May 19, 1925. 1,538,208

H. A. NORDWICK ET AL

INTERNAL COMBUSTION MOTOR

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Fig. 1

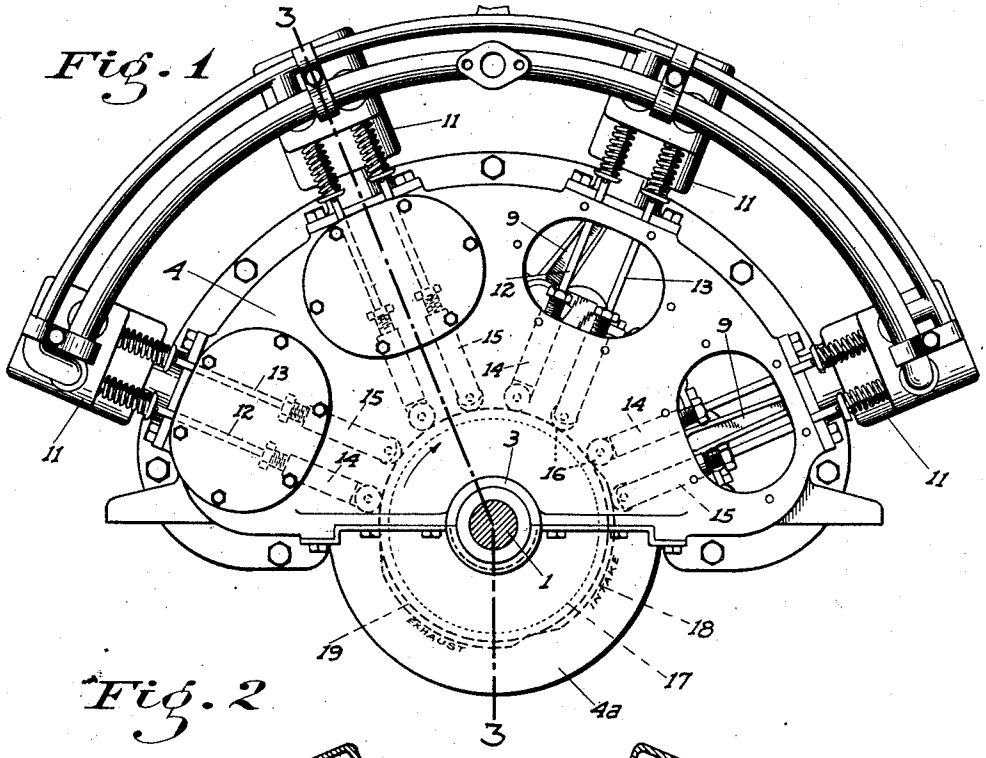
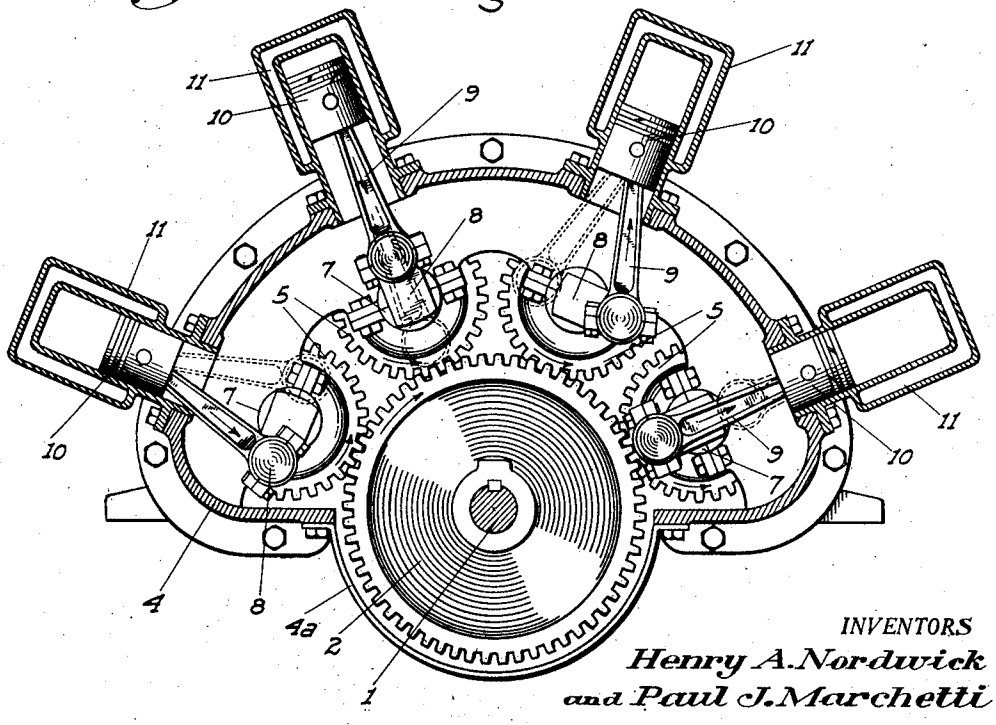


Fig. 2



INVENTORS
Henry A. Nordwick
and Paul J. Marchetti

BY Benj. F. Webster ATTORNEY

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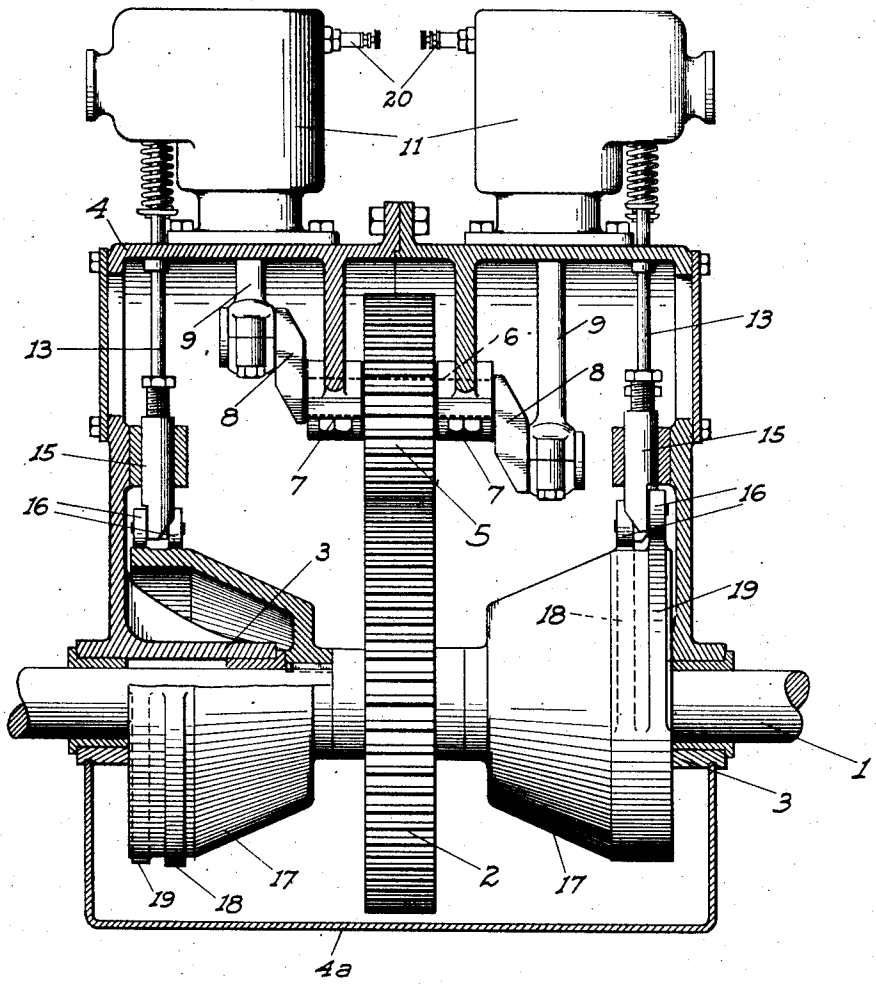
Fig. 3



INVENTORS

Henry A. Nordwick and
Paul J. Marchetti

BY *Chas. S. Webster* *ATTORNEY*

Patented May 19, 1925. 1,538,208

UNITED STATES PATENT OFFICE.

HENRY A. NORDWICK AND PAUL J. MARCHETTI, OF STOCKTON, CALIFORNIA.

INTERNAL-COMBUSTION MOTOR.

Application filed October 19, 1923. Serial No. 669,461.

To all whom it may concern:

Be it known that we, HENRY A. NORDWICK and PAUL J. MARCHETTI, citizens of the United States, residing at Stockton, county of San Joaquin, State of California, have invented certain new and useful Improvements in Internal-Combustion Motors; and we do declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, and to the characters of reference marked thereon, which form a part of this application.

This invention relates to improvements in gas engines of that general type which has a plurality of cylinders grouped radially about the drive shaft; the principal object of our invention being to provide an engine of this character so constructed that the power impulses of the different cylinders overlap and are distributed evenly and continuously to the shaft, so that there is no point in a complete revolution of the shaft when the latter is not under power, and the engine will be practically vibrationless and will deliver great power for its size and weight.

Another object is to construct the engine in such a manner that the only strain on the drive shaft is the natural revolving torque, the blows or impulses of the piston or connecting rods not being transmitted direct to said shaft, so that there is no bending strain applied to the latter. This construction enables a light shaft with only two bearings being used, and insures that such bearings, if once properly fitted, will wear without requiring take-up or running out of true, for a very long time.

A further object is to provide an engine so constructed that a very shallow pan, below the shaft, may be used, thus making our engine very suitable for marine use, where space below the shaft is usually cramped.

The engine is also constructed so that the drive shaft is indirectly driven from the pistons, and at a slower relative speed, so that without further "gearing down" such as is frequently resorted to, our engine is admirably adapted for airplane and similar service.

A still further object is to construct the engine so that all the parts, with the exception of the case, are small and of simple formation, and independent of each other, so that any one of the same may be easily withdrawn and replaced with a minimum of expense.

These objects we accomplish by means of such structure and relative arrangement of parts as will fully appear by a perusal of the following specification and claims.

In the drawings similar characters of reference indicate corresponding parts in the several views.

Fig. 1 is a front end view of the engine.

Fig. 2 is a sectional front view of the same.

Fig. 3 is a longitudinal section taken on the line 3—3 of Fig. 1.

Referring now more particularly to the characters of reference on the drawings, the numeral 1 denotes the drive shaft, fixed on which is a gear 2. This shaft, on opposite sides of said gear, is journaled in bearings 3 formed on a casing 4, the end walls of which are preferably parallel to the gear while its surface between said walls and above the shaft is concentric therewith, said casing preferably terminating in a horizontal plane in alinement with said shaft. A pan 4^a, which need be no greater in diameter than sufficient to clear the gear, is secured to the casing and encloses the lower half of the gear.

Meshing with the gear 2 are pinions 5, half the size of the gear, and spaced each from the other a distance of 45°. These pinions are fixed on individual shafts 6 journaled in bearings 7 formed with the casing, each shaft having opposed crank arms 8 beyond the bearings.

Connecting rods 9 extend from the cranks to pistons 10 slidable in cylinders 11 mounted on the casing, there being two parallel sets of the cylinders, four in each set, those of each set being in radial alinement with lines drawn from the shaft 1 through the shafts 6.

Each cylinder (the engine being of the four-cycle type) has the usual intake and exhaust valve mechanisms, operated from stems 12 and 13 respectively. These stems are actuated by tappets 14 and 15, having rollers 16 at their lower ends facing in opposite directions and riding on discs 17 mounted on the shaft 1 on both sides of the gear. Each disc has peripheral and trans-

versely spaced cams 18 and 19 to engage and raise, at the proper times, the rollers 16 of the intake and exhaust valves respectively, those on one of the discs being located in diametrally opposed relation to the other, since the pistons of the two sets of cylinders are similarly disposed relative to each other.

When assembling the engine, each crankshaft is arranged so as to be 90° ahead of the one ahead, considering the shaft 1 as turning to the right in Figs. 1 and 2, as is preferable.

It is of course understood that suitable ignition means, to create sparks at the plugs 20, is provided and arranged to operate in suitably timed relation with the movements of the pistons and the opening and closing of the valves.

In operation, with the arrangement of parts shown and described above, each set of four cylinders in the same transverse plane will fire, etc., one after the other, from left to right, or in the direction of rotation of the shaft 1, with a rotation of 45° of the gear 2 between adjacent cylinders, since this is the arcuate spacing of said cylinders relative to the shaft.

With each movement of 45° of the gear, the pinions will move through a 90° arc, since the gear is double the size of the pinions, and the pistons will therefore travel half a stroke. It will therefore be seen that as soon as any piston, on its firing stroke, has travelled half the length of such stroke, the next cylinder will be fired, so that the power impulses overlap, and there will never be any "dead spots" between said power impulses.

After a 45° movement of gear 2 has taken place following the firing of the cylinder farthest to the right, the left-end cylinder of the other set of four cylinders is fired, the others then following in the same order as described for the first set. This of course is both because the connecting rods, etc., of the two sets of cylinders are arranged in diametrally opposed relation to each other, and because the valve operating cams, etc., are oppositely disposed on the discs 17.

A continuous flow of power from all eight cylinders is thus had, each cylinder firing once for each revolution of the drive shaft. Between the firing impulses of each cylinder, the remaining cycles of operation—exhaust, intake and compression—of course take place automatically with the rotation of the shaft 1, since the speed of the drive shaft relative to the crank shafts is the same as that commonly employed between the cam and drive shafts of four cycle motors, so that shaft 1, with the cams operatively connected thereto, functions to operate the valves of each cylinder in the same manner as the ordinary cam shaft.

The above represents what we believe to be the most practical embodiment of the engine, taking all points into consideration, but it will be evident that a continuous flow of power may also be obtained with the use of four cylinders only, in two ways:

First, by retaining the 2 to 1 gear ratio and making use of the two-cycle principle of operation, each cylinder thus firing twice for each revolution of the drive shaft, and second, by employing the four cycle principle but increasing the gear ratio to 4 to 1, each cylinder thus also firing twice with each revolution of the drive shaft.

From the foregoing description it will be readily seen that we have produced such a device as substantially fulfills the objects of the invention as set forth herein.

While this specification sets forth in detail the present and preferred construction of the device, still in practice such deviations from such detail may be resorted to as do not form a departure from the spirit of the invention, as defined by the appended claims.

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

1. A gas engine comprising a casing, a shaft projecting therethrough, cylinders mounted on the casing and extending in parallel alinement to the shaft, a member mounted on the shaft in a plane between the cylinders, pistons in the cylinders, connecting means between said piston and shaft member to cause rotation of the shaft with the reciprocation of the pistons, valves for the cylinders, located in the sides thereof farthest from the connecting means, tappets for the valves disposed in the casing and extending toward the shaft, cylindrical members with the outer faces of which the tappets engage and having connection with the shaft adjacent the first named member thereon, and bearings for the shaft projecting inwardly from the casing toward the inner ends of the cylindrical members.

2. A four cycle gas engine comprising a drive shaft, a gear thereon, four pinions half the size of the gear meshing therewith, whereby each pinion will have two complete revolutions for each revolution of the shaft and the latter may be used as a valve-operating cam-shaft, a crank shaft for each pinion having cranks 180° apart, the cranks of each shaft being set 90° apart relative to the cranks of adjacent shafts, a pair of cylinders for each crank shaft, two transverse rows of four cylinders each being thus provided; pistons in the cylinders operatively connected to the corresponding cranks, valves for the cylinders, operating means therefor, and cam means mounted with the drive shaft for actuating said operating means of each cylinder in rotation and once

for each revolution of the shaft, the pinions being spaced 45° apart about the gear whereby to enable power impulses to be imparted to all the pistons of one row in successive and overlapping order and then to the pistons of the other row in corresponding order and so that a stroke of an end piston of one row overlaps the corresponding stroke of the opposite end piston of the other row.

In testimony whereof we affix our signatures.

PAUL J. MARCHETTI.
HENRY A. NORDWICK.