H. O. EWING.

INTERNAL COMBUSTION ENGINE.

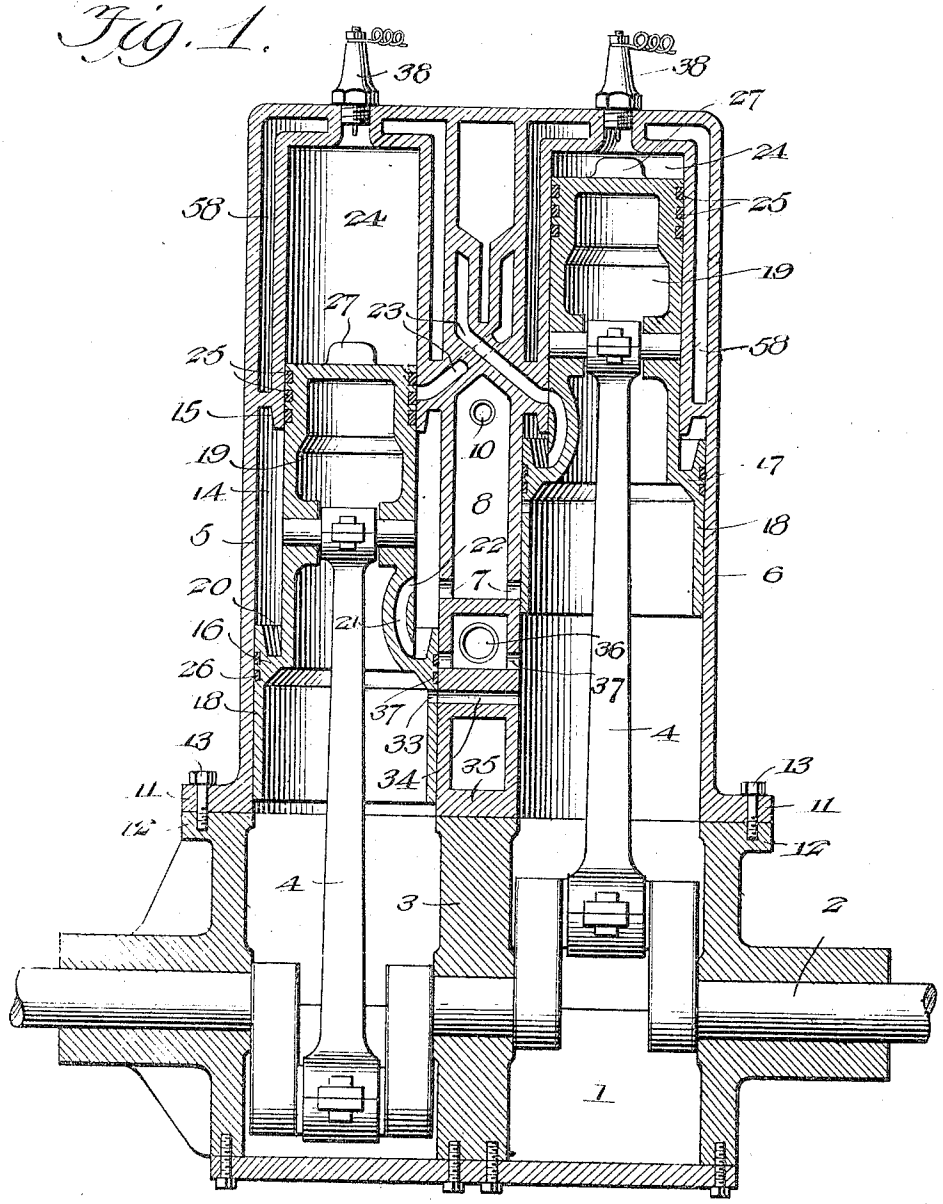
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2 SHEETS—SHEET 1.

Fig. 1.



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Witnesses

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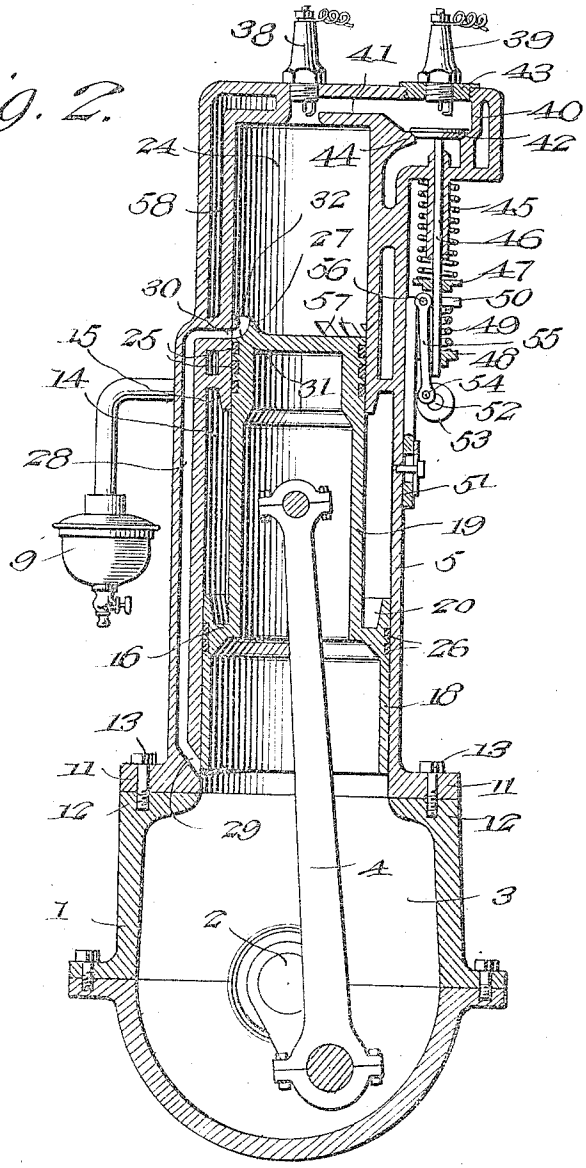
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2 SHEETS—SHEET 2.

Fig. 2.



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INTERNAL-COMBUSTION ENGINE.

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To all whom it may concern:

Be it known that I, HERBERT O. EWING, a citizen of the United States, residing at Middleport, in the county of Meigs and State of Ohio, have invented new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

This invention relates to internal combustion engines operating on the two cycle type, the engine embodying companion cylinders so related and arranged with respect to each other, including the pistons operating therein, that crank case compression is eliminated as far as the explosive mixture is concerned, and a thorough scavenging of the combustion chambers by means of air is obtained during each cycle of operation of each piston, the combustion chamber and piston head being also cooled by the same means.

One of the principal objects of the invention is to produce in connection with companion cylinders, a novel arrangement of ports and passages for admitting explosive mixture to pump cylinders and automatically pumping or compressing the same and transferring the compressed mixture to the working ends or combustion chambers of the cylinders; also a novel arrangement of passages and ports whereby scavenging air compressed in the crank case is forced into the combustion chambers and outwardly through the exhaust ports just prior to the admission of the compressed mixture to the combustion chambers.

With the above and other objects in view, the invention consists in the novel construction, combination and arrangement of parts, as herein described, illustrated and claimed.

In the accompanying drawings:—Figure 1 is a longitudinal section taken through the companion cylinders of the engine which is of the two cycle type and shown as comprising a pair of cylinders. Fig. 2 is a longitudinal section taken through one of the cylinders at right angles to Fig. 1.

In the accompanying drawings I have illustrated a single power unit consisting of two companion cylinders arranged side by side but it will of course be understood as the description proceeds that said two cylinders constitute only a single unit and that as many of said units may be employed as found desirable or necessary in accordance with the aggregate power to be produced.

1 designates the crank case, 2 the crank shaft journaled therein, 3 a central partition which is also formed with a central bearing for the crank shaft 2, and 4 the connecting rods, all of said parts being of the usual construction and arrangement found in all two cycle engines, it being understood that the crank case 1 is tight so as to retain the air which is compressed therein by the action of the pistons.

The cylinders 5 and 6 are the counterpart of each other but are reversely arranged or, in other words, said cylinders are so arranged that the inlet ports 7 thereof are arranged close together and are both in communication with a centrally arranged distributing chamber 8 into which the mixture is drawn from a carbureter 9 through the intake orifice 10 which is in communication with the carbureter 9 by means of the usual intake pipe. The cylinders are shown as cast *en bloc* and formed with the usual bottom flanges 11 by which they are fastened to corresponding flanges 12 of the crank case by means of cap screws 13 or the equivalent thereof. Each of the cylinders is formed with a pump chamber 14 having a reduced and extended opposite end portion 15. The pistons 16 and 17 reciprocating respectively in the cylinders 5 and 6 are enlarged as to their lower end portions, the said enlarged lower end portions 18 of the pistons being formed adjacent to their junction with the relatively small upper end portions 19 with annular channels 20. Each piston is formed with a by-pass 21 communicating at one end with the annular channel 20 of the piston and communicating with the pumping chamber 14 at 22, 22 thus designating a port which, when the piston is at the outward limit of its movement, registers with one of a pair of compressed gas passages 23. These passages 23 cross each other as shown in Fig. 1 but do not communicate with each other, the function of each of the passages 23 being to transfer the mixture compressed by the piston of one cylinder to the combustion chamber 24 of the other cylinder of the pair. This arrangement is true with respect to both cylinders the pistons of which operate alternately to compress a charge and force the same into the combustion chamber of the other cylinder. As shown, each of the pumping or compressing chambers 14 is of annular formation, ex-

tending entirely around the smaller portion 19 of the piston when the latter is at the inward limit of its stroke, the upper reduced end of each chamber 14 being also of annular formation. Each piston is provided with packing rings 25 in the smaller portion thereof and is also provided with other packing rings 26 in the enlarged portion thereof, said piston rings being for the usual purpose of holding compression and preventing leakage.

Each of the pistons is provided on the head thereof with a deflector 27 which is for the purpose of deflecting the scavening air toward and against the head of the cylinder. The explosive mixture is not admitted at this point but merely air which is compressed in the crank case 1, said air being forced through a by-pass 28 in the cylinder wall, the lower extremity of said by-pass opening through the inside cylinder wall in the form of a port 29 while the opposite or outer end of the by-pass 28 terminates in a port 30 which can communicate with the combustion chamber 4 only through one or more ports 31 formed in and extending through the deflector 27 as best illustrated in Fig. 2. When the piston is in its innermost position, the outer face of the deflector 27 forms a closure 32 which closes the port 30 and prevents any more compressed air from entering the combustion chamber 24, at which time the explosive mixture is being forced under pressure into said combustion chamber. Furthermore, when the piston is in the position last named or, in other words, at the inner limit of its stroke, the enlarged portion thereof covers the port 29 and prevents any more compressed air from entering the by-pass 28. Just at this time, another port 33 in the enlarged portion of the piston registers with an air transfer passage 34 which extends through the center wall 35 of the cylinder block, said passage thereby serving to equalize the pressure of air in the lower portions of the two cylinders and in the two portions of the crank case which are separated from each other by the central partition 3. The scavenging air enters through an inlet port 36 from which branch ports 37 lead in opposite directions into the cylinders below the bottom edges of the pistons when at the outer limit of their movement as clearly indicated in Fig. 1.

As illustrated in Fig. 2, a spark plug 38 is inserted in the head of each cylinder and another spark plug 39 is inserted in the head of an offset valve chamber 40 which is in direct communication with the combustion chamber 24 by means of the space 41 in which combustion also takes place. In Fig. 2 the admission valve is shown at 42 the same being arranged directly under the screw plug 43 through which the spark plug 39 is inserted. The valve 42 is held normally against its seat 44 by means of the usual spring 45 which encircles the stem 46 of the valve and bears against a collar 47 having a fixed relation to the valve stem, the opposite end of the spring bearing against the under side of the valve chamber. In carrying out this invention, the stem 46 is extended considerably beyond the collar 47 and provided with another collar 48 having a fixed relation thereto, a stout spring 49 being interposed between the collar 48 and the overhanging head 50 of a bracket or slide 51 which is mounted in suitable guide ways on the adjacent cylinder wall. A rock shaft 52 is mounted at one side of the cylinder and has thereon a crank disk 53 the wrist pin 54 of which receives one end of a link 55. The other end of this link is connected at 56 to the bracket or slide 51. The spring 49 is of greater strength than the spring 45 and when the spring 49 is partially compressed by turning the shaft 52, greater resistance is provided for the opening of the valve 42. This, therefore, has the result of cutting down the amount of explosive mixture which is allowed to pass by the valve 42 and enter the adjacent combustion chamber. When the shaft 52 is turned in the opposite direction so as to relax the spring 49, the valve 42 is held seated only by the tension of the spring 45 which is so regulated as to allow a full charge of mixture to enter the combustion chamber of the cylinder. By the means just described, the speed of the engine as a whole may be varied and incidentally thereto the rapidity of movement of the explosive mixture through the inlet passages and also the rapidity of movement of the scavenging air through the inlet passages are correspondingly varied.

From the foregoing description, taken in connection with the accompanying drawings, it will now be seen that the explosive mixture never enters the crank case but is compressed above the enlarged portions of the pistons and is transferred under compression from one cylinder to the combustion chamber of the companion cylinder; that a fresh charge of mixture is not admitted to the combustion chamber of either cylinder until the burned gases have first been expelled from the combustion chambers through the exhaust ports 57 at the time when the passage 31 of the deflector 37 is registering with the port 30 of the compressed air by-pass 28. Just as soon as the scavenging air is cut off by the closure 32 and by closing the port 29 at the receiving end of the by-pass 28, the new charge is allowed to enter the combustion chamber by the registration of one of the ports 22 with the corresponding transfer passage 23. The mixture under compression lifts the valve 42 from its seat and enters the combustion

chamber in which it is compressed by the outward movement of the piston and fired by the plugs 38 and 39. The combustion chamber of each cylinder is shown as surrounded by the usual water jacket 58 in the side walls and head thereof.

By the use of cold air in the manner above described for scavenging purposes, the gases remaining in the combustion chamber are cooled by the inrushing cold air, as well as the heated parts or walls of the combustion chamber and adjacent parts thus preventing premature ignition, back firing and the like. In view of the specified arrangement and location of the admission valve and the manner in which the same is operated, better acceleration of the engine is obtained due to the fact that the fresh mixture is against the admission valve at each stroke so that it is instantly admitted to the combustion chamber as soon as the valve is unseated. Furthermore, by forcing the new charge through a very narrow space between the admission valve and its seat, the liability of back firing is eliminated by the small size of said opening and the high speed or travel of the mixture therethrough. By obtaining the advantage of smaller charges of a highly combustible mixture in the small combuston chamber located above the admission valve, the full power of the expansion of the mixture is obtained as they are not altogether mixed with the air in the cylinder proper; therefore, they will ignite readily and flash down into the main cylinder igniting any gas that has been taken into the same during light loads or low engine speed. Thus better, faster and more complete ignition is obtained as the body of the mixture is fired in the combustion chamber and flashed into the cylinder proper which is filled mostly with air on light loads or low engine speeds. Thus all of the combustible gases are consumed and the disagreeable odor common to two cycle engines is eliminated. Additionally, there is an economy of fuel. Of course, at low or high speed, the entire cylinder and combustion chamber are filled with the explosive mixture.

I claim:—

1. In a two cycle internal combustion engine, an air compression crank case, a cylinder in communication therewith, a reciprocatory piston working in said cylinder, and a deflector mounted on and projecting from the piston head and formed with an air inlet passage extending therethrough, the cylinder wall being formed with a by-pass adapted to communicate with the crank case and to be covered by the piston when at the inner limit of its movement, said by-pass being also adapted to register with the air inlet passage in the deflector on the piston head before the piston reaches the inner limit of its movement.

2. In a two cycle internal combustion engine, an air compression crank case, a cylinder in communication therewith, a reciprocatory piston working in said cylinder, and a deflector mounted on and projecting from the piston head and formed with an air inlet passage extending therethrough, the cylinder wall being formed with a by-pass adapted to communicate with the crank case and to be covered by the piston when at the inner limit of its movement, said by-pass being also adapted to register with the air inlet passage in the deflector on the piston head before the piston reaches the inner limit of its movement, said deflector being arranged to cover said by-pass when the piston reaches the final limit of its inward movement.

3. In a two cycle internal combustion engine, the combination of a pair of companion cylinders each embodying a combustion chamber and a compression chamber, the compression chamber being arranged closer to the crank case than the combustion chamber and being of larger diameter than the combustion chamber, pistons working in said cylinders and each embodying a portion operating in the combustion chamber and a relatively larger portion operating in the compression chamber, and a mixture admission and distributing chamber located between said compression chambers and ported into each of said compression chambers, each of said pistons being formed with a by-pass communicating with the respective compression chamber, the cylinders being formed with transfer passages which cross each other and lead from one cylinder to the other, each of said transfer passages being adapted to register with the by-pass of one of the pistons, the cylinder block being formed with a compressed air equalization passage extending from one cylinder to the other, and the pistons being formed with ports to register with the last named passage when at the inner limit of their movement.

In testimony whereof I affix my signature.

HERBERT O. EWING.