Feb. 5, 1957 A. E. BROWN 2,780,208

RECIPROCATING ENGINE

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FIG. I

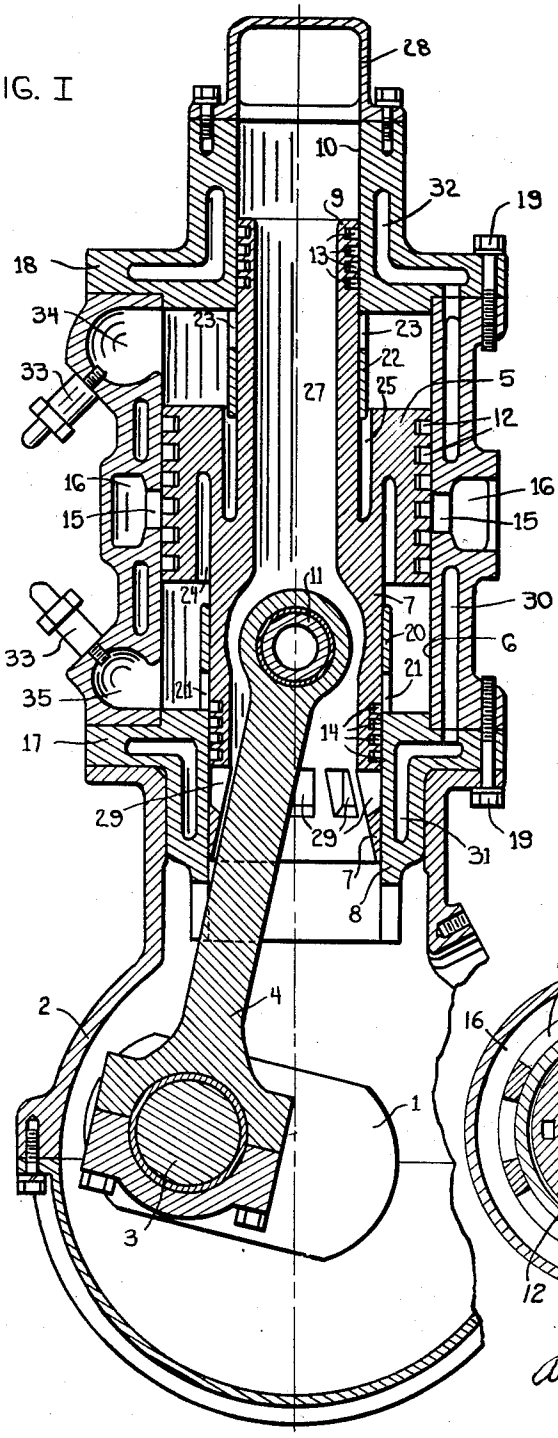
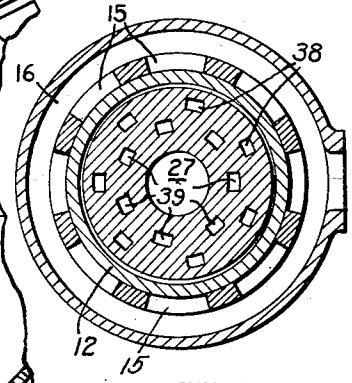


FIG. III



INVENTOR.

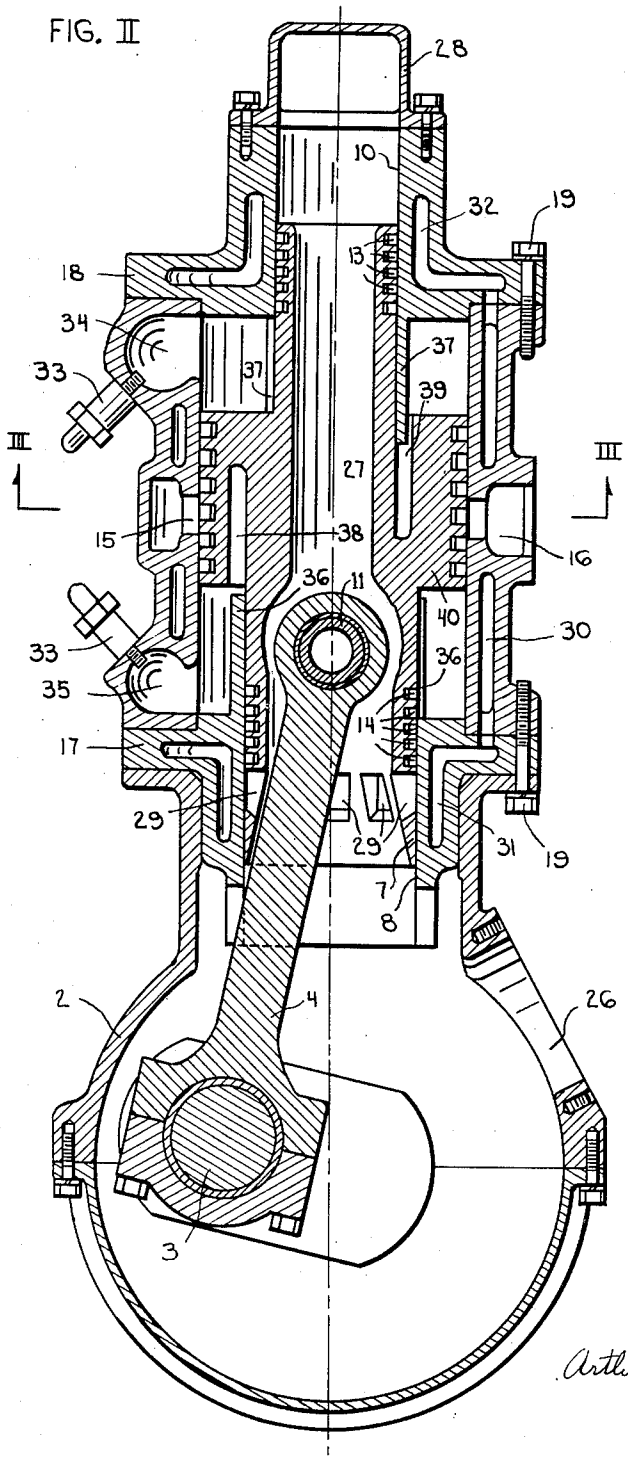
Arthur E. Brown

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RECIPROCATING ENGINE

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FIG. II



INVENTOR.
Arthur E. Brown

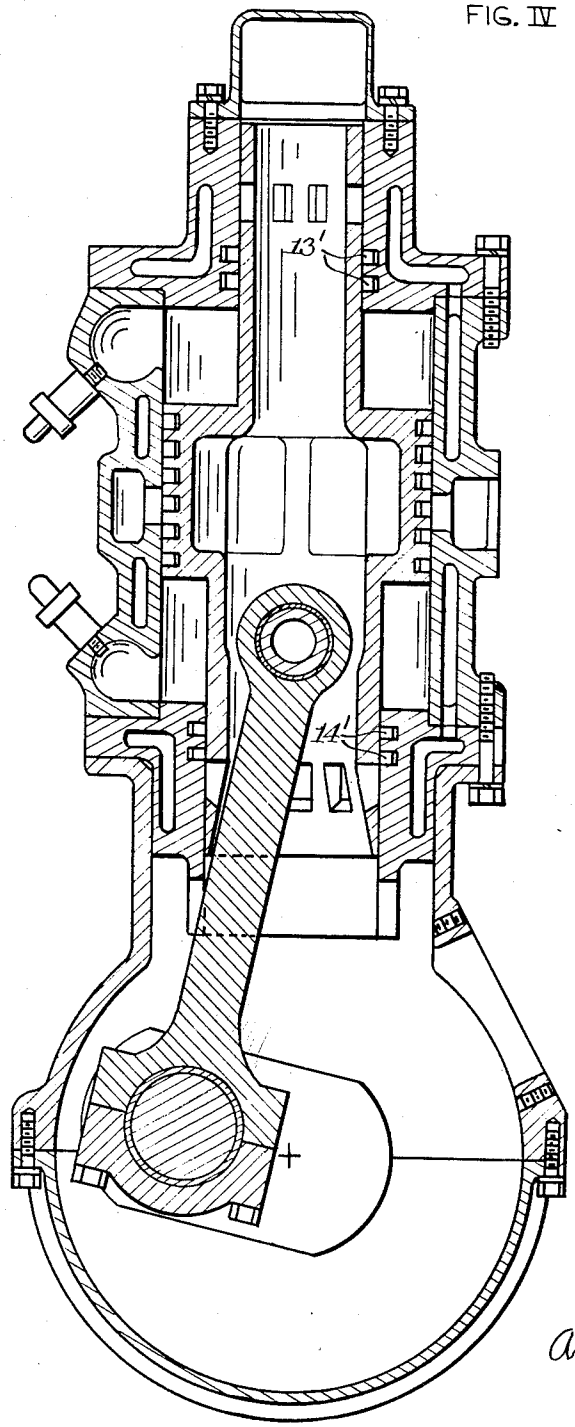
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RECIPROCATING ENGINE

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3 Sheets-Sheet 3

FIG. IV



INVENTOR.
Arthur E. Brown

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2,780,208

RECIPROCATING ENGINE

Arthur E. Brown, Scotia, N. Y.

Application June 23, 1953, Serial No. 363,495

4 Claims. (Cl. 123—61)

This invention relates to a reciprocating engine. One particular application of the invention is a two cycle double acting internal combustion engine.

Figure I is a detailed sectional view of the invention which illustrates a two cycle double acting internal combustion engine. The section is taken along the axis of the working cylinder and perpendicular to the axis of the crankshaft.

Figure II is a detailed sectional view of another form of the invention. The two cycle, double acting, internal combustion engine shown in Figure II is essentially the same as that shown in Figure I except that projecting pin members (instead of sleeves) are employed to keep the seal rings compressed on the valve pistons.

Figure III is a transverse sectional view of the engine shown in Figure II. The section is taken perpendicular to the axis of the working cylinder and along the line III—III in Figure II.

Fig. IV illustrates an engine similar to Figs. I and II except packing rings in the valve cylinders are used in place of piston rings on the valve pistons.

A general object of my invention is to provide a two cycle engine in which many of the disadvantages of the engines illustrated in Figure IV are overcome.

One object is to provide an engine which has more power output for a given overall size. This object is attained because the engine is double acting (instead of single acting) and because the design of the engine lends itself to compactness.

A second object of the invention is to provide a two cycle engine in which the flow of scavenging air through the working cylinder is substantially unidirectional so as to reduce the amount of eddy currents of exhaust gas in the cylinder during the scavenging operation.

An advantageous feature of the invention is that the flow of the scavenging air in the front end of the double acting cylinder is both concentric and substantially unidirectional. It is noted that no poppet type valves are employed in the front end of the cylinder.

A third object of the invention is to provide a double acting engine which does not require a cross head guide, a cross head, a piston rod, or a stuffing box. Since these parts are eliminated, the construction and maintenance costs of the engine are reduced.

An advantageous feature of the invention is that the reciprocating weight is less because it does not require a cross head or a piston rod.

Another object of the invention is to provide a double acting engine in which the piston is air cooled. This means that it is not necessary to provide water cooling jackets in the piston or provide a piping system for conducting cooling water to and from the piston.

An advantageous feature of my invention over a single acting engine is that the peak loads on the crankshaft and connecting rod bearings (due to inertia forces) are less because the piston bounces at each end of the stroke on the compressed air in each end of the double acting cylinder.

An advantageous feature of the invention is that there is more port area because the exhaust ports are distributed around the complete circumference of the cylinder and the intake ports are distributed around the complete circumference of the piston type valves. It is noted that this gain in port area is obtained without increasing the length of the ports in the axial direction of the cylinder as this would decrease the effective displacement volume of the engine.

An advantageous feature of the invention is that the flow of the scavenging air through the working cylinder is substantially unidirectional and no poppet valves are required yet, only one crankshaft is required. The invention is compared to the prior opposed piston engine which requires two crankshafts geared together.

Refer to Figure I. A crankshaft **1** is rotatably mounted in the crankcase **2**. The crankshaft has a crankpin **3**. A connecting rod **4** is rotatably fastened to the crankpin. A working piston **5** is reciprocable in the working cylinder **6**. A valve piston **7** is reciprocable in the valve cylinder **8**. A valve piston **9** is reciprocable in the valve cylinder **10**. The valve pistons **7** and **9** are fastened integrally to the working piston **5**, so that the three pistons are reciprocable as a unit. The connecting rod is articulatively connected to the valve piston **7** by means of the piston pin **11**. The working piston **5** is provided with piston rings **12**. The valve pistons **7** and **9** are provided with seal rings **13** and **14**. Exhaust ports **15** are located in the wall of the working cylinder. The exhaust ports are located around the complete circumference of the cylinder. The exhaust ports empty into a manifold or collector ring **16**. The front cylinder head **17** and the back cylinder head **18** are fastened to the working cylinder by means of the bolts **19**. A thin sleeve **20** is integrally mounted on the front cylinder head **17**. The valve piston **7** is reciprocable in the sleeve **20**. Intake ports **21** are provided in the sleeve. Another thin sleeve **22** is similarly mounted on the back cylinder head **18**. Intake ports **23** are provided in the sleeve **22**. Circular clearance grooves **24** and **25** are provided in the working piston. When the working piston **5** is at the top dead center position, the sleeve **22** enters the groove **25** and when the working piston is at the bottom dead center position, the sleeve **20** enters the groove **24**.

Scavenging air is supplied from a separate air pump or blower (not shown) to the crankcase through the port **26**. A portion of the scavenging air then passes through the air passage **27** in the working piston so as to supply scavenging air to the intake ports **23**. In a multicylinder engine, a manifold **28** may be connected to the top of each valve cylinder **10**. One plan is to supply the scavenging air to the manifold **28**. A third plan is to supply scavenging air directly to both the manifold **28** and the port **26**.

The valve piston **7** is adapted to control the flow of scavenging air through the intake ports **21**. Radial ports **29** pass through the shell of the valve piston **7**. When the working piston **5** is at the top dead center position, the ports **29** register with the intake ports **21** and the scavenging air then passes through the ports **29** and **21** into the working cylinder **6**. Also, when the working piston **5** is at the top, dead center position, the exhaust ports **15** are uncovered by the working piston. The exhaust gas is then forced out of the working cylinder through the exhaust ports by the incoming scavenging air.

When the working piston **5** is at the bottom dead center position, the valve piston **9** uncovers the intake ports **23** and the scavenging air then passes through the intake ports **23** into the working cylinder **6**. Also when the working piston **5** is at the bottom dead center position, the exhaust ports **15** are uncovered by the working piston. The exhaust gas is then forced out of the working cylinder

through the exhaust ports by the incoming scavenging air.

It is noted that the purpose of the sleeves **20** and **22** is to keep the seal rings **13** and **14** compressed in their respective ring grooves. Without the sleeves, the seal rings would spring outwardly when they enter the working cylinders and then they would catch on the edge of the valve cylinders on the return stroke.

An alternate method of keeping the seal rings compressed on the valve pistons is to use projecting pins instead of sleeves. This method is illustrated in Figures II and III.

A third method of keeping the seal rings compressed on the valve pistons is to depend on the valve piston member itself to keep the seal rings compressed. This may be done by providing the seal rings with ridges which bear against overhanging lips on the edge of the ring grooves. In this manner the seal rings are allowed to spring radially enough to accomplish their sealing function, yet are prevented from springing outwardly so far that they catch on the edge of the valve cylinder.

A feature of the invention is that an air passage **27** extends through the working piston **5**. Flow of air through this passage serves to cool the piston.

Water jackets **30**, **31**, and **32** are provided in the cylinder and in the front and back cylinder heads for the purpose of cooling.

The design shown in Figure I operates on a Diesel cycle. Fuel injection nozzles **33** are adapted to spray fuel into the combustion chambers **34** and **35**. The fuel injection pumps for supplying fuel to the nozzles are not shown.

Refer to Figures II and III which illustrate another form of the invention. The design shown in Figures II and III is the same as that shown in Figure I except that projecting pins instead of thin sleeves are employed to keep the seal rings **13** and **14** compressed. In the design shown, seven projecting pins **36** are integrally fastened to the front cylinder head **17** and seven pins **37** are integrally fastened to the back cylinder head **18**. Matching holes **38** and **39** are located in the working piston **40**. An advantage of the design shown in Figures II and III over the design shown in Figure I is that the working piston is stronger structurally. This is because the working piston **40** has staggered sets of holes **38** and **39** but it does not have deep circular clearance grooves such as those shown in Figure I.

In the engine designs shown in Figures I, II, and III, a piston type valve is used at both the front end and the back end of the double acting working cylinder. An alternate plan would be to employ a piston type valve at only the front end of the working cylinder.

In the engine designs shown in Figs. I, II, and III, seal rings are mounted on the valve pistons in order to obtain an effective seal. An alternate method of sealing the valve pistons is to use packing rings **13'** and **14'** mounted in the valve cylinders such as is shown in Fig. IV.

Although certain specific forms of the invention have been illustrated and described, it will be apparent that numerous modifications might be made without departing from the scope of the invention. For instance, a motion converting mechanism other than a crank-connecting rod mechanism may be employed with the piston and cylinder combination shown. It is therefore my intention that such scope be limited only by the terms of the appended claims.

I claim:

1. The combination in a double acting two stroke cycle internal combustion engine of a crankcase; a crankshaft rotatably mounted in said crankcase; a working cylinder fastened to said crankcase; a double acting working piston reciprocable in said working cylinder; a front valve cylinder and a back valve cylinder fastened to the front and back ends respecively of said working cylinder; a front valve piston and a back valve piston reciprocable in their respective valve cylinders; said three pistons being fastened together so as to form a reciprocating piston assembly; a connecting rod connecting said piston assembly to said crankshaft; an exhaust port located in the wall of said working cylinder; said exhaust port being controlled by said working piston; a ring shaped front working chamber and a ring shaped back working chamber inside said working cylinder; each valve piston being adapted to control the admission of air to its respective working chamber; each working chamber having a uniflow scavenging operation exhausting through said exhaust port; and said working piston, said front valve piston, and said back valve piston being formed with a through passage commuting with the interior of said crankcase.

2. The combination of a working cylinder, a working piston reciprocable in said working cylinder, a valve cylinder fastened to said working cylinder, a valve piston reciprocable in said valve cylinder, said valve piston being fastened to said working piston so as to reciprocate with the working piston, said valve piston being smaller in diameter than said working piston, a plurality of projecting pins fastened to said valve cylinder, said pins being located about the periphery of said valve piston and projecting inside said working cylinder, said working piston having a plurality of clearance holes for said pins, seal rings mounted on said valve piston, and said pins being adapted to retain said seal rings.

3. The combination in a double acting two stroke cycle internal combustion engine of a crankcase, a crankshaft rotatably mounted in said crankcase, a working cylinder fastened to said crankcase, a double acting working piston reciprocable in said working cylinder, a front valve cylinder fastened to the front end of said working cylinder, a front valve piston reciprocable in said front valve cylinder, said pistons being fastened together so as to form a reciprocating piston assembly, an exhaust port located in the wall of the working cylinder, said exhaust port being controlled by said working piston, said engine having a back working chamber and a ring shaped front working chamber, said front working chamber having a uniflow scavenging operation exhausting through said exhaust port, means for scavenging said back working chamber, said front valve piston having an edge which controls the flow of air into the front working chamber, said edge being in open communication with said crankcase, a piston pin located in said piston assembly, a connecting rod directly connecting said crankshaft and said piston pin, and said piston pin being located between said edge and the back end of said working piston.

4. The combination recited in claim 3 wherein pins are fastened to said valve cylinder, holes are in said working piston, said holes being for clearance of said pins, a seal ring is mounted on said valve piston, and said pins being adapted to retain said seal ring.

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