United States Patent

Londo

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[54] **ROTARY INTERNAL COMBUSTION ENGINE**

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[52] **U.S. Cl.** ..... **123/43 A**

[51] **Int. Cl.** **F02b 57/04**

[58] **Field of Search** ..... 123/43 A; 91/499, 502; 417/269, 271

[56] **References Cited**

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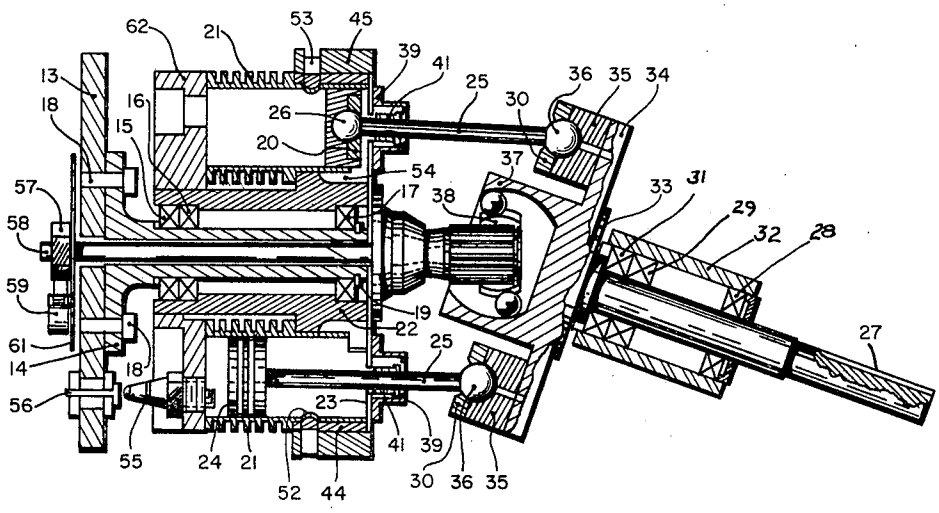
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Assistant Examiner—Michael Koczo, Jr.
Attorney—Theodore C. Browne

[57] **ABSTRACT**

The characteristic feature of the present engine is a circular array of cylinders arranged to rotate about a fixed support. Each of the piston rods is connected by a ball and socket connection to a rotatable plate set at such an angle that the stroke of the piston equals the base of a right triangle defined by the rotatable plate and the base of the cylinders. A power shaft projects from the plate. Alignment is maintained through a constant velocity universal joint. Substantially vibrationless operation is achieved.

6 Claims, 6 Drawing Figures



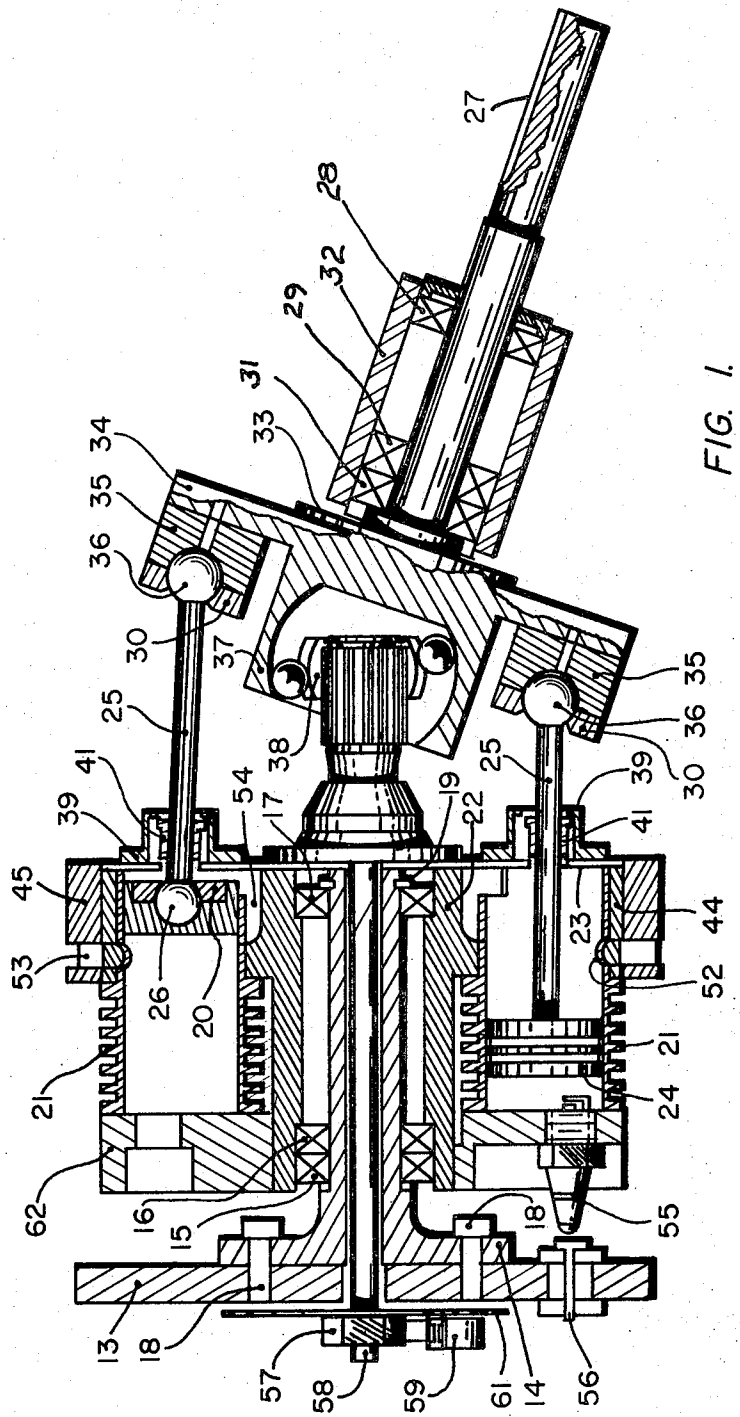

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FIG. 1.

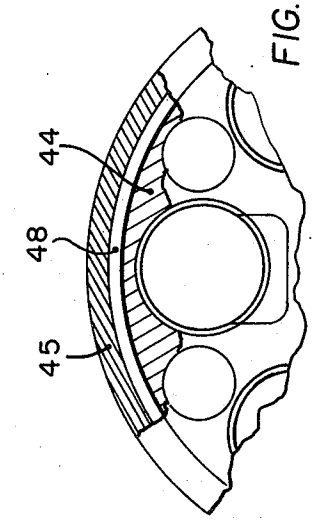


FIG. 3

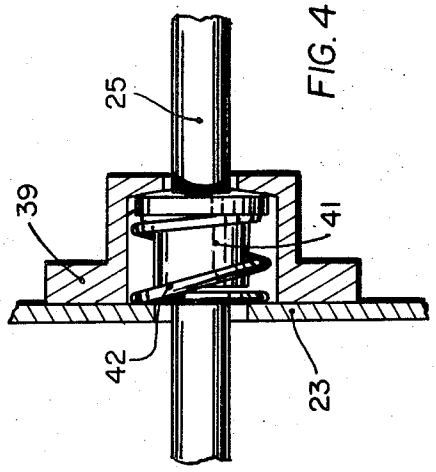


FIG. 4

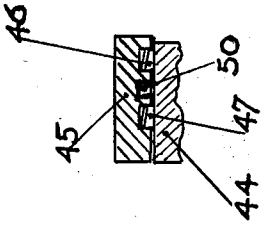


FIG. 3A

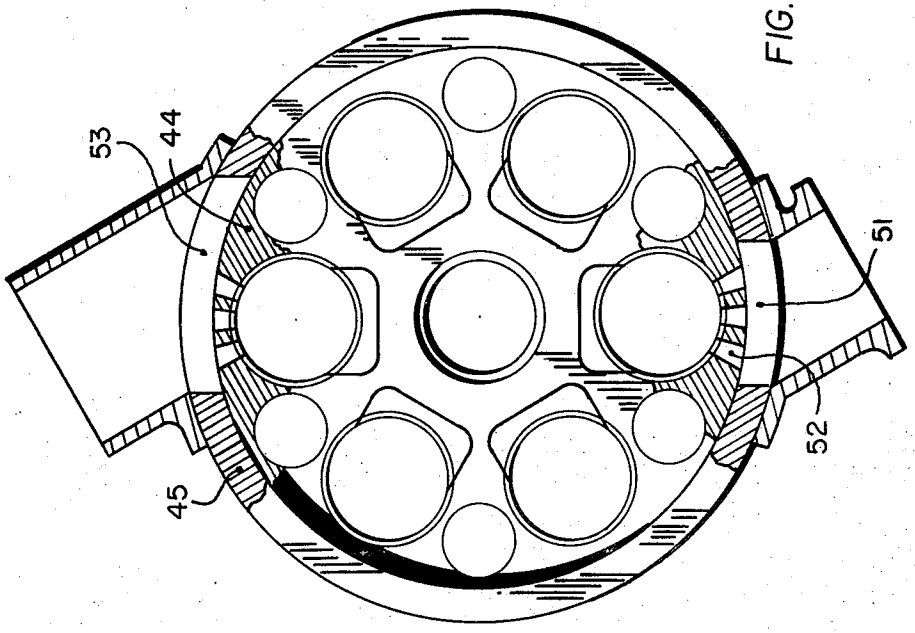


FIG. 2

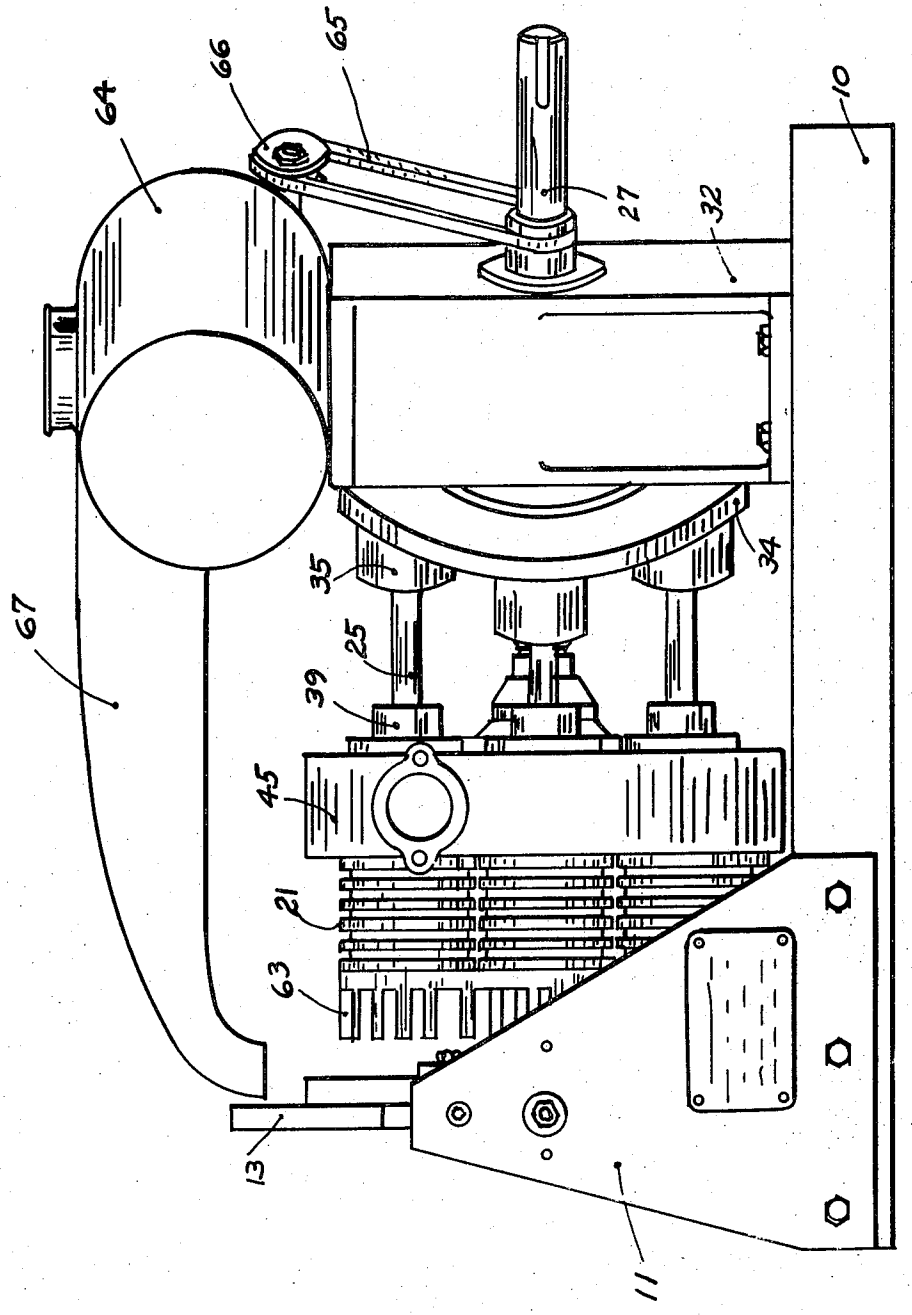


FIG. 5

ROTARY INTERNAL COMBUSTION ENGINE

This invention is concerned with a rotary internal combustion engine.

Among the advantages which flow from this design are: substantially smooth and continuous torque, freedom from vibration, and a considerable power output developed in a very small space.

A characteristic feature of the engine is a multiplicity of horizontal cylinders arranged on the periphery of a circle. The cylinder assembly is hung on and rotates about a fixed horizontal shaft. Each of the cylinders, as it fires, drives a piston and piston rod directly forward, and each rod terminates in a driven plate set at such an angle that the base of the right triangle, determined by the base of the cylinders and the face of the driven plate, equals the stroke of the engine. The driven plate which occupies a rigid position turns the drive shaft of the engine.

The construction will become apparent from the specification and from the drawings, in which

FIG. 1 is an illustrative section of the engine, omitting all supports and auxiliary structures for clarity,

FIG. 2 is a sectional view of the engine assembly on the center line of the exhaust and intake manifolds,

FIG. 3 is a partial section showing a portion of a sealing ring in elevation,

FIG. 3*a* is a partial cross-section of the manifold.

FIG. 4 is a sectional view through the stuffing box assembly surrounding the piston rod, and

FIG. 5 is a side elevation of the general assembly.

The engine comprises a base, **10** (FIG. 5), which is provided with two side plates, **11–11**, which, together with the base, **10**, hold the main supporting plate, **13**. Referring to FIG. **1**, it will be seen that the supporting plate, **13**, carries a flanged and hollow stub shaft, **14**, over which is fitted the internal race of radial ball bearings, **15**, **16**, and **17**.

Stub shaft, **14**, is held to the supporting plate, **13**, by suitable means such as cap screws, **18-18**. Snap ring, **19**, holds the lower bearing, **17**, in place. A multiplicity of cylinders, **21-21** (in this instance, 6) , are arranged in a circle about a hub, **22**, in which the outer races of the bearings, **15**, **16**, and **17**, are seated, and to which the engine bottom plate, **23**, is attached.

Each of the cylinders, **21**, is provided with a piston, **24**. Piston rods, **25-25**, are attached to the pistons by means of the ball joints, **26**, and, save for a very slight elliptical motion which later will be described, move directly forward and back, as the plate, **23**, and all of the cylinders, **21**, carried by it revolve about stub shaft, **14**. One ball on each rod is threaded and pinned to permit the rod seat to be assembled. Because there is essentially no side thrust, the pistons need no skirts.

Power is delivered as torque on the shaft, **27**, which is supported on standard, **32**, in the radial bearings, **28**, **29**, and **31**. The inboard end of shaft, **27**, terminates in a flange, **33**, which is fastened to a thrust plate, **34**. Ball sockets, **35-35**, which receive the balls, **36**, formed on the lower ends of the piston rods, **25**, are fastened adjacent the periphery.

The central portion, **37**, of thrust plate, **34**, projects inwardly and houses the constant velocity universal joint, **38**. Therefore the rotational velocity of the cylinder assembly and that of the thrust plate, **34**, are always equal, and exact positioning is secured.

It can be seen that as the plate, **34**, rotates, the ends of the piston rods, **25**, describe a small ellipse. It is therefore necessary to accommodate this elliptical motion by a special design of the piston rod.

By referring to the detailed view, FIG. **4**, it is seen that the piston rods pass through a stuffing box formed by a close fitting sleeve, **41**, which terminates in a convex flange head which rests on the floor of the piston rod sealing cage, **39**. The end wall of the sealing cage is ground to a shallow concavity. The lower and flange face of the sleeve, **41**, is ground to a mating convex shape. The sleeves can be bronze, but it has been found, however, that sleeves made of teflon will give good service, and seal consistently.

Spring, **42**, maintains a pressure on the mating surfaces of the piston rod seal. Because of the concave-convex shape of the sealing surface, it is possible therefore for the piston rod, **25**, which swings on the ball joints, **26** and **36**, on both ends of the rod, **25**, to travel in the necessarily small elliptical path by sliding the face of the sleeve, **41**, over the inner face of the cage, **39**. Spring, **42**, is optional.

FIG. **1** shows that the lower ends of the cylinders are fitted into an upward extension, **44**, of the bottom plate, **23**.

A manifold ring, **45**, fits closely around extension, **44**, and it is sealed by two or more split rings, **46** and **47**, which are held in slots, **48–48**, cut in the manifold ring, **45**.

The charge is drawn into the lower portion of cylinder, **21**, through the ports, **52** (FIG. **2**), whenever the cylinder comes opposite the inlet passage, **51**. Inlet passage, **51**, passes through the manifold ring, **45**, and terminates in a slot, **48**, which extends along the inner face of manifold ring, **45**, a sufficient distance to allow the cylinder port, **52**, of one cylinder to remain in communication with slot, **48**, until the port, **52**, of the succeeding cylinder begins its suction stroke and can aspirate the charge into the lower portion of the second cylinder.

This arrangement of overlapping intakes from the carburetor into space which conventionally would be considered the crank case of a two-cycle engine, maintains a negative pressure in the intake portion of the manifold at all times, and much improves carburetor performance.

Assuming that the cylinder shown at the bottom position of FIG. **2** is moved into the exhaust position shown at the top of FIG. **2**, the ports, **52**, now come opposite the exhaust passage, **53**. The charge above the piston has fired and the right cylinder is receiving its fresh charge of gas which travels from the space beneath the piston through the transfer port, **54**, into the cylinder. The exhaust passes outward through the port, **52**, and into the exhaust passage, **53**.

The engine is fired by conventional spark plugs, **55—55**, which fire whenever the electrode, **56**, is energized and a spark plug, **55**, rotates across but not in contact with its lower face. Ignition is secured in a conventional manner by a rotor cam, **57**, fixed to the rotor shaft, **58**, which opens and closes a conventional set of breaker points, **59**, attached to a movable plate, **61**, which may be advanced or retarded to determine the moment of ignition.

A single annular cylinder head, **62**, provided with a multiplicity of upstanding fins, **63—63**, closes all of the cylinders. In small sizes, the fins produce a considerable air blast, but it is preferred to equip the engine with a shroud, **67**, and blow air through the shrouding while the engine is in operation.

As the assembly view (FIG. **5**) shows, cooling is accomplished by a squirrel cage blower which is hidden by the gasoline tank, **64**. The blower is driven from the main shaft, **27**, through the belt, **65**, and the pulley, **66**. The outflow of air is directed downward on to the cylinders by the shrouding, **67**.

One such engine having six air-cooled cylinders, each of 1½-inch bore by 1 15/16-inch stroke, set on a circle ten inches in diameter, was tested on the engine-testing stand of the Experimental Station of the State University.

The test was conducted using a General Electric direct current dynamometer with a rated capacity of 50 hp. The engine drove the dynamometer using a V-belt and pulley in the ratio of 1.75 to 1.0. The smaller pulley was mounted on the engine. Speed measurements taken from the engine shaft and the dynamometer shaft showed that the loss of power due to belt slippage was less than .05 percent. The maximum power output of the engine was calculated to be 2.15 hp, which was obtained at a dynamometer shaft speed of 1050 rpm and a torque of 8.4 foot lbs. These figures were essentially duplicated in three separate runs. The engine speed during all of the tests was approximately 1720 rpm.

The most unusual aspect of the operation of the engine was its lack of vibration and its smooth running qualities due to the lack of any reciprocating action in the motion of its parts. Constancy of torque in such a small engine adapts it for many uses which presently suffer from the non-constant characteristics of the common single cylinder appliance engine. The design lends itself to substantial power output in a small space, and its smooth running characteristics are highly advantageous in machines where the constant torque characteristics of this multi-cylinder engine make it possible to use engines of smaller horse power than is possible with single cylinder design to perform the task satisfactorily.

I claim:

1. An internal combustion engine, having

a. a plurality of cylinders in circular array, arranged to rotate about a fixed axle support,

b. the said support,

c. pistons in each of the cylinders,

d. piston rods connected to each piston by a ball and socket joint,

e. a plate closing the lower ends of each cylinder,

f. seals to prevent the escape of gas between the plate and each piston rod,

g. a ring manifold having intake and exhaust portions in the said ring,

h. a port in the wall of each cylinder to connect respectively the intake portion of the manifold and the exhaust portion of the said manifold as the engine revolves,

i. a thrust plate maintained in a fixed angular position, ball sockets connecting the ends of the pistons to said plate,

j. bearing means to support the thrust plate, and

k. a constant velocity universal joint fixed to the thrust plate in alignment with its axis of rotation, and connecting the said rotatable engine to said plate.

2. An engine as claimed in claim **1** having spark plugs projecting from each cylinder, breaker points adjustably associated with the fixed support of said engine, a cam affixed to a shaft secured to the rotating end wall of said engine and arranged to operate the said points, a fixed electrode associated with the stationary support of said engine whereby ignition in each cylinder will be secured as the cylinder and its spark plug rotates beneath the fixed electrode and the electric discharge is controlled by the opening and closing of the said breaker points.

3. The engine as claimed in claim **1** wherein the intake portion of the said engine manifold extends for such a circumferential distance that the intake stroke of the succeeding cylinder may begin to draw a charge into the space beneath the piston of said succeeding cylinder just prior to the closing of the intake passage to the first named cylinder as the array of cylinders rotates.

4. An engine as claimed in claim **1** wherein the lower portion of the engine is surrounded by a combined intake and exhaust manifold, and wherein the sealing between the said engine base and the manifold is secured by a plurality of split rings maintained in slots formed in the interior face of the said manifold.

5. An engine as claimed in claim **1** wherein each of the cylinders in the said array possesses a single port alternately acting as an intake and exhaust passage as the said array of cylinders revolves about its said support.

6. An engine as claimed in claim **1** wherein the sealing means to prevent the escape of gas along the piston rod includes a sleeve having a slide fit on said rod, and wherein the said sleeve includes a lower, outer, convex face, a piston rod sealing cage surrounding the sleeve and holding it in position, the said cage having a concave interior end wall mating with the convex outer face of said sleeve.

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