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RADIAL ENGINE

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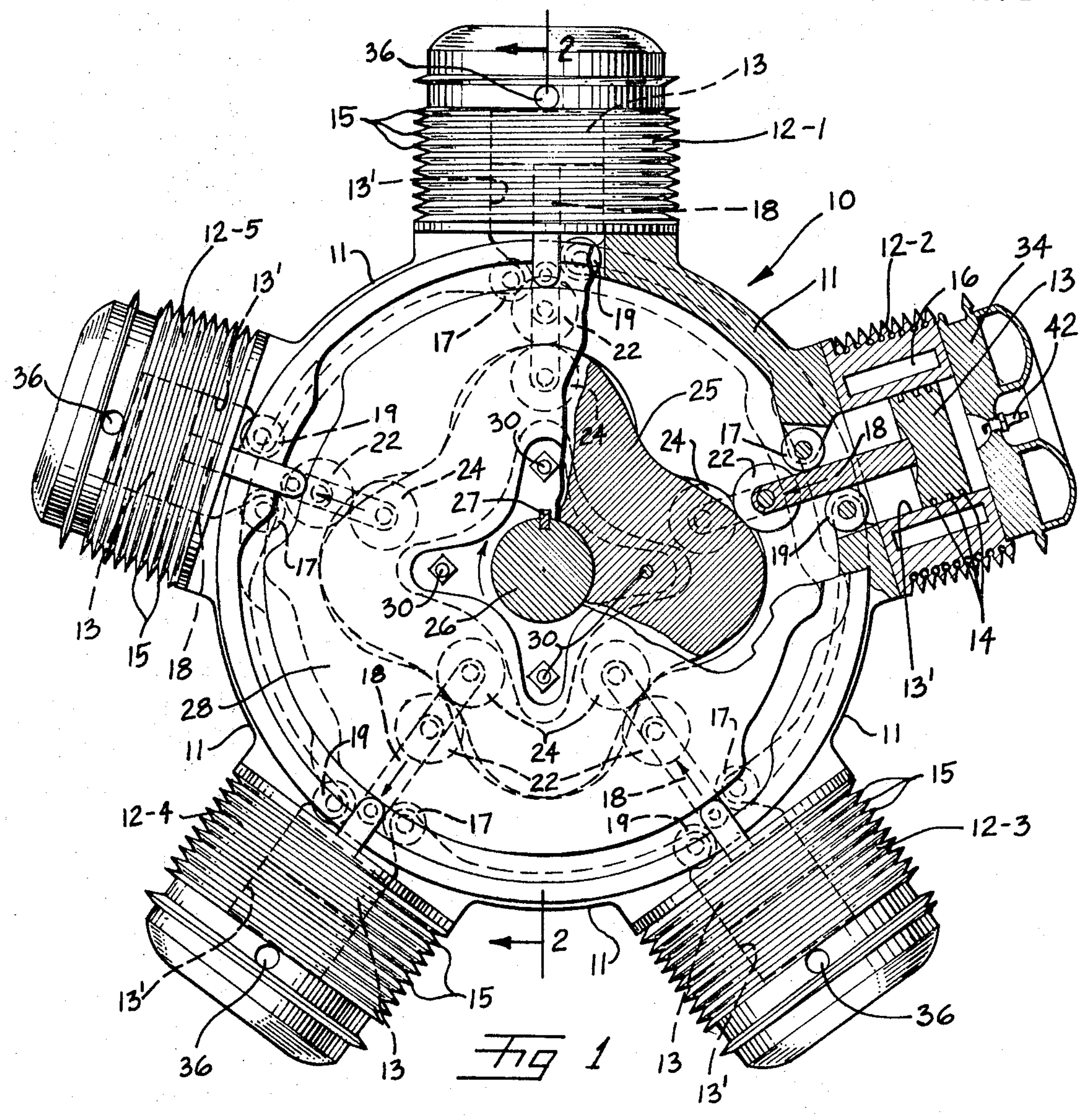

Fig 1

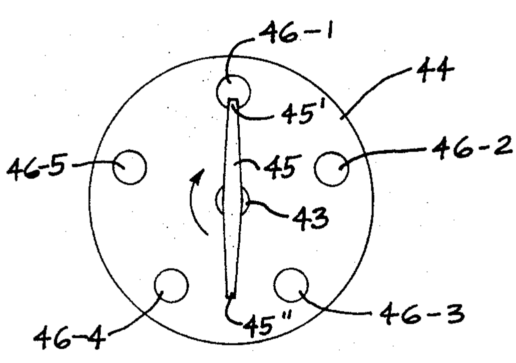

Fig 4

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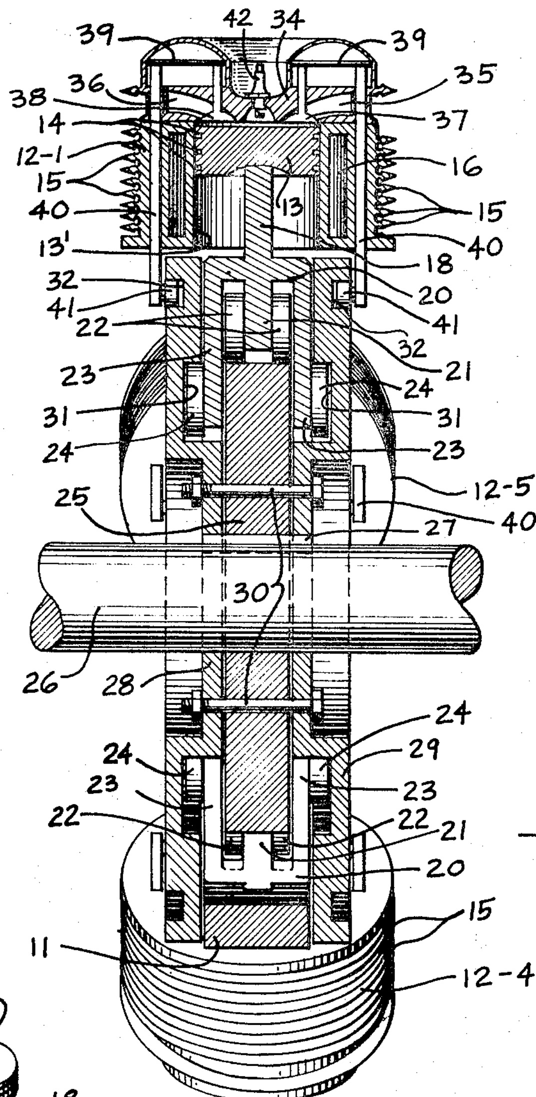

Fig 2

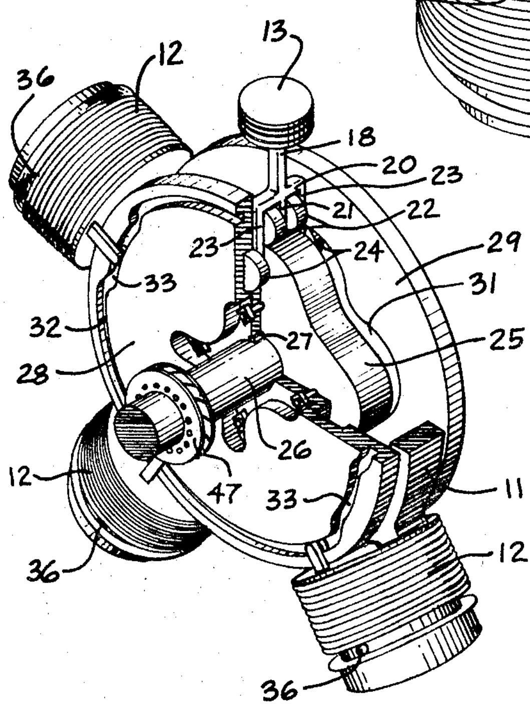

Fig 3

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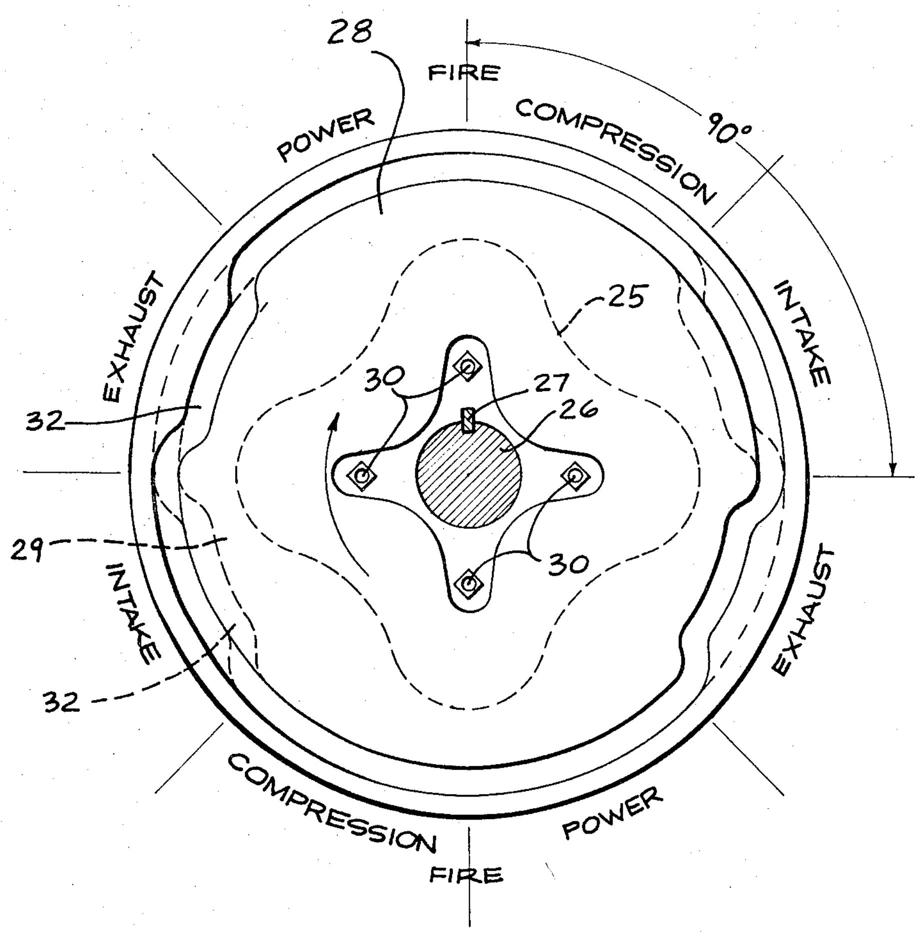

Fig 5

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RADIAL ENGINE

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U.S. Cl. 91—188 4 Claims

ABSTRACT OF THE DISCLOSURE

A radial type internal combustion engine having a cam drive wheel, radially disposed piston and piston rod assemblies, and separate and distinct roller bearings alternately supporting the piston rods during operation of the engine.

This invention relates to internal combustion engines and more particularly to radial type internal combustion engines of the type utilizing cam wheels for power transmission.

In the past, various types of internal combustion engines have been developed in attempts to produce a maximum power output with a minimum weight and size penalty. In-line and V-type engines have been suitable for certain applications while radial type engines have been developed for other uses. Even though in certain applications the radial engine has advantages over the other types of engines, they are costly to manufacture and maintain due to the extremely complex master and articulated piston rods, the required counterweights and the interconnection of the crankshaft.

In addition to the above, the various types of engines heretofore known have required delicate and complex systems for properly tuning and for setting the timing of the valve operations. Even with all their complexities, the prior art engines have not been adaptable to adding more power to a shaft when needed and in the usual case, a larger engine must be substituted when more power is needed.

After much research and study into the above mentioned problems, the present invention has been developed to provide an engine which is compact and sturdy yet simple in construction and which will give smoother more powerful operation at a slower r.p.m. than has heretofore been possible. In accompilshing this, applicant has provided an engine which has a minimum of wear on its internal parts and at no point has a bearing which must be reversed during operation.

The present invention further eliminates complicated and delicate counterbalance systems heretofore required in radial type engines operating on the crankshaft principle while also eliminating the complex valve and piston rod linkages. Applicant's invention has also eliminated the complex and delicate timing systems required to properly tune all types of prior art engines while at the same time providing a simple to construct, simple to repair power source which is compact in construction and is adapted to allow a series of engines to be placed on a single shaft according to the dictates of the power requirements.

It is an object, therefore, of the present invention to provide an improved radial engine of compact construction capable of sustained operation with a high horsepower output at a comparable slow r.p.m.

Another object of the present invention is to provide a radial engine which does not require counterbalances nor master and articulated rods.

A further object of the present invention is to provide

a radial type engine wherein each bearing rotates in a single direction thereby reducing wear and increasing the life of the entire system.

Another object of the present invention is to provide a radial engine having an improved valve system wherein the timing of operation is preset during the assembly of the engine.

Another object of the present invention is to provide a radial engine constructed in a flattened bank configuration and adapted to mount on a shaft in such a manner that additional banks may be attached to such shaft to impart additional rotative power thereto.

Other objects and advantages of the present invention will become apparent and obvious from a study of the following description and the accompanying drawings which are merely illustrative of the present invention.

In the drawings:

FIG. 1 is a transverse cross section showing the relationship of the basic parts of the present invention;

FIG. 2 is a section taken through lines 2—2 of FIG. 1;

FIG. 3 is a cutaway perspective disclosing the relation of the bearings and cam guides;

FIG. 4 schematically illustrates a distributor for controlling the firing of the engine of the present invention; and

FIG. 5 schematically illustrates the order of operation for each cylinder as the drive wheel and associated parts rotate.

With further reference to the drawings, FIG. 1 discloses a radial type engine indicated generally at **10** composed of a generally cylindrical housing **11** which is roughly equivalent to the crankcase of prior art devices. Integral with and equally spaced about the periphery of the housing **11** is a series of cylinders indicated at **12** and numbered in order, **12–1**, **12–2**, **12–3**, **12–4** and **12–5**. The purpose of this sequential numbering of the cylinders is to assist in the description of the operation of the engine has hereinafter set forth.

The interior of each of the cylinders **12** has an opening **13** therein which is adapted to slideably receive a piston **14**. Standard oil rings **14′** are provided about the periphery of each of the pistons in the usual manner.

Each of the cylinders **12** can be provided a series of cooling fins **15** or, in addition to or as an alternative, a cooling channel **16** may be provided through which a cooling fluid may be circulated during operation of the engine.

Fixedly secured to and interiorly projecting from housing **11** adjacent each of the cylinders **12** are downward movement support bearings **17**. These bearings are adapted to support piston rods **18** during their downward travel. On the opposite side of piston rods **18** from downward movement support bearings **17** are upward movement support bearings **19** which are fixedly secured relative to their respective cylinders to the interior of housing **11**.

One end of each of the piston rods **18** is fixedly secured to a piston **13** thus eliminating the usual point of wear between piston and piston rod. The end of each of the rods **18** opposite pistons **13** terminates in a fork shaped bearing support **20**. These forks may be either integral with or fixedly secured to the rods **18**. On each side of the central prong **21** of support **20** are rotatively mounted generally cylindrical shaped bearings **22** of the type commonly known as Hyatt bearings. Rotatively mounted on the side of outer prongs **23** opposite central prong **21** are generally cylindrical shaped Hyatt type bearings **24**.

A cam drive wheel **25** is provided which is adapted to operatively engage thrust bearings **22** particularly as disclosed in FIG. 3. This drive wheel is adapted to be removably mounted in fixed rotative relationship to a drive shaft **26**. A key-way and removable pin **27** is disclosed as one method of operatively securing the drive shaft to the drive wheel.

The cam drive wheel 25 is so shaped that high points occur at every 90 degrees about the circumfeernce thereof while low points occur at 45 degrees or mid-way between such high points. As will be noted particularly from FIG. 1, there are no flat places on the periphery of this wheel thus allowing smooth operation in relation to the bearings 22.

Fixedly secured by bolts 30 to opposite sides of drive wheel 25 are housing ends 28 and 29 particularly as disclosed in FIG. 2. Along the interior of each of these housings 28 and 29 is provided a cam channel 31 generally coinciding in outline with cam drive wheel 25. As is particularly obvious from FIG. 1, there are slight variations in the contours of channel 31 and wheel 25 in the area immediate the four high and four low points about the peripheries thereof. The purpose of this slight variation between these two parts is to allow pull-down bearing 24 to travel in constant operative contact with the edge of channel 31 farthest from drive shaft 26 while at the same time allowing thrust bearings 22 to remain in constant operative contact with cam wheel 25. This operative relationship is particularly obvious from close examination of the relationshp of bearings 22 and 24 of cylinders 12–5 or 12–2 in FIG. 1.

Formed into the exterior portion of both housings 28 and 29 are valve control cam channels 32. Each of these channels has in predetermined locations dips or drops 33 for operating the valves as will be hereinafter described.

Each of the cylinders 12 has secured to the top thereof a cylinder head 34 which has an intake port 35 and an exhaust port 36 provided therein. The outer portion of each of these ports may be adapted to receive respective intake and exhaust manifolds (not shown) of any desired configuration.

The interior portion of both the exhaust and intake ports terminate in valve seats which are adapted to operatively receive respectively intake valve 37 and exhaust valve 38. To the stem portion of each intake and exhaust valve of each cylinder is secured a connecting arm 39 preferably composed of spring steel. To the other end of each of these connecting arms is secured a push rod 40 which is slideably mounted through the cylinder walls to a point adjacent channels 32. Rotatively mounted on the end of each of the push rods 40 opposite the end secured to connecting arms 39 are bearings 41 adapted to be operatively mounted within said channel 32.

Passing through the central portion of each of the cylinder heads 34 and secured in the normal manner thereto are sparkplugs 42.

To prevent operation in reverse or accidental reverse backfiring, a uni-directional clutch 47, which is readily available commercially, is secured to shaft 26 particularly as disclosed in FIG. 3.

A suitable source of electrical current (not shown) is connected to the high-tension center electrode 43 of distributor 44. This electrode is conductively secured to distributor rotor 45 which in turn is operatively connected by means (not shown) to a rotative source of power such as the engine itself. Each of the distributor electrodes 46 are adapted to be connected to the sparkplugs of their corresponding cylinders by any suitable means (not shown). In other words, electrode 46–1 to cylinder 12–1, electrode 46–2 to cylinder 12–2, electrode 46–3 to cylinder 12–3, electrode 46–4 to cylinder 12–4 and electrode 46–5 to cylinder 12–5 thus forming what is commonly known as an ignition harness.

To give the engine of the present invention any additional strength which may be required and to seal the same, additional structural housing (not shown) will be provided but is not described in further detail since this is considered well within the abilities of one skilled in the art.

In order to set up the engine of the present invention for operation, such engine 10 is mounted on a drive shaft 26 and held in fixed rotative relationship thereto by a pin 27 which is keyed into both the drive wheel 25 and said drive shaft. Suitable intake and exhaust manifolds (not shown) are operatively connected to the exterior portion of each of the intake and exhaust ports. A suitable carburetor means (not shown) is operatively connected to the intake manifold. A suitable exhaust pipe (not shown) is operatively connected to the exhaust manifold. A suitable source of electrical current is connected to center electrode 43 and the ignition harness is connected in predetermined sequence to the engine.

To actually operate the engine of the present invention, shaft 26 is rotated by a starter means (not shown) in the single direction allowed by one-way clutch 47. This rotative motion rotates drive wheel 25 with its associated housings 28 and 29 relative to housing 11 and the cylinders fixed thereto thus causing the pistons to move transversely toward and away from shaft 26 in intake, compression and exhaust strokes. Assuming that cylinder 12–1 is in the upper most fire position shown schematically in FIG. 5; and further assuming that shaft 26 has rotated clockwise at least 90 degrees to accomplish fuel-air mixture intake and compression, as end 45′ of distributor rotor 45 contacts the electrode 46–1, it will fire the cylinder. For the next 45 degrees of rotation of cam drive wheel 26, the cylinder moves downwardly in its power stroke. As the wheel continues to rotate, the drop 33 in housing 28, which controls the exhaust valves of the engine, pulls rod 40 downwardly to open the exhaust valve. During this 45 degrees of rotation, the piston moves from its low point back toward the cylinder head 34. As the next high point of the drive wheel is reached, the exhaust valve closes and the intake valve 37, controlled by the cam channel within housing 29, opens and remains open for the next 45 degrees of rotation to the next low point in wheel 26. During this last described 45 degrees rotation, the pull-down bearings 24 cause the piston to move downwardly thereby sucking into the cylinder a mixture of air and fuel from the intake manifold (not shown). As the low point is reached, the intake valve closes and as thrust bearings 22 push the piston upwardly so the fuel and air within the cylinder are compressed. As this 45 degrees of rotation is accomplished, which is 180 degrees from the initial firing point, the end 45″ of distributor rotor 45 has also traveled 180 degrees and contacts electrode 46–1 which again fires, through the sparkplug 42, cylinder 12–1.

As shaft 26 and the parts secured thereto continue to rotate for the next 180 degrees, the cycle hereinabove described is repeated and is continued to be repeated as the engine operates. The sequence described for cylinder 12–1 is likewise repeated with each of the cylinders firing in predetermined order as controlled by distributor rotor 45. As can be seen from FIG. 4, when cylinder 12–1 is being fired the other end of the rotor is between the electrodes which are controlling cylinders 12–3 and 12–4. As the rotor continues to rotate, it next fires cylinder 12–4. During one complete revolution of the shaft 26 and its coordinated rotor 45, a firing order for cylinders 12 is accomplished as follows: 1–4–2–5–3–1–4–2–5–3. It is to be particularly noted that each cylinder fires twice during a single revolution of the drive shaft.

Assuming that cylinder 12–1 is in its firing position in FIG. 1, cylinder 12–2 would be in intake stroke, cylinder 12–3 would be completing its power stroke, cylinder 12–4 would be beginning its compression stroke and cylinder 12–5 would be nearing the end of its exhaust stroke.

As is obvious, once housings 28 and 29 are secured to drive wheel 25, the coordinating of the operation of the intake and exhaust valves to the motion of the cylinders is preset thus eliminating the skill and equipment heretofore required to properly time and engine. Further since the valves are controlled by the two cam channels, they are not susceptible to getting out of adjustment during operation or what is commonly called "jumping timing."

It is obvious that the present invention has the advantages of providing an engine that is simple in construction and operation and which does not require constant adjusting to operate at peak performance. Another advantage of the present invention is the provision of an engine which rotates at a relatively slow r.p.m. compared to its power output since each cylinder fires four times as often as is possible in the four stroke cycle engine. The design of this invention further has the advantage of allowing either a seven or a nine cylinder engine to be developed using the basic principles taught by the present disclosure. Another advantage of the invention is the provision of an engine in which no bearing reverses itself and which is adapted to have a series of engines readily mountable and dismountable on the same drive shaft.

The terms "high," "low," "upper" and so forth have been used herein merely for convenience of the foregoing specification and in the appended claims to describe the engine and its parts as oriented in the drawings. It is to be understood, however, that these terms are in no way limiting to the invention since the engine may obviously be disposed in many different positions when it is in use.

The present invention may, of course, be carried out in other specific ways than those herein set forth without departing from the spirit and essential characterstics of the invention. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive and all changes coming within the meaning and equivalency range are intended to be embraced herein.

What is claimed is:

1. In an engine of the type having a rotatable cam drive wheel including at least one lobe and a relative fixed attachment between each of several associated pistons and piston rods, cam bearing means interposed between said cam drive wheel and said piston rods, said piston rods being capable of lateral movement during the operation of said engine, the improvement comprising: separate and distinct support means on opposite sides of said rod and disposed generally in line with the direction of travel of said drive wheel, said support means being spaced opposingly apart a distance slightly greater than the width of said rod adjacent said support means whereby when the cam lobe is pushing the piston rod and associated piston in one direction, one support means will be engaged by said piston rod and when the piston and associated piston rods are pushing said lobe in the opposite direction, the other support means will be engaged by said piston rod thus giving each support means a unidirectional movement relative to said piston rod.

2. A radial type engine comprising: a rotatable drive shaft; a cam type drive wheel having four evenly spaced

lobes disposed about its periphery, said drive wheel being removably mounted on and secured to said drive shaft; an odd number of evenly spaced cylinders operatively radially disposed about said drive wheel; pistons operatively mounted within each of said cyinders; piston rods disposed in relatively fixed attachment to said pistons; cam bearing means interposed between said cam type drive wheel and said piston rods, said piston rods being capable of lateral movement during the operation of said engine; and separate and distinct bearing support means in the form of rollers disposed on opposite sides of each of said rods and disposed generally in line with the direction of rotation of said drive shaft and its associated drive wheel, said opposing support means being spaced apart a distance slightly greater than the width of the rod disposed between such support means whereby when a cam lobe is pushing the piston rod and associated pistion in one direction, one support means will be engaged by said piston rod and when the piston and associated piston rod are pushing said lobe in the opposite direction, the other support means will be engaged by said piston rod thus giving each support means a uni-directional support movement relative to said piston rod.

3. The engine of claim **2** including valve means for controlling the intake and exhaust of gases to and from said cylinders; means secured to said drive wheel containing at least one cam channel means; and means for operatively connecting said valve means to said channel means whereby said valves may be controlled.

4. The engine of claim **2** including means for removably securing additional engines to said shaft whereby additional power may be added as necessary.

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92—72, 165; 123—44, 55