United States Patent [19]

Kiekhaefer

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[54] DIE CAST V-TYPE TWO-CYCLE ENGINE

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[52] **U.S. Cl.** ..... **123/55 R,** 123/73 R, 123/73 A, 123/193 P

[51] **Int. Cl.** **F02b 25/28,** F02f 3/00

[58] **Field of Search** ..... 123/55 R, 55 VF, 55 VS, 123/55 VE, 55 V, 65 A, 65 P, 73 R, 73 A, 73 PP, 193 P

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Attorney, Agent, or Firm—Andrus, Sceales, Starke & Sawall

[57] **ABSTRACT**

A compact V-type two-cycle engine has one-half of the crankcase cast integrally with the cylinder or cylinders on one side of the V and joined with a corresponding cast unit in a parting plane bisecting the V. The cylinder heads are cast integral with the corresponding cylinders, and each pair of cylinders in the V formation has its pistons connected to the same crank pin of the crank-shaft. A liner sleeve in the crankcase cooperates with a circular disc centrally of the crank pin to separate the compression chambers for the two cylinders. The engine is disposed with the V inverted and provision is made to keep the crankcase and pistons free of any unburned fuel charge accumulation.

14 Claims, 9 Drawing Figures

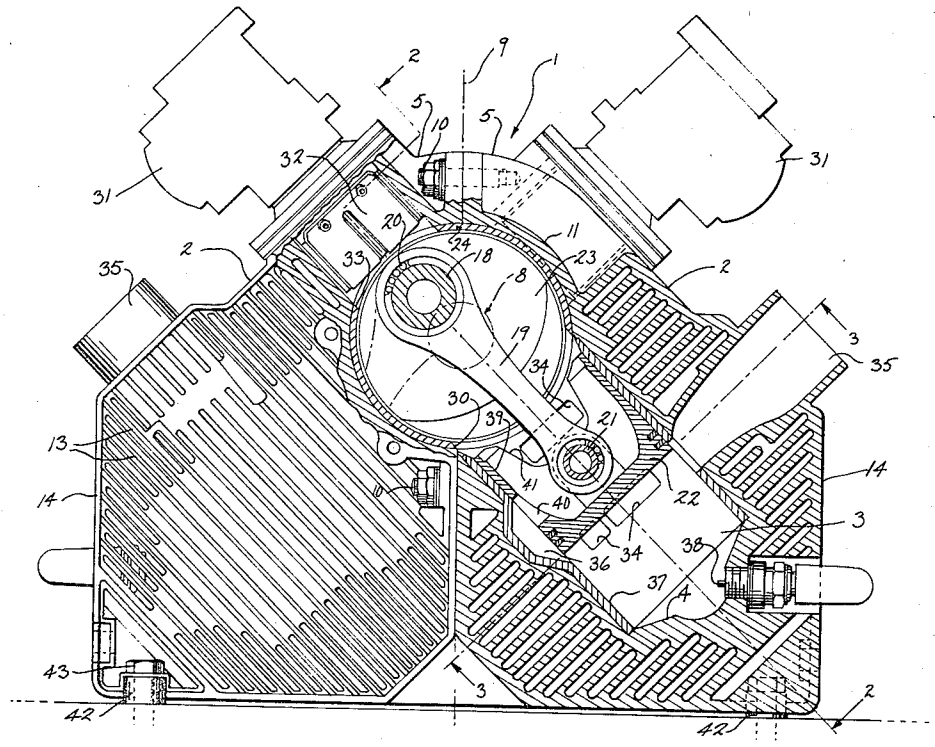


Fig. 1

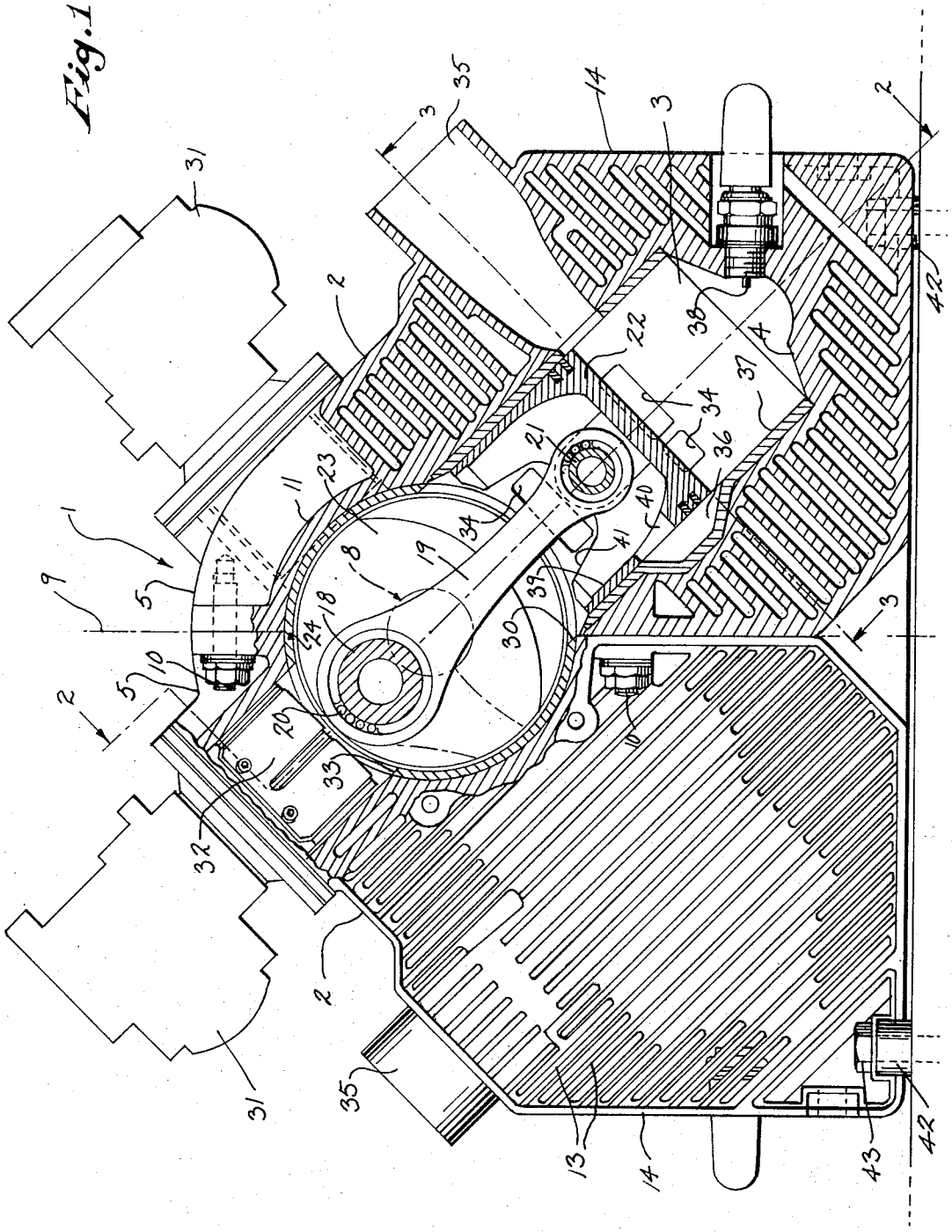

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Fig. 3

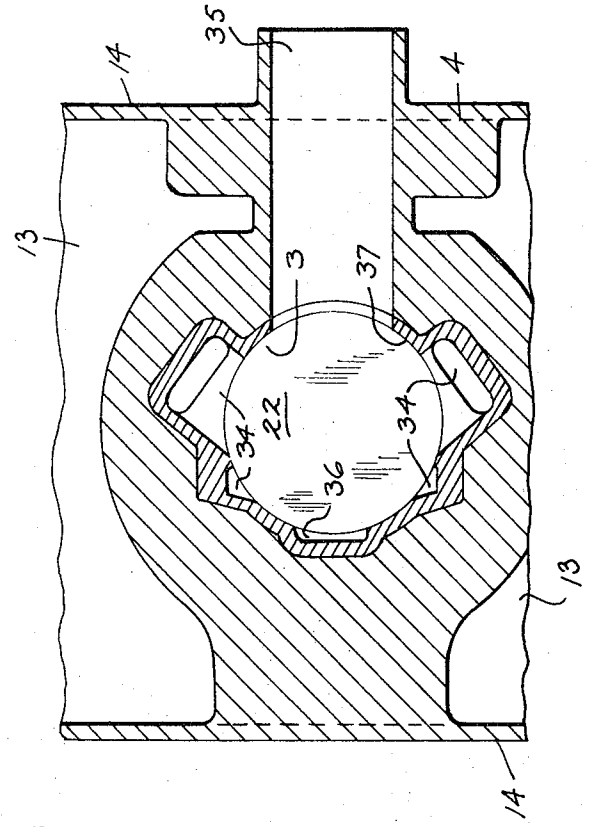
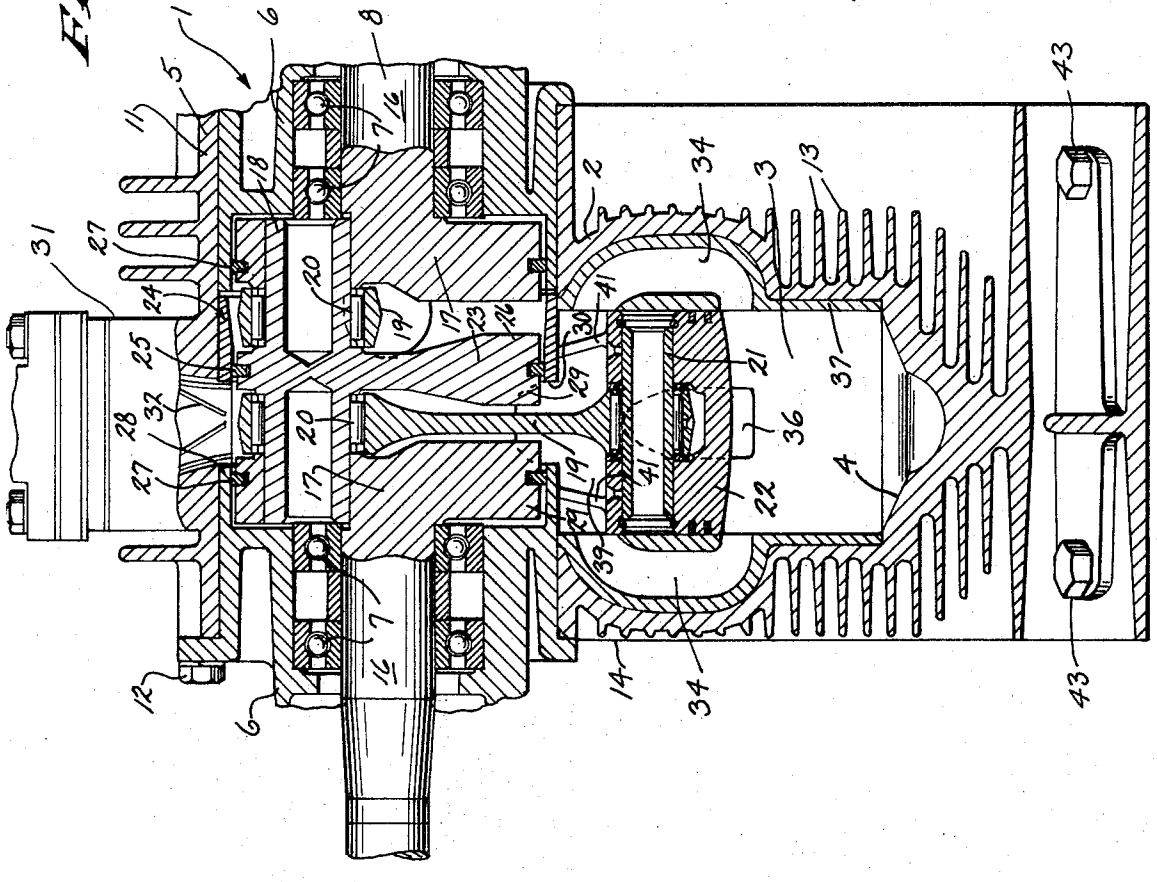

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Fig. 2


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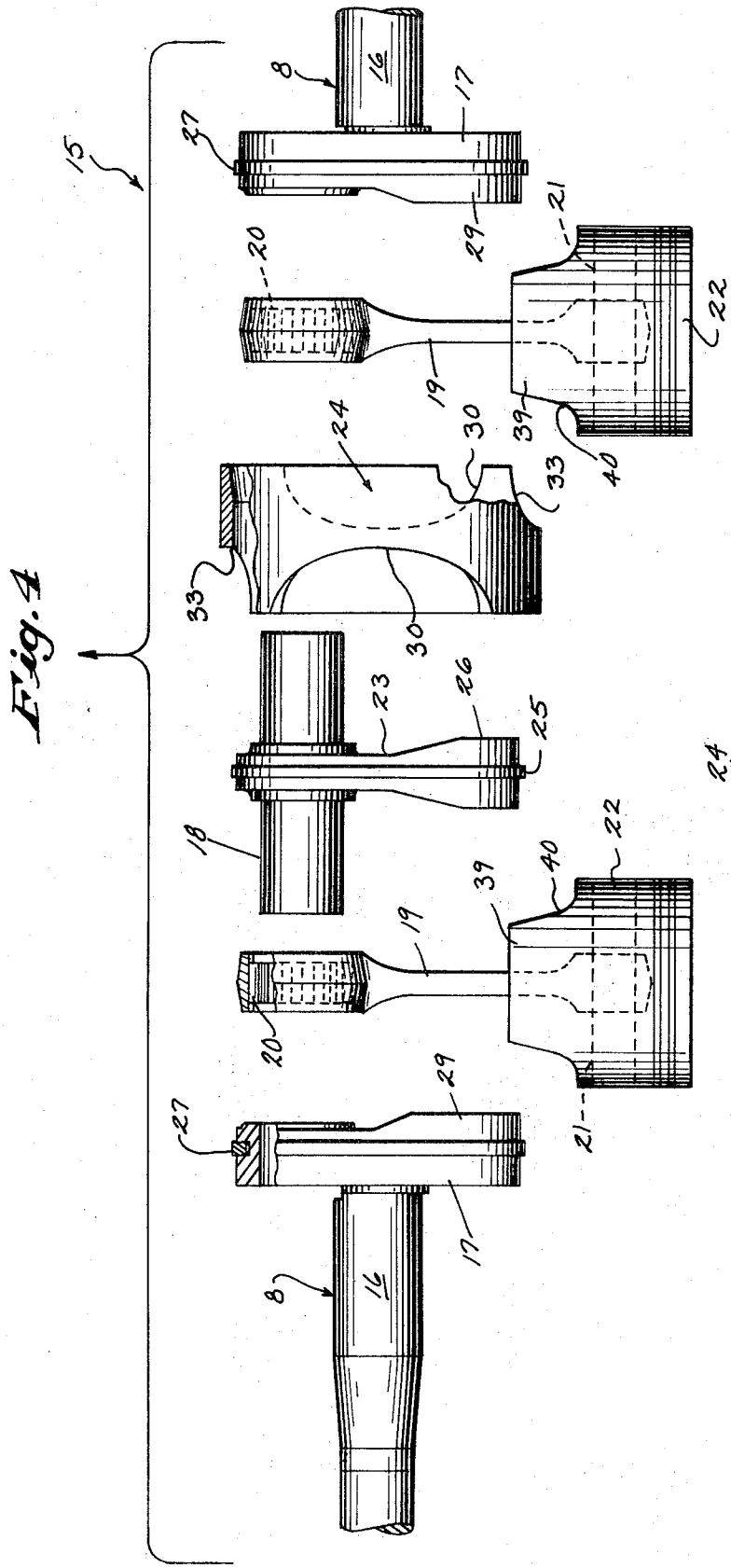


Fig. 4

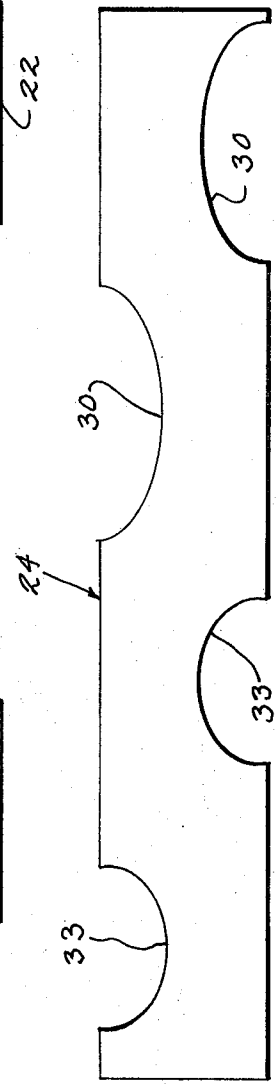


Fig. 6

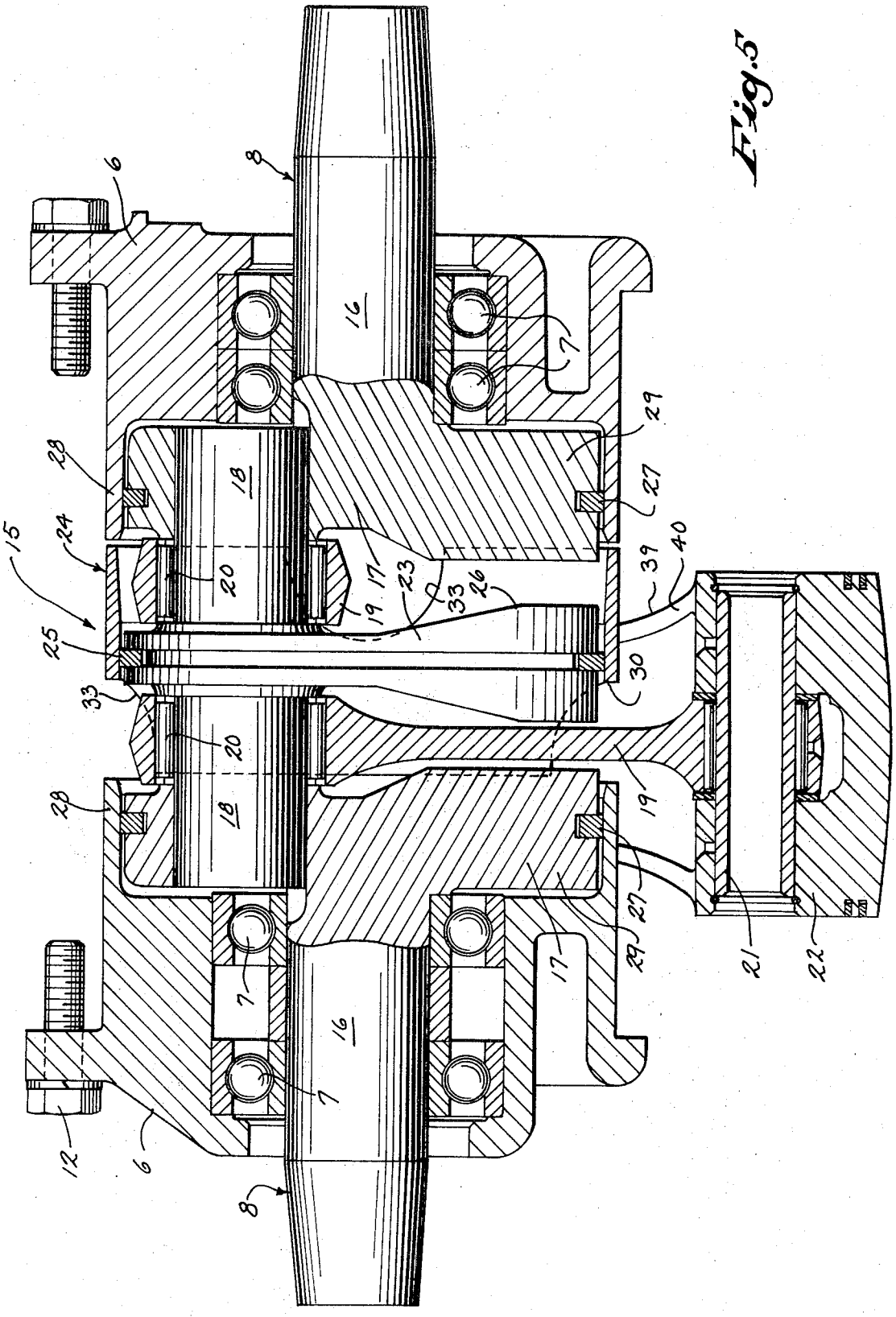

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Fig. 5

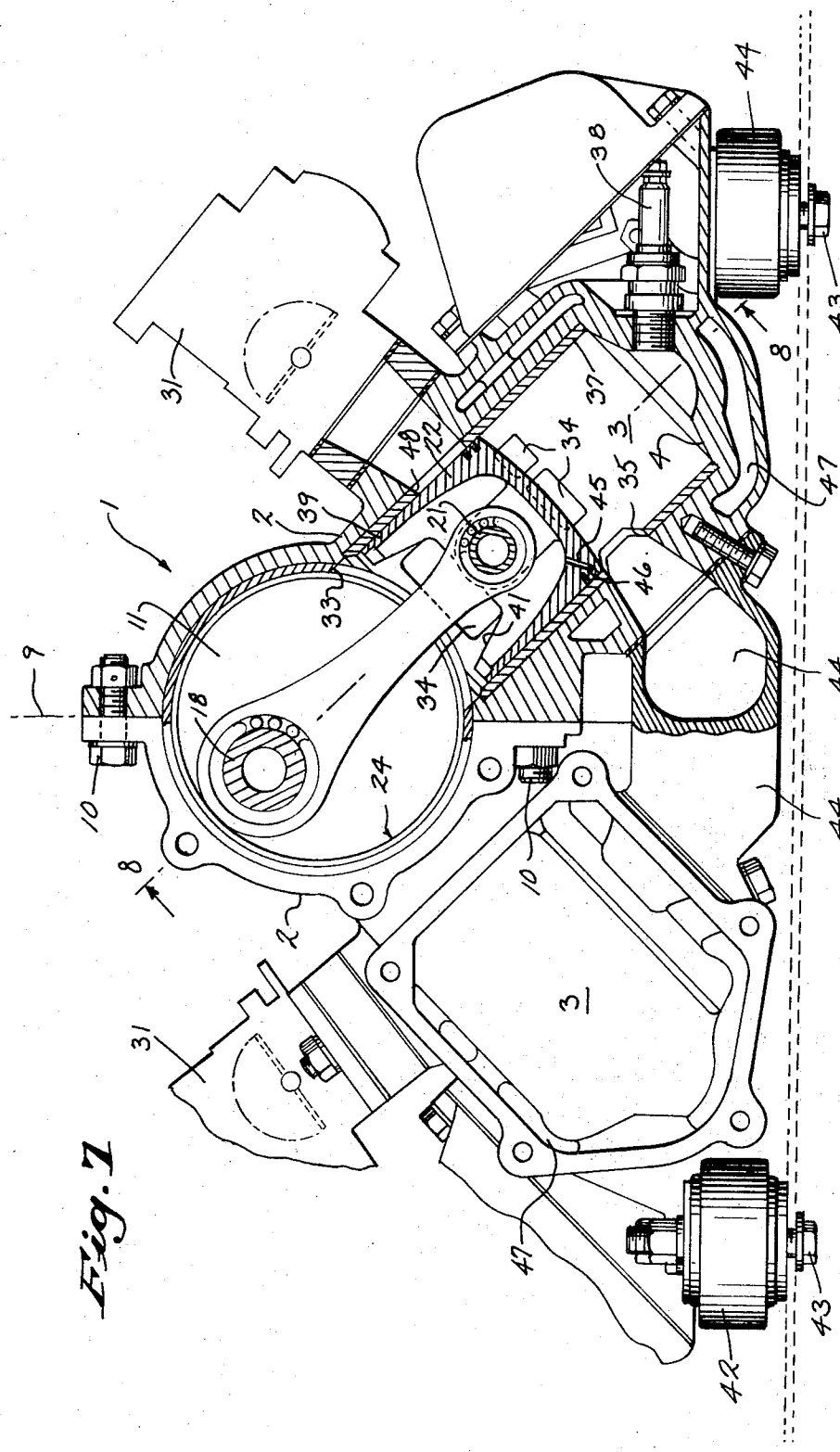
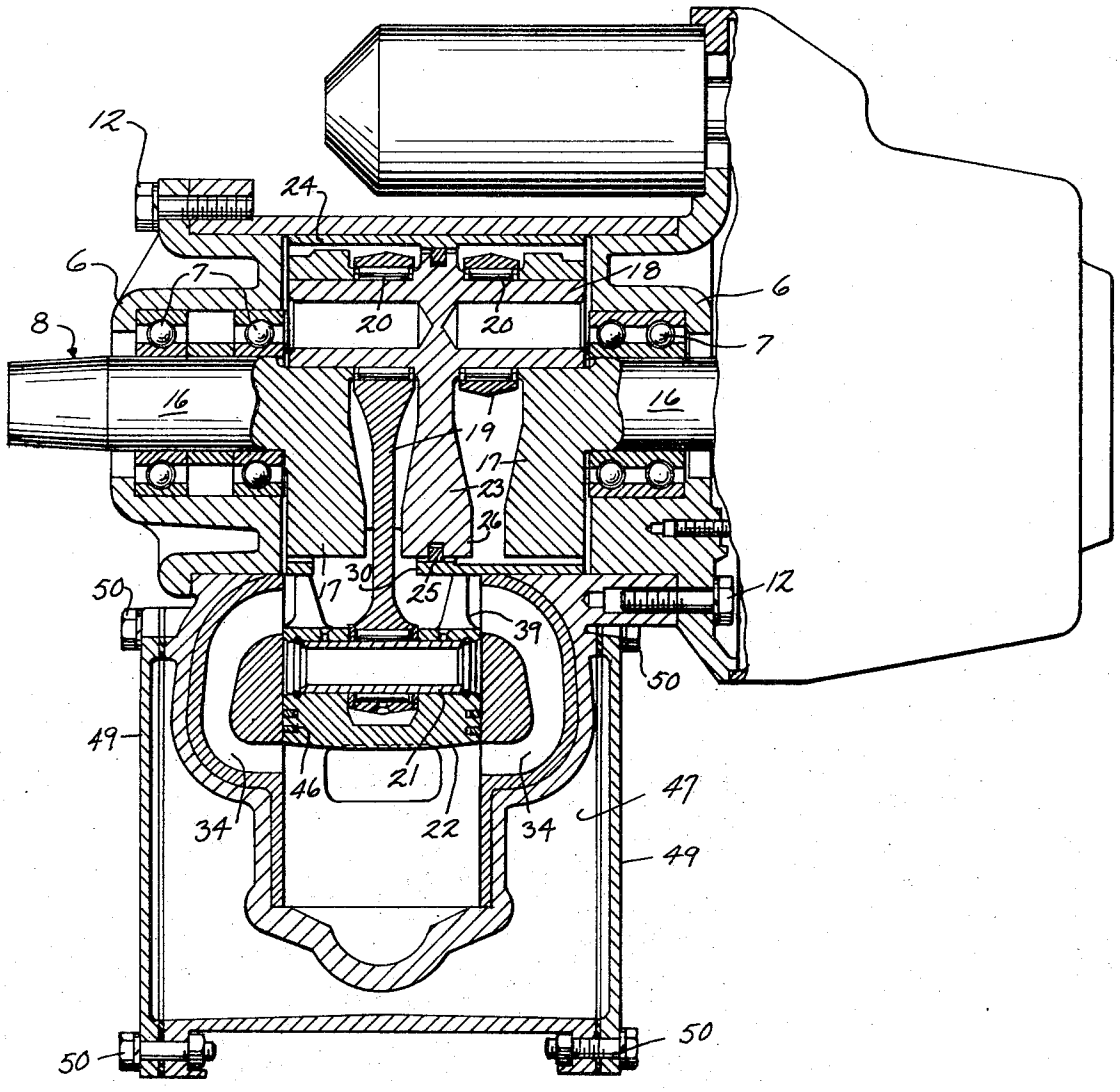

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Fig. 1

Fig. 8


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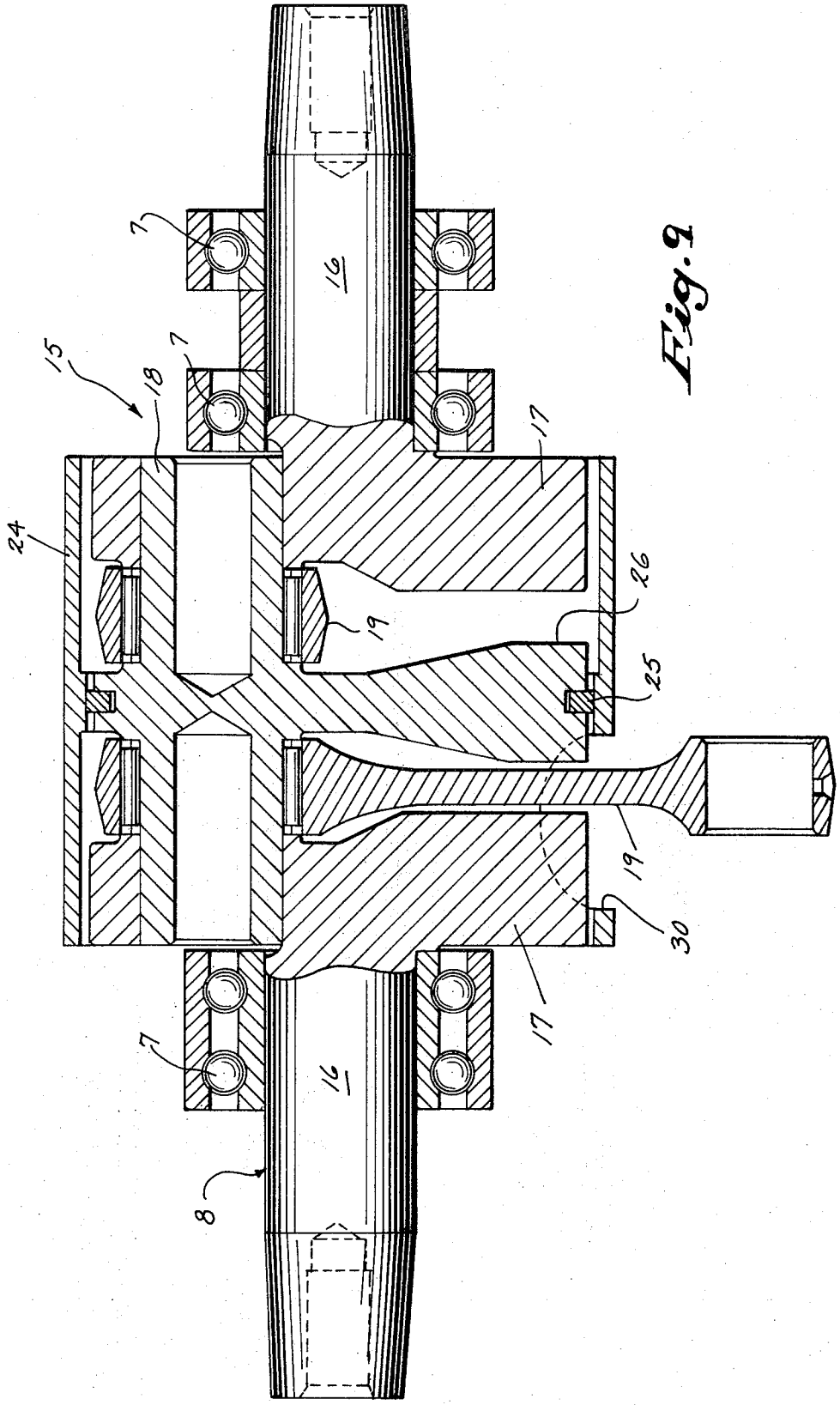


Fig. 9

DIE CAST V-TYPE TWO-CYCLE ENGINE

BACKGROUND OF THE INVENTION

This invention relates to a V-type two-cycle engine.

The problem, as in most small engine manufactures, is to provide a smaller lower cost and lighter weight engine for a given power output, and at the same time to lengthen the useful life, reduce the maintenance cost and produce less objectionable pollution of the air.

Most engine designers are happy if they can gain an increment in any one of these factors.

V-type two-cycle engines have been proposed with vertical crankshafts and utilizing a circular disc on a single crank pin sealed circumferentially with the crank case for separating the two compression chambers for fuel-air charge. Such engines have employed removable cylinder heads providing for machining of the cylinders from the outer end and have cast the two cylinders in a single block with a separate removable crank case member for access to assemble the crank shaft in situ.

Where the crank shaft was horizontal, the crank case was disposed at the base of the engine with the cylinders extending upwardly at a therefrom. angle therefrom

With both of these constructions, there has been a tendency for heavier fuel-air charge constituents to accumulate in portions of the compression chamber causing inefficiency and undesired air pollution.

SUMMARY OF THE INVENTION

According to the present invention, the V-type engine is die-cast in two like units, each containing the cylinder or cylinders and that part of the crank case disposed on one side of the axial plane that bisects the V angle between the cylinders. The cylinder heads are cast integral with the corresponding cylinders.

Because of the construction described, the angularly opposing cylinders are disposed at an angle that will provide access for machining tools to the inner end of the cylinder without interference from the crank case portion of the unit.

A liner sleeve is fitted in the crank case to cooperate with the circular disc on the crank pin in separating the two adjacent compression chambers, thereby freeing the design of the unit casting from consideration of any sealing problem.

By constructing the crank pin integral with the circular disc and of a metal alloy capable of being carburized or otherwise hardened, and constructing the crank cheeks integral with the main journals of the crank shaft and of a stronger tougher metal alloy generally not carburizable, the crank shaft is greatly improved and at the same time substantially reduced in cost over other types of crank shaft construction.

The end bearings for the crank shaft are carried by two preferably identical end closure castings for the crank case, thereby basically requiring only two sets of dies for casting the major parts of the engine, i.e., one set for casting the cylinder block units and one set for casting the end closures for the crank case.

The V-type engine is designed for mounting inverted with the crank case above the cylinders and the cylinder heads providing a broad base of support at the extremities of the V and that enables use of highly resilient mountings and increases the stability of the engine against belt or chain power take-off.

By reason of the inverted mounting of the engine all fuel-air charge readily drains by gravity into the cylinders thereby giving a more uniform charge and avoiding accumulation of unburned fuel in the crank case or other parts of the compression chambers therefor.

The fuel-air charge is thus more completely combusted at each stroke without leaving accumulations in the compression chamber or combustion chamber, thereby providing a more efficient use of fuel and a smoother smokeless starting of the engine, all of which means less exhaust pollution of the air.

Since the two pistons operate on the same crank pin, the engine has off-beat firing which produces a lower frequency intake and exhaust sound and eliminates harsher higher frequency sounds produced by conventional evenly spaced firing intervals.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings illustrate preferred embodiments constituting the best mode presently contemplated for carrying out the invention.

In the drawings:

FIG. 1 is an end elevation of an air cooled engine of one embodiment with parts broken away and sectioned generally on a transverse plane containing the centerline of the near cylinder to show details of construction;

FIG. 2 is a longitudinal section taken on line 2—2 of FIG. 1;

FIG. 3 is a detail central section of the cylinder taken on line 3—3 of FIG. 1;

FIG. 4 is an exploded view of the sub-assembly parts for the engine of FIG. 1;

FIG. 5 is an elevation of the sub-assembly of FIG. 4 prior to applying the engine block elements thereto;

FIG. 6 is a development view of the cylindrical liner sleeve employed in the sub-assembly;

FIG. 7 is an end elevation similar to FIG. 1 of a second embodiment showing a water cooled engine;

FIG. 8 is a longitudinal section taken on line 8—8 of FIG. 7; and

FIG. 9 is a sectional view of the sub-assembly for the engine of FIGS. 7 and 8.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The drawings illustrate two embodiments, i.e., FIGS. 1 to 6 illustrate an air cooled engine, and FIGS. 7 to 9 illustrate a water cooled engine.

Referring to the first embodiment, FIGS. 1–6, the engine 1 comprises four basic die-cast stationery parts, i.e., two substantially like engine block units 2 each embodying a complete cylinder 3 with integral head 4 and crank case half 5; and two identical end closure castings 6 adapted to receive ball bearings 7 for supporting the crank shaft 8.

The two engine block units 2 are joined together on the parting plane 9 which contains crank shaft axis 8 and bisects the V angle between the cylinders 3, and are secured by bolts 10.

The crank case halves 5 are complemental and together provide a crank case 11 containing the crank shaft 8 and which is closed at the ends by the end closure castings 6 secured to the units 2 by bolts 12.

The engine is air cooled and the units 2 are therefore covered with air cooling fins 13 surrounding the cylinders 3, cylinder heads 4 and portions of the crank case halves 5. An outer shroud 14 may be provided to protect the fins 13 from damage, damp their vibration and direct the air between the same for better cooling.

The internal working parts of the engine, represented in part by the crank shaft 8, constitute a sub-assembly 15, as shown in FIGS. 4 and 5.

The crank shaft 8 comprises aligned end main journals 16 operable in the ball bearings 7 in end closure 6.

Each main journal 16 has a circular cheek 17 concentric thereto on its inner end of a diameter and shape generally conforming to the inner dimensions of crank case 11 adjacent the inner face of the corresponding closures 6.

A crank pin 18 extends between and is press fit into openings in the opposite cheeks 17 with the axis of the crank pin parallel to and offset radially from the axis of journals 16.

A one piece connecting rod 19 with suitable needle bearings 20 is mounted on each end portion of the crank pin 18 and similarly upon a wrist pin 21 in a piston 22 operable in the corresponding cylinder 3.

The crank case 11 is divided into two separate compression chambers for the two cylinders 3 by a circular disc 23 which serves as a rotating partition and is integrally formed centrally of crank pin 18 and of a diameter generally similar to that of cheeks 17.

A liner sleeve 24 fits within crank case 11 between cheeks 17, and disc 23 is radially sealed against sleeve 24 by a suitable split ring 25 operative in a circumferential groove in the disc. Disc 23 incorporates a counterweight 26 opposite the pin 18.

The compression chambers thus provided in crank case 11 may be further reduced in volume by providing a split ring seal 27 disposed in a circumferential groove in each of the cheeks 17, the seals 27 bearing outwardly against the inner surface of a cylindrical lip 28 extending inwardly from the corresponding end closure 6. Cheeks 17 incorporate a counterweight 29 opposite pin 18.

The liner sleeve 24 has an opening such as notch 30 therein as shown in FIG. 6 to accomodate and provide working clearance for each corresponding connecting rod 19.

In construction of crank shaft 8, the integral circular disc 23 and crank pin 18 are of a steel capable of having the bearing surface of the crank pin carburized or otherwise hardened to better withstand the wear of the needles 20 thereon.

The integral main journals 16 and checks 17 are of a tough non-hardenable metal composition since they ride in the ball bearing inner races and are not subject to wear.

The breakage and wear problems generally encountered with conventional heat treated crank shafts are thereby greatly reduced.

The fuel-air charge is supplied to each compression chamber from a carburetor 31 through suitable reed valves 32 directly into the crank case 11 through a notch 33 in liner sleeve 24 and which is in line with the corresponding cylinder 3. The charge is transferred to the combustion chamber of the cylinder by transfer passages 34 on either side of the cylinder and which are uncovered by the piston 22 in timed relation to its reciprocation in the cylinder.

Each cylinder 3 also has an exhaust port 35 in its outer upper side and which is uncovered by the piston 22 in timed relation to its reciprocation as is well known in two cycle engine operation.

Additionally, each cylinder 3 has an auxiliary transfer passage 36 formed as a recess in the cylinder lining 37 generally opposite the exhaust port 35, on the inner lower side of the cylinder, to direct the incoming fuel-air charge toward the spark plug 38 as the piston uncovers the passage. For this purpose the skirt 39 of piston 22 has an opening 40 therethrough registering with the auxiliary transfer passage 36 and disposed as near to the head of the piston as reasonably practical.

The free end of skirt 39 is recessed at 41 to provide necessary registry with the inner end of transfer passages 34 when the piston is at the end of its power stroke.

The spark plug 38 is disposed laterally to enter combustion chamber of cylinder head 4 at one side above the lower extremity of the combustion chamber, whereby the spark plug is kept dry from liquid constituents of the fuel-air charge at all times, thus preventing fouling of the spark plug by wet fuel.

The construction described and illustrated effects an efficient transfer of all fuel and air constituents from the compression chambers to the combustion chambers with each cycle of piston reciprocation. The auxiliary transfer passage 36 avoids accumulation of heavier fuel constituents within the hollow inverted piston which would otherwise undesirably retain heavier fuel constituents and not pass them to the combustion chamber.

This provides a more uniform transfer and mixture of all of the fuel-air constituents to the combustion chamber for each firing of the cylinder.

The construction of the compression chambers and passages as described provides a direct passage of the fuel-air charge by gravity flow from the carburetor to the combustion chamber in the cylinder, thereby minimizing accumulation of fuel constituents in the system.

The cylinders 3 will be arranged generally at a V angle which permits access thereto through the crank case halves 5 for machining purposes before the engine is assembled. Generally the V angle will be at least about 90° in order that the crank case half 5 does not interfere with the machining operation.

The engine is mounted on resilient cushions 42 by bolts 43 passing downwardly through a reinforced portion of shroud 14 beneath the cylinder heads 4.

In the manufacture of the engine the crank shaft 8 with the connecting rods 19, pistons 22, liner sleeve 24, ball bearings 7 and end closure castings 6 are first assembled on the work bench as a sub-assembly as shown in FIG. 5, and thereafter the engine block units are successively applied thereto with the pistons inserted into the corresponding cylinders.

Referring to the embodiment illustrated in FIGS. 7 to 9, inclusive, the same general principles of construction and assembly apply as with the embodiment of FIGS. 1–6.

The differences lie in:

1. the elimination of the seals represented by the split rings 27 circumferential of the cheeks 17, and the lips 28;

2. shifting of the carburetors 31 from the crank case to the upper sides of the corresponding cylinders and elimination of notches 33 in sleeve 24;

3. shifting of the exhaust ports 35 from above the cylinders to beneath the cylinders where they lead to separate exhaust passages 44 for individual tuning of the exhaust from each cylinder;

4. widening of the base support for the engine by spreading resilient mounts 42 farther apart;

5. widening of sleeve 24 to substantially span the distance between end castings 6; and

6. elimination of the auxiliary transfer passage 36 and piston opening 40 and substitution of an oil drain hole 45 in the lower corner of the piston directing any fuel residue to the piston ring groove 46.

In addition, the engine of FIGS. 7–9 is a water cooled engine, eliminating fins 13 and substituting therefor the water jackets 47 cast integrally with units 2.

Having in mind the foregoing changes, the same names and numerals are applied to the several parts in the embodiment of FIGS. 7–9, where applicable, as previously herein applied to the parts in the embodiment of FIGS. 1–6.

The opening 48 through cylinder lining 37 for the fuel-air charge from carburetor 31 is located where piston 22 closes the same at all times except when the piston is near to its maximum compression of gases in the combustion chamber of the cylinder.

The water jackets 47 are constructed open on each side of the cylinders, and a closure plate 49 is applied thereto and gasketed for sealing the jacket. Bolts 50 secure plates 49 in place.

The engine of FIGS. 7–9 has the advantage of being very quiet and also very compact and light in weight for the power output.

Various modes and embodiments for carrying out the invention are contemplated within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention:

1. A V-type two-cycle engine comprising a pair of symmetrically disposed separate engine block units, each unit providing an integral cylinder, cylinder head and a crank case half; a pair of like end closure members for the crank case, each carrying a bearing for supporting a crank shaft main journal; a crank shaft having a single crank pin carrying the connecting rods for the pistons operative in said cylinders; sleeve means lining said crank case between said end closures; rotating partition means on said crank pin and radially sealed at its periphery to said sleeve means to divide said crank case into separate compression chambers for feeding fuel-air charge to said cylinders; and means joining said engine block units on a parting plane containing the axis of said crank shaft and bisecting a V angle of approximately 90° between the cylinders of said two units.

2. The engine of claim 1 in which the rotating partition means is integral with said crank pin.

3. The engine of claim 1 in which only said crank pin of said crank shaft is hardened to provide a hard wear resisting surface for the bearings of said connecting rods, and the main journals of the crank shaft are of a material specifically selected for toughness rather than hardenability.

4. The engine of claim 1 and means to mount the same inverted whereby said cylinders extend downwardly from said crank case at an angle to each other.

5. The engine of claim 4 in which said mounting means comprises resilient support means for the corresponding engine block units located substantially at the extremities of the V angle between the cylinders.

6. The engine of claim 4 and means to drain the inside of each piston of any accumulation of fuel constituents.

7. A V-type two-cycle engine as specified in claim 1 in which the engine is disposed with the V angle between the cylinders inverted, and resilient support means therefor located substantially at the extremities of the V angle between the cylinders.

8. A V-type two-cycle engine disposed with the V angle between the cylinders inverted, and means to drain the inside of each piston of any accumulation of fuel constituents.

9. The engine of claim 8 in which said drain means comprises an auxiliary fuel-air charge transfer passage on the underside of the cylinder bore with means to connect the same to the lower region inside the corresponding piston to additionally drain any accumulation of fuel constituents from inside of the piston to the combustion chamber.

10. The engine of claim 8 in which said drain means comprises a passage leading angularly downward from the lower region of the inside of each piston to a piston ring groove of the corresponding piston.

11. The engine of claim 4 wherein a spark plug for each cylinder is disposed with its spark gap region above the lowermost extremity of the combustion chamber in the cylinder.

12. The engine of claim 4 and means to supply a fuel-air charge to the compression chamber above the combustion chamber of each cylinder, whereby gravity assists in the transfer of the fuel-air charge from said means to the combustion chamber.

13. The engine of claim 12 in which said fuel-air charge supply means is disposed above the corresponding crank chambers.

14. The engine of claim 12 in which each said fuel-air charge supply means connects with the compression chamber through a piston controlled passage in the wall of the corresponding cylinder above the combustion chamber.

* * * * *