Sept. 24, 1957 C. MALONEY 2,807,248

INTERNAL COMBUSTION ENGINE

Filed Dec. 5, 1955

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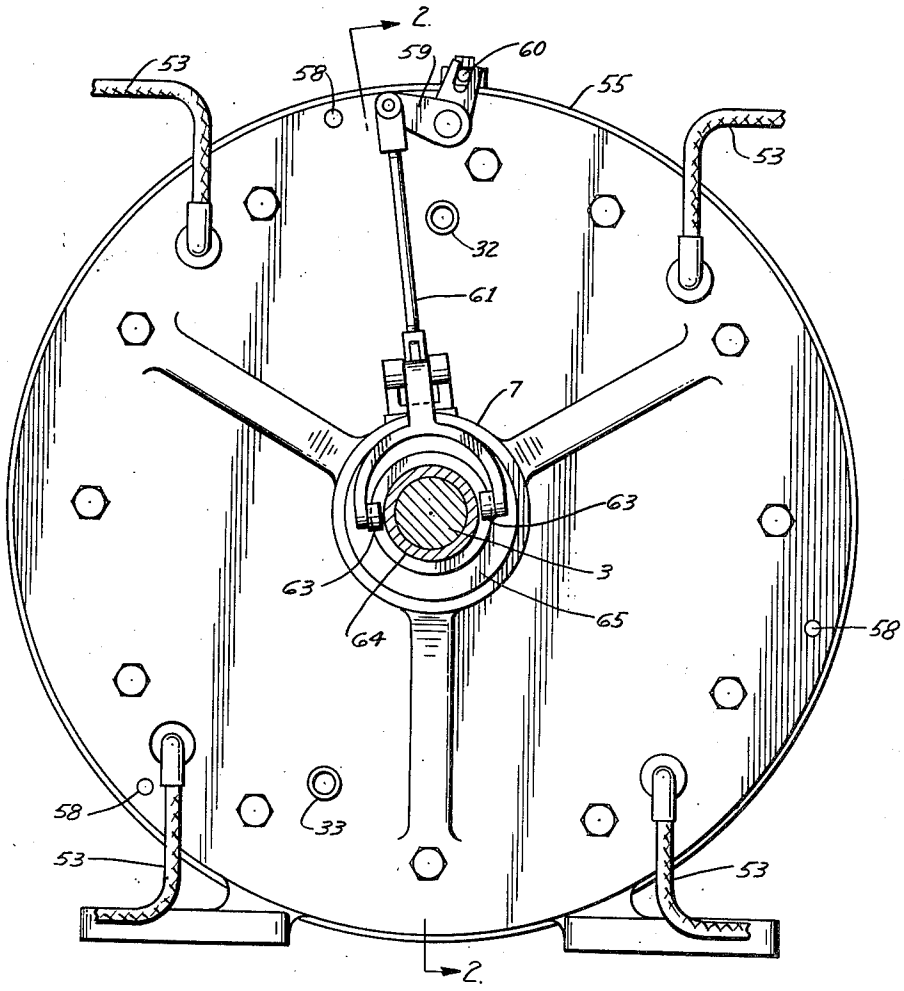



Fig. 1.

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4 Sheets-Sheet 2

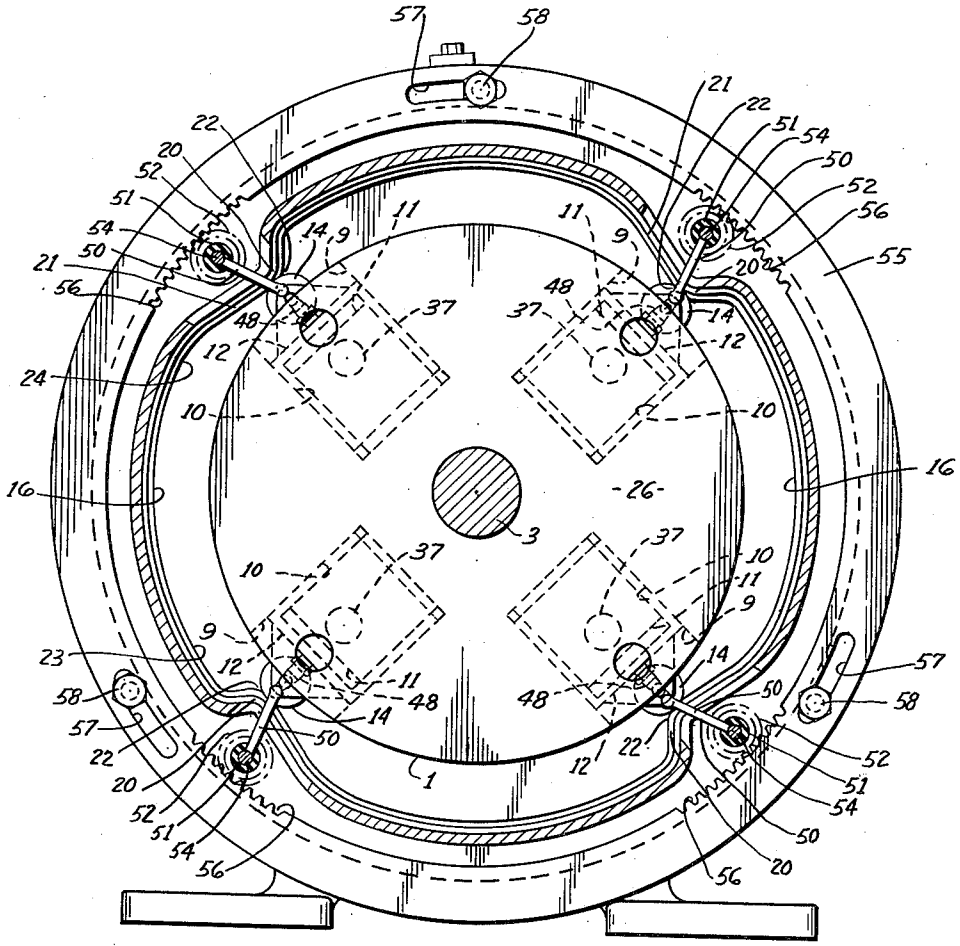



Fig. 3

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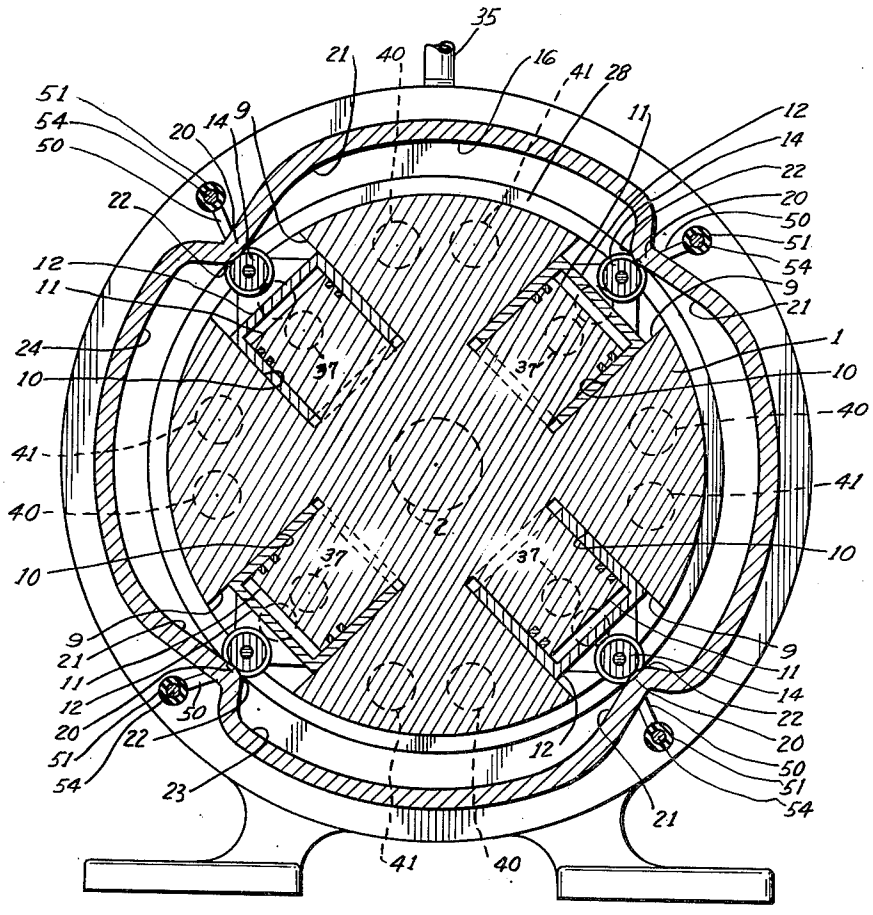



Fig. 4.

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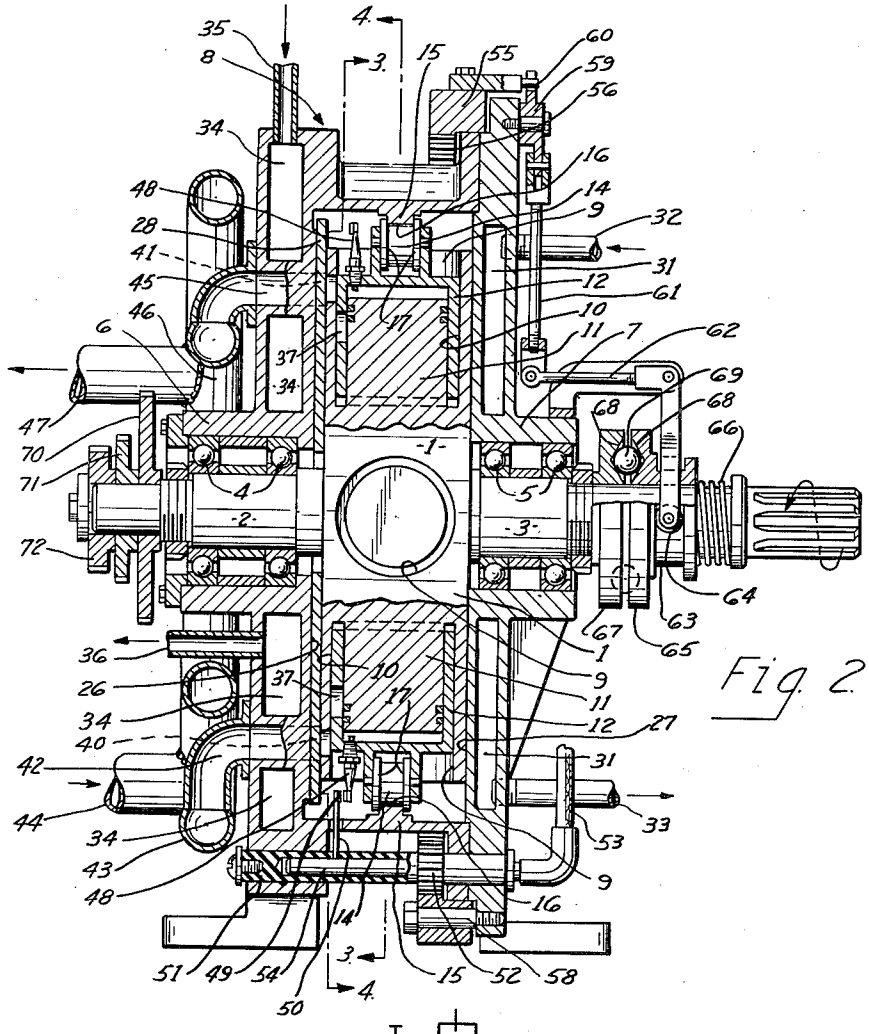



Fig. 2.

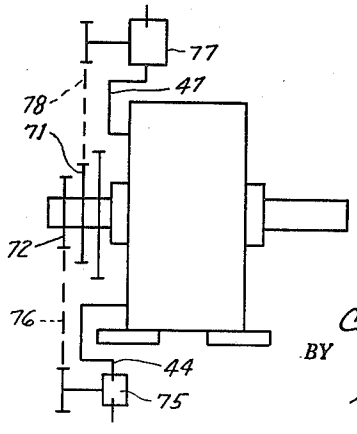



Fig. 5.

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2,807,248

# INTERNAL COMBUSTION ENGINE

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Application December 5, 1955, Serial No. 551,085

6 Claims. (Cl. 123—44)

This invention relates to internal combustion engines and particularly to internal combustion motors of the radial piston and cylinder type.

In most of the conventional crankshaft types of internal combustion motors, the cycling is such that each piston and cylinder completes one complete cycle, including a power stroke, an exhaust stroke, an intake stroke, and a compression stroke, once for each two successive revolutions of the crankshaft. The power developed in such engines is transmitted from each piston successively to the crankshaft by a connecting rod. The power is supplied by the connecting rod to the crankshaft in the form of two components, the most important being the component which is tangential to the path of rotation of the axis of that bearing of the crankshaft which is connected to the connecting rod. Generally, the eccentricity of the axis of such bearing and the axis of rotation of the shaft is quite short and hence imposes a limitation on the developed torque.

The power input into the crankshaft of the prior motors of the type described is in a series of successive impulses applied at the end of short lever arms relative to the axis of rotation of the crankshaft. For smoothness of the operation, such a motor requires a heavy flywheel rotatable with the crankshaft, and preferably a large number of short stroke cylinders. The flywheel is, in fact, the principal rotating member or rotor of the motor.

The internal combustion motor of the present invention is one in which the thrust of the piston and cylinder assemblages are applied directly to the principal rotating body member or rotor of the motor and at a relatively great distance outwardly from the axis of rotation of rotor.

Further, the arrangement of the present motor is such that the thrust applied to the rotor for causing its rotation is directed more nearly tangentially to the path of rotation of the rotor at the point of application at all times.

Another advantage of the present motor is that a large number of complete cycles of operation of each piston and cylinder assembladge can be effected during a single rotation of the rotor, whereas two revolutions for each cycle are required in the conventional internal combustion engine.

Other advantages reside in the manner of timing the present structure.

Additional objects and advantages will become apparent from the following description wherein reference is made to the drawings, in which:

Fig. 1 is a right end elevation of an internal combustion motor embodying the principles of the present invention, part thereof being shown in section for clearness in illustration;

Fig. 2 is a vertical longitudinal sectional view through the axis of the motor illustrated in Fig. 1, and is taken on line 2—2 thereof, part thereof being shown in elevation;



Figs. 3 and 4 are vertical cross-sectional views taken on the lines 3—3 and 4—4, respectively, of Fig. 2; and

Fig. 5 is a flow diagram showing the introduction of fuel into, and the exhaust of products of combustion from, the motor illustrated in Figs. 1 through 4.

Referring to the drawings the motor comprises a solid disc-like rotor 1 having coaxial shafts 2 and 3 extending from opposite ends thereof and preferably integral therewith. The shafts 2 and 3 are mounted for rotation in suitable dual antifriction bearings 4 and 5, respectively, which, in turn, are mounted in end covers 6 and 7, respectively, of a rigid casing indicated generally at 8. The end covers 6 and 7 may be of the usual bell formation with hub portions in which the shafts 2 and 3 are supported on their respective sets of bearings 4 and 5.

The rotor, at regularly spaced intervals about its circumference, is provided with a plurality of cylinder bores 9 each of which extends radially partway inwardly from the periphery of the rotor and connects at its inner end with an annular channel 10 of which the outer circumferential wall is concentric with, and of the same diameter as, the bore 9. This arrangement provides, for each bore 9, a central boss or piston 11, concentric with the bore 9 and channel 10 and of the same diameter as the inner circumferential wall of the channel.

Mounted in each bore 9 and its associated channel 10, with operating clearance, is a cylinder 12 which cooperates with the boss or piston 11 to provide a relatively reciprocating piston and cylinder assemblage. The cylinder 12 operates with its outer circumferential wall in sealed sliding engagement with the circumferential wall of the bore 9 and the outer circumferential wall of the channel 10, and with its inner circumferential wall in sealed sliding engagement with the outer wall of the piston 11.

At its outer end, each cylinder is provided with a cam roller 14 which is adapted to engage and roll upon a circumferential reaction cam 15. The cam 15 has a raised track 16 and the roller 14 is provided with suitable flanges 17 which engage the sides of the track and constrain their associated cylinder 12 from rotation about its own axis, thus keeping the cylinder in fixed position circumferentially of the piston 11 or bore 9 for proper valving relation, as hereinafter set forth.

The track 16 of the cam 15 is porvided with a plurality of lobes 20, the number depending upon the firing arrangement desired. In the form illustrated, the cam shown is one havinge four lobes 20 spaced equi-distantly about the cam 15.

Each lobe 20 has a gradual incline 21 which is arranged so that, as the rotor is driven forwardly, the incline 21 first is engaged by a roller 14 and moves the cylinder 12 gradually on its inward or compression stroke. The peak 22 of each lobe is positioned so that the maximum compressions of the charge within the cylinder, consistent with efficiency, is obtained at the instant of firing.

It is to be noted that continuing in the direction of rotation of the rotor 1, each lobe drops off or outwardly rapidly from its peak 22, preferably at about 45° or more so as to impart a large component of thrust tangentially of the path of rotation. The remaining portion 23 of the track 15 is preferably almost substantially circular, this portion being of sufficient extent so that the cylinders do not move appreciably outwardly or inwardly as they pass porting position, as hereinafter described, after which, for example, beginning at a point 24 in advance of the next lobe the incline 21 begins.

The rotor 1 is provided with flat end faces 26 and 27, respectively. The face 26 engages the flat inner face of a wear resistant bearing or sealing plate 28, and the face 27 engages a flat inner face of the right hand end cover

plate 7 of the casing. The plate 28, in turn, is firmly affixed to, and in heat conducting relation with the end cover 6 of the casing.

Both of the end covers of the casing are arranged with water jackets for cooling. Thus the end cover 7 is provided with an internal cooling passage 31 into which circulating cooling water is admitted through a pipe 32 and from which it is discharged through a pipe 33. The end plate 6 is provided with an internal cooling passage 34 into which cooling water is admitted through a pipe 35 and from which it is discharged through a pipe 36. Each cylinder 12 is provided with a valve port 37.

In order to admit fuel to the cylinders through the ports 37, suitable inlet ports 40 are provided in the bearing plate 28. These ports are arranged in the direction of rotation in advance of the lobes of the cams, respectively. Correspondingly, the end exhaust ports 41 are provided in the plate 28, one exhaust port for each inlet port 40. In the direction of rotation, each port 41 precedes its associated inlet port 40 so that the port 37 of each cylinder first passes a port 41 for exhausting therethrough and then passes port 40 for receiving the charge of combustible fuel mixture therefrom.

The inlet ports 40 are connected by ducts 42, respectively, to an intake manifold 43 to which fuel is supplied through a line 44. The exhaust ports 41 are connected by ducts 45, respectively, to an exhaust manifold 46 which leads to an exhaust pipe 47.

The combustible mixture supplied to the intake manifold 43 may be supplied under pressure from a suitable pump and the products of combustion from the exhaust manifold may be withdrawn by subatmospheric pressure by a suitable exhaust pump connected to the manifold, whereby almost instantaneous evacuation and recharging of each cylinder 12 is accomplished as it moves between adjacent lobes of the cam track 16.

In order to fire its charge, each cylinder is provided with a conventional type of spark splug 48. Thus each spark plug is carried by, and rotates with, the rotor 1 itself through the medium of its associated cylinder 12.

For distributing to the spark plugs the necessary high tension current for providing ignition, a plurality of distributor points 49, respective to the cylinders 12, are provided. The points 49 are arranged in proper position with respect to the lobes 20 to effect firing at the desired relative position of each cylinder relative to its instantly associated lobe. Each distributor point 49 is mounted on a suitable arm 50 and is supported thereby so as to be so closely alongside the path of rotation of the outer ends of the spark plugs that the spark can jump from the point to the passing plug and therefore provide a suitable spark within the cylinder.

Each of the arms 50 is mounted on a suitable insulated shaft 51. Each shaft 51 is mounted for rotation about its axis in the casing by a gear 52. High potential electric power is supplied from a conventional source to the distributor points through suitable wires 53 and electrodes 54.

Mounted in the casing 6 in concentric relation to the rotor and for limited adjustment circumferentially of the casing is a timing ring 55. At spaced portions about its length, the ring 55 is provided with rack segments 56 which are in driving engagement with the gears 52, respectively. The ring 55 is provided with elongated circumferential slot 57 through which extend bolts 58 by which the ring may be clamped, if desired, firmly in position in circumferentially fixed position in the casing. By loosening the bolts the ring 55 is supported for rotation a limited amount about the axis of the rotor, thus causing the rotation of the gears 52 and swinging the distributor points 49 to and fro along the path of rotation. This changes the position of the points circumferentially of the cam 15 relative to the lobes of the cam and thus changes the timing of the motor.

If automatic timing is desired, the bolts 58 can be set so as to allow the ring 55 to float slightly circumferentially and the ring then can be controlled by a suitable governor. In the form illustrated, the governor for shifting the ring circumferentially comprises a bell crank 59 operatively connected to the ring 55 by means of the pin 60 so that upon rocking of the bell crank the ring can be shifted circumferentially of the axis of rotation of the rotor 1. The bell crank 59 is connected to a rod 61 which, in turn, is connected to one end of a bell crank 62. The other end of the crank 62 is connected to a yoke which carries rollers 63. The rollers 63 operate in a peripheral slot 64 in a movable clutch plate 65 which is mounted on the shaft 3 for movement axially thereof. A spring 66 yieldably urges the plate 65 inwardly toward the rotor 1 or casing. Also mounted on the shaft 3 for rotation therewith is a clutch plate 67. The clutch plates are provided with grooves 68 which are aligned endwise of the rotor and in whrich are balls 69. The walls of the grooves 68 converge outwardly radially of the shaft 3. Accordingly, as the speed of rotation increases, the balls are thrown outwardly by centrifugal force and force the movable clutch plate 65 endwise away from the rotor against the force of the spring 66. The movable plate 65 moves the rollers 63 and their supporting yoke outwardly, thereby operating the bell cranks 62 and 59 to shift the ring 55 circumferentially to different positions depending upon rotor speed. This action advances and retards the spark.

Different adjustments can be obtained by screwing the rod 61 in and out of the yoke which carries the rollers 63.

On the shaft 2, at the opposite end of the rotor 1 from the governor, are sprockets 70, 71 and 72. All of these sprockets are rotatable with the shaft 2. The sprocket 70 is connected by means of a driving chain to a conventional motor starter. The sprockets 71 and 72 are connected by suitable driving chains to a conventional exhaust pump and to a conventional inlet blower or pressure pump, respectively, the first pump being driven to maintain subatmospheric pressure in the exhaust manifold 46 and the blower or pressure pump being adapted to maintain a supply of gaseous fuel under pressure in the manifold 43.

In Fig. 5 there is shown diagrammatically an inlet pump 75 connected to the pipe line 44 and driven by a suitable chain 76 from the sprocket 72 and an exhaust pump 77 connected to the pipe line 47 and driven by a chain 78 from the sprocket 71.

In operation, therefor, the motor is driven initially by a suitable starter until the rotor rotates to a position in which the cylinders 12 have received a charge of combustible mixture and have reached substantially the peak 22 of the lobes 20 of the cam 15. Thereupon firing occurs and, due to the reactance of the rollers 14 with the steep sloping sides of the associated cam, between the peaks 22 and low points 23, the rotor is urged in the clockwise direction in Fig. 3, as indicated by the arrow, the rotor itself acting as its own flywheel. Partway to the next cam lobe the cylinder ports 37 are aligned with the ports 41 whereupon, due to the exhaust pump 77, the spent gases are promptly discharged. The port 37 cannot be shifted from its proper position circumferentially of the bore 9 due to the coaction of the cam track 16 and flanges 17 of the rollers 14. Shortly therebeyond in the direction of rotation, the cylinder ports 37 are aligned with the inlet ports 40 through which new charges are taken into the cylinders. The new charges are compressed as the roller rises along the sloping portion 21 of the cam. Firing occurs at the proper position relative to the peak of the cam, depending upon the type of power desired, whether slower speed with greater torque or higher speed with less torque. The end wall of the rotor fits slidably against the plate 28 in sufficiently sealed relation to prevent the escape of exhaust gases and intake gases therebetween. Thus all cylinders fire simultaneously four times for each revolution of the rotor. As a result of the repeated firings at each one quarter

revolution and the dynamic inertia of the heavy rotating rotor, a smooth flow of power is obtained.

Having thus described my invention, I claim:

1. In a motor, a rotor, a casing, means supporting the rotor in the casing for rotation about a predetermined axis, a plurality of piston and cylinder assemblages carried by the rotor, a multi-lobed reactance cam coaxial with the rotor, reactance rollers respective to the assemblages and operatively connecting the same to the cam for causing the assemblages to rotate the rotor on their firing strokes, for operating the assemblage on their compression strokes, and for controlling the operation of the assemblages on their intake strokes and exhaust strokes, means having a closure wall with sets of ports therein, the sets being arranged, in a direction circumferentially of the rotor, between the peaks of the adjacent lobes of the cam, respectively, each set including an exhaust port and an inlet port, the inlet port of each set being positioned, in the direction of rotation of the rotor, beyond the exhaust port of the set, said rotor having a wall in slide fitting relation to said closure wall and with ports therein respective to the assemblages and cooperable, successively, with the ports of each set upon rotation of the rotor, conduit means connecting the rotor ports to the interiors of the assemblages, respectively, and firing means for the assemblages, arranged for firing each assemblage, as many times during each revolution of the rotor, as there are lobes.

2. In a motor, a rotor, a casing, means supporting the casing for rotation about a fixed axis, a plurality of piston and cylinder assemblages carried by the rotor and distributed circumferentially thereof and having their axes disposed radially thereof, a multi-lobed cam coaxial with and surrounding the rotor, each of said assemblages including a piston member and a cylinder member, one of said members of each assemblage being in fixed relation to the rotor and the other being reciprocable radially of the rotor, reactance means on the reciprocable ones of the members and in engagement with the cam, said rotor having an end wall with ports therein respective to the assemblages and passages leading from said ports into the interior of the assemblages, respectively, means having a closure wall juxtaposed against the said end wall of the rotor and normally closing said ports in all relatively rotated positions of the rotor, said closure wall having sets of ports arranged respectively between successive lobes, the sets being equal in number to the assemblages, each set including an inlet port and an outlet port and both said inlet and outlet port being positioned for registry, successively, with the ports of the rotor as the rotor rotates, manifold means to supply combustible fuel to the



inlet ports of said sets, exhaust manifold means connected to the outlet ports of said sets, and means for firing each assemblage, as many times during each revolution of the rotor as there are lobes and in predetermined relation to the relative positions of each assemblage and the lobes.

3. A structure according to claim 2 characterized in that the firing means comprise spark plugs respective to the assemblages and rotatable with the rotor, distributor points arranged about the path of the rotor and closely along side the path of the outer ends of the spark plugs so that sparks from a source can jump from the points to each spark plug, successively, as the plugs pass thereby.

4. A structure according to claim 3 characterized in that means are provided to shift the circumferential position of the points relative to the lobes.

5. A structure according to claim 4 characterized in that governor means are provided and are arranged for operation by the rotor in response to the speed of the rotor, means are operable by the goveronr means, when the governor means is operated, to shift the distributor points circumferentially of the rotor.

6. A structure according to claim 2 characterized in that the cylinder members are the reciprocable members, that the rotor has radial bores extending inwardly thereof from the outer periphery thereof, the pistons are in fixed relation to the rotor and are coaxial with and extend outwardly from the inner ends of the bores partway only toward the outer ends of the bores, each cylinder member is in slide fitting relation interiorly with the exterior of its associated piston member and exteriorly with the wall of its associated bore, the ports of the rotor are connected with the bores, respectively, radially outwardly from the axis of rotation beyond the outer ends of the piston members, and each cylinder member has a port adapted to register with the associated port of its bore in an extended position of the cylinder member, and said cylinder members and cam are arranged so that the cylinder members are in extended positions when their ports and associated bore are passing the ports of said closure wall.

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