Feb. 16, 1937. B. READ 2,070,806

INTERNAL COMBUSTION ENGINE

Filed May 28, 1934 2 Sheets-Sheet 1

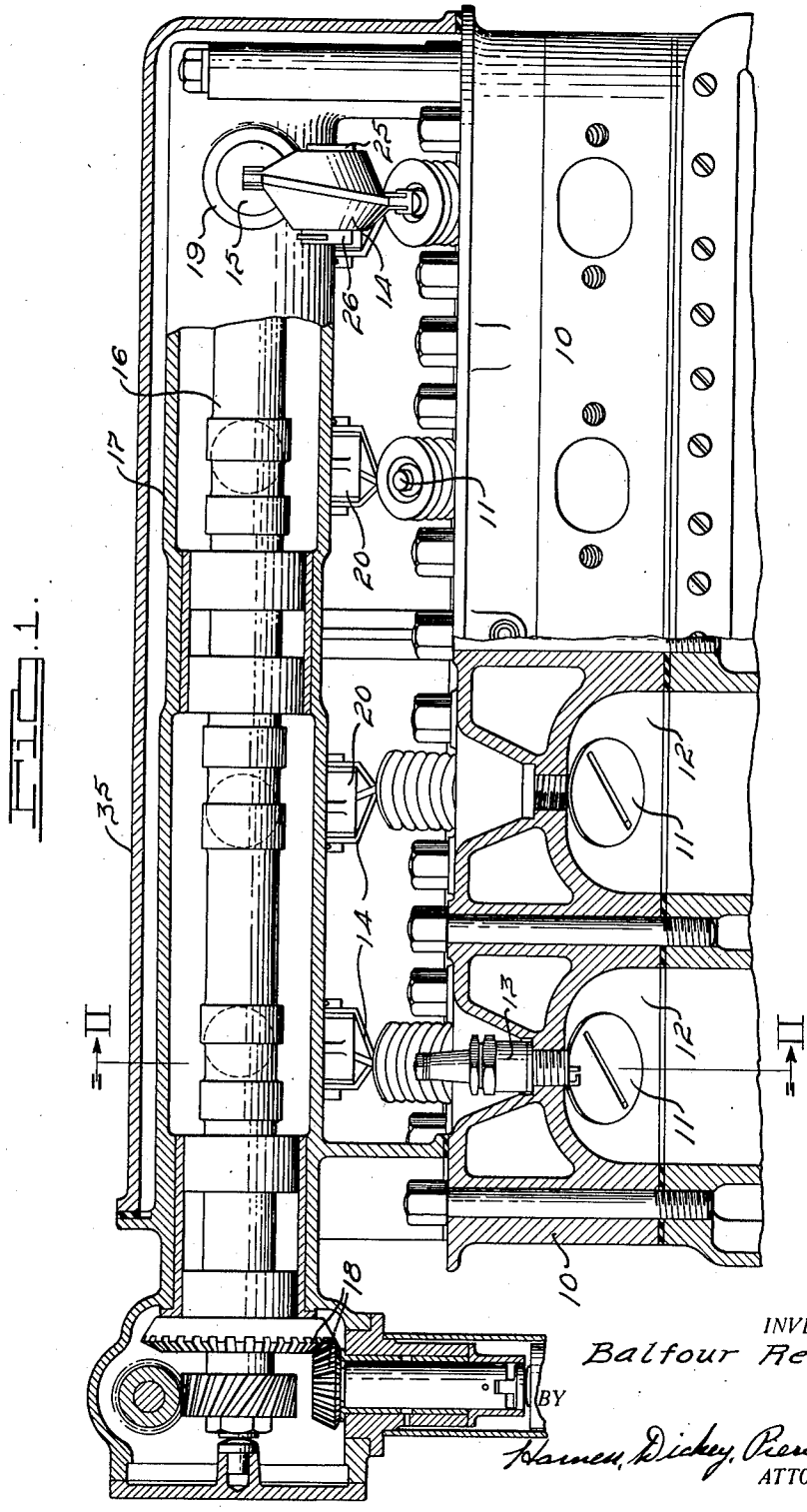



Fig. 1.

INVENTOR.
Balfour Read.
BY
Harness, Dickey, Pierce & Hanna.
ATTORNEYS.

Feb. 16, 1937. B. READ 2,070,806

INTERNAL COMBUSTION ENGINE

Filed May 28, 1934 2 Sheets-Sheet 2

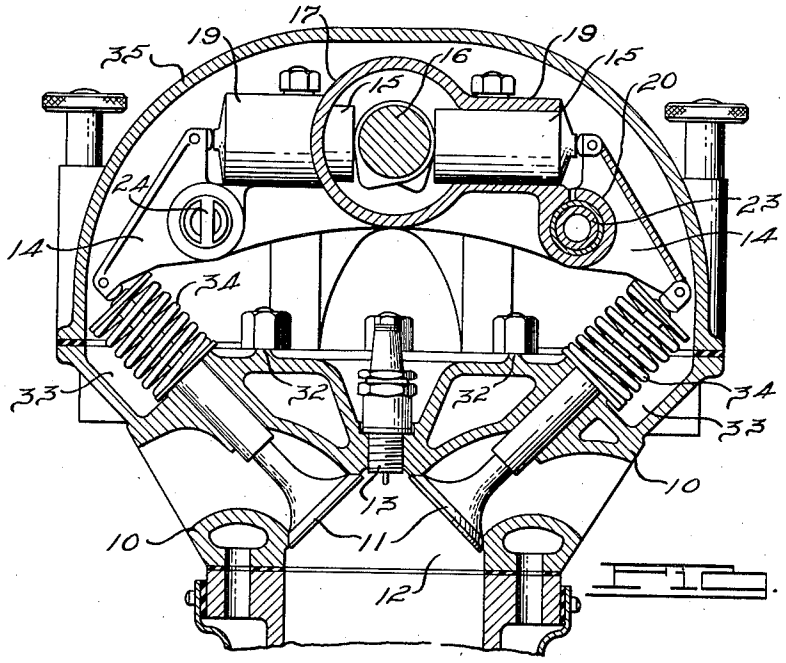



Fig. 2.

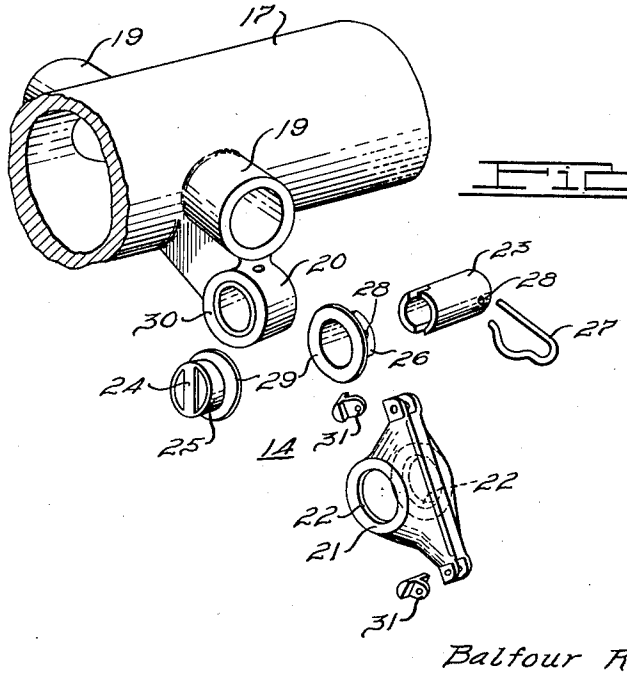



Fig. 3.

INVENTOR.
Balfour Read.

BY
Harness, Dickey, Pierce & Mann.
ATTORNEYS.

Patented Feb. 16, 1937 2,070,806

# UNITED STATES PATENT OFFICE

2,070,806

## INTERNAL COMBUSTION ENGINE

Balfour Read, Detroit, Mich.

Application May 28, 1934, Serial No. 727,969
In Great Britain June 2, 1933

9 Claims. (Cl. 123—90)

This invention relates to multi-cylinder internal-combustion engines with cylinders in line, of the kind embodying a single overhead camshaft parallel to the crankshaft and more or less coplanar with the cylinder axes, and one exhaust and one inlet valve for each cylinder arranged in the head in a plane at right angles to the axis of the camshaft.

In an engine of this kind, it has been proposed to arrange for the camshaft to engage rockers for the valves through sliding tappets guided in a housing enclosing and supporting the camshaft. Furthermore, in another engine of the above kind it has been proposed that a one-piece cylinder-head for all the cylinders should directly support a housing for the camshaft.

The main object of the present invention is to provide an improved arrangement of the above kind which will reduce manufacturing costs and simplify the assembly of the engine; and, according to the invention, the above two proposals are both incorporated in the engine. In addition, the housing may be adapted to provide individual rigid supports for the valve rockers as well as for the tappet guides, and these supports may be formed integrally with the housing. Preferably, too, each sparking plug is arranged in the cylinder head to be co-axial with the cylinder.

The invention further involves a preferred form of rocker construction and mounting substantially as hereinafter described.

In the accompanying drawings:

Figure 1 is a part-sectional elevation of a cylinder head, according to the invention, for a vertical four-cylinder engine;

Figure 2 is a transverse section through one of the combustion chambers, taken, for example, on the line 2—2 of Figure 1; and

Figure 3 is a perspective view of part of the tunnel-shaped housing enclosing the camshaft, showing a preferred form of rocker and pivot pin therefor with the parts disassembled from one another.

In the arrangement illustrated, a one-piece cylinder-head 10 for all the cylinders carries the inlet and exhaust valves 11, those for each combustion chamber 12 being arranged in a plane transverse to the camshaft axis and inclined at approximately 45 degrees to the cylinder axis, while the spark plugs 13 are substantially co-axial with the cylinders and may be inserted and removed upon removal of the cylinder head cover, this design of combustion chamber generally being considered to be ideal from the point of view of efficiency. The valves are operable through rockers 14, 14 the other ends of which are engaged by sliding tappets 15, 15 associated with the cams on the camshaft 16. By this means harmonic cams can be used with their well-known advantages for high speed operation. The camshaft is supported within a tunnel-shaped housing 17 located above the spark plugs 13 and driven from one end through suitable gearing 18, and the housing may be oil filled to insure lubrication of the cams and tappets.

In the particular arrangement illustrated, where the valves of each combustion chamber 12 are in the central transverse plane, the associated tappets are horizontally arranged with their axes parallel to one another and on opposite sides of the central transverse plane, the rockers being shaped as indicated at the right hand end of Figure 1, to allow of the valves being operated from pairs of side-by-side cams.

The tappets are guided in cylindrical extensions 19, 19 formed integrally with the housing, which also provides a support for the associated rocker, this support also being integral with the housing. Thus the likelihood of distortion arising, as often occurs with the usual form of rocker shaft, is materially reduced, as the supports for the rockers are integral with the substantial housing for the camshaft. This makes for quietness in operation.

In the arrangement of Figure 3, the rocker is shown as being formed mainly from sheet metal pressings, with two cheeks 21 having co-axial holes 22, 22, the cheeks being spaced apart to a greater extent than the width of the support 20. The latter is bushed to receive a pin 23 one end of which has a slot cut in it to receive the cross piece 24 on an end cap 25 while the other end carries an end cap 26 which can be held in position by a spring pin 27 adapted to pass through the holes 28. These end caps 25, 26 have cylindrical portions which fit the holes 22, 22 and flanges 29 which engage against the inside faces of the cheeks 21 and against the radial faces 30 of the support 20 when the parts are secured in position, the pin 23 then turning with the rocker. The tips 31 and bushings 25 and 26 may be copper-brazed or otherwise secured to the rocker, or instead, adjusting screw means may be mounted on the rocker, or on the tappet, in a well understood manner.

With the above arrangement the most efficient type of combustion chamber can be utilized with the sparking plug centrally arranged, the valves are operated from a single overhead camshaft in a very simple manner, and harmonic cams with

linearly moving tappets can be used. The invention thus combines the known advantages of the relatively expensive and complicated two camshaft type of engine with the simplicity and economy of the single camshaft type, without the disadvantages of the latter being introduced. The holding down studs can be equally spaced to distribute the clamping pressure evenly and so avoid distortion. As shown in Figure 2 ridges 32 are provided which form dams to prevent oil leaking past the tappets from reaching the sparking plug pockets. This leakage thus collects in the gutters 33 whence it can be led to the crankcase. Furthermore, there is ample room for fitting hairpin springs for the valves instead of the coil springs 34 shown.

By having a one-piece cylinder head the camshaft housing can be easily supported therefrom without introducing any difficulties in machining operations or assembling such as would occur if each cylinder was provided with an independent head and the camshaft casing supported from these. Valve clearances are also not so liable to variation when the camshaft housing is supported according to the present invention.

An important advantage obtained by placing the sparking plug substantially co-axial with the cylinder axis is the fact that the conical-shaped jacket wall surrounding the plug acts as a strut to support the combustion chamber roof, and thus tends to prevent distortion of the valve seats.

It should also be noted that the design allows the use of a one-piece oil-tight cover 35 enclosing the camshaft, its housing, the tappets, the rockers, the valves, and also the plugs and the wiring therefor, the distributor, of course, being outside.

Formal changes may be made in the specific embodiment of the invention described without departing from the spirit and substance of the broad invention, the scope of which is commensurate with the appended claims.

I claim:

1. In combination with an internal combustion engine having a row of aligned cylinders, a one-piece detachable cylinder head common to all of said cylinders having inlet and exhaust ports, a valve for each of said ports, the axes of the valves for each of said cylinders being angularly arranged with respect to each other and to the cylinder axis, an overhead cam shaft in parallel relation to the axis of the engine crank shaft, a tunnel-shaped housing enclosing and supporting said cam shaft, means for supporting said housing from said cylinder head in vertically spaced relation with respect thereto, a pair of approximately axially parallel tappets for each of said cylinders slidably supported by said housing on opposite sides thereof and engaging said cam shaft, rocker arms interposed between said tappets and said valves, and a spark plug for each of said cylinders projecting through said cylinder head between said valves therefor.

2. In combination with an internal combustion engine having a row of aligned cylinders, a one-piece detachable cylinder head common to all of said cylinders having inlet and exhaust ports, a valve for each of said ports, the axes of the valves for each of said cylinders being angularly arranged with respect to each other and to the cylinder axis, an overhead cam shaft in parallel relation to the axis of the engine crank shaft, a tunnel-shaped housing enclosing and supporting said cam shaft, means for supporting said housing from said cylinder head in vertically spaced relation with respect thereto, tappets slidably supported by said housing in engagement with said cam shaft and having their axes arranged in approximately perpendicular relationship with respect to the plane of the cylinder axes, rocker arms interposed between said tappets and said valves, and a spark plug for each of said cylinders projecting through said cylinder head between the valves for the corresponding cylinder.

3. In combination with an internal combustion engine having a row of aligned cylinders, a one-piece detachable cylinder head common to all of said cylinders having inlet and exhaust ports, a valve for each of said ports, the axes of the valves for each of said cylinders being angularly arranged with respect to each other and to the cylinder axis, an overhead cam shaft in parallel relation to the axis of the engine crank shaft, a tunnel-shaped housing enclosing and supporting said cam shaft, means for supporting said housing from said cylinder head, tappet guides fixed to said housing and projecting in an approximately horizontal direction outwardly on opposite sides thereof, tappets slidably received in each of said guides for engagement with said cam shaft, rocker arm supports fixed to said housing, and rocker arms pivoted to said supports and interposed between said valves and tappets.

4. In combination with an internal combustion engine having a row of aligned cylinders, a one-piece detachable cylinder head common to all of said cylinders having inlet and exhaust ports, a valve for each of said ports, the axes of the valves for each of said cylinders being angularly arranged with respect to each other and to the cylinder axis, an overhead cam shaft in parallel relation to the axis of the engine crank shaft, a tunnel-shaped housing enclosing and supporting said cam shaft, means for supporting said housing from said cylinder head, tubular tappet guides projecting substantially horizontally outwardly from opposite sides of said housing, tappets slidably received in each of said guides for engagement with said cam shaft, rocker arm supports carried by said housing, rocker arms interposed between said tappets and said valves, and a pivot pin for each of said arms oscillatable therewith and having bearing in the corresponding of said supports.

5. A structure as called for in claim 4 in which the rocker arms are formed from sheet metal, and flanges and contact tips are brazed thereto.

6. A structure as called for in claim 4 in which the rocker arms are each provided with a pair of parallel cheeks adapted to receive the corresponding of said supports between them and having co-axial openings to receive a pivot pin.

7. A structure as called for in claim 4 in which the rocker arms are each provided with a pair of parallel cheeks having co-axial openings, and a pivot pin is received in the openings, a bushing is provided in each support for a corresponding pivot pin, and each pivot pin comprises a tube and end caps fitting said openings and secured thereto.

8. A structure as called for in claim 4 in which the rocker arms are each provided with a pair of parallel cheeks having co-axial openings, and a pivot pin is received in the openings, a bushing is provided in each support for a corresponding pivot pin, and each pivot pin comprises a tube and end caps fitting said openings and having flanges engaging the inside faces of said cheeks and secured to said tube.

9. In combination with an internal combustion engine having a row of aligned cylinders, a one-piece detachable cylinder head common to all of said cylinders having inlet and exhaust ports, a valve for each of said ports, the axes of the valves for each of said cylinders being angularly arranged with respect to each other and to the cylinder axis, an overhead cam shaft in parallel relation to the axis of the engine crank shaft, a tunnel shaped housing enclosing and supporting said cam shaft, means for supporting said housing from said cylinder head in vertically spaced relation with respect thereto, a pair of approximately axially parallel tappets for each of said cylinders slidably supported by said housing on opposite sides thereof and engaging said cam shaft, rocker arms interposed between said tappets and said valves, a spark plug for each of said cylinders projecting through said cylinder head between the valves for the corresponding of said cylinders, and a substantially oil tight enclosure secured to said head and enclosing the otherwise exposed portions of said valves, cam shaft, rocker arms and spark plugs.

BALFOUR READ.