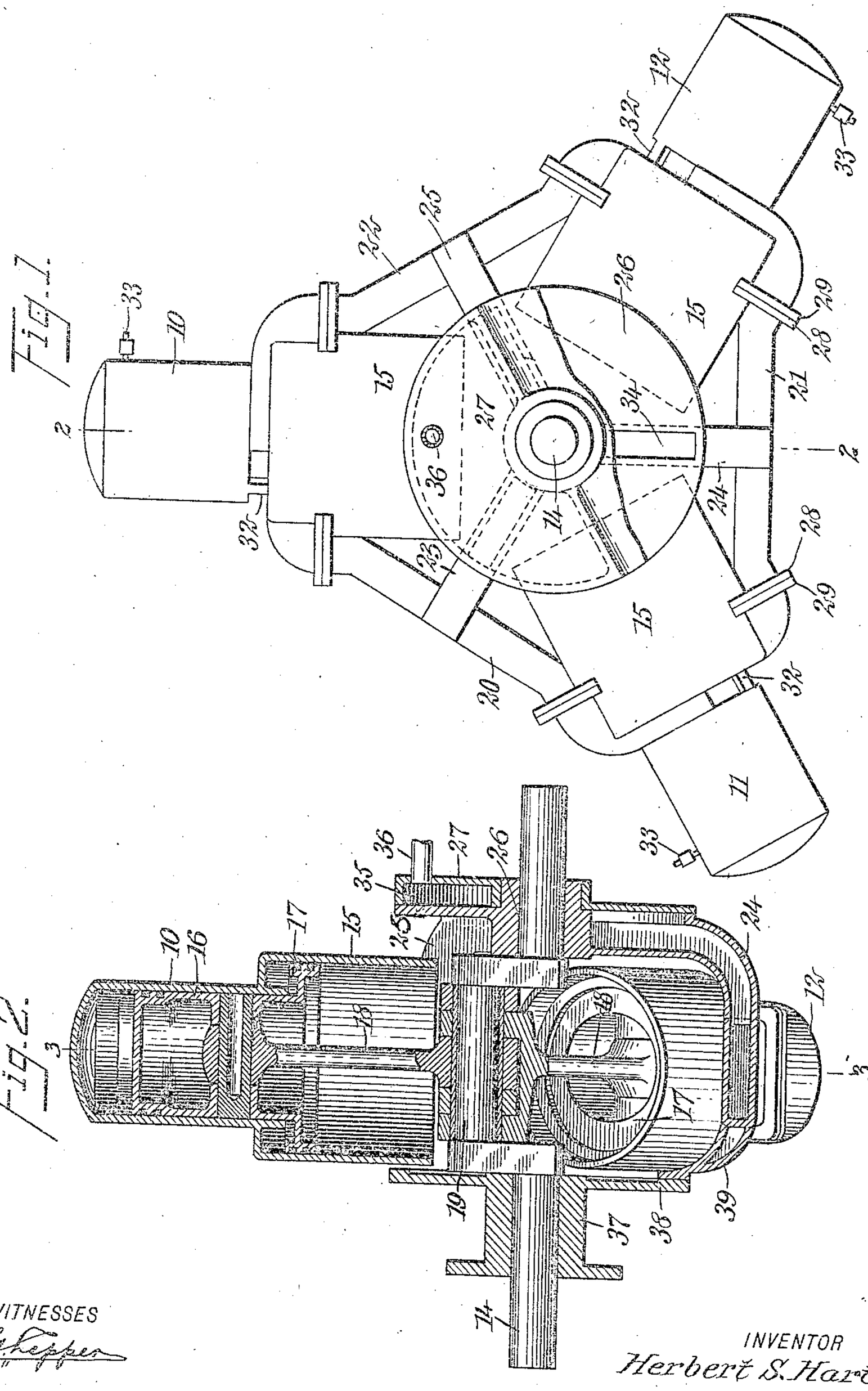


Fig. 2.

WITNESSES

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Fig. 4.

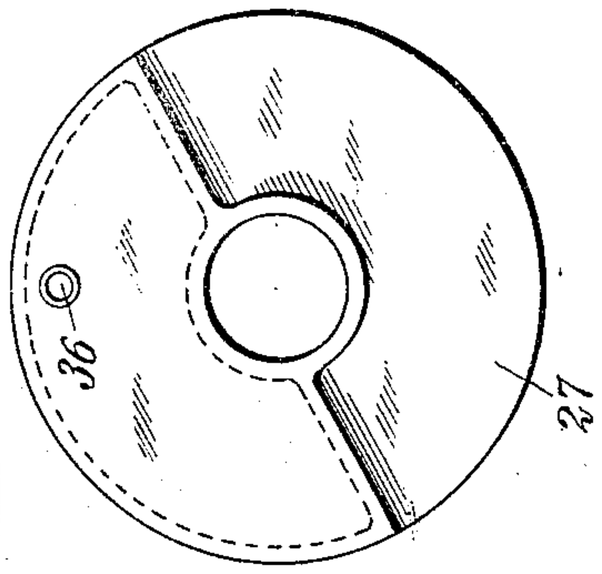
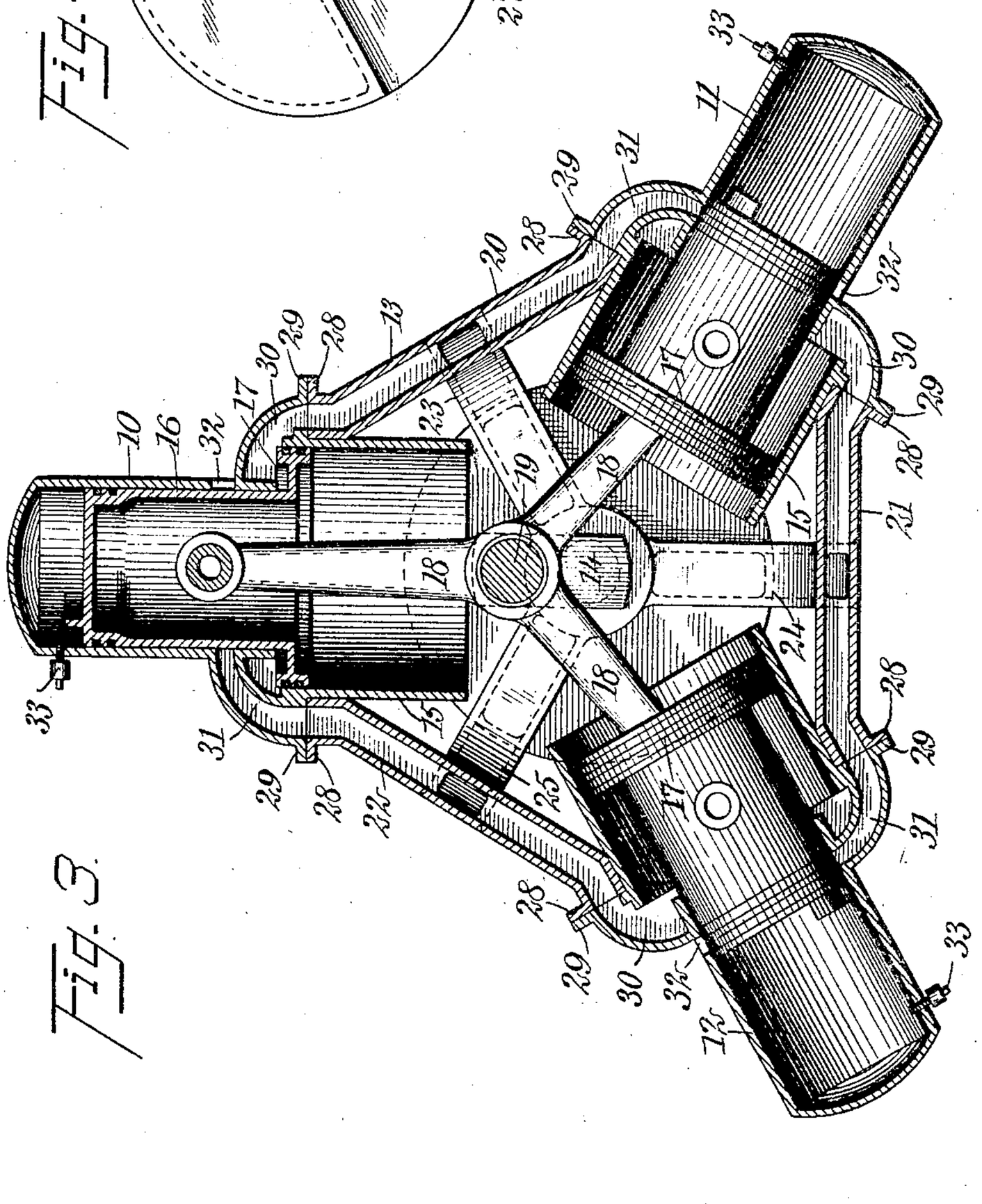



Fig. 3.

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## TWO-CYCLE INTERNAL-COMBUSTION ENGINE.

No. 890,643. Specification of Letters Patent. Patented June 16, 1908.

Application filed July 13, 1907. Serial No. 383,605.

*To all whom it may concern:*

Be it known that I, HERBERT S. HART, a citizen of the United States, and a resident of Madison, in the county of Dane and State of Wisconsin, have invented a new and Improved Two-Cycle Internal-Combustion Engine, of which the following is a full, clear, and exact description.

This invention relates to certain improvements in two-cycle internal combustion engines, and more particularly to a multiple cylinder engine, the cylinders of which are arranged in respect to a common shaft and so mounted as to rotate about the shaft, said shaft being held stationary.

The object of the invention is to provide means, whereby a fuel charge is compressed by the piston of each engine, and whereby this charge is delivered to the working chamber of the next successive cylinder of the series.

A further object of the invention is to provide a stationary fuel supply chamber adapted to be put in communication with the several compression chambers in succession as the latter are rotated about the common crank shaft.

A further object of the invention is to so construct the cylinders and supporting parts that by unbolting each cylinder and rotating it through a portion of a revolution, the engine may be caused to rotate in the reverse direction, the positions of the cylinders in respect to the frame determining the direction of rotation.

In my improved engine the cylinders in rotating about the common crank shaft constitute a fly wheel, thus avoiding the necessity for the provision of special means for facilitating a substantially uniform rate of rotation. No fan is necessary, due to the movement of the cylinders and their rapid rotation, thus the necessity for a water jacket or other special cooling means is avoided. Each cylinder is so constructed that the movement of the piston and the rotation of the cylinder serve to control not only the inlet and exhaust ports of the working chamber, but also control the supply and exhaust ports of the compression chamber, thus avoiding the necessity for valves, gears, or other separate mechanism for controlling the passage of the gases at the different points in the cycle of operation. I preferably provide an odd number of cylinders, as, for instance, three, and provide the crank shaft with only a single crank, whereby there is no single point of dead center.

The engine is very much lighter in weight than an engine of the same horse-power constructed along the customary lines, the reduction in weight being largely due to the elimination of the fly wheel and all valves, springs, levers, and gears for controlling the operation.

The invention consists in certain features of construction and combinations of parts, all of which will be fully set forth hereinafter and particularly pointed out in the claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures, and in which

Figure 1 is an end view of an engine constructed in accordance with my invention; Fig. 2 is a central section longitudinally of the crank shaft, and taken on the line 2—2 of Fig. 1; Fig. 3 is a central section taken at right angles to the crank shaft and upon the line 3—3 of Fig. 2; and Fig. 4 is a view of the stationary inlet controlling plate.

In the specific form of my invention illustrated in the accompanying drawings, I provide three cylinders 10, 11 and 12; and each is rigidly secured to a skeleton frame 13 and mounted to rotate about a stationary crank shaft 14. Each of the cylinders is so constructed, as to compress a second fuel charge at the same time that the fuel charge in the main working chamber of the cylinder is being compressed previous to ignition. The gas compressed in the compression chamber of each cylinder is conducted to the working chamber of the next adjacent cylinder, to be further compressed and ignited therein. As illustrated, each cylinder is formed in two diameters, the portion of smaller diameter being outermost from the crank shaft and provided with an inlet and an exhaust port, while the portion of larger diameter is arranged nearer to the crank shaft and provided with a single port adapted to act as an admission port and also as an outlet port. The cylinder is secured to the skeleton frame intermediate the ends of the cylinder, and the

portion of larger diameter comprises merely a cylindrical flange 15.

Within each cylinder is mounted a piston having a portion 16 of such a diameter as to fit the smaller portion of the cylinder, and having an outwardly directed flange 17 forming a portion of larger diameter in engagement with the larger portion of the cylinder. The smaller end of the piston coöperates with the smaller end of the cylinder to form a working chamber, while the larger portion of the piston coöperates with the larger portion of the cylinder to form a compression chamber. Each piston is provided with a piston rod 18, and all three piston rods are connected to a single crank 19 upon the crank shaft, whereby all of the pistons operate simultaneously, but each piston is always at a different portion of its stroke than another piston. The skeleton frame is preferably made hollow, whereby it forms the conduits for delivering the gases to and from the compression chambers and to the working chambers. As shown, the frame comprises three connecting conduits 20, 21 and 22, each leading from the compression chamber of one cylinder to the working chamber of the next adjacent cylinder, and leading from the central portion of each of the three connecting conduits are three radially disposed conduits 23, 24 and 25, communicating with a hub portion 26 journaled upon the crank shaft 14. This hub portion coöperates with a stationary valve plate 27 controlling the admission of the fuel charge to the several radially disposed conduits 23, 24 and 25.

Each end of each of the connecting conduits 20, 21 and 22 terminates in a plane at right angles to the axis of the adjacent cylinder, and both ends of each conduit are exactly alike even though one end is connected to the compression chamber and the other end connected to the working chamber. The ends of the conduits are provided with outwardly extending flanges 28, which are adapted to be bolted to corresponding flanges 29 upon the cylinders for rigidly securing the latter in place. The walls of each cylinder intermediate its ends are so constructed that there are formed two passages 30 and 31, the position of the outer ends of these passages being symmetrical in respect to the cylinder, while the inner end of the passage 30 leads to the compression chamber and the inner end of the passage 31 leads to the working chamber. Adjacent the passage 30, the portion of the cylinder forming the working chamber is provided with an exhaust port 32 and at the outer end of the cylinder is provided any suitable igniting means, as, for instance, a spark plug 33.

The three radially disposed conduits 23, 24 and 25 communicate at their outer ends with the connecting conduits 20, 21 and 22, and at their inner ends terminate in ports 34. In engagement with the hub portion 26 having these ports, is the valve plate 27, approximately one-half of which is provided with a chamber 35 adapted to communicate with the ports 34, and the remaining half of which comprises a flat plate completely closing the ports when they are in engagement therewith. The entire valve plate 27 is held stationary in any suitable manner, as, for instance, by being connected to the supports for the stationary crank shaft 14, and delivering to the chamber 35 within the valve plate is a suitable conduit 36 leading from the carbureter or other source of explosive mixture. As there is normally provided but one valve plate 27 and one set of radially disposed delivering conduits 23, 24 and 25, the skeleton frame preferably includes a second hub 37 rotatably mounted upon the crank shaft upon the opposite side of the engine from the hub 26 and having an annular flange 38 rigidly connected to the conduits 20, 21 and 22 by radially disposed hollow braces 39, which braces are oppositely disposed to the radial conduits.

In the operation of my improved engine, the crank shaft 14 and the valve plate 27 are rigidly and non-rotatably supported, and by the explosions within the working chambers of the several cylinders, the cylinders and skeleton frame are caused to rotate about the crank shaft. The explosive mixture is supplied through the conduit 36 to the chamber 35, and as the several ports 34 come successively into communication with this chamber, the charge is drawn into the compression chambers of the several cylinders in succession. The compression chambers of the several cylinders receive the explosive charge through the corresponding connecting conduit and radial conduit, while the piston is being drawn inwardly. For instance, at the time the piston of the cylinder 10 starts upon its outward movement, the port 34 of the supply conduit 23 communicating therewith is closed and the charge within the compression space is compressed into the connecting conduit 20 and radial conduit 23. Just previous to the time at which the piston reaches the end of its outward movement, the piston of the cylinder 11 reaches its innermost position and the exhaust gases escape therefrom through the exhaust post 32, and the charge compressed in the compression chamber of the cylinder 10 and conduits 20 and 23 is delivered through the passage 31 into the working chamber of the cylinder 11. Upon a further rotation, the piston moves outward to close the passage 31 and the port 32, and the charge which has already been compressed in the compression chamber of

the cylinder 10 is further compressed in the working chamber of the cylinder 11 until the time at which it is ignited by the spark plug 33 of this cylinder. The same operation is repeated in connection with each of the other cylinders, namely, the port 34 opens to permit the intake of a charge to the several compression chambers, and is then closed to permit of a compression of the gas and its delivery into the working chamber of the next successive cylinder.

With the engine constructed as illustrated in the accompanying drawings, and with the parts arranged as shown, it is evident that the engine is non-reversible, but it is also evident that the direction of rotation may be readily reversed by a slight change in the relative position of certain parts. The outer ends of the passages 30 and 31 are, a previously stated, symmetrical, and thus to cause the engine to rotate in the opposite direction, all that is necessary is to unbolt the several cylinders and pistons and rotate each about its own axis through an angle of 180 degrees. This would bring the passage 30 of the cylinder 10 into communication with the conduit 22 and the passage 31 of the cylinder 10 into communication with the conduit 20. With each of the cylinders thus re-bolted in its new position, the compression chambers which had previously communicated with the working chambers of the next successive cylinders to the right would now communicate with the working chambers of the next successive cylinders to the left. With the cylinders in either of their two positions, there is no possibility of back-firing or accidental reversal in the direction of rotation, but rotation in either direction may be secured by the proper adjustment of the parts.

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

1. In a two-cycle engine, a plurality of cylinders, each having a working chamber and a compression chamber, said working chamber having independent inlet and exhaust ports and said compression chamber having a common inlet and exhaust port, pistons mounted within said cylinders and controlling the inlet and exhaust ports of the working chambers, conduits each having an inlet port and connecting the inlet port of each working chamber with the port of the compression chamber of another cylinder and revoluble means for controlling the inlet ports of all of said conduits.

2. In a two-cycle engine, a stationary crank shaft, a plurality of cylinders radially mounted in respect thereto and revoluble about the same and each having a compression chamber and a working chamber, pistons mounted within said cylinders and operatively connected to said shaft, a skeleton frame for supporting said cylinders, said frame including connecting conduits leading from the compression chamber of each cylinder to the working chamber of the next successive one and radially disposed conduits joining said connecting conduits intermediate their ends.

3. In a two-cycle engine, a stationary crank shaft, a plurality of cylinders radially mounted in respect thereto and revoluble about the same and each having a compression chamber and a working chamber, pistons mounted within said cylinders and operatively connected to said shaft, a skeleton frame for supporting said cylinders, said frame including connecting conduits leading from the compression chamber of each cylinder to the working chamber of the next successive one and radially disposed conduits joining said connecting conduits intermediate their ends, and a stationary valve plate having a chamber therein adapted to communicate with said radial conduits in succession during the revolution of the engine.

4. In a two-cycle engine, a stationary crank shaft, a plurality of cylinders radially disposed in respect thereto and revoluble about said crank shaft and each having a compression chamber and a working chamber, pistons operating within said cylinders, conduits connecting said cylinders whereby a fuel charge compressed in the compression chamber of one cylinder may be delivered to the working chamber of the next successive cylinder to be exploded therein, and means whereby each cylinder may be rotated through a portion of a revolution to reverse the connection of the conduits and cause a reversal in the direction of rotation of the engine.

5. In a two-cycle engine, a crank shaft, a plurality of cylinders radially mounted in respect thereto and each having a compression chamber and a working chamber, pistons mounted within said cylinders and operatively connected to said shaft, and a skeleton frame for supporting said cylinders, said frame including conduits leading from the compression chamber of each cylinder to the working chamber of the next successive one, and supply conduits communicating with each of said connecting conduits intermediate its ends.

6. In a two-cycle engine, a crank shaft, a plurality of cylinders radially disposed in respect thereto, each cylinder having a compression chamber and a working chamber, pistons operating within said cylinders, conduits connecting said cylinders, whereby a fuel charge compressed in the compression chamber of one cylinder may be delivered to the working chamber of the next successive

cylinder to be exploded therein, and means whereby each cylinder may be rotated through a portion of a revolution to reverse the connections of the conduits and cause a reversal in the direction of rotation of the engine.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HERBERT SELATHIEL HART.

Witnesses:
R. M. LAMP,
C. F. SPOONER.