P. O. FREDLUND.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED NOV. 2, 1914.

1,170,059.

Patented Feb. 1, 1916.

2 SHEETS—SHEET 1.

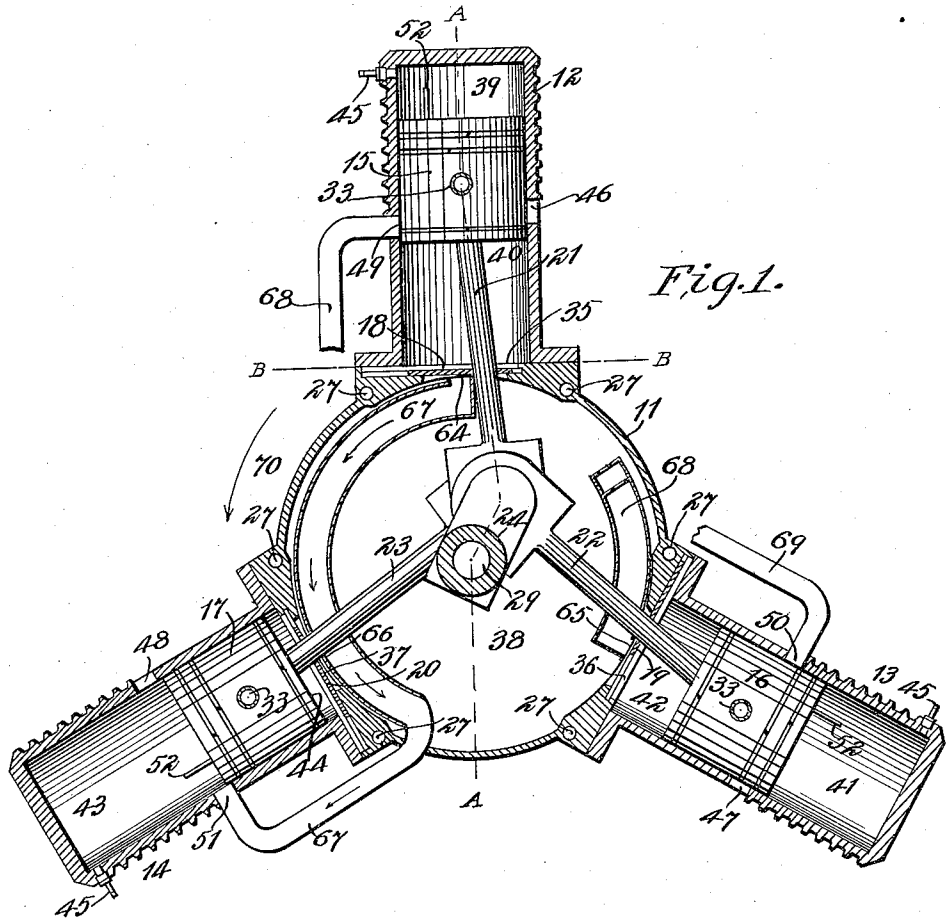


Fig. 1.

Witnesses:

Andrew Ostlund

Erick Ostlund

Inventor:

Per Olof Fredlund

P. O. FREDLUND.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED NOV. 2, 1914.

1,170,059.

Patented Feb. 1, 1916.

2 SHEETS—SHEET 2.

Fig. 2.

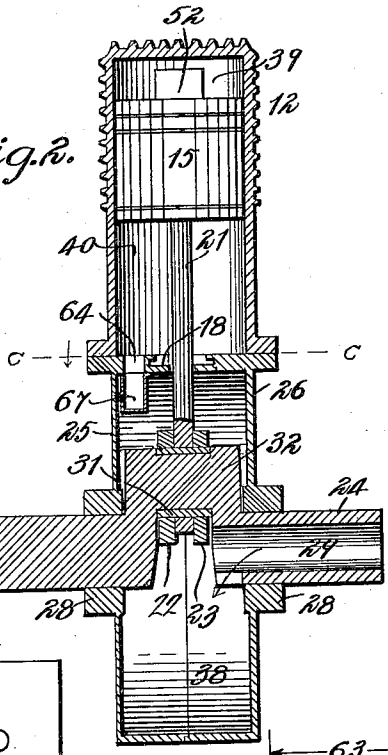


Fig. 3.

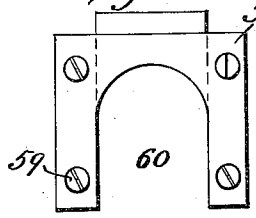
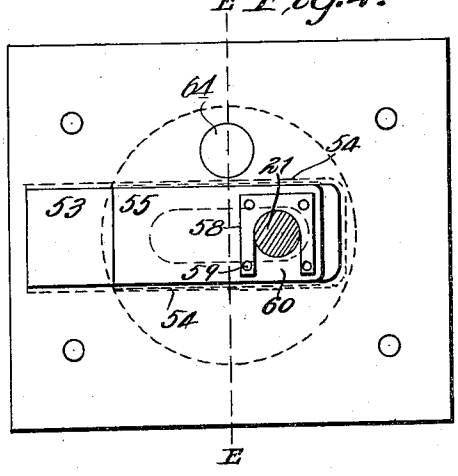


Fig. 4.



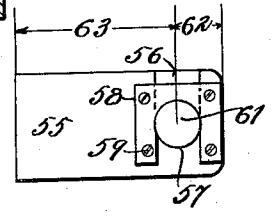


Fig. 5.

Witnesses:

Andrew Ostlund

Erick Ostlund

Inventor:

Per Olof Fredlund

THE COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

PER OLOF FREDLUND, OF PASADENA, CALIFORNIA.

INTERNAL-COMBUSTION ENGINE.

1,170,059. Specification of Letters Patent. Patented Feb. 1, 1916.

Application filed November 2, 1914. Serial No. 869,914.

To all whom it may concern:

Be it known that I, PER OLOF FREDLUND, a citizen of Sweden, residing at Pasadena, in the county of Los Angeles, State of California, have invented a new and useful Internal-Combustion Engine, of which the following is a specification.

My invention relates to internal combustion engines, and more particularly to internal combustion engines in which the cylinders and their associated parts rotate about a fixed crank shaft.

The first object of the invention is to provide a two stroke cycle engine of this character which will be simple in construction and in which the width of the engine along the shaft will be small, so that it may be placed in a narrow space, as for example inside a wheel of a tractor or the like.

The second object of the invention is to provide an engine which will use the ordinary type of trunk piston commonly employed in automobile engines, but which will utilize the cylinder space below this piston for charging and scavenging an adjacent cylinder.

The third object of the invention is to provide a novel form of closure between the cylinder and the crank case which includes a valve which performs the double function of separating the space below the piston from the crank case and regulating the admission of fresh mixture to said space.

In the drawings, which are for illustrative purposes only:

Figure 1 is a central section of the engine. Fig. 2 is a section on the plane A—A of Fig. 1. Fig. 3 is an enlarged view of a connecting rod valve block. Fig. 4 is an enlarged section on the line C—C of Fig. 2, a portion of the engine being omitted for the sake of clearness, and Fig. 5 is a view of the connecting rod valve.

The invention, one modification of which is illustrated in the drawing, consists broadly of a crank case 11, three cylinder castings 12, 13 and 14, three pistons 15, 16 and 17, three inlet valves 18, 19 and 20, three connecting rods 21, 22 and 23, and a shaft 24.

The crank case 11 is made up in two halves 25 and 26 fastened together by bolts 27. The crank case is so constructed that it forms a vapor tight structure. Bearings 28 are formed on each of the halves 25 and 26 upon which the crank case 11 and the parts secured thereto rotate upon the shaft 24 which is stationary. An opening 29 extends through the shaft 24, the outer end being connected to a carbureter or other suitable means for producing an explosive mixture, and the inner end opening into the interior of the crank case 11 which is normally kept full of this explosive mixture which enters through the opening 29. A single crank 30 is formed on the shaft 24 and a bushing 31 is placed on the pin 32 of the crank, the inner ends of the connecting rods 21, 22 and 23 being journaled on this bushing. The outer ends of the connecting rods 21, 22 and 23 are journaled on pins 33 in the pistons 15, 16 and 17.

The cylinder castings 12, 13 and 14 are tightly secured to the crank case 11, the interior of the cylinders communicating through openings 35, 36 and 37 with a space 38 inside the crank case 11. The piston 15 divides the interior of the cylinder 12 into an explosion space 39 above the piston, and a compression space 40 below the piston. The piston 16 divides the interior of the cylinder 13 into an explosion space 41 above the piston, and a compression space 42 below the piston. The piston 17 divides the cylinder 14 into an explosion space 43 above the piston, and a compression space 44 below the piston. Spark plugs 45 connected to a suitable timing and ignition system, not shown, are placed in each of the explosion spaces 39, 41 and 43, and exhaust ports 46, 47 and 48 are cut in the cylinder walls connecting the spaces 39, 41 and 43 with the outer air just before the spaces 39, 41 and 43 reach their greatest volume, due to the travel of the pistons 15, 16 and 17. Inlet ports 49, 50 and 51 are similarly cut in the cylinder walls diametrically opposite the ports 46, 47 and 48. Deflectors 52 are placed on the top of each piston.

The openings 35, 36 and 37 are of similar shape, each consisting of an elongated slot with circular ends, as shown in Fig. 4. Surrounding each of the openings 35, 36 and 37 is an inlet valve seat 53 consisting of a flat surface forming the bottom of a recess in the bottom of the cylinder, the walls of the recess having a shallow groove 54 formed therein. The inlet valves 18, 19 and 20 slide on the seats 53, the edges of the valves sliding smoothly in the grooves 54. Each of the valves 18, 19 and 20 consists of a flat plate 55 having a slot 56 cut in one end thereof, this slot terminating in a semicylindrical

wall 57. A block 58 is secured to the plate 55 by screws 59 and has a slot 60 formed therein. The slots 56 and 60 combined form a circular hole 61 which fits around the connecting rods 21, 22 and 23 forming a moderately tight joint therewith. This hole 61 is located near one end of the valve so that the distance 62 to one end is short and the distance 63 to the other end is long. When the valve 18, for example, is in place, and the connection rod 21 is at the right hand side of the slot 35, the opening in that slot is entirely closed by said valve. As the valve 18 slides away from that end of the slot, the opening in the slot is uncovered, due to the distance 62 being short.

In addition to the inlet openings 35, 36 and 37, each of the spaces 40, 42 and 44 has an outlet opening 64, 65 and 66 formed in the crank case 11. The opening 64 communicates at all times through a pipe 67 with the inlet opening 51 of the cylinder 14, so that the space 40 is always directly connected to the inlet opening 51 regardless of the position of the other parts. Similarly the space 42 is in open communication with the inlet 49 through a pipe 68, and the space 44 is in open communication with the inlet 50 through a pipe 69, portions of the pipes 68 and 69 being shown broken away in the drawings for the sake of clearness.

The method of operation is as follows. The shaft 24 being fixed, and the crank case 11 being free to rotate thereon on the bearings 28, the crank case 11, or some connected part, is connected by means not shown to the mechanism to be driven. An explosive mixture, such as gasolene and air is fed into the space 38 through the opening 29, the space 38 being kept full of this explosive mixture during the time the engine is running. The engine is then started by external means, the crank case and rigidly connected parts, which may be called for convenience the rotor, moving in the direction of the arrow 70 of Fig. 1. The parts being in the position shown in Fig. 1, it is evident that the piston 15 will move down in its cylinder, the piston 16 will move up, and the piston 17 will remain practically stationary for a considerable interval of time. The word down, when used in this connection, means "toward the shaft," and the word up means "away from the shaft." The valve 19 is in such a position that a large part of the opening 36 is uncovered and the space 42 is in open communication with the space 38. As the piston 16 moves up, mixture will consequently be drawn into the space 42 from the space 38. This will continue until the piston reaches its extreme position and starts to return or until it reaches the position in which the piston 15 is shown in Fig. 1. In this position, the space 42 is full of mixture, and the valve 18 is just closing the opening 35, thus shutting off communication between the space 40 and the space 38 and trapping the mixture in the space 40. The movement of the rotor causes the piston 15 to move down, and the inlet port 51 being uncovered the mixture is forced through the pipe 67 from the space 40 into the space 43, being deflected by the deflector 52 so that the former contents of the cylinder are forced out through the outlet port 48. It should be noted that the inlet 51 is uncovered for quite a large portion of the down stroke of the piston 15 and during this portion the piston 15 forces a charge into the space 43. This stops as soon as the piston 17 closes the port 51 and the port 48 being closed immediately after the charge in the space 43 is compressed during the upward stroke of the piston 17. When the piston reaches the top of its stroke, the compressed mixture is exploded by the spark plug 45 and the pressure reacting between the pistons and the rotor causes a vigorous rotation of the rotor which may be applied to do useful work.

Each cylinder acts as a charging means for its adjacent cylinder, this charging being controlled by the valves 18, 19 and 20 which are actuated by the rods 21, 22 and 23. The closure about the rods 21, 22 and 23 can be quite imperfect, there being a large leakage without greatly impairing the efficiency of the engine for the reason that the charge is not really compressed in the chambers 40, 42 and 44, the charge moving freely through the pipes 67, 68 and 69 against a pressure only slightly greater than that of the atmosphere, as the ports 46, 47 and 48 are open during the charging period in any cylinder. Further, this leakage is not important as the mixture is simply forced back into the space 38 and is not lost. In considering the action of the engine it should be borne in mind that the valves 18, 19 and 20 are inlet valves governing the admission of mixture to the spaces 40, 42 and 44 and that they do not open and close the ends of the pipes 67, 68 and 69, these pipes being at all times in open communication with the spaces 40, 42 and 44.

While the operation of the engine has been described as applied to an engine having a stationary shaft and rotating cylinders, it is obvious that the cylinders could be stationary and the shaft revolving, without departing from the spirit of my invention.

In the attached claims the words "up" and "down" are used to designate parts within the cylinder 12, "up" meaning away from the shaft 29 and "down" meaning toward the shaft 29.

My invention should not be confused with those in which a charge is first compressed in the bottom of one cylinder or in an auxiliary cylinder, and after being compressed is

admitted to the explosion space of another or the same cylinder. In such engines the fitting must be first class to obtain the desired compression and this fitting is difficult to maintain. My engine is designed especially for farm tractor use and there is no compression of the charge below the pistons as the port 51, for example, opens almost as soon as the piston 15 starts down. The charge in the space 40 is therefore forced through the conduit 67 against practically atmospheric pressure, the port 48 providing an open communication with the space 43 and through the conduit 67 with the space 40. By eliminating any compression except that produced in the spaces 39, 41, and 43, the valves 18, 19, and 20 need not be compression tight and they can be cheaply machined and loosely fitted. Moreover wear on the valves will not materially affect the performance of the engine. This is very important where a cheap, light, and long lived engine is desired as in farm tractor work.

I claim as my invention:—

1. In an internal combustion engine, a plurality of cylinders each with a single bore of uniform diameter, a piston sliding freely in each of said bores dividing the interior of the cylinder into an upper and a lower space, a crank case forming a mixture space below said lower space in the cylinders, a crank shaft in said crank case, a connecting rod connecting each of said pistons to said crank shaft, valve means actuated by said connecting rod and so arranged that an open connection is provided between said mixture space and said lower space during the up stroke of the piston, said open connection being closed during the down stroke of the piston, and conduit means connecting said lower space in each cylinder with a port located in the walls of another cylinder in such a position that it is uncovered and communicates with the space above said piston when said piston is in its lowest position.

2. An internal combustion engine comprising three cylinders set with their axes intersecting and 120 degrees apart, a piston in each cylinder, a crank shaft set at the intersection of the axes of the cylinders, a crank formed on said crank shaft, means for connecting said crank with each of said pistons, means for admitting an explosive mixture to the space below each of said pistons on the up stroke of said piston, and means whereby said mixture is conducted from the space below each of said pistons into the space above the piston in an adjacent cylinder during the time the piston in the adjacent cylinder is at or near its lower position.

3. An internal combustion engine comprising a plurality of cylinders, a piston in each cylinder dividing that cylinder into an upper and a lower space, valve means for admitting an explosive mixture into each lower space during the up stroke of the piston of said space, a crank shaft, means for connecting said pistons to said crank shaft in such a manner that one piston is moving downwardly while another is at its lower stationary position, and means for connecting the space below the downwardly moving piston with the space above the lower stationary piston while the latter piston is at or near said lower stationary position.

4. An internal combustion engine comprising a plurality of cylinders, a piston in each cylinder dividing that cylinder into an upper and a lower space, valve means for admitting an explosive mixture into each lower space during the up stroke of the piston of said space, a crank shaft, means for connecting said pistons to said crank shaft in such a manner that one piston is moving downwardly while another is at its lower stationary position, and means for connecting an inlet port located in the cylinder walls of said last named piston just above the upper edge of said piston when in the extreme lower position of that piston with the lower space of said first named piston.

5. An internal combustion engine comprising three cylinders set with their axes intersecting and 120 degrees apart, a piston in each cylinder, a crank shaft, means for connecting said crank shaft with each of said pistons, means for admitting an explosive mixture to the space below each of said pistons on the up stroke of said piston, and means whereby said mixture is conducted from the space below each of said pistons into the space above the piston in an adjacent cylinder during the time the piston in the adjacent cylinder is at or near its lower position.

PER OLOF FREDLUND.

Witnesses:
GEORGE A. GIBBS,
ELSIE ROSS.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."