Sept. 7, 1965 L. RUBINOWITZ ETAL 3,204,619

INTERNAL COMBUSTION ENGINE

Filed July 2, 1962 3 Sheets-Sheet 1

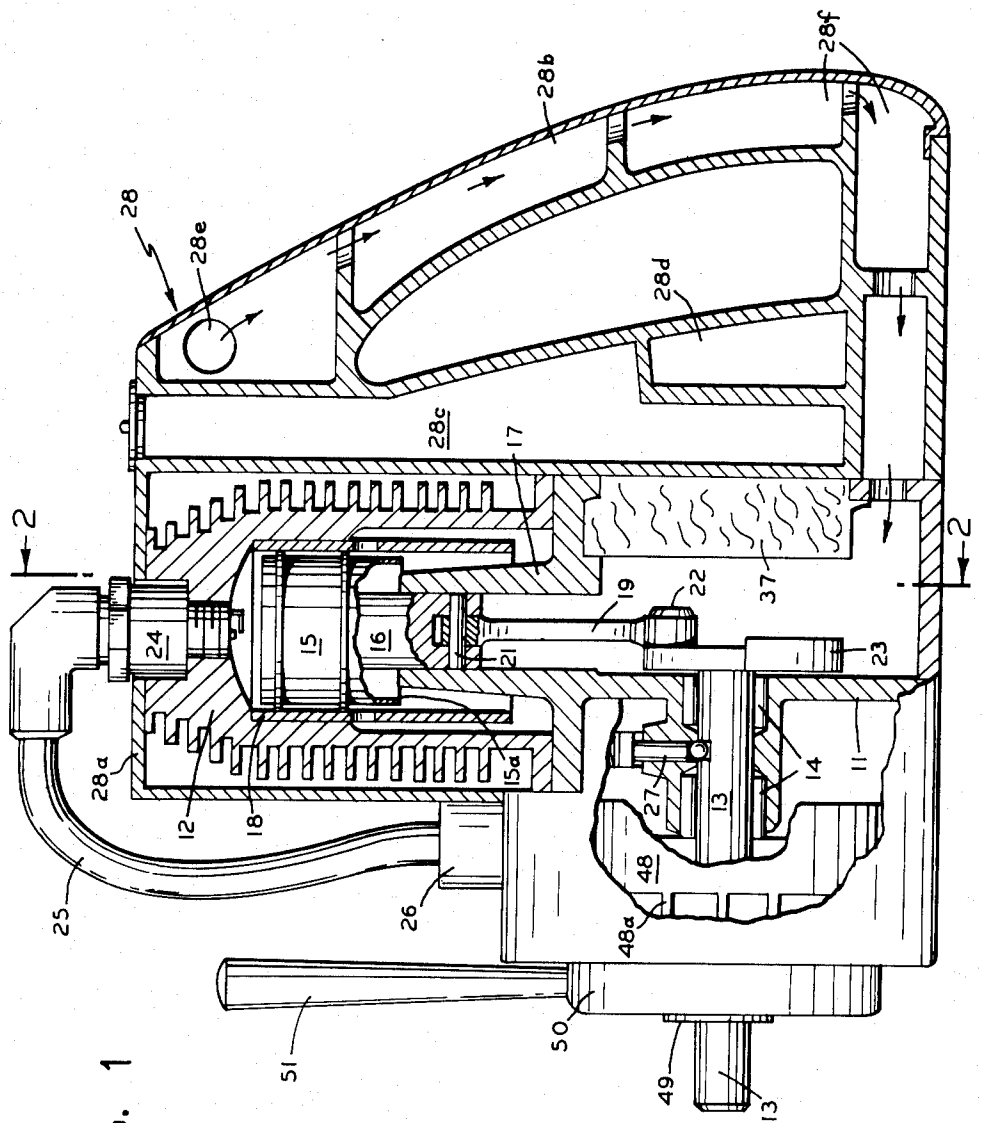

FIG. 1

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FIG. 2

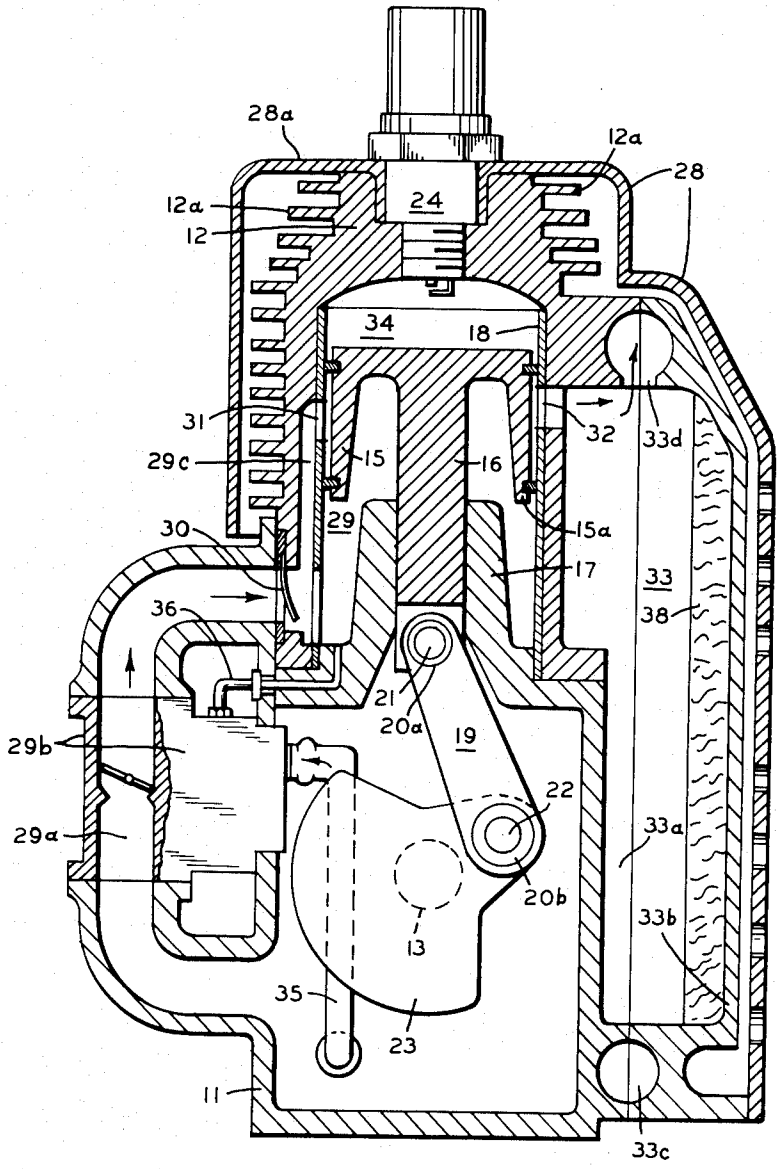

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FIG. 3

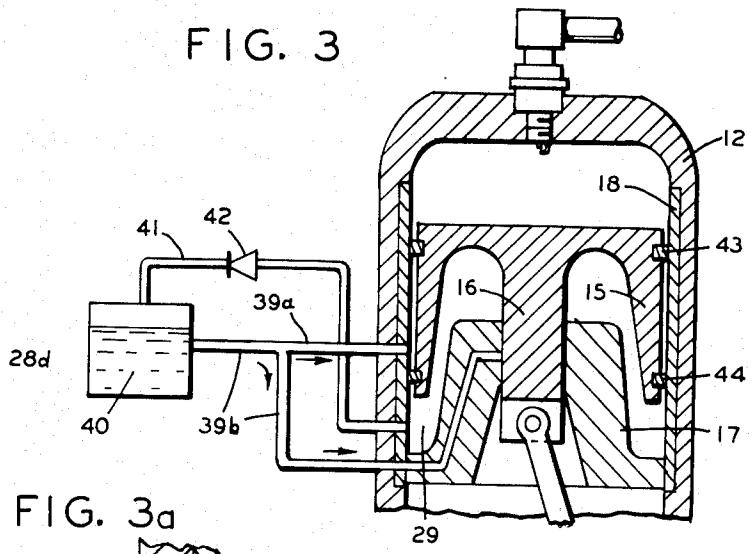


FIG. 3a

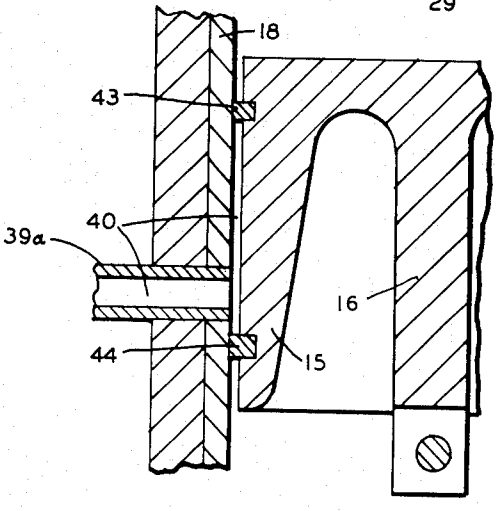


FIG. 3b

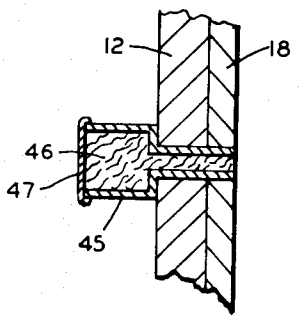
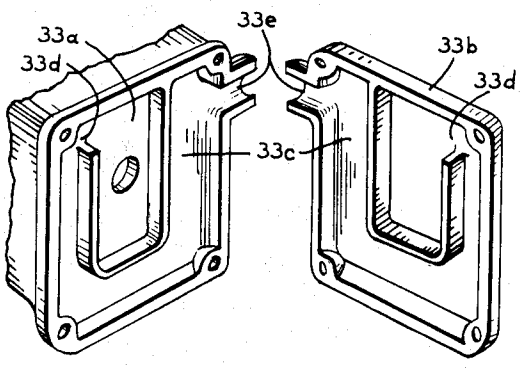


FIG. 4



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3,204,619

INTERNAL COMBUSTION ENGINE

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8 Claims. (Cl. 123—74)

This invention relates to two-cycle internal combustion engines. More particularly the invention is directed to a two-cycle internal combustion engine in which the compression chamber for the fuel-air mixture is isolated from the crankcase and in which the fuel intake to the cylinder and exhaust of combustion gases therefrom occurs through ports in the sides of the cylinder; the fuel charge being directed within the cylinder in a manner such as to prevent its escape through the exhaust ports and to scavenge the cylinder of the burned gases.

The conventional two-cycle engine uses crankcase compression of the air-fuel mixture to provide pressure for scavenging. This requires mixing of the lubricating oil with the fuel, as oil cannot be stored in the crankcase. This, in turn, creates a nuisance in that a heavy mist of unburned oil is continuously blown out through the engine exhaust.

The oil laden exhaust fumes from the engine is particularly undesirable when the engine is used in conjunction with portable hand tools as it soils the operator's hands and clothing. Moreover, because of the proximity to the operator, fumes from the engine became noxious after continued inhalation. As a consequence, the utilization of these small internal combustion engines for the portable tool market have not met with success heretofore.

As a rule in the manufacture of engines of this kind, close tolerance between piston and cylinder is an important requisite for proper performance which adds to the cost of the engines. The present invention utilizes an arrangement which avoids the necessity of close tolerance between the piston and the cylinder thereby substantially minimizing costs.

Another important consideration in engines of this kind has been the noise occasioned in operation. Engine noise is due not only to exhaust gases but results also substantially from intake air. The present invention affords a novel and compact arrangement which very substantially cuts down engine noise attributable to intake air as well as exhaust gas.

It is an object of the present invention to provide an internal combustion engine characterized by the elimination of admixture of fuel and lubricating oil thereby eliminating the exhaust oil fume nuisance.

It is another object of the invention to provide an internal combustion engine of novel construction in which the piston rod, which is an integral part of the piston, is made a close running fit in the bore of the stuffing block. The diameter of the piston proper is made slightly less than the cylinder bore so that the piston skirt does not bear against the cylinder wall. Guiding is performed entirely by the piston rod, and the connecting rod side forces are taken by the stuffing-block bore. Sealing of the combustion chamber is provided by piston rings.

It is still a further object of the present invention to provide an internal combustion engine having a novel and compact dual muffler configuration incorporating a muffler for both intake air as well as exhaust gas so arranged as to utilize existing components of the engine as parts of the mufflers.

Additional objects of the invention are to provide an internal combustion engine requiring less exacting tolerances, is relatively inexpensive to construct and is of durable and dependable operation.

Further objects and a better understanding of the invention will become apparent by reference to the detailed description provided herein taken in conjunction with the accompanying drawing in which:

FIG. 1 is a side elevation partially in section of a two-cycle internal combustion engine, embodying the various features of our invention.

FIG. 2 is an end elevational view partially in section taken substantially along line 2–2 of FIG. 1.

FIG. 3 is an enlarged sectional view of the piston and cylinder illustrating one form of a suitable lubricating system.

FIG. 3*a* is a sectional view of a fraction of the piston and cylinder wall illustrating the lubricant duct feed.

FIG. 3*b* is a fraction sectional view illustrating an alternate lubricating feed.

FIG. 4 is a perspective exploded view of the exhaust muffler arrangement.

The basic engine construction consists of a crankcase **11** and cylinder **12**. Preferably the crankcase and cylinder are manufactured of die-cast aluminum construction for light weight and low cost, although other materials such as cast iron, conventionally employed in the engine art, may be used. Cylinder **12** is finned as shown at **12***a* to provide adequate air cooling surface. Crankshaft **13** is suitably supported in anti-friction bearings **14** preferably of the needle roller type. Bearings **14** of the sealed type prepacked with a suitable grease lubricant are advantageously used so that no external lubrication for this element is required indefinitely, i.e. normally no lubrication is necessary for the life of the engine.

Piston **15** and piston rod **16** are rigidly connected or preferably are of integral construction. Piston rod **16** is of relatively thick cross section to provide solid and substantially complete bearing for the piston. The rod **16** is accurately fitted to slide freely in stuffing block **17** with a small clearance. The stuffing block thus acts as the essential guide for the piston rod and piston. The piston **15** itself is of appreciably smaller diameter than the cylinder liner **18** and does not touch the cylinder liner wall, as shown, since the guiding is performed by the piston rod. Sealing of the piston **15** against the cylinder liner **18** is effected by piston rings **43** and **44**. The rings function as seal only; the guiding of the piston as noted is accomplished by the piston rod **16** in the stuffing block **17**. This avoids the need for accurate fitting of the piston as in conventional construction and provides a significant advantage. Because precise concentricity of the piston rod and piston are not necessary the cost of manufacture is minimized appreciably.

The cylinder liner **18** is preferably made of cast iron although it is apparent that other material with suitable low-friction and wear-resisting properties may be used. This sleeve also, for example, may consist of a suitable electro-plated material applied to the cylinder wall. Likewise, the stuffing block **17** is constructed of a similar material or combination of materials with or without plated surface.

The piston rod is suitably fitted with wrist pin **21**. Connecting rod **19** is fitted with anti-friction bearings **20***a* and **20***b*, at both ends, which in turn are fitted to wrist pin **21** and crankpin **22**. Crankpin **22** is generally formed as an integral part of crankshaft **13**. Bearings **20***a* and **20***b* are also advantageously of the sealed needle-bearing type, prepacked with lubricant so that no external lubrication is anticipated normally for the life of the engine.

Crankshaft **13** is fitted with counterweight **23** as is conventional to reduce vibratory forces due to the reciprocating masses of the piston and piston rod.

Spark plug **24** is energized via electrical lead **25** by a standard magneto **26** in conventional manner as widely used in small engines. The magneto ignition points are

driven by cam and follower arrangement 27 from the crankshaft, which may again be any one of the conventional arrangements used in small engines.

Housing 28, preferably of die-cast construction, performs several functions. It provides a cover and shrouding 28*a* for the cylinder head, a hollow handle 28*b*, for carrying the unit, a fuel tank 28*c*, and oil reservoir 28*d*.

Intake air required for the fuel combustion is admitted through opening 28*e* in the side of the handle, and passes thru internal passages 28*f* into the interior space of crankcase 11 as indicated by the arrows. Opening 28*e* may be fitted with an air filter of porous paper or plastic or other conventional filter construction.

During the up-stroke of the piston, a vacuum is created in space 29 underneath the piston, which causes reed valve 30 to open. The intake air is then sucked from the crankcase through throat 29*a* of the carburetor, 29*b*, where it picks up the fuel required for combustion, and the fuel mixture then passes through the reed valve into space 29*c*. Near the top of the stroke, the spark plug ignites the previously admitted fuel mixture charge and the piston is driven downward. During the first part of the downstroke, intake port (or ports) 31 is closed off by the piston skirt 15*a*, so that the mixture is compressed in space 29 effecting closure of reed valve 30 during compression. Chamber 29 is proportioned so that further downward motion of the piston produces a high degree of compression of the mixture. As the piston progresses downward, the top of the piston first reaches exhaust ports 32, only one of which is shown, and the burned gases immediately begin to pass into the exhaust muffler chamber 33. A brief time interval later in the downstroke, the piston uncovers intake ports 31, only one of which is shown, and the compressed fuel mixture passes through the intake ports via transfer passage 29*c* into combustion space 34. This fresh fuel mixture helps scavenge the combustion chamber clear of burned gases.

Fuel line 35 carries fuel from tank 28*c* to the carburetor. The latter is preferably of the diaphragm type, as commonly used in chain saw engines and similar types of portable engines, to permit operation of the engine in any attitude. Pipe line 36 supplies, from compression chamber 29, pulsating gas pressure required for operation of the diaphragm carburetor.

By proper selection of diameter and length of intake air passage 28*f* with reference to the internal volume of crankcase 11, an effective acoustic filter is obtained which greately reduces noise emanating from the engine intake. This noise is due in substantial part to the vibration of the reed valve 30. In the novel arrangement of the invention, very significant noise silencing is obtained by using elements already present for other reasons; in this way additional cost and bulk are avoided. As shown, a pad of fiberglass 37 or other suitable porous material may be additionally mounted within the crankcase to help absorb high frequency noise.

In addition to the intake muffler, a resonating chamber or muffler space 33 with tailpipe 33*e* are provided to act as a muffler to reduce exhaust noise by a construction using a minimum number of parts. The resonating chamber 33 is made up in part of volume 33*a*, which is integrally cast as part of the cylinder and crankcase, and in part by cover piece 33*b*, which is another one-piece die casting whose interior volume also contains integrally formed therein a part of the resonating chamber and tailpipe and completes the resonator chamber. Exhaust gases enter passage 33*c* via opening 33*d* and are discharged to the atmosphere via opening 33*e*, see FIG. 4.

A pad of material 38 similar to that used in pad 37 is mounted in the resonator chamber to help absorb high frequency noises in the exhaust.

Cover 28 extends around the exhaust muffler and is spaced from it as shown to protect the operator from the hot surface of the muffler.

Piston 15 is fitted with piston ring 43 which seals the combustion chamber 34 and with a second piston ring 44 at its lower end. Lubrication for the running surface between piston rod 16 and stuffing block 17, and for piston rings 43 and 44 is provided by an oil supply 40 pumped from oil reservoir 28*d* (shown schematically in FIG. 3). The reservoir 28*d* is pressurized by gas pressure from chamber 29 via tubing 41. Check valve 42 permits flow of pressurized gas from 29 to 28*d*, but prevents its return, thereby maintaining pressure in 28*d*, which forces the oil through tubes 39*a* and 39*b* to the respective lubricating points. FIG. 3*a* shows in detail how the oil through 39*a* fills the space between rings 43 and 44, thereby maintaining an adequate film of oil on the cylinder wall at all times.

FIG. 3*b* shows an alternate construction whereby the oil reservoir 28*d* is eliminated by use of wick-fed lubrication. A small reservoir 45 is filled with wicking 46 made of cotton or other suitable porous material. Hinged cap 47 can be lifted to permit saturation of the wicking at periodic intervals; the wicking conducts the oil to the rubbing surfaces by capillary action. FIG. 3*b* shows the arrangement at the cylinder wall; a similar arrangement will supply oil to the piston rod.

Flywheel 48 (see FIG. 1) is provided with integral blades 48*a* of conventional construction which act as a fan to blow air over the cylinder fins and provide suitable cooling. The propelled air is guided by shroud passages cast into housing 28 over the cooling fins.

A plate 49 is provided of suitable design for mounting attachments to be driven by the engine.

A starting mechanism 50 is mounted on the front of the engine. The starting mechanism is of conventional commercial arrangement; preferably it is a "stored-energy" type of starter, in which a spring is wound up and the stored energy is released suddenly to rotate the engine, as is now widely used in practice. Examples of this type of starter are described in "Small Engines Service Manual," 5th Ed., pages 175 and 176, published by Technical Publications, Inc., a division of Implement and Tractor, Kansas City, Mo.

Handle 51 is used to wind up and release the starter spring and can also be set in a locked position to be used as an auxiliary handle when it is desired to use both hands to support the engine.

It will be apparent to those skilled in the art that various modifications may be made in the invention without departing from the scope of the invention. Accordingly, the invention is not to be limited by details provided in describing the invention except insofar as necessitated by the appended claims.

We claim:

1. In a two stroke single cylinder internal combustion engine, a cylinder, a piston spaced from the cylinder wall, piston rings on said piston, and a piston rod which entirely performs the guiding for said piston, said cylinder having inlet and outlet ports adapted to be intermittently covered and uncovered by the piston; a crankcase and a stuffing block interposed between said piston and crankcase; said piston and stuffing block defining a compression chamber; a combustion air passage to said compression chamber through said crankcase; said stuffing block having a central bore for passage of the piston rod, said bore comprising the sole guide for said piston rod.

2. The engine of claim 1 which contains a noise suppressing element comprising a resonator and tailpipe as integral parts of said cylinder and crankcase.

3. The engine of claim 1 in which bearings for the connecting rod and crankshaft comprise prelubricated anti-friction bearings.

4. In a two stroke single cylinder internal combustion engine: a cylinder; a piston spaced from the cylinder wall; piston rings on said piston; and a piston rod which entirely performs the guiding for said piston in said cylinder, said cylinder having inlet and outlet ports adapted to be intermittently covered and uncovered by the piston; a crankcase and a stuffing block interposed between said

piston and crankcase; said piston and stuffing block defining a compression chamber; a combustion air passage to said compression chamber through said crankcase; said stuffing block having a central bore for passage of the piston rod, said bore comprising the sole guide for said piston; a housing for said cylinder, stuffing block and crankcase; said cylinder and crankcase housing incorporating an exhaust silencing resonating chamber and tailpipe; and a cover plate for said chamber and tailpipe.

5. The engine of claim 4 in which said housing incorporates a hollow handle, said handle in combination with, and by a continuous passage into, the crankcase forming an air intake muffler.

6. A portable two stroke single cylinder internal combustion engine comprising a housing; a hollow handle integral with said housing; a cylinder in said housing; a piston in said cylinder spaced from the cylinder wall; piston rings on said piston; and a piston rod which is the sole guide for said piston; said cylinder having inlet and outlet ports adapted to be intermittently covered and uncovered by the piston; a crankcase and a stuffing block interposed between said piston and crankcase; said piston and stuffing block defining a compression chamber; a combustion air passage to said compression chamber through said crankcase; said stuffing block having a central bore for passage of the piston rod; said bore comprising a sole guide for said piston rod; and an air intake muffler formed by a passage for intake air through said hollow handle and into said passage to the combustion chamber through said crankcase.

7. A portable two stroke single cylinder internal combustion engine comprising a housing; a hollow handle integral with said housing; a cylinder in said housing; a piston in said cylinder spaced from the cylinder wall; piston rings on said piston; and a piston rod which is the sole guide for said piston; said cylinder having inlet and outlet ports adapted to be intermittently covered and uncovered by the piston; a crankcase and a stuffing block interposed between said piston and crankcase; said piston and stuffing block defining a compression chamber; a combustion air passage to said compression chamber through said crankcase; said stuffing block having a central bore for passage of the piston rod, said bore comprising the sole guide for said piston rod; an exhaust muffler formed in part integrally with said cylinder and crankcase.

8. A portable two stroke single cylinder internal combustion engine comprising a housing; a hollow handle integral with said housing; a cylinder in said housing; a piston in said cylinder spaced from the cylinder wall; piston rings on said piston; and a piston rod which is the sole guide for said piston; said cylinder having inlet and outlet ports adapted to be intermittently covered and uncovered by the piston; a crankcase and a stuffing block interposed between said piston and crankcase; said piston and stuffing block defining a compression chamber; a combustion air passage to said compression chamber through said crankcase; said stuffing block having a central bore for passage of the piston rod; said bore comprising the sole guide for said piston rod; an air intake muffler formed by a passage for intake air through said hollow handle and into said passage to the combustion chamber through the crankcase; and an exhaust muffler formed in part integrally with said cylinder and crankcase.

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