June 28, 1966 B. L. SHEAFFER 3,257,997

PISTON FOR INTERNAL COMBUSTION ENGINE

Filed Feb. 4, 1965

Fig. 1.

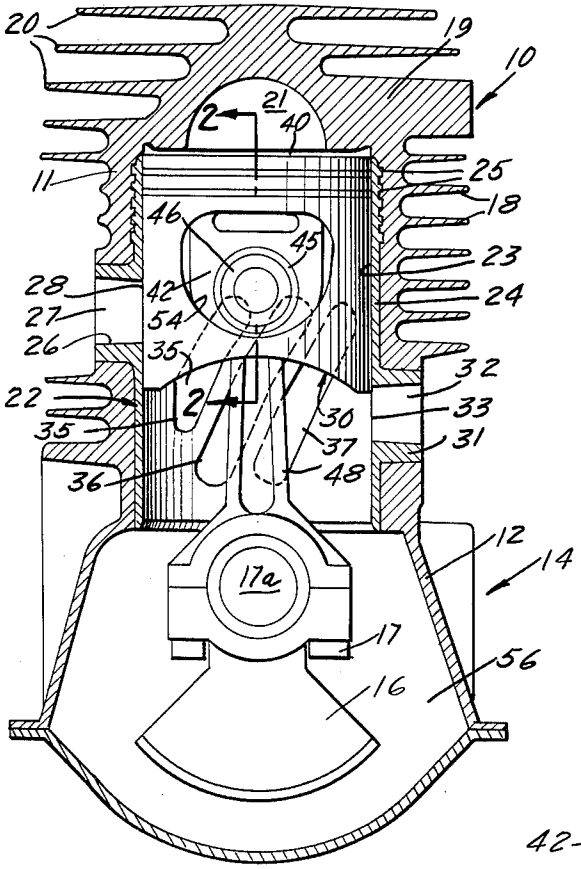


Fig. 2.

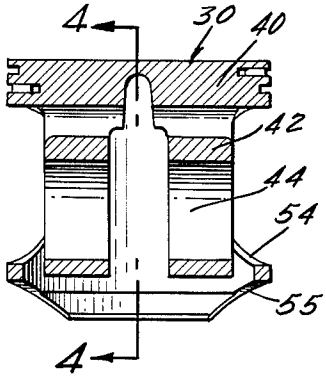
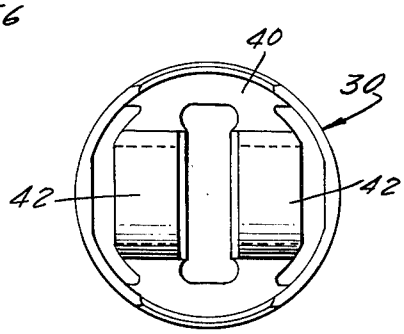


Fig. 3.



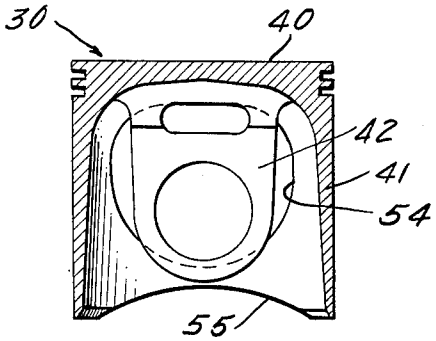


Fig. 4.

Benjamin L. Sheaffer,
INVENTOR.
WHANN & McMANIGAL
Attorneys for Applicant
by Robert M. McManigal

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PISTON FOR INTERNAL COMBUSTION ENGINE

Benjamin L. Sheaffer, Palos Verdes, Calif., assignor to McCulloch Corporation, Los Angeles, Calif., a corporation of Wisconsin

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This invention relates generally to internal combustion engines and relates more particularly to pistons for two-cycle engines.

While the invention has particular utility in connection with pistons for two-cycle engines, and is shown and described in such connection, it is to be understood that its utility is not confined thereto.

As is well known, there are certain problems and difficulties involved in the provision of suitable pistons for internal combustion engines. For example, there is the problem of eliminating or reducing to a minimum piston distortion due to internal strains and stresses set up by the rise in temperature resulting from the combustion of gases in the cylinder combustion chamber and it is an object of the present invention to provide a piston wherein the problems and difficulties involved therein are solved and overcome.

Another object of the invention is to provide a piston of this character that runs much cooler than prior pistons of which I am aware.

It is another object of the invention to provide a piston of this character that is relatively light in weight and wherein loads on the piston pin bosses will not distort the piston skirt.

Still another object of the invention is to provide a piston of this character wherein the piston pin wear is greatly extended, such wear having been found to be extended over 20%.

A further object of the invention is to provide a piston of this character that is very much lighter in weight than conventional pistons, thus correspondingly reducing inertia and problems resulting from high inertia factors and lowering reciprocating weight.

A still further object of the invention is to provide a piston of this character that will work efficiently under all operating conditions.

Another object of the invention is to provide a piston of this character that is well balanced and has the required stability.

Still another object of the invention is to provide a piston of this character that is adapted to efficiently and effectively control transfer ports in the walls of cylinders of two-cycle engines.

The characteristics and advantages of the invention are further sufficiently referred to in connection with the following detailed description of the accompanying drawings, which represent one embodiment. After considering this example, skilled persons will understand that many variations may be made without departing from the principles disclosed, and I contemplate the employment of any structures, arrangements, or modes of operation that are properly within the scope of the appended claims.

Referring to the drawings, which are for illustrative purposes only:

FIG. 1 is a longitudinal section through a two-cycle internal combustion engine having a piston embodying the present invention operably disposed therein, said piston being at the top of its stroke;

FIG. 2 is a sectional view taken on line 2—2 of FIG. 1;

FIG. 3 is a lower end view of the piston; and

FIG. 4 is a sectional view taken on line 4—4 of FIG. 2.

Referring more particularly to the drawings, there is

diagrammatically shown a two-cycle internal combustion engine, indicated generally at 10, having a cylinder block 11, the upper part 12 of a crankcase indicated generally at 14, and the lower part 15 of the crankcase. The crankcase is of any suitable well known type and has an engine crankshaft 16 therein which includes a crank 17.

While the engine may be water cooled, it is shown as being of the air cooled type and the cylinder block is provided with a plurality of cooling fins 18 of the usual character and arrangement. There is a cylinder head 19 which is shown as being integral with the cylinder block but, it is to be understood, the cylinder head could be a separate part secured to the cylinder block by any suitable well known means and in any suitable well known manner. The cylinder head is also provided with cooling fins 20 and there is a combustion chamber 21 in the inner side of said cylinder head.

A liner, indicated generally at 22, is cast in the cylinder block, said liner also being cast of suitable material, such as, for example, iron.

Liner 22 has a longitudinally extending interior bore 23 defined by a wall 24, said bore 23 being open at both ends.

An upper end portion of the liner wall 22 is provided with a plurality of external, annular ribs 25 spaced apart longitudinally or axially and when the liner is cast in the cylinder block said ribs securely anchor same in position in said cylinder block and against any longitudinal displacement. At one side the liner is provided with a boss 26 having at least one exhaust passage 27 which are in communication with the bore 24 of the liner by way of an exhaust port 28. The exhaust port is disposed at an intermediate position relative to the length of the liner and is adapted to be controlled by a piston, indicated generally at 30, reciprocably mounted in the bore 24.

At the oposite side of the liner there is an external boss 31 having an inlet passage 32 therethrough which communicates with the bore 23 of the liner by means of an inlet port 33. Inlet port 33 is positioned below the exhaust port 28, and said inlet port 33 is adapted to be controlled by said piston 30 and to be uncovered when the piston is in an upper range of movement.

At generally right angles to the bosses 26 and 31 for the exhaust and inlet passages, the liner is provided with diametrically arranged bosses or what may be termed blisters, each of which has a plurality of transfer passages or channels 35, 36 and 37, respectively. These passages are inclined upwardly and away from the side of the cylinder or bore 23 having the exhaust port 28, the upper ends of said passages being at substantially the same level and terminating in a horizontal plane below the plane of the top of said exhaust port 28. The lower ends of the passages or channels 35, 36 and 37, are shown as terminating upwardly of the lower end of the cylinder or bore 23, the lower ends of the passages 36 and 37 being lower than the lower end of the passage 35. While a plurality of transfer passages or channels are shown, it is to be understood that there may be only one or two or more than three.

The piston 30 has a flat topped head 40 and a depending skirt 41. Depending from and integral with the head 40 of the piston are a pair of laterally spaced bosses 42 which have axially aligned openings 44 therethrough for reception of wrist pin bearings 45 in which a wrist pin 46 is operably disposed. The upper end of a connecting rod, indicated generally at 48, is operably disposed on said wrist pin in the space between the bosses 42, the construction and mounting of the connecting rod on said wrist pin is of well known character and need not be specifically described herein.

At its lower end the connecting rod is provided with the usual enlargement having a substantially semi-cylin-

drical notch **49** therein for reception of a portion of the crank pin **17***a* of crank **17**. There is also the usual clamp part **50** having a substantially semicylindrical notch for reception of the rest of the crank pin, **17***a*, said clamp part **50** being secured to the enlarged part of the connecting rod **48** in the usual manner by screws or bolts, not shown.

Piston **30** has a pair of openings **54** in the skirt in alignment with the openings in the bosses, said openings **54** being positioned at diametrical sides of the piston and in longitudinal alignment with said skirt openings **54** the skirt having arcuate relieved portions or notches **55** in the free end, said notches **55** being at diametrically opposite sides of the piston. Notches **55** are of the same size and character and openings **54** are also of the same size and character. This is done to keep the piston in balance and said notches and openings provide a piston of very light weight with the advantages of such light weight, as pointed out above.

Openings **54** in the piston also serve another purpose; that is, they serve as ports for the flow of fluid from the crankcase to the transfer passages or channels **35**, **36** and **37**, as will be described hereinafter.

The general sequence of engine operation

Assuming that the engine is in operation and starting the description of such operation with the piston at lower dead center, the openings **54** in the piston skirt will be in communication with the transfer passages or channels **35**, **36** and **37**. A fuel mixture has been drawn into the crankcase interior **56** and compressed therein by the downstroke movement of the piston. At this time the inlet port **33** is, of course, closed by that portion of the piston skirt between the openings **54** at the right hand side thereof, as seen in the drawing, and the exhaust port **28** is uncovered and open.

For the first 45° to 70° of crankcase rotation from bottom dead center the transfer or scavenging channels **35**, **36** and **37** are open so that the fuel mixture charge in the crankcase may flow therefrom through the openings **54**, passages **35**, **36** and **37**, and into the cylinder above the piston. For the first 60° to 90° of crankshaft rotation from the bottom dead center the exhaust ports are open to facilitate scavenging flow of combustion products therefrom. As the piston moves upwardly it begins to cover the exhaust port **28** and the upper ends of the transfer passages **35**, **36** and **37**. When the piston head or the top of the piston reaches the upper edges of the transfer passages **35**, **36** and **37**, said passages are closed against the flow of fuel mixture upwardly into the upper portion of the cylinder **23**. This occurs before the upper end of the piston reaches the upper edge of the exhaust port **28**, so that the exhaust port remains open for a longer period than the transfer passages. When the upper end of the piston reaches the upper edge of the exhaust port the latter is fully closed and the fuel mixture charge in the cylinder above the piston is compressed with further upward movement of the piston.

As the piston moves upwardly from this position the fuel mixture is compressed in the upper part of the cylinder above the piston and in the combustion chamber **21**. At the same time the skirt of the piston begins to uncover the inlet port **33** which is connected with the carburetor or other charge forming device, not shown. The upward movement of the piston has created a partial vacuum in the crankcase and as soon as the piston skirt begins to uncover the inlet port **33** a fresh charge of fuel mixture begins to be drawn through said inlet port **33**, and thence into the bore or cylinder **23** and into the crankcase interior **56** with which the piston below its head **40** is in full communication.

When the piston has reached upper dead center, as shown in FIG. 1, and the fuel mixture in the upper end of the cylinder and combustion chamber **21** has been fully compressed, it is then ignited by a spark plug, not shown. Upon ignition of this fuel mixture in the combustion chamber the piston is driven downwardly in its power stroke. As the piston moves downwardly it first reaches the upper edge of the exhaust port **28** and begins to uncover said port so that the exhaust gases or combustion products begin to escape through said port. At the same time the piston has closed the inlet port **33** and begun to compress the fresh fuel mixture charge in the crankcase interior **56**.

Upon further downward movement of the piston the upper ends of transfer passages **35**, **36** and **37** are uncovered and since the openings **54** in the piston skirt communicate with said transfer passages the fuel mixture being compressed in the crankcase flow through said openings **54** and into the transfer passages **35**, **36** and **37** and thence upwardly into the upper part of the cylinder. Because of the inclination of the transfer passages **35**, **36** and **37** away from the side of the cylinder having the exhaust port, the fresh charge of fuel or the fuel mixture flows upwardly in the upper part of the cylinder toward the side away from the exhaust port and circulates so as to clear out or scavenge the combustion products in the upper end of the cylinder and the combustion chamber **21** and drive such combustion products downwardly along the side of the piston having the exhaust port and thence out of said exhaust port.

When the piston reaches lower dead center it begins its upward movement or stroke and the cycle of operation described above is repeated.

The invention and its attendant advantages will be understood from the foregoing description and it will be apparent that various changes may be made in the form, construction and arrangement of the parts of the invention without departing from the spirit and scope thereof or sacrificing its material advantages, the arrangement hereinbefore described being merely by way of example, and I do not wish to be restricted to the specific form or uses mentioned except as defined in the accompanying claims, wherein various parts or portions have been separated for clarity of reading and not for emphasis.

I claim:

1. In a piston for an internal combustion engine:

(A) a piston head;

(B) means for operable connection of a connecting rod to said piston;

(C) and a generally cylindrical skirt depending from said head, said skirt having oppositely arranged openings therein, said skirt having notches at opposite sides and in parallel alignment with the openings in said skirt, means connecting said rod with said piston comprising a pair of laterally spaced bosses integral with said head and depending therefrom, the outer sides of said bosses being spaced inwardly from the plane of inside configuration of the skirt, said bosses having aligned openings therein which are also aligned with the openings in the skirt, and a wrist pin in said bosses with its ends in spaced relation to the inner surface of the skirt.

2. In an internal combustion engine, including:

(A) wall means defining a cylinder having a piston receiving bore open at the inner end, said cylinder having

(a) at least one exhaust passage therein communicating with the piston receiving bore by means of an exhaust port,

(b) an inlet passage communicating with said piston receiving bore by means of an inlet port spaced closer to the inner end of said cylinder than said exhaust port,

(c) at least one blister positioned at an angle to said ports,

(d) at least one transfer passage in said blister for the flow of fuel and oil into the cylinder bore, the inner end of said passage terminating short of the inner end of the cylinder;

(B) and a piston reciprocably disposed in the piston receiving bore of the cylinder, said piston including
(a) a piston head,
(b) means for operably connecting said piston with an engine connecting rod,
(c) and a generally cylindrical skirt depending from said piston head, said skirt having at least one opening therein adapted for communication with the transfer passage while the piston is within a predetermined range of movement in the bore of the cylinder so that fuel and oil may flow through said opening, about the means for operably connecting said piston with an engine connecting rod, into said transfer passage, and thence into the cylinder bore outwardly of the piston,

the means connecting said rod to said piston including a pair of laterally spaced bosses depending from said piston head and a wrist pin in said bosses with its ends in spaced relation to the inner surface of said skirt, said bosses having aligned openings therein which are also aligned with the openings in the skirt, said bosses being spaced inwardly from the plane of inside configuration of the skirt, the free end of said skirt having notches in parallel alignment with respective openings in said skirt.

3. In an inernal combustion engine, including:
(A) wall means defining a cylinder having a piston receiving bore open at the inner end, said cylinder having
(a) at least one exhaust passage therein communicating with the piston receiving bore by means of an exhaust port,
(b) an inlet passage communicating with said piston receiving bore by means of an inlet port spaced closer to the inner end of said cylinder than said exhaust port,
(c) at least one blister positioned at an angle to said ports,
(d) at least one transfer passage in said blister for the flow of fuel and oil into the cylinder bore, the inner end of said passage terminating short of the inner end of the cylinder;
(B) and a piston reciprocably disposed in the piston receiving bore of the cylinder, said piston including
(a) a piston head,
(b) means for operably connecting said piston with an engine connecting rod,
(c) and a generally cylindrical skirt depending from said piston head, said skirt having at least one opening therein adapted for communication with the transfer passage while the piston is within a predetermined range of movement in the bore of the cylinder so that fuel and oil may flow through said opening, about the means for operably connecting said piston with an engine connecting rod, into said transfer passage, and thence into the cylinder bore outwardly of the piston,
(d) a crankshaft having a crank pin,
(e) means supporting said crankshaft in operable relation to the piston receiving bore of the cylinder,
(f) and a connecting rod, one end of said connecting rod having an operable connecting with the crank pin of said crankshaft, the other end of the connecting rod having the operable connection with the piston,

the free end of the skirt having notches therein in parallel alignment with the respective openings in said skirt, the means connecting said rod to said piston comprising a pair of laterally spaced bosses depending from the head of the piston, said bosses having aligned openings therein which are also aligned with the openings in the skirt, the adjacent end of the connecting rod also having an opening therein aligned with the openings in said bosses; and a

wrist pin disposed in said aligned openings in the bosses and connecting rod, and said bosses being spaced inwardly from the plane of the inside configuration of the skirt.

4. In a two-cycle internal combustion engine assembly:
(A) a cast iron cylinder liner having a longitudinally extending cylindrical bore therethrough open at both ends, said cylinder liner having
(a) a plurality of annular, longitudinally spaced external ribs on an upper end portion,
(b) a boss at one side having an exhaust passage therein communicating with the bore of said liner by means of a port,
(c) said exhaust port being located intermediate the ends of the liner and intermediate the ends of the stroke of a piston reciprocably mounted in said bore,
(d) a second boss having an inlet passage therethrough communicating with the cylindrical bore of the liner by means of an inlet port,
(e) said inlet port being spaced closer to the inner end of the liner than said exhaust port,
(f) a pair of blisters at right angles to the exhaust and inlet bosses and arranged diametrically opposite to each other, each of said blisters having a plurality of passages formed therein opening into said cylindrical bore and extending toward the outer end of said liner and inclined away from the side having the exhaust port, the upper ends of said transfer passages in said blisters having their upper ends terminating longitudinally inwardly of the outer edge of the exhaust port;
(B) a cylinder block cast about said liner and leaving the outer ends of the inlet passage and the exhaust passage free;
(C) and a piston for reciprocable motion within the bore of the liner, said piston having a head and a generally cylindrical skirt, the latter having oppositely arranged openings therein adapted to be in communication with the transfer passages, said skirt having notches at opposite sides and in parallel alignment with the openings in said skirt, and means connecting a connecting rod with said piston comprising a pair of laterally spaced bosses integral with said head and depending therefrom, the outer sides of said bosses being spaced inwardly from the plane of the inside configuration of the skirt, and said bosses having aligned openings therein which are also aligned with the openings in the skirt and a wrist pin in said bosses with its ends in spaced relation to the inner surface of the skirt whereby fluid from the crankcase of the engine may pass into the piston, through said openings in the skirt thereof, thence into the transfer passages and into the upper end of the bore of the liner, said inlet port, exhaust port and transfer passages being controlled by the piston.

5. In a two-cycle internal combustion engine assembly:
(A) a cylinder liner having a longitudinally extending cylindrical bore therethrough open at both ends, said cylinder liner having
(a) a boss at one side having an exhaust passage therein communicating with the interior bore of said liner by means of an exhaust port,
(b) said exhaust port being located intermediate the ends of the liner and intermediate the ends the stroke of a piston reciprocably mounted in said bore,
(c) a second boss having an inlet passage therethrough communicating with the cylindrical bore of the liner by means of an inlet port,
(d) said inlet port being spaced closer to the inner end of the liner than said exhaust port,

(e) at least one blister at substantially right angles angles to the exhaust and inlet bosses, said blister having a plurality of passages formed therein having at least a portion of their length opening into said bore and extending toward the outer end of said liner and inclined away from the side having the exhaust port, the upper ends of said transfer passages in said blister having their upper ends terminating inwardly of the outer edge of the exhaust port;

(B) a cylinder block cast about said liner and leaving the outer ends of the inlet passage and the exhaust passage free;

(C) and a piston for reciprocable motion within the bore of the liner, said piston having a head and a generally cylindrical skirt, the latter having oppositely arranged openings therein adapted to be in communication with the transfer passages, said skirt having notches at opposite sides and in parallel alignment with the openings in said skirt, and means connecting a connecting rod with said piston comprising a pair of laterally spaced bosses integral with said head and depending therefrom, the outer sides of said bosses being spaced inwardly from the plane of the inside configuration of the skirt, and said bosses having aligned openings therein which are also aligned with the openings in the skirt and a wrist pin in said bosses with its ends in spaced relation to the inner surface of the skirt whereby fluid from the crankcase of the engine may pass into the piston, through said opening in the skirt thereof, thence into the transfer passages and into the upper end of the bore of the liner, said inlet port exhaust port and transfer passages being controlled by the piston.

6. In a two-cycle internal combustion engine assembly:

(A) a cast iron cylinder liner having a longitudinally extending cylindrical bore therein, said cylinder liner having

(a) an exhaust port communicating with the interior bore of said liner,

(b) said exhaust port being located intermediate the ends of the stroke of a piston reciprocably mounted in said bore,

(c) an inlet port communicating with the cylindrical bore of the liner,

(d) said inlet port being spaced closer to the inner end of the liner than said exhaust port,

(e) at least one blister spaced circumferentially from said exhaust port approximately 90°, said blister having at least one passage formed therein extending toward the outer end of said liner and inclined away from the exhaust port, said transfer passage being open along at least a portion of the inner side and having its upper end terminating inwardly of the outer edge of the exhaust port;

(B) a cylinder block cast about said liner;

(C) and a piston for reciprocable motion within the bore of the liner, said piston having a head and a generally cylindrical skirt, the latter having oppositely arranged openings therein adapted to be in communication with the transfer passage, said skirt having notches at opposite sides and in parallel alignment with the openings in said skirt, and means connecting a connecting rod with said piston comprising a pair of laterally spaced bosses integral with said head and depending therefrom, the outer sides of said bosses being spaced inwardly from the plane of the inside configuration of the skirt, and said bosses having aligned openings therein which are also aligned with the openings in the skirt and a wrist pin in said bosses with its ends in spaced relation to the inner surface of the skirt, whereby fluid from the crankcase of the engine may pass into the piston through said opening in the skirt thereof, thence into the transfer passage and into the upper end of the bore of the liner, said inlet port, exhaust port and transfer passage being controlled by the piston.

7. In an internal combustion engine; wall means defining a cylinder having a piston receiving bore extending longitudinally therein, said cylinder having

(a) at least one exhaust passage therein communicating with the piston receiving bore by means of an exhaust port,

(b) an inlet passage communicating with said piston receiving bore by means of an inlet port, said inlet port being spaced closer to the inner end of said cylinder than said exhaust port,

(c) at least one blister positioned at an angle to said ports, a plurality of generally parallel transfer passages in said blister, said passages being inclined toward the outer end of the bore away from the exhaust port, the transfer passage adjacent the exhaust port being shorter than the other passages, the outer ends of said transfer passages terminating in substantially the same plane normal to the axis of the cylinder, the inner ends of said passages terminating short of the inner end of the cylinder with the shorter passages having their inner ends spaced further outwardly longitudinally of the cylinder than the inner ends of the longer passages, a second blister positioned diametrically opposite the first mentioned blister, said second blister also having a plurality of generally parallel transfer passages therein and the passages in said second blister being substantially similar to the passages in said first blister, a piston in said cylinder, said piston having a head and a generally cylindrical skirt depending therefrom, said skirt having openings therein at diametrically opposite sides and at the sides having said blisters, said openings being so dimensioned as to be in communication with some of said passages at various piston positions, said skirt having notches at opposite sides and in parallel alignment with the openings in said skirt, and means connecting a connecting rod with said piston comprising a pair of laterally spaced bosses integral with said head and depending therefrom, the outer sides of said bosses being spaced inwardly from the plane of the inside configuration of the skirt, and said bosses having aligned openings therein which are also aligned with the openings in the skirt and a wrist pin in said bosses with its ends in spaced relation to the inner surface of the skirt.

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CARLTON R. CROYLE, *Primary Examiner.*

WENDELL E. BURNS, *Examiner.*