

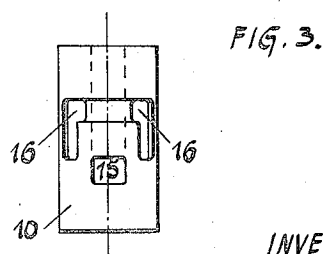
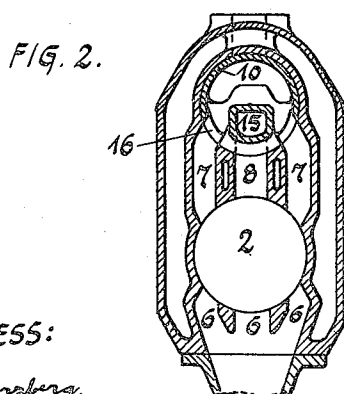
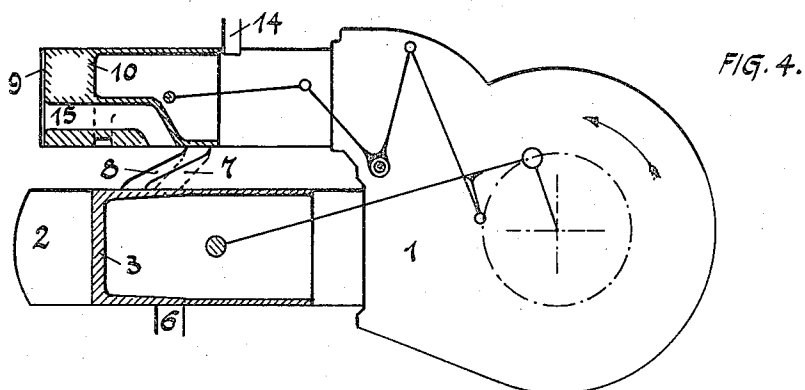
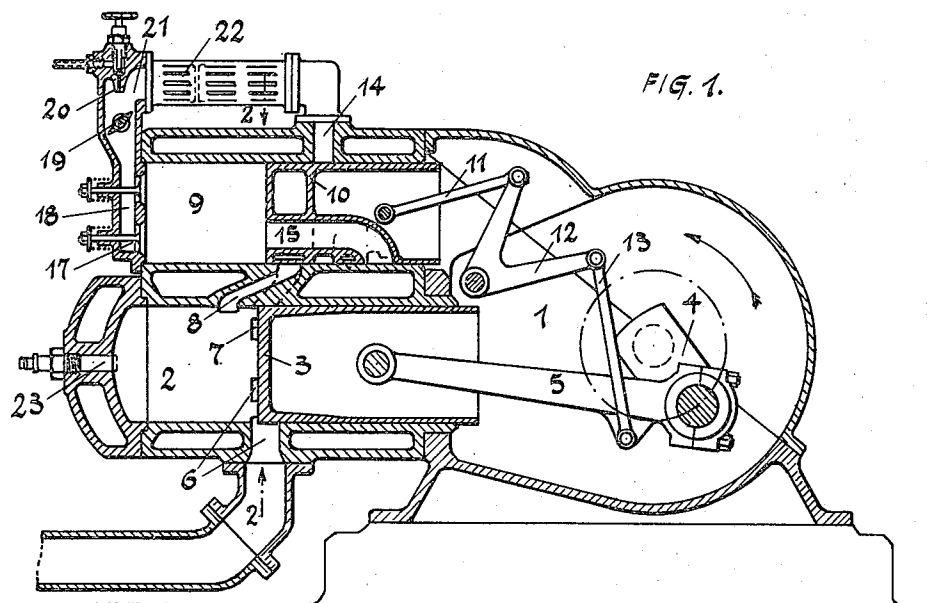
Oct. 7, 1924.

1,510,620

P. HENTSCHE

INTERNAL COMBUSTION ENGINE

Original Filed April 4 1921 2 Sheets-Sheet 1



WITNESS:

H. C. Fensberg.

INVENTOR:

Rud. Heutschke.

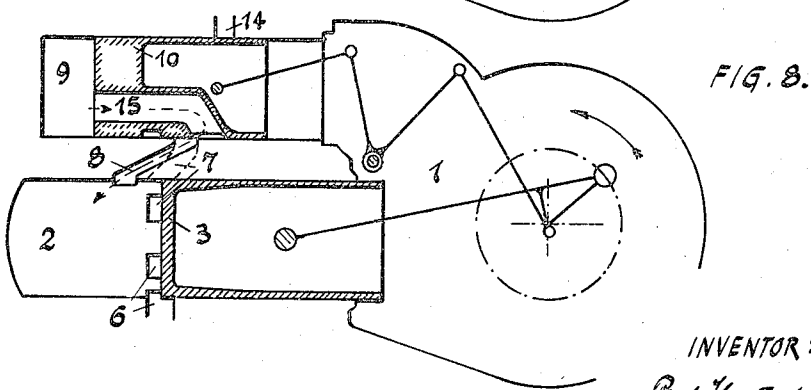
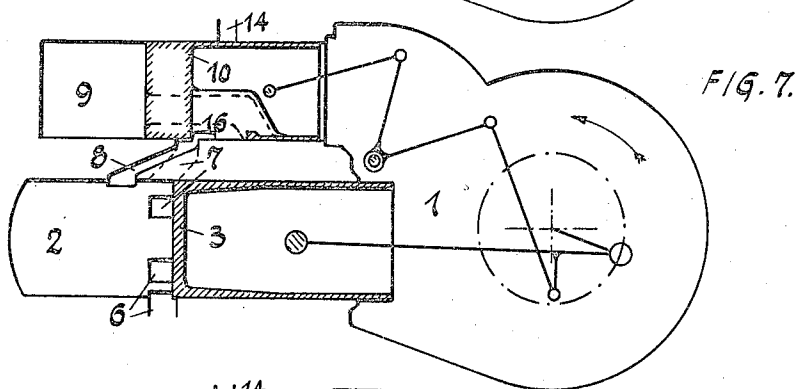
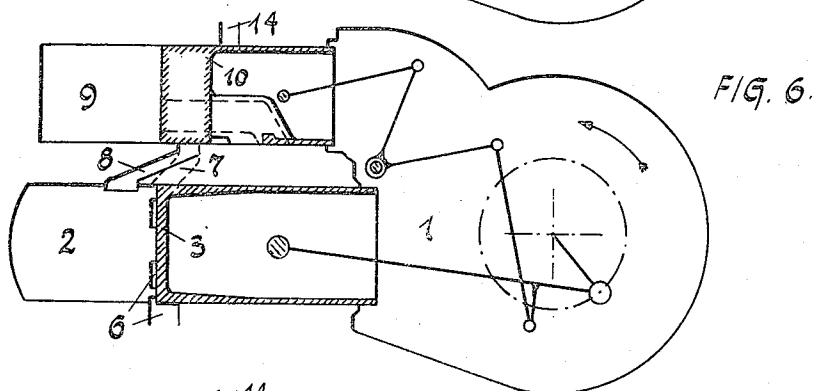
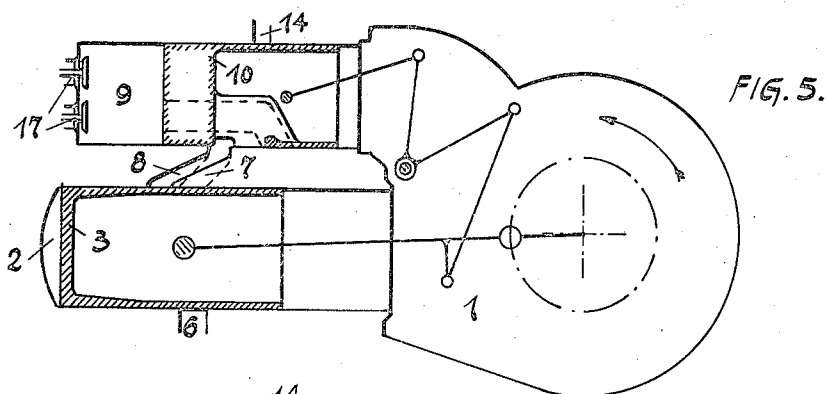
Oct. 7, 1924:

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P. HENTSCHKE

INTERNAL COMBUSTION ENGINE

Original Filed April 4, 1921 2 Sheets-Sheet 2



WITNESS:
H.C. Forsberg

INVENTOR:
Paul Hentschke

UNITED STATES PATENT OFFICE.

PAUL HENTSCHEKE, OF NEW YORK, N. Y.

INTERNAL-COMBUSTION ENGINE.

Refile of abandoned application Serial No. 458,434, filed April 4, 1921. This application filed March 13, 1924. Serial No. 699,065.

To all whom it may concern:

Be it known that I, PAUL HENTSCHEKE, a citizen of Germany, residing at New York, in the State of New York, have invented new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

This application is a re-filing of abandoned application Serial Number 458,434, filed April 4, 1921.

This invention relates to two cycle internal combustion engines, in which the cycle of the operation is completed by two strokes of the working piston, comprising one stroke during which a charge of working fluid, as for instance a mixture of gasoline vapours and air, is admitted to and compressed in the working cylinder, and a second stroke, beginning with the combustion, during which the pressure of the expanding gases is transmitted to the crankshaft; the burned gases are usually allowed to escape from the cylinder during the latter part of this second stroke thru exhaust ports in the cylinder wall, which are uncovered by the piston towards the end of its movement. A new charge of working fluid admitted thru passages adjacent to the mentioned exhaust ports as soon as the pressure of the exhaust gases in the cylinder is near the atmospheric pressure repeats the cycle as described before.

This arrangement of ports and passages in the cylinder distinguishes itself by simplicity compared with engines of the four cycle type, there are however disadvantages encountered with the former type, which heretofore have reduced its usefulness. A disadvantage of the first order is the possibility of a preignition of the new charge of working fluid by contact with the hot exhaust gases of the old charge before the charging passages are closed again. This has the effect of seriously endangering the means employed to charge the cylinder, which former are not built to resist explosion pressures.

A second disadvantage is the partial mixing of the fresh charge of working fluid with burnt gases remaining in the cylinder after the exhaust period. This causes not only a loss of working fluid escaping thru the exhaust ports in the place of the

gases, but also fouls the new charge remaining in the cylinder, thereby reducing the power output of the engine.

A further disadvantage encountered in engines using the crankcase and outer side of the piston as a pump to deliver working fluid to the cylinder is the low pressure thereby created and the natural consequence of a lack of working fluid for the combustion in the cylinder and also a reduced power output of the engine.

It is the object of this invention to overcome by simple mechanical means these difficulties and to add to the possible specific power output of a two cycle engine; my invention for said purpose provides for separate means for scavenging the cylinder of the burnt gases by the admission of pure air as a scavenger, and provides for a source, independent from the former means for scavenging, to deliver a precompressed charge of fresh working fluid into the cylinder after the burnt gases have been expelled therefrom.

The mechanism by which I attain these objects is shown in the accompanying drawings, in which—

Fig. 1 is a longitudinal section thru the entire engine,

Fig. 2 is a vertical cross section on the line 2—2 in Fig. 1 showing an ideal section through all ports and passages in the cylinder wall.

Fig. 3 is a separate view of the pump piston and the passage therein.

Figs. 4, 5, 6, 7 and 8 are diagrams showing the mechanism in various positions of the crankshaft.

Similar numerals refer to similar parts thruout the several views.

In Fig. 1 is seen a crankcase or, as it is hereafter called, a crankspace 1 and a working cylinder 2 suitably attached to the former, the working piston 3 is reciprocated by crankshaft 4 and connecting rod 5; the working cylinder 2 is provided with exhaust ports 6 and passages 7 and 8 for the passage of scavenging air and working fluid, the former delivered by the crankspace 1 acting in the chosen arrangement as a scavenging air pump space, while the working fluid is delivered by a pump cylinder 9 in which the pump piston 10 is reciprocated

by rod 11, bellcrank 12 and rod 13, which latter is pivoted to the connecting rod 5 of the main drive.

The air intake opening 14 in the wall of the pump cylinder 9 connects the crankspace 1 with the atmosphere when the pump piston 10 is in its inner dead center position.

The pump piston 10 is provided with a duct 15 which, in a certain hereafter described position of the pump piston 10, connects the working cylinder 2 with the pump cylinder 9 thru the passage 8 in both cylinder walls. 16 is a slot in the shape of a reversed U in the wall of the pump piston 10 which, in another hereafter described position of the pump piston 10, establishes a communication between the scavenging side of the pump piston 10 and the working cylinder 2 thru the passages 7 and 8 in the wall of both cylinders. 17 denotes automatic intake valves which, on the outward stroke of the pump piston 10, allow the working fluid to enter the pump cylinder 9 from valve chest 18; 19 is a throttle for the control of the amount and quality of the working fluid which, in the shown arrangement of the invention as applied to a gasoline burning engine, is carburated by the fuel jet 20. Suction pipe 21 leads to the intake muffler 22 which is also attached to the air intake opening 14 on the scavenging side of the pump cylinder 9 by a second compartment separated from the former. 23 in the head of cylinder 2 denotes any one of the customary means used for the ignition of a compressed charge of a combustible working fluid in the working cylinder 2.

The performance of the invention can clearly be seen in the accompanying diagrams of Figs. 4 to 8 which show the mechanism in the following distinguished positions:

Fig. 4. The pump piston 10 arrived in its inner dead center position, the air intake opening 14 to crankspace 1 is wide open allowing the crankspace 1 to fill with atmospheric air; passage 8 between the cylinders has just been closed by both pump piston 10 as well as by the working piston 3, indicating a slight compression of the remaining working fluid in the pump cylinder 9; working piston 3 has commenced to compress the fresh charge of working fluid in the working cylinder 2.

Fig. 5. The working piston 3 arrived in its inner dead center position indicating the compression in the working cylinder 2 as completed and the charge of working fluid ready for the ignition and the following pressure rise in same. The pump piston 10 is now moving outward, thereby drawing working fluid thru the automatic intake valves 17 into the pump cylinder 9, pump piston 10 is at the same time compressing within the crankspace 1 the atmospheric air

previously admitted thru the air intake opening 14.

Fig. 6. The shown position of the working piston 3 indicates the end of the expansion of the burnt gases in the working cylinder 2 and the beginning of the exhaust thru the exhaust ports 6; the position of both pistons, the working piston as well as the pump piston 10, indicates an advanced compression of the atmospheric air within the crankspace 1.

Fig. 7. The working piston 3 arrived in its outer dead center position, maximum compression in the crankspace 1 by the common action of the working piston 3 and the pump piston 10, equalization of the pressure of the burnt gases thru the exhaust ports 6 is completed; beginning of the admission of compressed air for scavenging from the crankspace 1 thru the slot 16 in the pump piston 10 and the passages 7 and 8 into the working cylinder 2; also beginning of the compression of the charge of working fluid previously drawn into the pump cylinder 9.

Fig. 8. The exhaust ports 6 are almost closed by the partial inward travel of the working piston 3, indicating the end of the scavenging period for the working cylinder 2, filling of the working cylinder with pure air from the crankspace 1 completed and beginning of the admission of the fresh precompressed charge of working fluid from the pump cylinder 9 thru duct 15 in the pump piston 10 and the passage 8 in both cylinder walls, this passage 8 now being separated from the crankspace 1 by the pump piston 10; the passages 7 begins to be covered by the pump piston 10 and the admission period of compressed scavenging air from the crankspace 1 to the working cylinder 2 is finished; duct 15 begins to register with the passage 8 for the admission of working fluid from the pump cylinder 9 to the working cylinder 2. The passage 8 is closed shortly before the pump piston 10 has reached its inner dead center position and an additional compression in the pump cylinder 9 is effected which serves for the facilitation of the return movement of the pump piston 10. The working piston 3, after cutting off the passage 8, begins to compress the fresh charge in the working cylinder preparatory to the following ignition and combustion. The charging operation finished, completes the cycle of the engine in one revolution of the crankshaft 4 and the operations indicated in the diagrams are repeated.

The arrangement described and shown in all figures is the application of my invention to an internal combustion engine in which a mixture of a combustible gas or gasoline vapors with atmospheric air is compressed within the working cylinder

2 to a certain degree below the selfignition point and is ignited by suitable means; the principle described in the foregoing is also applicable to those types of internal combustion engines in which only pure air or a relatively poor mixture is compressed within the working cylinder to any desired degree, and in which engines all fuel or fuel in addition to a previously admitted small amount is injected into the working cylinder at the time of the full compression therein. For an engine of this kind the fuel jet 20 in the suction pipe 21 would be eliminated, while 23 in the head of the working cylinder 2 would represent any one of the customary means for injecting liquid fuel into the cylinder of an internal combustion engine. The throttle 19 would be used as described in the foregoing to adjust the amount of air charged by the pump piston 10 into the working cylinder 2, to the quantity of liquid fuel to be injected into the cylinder, the throttle preferably being under the control of the usual means used for the control of the engine speed.

The invention is without modification applicable to a vertical engine of the multicylinder type, but it is understood that the arrangement for the reciprocation of the pump piston 10 can be made in various ways which however have no bearing on the essential features of the invention. The principle of the invention is also applicable to engines which do not resort to the crankcase as a scavenging pump space as the source of the air used for scavenging the cylinder is inessential.

I am aware that types of two cycle internal combustion engines are known in which scavenging pumps and scavenging valves of various construction are used, but what I claim and desire to secure by a patent is a new arrangement of means for scavenging the cylinder and independent means for positively charging the cylinder with a fresh supply of working fluid.

I claim:

1. In an internal combustion engine of the class described, the combination of a working cylinder and a working piston, a double acting pump cylinder adjacent to said working cylinder, passages in the walls of said cylinders adapted to admit scavenging air from the scavenging side of said pump cylinder, to admit working fluid from the working fluid pump side of said double acting pump cylinder, and exhaust ports in the wall of said working cylinder adapted to allow the burnt gases to escape from the working cylinder on the outward stroke of said working piston, a double acting pumping piston adapted to draw from the atmosphere, to compress and to deliver to said working cylinder a charge of scavenging air on one stroke

and a charge of working fluid on the return stroke, and means to reciprocate said pumping piston a predetermined fraction of its stroke head of the stroke of said working piston.

2. In an internal combustion engine the combination of a working cylinder and a working piston, a pumping cylinder and a double acting pumping piston adapted to deliver scavenging air on its outward stroke and to deliver working fluid on its inward stroke to said working cylinder, exhaust ports for direct exhaust of the burnt gases from said working cylinder, passages connecting said cylinders and adjacent to said exhaust ports adapted to be controlled by said working piston, slots in the wall of said pumping piston adapted on the travel of said pumping piston to admit scavenging air to said working cylinder from the scavenging side of the pumping piston after the exhaust ports and said passages are uncovered by the working piston, a duct in the wall of said pumping piston adapted to register with one of said passages connecting the cylinders and to admit during the inward stroke of said pumping piston compressed working fluid from the working fluid side of said pumping cylinder to said working cylinder after the exhaust ports are covered by said working piston on its inward stroke at a higher pressure than that of the scavenging air admitted previously, with direct inlet means adapted to admit air to the scavenging pump side and working fluid to the working fluid pump side of said pumping piston on the respective suction strokes.

3. In an internal combustion engine of the two cycle type the combination of a working cylinder and a working piston, a pumping cylinder and a double acting pumping piston, ports for direct exhaust of the burnt gases from said working cylinder, scavenging and charging passages between said cylinders and adjacent to said exhaust ports, a scavenging pump space and a member in said pumping piston controlling said passages in cooperation with said working piston, to admit air from said scavenging pump space to said working cylinder when the exhaust ports and said passages are uncovered by said working piston, a working fluid pump space and a duct in said pumping piston to admit on the inward stroke of said pumping piston compressed working fluid from said working fluid pump space thru one of said passages to the working cylinder after the exhaust ports are covered by said working piston, and direct inlet means adapted to admit a charge of working fluid to said pump space on the outward stroke of said pumping piston.

4. In an internal combustion engine a working cylinder having exhaust ports, a

pumping cylinder, scavenging passages between said cylinders, a working piston controlling said exhaust ports and said scavenging passages, a pumping piston controlling said scavenging passages in the wall of said pumping cylinder, crankshaft, bell-crank and connecting rod means in a crankspace adapted to reciprocate said pistons, to draw air by their cooperation into said crankspace and to compress by their common action the air in the crankspace until the scavenging passages between the cylinders are uncovered by said pumping piston at the beginning of its inward stroke permitting the admission of scavenging air to the working cylinder after the said exhaust ports are uncovered by said working piston.

5. In an internal combustion engine of the two cycle type the combination of a working cylinder having exhaust ports, a pumping cylinder, passages between said cylinders, a working piston controlling said exhaust ports to allow the burnt gases to escape from the working cylinder, a pumping piston having a duct in its wall and controlling said passages in cooperation with said working piston to scavenge the working cylinder of burnt gases when the exhaust ports are open and to admit and deliver working fluid to said working cylinder after the exhaust ports are closed, with crankshaft, bellcrank and connecting rod means adapted to reciprocate said pumping piston approximately one quarter of one revolution of the engine crankshaft in advance of the working piston in regards to their inner dead center position permitting said pumping piston to complete its stroke and to deliver a charge of working fluid before the working piston reached the middle of its inward stroke.

6. In an internal combustion engine of the two cycle type a working cylinder having exhaust ports, a pumping cylinder and scavenging passages between said cylinders, a working piston controlling said exhaust ports, a crank space at the open end of said working and pumping cylinders, a pumping piston and controlling slot-means in the wall of said pumping piston to provide for communication between said crankspace and said working cylinder by way of said passages, a rotating member and a connecting rod for causing a reciprocating movement of said working piston, a bellcrank and a connection therebetween and said connecting rod and pivoted to same. a rod to recip-

rocate said pumping piston in relation to the reciprocating movement of said working piston adapted to establish communication between said crankspace and said working cylinder when the maximum pressure in said crankspace by the common action of both said pistons is reached.

7. In an internal combustion engine of the two cycle type a working cylinder having exhaust ports, a working piston controlling said exhaust ports, a pumping cylinder and passages between said cylinders, a pumping piston controlling said passages in cooperation with said working piston to admit air for scavenging said working cylinder of burnt gases after the exhaust ports are uncovered by the working piston, a pump space for working fluid, a duct in said pumping piston to admit working fluid from said pump space to said working cylinder after the exhaust ports are covered by the working piston, a suction pipe and throttling means in the inlet to said pump space adapted to regulate the pressure and mixture of each charge of working fluid delivered by the pumping piston.

8. In an internal combustion engine of the two cycle type a working cylinder having exhaust ports in its wall, a working piston controlling said exhaust ports, a pumping cylinder, short passages between said pumping cylinder and said working cylinder, an elongated passage adjacent to said short passages adapted to maintain communication between said pumping cylinder and said working cylinder after said exhaust ports are covered by said working piston, a pumping piston and a slot in said pumping piston adapted to uncover all of said passages for the admission of scavenging air to said working cylinder when said working piston reaches its outer dead center position, a duct in said pumping piston adapted to establish communication between the pump space of said pumping cylinder and said elongated passage on the inward stroke of said pumping piston after said working piston covers said exhaust ports, a member in said pumping piston adapted to cover all of said passages at the end of its outward stroke when the said working piston approaches its outer dead center position on the outward stroke until the exhaust ports are uncovered by the working piston, and means to reciprocate said pistons.

In testimony whereof I affix my signature.

PAUL HENTSCHKE.