C. S. LEONARD AND R. H. AND R. J. BECK.

ENGINE.

APPLICATION FILED AUG. 2, 1916.

1,338,311.

Patented Apr. 27, 1920.

4 SHEETS—SHEET 1.

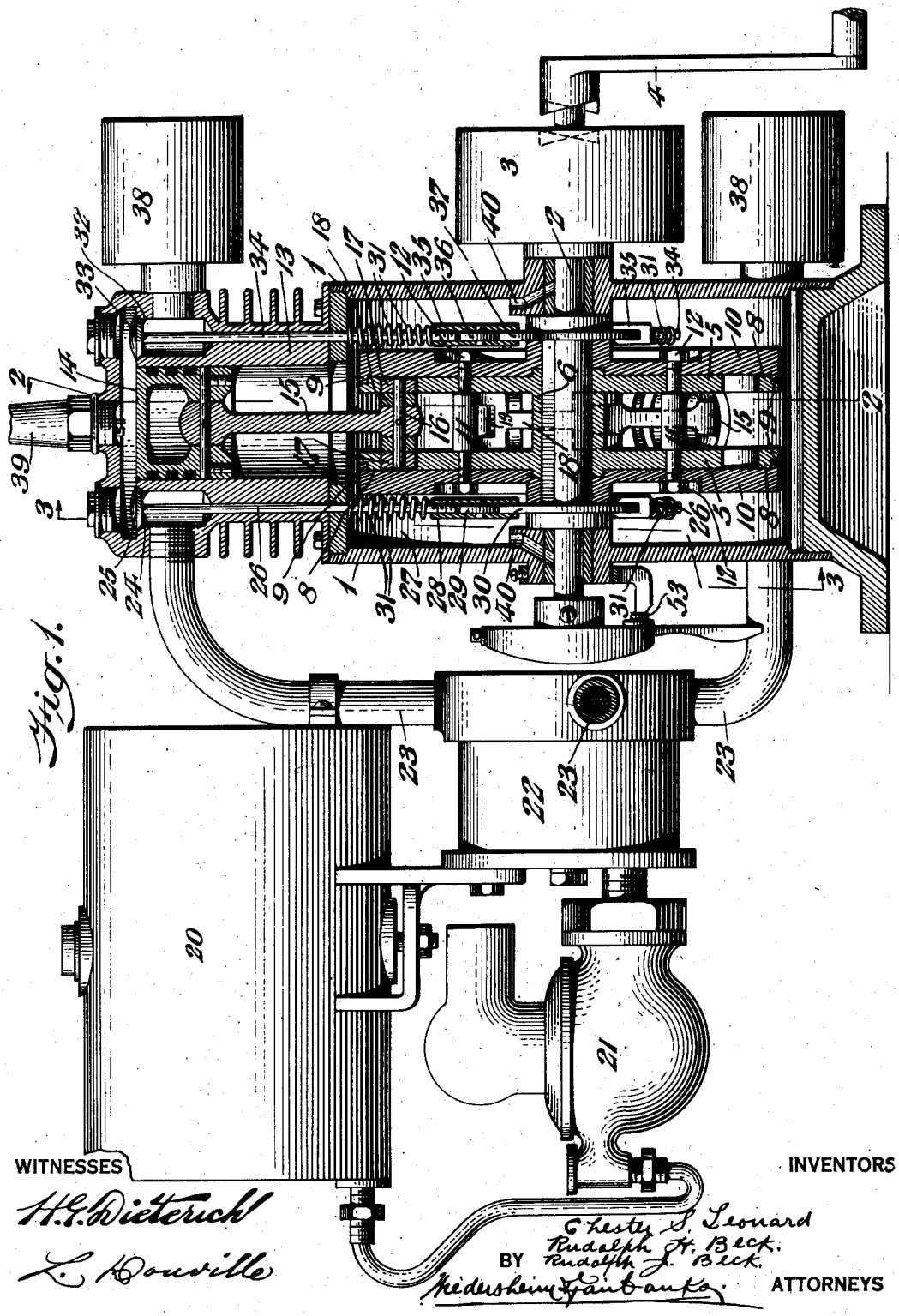


Fig. 1.

WITNESSES

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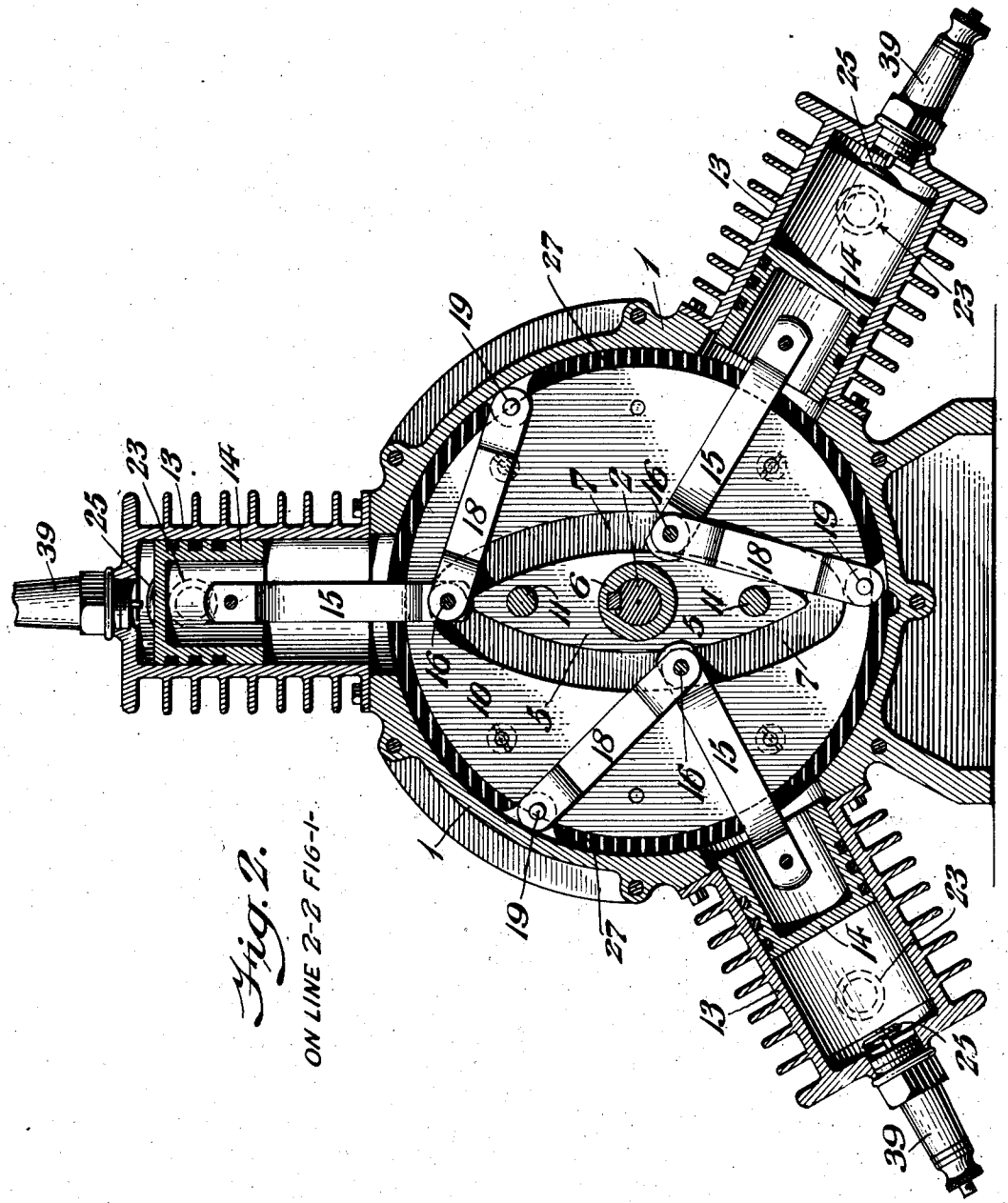


Fig. 2.

ON LINE 2-2 FIG-1-

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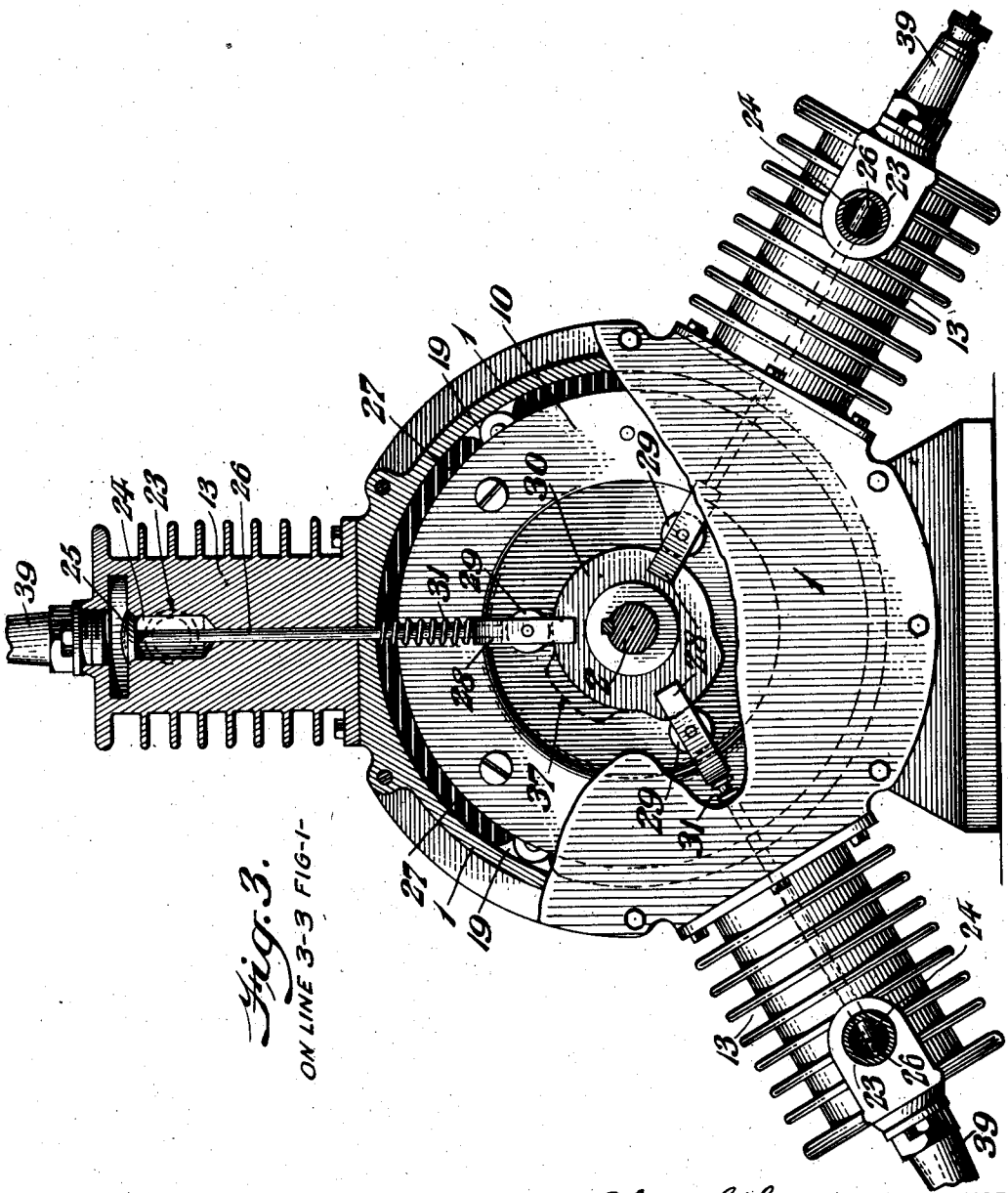


Fig. 3.

ON LINE 3-3 FIG-1-

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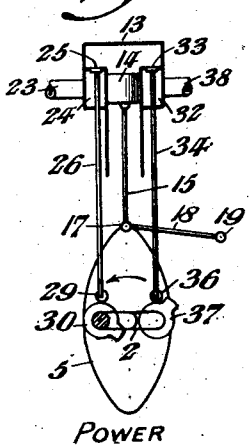
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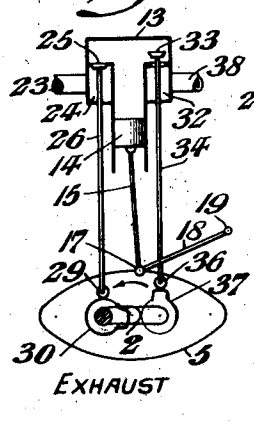
4 SHEETS—SHEET 4.

Fig. 4.



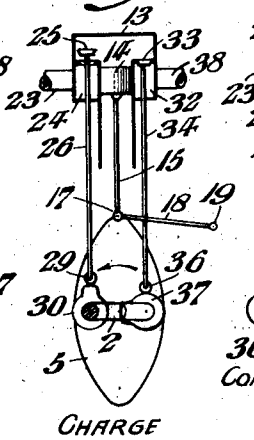
POWER

Fig. 5.



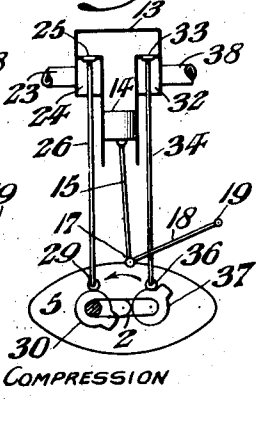
EXHAUST

Fig. 6.



CHARGE

Fig. 7.



COMPRESSION

Fig. 8.

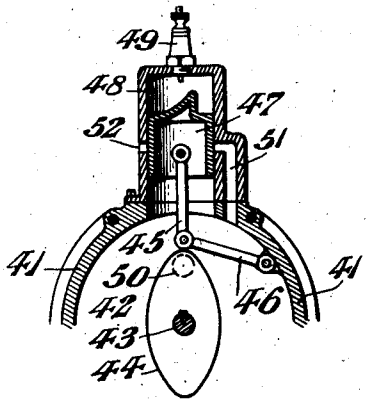


Fig. 9.

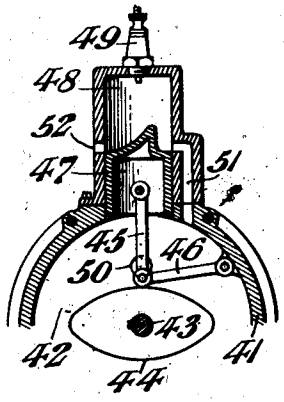
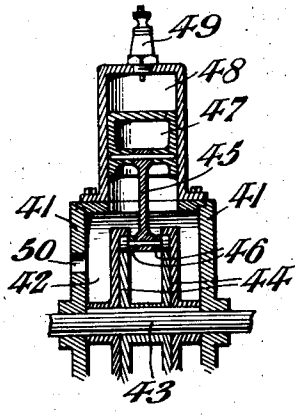


Fig. 10.



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UNITED STATES PATENT OFFICE.

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ENGINE.

1,338,311. Specification of Letters Patent. Patented Apr. 27, 1920.

Application filed August 2, 1916. Serial No. 112,643.

To all whom it may concern:

Be it known that we, CHESTER S. LEONARD, a citizen of the United States, residing at Lansdowne, county of Delaware, State of Pennsylvania, and RUDOLPH H. BECK and RUDOLPH J. BECK, both citizens of the United States, residing in the city and county of Philadelphia, State of Pennsylvania, have invented a new and useful Engine, of which the following is a specification.

Our present invention consists of a novel construction of a multiple cylinder engine which may be driven by means of any desired type of motive fluid and wherein each cylinder piston has a power stroke at each revolution of the driving shaft. In case the engine is operated as an internal combustion engine, an explosion in each engine cylinder is obtained during one revolution of the driving shaft.

It further consists of a novel multiple cylinder engine wherein two power strokes for each cylinder piston or two explosions for each engine cylinder take place during each revolution of the power or driving shaft.

It further consists of a novel engine which is never on dead center and therefore very easy to start and a great range for throttling the speed of the engine is provided which is especially valuable in the case of motors used in conjunction with motor driven vehicles.

The present invention is adapted to be applied to all forms of heat engines including the two stroke cycle gas engine.

It further consists of a novel construction of a cam and novel means connected with the piston rods to increase the flexibility of such rods, and reduce to a minimum the wear on the cylinder.

It further consists of novel means for actuating the intake and exhaust valves.

Other novel features of construction and advantage will hereinafter appear in the detailed description of our invention.

For the purpose of illustrating our invention, we have shown in the accompanying drawings those forms thereof which are at present preferred by us, since the same will be found in practice to give satisfactory and reliable results, although it is to be understood that the various instrumentalities of which our invention consists can be variously arranged and organized and that our invention is not limited to the precise arrangement and organization of these instrumentalities as herein shown and described.

Figure 1 represents a sectional elevation of an engine embodying our invention.

Fig. 2 represents a sectional view on line 2—2 of Fig. 1.

Fig. 3 represents a sectional view on line 3—3 of Fig. 1.

Fig. 4 represents diagrammatically the position the working parts of a cylinder and its adjuncts assume at the beginning of the power stroke.

Fig. 5 represents diagrammatically the position the moving parts of a cylinder and its adjuncts assume at the beginning of the exhaust stroke.

Fig. 6 represents diagrammatically the position the parts of an engine cylinder and its adjuncts assume during the charge stroke.

Fig. 7 represents diagrammatically the position the parts of an engine cylinder and its adjuncts assume at the beginning of the compression stroke.

Figs. 8 and 9 represent sectional views of another embodiment of our invention, the working parts being shown in different positions.

Fig. 10 represents a longitudinal section through the power shaft, cam chamber and engine cylinder.

Similar numerals of reference indicate corresponding parts in the figures.

Referring to the drawings,

1 designates the engine housing or framework in which is journaled a driving shaft 2 which may be connected to the mechanism to be driven in any desired or conventional manner and for the purpose of illustration we have shown the shaft 2 as having mounted thereon a pulley 3. 4 designates a crank adapted to be operatively connected with the driving shaft to effect its initial rotation to turn over the engine. 5 designates cams in the form of plates or disks which are connected by an integral hub 6 fixed on the driving shaft 2. Each of these cams is provided with an elliptically shaped cam groove 7, as best seen in Fig. 2.

The side of each cam plate near its outer periphery is preferably grooved, as indicated at 8, in order to receive a retaining flange 9 projecting laterally from outer

plates or disks 10 which form fly wheels and are secured in position by means of spacing rods 11, the ends of which are threaded and provided with fastening devices 12, whereby cam plates 5 are properly reinforced.

13 designates the engine cylinders any desired number of which may be employed in a group about the shaft 2, but, for purposes of illustration, we have shown a multiple cylinder engine having three engine cylinders, and these cylinders may be secured with respect to the framework in any desired or conventional manner. Within each engine cylinder is a piston 14 to which is pivotally connected its piston rod 15. The inner end of each piston rod 15 is connected with a cross bar 16, the ends of which are provided with antifriction members, such as rollers 17, which travel in their respective cam grooves 7.

18 designates a link having one end bifurcated to straddle the piston rod and such bifurcated end is apertured to receive the cross bar 16. The outer end of a link 18 is pivotally connected, as at 19, to a stationary portion of the engine housing. By such construction a piston rod is deflected in the direction of rotation of the engine and all unnecessary friction between the rollers and the cam grooves is eliminated so that the forces exerted on the pistons can be transmitted with highest efficiency through the flexible linkage to the power or driving shaft on which the cams are fixedly mounted. The slight deflection of the piston rod produces such a small side thrust of the piston that the oval wear ordinarily present in cylinders wherein the pistons are reciprocated by a crank shaft under the four stroke cylinder method is practically eliminated.

20 designates a fuel tank which is operatively connected with a carbureter 21 of any desired or conventional type. The carbureter 21 communicates with the mixing chamber of a casing 22 which is in communication by means of its respective conduit 23 with a cylinder intake port 24 which is controlled by a valve 25. The valve 25 has its stem 26 guided in the cylinder wall and extending into the cam chamber 27, and its lower end is connected to a roller guide 28 in which is mounted a roller 29. 30 designates a cam fixed to the shaft 2 and having its outer periphery extending into the roller guide 28. A spring 31 interposed between the roller guide 28 and a wall of the cam chamber maintains the intake valve 25 in its normally closed position. 32 designates the exhaust port from an engine cylinder which is controlled by an exhaust valve 33 having a stem 34 guided in the cylinder wall, extending into the cam chamber 27 and connected with a roller guide 35 in which is mounted a roller 36 which travels on the periphery of a cam 37 fixed on the shaft 2. The exhaust port leads to a muffler 38. Each engine cylinder is provided with a spark plug 39 of any desired or conventional type. 53 designates a timing mechanism of any desired or conventional type and it is therefore believed to be unnecessary to illustrate and describe in detail its construction and operation. The cam chamber is adapted to receive lubricant which passes to the shaft through passages 40. The cams 30 and 37 are constructed in such a manner that they will actuate their respective valves on their rotation in either direction so that the engine can be reversed when desired.

In the embodiment seen in Figs. 8, 9 and 10, we have shown a construction wherein two explosions are produced in each engine cylinder during one rotation of the driving shaft. In this embodiment 41 designates the casing forming the cam chamber 42 through which extends the driving shaft 43 on which is mounted an elliptical shaped cam 44 which coöperates with the piston rod 45 to which is pivoted one end of a link 46, the other end of which is pivoted to the casing 41. The piston rod is connected to its piston 47 located in an engine cylinder 48 provided with a spark plug 49. The suction caused by the upstroke of the piston draws a charge of gas through a port 50 leading from the intake manifold into the cam chamber 42, see Fig. 8. This charge is compressed in the cam chamber by the following downstroke and as the piston reaches the end of this stroke the admission port 51, see Fig. 9, is opened thus permitting the explosive charge to pass into the engine cylinder. The next upstroke of the piston compresses the charge into the compression space at the top of the cylinder where it is ignited by the spark plug 49. The force of the explosion drives the piston downwardly on its power stroke and as it passes the exhaust port 52, see Fig. 9, the waste products of combustion are expelled, and a fresh charge of explosive mixture passes from the cam chamber to the engine cylinder. The momentum of the fly wheels carries the piston upward on another compression stroke and the cycle of the operation is repeated giving a power stroke in every two strokes of the piston and since the piston makes four strokes in every revolution of the elliptically grooved cam there are two power strokes delivered to it and to the power shaft in each of their revolutions by each piston. This applied to any number of cylinders that can be located around the power shaft.

In Figs. 4 to 7 inclusive, we have illustrated diagrammatically the positions the parts assume during a single revolution of the power shaft. In Fig. 4 is illustrated the existing condition prevailing at any cylin-

der ready to deliver the power stroke. In Fig. 5 is illustrated the condition prevailing in any cylinder ready to deliver the exhaust stroke. In Fig. 6 is illustrated the condition prevailing in any cylinder ready to deliver the charging stroke. In Fig. 7 is illustrated the condition prevailing in any cylinder ready to deliver the compression stroke.

Since the cycle is completed in one revolution of the power shaft the power of the engine seen in Figs. 1 to 7 inclusive is double that of the ordinary four stroke cycle which requires two revolutions of the crank shaft for its completion.

The cams controlling the valves have each an operative surface which will actuate the valves of any possible number of cylinders which can be radially located on a frame about a power shaft. The ignition of the gas in any cylinder at the proper time is accomplished by a timer secured directly on the power shaft.

The elliptically grooved cams being fastened to the fly wheels act as a part of them at all times. This cannot be accomplished by the crank shaft drive which is used on the four stroke cycle engine without counterbalancing, which produces an increase of weight and loss of power.

It will now be apparent that we have devised a novel and useful construction of an engine which embodies the features of advantage enumerated as desirable in the statement of the invention and the above description, and while we have, in the present instance, shown and described preferred embodiments thereof which will be found in practice to give satisfactory and reliable results, it is to be understood that the same are susceptible of modification in various particulars without departing from the spirit or scope of the claims or sacrificing any of the advantages of the invention.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent, is:—

1. In an engine, the combination of a housing, a shaft journaled therein, equidistant cylinders fixed to the housing and spaced apart about the shaft, pistons movable in said cylinders, means for actuating said pistons, piston rods connected to the pistons and extending within the housing, links connected at one end to the inner portions of the piston rods and pivotally connected at their opposite ends to the housing, anti-friction rollers connected with the inner portions of the piston rods, spaced disks, at opposite sides of the rods and links, fixed on the shaft and having elliptical cam grooves in which said rollers are disposed, outer disks fixed to the shaft and arranged against the outer sides of the cam disks and having inwardly-extending retaining flanges surrounding the cam disks, and transverse means connecting the several cam disks and outer disks.

2. In an engine, the combination of a housing, a shaft journaled therein, equidistant cylinders fixed to the housing and spaced apart about the shaft and each having an inlet port at one side adjacent to its outer end and an exhaust port at its opposite side adjacent to its outer end, valves controlling said ports and having rods extending toward the shaft, means tending to normally close said valves, pistons movable in said cylinders, piston rods connected to the pistons and extending within the housing, links connected at one end to the inner portions of the piston rods and pivotally connected at their opposite ends to the housing, anti-friction rollers connected with the inner portions of the piston rods, spaced disks, at opposite sides of the rods and links, fixed on the shaft and having elliptical cam grooves in which said rollers are disposed, outer disks fixed to the shaft and arranged against the outer sides of the cam disks and having inwardly-extending retaining flanges surrounding the cam disks, transverse means connecting the several cam disks and outer disks, and cams fixed to the shaft at the outer sides of said outer disks with their perimeters opposed to the inner ends of the said valve rods.

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