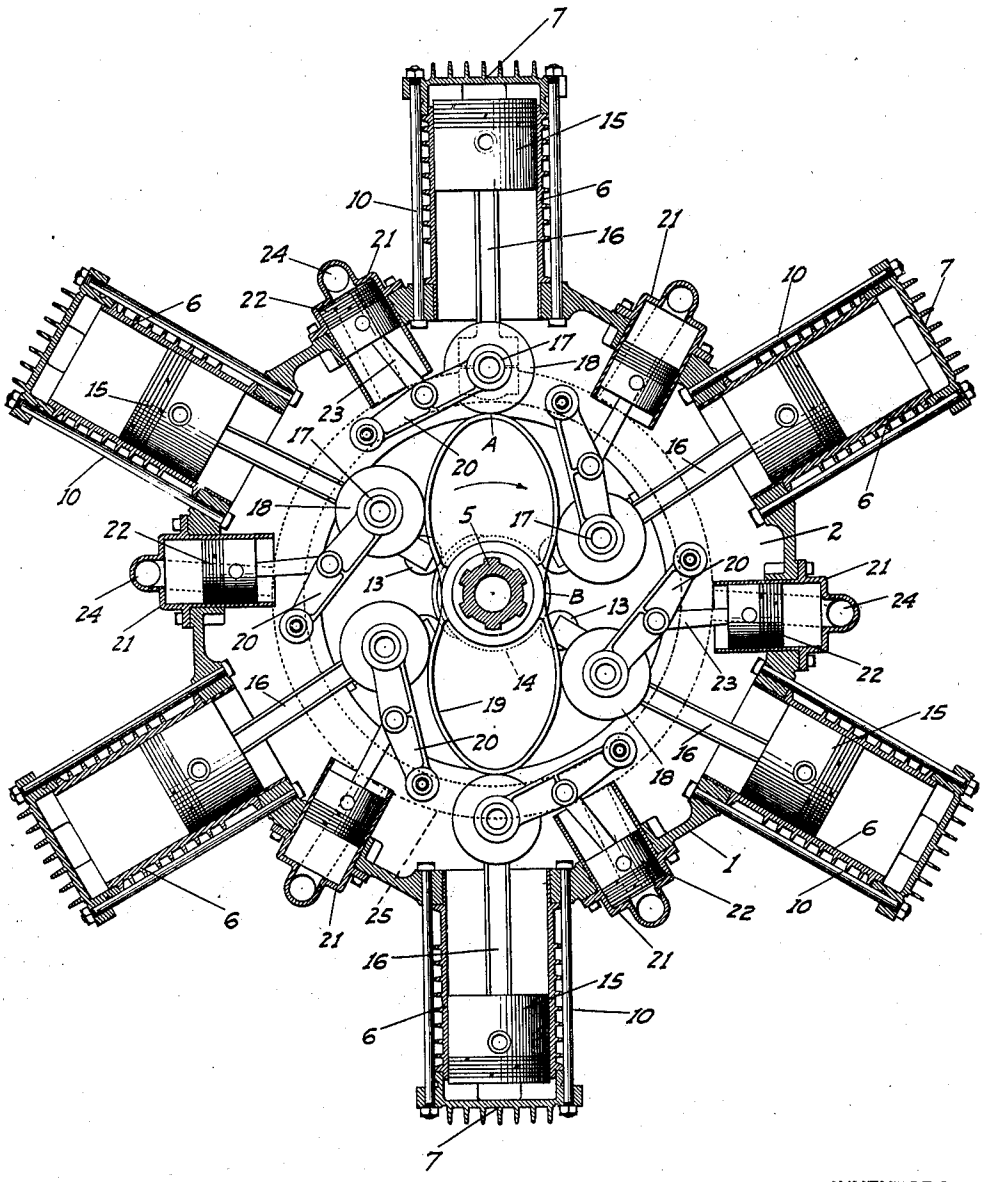
Aug. 24, 1926. 1,597,474

H. A. NORDWICK ET AL

INTERNAL COMBUSTION ENGINE

Filed Sept. 10, 1924 2 Sheets-Sheet 1

Fig. 1



INVENTORS

H. A. Nordwick
E. E. Wickersham
and Paul J. Marchetti

BY Percy L. Webster ATTORNEY

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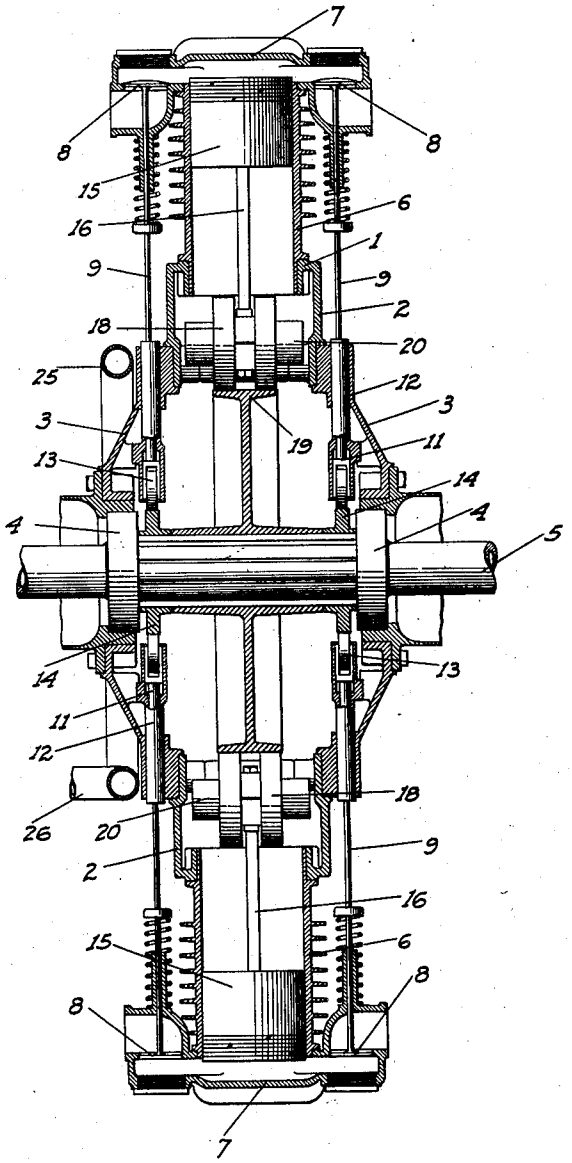
Fig. 2



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H. A. Nordwick

E. E. Wickersham

and Paul J. Marchetti

BY Percy L. Webster ATTORNEY

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UNITED STATES PATENT OFFICE.

HENRY A. NORDWICK, ELMER E. WICKERSHAM, AND PAUL J. MARCHETTI, OF STOCKTON, CALIFORNIA, ASSIGNORS, BY MESNE ASSIGNMENTS, TO SAID NORDWICK.

INTERNAL-COMBUSTION ENGINE.

Application filed September 10, 1924. Serial No. 736,899.

This invention relates to improvements in gas engines of the radially-disposed multiple cylinder type, in which a cam is used in place of a crank shaft.

The present invention particularly represents an improvement over the pending application of H. A. Nordwick, filed May 6th, 1922, Serial No. 559,018, Patent No. 1,528,164, March 3, 1925.

The present engine is especially intended for airplane use, having great power with relatively small weight, and developing a very even flow of power.

The principal object of this invention is to provide a means for causing the connecting rod rollers to firmly bear against the working face of the main shaft cam at all times, and with the use of only a single instead of a double-track cam such as was previously used. This enables the engine to be made of lesser diameter and width, with the same power.

The same structure by means of which the above end is attained, also prevents a certain pounding noise and vibration which was observed in the previous engine just at the period of reversal of movement of every piston at the top of its stroke.

A further object of our invention is to provide a cam so designed that sharp reversal of movement of the pistons is avoided, and the latter have a practically constant speed ratio relative to the rotation of the shaft, and the rollers on the connecting rods are at practically a constant pressure angle with the face of the cam irrespective of the position of the latter relative to the rods.

We have also provided cylinders of the T-head type, constructed so that the heads, with the valves mounted therein, are detachable from the main barrels of the cylinders, common means being provided for securing the heads, barrels and casing or crank case together as a rigid unit.

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

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 side section of the engine.

Fig. 2 is a cross section of the same.

Referring now more particularly to the characters of reference on the drawings, we provide a casing consisting essentially of a ring like member 1 with side flanges 2 to which are secured end plate structures 3, these three parts together being arranged to form an oil tight enclosure.

Mounted in the end plate members concentric with the ring 1 are roller or other suitable bearings 4 forming journals for the main drive shaft 5. Seated on the ring 1 radially of the shaft in a common transverse plane and in equally spaced relation circumferentially of the ring is a plurality of cylinders 6, preferably six in number. These cylinders have detachable heads 7 which project beyond the cylinders in planes longitudinally of the shaft to form chambers for the reception of intake and exhaust poppet valves 8 of ordinary character, the stems 9 of which project radially toward the shaft.

Bolts 10 pass through the heads, past the cylinder barrels and into the ring 1, thus bolting these parts firmly and individually together.

The tappets 11 for the valves are slidably mounted in suitable guides 12 secured inside the plates 3, the rollers 13 of the tappets riding on cams 14 fixed in suitable longitudinally spaced relation on the shaft 4. Each cam has a single tappet and valve lifting portion thereon, so that the corresponding valves of all the cylinders are actuated only once for each rotation of the shaft. In other words, for each revolution of the shaft, each cylinder mechanism completes one four cycle movement.

Pistons 15 are slidable in the cylinders, having swivelly mounted therein connecting rods 16 of ordinary character. These rods carry cross pins 17 on their outer ends, on each of which is mounted a pair of rollers 18, preferably formed of annular roll or ball bearings, and separated from each other by the connecting rod head.

The rollers ride on the face of a main cam 19 fixed on the shaft 5. This cam is provided with two high points A, 180° apart, and two low points B, also 180° apart, or 90° each from the high points. The radial distance between the high and low points of course determines the stroke of the pistons,

and it will thus be seen that for each quarter revolution of the shaft, each piston will have one complete stroke, or will move through a complete cycle of operations (four strokes) for each revolution of the shaft.

Between each high and low point, the cam surface is laid out or generated in such a manner that for substantially the entire distance between these points, the speed of piston travel will be constantly proportionate to the circumferential speed of the shaft, and the pressure angle of the axial line of the connecting rod rollers with the cam will be maintained practically constant.

Pivoted on the pins 17 outwardly of the rollers 18 are forked tension arms 20 which extend to the rear of the corresponding connecting rods with regard to the direction of rotation of the shaft, and are pivoted at their extremities opposite to the connecting rods onto, and extend between, the flanges 2. These arms of course take the strain and side thrust of the connecting rods at the roller ends thereof, as in said aforementioned copending application.

Mounted on the ring adjacent each of the power cylinders is an auxiliary cylinder 21, facing and substantially radial with the shaft 5. A piston 22 of ordinary character is slidable in said auxiliary cylinder, and has mounted therein one end of a connecting rod 23, the opposite end of which is connected to the corresponding tension arm 20 of the adjacent power cylinder, intermediate the ends of said arm.

All the cylinders 21 have constantly open intakes 24 at their outer ends, which communicate with a common endless pipe 25, preferably disposed adjacent but outside the engine casing and concentric therewith.

This pipe 25 has an intake 26 at any suitable point, from which air or any other suitable fluid under pressure is fed to and constantly maintained in the pipe 24, and consequently in the cylinders 21.

With this construction, it will be evident that the pressure of the air or other fluid, acting against the heads of the auxiliary pistons 22, will constantly press the tension arms inwardly and maintain the rollers 18 in firm engagement with the cam 19 at all times.

This pressure will be exerted evenly against the pistons 22, regardless of their positions in their cylinders. Also, on account of the fact that all said cylinders are in communication with each other, and the strokes of the different pistons are always in alternative relation to each other, the air pressure is always the same in one cylinder as in another, and regardless of whether the pistons are moving toward or away from the heads of their respective cylinders.

Therefore, once the pipe 24 and cylinders 21 are charged with air at the desired pressure, theoretically it would be unnecessary to have to provide any means to keep up the pressure in said pipe from an exterior source. In practice, however, a certain amount of leakage of air past the pistons can hardly be avoided.

It will be noted that since there are six cylinders 60° apart, while each cam-stroke is 90° in arcuate length, the various strokes of the different pistons will overlap each other, so that a continuous and even flow of power will be had with the operation of the engine.

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 including a shaft, a cylinder disposed radially thereof, a piston therein, a connecting rod associated with the piston, a roller on the outer end of the rod, a cam mounted with the shaft, the roller being adapted to bear on the face thereof, a casing on which said cylinder and shaft are mounted, a tension arm flexibly connected to the rod and to the casing to one side of the cylinder, an auxiliary cylinder, a piston therein, a connection between said piston and the arm, and means for enabling a constant pressure being maintained on said last named piston.

2. A gas engine including a shaft, a cylinder disposed radially thereof, a piston therein, a connecting rod associated with the piston, a roller on the outer end of the rod, a cam mounted with the shaft, the roller being adapted to bear on the fact thereof, a casing on which said cylinder and shaft are mounted, a tension arm flexibly connected to the rod and to the casing to one side of the cylinder, an auxiliary cylinder, a piston therein, a connection between said piston and the arm, and a source of fluid pressure leading to said auxiliary cylinder to act on the head of the piston therein.

3. A gas engine including a shaft, a plurality of cylinders disposed radially thereof, pistons in the cylinders, connecting rods associated with the pistons, rollers on the outer ends of the rods, a cam on the shaft with the face of which the rollers engage, said cam being designed to control the length and period of the piston strokes and the cylinders being disposed relative to the cam so that the strokes take place in alternating order, a casing in which the shaft and cylinders are mounted, tension arms flexibly con-

nected to the rods and to the casing to one side of the cylinders, auxiliary cylinders, pistons therein, connections between said pistons and arms, and means for enabling a constant and even pressure being maintained against the last named pistons irrespective of the positions of the latter in their respective cylinders.

4. A gas engine including a shaft, a plurality of cylinders disposed radially thereof, pistons in the cylinders, connecting rods associated with the pistons, rollers on the outer ends of the rods, a cam on the shaft with the fact of which the rollers engage, said cam being designed to control the length and period of the piston strokes and the cylinders being disposed relative to the cam so that the strokes take place in alternating order, a casing in which the shaft and cylinders are mounted, tension arms flexibly connected to the rods and to the casing to one side of the cylinders, auxiliary cylinders, pistons therein, connections between said pistons and arms, an endless passage member adapted to contain a fluid under pressure, and individual passage means from said passage member to the different auxiliary cylinders.

5. A gas engine including a shaft, a cam thereon, a cylinder having a piston therein, a roller mounted in connection with the piston and bearing on the cam, and fluid means acting to constantly press the roller against the cam.

6. A gas engine including a shaft, a cam thereon, a cylinder having a piston therein, a roller mounted in connectin with the piston and bearing on the cam, a casing in which the cylinder is mounted, a tension arm extending from the roller to the casing to one side of the cylinder and flexibly connected to the casing, and fluid means acting on the arm to cause the same to press on the roller in a direction which will maintain said roller in constant engagement with the cam.

In testimony whereof we affix our signatures.

HENRY A. NORDWICK.
ELMER E. WICKERSHAM.
PAUL J. MARCHETTI.