Jan. 15, 1929. 1,699,260

E. A. WINFIELD

INTERNAL COMBUSTION ENGINE

Filed April 29, 1926 2 Sheets-Sheet 1

Fig. 1.

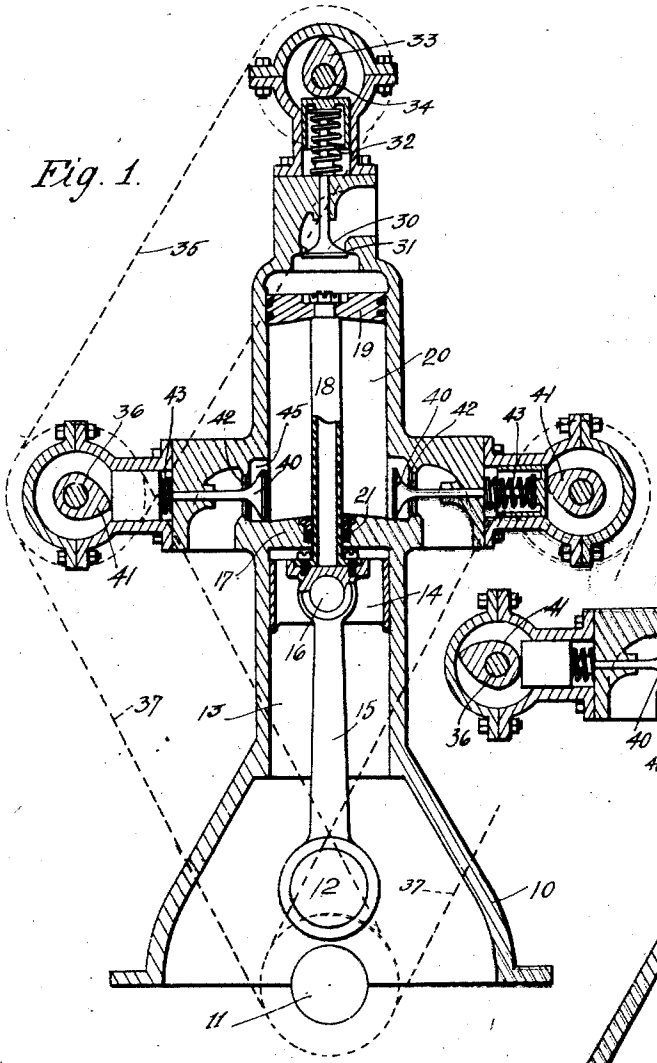
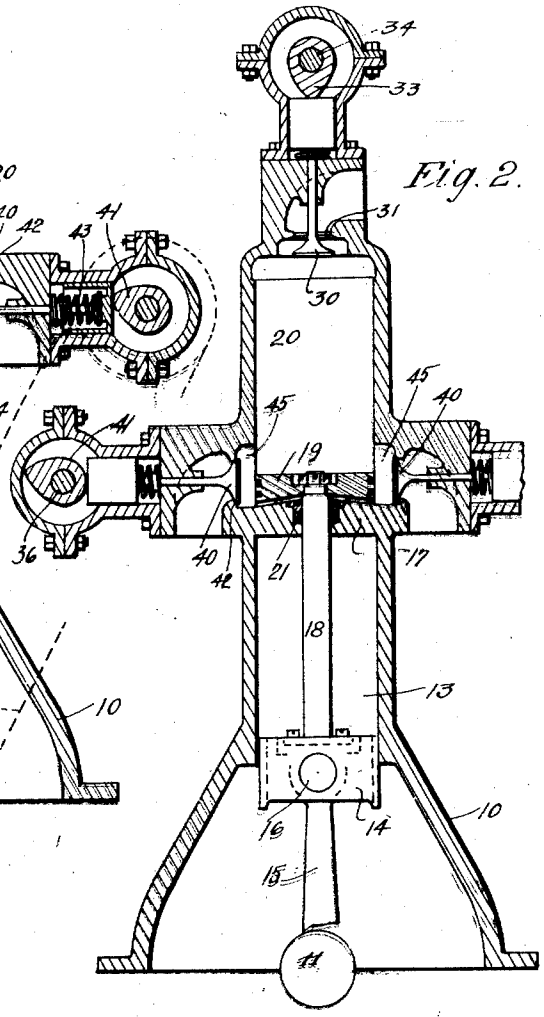


Fig. 2.



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Fig. 4.

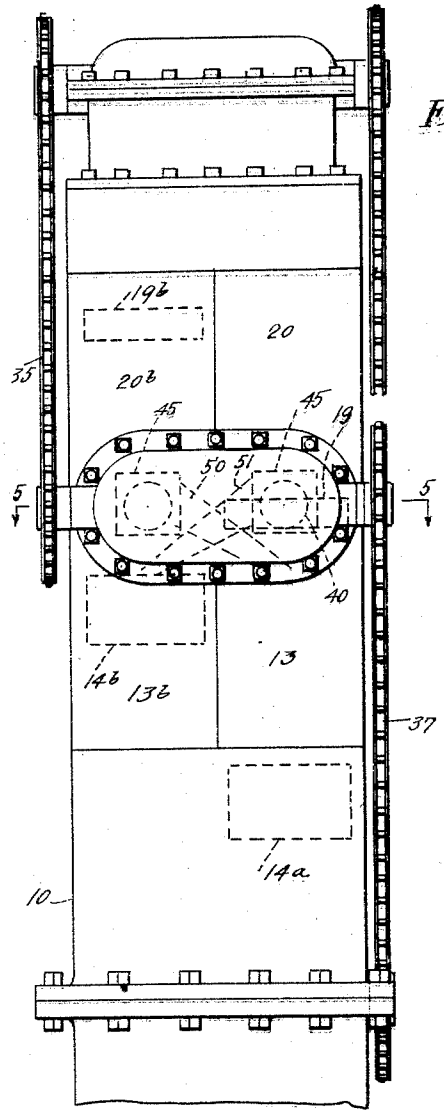


Fig. 3.

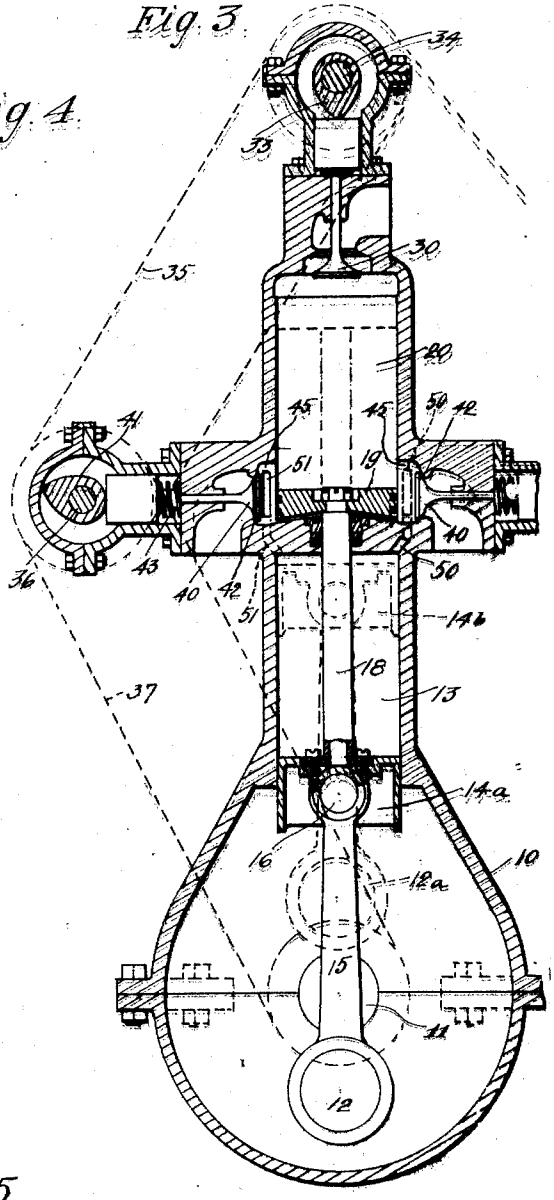
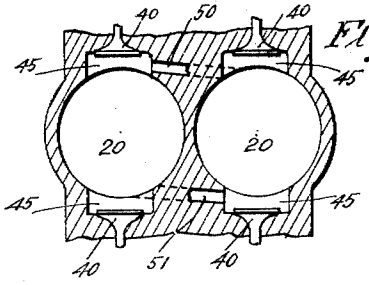


Fig. 5.



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UNITED STATES PATENT OFFICE.

EDWARD A. WINFIELD, OF LA CANADA, CALIFORNIA.

INTERNAL-COMBUSTION ENGINE.

Application filed April 29, 1926. Serial No. 105,357.

This invention relates to internal combustion engines of the two-cycle type; and the general object of the invention is the provision of a two-cycle engine of comparative simplicity and of high efficiency of operation, particularly as regards the introduction of charge to the work cylinder and the cleaning of exhaust gases therefrom.

The invention itself will be best understood from the following detailed description wherein are set forth preferred forms of arrangements embodying my invention, reference for this purpose being had to the accompanying drawings, in which:

Fig. 1 is a vertical central section showing a single cylinder of my improved engine, with its pistons in one position;

Fig. 2 is a similar view showing the pistons in an opposite position;

Fig. 3 is a similar view illustrative of an engine of two cylinders;

Fig. 4 is a side elevation of such a two-cylinder engine; and—

Fig. 5 is a horizontal section taken as indicated by line 5—5 on Fig. 4.

It will be understood that the specific arrangements and structures hereinafter described are not limitative of the invention except as is set out in the appended claims. Many of the specific features shown in the drawings and described in the following may be modified or changed as will be well understood by those skilled in the art.

In the drawings I illustrate at 10 a crank case carrying crank shaft 11 with crank 12; and immediately above the crank case there is a lower cylinder 13 in which a cylindrical cross head or guide 14 is adapted to reciprocate, connecting rod 15 being connected between crank pin 12 and a wrist pin 16 in crosshead 14.

In the form shown in Figs. 1 and 2 crosshead 14 is open so that it does not compress air between it and the cylinder head 17. A piston rod 18 is connected with cross-head 14 and extends through cylinder head 17 and carries the work piston 19 at its upper end, this work piston reciprocating in upper, vertically extending cylinder 20. Piston rod 18 is packed by a suitable packing or rings, at 21, where it passes through head 17.

In the head of work cylinder 20 I provide an exhaust valve. This exhaust valve may be in any relative arrangement with regard to the cylinder; but I prefer to arrange it centrally in the head and to open directly downwardly, as is shown in the drawings. Thus the exhaust valve 30 closes upwardly on seat 31, is moved upwardly by spring 32, and is moved downwardly by timed cam 33, mounted on cam shaft 34, which may be driven from the crank shaft in any suitable manner. For instance, it is diagrammatically shown as being driven by driving connection 35 from one of the inlet valve cam shafts 36, these cam shafts in turn being driven from crank shaft 11 by the driving connections 37. The exhaust valve is so timed that it opens about 70° before the piston reaches the bottom of its stroke and closes about 70° after the piston passes the bottom of its stroke.

One or more inlet valves 40 are provided for each cylinder, these inlet valves being opened inwardly by operation of cams 41 on shafts 36, and being seated outwardly on seats 42 by the action of springs 43. The inlet valve or valves open by horizontal movement into the lower end of work cylinder 20; they are timed so that they open after the piston has started on its up-stroke and close as it starts on its down-stroke. These timings are designed to give the proper intervals for inflow of charge and outflow of exhaust gases at any speed at which the engine is designed to operate. It will be noted that the intake valve or valves 40 open into recesses 45 (their movement being substantially radial with respect to the cylinder), valve seats 42 being some distance outside the bore of cylinder 20 so that the valves, when opened, as shown in Fig. 1, do not project into the cylinder bore but stand in recesses 45. However, these recesses are preferably of greater length than depth and they are alined in diametrically opposite relation. These recesses not only provide for the inward opening of the intake valves, but also provide for passage of the charge from the space below piston 19 to the work space above piston 19. This will be understood from the description of operation which follows. With the piston at the upper end of its stroke, as shown in Fig. 1, the intake valves are open, having been opened during the up-stroke of the piston. The charge is drawn in by vacuum past the intake valves, and continues to flow in, by inertia, until the piston has moved down a substantial distance, when the intake valves close. Then the piston moves on down, compressing the charge below it. When the upper surface of the piston has passed the upper

edges of recesses 45, then the compressed charge flows from under the piston around its edge and into the space above piston 19. By the time the upper surface of the piston on its down-stroke has reached the upper edges of recesses 45 the exhaust valve has been opened, and the burned gases are escaping through the exhaust port. Then, when the fresh charge begins flowing into the space above the piston, it presses the burned gases upwardly and outwardly through the exhaust port. It will be seen that the general direction of flow of the charge where it enters the upper part of the cylinder above piston 19 is transversely inwardly across the cylinder; so that the lower end of the cylinder is filled first with a fresh charge, and then, as more charge flows in, the fresh charge moves upwardly, pushing the exhaust gases out before it. The exhaust gases are thus cleaned out of the cylinder and the exhaust port closes at a time after the piston has started upwardly and at just the proper time to cut off any substantial escape of fresh charge through the exhaust port.

This fresh charge is compressed on the upstroke of the piston, ignition then takes place by a suitable ignition means (not shown) and the piston starts again its downward stroke. During this downward stroke it is again compressing below it another fresh charge that has been admitted below it in the manner before explained.

From what has been said, it will be noted that recesses 45 perform the double function of receiving the inlet valves and at the same time forming a port or passage through which the fresh charge, compressed below the piston, passes to the cylinder above the piston. My design also lends itself very readily to an arrangement in an engine of two or more cylinders, so that a double charge of fresh gas may be compressed preparatory to introduction to the work cylinder. As shown in Fig. 3 the lower guide or cross-head 14^a may be made in the form of a compression piston. By then operating the engine in pairs of cylinders, compression from one precompression cylinder 13 is easily made available for the work or main cylinder or chamber 20 of the other set. For instance, in Fig. 4 I show more or less diagrammatically an engine made up in duplicate of the parts shown in Figs. 1 and 2, having two cylinders 20 and 20^b and two cylinders 13 and 13^b. In such an engine the crank shaft will have another crank 12^a opposite crank 12, and the pistons 19^b and 14^b connected to this crank will travel oppositely to the other pistons 19 and 14^a. Thus, when compression piston 14^a is traveling downwardly, work piston 19^b will be traveling upwardly. Compression piston 14^b will be traveling up as work piston 19 is traveling down, and the compression piston 14^b can therefore compress charge above it at the same time that work piston 19 is compressing charge below it. And this observation also applies to compression piston 14^a and work piston 19^b. Now, by providing a passage 50 between cylinder 13 and one of the recesses 45 of cylinder 20^b; and another passage 51 between cylinder 13^b and one of recesses 45 in cylinder 20, a very simple provision is made whereby the lower cylinders will take and compress a charge at the same time that the cross-connected upper cylinder takes and compresses a charge. For instance, in the position shown in Fig. 3 piston 19 has just finished compressing its charge on its down stroke in cylinder 20, and piston 14^b has just finished compressing its charge on its up stroke in cylinder 13^b. The passage 51 connects cylinder 13^b with recess 45 in cylinder 20. Consequently, as soon as piston 19 has passed below recess 45, the compressed charge from both compression spaces passes into the work cylinder above piston 19. Then on the up stroke of piston 19 and the corresponding down stroke of piston 14^b, intake valves 40 of cylinder 20 open and fresh charge flows into the space below piston 19 and also flows through passage 51 into the cylinder 13^b of piston 14^b. Then, when piston 19 begins its down stroke, and piston 14^b begins its up stroke, the two pistons together compress a double charge.

The cross-connection passage 50 that connects the cylinder 13 with a recess 45 of cylinder 20^b performs the same service for those two cylinders as the port 51 performs for the two cylinders just described. It will be noted that passages 50 and 51 open directly into recesses 45, thus directly connecting cylinders 13 and 13^b with particular recesses 45, rather than providing for entry to said recesses through the inlet ports controlled by valves 40.

I claim:

1. In a two cycle internal combustion engine, the combination of a cylinder with a work space at one end and a compression space at the other, a piston reciprocating therein, a port recess in the cylinder wall near the compression end and extending lengthwise of the cylinder a distance greater than the length of the piston and open throughout its length to the cylinder interior, the piston passing one end of the recess at the end of its compression stroke, an exhaust valve for the work space, and an inlet valve of the poppet type opening into the recess by movement inwardly into it substantially radially with respect to the cylinder.

2. In a two cycle internal combustion engine, the combination of a vertically extending cylinder with a work space at one end and a compression space at the other end, a piston reciprocating in the cylinder, a mechanically controlled exhaust valve for the work space, a port recess in the cylinder wall at the compression end and extending length-

wise of the cylinder a distance greater than the length of the piston and open throughout its length and width to the cylinder interior, an inlet port for the port recess, and a mechanically operated poppet valve for the inlet port, said poppet valve having its seating portion within the recess and opening by horizontal movement into said recess.

3. In a two cycle internal combustion engine, the combination of a vertically extending cylinder with a work space at one end and a compression space at the other end, a piston reciprocating in the cylinder, a mechanically controlled exhaust valve for the work space, a port recess in the cylinder wall at the compression end and extending lengthwise of the cylinder a distance greater than the length of the piston and open throughout its length and width to the cylinder interior, said recess being of greater length than depth, an inlet port for the port recess, and a mechanically operated poppet valve for the inlet port, said poppet valve having its seating portion within the recess and opening by horizontal movement into said recess.

4. In a two cycle internal combustion engine, the combination of a vertically extending cylinder with a work space at one end and a compression space at the other end, a piston reciprocating in the cylinder, a mechanically controlled exhaust valve for the work space, a pair of port recesses in the cylinder wall at the compression end, said recesses being at diametrically opposite sides of the cylinder and in alinement, each recess extending lengthwise of the cylinder a distance greater than the length of the piston and open throughout its length and width to the cylinder interior, an inlet port for each port recess, and a mechanically operated poppet valve for each inlet port, each poppet valve having its seating portion within the associated recess and opening by horizontal movement into said recess.

5. In a two cycle internal combustion engine, the combination of a crank shaft, a pair of crank pins on said shaft which are angularly spaced from one another by 180°, a pair of cylinder and piston assemblies, each assembly embodying a cylinder, a partition in said cylinder intermediate its ends to divide it into a main chamber and a precompression chamber, a head closing the opposite end of the main chamber, a piston adapted to be reciprocated through the main chamber and defining with said partition the ends of a compression space within the main chamber, said piston further defining with said head the ends of a work space, a piston rod rigidly connected to the piston and extending through said partition and precompression chamber, a piston on said rod extension in said precompression chamber, a mechanically controlled exhaust valve for the work space, a pair of port recesses in the cylinder wall at the compression end of the work chamber and each extending lengthwise of the cylinder a greater distance than the length of the piston, said recesses being in alinement at diametrically opposite sides of the cylinder, an inlet port for each port recess, and a mechanically operated valve for each inlet port and opening into the associated recess, a connecting rod for each piston rod, said connecting rods being applied, one each, to said crank pins so the pistons of one assembly are at top center when the pistons of the other assembly are at bottom center; a cross port connecting the precompression chamber of one assembly directly to the port recess of the other assembly, and a cross port connecting the precompression chamber of said other assembly directly to the port recess of said one assembly.

In witness that I claim the foregoing I have hereunto subscribed my name this 6th day of April, 1926.

EDWARD A. WINFIELD.