Jan. 5, 1965 J. DOLZA 3,164,143

INTERNAL COMBUSTION ENGINE

Filed March 11, 1964 2 Sheets-Sheet 1

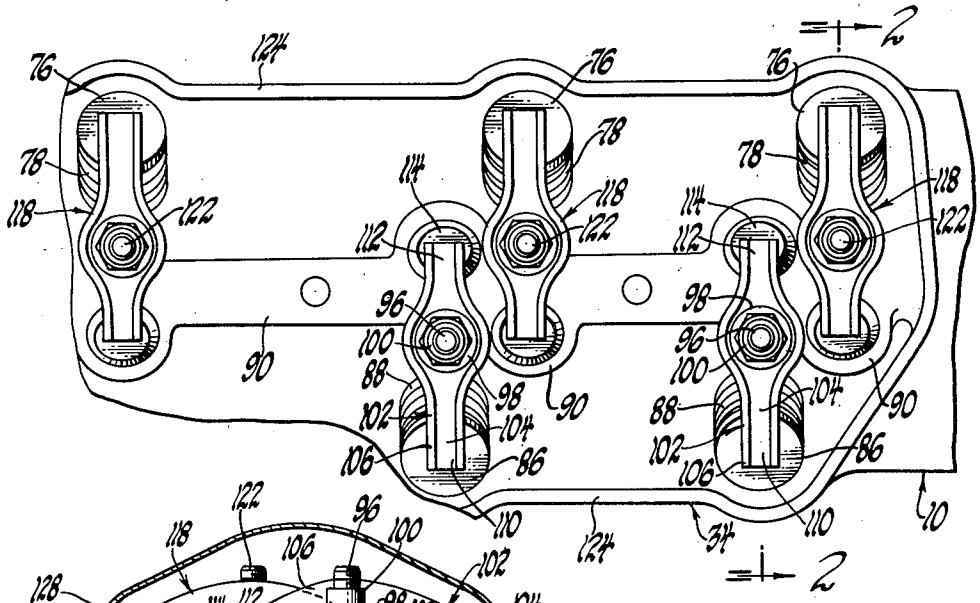


Fig. 1

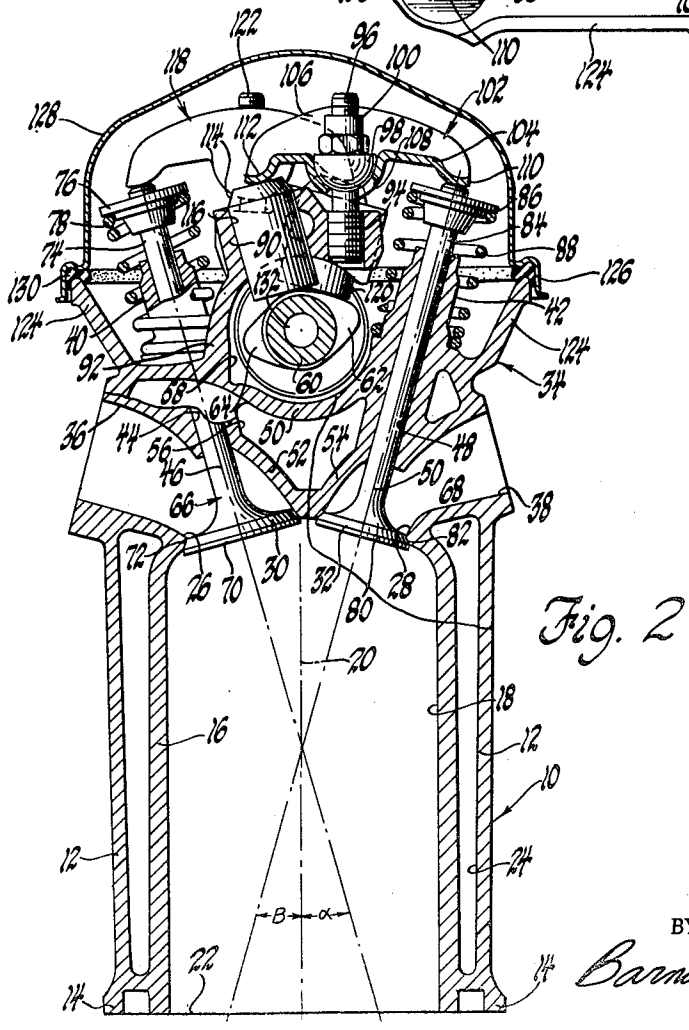


Fig. 2

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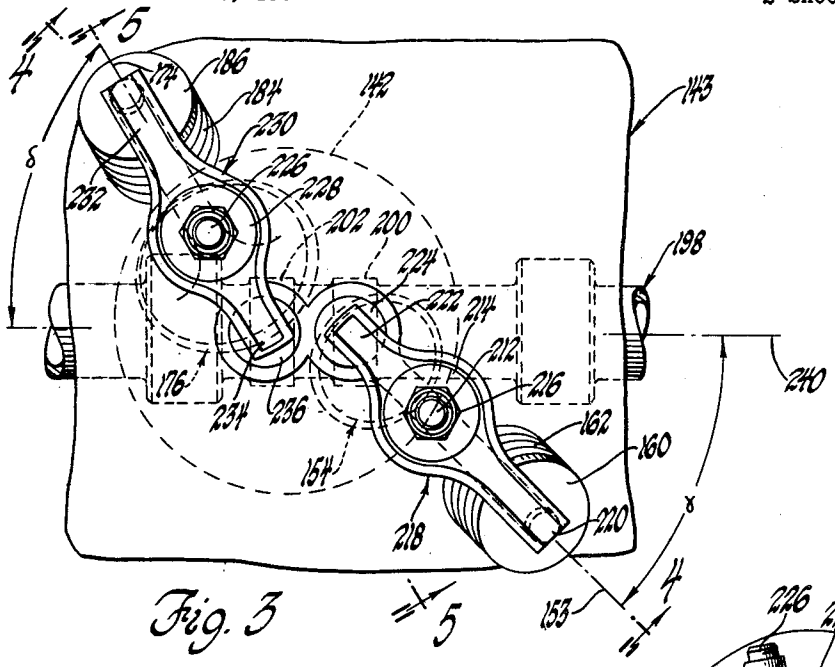


Fig. 3

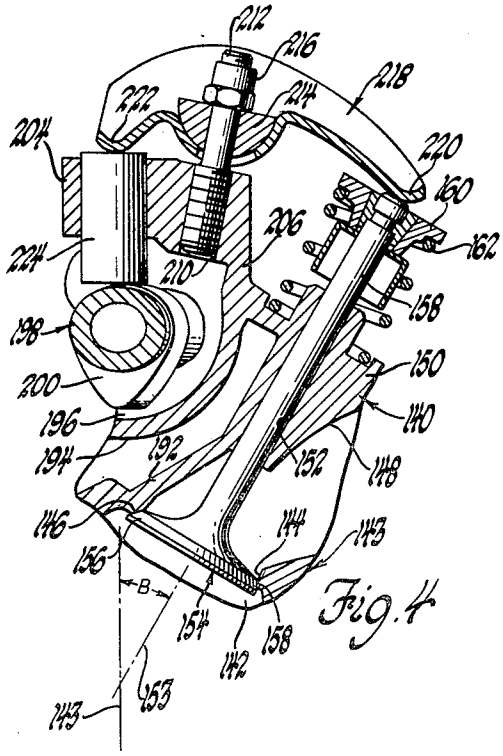


Fig. 4

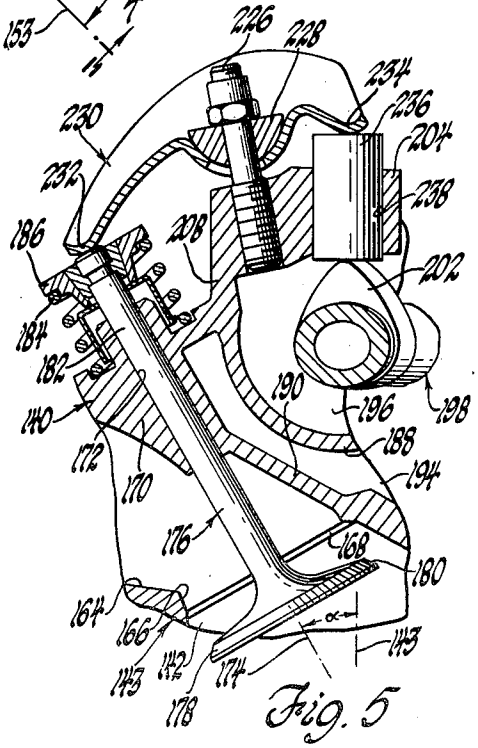


Fig. 5

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INTERNAL COMBUSTION ENGINE

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This invention relates to internal combustion engines and more particularly to a one-piece engine block and cylinder head construction and associated valving arrangements permitting the use of an overhead camshaft placed in an optimum position.

In the design and operation of internal combustion engines, it is often desirable to provide an engine having as much power as possible for a given size and weight of the engine. At the same time, it is desirable to provide an engine of as economic construction as possible. Heretofore, one of the limitations on the amount of power available from an engine of a given size and weight has been in the coring and machining of the engine block and cylinder head castings so as to permit assembly of optimum sized parts of the engine into a package consistent with the design dimensions available. For example, it is known to be desirable to have the intake ports as large as possible, permitting better air breathing at higher engine speeds and thus greater power for the given size and weight of engine. Problems have consistently arisen in obtaining optimum size valve openings in the cylinder head to communicate with the cylinder and through which the intake charge and the exhaust gases pass, such problems being directly caused by design and assembly limitations.

In the past it has been common to utilize two-piece engine constructions; that is, one piece containing the cylinder bores and the various parts associated therewith, and a second part containing the valve members and has the valve actuation means secured thereto. To provide as large valve openings as possible, the valves may be inclined relative to the axis of the cylinder bore, and a camshaft for driving the valves is generally located in some suitable place below the valves or to the side of the valves with the usual rocker arms and push rods actuating the valves from the camshaft. Such constructions are generally very large and heavy, oftentimes causing chassis installation difficulties and a sacrifice in power or economy for ease in assembly.

The construction in which this invention is embodied comprises, generally, a one-piece engine block and cylinder head contsruction which is so designed as to permit machining of the usual valve seats and other appropriate parts from the lower end of the engine block and to permit assembly of the valves from the lower end of the block. The cylinder head portion is machined to provide valve guides and to also provide suitable mounting means for the valve actuating assembly. The valves are inclined relative to the axis of the cylinder bore an amount desirable, so long as the machining of the valve seats and the like may be accomplished from the lower end of the engine block portion. Disposed between the valve members is a tunnel which conveniently receives the engine camshaft, so positioned as to properly actuate the valve members and at the same time provide as low an engine profile as possible. At the same time, the low position of the camshaft brings the camshaft closer to the crankshaft than is normally possible, thus shortening the length of the timing chain which drives the camshaft and reducing the tendency of the timing chain to vibrate. The tunnel serves as a convenient oil passage to lubricate the camshaft cams and other associated parts without the necessity of other machining or coring operations in the casting process to provide such lubricating passages.

With such a construction it is relatively simple to provide optimum valve openings, consistent with the desired size and weight of the engine, for a desired amount of power output from the engine. The contsruction is extremely economical and efficient in its manufacture and operation and is relatively simple and uncomplicated in design.

These and other advantages will become more apparent from the following description and drawings in which:

FIGURE 1 is a plan view of a portion of an internal combustion engine constructed in accordance with the invention.

FIGURE 2 is a cross sectional view of the engine of FIGURE 1 taken substantially along the line 2—2 of FIGURE 1 and looking in the direction of the arrows to indicate the position of the various parts.

FIGURE 3 is a plan view of a portion of an internal combustion engine showing a modification of the location of the valve actuating means.

FIGURE 4 is a partial sectional view of the engine of FIGURE 3 taken substantially along the line 4—4 of FIGURE 3 and looking in the direction of the arrows.

FIGURE 5 is a partial cross sectional view of the engine of FIGURE 3 taken substantially along the line 5—5 of FIGURE 3 and looking in the direction of the arrows.

Referring now to the drawings and with reference more particularly to FIGURES 1 and 2, a one-piece cylinder head and engine block construction is shown. The engine block portion illustrated generally by the numeral 10, has spaced and generally parallel outer walls 12. Walls 12 terminate at their lower extremities in rails 14 to which may be conveniently secured the usual crankcase cover, not shown, made of any suitable material such as aluminum or sheet steel. Disposed inwardly of side walls 12 is a cylindrical wall 16 forming a cylinder bore 18. A plurality of such cylinder bores may be provided, depending upon the number of cylinders desired in the engine. Cylinder bore 18 has a central axis 20 and is open at its lower end as at 22. Cylinder bore 18 receives the usual reciprocating piston, not shown, which operates to drive the crankshaft and the remainder of the engine assembly. The space between wall 16 and wall 12 forms a coolant chamber 24 to permit cooling of the bores 18 and the walls 12 during operation of the engine.

The upper end of cylinder bore 18 may be of any convenient shape and is shown for purposes of illustration and description as being of the pent roof type. The top surface may as well be spherical or wedge shaped, depending upon the desires of the engine designer. In the upper wall of the cylinder bore 18 are intake and exhaust ports, illustrated by the numerals 26 and 28, respectively. Ports 26 and 28 are surrounded by annular valve seats 30 and 32, respectively.

Disposed above the engine block portion 10 is the cylinder head portion, illustrated generally by the numeral 34. In the lower part of cylinder head portion 34 are located inlet passages 36 and exhaust passages 38 which communicate with the intake ports 26 and exhaust ports 28, respectively, in the engine block portion 10. One such intake passage and one such exhaust passage are provided for each cylinder bore 18 in the customary manner.

Extending upwardly and outwardly from the major part of the cylinder head portion 34 are valve guide bosses 40 and 42. Valve guide boss 40 has a central cylindrical bore 44 with a central axis 46. Bore 44 is so disposed that its axis 46 forms an angle α with the axis 20 of the cylinder bore 18. Axis 46 is also the axis of the annular valve seat 30 formed in the lower end of the intake passage 36. Angle α is so designed as to permit whatever machining tools are necesary to enter the cylinder bore 18 from the lower open end 22 and to engage the valve seat 30 in the proper forming orientation. Similar-

ly, boss 42 is provided with a central, generally cylindrical, bore 48 having an axis 50 angularly disposed relative to the cylinder bore center axis 20 by an angle β. Angle β is so designed as to permit machining tools or the like to engage the valve seat 32 in the proper machining orientation, such tools entering bore 18 from the lower open end 22.

Disposed between and connecting the valve guide bosses 40 and 42 is a lateral wall 51, overlying side walls 52 and 54 which enclose the intake and exhaust passages 36 and 38, respectively. Walls 51, 52, and 54 define a longitudinally extending chamber or passage 56 for carrying engine coolant along the length of the cylinder head portion 34.

Lateral wall 51, extending between the valve guide bosses 40 and 42, also provides the lower wall for a tunnel 58 extending lengthwise of the cylinder head portion 34. Suitably retained and supported in the tunnel 58 is the engine camshaft 60. Camshaft 60 is journalled in the cylinder head portion 34 in any suitable manner and is rotatably driven by the usual crankshaft, not shown, which in turn is driven by the engine pistons. Camshaft 60 is provided with the usual cams 62 and 64 which actuate the valve actuating mechanism in a manner to become hereinafter more apparent.

Reciprocably mounted in the valve guide bosses 40 and 42 are the intake and exhaust valves, indicated by the numerals 66 and 68, respectively.

Valve 66 has a valve head 70 with a valve surface 72 suitably engaging the valve seat 30 formed in the upper wall of the cylinder bore 18. Extending from valve head 70 is a valve stem 74, slidably received in the bore 44 in the boss 40. In order to hold the valve member 66 in place, a spring retainer 76 is secured to the upper end of valve stem 74 in any suitable manner. A spring 78 extends between the spring retainer 76 and the cylinder head portion 34 surrounding the valve guide boss 40, and is of such type as to bias the valve outwardly to seat the valve head 70 against the valve seat 30. Similar in construction is the valve 68, having a valve head 80 and a seat portion 82. Seat portion 82 engages the valve seat 32 formed in the exhaust port 28. Valve member 68 includes a valve stem 84 slidably disposed in the bore 48 in the valve guide boss 42 and has mounted at its outward end a spring retainer 86 in any suitable manner. Coil spring 88, engaging the spring retainer 86 and the cylinder head portion 34 about the boss 44, biases the valve 68 outwardly such that the seats 82 and 32 are in proper engagement.

Extending across the top of tunnel 58 and spaced upwardly from the lower wall 51 is a bridge portion 90, located between the valve guide bosses 40 and 42 and extending from one of such bosses, as boss 40. Bridge 90 is connected to boss 40 by the web or wall 92 and is enlarged at spaced points along the length of the engine to form valve lifter guide bosses 91 and 93.

Bridge 90 serves to secure and retain the valve driving mechanism which actuates the valves 66 and 68 in accordance with the rotation of the camshaft 60. Received in a suitably threaded aperture 94 in the bridge 90 is a threaded stud 96, having a hemispherical rocker arm seat 98 secured thereon as by nut 100. Also received on the stud 96, beneath the seat 98 and pivotal on the seat 98, is a rocker arm, illustrated generally by the numeral 102, which may be of any suitable configuration. For purposes of illustration and description, rocker arm 102 is shown to be of the stamped sheet metal type having a floor 104 and upwardly extending side walls 106. A suitable slot 108 is formed in the floor 104 to permit rocking motion of the rocker arm 102 about the seat 98 and on the threaded stud 96. The outward end 110 of rocker arm floor 104 engages the end of valve stem 84 and may be spherically formed if desired to provide the proper contact with respect to the valve stem. The inner end 112 of rocker arm 102 engages a valve lifter 114 disposed in a bore 104 formed in the bridge 90. Valve lifter 114 may be of any suitable or known construction and is engaged by cam 64 on the camshaft 60 to drive rocker arm 102 in the usual manner. Rotation of the camshaft 60 and the engagement of the cam 64 with the valve lifter 114 causes the rocker arm 102 to pivot or rock about the seat 98 and thus actuate the valve 68 against the force of spring 88.

Bridge 90 also retains a similar actuating mechanism for the intake valve 66 which includes a rocker arm, indicated generally by the numeral 118. Rocker arm 118 engages the end of valve stem 74 at one end and engages a valve lifter 120 at its other end, in a manner as above described. Rocker arm 118 is suitably pivotally mounted on a threaded stud 122 received in the bridge 90 and spaced from stud 96 supporting rocker arm 102.

In order to close and protect the upper end of cylinder head portion 34 and to protect the valve actuating mechanism, cylinder head portion 34 includes side walls 124 which extend upwardly and outwardly to engage a rim 126 formed on a sheet metal cover or the like 128. A suitable gasket 130 may be provided between the rim 126 and the wall 124 if desired and cover 128 is secured to the cylinder head portion 34 in any convenient manner.

The planes of rotation of rocking movement of the rocker arms 102 and 118 are shown in FIGURES 1 and 2 to be disposed in normal or perpendicular relationship to the axis 132 of the camshaft 60. Thus, the angularity between the valve members 66 and 68 and the axis of the cylinder bore 20 are in planes parallel to the plane containing the cylinder bore central axis 20. As a result, the plane of any valve axis and its valve lifter is perpendicular to the axis of the camshaft. It is apparent that the size of the port openings 26 and 28 may be varied in diameter by angulating the planes of the valve seats 30 and 32. Since these planes are normal to the axes of the bores 44 and 48, the relationship between these axes and the bore axis 20 may be established. By varying angles α and β, the desired port opening size 26 and 28 is provided, depending upon the power requirements consistent with the engine size and weight and the desires of the designer.

Should the maximum angle limitations α and β be too small to permit the amount of power required, it would be possible to obtain still larger port openings in a manner to be now described. Reference is made to FIGURES 3 through 5 showing a modification of the construction of FIGURES 1 and 2 which will permit the formation of even larger intake and exhaust port openings. In the embodiment illustrated in FIGURES 3 through 5, the cylinder head portion of the construction is illustrated generally by the numeral 140.

Referring to FIGURE 4, the cylinder bore 142, formed in the engine block portion 143, is shown provided with an exhaust port 144 in which is formed a valve seat 146. Valve seat 146 and port 144 communicate with an exhaust passage 148 extending through the cylinder head portion 140. Above the passage 148 and aligned therewith is a valve guide boss 150 having a central bore 152 formed therein. Bore 152 may have an axis angularly disposed an angle β with respect to the axis of the cylinder bore 142 in the plane of the drawing.

Slidably disposed within the valve guide boss 150 is an exhaust valve, indicated generally by the numeral 154. Valve 154 has a valve head 156 with a valve seat 158 suitably engaging the valve seat 146 formed in the port 144. A valve stem 158 extends outwardly from the valve port 144 and is slidably mounted in the valve guide boss 150. A suitable spring retaining means 160 is secured to the upper end of valve stem 158 and a spring 162 biases the valve in an outward direction.

Referring to FIGURE 5, the cylinder head portion 140 includes an intake port 164 communicating with the cylinder bore 142 through the intake port 166. Port 166 is suitably provided with a valve seat 168, and located

above the intake passage 164 is a valve guide boss 170. Boss 170 has a central bore 172 with an axis 174 angularly disposed relative to the axis 143 of the cylinder bore 142 by an angle α. Slidably disposed in the bore 172 is an intake valve, indicated generally by the numeral 176, having a valve head 178 and valve seat surface 180 which engages the valve seat 168 in the intake port 166. Valve 176 has a valve stem 182 extending through the valve guide boss 170 and biased in its proper position by a spring 184 acting between a suitable retainer 186 and the cylinder head portion 140.

Extending between the valve guide bosses 170 and 150 is a wall 188, forming with the port walls 190 and 192 a cooling passage 194. Wall 188 also forms the lower wall of a tunnel 196 extending lengthwise of the cylinder head portion 140 and in which is supported and journalled the camshaft 198. Camshaft 198 includes the usual cams 200 and 202.

Extending partway between the valve guide bosses 150 and 170 is the bridge 204. Bridge 204 is secured to the various valve guide bosses, as boss 150, through a web or wall 206 and to the boss 170 as by web or wall 208. Bridge 204 secures and retains the actuating means for the valves 154 and 176. Suitably received in a threaded bore 210 formed in bridge 204 is a threaded stud 212, retaining the hemispherical rocker arm seat 214 in some suitable manner as by nut 216. A rocker arm 218 of any suitable construction is received over the stud 212 and rocks on the ball seat 214. The outward end 220 of the rocker arm 218 engages the end of valve stem 158, and the inward end 222 of rocker arm 218 engages a suitable valve lifter 224 which in turn engages the cam 200 on the camshaft 198. Similarly, in FIGURE 5, the bridge 204 retains the threaded stud 226 carrying the hemispherical ball seat 228 for rocker arm 230. The outward end 232 of rocker arm 230 engages the valve stem 182, and the inner end 234 of rocker arm 230 engages a suitable valve lifter 236 received in a bore 238 in the bridge 204. Valve lifter 236 engages the cam 202 on the camshaft 198 in the usual manner and causes actuation of valve 176 in the port 166.

It will be apparent from viewing FIGURE 3 that the valves 154 and 176 are disposed in a compound angle relative to the center line 143 of the cylinder bore 142. As above noted, FIGURES 4 and 5 indicate angularities of angles α and β of the valve axes relative to the center line 143. FIGURE 3 further indicates angularity relative to the axis 240 of the camshaft 198. The axis 153 of valve 154 is shown inclined relative to the camshaft axis 240 by an angle γ. Similarly, the axis 174 of valve 176 is shown inclined or angularly disposed relative to axis 240 by an angle δ. Thus, the valves 154 and 176 are angulated in a compound manner relative to the cylinder bore 143 and relative to the axis 240 of the camshaft 198.

It is apparent that the compound angularity of the valves permits the valve openings or ports 144 and 166 to be enlarged as compared to, for example, the port construction of the modification illustrated in FIGURES 1 and 2 and maintain a moderate cylinder head width and engine width. The preservation of engine width is of importance to facilitate installation in automobiles. It will also be apparent that the rocker arms 218 and 230 must be angularly disposed relative to the camshaft axis 240 to provide proper operation of the valves 154 and 176. Valve lifters 224 and 236 permit the proper actuation of rocker arms 218 and 230, respectively, by the camshaft 198. A high-performance, high-power engine may thus be easily designed with the modification of FIGURES 3 through 5.

This valve arrangement may be used with the classic engine design, the cylinder head separated from the cylinders, or may be used with an integral engine construction. In the latter case, the major limitation on the port openings is again the size of the openings at the bottom of the cylinder bore. The angularity must be such as to permit the entry of the valve forming tools and machining devices and to permit assembly of the valves in the valve guide bosses.

It will thus be apparent that a means is provided for increasing the power output possible in a given size and given weight engine. The resulting engine design is extremely efficient and economical in operation and manufacture. The design permits lower profile engines and an increase in savings, in parts, and materials. The lower profile of the engine has numerous other advantages such as, for example, a shorter length of timing chain and the resultant reduction in vibration caused therein. An engine block of this design may be varied in accordance with the desired power output with relative ease and simplicity. It will be apparent from viewing the various figures of the drawings that the manufacture of the construction from the standpoint of machining and coring of the engine block and cylinder head casting is extremely simple. Thus, considerable savings may be realized in the manufacture and production costs of an engine manufactured in accordance with the invention.

I claim:

1. A one-piece engine block and cylinder head construction for an internal combustion engine comprising:
an engine block portion having a plurality of cylinders formed therein and being open at the lower end thereof;
a cylinder head portion having inlet and exhaust passages formed therein and communicating with said cylinders and terminating in said cylinders with valve seats, said valve seats being angularly disposed relative to a vertical longitudinal median plane of said cylinder head portion to permit machining thereof through said open end of said engine block portion;
valve guide bosses formed in said cylinder head portion and having valve steam receiving bores formed therethrough, said bores being angularly disposed relative to a vertical longitudinal plane of said cylinder head portion and opening into said intake and exhaust passages, said bosses being adapted to receive intake and exhaust valves reciprocable therein and seatable on said valve seats;
means formed in said cylinder head portion for rotatably receiving and supporting a camshaft, said means being disposed along a longitudinal axis of said cylinder head portion and between said bosses;
and bridge means extending inwardly from one of said bosses and over said axis and adapted to receive the actuating mechanism for the valves mounted in said bosses.

2. The construction set forth in claim 1 wherein the axes of said valve stem receiving bores are disposed in planes normal to said longitudinal axis of said cylinder head portion.

3. The construction set forth in claim 1 wherein the axes of said valve stem receiving bores are disposed in planes angularly located relative to said longitudinal axis of said cylinder head portion.

4. A one-piece engine block and cylinder head construction for an internal combustion engine comprising:
an engine block portion having a cylinder bore formed therein, said cylinder bore being open at the lower end thereof and having an intake port and an exhaust port at the upper end thereof, said ports being surrounded by annular valve seats having axes angularly disposed relative to the axis of said cylinder bore to permit forming of said valve seats from said open end of said cylinder bore;
a cylinder head portion above said engine block portion and having intake and exhaust passages formed therein communicating respectively with said intake and exhaust ports in said cylinder bore;
valve guide bosses formed in said cylinder head portion

having valve stem receiving bores adapted to reciprocably receive intake and exhaust valves, said bores having axes angularly outwardly disposed relative to said axis of said cylinder bore;

a wall extending across said cylinder head portion and between said bosses;

a bridge extending from one of said bosses and above said wall and defining with said wall a tunnel extending axially of said cylinder head portion adapted to receive a camshaft, said bridge being formed to receive and retain actuation means for operating the valves in said bosses.

5. The construction set forth in claim 4 wherein said axes of said bosses are disposed in planes parallel to said axis of said cylinder bore and normal to the axis of said tunnel.

6. The construction set forth in claim 4 wherein said axes of said bosses are disposed in planes angularly disposed relative to the axis of said tunnel.

7. The construction set forth in claim 6 wherein the axes of said bosses are angularly disposed relative to each other.

8. A one-piece engine block and cylinder head construction for an internal combustion engine comprising:

an engine block portion having a cylinder bore therein, said cylinder bore having an open lower end and intake and exhaust ports in the upper end, said ports being surrounded by annular valve seats having axes angularly disposed relative to the axis of said cylinder bore an amount permitting machining of said valve seats from said open end of said cylinder bore;

a cylinder head portion disposed above said engine block portion and having an axially disposed tunnel formed therein adapted to receive a camshaft, the upper wall of said tunnel being formed to receive and support valve operating means engageable with said camshaft;

and valve guide means formed in said cylinder head portion and having axes angularly disposed relative to the axis of said cylinder bore in planes normal to the axis of said tunnel, said valve guide means being adapted to reciprocably receive intake and exhaust valves engageable with said valve seats.

9. The construction set forth in claim 8 wherein said axes of said valve guide means are disposed in planes angularly disposed relative to said axis of said tunnel.

10. The construction set forth in claim 9 wherein said axes of said valve guide means are disposed in non-parallel planes.

11. The construction set forth in claim 9 wherein said axes of said valve guide means are disposed in parallel planes.

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