May 23, 1933. C. H. POWELL 1,910,813

INTERNAL COMBUSTION ENGINE

Filed Sept. 19, 1929 3 Sheets-Sheet 1

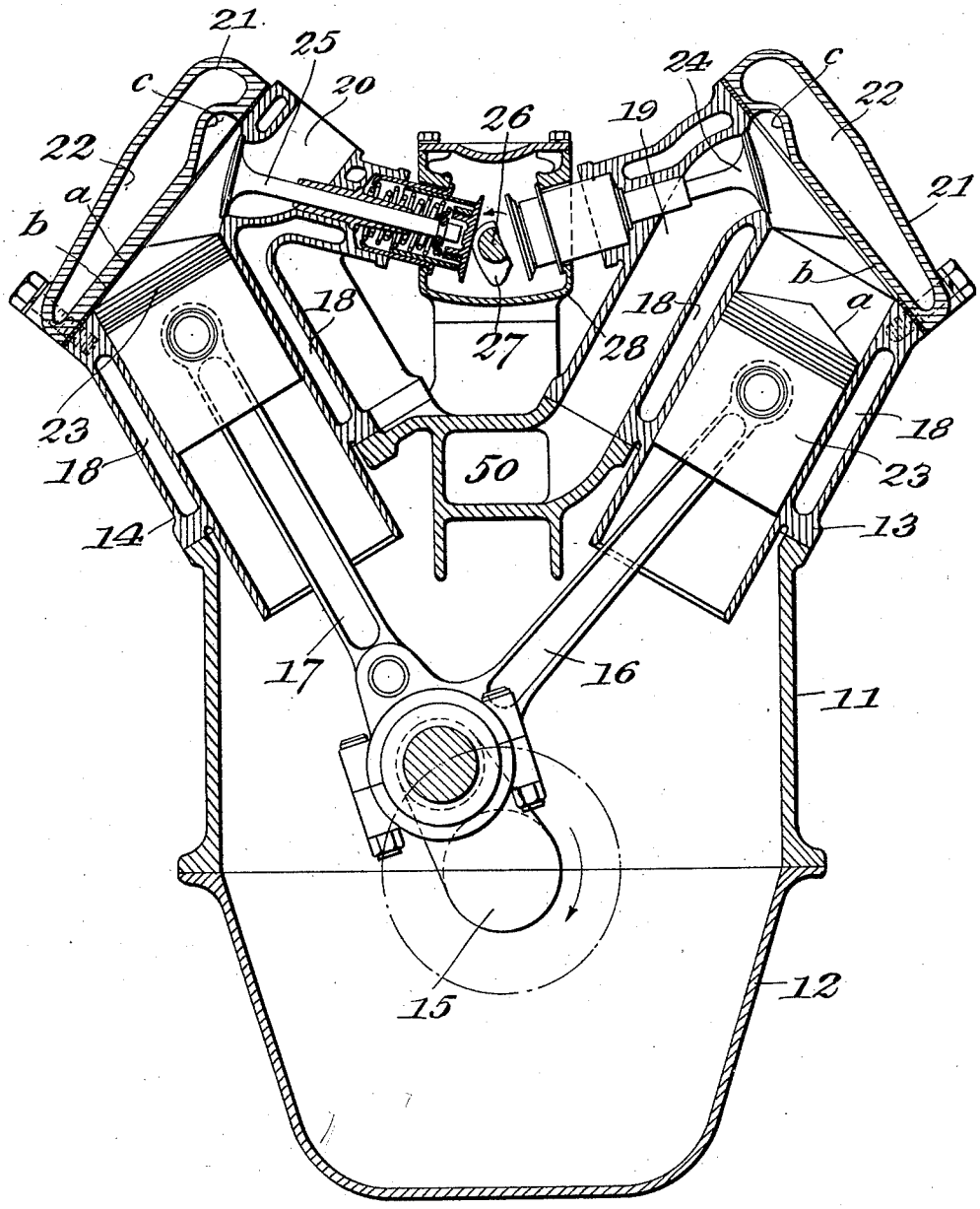


Fig. 1

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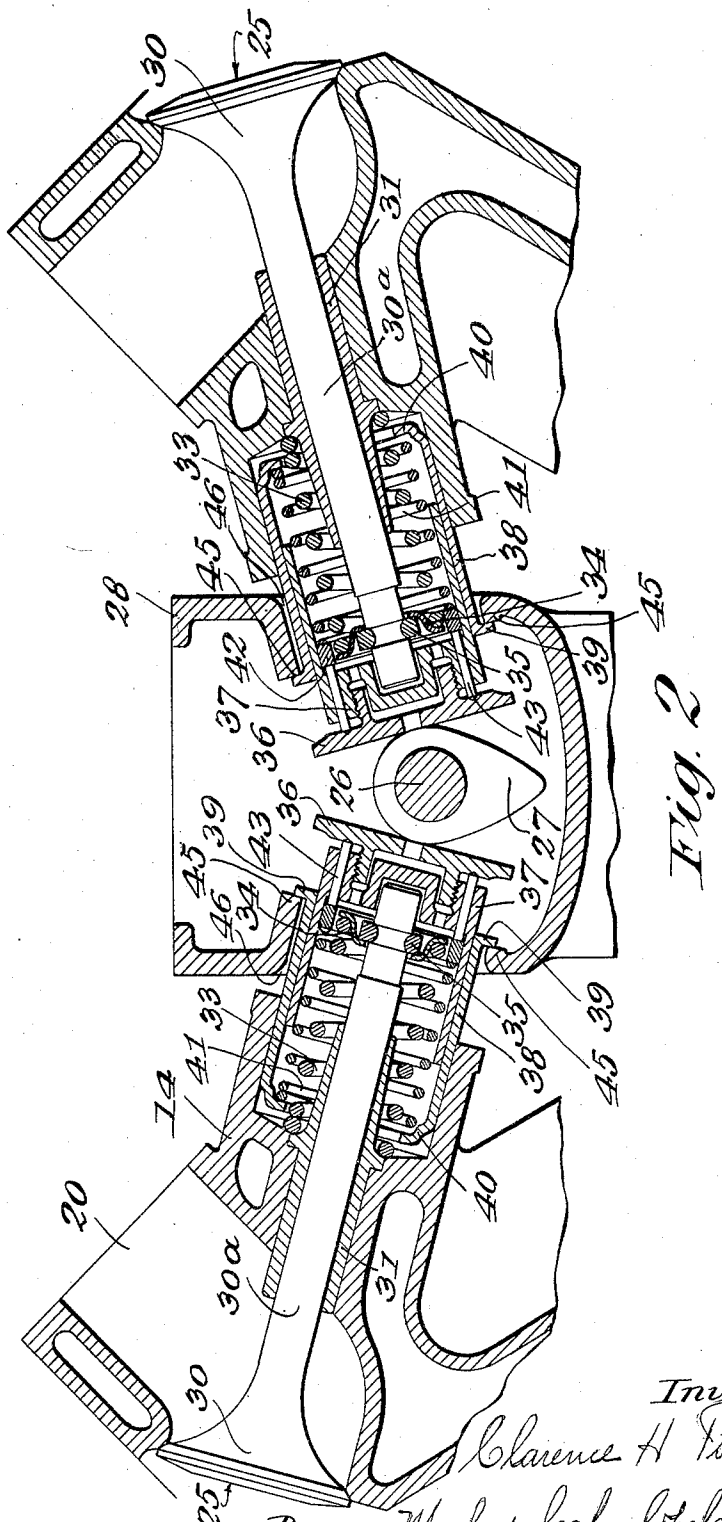


Fig. 2

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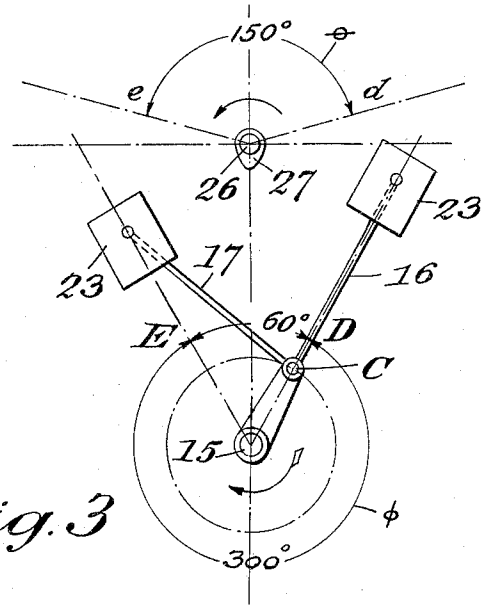


Fig. 3

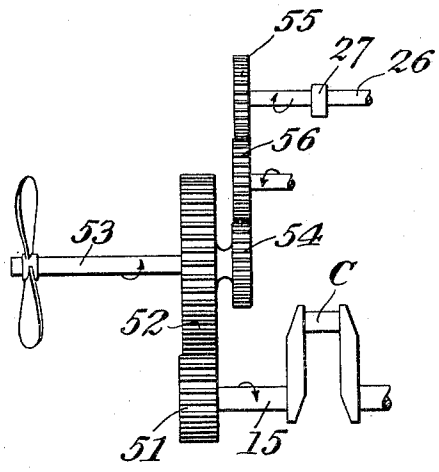


Fig. 4

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Patented May 23, 1933

1,910,813

UNITED STATES PATENT OFFICE

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INTERNAL COMBUSTION ENGINE

Application filed September 19, 1929. Serial No. 393,790.

My present invention relates to improvements in internal combustion engines of the so-called V-type such as are particularly adapted for use in aeroplanes and automobiles, and is to some extent an improvement on the engine shown in the patent to Stephen I. Fekete No. 1,173,105, patented February 22, 1916. The particular improvements comprising the present invention relate especially to the construction and arrangement of the gas passages and manifolding, to the construction and arrangement of the valve mechanism, and to the construction and arrangement of the crank case and cylinder block castings. The engine embodying my invention is very compact in form and can be made extremely light in weight and readily accessible; it is perfectly water-jacketed with a slight increase in weight, and the flow of gas through the manifold and valves is impeded so little that the engine is very efficient and therefore is especially adapted to use in aeroplanes.

Referring to the drawings,

Fig. 1 is a transverse section of the engine, the right side being through the center line of the inlet valve, and the left hand side being through the center line of the exhaust valve to show the construction of the exhaust and inlet passages.

Fig. 2 is a true transverse section of the valve mechanism, on an enlarged scale, taken through two opposite exhaust valves.

Fig. 3 is a diagram illustrating the angular relation of the cylinders and valves.

Fig. 4 is a fragmentary diagrammatic side elevation of the gearing interposed between the crank shaft and the cam shaft.

In the drawings,

At 11 is shown the crank case casting to the bottom of which is secured an oil pan 12. The upper part of the crank case is slabbed off to form two oblique sides on which rest the cylinder blocks 13 and 14 having cylinders of any suitable but equal number. The crank shaft is shown at 15 and two connecting rods at 16 and 17 respectively. In the engine shown in the drawings the angle between the two cylinder blocks is 60°, and the inclination of the oblique surfaces is 30° to the horizontal. Each cylinder block has cast integrally therein water-jackets 18, a series of inlet passages 19, and a series of exhaust passages 20. The upper end of each cylinder block is closed by a detachable cylinder head 21 which is also provided with a water-jacket 22. The piston employed has preferably a dihedral top 23, one face of which *a* is parallel with the inclined inner face *b* of the removable head 21. The inlet valves 24 and the exhaust valves 25 are located side by side with their valve stems extending at a downward and inward inclination into the alley between the cylinder blocks. The inner wall of the removable head is arched away from the valves slightly as shown at *c* in Fig. 1 and this arrangement with the dihedral piston head gives a combustion chamber of a very efficient and satisfactory shape. Also, as in the engine of the Fekete patent above mentioned, the valves can be removed quickly and easily by removing the heads and the whole valve gear of the engine is rendered exceptionally accessible.

In the alley between the cylinder blocks and formed integral with the upper part of the crank case is a supporting member 28 for the cam shaft 26 one cam of which is shown at 27. The inlet valves 24 of opposite cylinders of the respective cylinder blocks are disposed opposite to one another as are likewise the exhaust valves 25 of said cylinders (see Fig. 2), so that a single cam is employed to operate both inlet valves and another single cam employed to operate both exhaust valves.

The cam shaft 26 is driven from the crank shaft 15 at half speed, in accordance with the requirements of a four-cycle engine, but, in accordance with the present invention, in the reverse direction, by gearing a suitable arrangement of which, particularly adapted for use in aircraft engines, is shown in Fig. 4. This gearing comprises a gear 51 on the crank shaft which meshes with a gear 52 fast on the propeller shaft 53, a gear 54 also fast on the propeller shaft and preferably formed integral with the gear 52, a gear 55 fast on the cam shaft 26, and an idler gear 56 meshing with the gears 54 and 55.

The valves for the respective cylinder blocks are symmetrically disposed with their

stems at an angle which is one half the obtuse or re-entrant angle between said blocks. Thus, referring to Fig. 3, if the cylinder blocks be disposed at an acute angle of 60°, the angular movement ϕ of the common crank C, between the successive firing of opposite cylinders, will be (assuming a clockwise direction of rotation of the crank shaft) from D to E; viz., $360° - 60° = 300°$. At the same time, the angular movement θ of the cam shaft 26 will be in a counterclockwise direction from d to e and will be one half that of the crank shaft; viz., 150°. The angle θ determines the relative positions of the opposite valve stems and is always less than 180°. Accordingly, by rotating the cam shaft reversely to the crank shaft, the valve stems may be inclined downwardly and inwardly toward the cam shaft, thereby bringing the latter nearer the crank shaft and providing a very compact structure. Moreover, when thus disposed, the valves can be accommodated in combustion chambers of good shape and the cylinder heads can be reduced in height: an important consideration in aircraft and marine engines.

The cam shaft supporting member 28 also serves to support and guide the inner end of the valve tappet mechanism. This mechanism will be readily understood from examination of Fig. 2. A valve 30 of conventional shape having a valve stem 30a guided in a tubular valve guide 31 received in the upper part of the corresponding cylinder block is employed. Surrounding the valve guide is a valve spring 33 one end of which rests against the valve guide and the other end of which rests against a spring clip or dished washer 34 which is secured to the valve stem by the usual straddle cotter pin 35. The valve tappet is made in two parts 36 and 37 which are screwed together. The outer of these members slides in a tappet guide 38 which is flanged at its outer end as shown at 39 and inturned at its inner end as shown at 40. Inside the tappet guide 38 and outer member 37 of the valve tappet is a spring 41, one end of which rests on the inturned flange 40 of the tappet guide, and the outer end of which rests against a ring 42. The ring 42 itself rests on the heads of a series of pins 43 which are slidable in holes in the outer tappet member 37. These pins are pointed and engage holes in the under surface of the head of the tappet member 36 and prevent it from rotating and unscrewing from the outer tappet member 37. The pressure of the spring 41 against the inner end and flange of the tappet guide 38 holds the out-turned flange 39 against a seat 45 formed in the cam shaft supporting member 28. The hole 46 in the supporting member 28, and the hole in the cylinder block which receives the tappet guide 38 are in axial alinement with each other, but the hole in the supporting member is slightly the larger of the two holes. The flange 39 overlies the rim of the hole.

This construction is such that any lack of concentricity between the hole in the cylinder block which receives the tappet guide member and the hole 46 in the cam shaft supporting member 28 which may result in manufacturing or assembling the parts is compensated for. It also permits the several parts to adjust themselves to any change in position required and produced by variations in the temperatures or different amounts of expansion of the several parts. The same construction is employed for both inlet and exhaust valves. All the valves are therefore supported in part on the central supporting member and in part on the cylinder blocks, but the support is strong but sufficiently yielding to allow for any changes in the relation of the parts.

Underneath the cam shaft supporting member and formed in the crank case casting is a longitudinal intake passage or manifold 50 and branch passages leading sideways from it, to connect with the inclined inlet passages 19 which are cast in the cylinder blocks. By this construction it is possible to place the carburetor at the end of the engine where it is much more accessible than if placed in the alley between the cylinder blocks and at the same time entirely satisfactory carburetion is obtained.

The exhaust passages on the other hand lead directly through the cylinder castings into the space above the valves which forms a very convenient position for the exhaust manifold.

What I claim is:

1. An internal combustion engine of the V-type having a supporting member between the cylinder blocks, valve operating mechanism supported on said member and a valve tappet guide supported partly on said member and partly on the cylinder block.

2. An internal combustion engine of the V-type having a crank case, cylinder blocks mounted on the crank case and having valve tappet receiving holes in the adjacent sides thereof, a cam shaft supporting member between the cylinder blocks, said member having valve tappet and holes in the sides adjacent the cylinder blocks, the valve tappet receiving hole in one of said members being larger than in the other, a valve tappet guide fitting the smaller of said holes and passing through the larger and having a flange overlying the edge of the larger of said holes.

3. In a four-cycle internal combustion engine of the V-type having oppositely and angularly disposed cylinders, in combination, a crank shaft, a cam shaft disposed between said cylinders, means for rotating said cam shaft from said crank shaft at half speed and in the reverse direction, and valves for

said cylinders respectively having stems downwardly and inwardly inclined therefrom toward said cam shaft and disposed at an angle which is one half the obtuse angle between said cylinders.

4. In a four-cycle internal combustion engine of the V-type having oppositely and angularly disposed cylinders, in combination, a crank shaft, a cam shaft disposed between said cylinders, means for rotating said cam shaft from said crank shaft at half speed and in the reverse direction, valves for said cylinders respectively having stems downwardly and inwardly inclined therefrom toward said cam shaft and disposed at an angle which is one half the obtuse angle between said cylinders, and a single cam on said cam shaft for operating both of said valves.

In testimony whereof I affix my signature.

CLARENCE H. POWELL.