Sept. 8, 1942. H. O. HEDGES 2,295,037

INTERNAL COMBUSTION ENGINE

Filed Oct. 4, 1940

Fig. 1

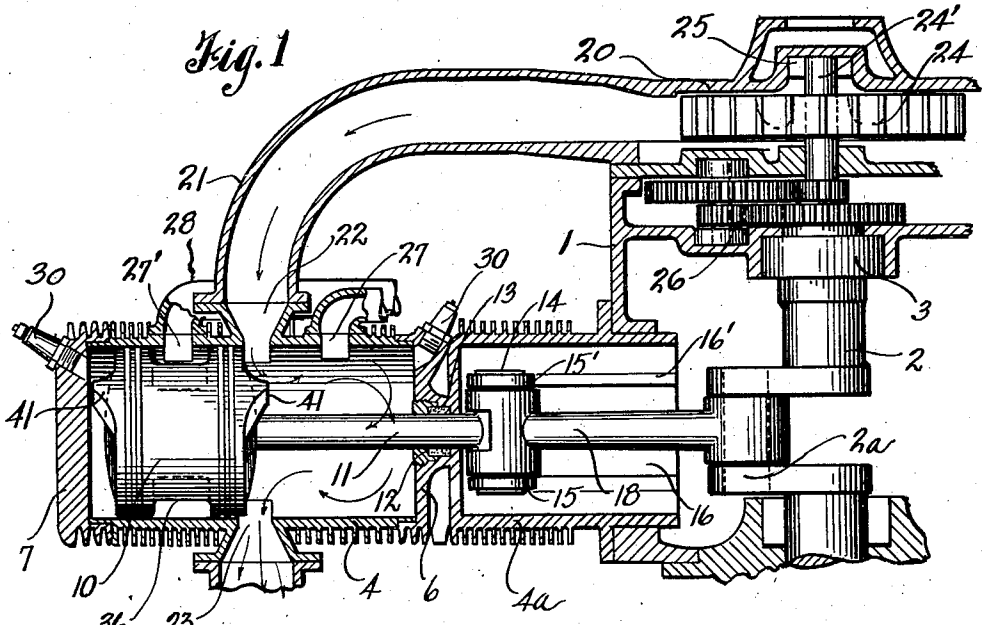



Fig. 2

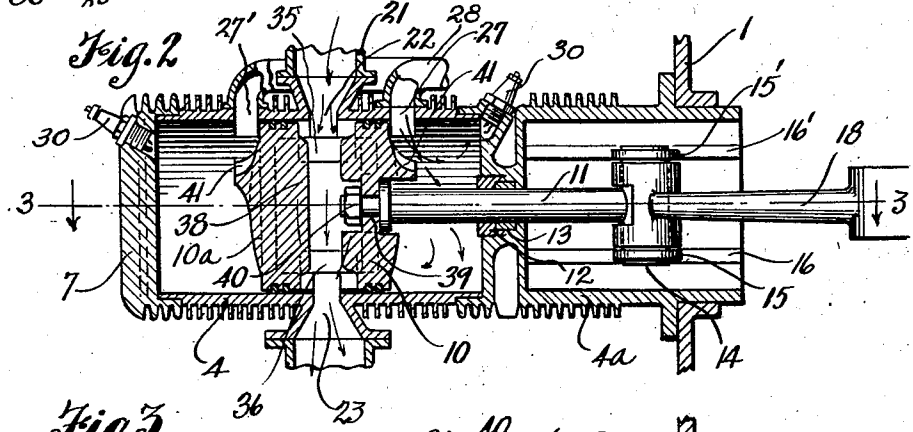
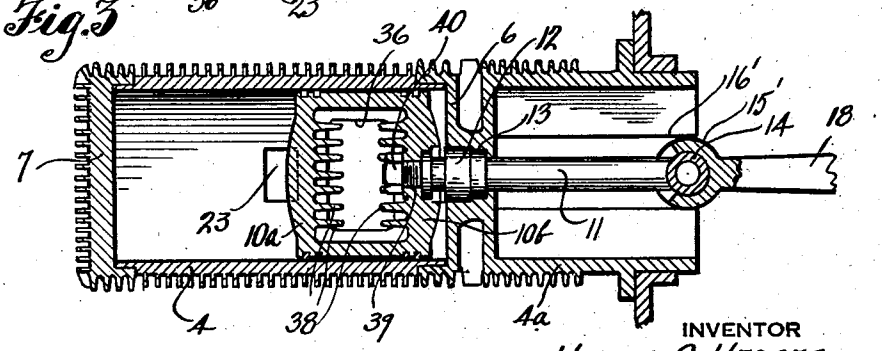



Fig. 3




INVENTOR
HARRY O. HEDGES
BY
Cook & Robinson
ATTORNEY

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## INTERNAL COMBUSTION ENGINE

Harry O. Hedges, Seattle, Wash.

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2 Claims. (Cl. 123—171)

This invention relates to internal combustion engines and has reference more particularly to improvements in means for and a method of maintaining the pistons of the engine in cooled condition during operation.

More specifically stated, the present invention has to do with the improved details of construction in an internal combustion engine of the power cylinder and its contained piston to provide for the air cooling of the piston. Furthermore, to provide means whereby cooling air may be directed through the body of the piston after each explosion in the cylinder to extract heat therefrom and thus keep the piston adequately cooled.

Still further objects of the present invention reside in the details of construction of the piston, cylinder and parts associated therewith, and in the relationship and combination of parts as will hereinafter be fully described.

In accomplishing these and other objects of the invention, I have provided the improved details of construction, the preferred forms of which are illustrated in the accompanying drawing, wherein—

Fig. 1 is a central, sectional view of the power cylinder of an internal combustion engine as equipped for and containing an air-cooled piston made in accordance with the present invention and showing the piston connected with the engine's crank shaft, and illustrating a means for supplying air to the cylinder, both for piston cooling and scavenging purposes.

Fig. 2 is a similar, sectional view of the cylinder, showing the piston at the position required for the passage of cooling air therethrough.

Fig. 3 is a horizontal, sectional view taken on the line 3—3 in Fig. 2, showing the piston advanced to that end of the cylinder that is opposite the end in which it is shown in Fig. 1.

Referring more in detail to the drawing—

In the drawing, I have illustrated the present air-cooled piston as used in an engine of the double acting type, and operating on a two-stroke cycle; that is, there is an explosion chamber provided at each end of the power cylinder, and the piston is reciprocally contained therein, common to both chambers and receives a power impulse at the start of each stroke in each direction.

It is to be understood, however, that the present drawing is to be considered illustrative only of one form of engine in which such air cooled pistons might be employed, and it is not the intent that their use be restricted to any particular type of engine.

In the drawing, 1 designates a crank case housing; 2 the engine crank shaft, revolubly supported at one end in a bearing 3. Mounted at one side of the crank case housing is a power cylinder 4 made in accordance with the present invention, the axial line of which is perpendicular to the axial line of the crank shaft. The cylinder 4 is rigidly supported at the outer end of a cylindrical base member 4a which, in turn, has its inner end portion fitted in a wall opening of the crank case, and fixed rigidly to the wall. The inner and outer ends of the power cylinder 4 are closed by cylinder heads 6 and 7 respectively, and a piston 10, embodied by the present invention, is reciprocally contained in the cylinder.

The piston 10 is fixed to the outer end of a piston rod 11 that passes slidably through a packing sleeve 12 that is fitted in an opening 13 in the cylinder head wall 6, and extends into the cylinder base 4a where it has a fixed connection with a cylindrical cross head 14. At its opposite ends, the cross head mounts roller bearings 15 and 15' thereon and these are movable in rolling contact with guide rails 16 and 16' extending lengthwise of the direction of travel. A connecting rod 18 has pivotal connection at one end with the cross head 14 and at its other end is operatively connected with a throw 2a of the crank shaft 2 whereby reciprocal action of the piston in its cylinder will impart a rotary motion to the crank shaft, and vice versa.

Mounted at the end of the crank case housing and axially alined with the crank shaft, is a fan housing 20, and from this housing, an air delivery manifold 21 extends to the cylinder 4, opening directly thereinto at a point medial of its ends through the cylinder port 22. Revolubly contained in the housing 20 is a blower fan 24 mounted on a shaft 24' that is rotatably supported in the housing in bearings 25 and adapted to be driven at high rate of speed to furnish air to the cylinder by a connection made with the crank shaft 2 through a gear train, designated at 26 in Fig. 1. The driving connection and the type of blower fan used might vary as desired or in accordance with any special requirements.

The length of the piston 10, and its extent of travel, are such that the piston, operating as a valve, will uncover the port 22 as it moves to the end of its stroke in either direction, and permit air from the manifold 21, as supplied under pressure by the fan, to be forcibly discharged into the cylinder, first for the scavenging of the burned fuel charge, and then for mixture with the injected fuel charge. To make this injection of fresh air into the cylinder possible for scavenging, the cylinder is also provided, at a point directly opposite the opening 22, with an outlet port 23 that is uncovered and covered by the piston simultaneously with the uncovering or covering of the opening 22.

There are also provided in the cylinder wall, at locations between the port 22 and the ends of the cylinder, fuel inlet ports 27 and 27' and leading to these ports are fuel delivery manifolds 28

which lead from a source of supply of atomized, combustible fuel; it being understood that this atomized, combustible fuel is forcibly injected into the cylinder through the manifolds 28 at properly timed intervals with reference to the travel of the piston under control of mechanical valve devices or other suitable means not shown, so that it will be retained in the explosion chambers for mixing with air and for compression. Also, at each end of the cylinder, a fuel ignition device, such as the spark plug 30, is mounted for the ignition of the compressed fuel charges, and these plugs would also be electrically connected with a source of electrical current and adapted to be energized in proper timing relative to the reciprocal action of the piston to effect the explosion of charges in proper timing for the best efficiency of the engine.

A feature of the present invention resides in the provision of means for effecting the air cooling of the piston, and therefore the details of construction of the piston and its operative relationship to the ports 22 and 23 of the cylinder will next be described.

It will be observed, especially by reference to Fig. 2, that the piston 10 is substantially hollow and is closed at its opposite ends by the end walls 10*a* and 10*b*. Also, it will be observed that the piston is provided at opposite sides with relatively large openings 35 and 36 which are so located as to simultaneously move across the openings 22 and 23 as the piston reciprocates, thus to allow discharge of cool air from the manifold through the interior of the piston. Thus, with the movement of the piston, when traveling in either direction across port 22, it will have a cooling blast of air delivered therethrough.

In order that heat contained in the walls of the piston may be more quickly dissipated, the passage afforded through the piston body by the openings in its opposite side walls is lined with longitudinally extending fins or ribs 38 as noted best in Fig. 2. These ribs are close together, thin and extend well into the passage from the opposite end walls of the piston, and by reason of their number and direction, will effect a quick dissipation of heat to the passing air stream. The number of these fins might be reduced or even eliminated in small engines. However, for larger engines, they are quite effective and desirable.

The inner end wall 10*b* of the piston has a central opening 39 in which the shouldered end portion of the piston rod is contained and secured by a nut 40 that is threaded onto this end of the rod to seat against the inner face of the wall.

Each end wall of the piston is formed on its outer surface with a baffle 41 that extends well beyond the plane of the end of the cylinder, and which is arcuately curved and faces that side wall of the cylinder in which the air port 22 is located so that, in the reciprocal action of the piston, the entering blasts of scavenging air will strike the face of the baffle, and be deflected thereby toward the cylinder end in such manner as to most effectively evacuate it of all burned fuel and gases. The deflecting faces of these shoulders are preferably curved, as illustrated, to insure best results.

In using the piston in an engine operating on the four-stroke cycle, it would not be necessary to equip the pistons with the baffles 41, and the cylinder would be equipped with valves as in the conventional types of motors.

Assuming the cylinder and the piston to be so constructed and assembled, the operation of the engine, briefly described, would be as follows:

Starting with the piston 10 at the extreme of its travel in one direction, as shown in Fig. 1, and assuming that a blast of fresh cool air has been delivered from the manifold 21 through the opening 22 and has cleared the explosion chamber at the right end of the piston, of burned fuel charges, and has filled the explosion chamber with fresh air, the piston next moves, under the driving impulse of a compressed fuel charge exploded in the chamber at the left-hand end of the cylinder, toward the right, and in so moving, covers the opening 22, thus cutting off the inflow of air. As the piston is thus moving, a charge of atomized combustible fuel is injected under valve control through the fuel manifold 28 and inlet port 27 for mixing with the air then trapped in the chamber. As the piston continues to move toward the right-hand end of the cylinder, the port 27 is covered and the fuel mixture is compressed; and as the piston reaches the end of its travel, the charge is ignited by the energization of the corresponding spark plug 30 to drive the piston in the opposite direction. As the piston is moving to its limit of travel toward the right-hand end of the cylinder, the port 22 is again uncovered and air is delivered from the manifold 21 through the port into the explosion chamber at the left of the piston, thus clearing the chamber of the burned fuel charge and filling the chamber with fresh air. The explosion in the right-hand end of the cylinder drives the piston outwardly, and as it moves, it first closes ports 22 and 23, then port 27' after a fuel charge has been injected, and then effects the compression of the fuel mixture in the chamber. This is followed by the exploding of the charge and the driving of the piston toward the right.

It is to be observed that with each reciprocal action of the piston, its body passage comes into registration with the air supply port 22 and a blast of cool air is delivered therethrough. Thus it is possible to keep the piston satisfactorily cooled for most effective operation of the engine.

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

1. In an internal combustion engine, a cylinder forming separate explosion chambers at its opposite ends and having an air inlet port and an exhaust port in its side walls at points intermediate its ends, means for the admittance of fuel charges to the chambers and for igniting the charges, means for supplying cooling air under pressure to the inlet port, a piston contained in the cylinder common to both chambers and adapted to be reciprocally actuated under the influence of fuel charges exploded in the chambers, and having a passage therethrough adapted to pass in registration with said air inlet and exhaust ports with each reciprocal movement for the periodic delivery of cooling air through the piston.

2. An engine as recited in claim 1 wherein the piston, in its travel in each direction moves across and beyond the air inlet and exhaust ports to permit the scavenging of burned fuel charges from the chamber then vacated by the piston and for the charging of the chamber with fresh air.

HARRY O. HEDGES.