May 22, 1928. 1,670,294

G. D. ANGLE

INTERNAL COMBUSTION ENGINE

Filed July 27, 1925 2 Sheets-Sheet 1

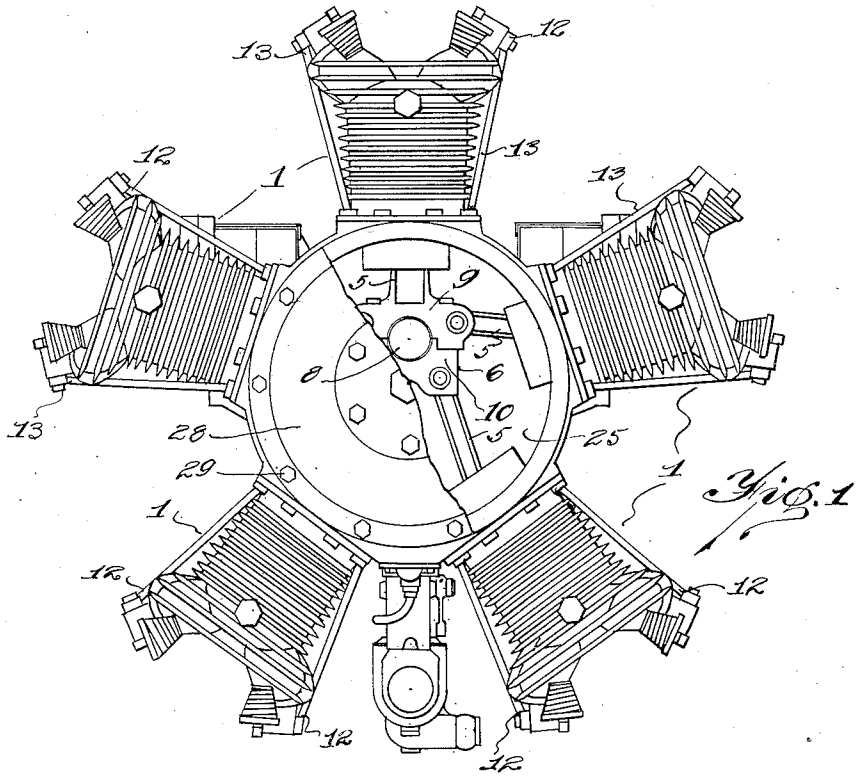


Fig. 1

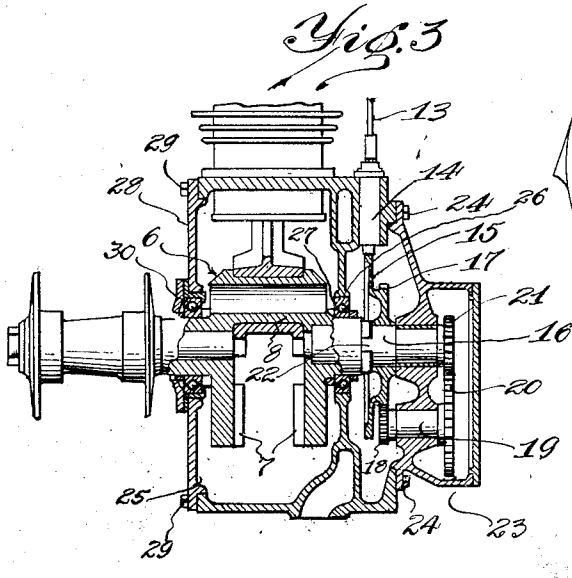


Fig. 3

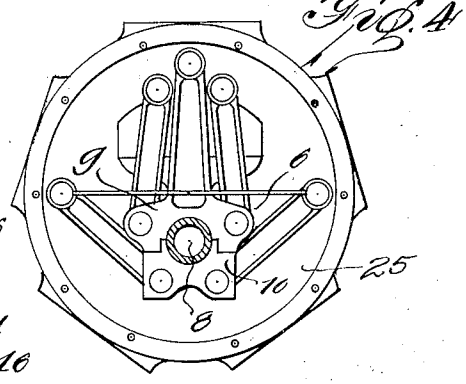


Fig. 4

INVENTOR.
Glenn D. Angle
BY Whittemore, Hulbert & Whittemore
ATTORNEYS

May 22, 1928. 1,670,294

G. D. ANGLE

INTERNAL COMBUSTION ENGINE

Filed July 27, 1925 2 Sheets-Sheet 2

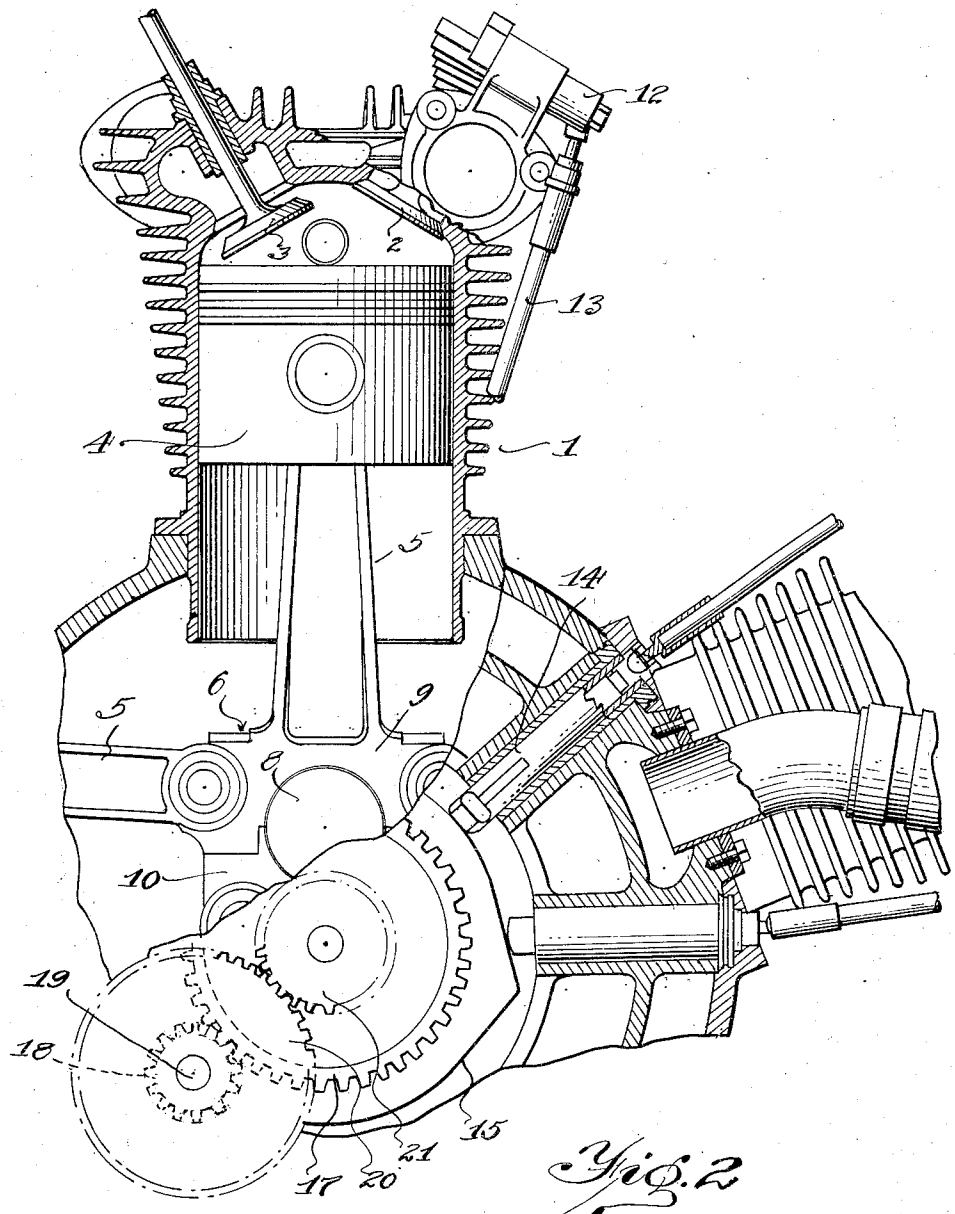


Fig. 2.

INVENTOR.

Glenn D. Angle

BY Whittemore, Hulbert & Whittemore

ATTORNEY.

Patented May 22, 1928. 1,670,294

UNITED STATES PATENT OFFICE.

GLENN D. ANGLE, OF DETROIT, MICHIGAN, ASSIGNOR TO DETROIT AIRCRAFT ENGINE CORPORATION, OF DETROIT, MICHIGAN, A CORPORATION OF MICHIGAN.

INTERNAL-COMBUSTION ENGINE.

Application filed July 27, 1925. Serial No. 46,431.

The invention relates to internal combustion engines and refers more particularly to multi-cylinder internal combustion engines of the radial type which are designed particularly for use in air craft. Heretofore it has been the usual practice to arrange the valve actuating gearing at the front or propeller end of the engine, which invariably involved a multiplicity of joints and further required the removal of the cam mechanism and associated parts before the crank shaft could be taken out of the crank case. Furthermore with this arrangement extra gears were required for driving the magnetos, tachometer and other accessories, which are usually located at the back of the engine and the over all length of the engine along the crank shaft was generally increased. It also has been the usual practice to connect the connecting rods to the crank shaft after the latter has been installed in the engine, this being a very difficult operation owing to the lack of space within the crank case.

My construction eliminates these disadvantages and also is extremely simple and should be relatively inexpensive to manufacture. Furthermore, with my construction, the assembly of the engine is greatly facilitated. In the first place the valve actuating gearing is located at the rear end of the engine. In the second place I provide for inserting the connecting rod and crank shaft assembly endwise into the crank case as a unit. In the third place the valve actuating gearing and the connecting rod and crank shaft assembly are removable from the crank case independently of each other.

With these as well as other objects in view the invention resides in the novel features of construction and combinations and arrangements of parts as more fully hereinafter set forth.

In the drawings:—

Figure 1 is a front elevation partly broken away of an internal combustion engine embodying my invention;

Figure 2 is a rear elevation thereof partly broken away;

Figure 3 is a transverse section therethrough;

Figure 4 is a front elevation of a portion thereof showing the manner of inserting the connecting rod and crank shaft assembly into the crank case.

As shown in the present instance my multi-cylinder radial internal combustion engine includes the cylinders 1, there being an odd number of cylinders such as 5 in order to obtain even firing when operating on the four stroke cycle. Each cylinder has the inlet and exhaust valves 2 and 3 respectively, located in its head and within each cylinder there is the piston 4, which is connected by means of the connecting rod 5 to the carrier 6, which is provided with the counter weight 7 and is journaled upon the throw of the crank shaft 8. The carrier 6 as shown is made in two sections 9 and 10, which are securely bolted to each other, the section 9 being rigidly connected to the master connecting rod 5 and being pivotally connected with the connecting rods adjacent to and on opposite sides of this connecting rod and the section 10 being pivotally connected to the two remaining connecting rods. With this arrangement the carrier 6 is held from rotation upon the crank shaft.

The inlet and exhaust valves 2 and 3, respectively, of each cylinder are actuated by suitable rock levers 12, which in turn are engaged by the push rods 13, the inner ends of which are actuated by the cam followers 14 engaging the cam member 15. The push rods, cam followers and cam member are located at the rear end of the engine and the cam member is driven by suitable gearing from the crank shaft 8 in the present instance. The cam member 15 is journaled upon the main shaft 16 and has secured thereto the gear 17, which is preferably integral therewith. This gear 17 meshes with the gear 18, which is mounted upon the inner end of the stub shaft 19, the outer end of the stub having secured thereto the gear 20, which meshes with the gear 21 upon the outer end of the main shaft 16. The inner

end of the main shaft 16 is suitably coupled to the crank shaft 8 as by means of projections 22 upon the main shaft engageable in slots in the adjacent end of the crank shaft. 23 is the gear support which has journaled therein the main shaft 16 and the stub shaft 19. This support further functions to house the valve actuating gearing, it being in effect a cover plate which is detachably secured to the rear end of the crank case by suitable means such as the bolts 24.

For the purpose of facilitating the removal or assembly of the engine parts the crank case has at its front end the large opening 25 and at its rear end the small opening 26, these two openings being in axial alignment. The large opening 25 has, as shown in Figure 4, a sufficient diameter to permit the connecting rods 5 to be assembled with the crank shaft prior to insertion of the crank shaft into the crank case. After these connecting rods have been secured to the crank shaft they are swung about their pivots to extend in the same general direction as the master connecting rod at which time the assembly may be inserted as a unit through the large opening 25 into the crank case, this being done prior to assembly of the pistons on the connecting rods and cylinders on the crank case. After the insertion of the connecting rod and crank shaft assembly the pistons are secured to the connecting rods and then the cylinders are secured to the crank case. The rear end of the crank shaft is journaled in suitable anti-friction bearings 27 located in the small opening 26 in the rear wall of the crank case. The cover plate 28 closes the large opening 25 and is detachably secured to the crank case by suitable means such as the bolts 29. This cover plate carries the anti-friction bearing 30 in which the crank shaft 8 is journaled, the crank shaft, however, extending forwardly beyond the crank case for attachment to the propeller of the air craft.

From the above description it will be seen that I have provided a simple construction of radial internal combustion engine which provides for the insertion of the connecting rod and crankshaft assembly into the crank case as a unit; which provides the valve actuating gearing at the rear end of the crank case and adapted to be connected to the crank shaft; and which provides for the removal of the connecting rod and crank shaft assembly and the valve actuating gearing independently of each other.

What I claim as my invention is:

1. In a multi-cylinder radial internal combustion engine, the combination of an annular crank case, a connecting rod and crank shaft assembly so constructed and proportioned as to be capable of being collapsed for endwise insertion within the open area of the crank case as a unit and gearing attached to the crank case, the said connecting rod and crank shaft assembly and the gearing being removable from the crank case independently of each other.

2. In a multi-cylinder radial internal combustion engine, the combination of an annular crank case having an opening in one of its ends and a collapsible connecting rod and crank shaft assembly capable of endwise insertion through the said opening into the crank case as a unit.

3. In a multi-cylinder radial internal combustion engine, the combination of an annular crank case having axially aligned openings of different sizes at its ends, a connecting rod and crank shaft assembly adapted for insertion through the large opening into the crank case as a unit, a detachable housing for closing the small opening and valve actuating gearing carried by said housing and adapted to be operated from the crank shaft when the said housing is in position.

4. In a multi-cylinder radial internal combustion engine, the combination of an annular crank case having axially aligned openings of different sizes at its ends, a connecting rod and crank shaft assembly adapted for insertion through the large opening into the crank case as a unit, a detachable housing for closing the small opening, a stub shaft journalled in said housing and adapted to be connected to and driven from said crank shaft when the housing is in position and valve actuating gearing carried by said housing and driven from said stub shaft.

5. In a multi-cylinder radial internal combustion engine, the combination of an annular crank case having axially aligned openings of different sizes at its ends, a connecting rod and crank shaft assembly adapted for insertion through the large opening into the crank case as a unit, a detachable housing for closing the small opening having a web portion, stub shafts journalled in said web portion, gearing connecting said shafts, a valve actuating cam journalled on one of said shafts and driven from the other, said cam carrying shaft being adapted to connect with and to be driven from said crank shaft when the said housing is in position.

6. In a multi-cylinder radial internal combustion engine, the combination of a crank case, a connecting rod and crank shaft assembly insertable into the crank case through one end thereof as a unit, and gearing attachable to the opposite end of the crank case and adapted to be driven from the crank shaft, the connecting rod and crank shaft assembly and the gearing being removable from the crank case independently of each other.

7. In a multi-cylinder radial internal combustion engine, the combination of a crank

case, a crank shaft extending through one end of the crank case for attachment to a member to be driven, and valve actuating gearing attachable as a unit to the other end of the crank case.

8. In a multi-cylinder radial internal combustion engine, the combination with a crank case having axially aligned openings of different sizes at its ends, a connecting rod and crank shaft assembly insertable through the large opening into the crank case as a unit, means in the openings for supporting the crank shaft, gearing adapted to be coupled to said crank shaft, and a housing for the gearing attachable to the end of the crank shaft having the smaller opening.

In testimony whereof I affix my signature.

GLENN D. ANGLE.