

Mar. 3, 1925.

1,528,164

H. A. NORDWICK

INTERNAL COMBUSTION ENGINE

Filed May 6, 1922

2 Sheets-Sheet 1

Fig. 1

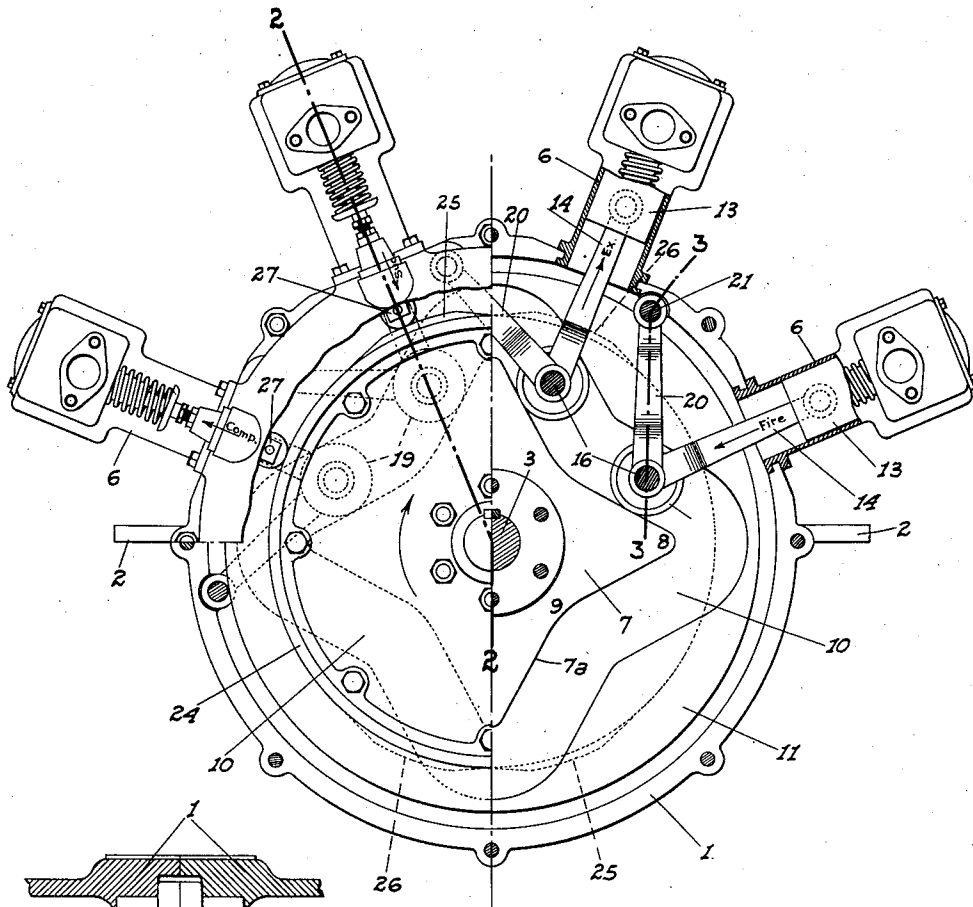
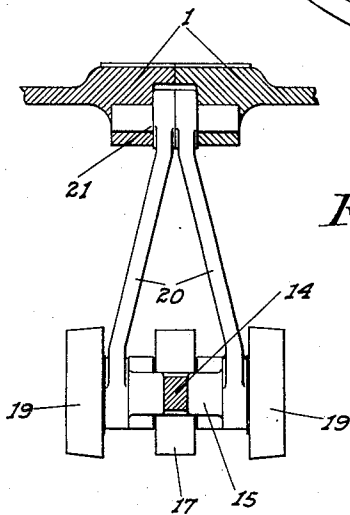


Fig. 3



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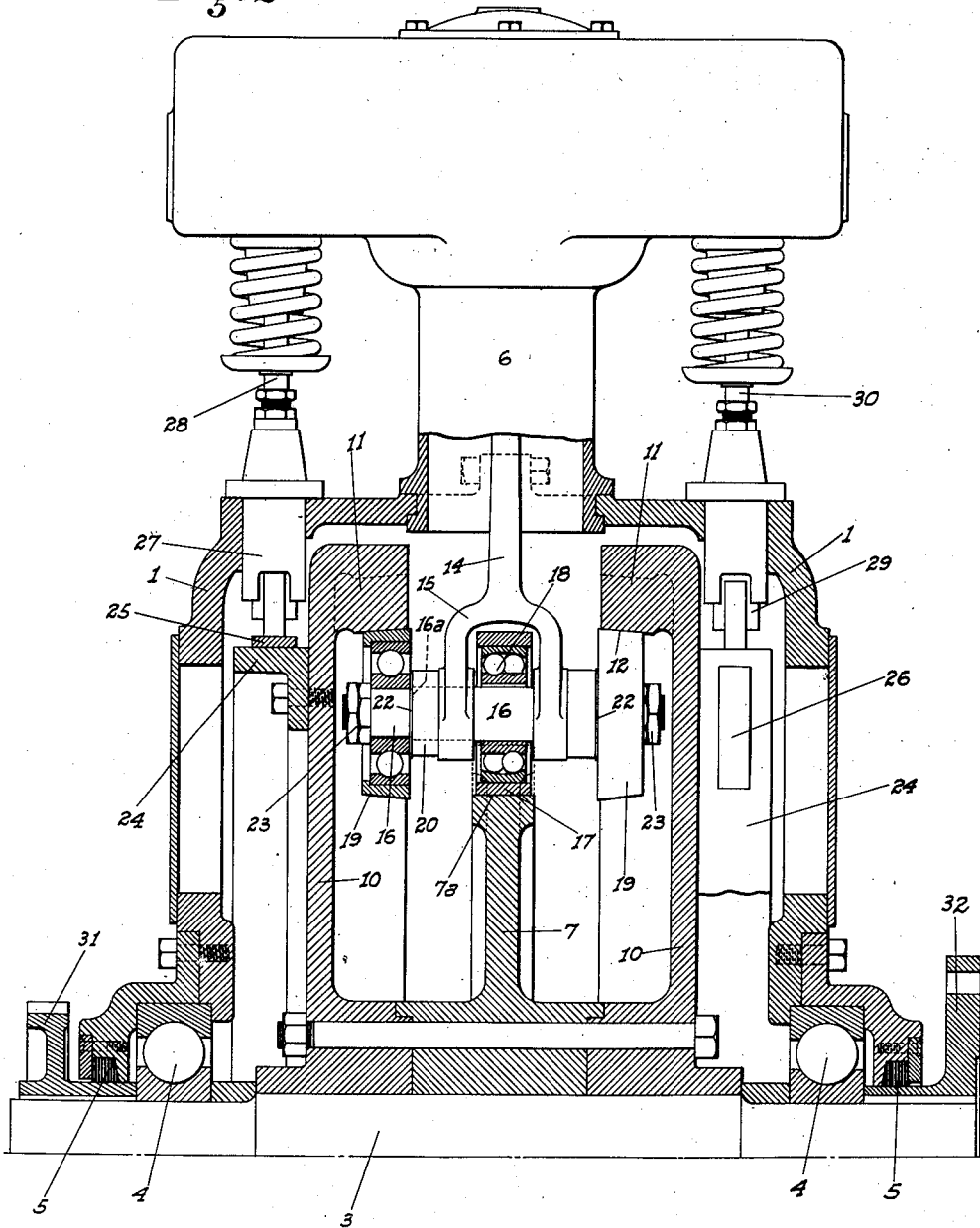
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2 Sheets-Sheet 2

Fig. 2



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Patented Mar. 3, 1925.

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UNITED STATES PATENT OFFICE.

HENRY A. NORDWICK, OF STOCKTON, CALIFORNIA, ASSIGNOR, BY MESNE ASSIGNMENTS, OF ONE-HALF TO PAUL J. MARCHETTI, OF STOCKTON, CALIFORNIA.

INTERNAL-COMBUSTION ENGINE.

Application filed May 6, 1922. Serial No. 559,018.

To all whom it may concern:

Be it known that I, HENRY A. NORDWICK, a citizen of the United States, residing at Stockton, county of San Joaquin, State of California, have invented certain new and useful Improvements in Internal-Combustion Engines; and I 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 internal combustion or gas engines, and particularly to a type in which the cylinders are arranged in a common plane radially of the crank shaft, the latter having cam-track means operatively connected to be turned with the reciprocation of the pistons.

The present engine is fundamentally of the same type as that shown in my United States Patent No. 1,374,164, dated April 5th, 1921, and in the arrangement of certain parts represents an improvement thereover.

The principal object of the present invention is to construct an engine of the above type so that the power-stroke cam is directly under the central plane of the cylinders and connecting rods of the pistons, so that the power is transmitted to the shaft in an undeviating line.

Another object is to provide suction and exhaust stroke cams independent of the power-stroke cam against all of which the connecting rods bear; and to provide means whereby the rollers may always be kept in close contact with both sets of cams, thereby preventing any lost motion, when the piston-strokes are reversed, thus eliminating the noisy operation and rapid wear of the parts inevitable with play therebetween.

A further object is to provide for enabling the cylinders to be fired in direct sequence, giving a very steady operation of the engine and enabling a single valve operating cam being used to actuate the intake valves of all the cylinders for one cycle of operation, and similarly a single cam for the exhaust valves.

A further object of the invention is to produce a simple and inexpensive device and yet one which will be exceedingly effective for the purposes for which it is designed.

These objects I 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 side view of the engine with the adjacent casing member removed, and half in section, through the cylinders.

Fig. 2 is a half cross section, enlarged, taken on the line 2—2 of Fig. 1.

Fig. 3 is a fragmentary 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 a casing, cylindrical in form, and preferably made in two parts split on a vertical plane, for ease of manufacture and assembly, each part being of the same size. Pads 2 project from the casing to enable the latter to be supported on a suitable base.

Journalled in the casing axially thereof and projecting therefrom at both ends is the drive shaft 3, annular ball bearings 4 being preferably employed, with oil-packing means 5 about the shaft outside the bearings, whereby the casing is made substantially oil-tight.

Fixed onto the casing and projecting outwardly thereof are the cylinders 6, preferably four in number, these being positioned in a common plane at right angles to the shaft and radially thereof, and spaced apart an even distance from each other.

Fixed on the shaft 3 in the plane of the center line of the cylinders is a cam-disc 7, having an even number of high points or major axes 8, and a corresponding number of low points or minor axes 9, positioned half way between the major axes, there being four of each of these points, which points are connected to form a star-shaped track 7^a on its outer surface.

Likewise fixed on the shaft and spaced from the disc 7 on both sides thereof are discs 10, which have overhanging flanges 11 extending toward the disc 7, the inner surfaces of which flanges are shaped symmetrical with or follow the contour of the cam track 7^a, but spaced outwardly thereof.

These latter tracks have a taper or slope inwardly and away from the disc 7 as shown at 12 in Fig. 2, for a purpose as will appear.

The cylinders are provided with pistons 13 in which are pivoted in the usual manner

the connecting rods 14, whose lower ends are formed as forks or yokes 15 which carry spindles or pins 16 disposed parallel to the shaft 3. On each pin between the
5 connecting rod fork is a roller 17 riding on the central track-surface 7^a, this roller preferably having ball bearings 18 between the same and the pin.

It will be noted that the cylinders are so
10 disposed that the rollers always bear on adjacent surfaces of the track, that is, between each successive minor and major axis, thereof. The cycle-order of each piston is therefore always but one stroke ahead of or behind that of the adjacent piston.
15

Mounted on the outer ends of the pins for longitudinal adjustment thereon are ball-bearing rollers 19, which bear against the tracks 12 and whose outer faces are
20 tapered or sloped to conform to the slope of said tracks.

Pivoted on each pin intermediate the fork 15 and rollers 19 are tension rods 20 which extend to a common pivotal mounting 21 with the casing at a point outwardly
25 of the cam-discs and to the rear of the corresponding connecting rod with regard to the direction of rotation of the shaft and discs.

Adjustment of the rollers 19 when necessary may be had by any suitable means, one way being to place shims 22 as needed between each roller and the adjacent rod to bear against the shoulder 16^a of the pin 16,
35 employing adjustable locknuts 23 on the pin 16 to clamp the inner race of the roller-bearing against the shims at the opposite ends.

By reason of this feature, if the inner cam track 7 or roller 17 wears faster than the
40 outer tracks, either or both the rollers 19 may be moved to always contact with the tracks 11 and take up the relative difference in radial spacing thus had between the
45 tracks, which if not the exact width of the rollers means lost motion with its consequent evils. This feature also aids in manufacture, since with this adjustment being possible, it is not necessary to so accurately finish the
50 tracks with respect to the radial spacing between each other, or to have the diameter of the rollers so exact.

Fixed on the discs 10 and projecting outwardly thereof are flanges 24, each carrying
55 an opposed pair of cams 25 and 26 respectively, the former to actuate the tappets 27 of the intake valve stems 28 of the cylinders, and the latter to actuate the tappets 29 of the exhaust valve stems 30, the exhaust-valve cams being positioned to be
60 one stroke ahead of the intake-valve cams.

Since there are four each of the high and low points on the track, there are eight
65 piston-stroke cam surfaces, giving two complete cycles of operation for each cylinder,

or in other words, each cylinder fires twice for each revolution of the shaft 3.

Owing to the fact that each piston-cycle is but one stroke ahead of the next, with respect to the direction of the shaft, the
70 cylinders may be fired in 1—2—3—4 order, without alternation as usual, so that single intake and exhaust valve actuating cams suffice for the first complete cycle of operation of all four cylinders, while the other
75 and opposed cams similarly actuate the valves during the second cycle of operations.

With the arrangement of cylinders and cam tracks as shown, when No. 4 cylinder
80 has fired, No. 1 cylinder then again fires immediately after, followed by Nos. 2, 3 and 4, regardless of the fact that the cylinders are not evenly spaced about the circumference of the casing, as might at first glance
85 seem necessary. There is therefore an even flow of power to the shaft, instead of an intermittent flow as usual, giving great freedom from vibration and smoothness of operation, eliminating the need of the usual
90 heavy fly wheel, though the cam-track discs serve this purpose.

It will be noted that the suction and firing strokes always take place with the same track surfaces engaging the connecting rod
95 rollers in each instance, and the same of course is true of the exhaust and compression strokes.

The tension rods 20 allow the connecting rods to be flexibly mounted in the pistons,
100 and eliminate the need of making rigid connections of the rods with the pistons, by taking the strain and side-thrust at the roller end of the connecting rods.

Timing of the engine may be accomplished, and any suitable ignition mechanism
105 driven, by means of a pinion or sprocket 31 on one end of the shaft 3, the opposite end carrying a driving flange 32 whereby to connect the shaft to a mechanism to be driven
110 thereby.

From the foregoing description it will be readily seen that I have produced such a device as substantially fulfills the objects of the invention, as set forth herein.
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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.
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Having thus described my invention, what I claim as new and useful and desire to secure by Letters Patent is:—
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1. An internal combustion engine comprising a casing, a shaft turnably mounted therein, cylinders secured to the casing in a plane at right angles to the shaft, pistons in the cylinders, connecting rods projecting therefrom, rollers on the outer ends of the
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rods, cam-track means on the shaft against which the rollers bear, and tension rods flexibly mounted with the connecting rods adjacent the rollers and to the casing to one side of the respective cylinders.

2. An internal combustion engine comprising a casing, a shaft turnably mounted therein, cylinders secured to the casing in a common plane at right angles to the shaft, pistons in the cylinders, connecting rods projecting therefrom, a plurality of rollers spaced longitudinally of the shaft on the outer ends of the rods, one such roller on each rod being centrally thereof, a cam-track fixed on the shaft in alinement with the central rollers and whose outer surface forms the inner track on which said rollers bear, and additional track members on the shaft spaced on both sides of the central track, said last named track members having track surfaces opposed but corresponding to that of the central track and spaced outwardly thereof, and against which the outer rollers bear.

3. An internal combustion engine comprising a casing, a shaft turnably mounted therein, cylinders secured to the casing in a common plane at right angles to the shaft, pistons in the cylinders, connecting rods projecting therefrom, a plurality of rollers spaced longitudinally of the shaft on the outer ends of the rods, one such roller on each rod being centrally thereof, a cam-track fixed on the shaft in alinement with the central rollers and whose outer surface forms the inner track on which said rollers bear, and additional track members on the shaft spaced on both sides of the central track, said last named track members having track surfaces opposed but corresponding to that of the central track and spaced outwardly thereof, said outer track surfaces having a slope projecting toward the shaft away from the central track, the outer rollers bearing thereagainst and having a simi-

lar slope, and means for altering the spacing of said outer rollers with respect to the central roller.

4. An internal combustion engine comprising a casing, a shaft turnably mounted therein, cylinders mounted on the casing in a plane at right angles to the shaft, pistons in the cylinders, a plurality of rollers spaced longitudinally of the shaft mounted in connection with the pistons at their outer ends, a track mounted on the shaft on whose outer surface certain of the rollers bear, and additional track means on the shaft whose track surfaces correspond with but are opposed to the first named track and spaced outwardly thereof and against which the remaining rollers bear.

5. An internal combustion engine comprising a casing, a shaft turnably mounted therein, cylinders mounted on the casing in a plane at right angles to the shaft, pistons in the cylinders, a plurality of rollers spaced longitudinally of the shaft mounted in connection with the pistons at the outer ends, a track mounted on the shaft on whose outer surface certain of the rollers bear, additional track means on the shaft whose track surfaces correspond with but are opposed to the first named track and spaced outwardly thereof and against which the remaining rollers bear, and means for taking up any lost motion between the rollers and tracks.

6. A gas engine of the type described having the cylinders spaced forty five degrees apart and arranged to fire in consecutive order, intake and exhaust valves for the cylinders, and a pair of cams on the engine shaft for operating each class of valves, the cams of a pair being diametrically opposed and of a length such that but one valve of a class will be opened at a time with the rotation of the shaft.

In testimony whereof I affix my signature.

HENRY A. NORDWICK.