Sept. 4, 1934. C. BALOUGH 1,972,752

INTERNAL COMBUSTION ENGINE AND STRUCTURE THEREFOR

Original Filed May 2, 1929 2 Sheets-Sheet 1

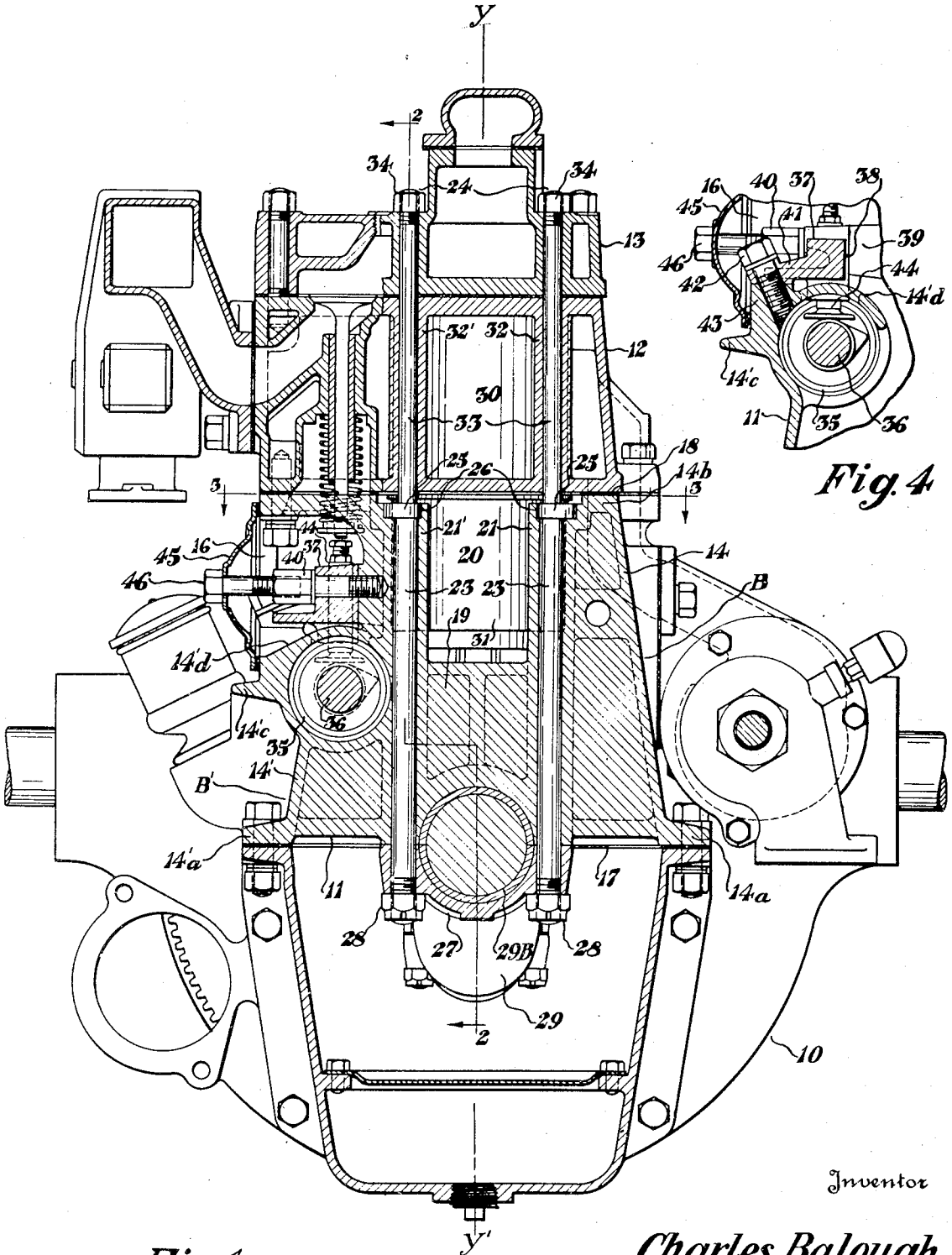


Fig 1

Fig. 4

Inventor

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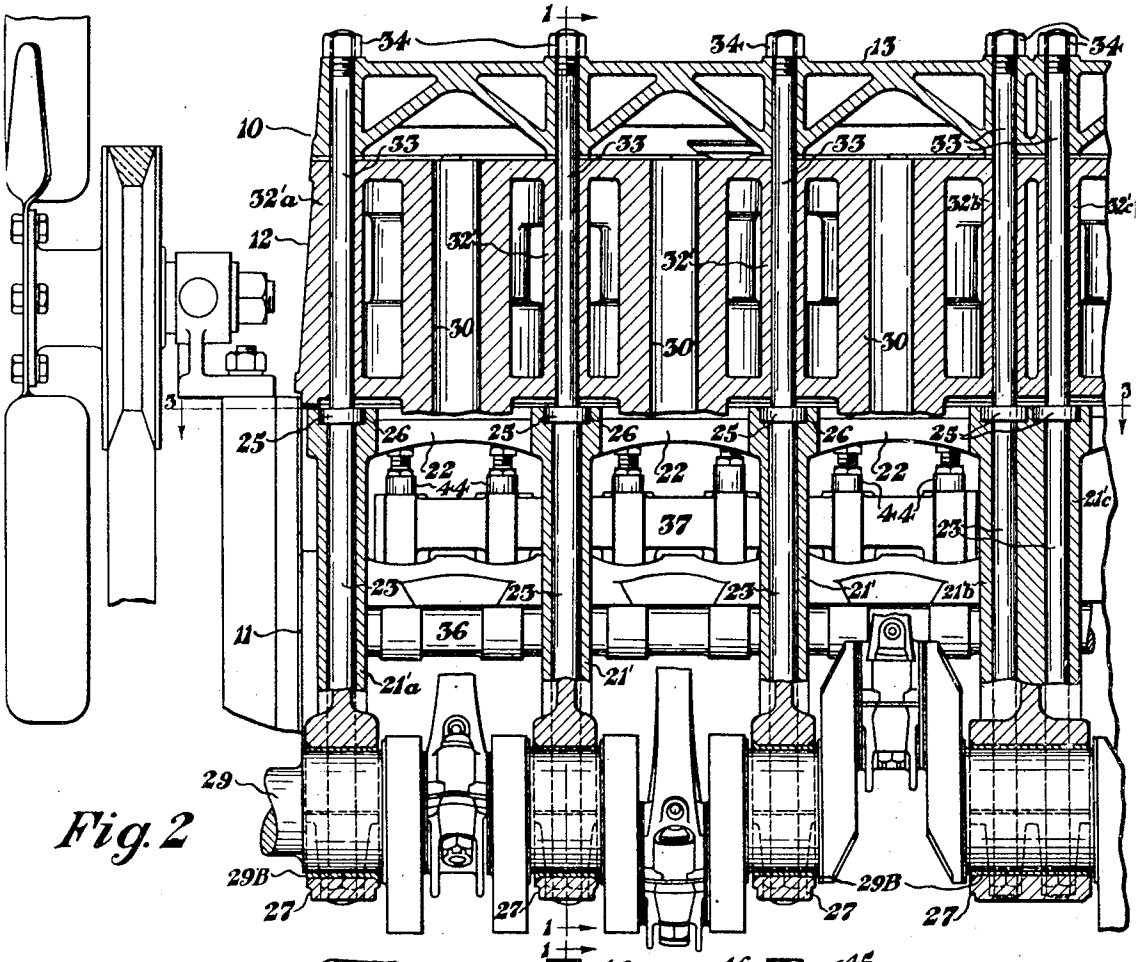


Fig. 2

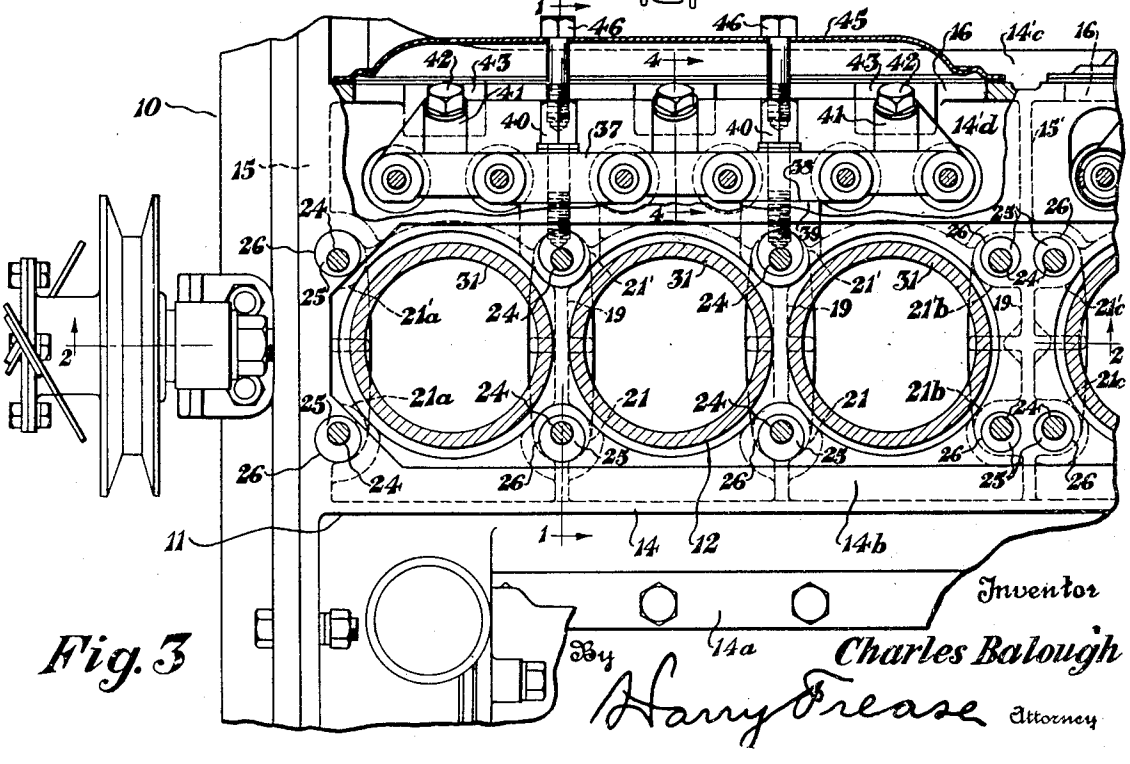


Fig. 3

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INTERNAL COMBUSTION ENGINE AND STRUCTURE THEREFOR

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Refiled for abandoned application Serial No. 359,863, May 2, 1929. This application November 22, 1930, Serial No. 497,589

12 Claims. (Cl. 121—194)

My invention relates to internal combustion engines and to structures for such engines, and this application is a substitute for my abandoned application, Serial No. 359,863, filed May 2, 1929.

Internal combustion motors as now constructed are of two general types relative to the valve mechanism, one of which embodies a construction in which the valves are carried by the cylinder block and the other of which embodies a construction in which the valves are carried by the cylinder head.

Prior motor constructions in which the valves were carried by the block necessitated grinding of the valves in the block in assembled relation with the crankcase or necessitated a laborious task of removing the block for grinding the valves at a bench.

While in the valve-in-head type of motors now constructed the valves can readily be ground as a bench job the present invention has a primary object to provide a motor construction of the valve-in-block type wherein the block is readily removable for facilitating grinding of the valves for reboring the cylinders and in order to readily secure access to the pistons.

In engines including separable cylinder blocks and crank cases, it has been difficult to attain a strength and rigidity for such a composite structure equal to the strength and rigidity of a one piece cylinder block and crank case structure.

The objects of the present improvements include the provision of an engine structure, including a cylinder block and a separate crank case, connected with each other in such manner that the strength and rigidity of the resulting structure approximates the strength and rigidity of a one piece cylinder block and crank case structure, it being understood that a one piece cylinder block is generally believed to approach maximum strength and rigidity.

Further objects of the improvements include the provision of an engine structure including a crank case made of aluminum or like material, and a cylinder block made of cast iron or like material, and connected with each other in such manner as to subject the crank case largely to compression loads, and substantially eliminating the application of tension loads to the crank case, it being understood that the use of aluminum facilitates the attainment of a light weight engine structure.

Further objects of the improvements include the provision of an engine structure including a crank case having access openings therein, and having a strength and rigidity substantially equal to its strength if the access openings were not provided in the crank case, it being understood that access openings usually weaken an engine structure.

A further object of the present invention is to provide an internal combustion motor comprising a relatively light removable cylinder block provided with the valve mechanism.

A still further object of the invention is to provide an internal combustion motor comprising a relatively deep crank case, a relatively shallow cylinder block supported on said crank case for expeditious removal therefrom and assembly thereon, said crank case and said cylinder block provided with interrelated alining means.

A still further object of the invention is to provide an internal combustion motor comprising a crank case, a cylinder block removably supported on said crank case, said cylinder block being provided with cylindrical extensions projecting into said crank case, said cylindrical extensions alining with cylindrical bores in said cylinder block forming the cylinders, and said crank case provided with receiving and centering means for said extensions.

A still further object of the invention is to provide an internal combustion motor comprising a crank case embodying a plurality of main bearings, a crank shaft rotatably supported in said bearings by removable bearing caps, a cylinder block removably supported on said crank case, a cylinder head removably supported on said cylinder block, and common means for maintaining said bearing caps, cylinder block and cylinder head in assembled relation.

A still further object of the invention is to provide an internal combustion motor comprising a crank case, bearings supported in said crank case, a crank shaft rotatably supported in said bearings by bearing caps, bolts projecting through said bearings and said caps and provided with nuts for holding said caps in operative position, a cylinder block removably supported on said crank case, a cylinder head removably supported on said cylinder block, said cylinder block and said cylinder head being retained in assembled position by said bolts.

A still further object of the invention is to provide an internal combustion motor comprising a crank case provided with crank shaft bearings, shouldered bolts projecting vertically through said bearings and above said crank case, the inner ends of said bolts extending through bearing caps and provided with nuts for maintaining said bearing caps in position, a cylinder block and a cyl-

inder head supported by said crank case through both of which said bolts extend, and said bolts provided with nuts on the outer ends thereof for drawing said cylinder block and said cylinder head into assembled position.

These and other objects are attained in the present invention as will hereinafter be set forth in detail and claimed.

A preferred embodiment of the improvements is illustrated in the accompanying drawings forming part hereof, in which

Figure 1 is a fragmentary transverse sectional view as on line 1—1, Figs. 2 and 3, of an internal combustion engine including the improved engine structure hereof, the walls about one of the valves in the cylinder block being broken away;

Fig. 2, a fragmentary longitudinal sectional view thereof as on line 2—2, Figs. 1 and 3;

Fig. 3, a fragmentary plan sectional view thereof as on line 3—3, Figs. 1 and 2; and

Fig. 4, a detached fragmentary transverse sectional view thereof as on line 4—4, Fig. 3.

Similar numerals refer to similar parts throughout the several views.

The internal combustion engine indicated generally at 10 includes in combination with other usual parts of an engine, a crank case 11, a cylinder block 12, and a cylinder head 13.

For attaining lightness, the crank case 11 is preferably made of aluminum, aluminum alloy, or like material. On the other hand for attaining strength and rigidity, the cylinder block 12 is preferably made of semi-steel, cast iron or the like; and likewise the cylinder head 13 may be made of cast iron.

The crank case includes laterally spaced side walls 14 and 14' and a plurality of longitudinally spaced transverse walls 15 and 15' extending between and connected with the side walls. The transverse walls may be either end walls or intermediate walls.

In order to permit access to the interior of the crank case, the wall 14' may have formed therein a plurality of access openings 16, each of which may extend for a greater portion of the length between any two of the transverse walls, such as 15 and 15'.

These access openings weaken the side wall 14', and other members of the structure about to be described are adapted not only for counteracting the weakening of the side wall 14' by the access openings 16, but also for providing a strength and rigidity for the resulting engine structure approximately equal to that which it would have if the crank case and cylinder block were made in one piece.

The side wall 14 extends from the inner end of an outwardly projecting longitudinally extending flange 14*a* at the bottom face 17 of the crank case, upwardly and inwardly towards the vertical axial plane Y—Y' of the engine to an inwardly projecting longitudinally extending flange 14*b* at the top face 18 of the crank case.

Accordingly the wall 14 and its flanges 14*a* and 14*b* comprise in one sense a Z beam B having a depth equal to the distance between the top and bottom of the crank case, with respect to loads or components in the vertical plane; and in another sense comprise a box beam flange having a width equal to the distance between top and bottom of the crank case, with respect to loads or components in the horizontal plane.

The wall 14' extends from the inner end of a similar outwardly projecting longitudinally extending flange 14'*a* upwardly and inwardly towards the vertical axial plane Y—Y'. As aforesaid, the wall 14' has the apertures 16 formed therein, and does not extend without a break the entire distance to the top 18. Without the structural reinforcements about to be described, the wall 14' would not be as strong either as a web beam against loads or components in the vertical plane, or as the flange of a box beam against loads or components in the horizontal plane.

Obviously both walls 14 and 14' and their structurally cooperating elements, should be equally strong against both horizontal and vertical loads or components.

Accordingly the wall 14' extends outwardly intermediate the bottom and top surfaces 17 and 18 of the crank case, and includes at one side an outwardly projecting longitudinally extending flange 14'*c*, and at the other side an inwardly projecting longitudinally extending transversely arched flange 14'*d*, both the flanges 14'*c* and 14'*d* being located intermediate the bottom and top of the crank case.

The wall 14' and its bottom flange 14'*a* and top flanges 14'*c* and 14'*d* comprise a distorted channel beam B' which is designed to have sufficient cross sectional area to equal the strength against vertical loads or components, of the Z beam B formed by the wall 14 and its flanges 14*a* and 14*b*, provided that suitable means transmit the vertical loads to the aforesaid crank case side beams B' and B of different cross sections, that is a distorted channel section for the one, and a Z section for the other.

The distorted channel beam B' is likewise designed to be substantially equal as a box beam flange against horizontal loads or components, to the strength of the Z beam B, provided that suitable means transmit the loads between the beams B' and B.

The means for transmitting loads to and between the side beams B and B' include a plurality of longitudinally spaced transverse webs 19, each extending at their lower end between the walls 14 and 14', and at each side between the top and bottom of the crank case, and each being preferably provided with a central notch opening 20 at its upper end.

Preferably at equal distances at each side of the vertical axial plane Y—Y' of the engine, each web has formed therein vertical cylindric tubular columns 21 and 21' extending from the top to the bottom of the crank case.

Similarly the crank case transverse end wall 15 preferably includes vertically extending cylindric tubular columns 21*a* and 21'*a*; and the intermediate transverse wall 15' includes vertically extending cylindric tubular columns 21*b* and 21'*b* at one side thereof, and 21*c* and 21'*c* at the other side thereof.

The several columns at each side of the center line of the engine, are preferably longitudinally alined with each other, and their extreme upper ends may be connected by longitudinally extending ribs 22.

As best illustrated in Fig. 1, the inner end of the longitudinally extending arched flange 14'*d* projecting inwardly from the wall 14', preferably connects with the column member at that side of the engine; and the arched flange 14'*d* is spaced a substantial distance below the upper end of the columns, and below the lower edges of the ribs 22, providing clear longitudinally spaced openings between the columns.

The bore in each of the tubular columns re-

ceives the lower end 23 of an improved clamp bolt 24, each of which includes an eccentric collar 25 formed thereon intermediate its ends, and each eccentric collar 25 is seated in a counterbore 26 formed in the upper end of the crank case and eccentric to the bore of its column.

The lower end 23 of each clamp bolt extends through the bore of its column, and below the bottom of the crank case through an aperture formed at one side of a main crank shaft bearing cap 27.

The extremity of each lower end 23 of each clamp bolt extends below the cap 27 and is threaded, and a nut 28 is screwed thereon and securely clamps the cap to the crank case, and anchors the bolt 24 in the crank case. Each eccentric head 25 serves to prevent its clamp bolt from turning during the application of the nut 28, and each head also reacts against its nut for anchoring the clamp bolt in the crank case, and the material in the crank case is thus subject to compression between each cap and each eccentric head 25.

In the lower end of each web 19 preferably between each pair of transversely spaced clamp bolts, and in the upper end of each cap 27, semicircular complementary seats are formed for a crank shaft bearing 29B secured therein, and the crank shaft 29 is mounted for rotation in the usual manner in the several crank shaft bearings 29B.

The cylinder block 12 includes a plurality of cylinders 30 each of which preferably includes a skirt 31 extending into the upper end of the crank case between the longitudinally and transversely spaced clamp bolts and columns.

The cylinder block 12 also includes a plurality of cylindric tubular columns 32 and 32' registering with the columns 21 and 21' of the crank case, as well as other columns including the columns 32'*a*, 32'*b*, and 32'*c* registering with the other columns of the crank case, including the columns 21'*a*, 21'*b*, and 21'*c*, respectively.

Each clamp bolt 24 includes above the eccentric collar 25, an upper end 33 extending through the bore of the registering column in the cylinder block, and preferably through a registering bore in the cylinder head 13. The extremity of each clamp bolt upper end 33 is threaded and a nut 34 screwed thereon securely clamps the cylinder block and cylinder head to the crank case, forming in effect an integral structure.

In the crank case below the arched flange 14'*d* and between the wall 14' and the adjacent clamp rods, cam shaft bearings 35 are mounted, and a cam shaft 36 is journalled in the bearings.

A longitudinally extending push rod guide member 37, which is also sometimes known as a cluster, has formed at one side thereof a vertical face 38 which seats against the outer ends of lugs 39 projecting outwardly from the web columns.

Horizontally extending cap screws 40 pass through horizontal bores in the cluster 37 and are screwed in threaded sockets in the lugs 39.

The cluster 37 includes outwardly extending feet 41, having angled bores therein, through each of which a cap screw 42 extends and is angled downwardly and towards the center line of the engine, and is screwed into an angled threaded bore in a lug extension 43 of the flanges 14'*c* and 14'*d*.

The abutting faces between the feet 41 and the lugs 43 are preferably horizontal, and the combined clamping and crowding action of the horizontally extending screws 40 and the downwardly and inwardly extending angled screws 42 serve to crowd the push rod guide member or cluster 37 towards the columns, insuring vertical alinement for the push rods 44 slidably mounted in the cluster. At the same time the provision of the angled and horizontal screws for mounting the cluster serve to stiffen the crank case between bearings.

Each access opening 16 is provided with a cover 45 which may be secured on the engine as by means of screws 46 extending through suitable apertures in the cover, and screwed into threaded sockets in the heads of the screws 40.

The foregoing engine structure thus includes a cylinder block and a separate crank case, with no flanges at the joint between the cylinder block and crank case, and the cylinder block having access openings therein, but being substantially as strong as if it had no access openings, by reason of the distorted channel beam side member, and by reason of the compression clamp connection of the crank case with the cylinder block.

I claim:

1. An engine structure including a crank case, a cylinder block, and a cylinder head, the crank case including spaced side walls and one of the side walls having an access opening formed therein, and the crank case including from end to end thereof a longitudinally continuous externally flanged beam portion located below the access opening, transversely extending webs connecting the side walls and extending from top to bottom of the crank case at opposite sides of the access opening, bores in the webs extending from top to bottom of the crank case, bores in the cylinder block registering with bores in the crank case, bores in the cylinder head registering with the crank case and cylinder block bores, and clamping bolts extending through the bores and separably connecting the crank case, cylinder block, and cylinder head together.

2. An engine structure including a crank case, a cylinder block, and a cylinder head, the crank case including spaced side walls and one of the side walls having an access opening formed therein, and the crank case including from end to end thereof a longitudinally continuous externally flanged beam portion located below the access opening, transversely extending webs connecting the side walls and extending from top to bottom of the crank case at opposite sides of the access opening, bores in the webs extending from top to bottom of the crank case, bores in the cylinder block registering with bores in the crank case, bores in the cylinder head registering with the crank case and cylinder block bores, clamping bolts extending through the bores and separably connecting the crank case, cylinder block, and cylinder head together, and a collar on each clamping bolt between the cylinder block and the crank case.

3. An engine structure including a crank case, a cylinder block, and a cylinder head, the crank case including spaced side walls and one of the side walls having an access opening formed therein, and the crank case including from end to end thereof a longitudinally continuous externally flanged beam portion located below the access opening, transversely extending webs connecting the side walls and extending from top to bottom of the crank case at opposite sides of the access opening, bores in the webs extending from top to bottom of the crank vase, bores in the cylinder block registering with bores in the crank case,

bores in the cylinder head registering with the crank case and cylinder block bores, clamping bolts extending through the bores and separably connecting the crank case, cylinder block, and cylinder head together, and a counterbore at the end of each crank case bore adjacent the cylinder block, and eccentric collars on the clamping bolts, the eccentric collars fitting in the counterbores.

4. An engine structure including a crank case, a cylinder block, and a cylinder head, the crank case including spaced side walls and one of the side walls having an access opening formed therein, transversely extending webs connecting the side walls and extending from top to bottom of the crank case, bores in the webs extending from top to bottom of the crank case, bores in the cylinder block registering with the bores in the crank case, bores in the cylinder head registering with the bores in the cylinder block and the crank case, clamping bolts extending through the bores and connecting the crank case, cylinder block, and cylinder head together, and a collar on each clamping bolt between the cylinder block and the crank case.

5. An engine structure including a crank case, a cylinder block, and a cylinder head, the crank case including spaced side walls and one of the side walls having an access opening formed therein, transversely extending webs connecting the side walls and extending from top to bottom of the crank case, bores in the webs extending from top to bottom of the crank case, bores in the cylinder block registering with the bores in the crank case, bores in the cylinder head registering with the bores in the cylinder block and the crank case, clamping bolts extending through the bores and connecting the crank case, cylinder block, and cylinder head together, and a counterbore at the end of each crank case bore adjacent the cylinder block, and eccentric collars on the clamping bolts, the eccentric collars fitting in the counterbores.

6. An engine structure including a crank case, a cylinder block, and a cylinder head, the crank case including spaced side walls and one of the side walls having an access opening formed therein, transversely extending webs connecting the side walls and extending from top to bottom of the crank case, bores in the webs extending from top to bottom of the crank case, bores in the cylinder block registering with the bores in the crank case, bores in the cylinder head registering with the bores in the cylinder block and the crank case, clamping bolts extending through the bores and connecting the crank case, cylinder block, and cylinder head together, and a counterbore at the end of each crank case bore adjacent the cylinder block, and eccentric collars on the clamping bolts, the eccentric collars fitting in the counterbores, and a member extending longitudinally across the transverse webs and removably connected therewith.

7. An engine structure including a crank case, a cylinder block, and a cylinder head, the crank case including spaced side walls and one of the side walls having an access opening formed therein, transversely extending webs connecting the side walls and extending from top to bottom of the crank case, bores in the webs extending from top to bottom of the crank case, bores in the cylinder block registering with the bores in the crank case, bores in the cylinder head registering with the bores in the cylinder block and the crank case, clamping bolts extending through the bores and connecting the crank case, cylinder block, and cylinder head together, a collar on each clamping bolt between the cylinder block and the crank case, rows of seats formed on the transverse webs, a member extending longitudinally across the transverse webs on the seats thereof, apertures formed in the longitudinally extending member and angled acutely with respect to one row of seats, and screws extending through the angled apertures into the webs and crowding the longitudinally extending member against the other row of seats.

8. An internal combustion motor comprising a crank case; a cylinder block provided with intake and exhaust valves removably supported on said crank case; a cylinder head removably supported on said cylinder block; and common securing means for said crank case; cylinder block and cylinder head.

9. The combination defined in claim 8 in which said crank case and said cylinder block are provided with co-operating means for aligning said block and said case.

10. An internal combustion motor comprising a crank case; crank shaft bearings supported within said crank case; bearing caps removably secured to said bearings; a valve supporting cylinder block removably supported on said crank case; a cylinder head removably supported on said cylinder block; bolts extending through said bearing caps, cylinder block and cylinder head; and nuts threadedly engaged with the opposite ends of said bolts for removably securing said bearing caps, cylinder block and cylinder head in operative position.

11. The combination defined in claim 10 in which said bolts are provided with shoulders adapted for seating engagement in recesses in said crank case.

12. An internal combustion motor comprising a crank case; a cylinder block removably supported on said crank case; a cylinder head removably supported on said cylinder block; said cylinder block supporting intake and exhaust valve mechanism; and common securing means for removably maintaining said block in said crank case and said head on said block whereby upon removal of said head said block is free for removal from said crank case.

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