United States Patent [19]

James

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[54] **OPPOSED PISTON POWER UNIT**

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[52] **U.S. Cl.** .... **123/18 R**
[51] **Int. Cl.**[2] **F02B 53/00;** F02B 55/00
[58] **Field of Search** .... 123/18 R, 18 A

[56] **References Cited**

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3,338,137	8/1967	James	128/18 R
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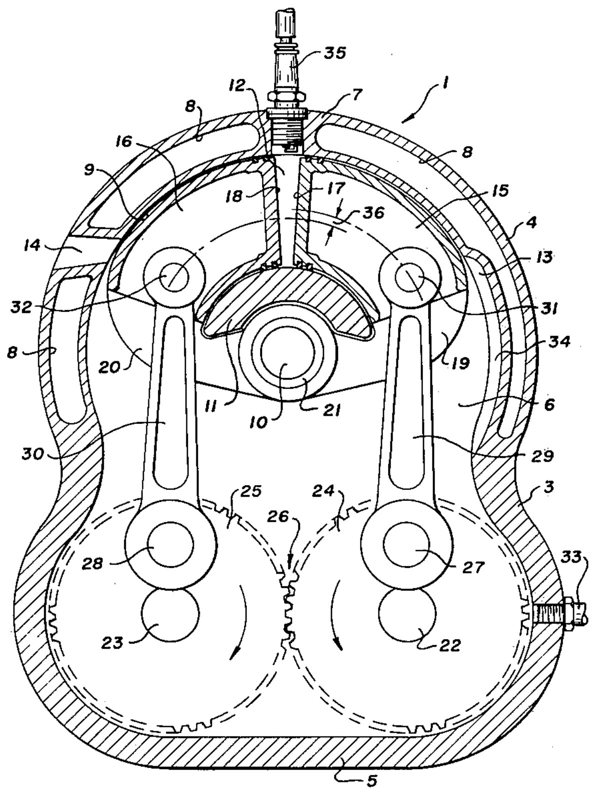
[57] **ABSTRACT**

A piston power unit primarily for use as an internal combustion engine and having a single cylinder curved about a center, intake and exhaust ports at opposite ends of the cylinder, a pair of opposed pistons movable in the cylinder towards and away from each other in compression and power strokes, said pistons covering these ports during most of their strokes and successively opening the ports as the pistons approach the ends of their respective power strokes, a pair of crank shafts including intermeshing gears, and a pair of connecting rods connecting the crankshafts to the pistons. The pistons are oscillated so that one opens the exhaust port a little before the other piston opens the intake port, and the pistons close the two ports at substantially the same time. This can be accomplished by locating the journal of the connecting rod of one piston closer to the centre of arc of the cylinder than that of the other piston, or by making the throw of one crankshaft greater than that of the other crankshaft, or by advancing the throw of one crankshaft ahead of the throw of the other crankshaft.

9 Claims, 3 Drawing Figures



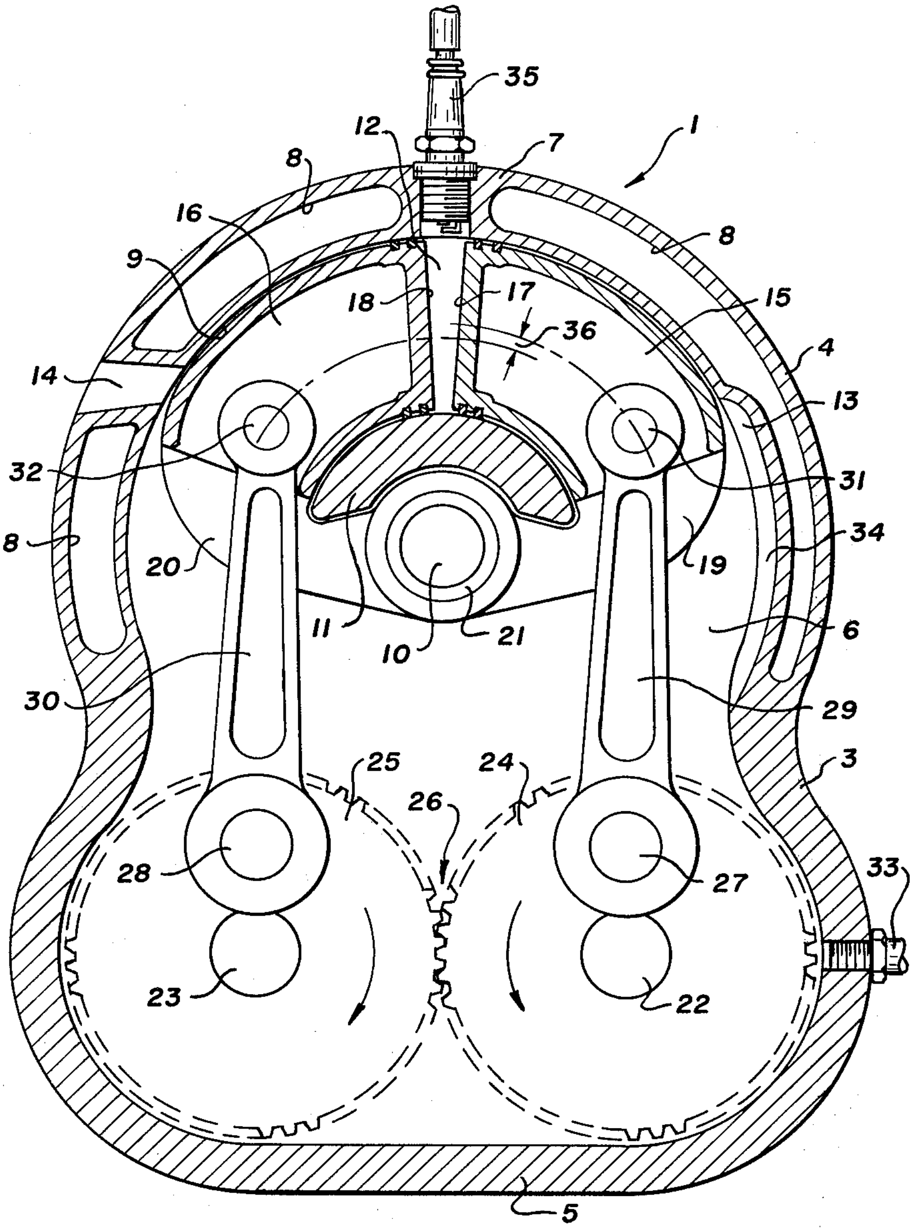

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Fig. 1.

Fig. 2.

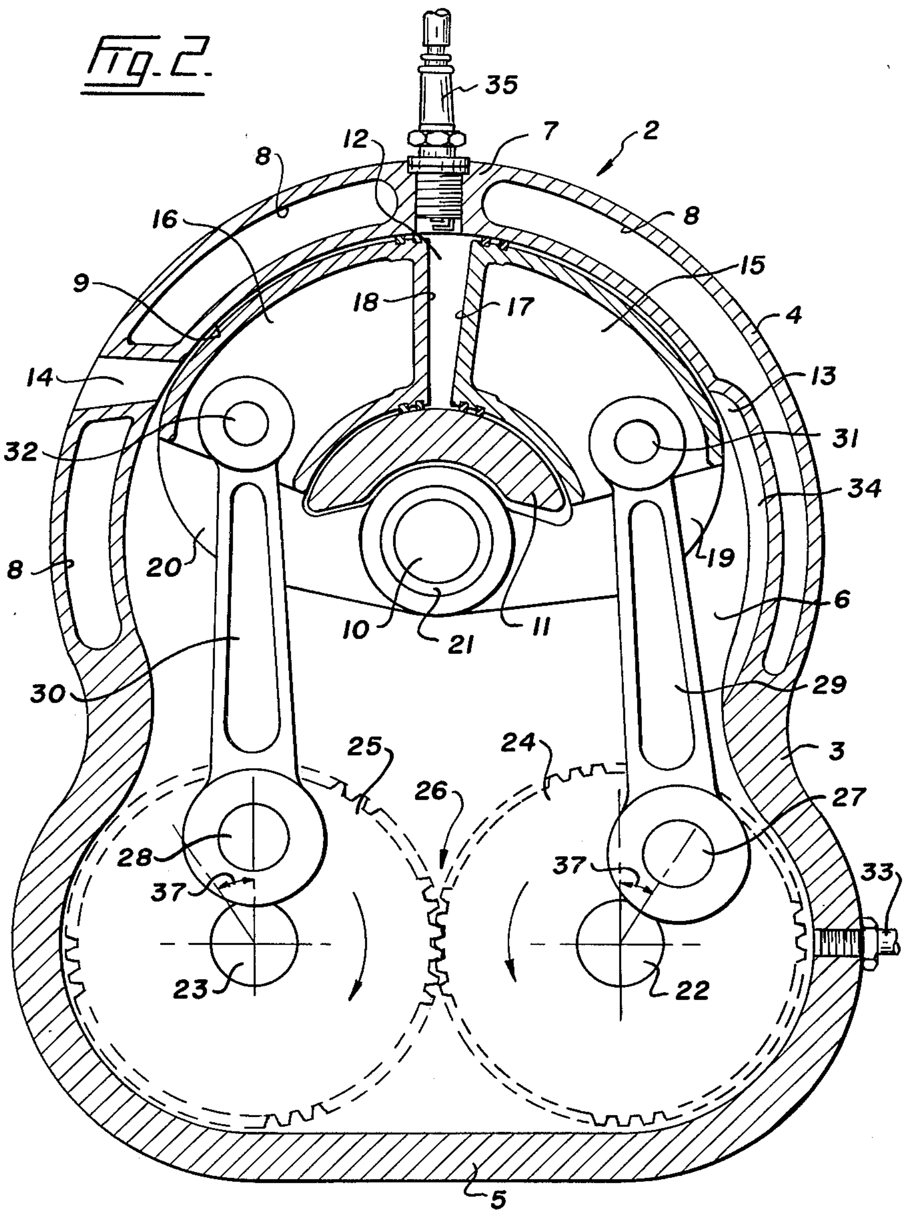
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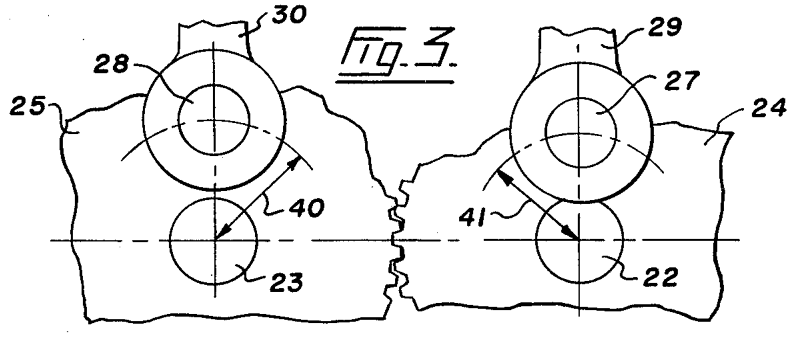
Fig. 3.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OPPOSED PISTON POWER UNIT

The invention relates to opposed piston power units and in particular to a modification in the piston power unit of U.S. Pat. No. 3,338,137.

The piston power unit disclosed in the above numbered patent has a single cylinder curved about a centre and having inlet and exhaust ports at opposite ends, and in which a pair of opposed pistons are movable. The pistons are connected through connecting rods to two different cranks of a single crankshaft, said cranks being phased so as to cause the exhaust port to be uncovered in advance of the inlet port and for both ports to be covered substantially simultaneously. This arrangement allows for a blowdown period before the intake port is opened, and the closing of the ports at substantially the same time reduces or eliminates the loss of new charge fuel from the intake port through the exhaust port. An engine which displays these characteristics is said to have assymetrical port timing.

However, the use of a double throw single crankshaft although satisfactory in operation, leads to expensive complications in construction of the engine. Due to the inevitable offset of the connecting rods axially of the crankshaft, the pistons must have complementary offset portions and journals. This leads in turn to a necessity for complex machining both of the pistons and of the cylinder. In addition, it is difficult to seal the pressure in the cylinder, and the offset disturbs the scavenging air flow, thereby creating a turbulence which causes some of the new charge to mix with the exhaust gases. This prevents complete scavenging of the gases, leaving a contaminated charge in the cylinder.

It is among the objects of the present invention to provide a simplified form of opposed piston power unit of the same general type as disclosed in the above numbered United States patent but eliminating the stated problems and which still achieves assymetrical port timing with the desirable characteristics associated therewith. Another advantage of the present power unit is reduced vibration.

The invention therefore provides a piston power unit comprising a cylinder curved longitudinally about a center and formed with exhaust and intake ports respectively adjacent its first and second ends thereof, first and second opposed pistons slidably fitting in said cylinder for movement towards and away from each other in compression and power strokes respectively, and so as to uncover said exhaust and intake ports respectively during their power strokes, each piston having a head at one end facing the opposed piston and journal means at the other end for journalling the end of a connecting rod, means connected to the other end of each piston constraining said piston to move about said centre when the pistons oscillate in the cylinder, first and second crankshafts for the first and second pistons and each having a crank, means operatively interconnecting said crankshafts for rotation at the same speed and in phase, and first and second connecting rods each journalled at one end to the crank of the respective crankshaft and at the other end to the journal means of the respecitve piston, said piston journal means and said cranks being arranged so that the first piston uncovers the exhaust port before the second piston uncovers the intake port.

In a preferred form of the invention, the axis of the journal means for the first piston is closer to said center of the cylinder than the axis of the journal means for the second piston. Alternatively, the throw of the crank of the first piston can be greater than the throw of the crank of the second piston.

Two embodiments of the invention will now be described with reference to the accompanying drawings in which,

FIG. **1** is a sectional elevation of the preferred embodiment of the invention,

FIG. **2** is a sectional elevation of an alternative embodiment of the invention, and

FIG. **3** is a fragmentary sectional elevation illustrating another alternative embodiment of the invention.

Since the embodiments of FIGS. **1** and **2** are closely related structurally, the initial part of the following description relates to both Figures, the features which differ being subsequently described.

Referring to the drawings, FIGS. **1** and **2** show piston power units **1** and **2** respectively each in the form of an internal combustion engine. Each unit is generally circular in form and has a casing **3** including a generally circular upper lobe **4** and an elongated lower lobe **5.** The ends of the casing are closed by opposed side walls **6,** only one of which is shown in the drawings.

The upper lobe **4** of the casing is formed by a wall **7** in which cavities **8** are formed for the passage of a coolant such as water. The inner wall of the wall **7** is formed with a circular inner surface **9** which curves around a fulcrum shaft **10** located centrally and extending transversely of the casing **3.** The ends of the shaft are rotatably supported by the walls **6** in a conventional manner (not shown).

A curved inner wall **11** is spaced inwardly from the inner surface **9** of the wall **7** and is concentric therewith and with the shaft **10.** Inner wall **11,** the wall surface **9** and the end walls **6** form a cylinder **12** which is curved longitudinally about the center or longitudinal axis of shaft **10.** In this example, the cylinder **12** is rectangular in cross-section, but it is to be understood that it may have any desired cross-sectional shape, for example it may be circular or elliptical. At one end of the cylinder **12,** an intake port **13** is formed in the wall **7,** whilst at the other end, an exhaust port **14** extends through the wall **7.**

Opposed longitudinally curved pistons **15** and **16** of the same cross-sectional shape as the cylinder **12** are slidably mounted in the cylinder for movement towards and away from each other in compression and power strokes, respectively. The pistons **15** and **16** have heads **17** and **18** at adjacent ends thereof and facing each other. At the ends of the pistons remote from the heads **17** and **18,** arms **19** and **20** are fixedly secured thereto. The arms **19** and **20** project inwardly and are journalled on shaft **10,** a suitable low friction bearing **21** being provided for each arm.

Pistons **15** and **16** are adapted to oscillate in the cylinder **12,** and as the cylinder is concentric with the shaft **10,** the pistons oscillate around the longitudinal centre or axis of the shaft. As the arms **19** and **20** are fixedly secured to pistons **15** and **16** and are rotatably connected to the shaft **10,** the arms constrain the pistons to move along circular paths about the centre of the shaft **10** so that there is no side thrust against the walls of the cylinder. The pistons **15** and **16** are provided with one or more piston rings adjacent their respective heads in a conventional manner. The lower lobe of the casing **3** constitutes a crank case having a pair of crankshafts **22** and **23** therein, the crankshafts being journalled in journals (not shown) in the end walls **6.** One of the crankshafts extends through an end wall to provide a drive. Within the crank case, the crankshafts **22** and **23** carry gears **24** and **25** of the same size which mesh at **26.** The gears and crankshafts are thus constrained to rotate at the same speed in opposite directions. Cranks **27** and **28** of the crankshafts **22** and **23** are connected respectively to the pistons **15** and **16** by connecting rods **29** and **30.** The upper ends of the connecting rods **29** and **30** are journalled or wrist pins **31** and **32** of pistons **15** and **16**, respectively.

The crank case has an inlet connection **33** for a combustion mixture. The mixture within the crank case is transferred to the cylinder **12** during each down-stroke of the pistons through a transfer passage **34** in wall **7** which extends from the crank case to intake port **13.** However, it will be appreciated that if fuel injection techniques are used, air alone will be introduced through the intake **33.** Alternatively, the intake port **13** may extend directly through the wall **7** from a carburetor and supercharger combination. Such alternatives are well known in the art and will not be described further. For a gasoline engine, a spark plug **35** will be provided in wall **7** substantially midway between the ends of cylinder **12**, as shown, but it will be evident that in case of a compression ignition engine the plug will be omitted.

Referring now specifically to the embodiment of FIG. **1**, the axis of the wrist pin **32** is set closer to the axis of the shaft **10** than the axis of the wrist pin **31**, the spacing between axes of movement of the wrist pins being indicated at **36.** At the same time, the cranks **27** and **28** are set in phase in their opposed directions of rotation.

With the arrangements shown in FIG. **1**, the piston **16** will move downwardly during the power stroke at a greater rate than the piston **15**, thus uncovering the exhaust port **14** before piston **15** uncovers intake port **13.** A blowdown period will thus be provided for the scavenging of the cylinder before the intake port opens. At the same time, due to the fact that the two halves of the engine, each comprised by a piston, connecting rod and crankshaft, are in dynamic balance, vibration in the engine will be reduced to a minimum. Furthermore, pistons **15** and **16** close the intake and exhaust ports at substantially the same time.

Turning now the embodiment of FIG. **2**, it will be seen that crank **28** of the crankshaft **23** is advanced in phase by an angle **37** relative to crank **27** of crankshaft **23.** In this case however the axes of the wrist pins **31** and **32** are equally spaced from the axis of the shaft **10.** The phasing of the crankshafts in this case achieves the earlier opening of the exhaust port **14.** It will be appreciated that the angle **37** has been exaggerated in FIG. **2** in order to illustrate the principle involved. In practice, the angle **37** is in the region of 3°.

In the embodiment of FIG. **3**, the desired movement of piston **16** is attained by making the throw of crank **28** greater than the throw of crank **27.** This difference is indicated in exaggerated form by lines **40** and **41**, line **40** being longer than line **41.** This arrangement causes piston **16** to travel further than piston **15** during each stroke so that piston **16** covers and uncovers exhaust port **14** before piston **15** respectively covers and uncovers intake port **13.** The axes of wrist pins **31** and **32** are equally spaced from the axis of shaft **10**, as in FIG. **2.**

As there are two crankshafts rotating in opposite directions, there is less vibration created than there would be in a single crankshaft engine of this type. As each connecting rod is substantially moving up and down, there is comparatively little bending movement where each piston is attached to its connecting arm. In addition, it is comparatively easy to balance this engine, since each crankshaft balances only the piston to which it is connected.

I claim:

1. A piston power unit, comprising
a cylinder curved longitudinally about a centre and formed with exhaust and intake ports respectively adjacent first and second ends thereof,
first and second opposed pistons slidably fitting in said cylinder for movement towards and away from each other in compression and power strokes respectively, and so as to uncover said exhaust and intake ports respectively during their power strokes, each piston having a head at one end facing the opposed piston and journal means at the other end for journalling the end of a connecting rod,
means connected to the other end of each piston constraining said piston to move about said centre when the pistons reciprocate in the cylinder,
first and second crankshafts for the first and second pistons and each having a crank,
means operatively interconnecting said crank-shafts for rotation at the same speed and in phase, and
first and second connecting rods each journalled at one end to the crank of the respective crankshaft and at the other end to the journal means of the respective piston,
said piston journal means and said cranks being arranged so that the first piston uncovers the exhaust port before the second piston uncovers the intake port.

2. A piston power unit as claimed in claim **1**, wherein said piston journal means and said cranks are arranged so that the first piston starts to uncover the exhaust port before the second piston starts to uncover the intake port during the power strokes of the pistons, the pistons covering said ports at substantially the same time during the compression strokes of the pistons.

3. A piston power unit as claimed in claim **1**, wherein the means operatively interconnecting said first and second crankshafts comprises intermeshing gears.

4. A piston unit as claimed in claim **1**, wherein said means operatively interconnecting said first and second crankshafts constrain said crankshafts to rotate in opposite directions.

5. A piston power unit as claimed in claim **1**, wherein the journal means of the first piston is closer to said center than the journal means of the second piston.

6. A piston power unit as claimed in claim **1**, wherein the throw of the crank of the first piston is greater than the throw of the crank of the second piston.

7. A piston power unit, comprising
a cylinder curved longitudinally about a centre and formed with exhaust and intake ports respectively adjacent first and second ends thereof,
first and second opposed piston slidably fitting in said cylinder for movement towards and away from each other in compression and power strokes respectively, and so as to uncover said exhaust and intake ports respectively during their power

strokes, each piston having a head at one end facing the opposed piston and journal means at the other end for journalling the end of a connecting rod with the axes of the journal means for said pistons being equally spaced from said centre,

means connected to the other end of each piston constraining said piston to move about said centre when the pistons reciprocate in the cylinder,

first and second crankshafts for the first and second pistons and each having a crank,

means operatively interconnecting said crankshafts for rotation at the same speed, with the throw of the crank of the first crankshaft being phased in advance of the crank of the second crankshaft, and

first and second connecting rods each journalled at one end to the crank of the respective crankshaft and at the other end to the journal means of the respective piston.

8. A piston power unit as claimed in claim **7,** wherein the means operatively interconnecting said first and second crankshafts comprises intermeshing gears.

9. A piston power unit as claimed in claim **7,** wherein said means operatively interconnecting said first and second crankshafts constrain said crankshafts to rotate in opposite directions.

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