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R. S. JOHNSON ET AL  
INTERNAL COMBUSTION ENGINE

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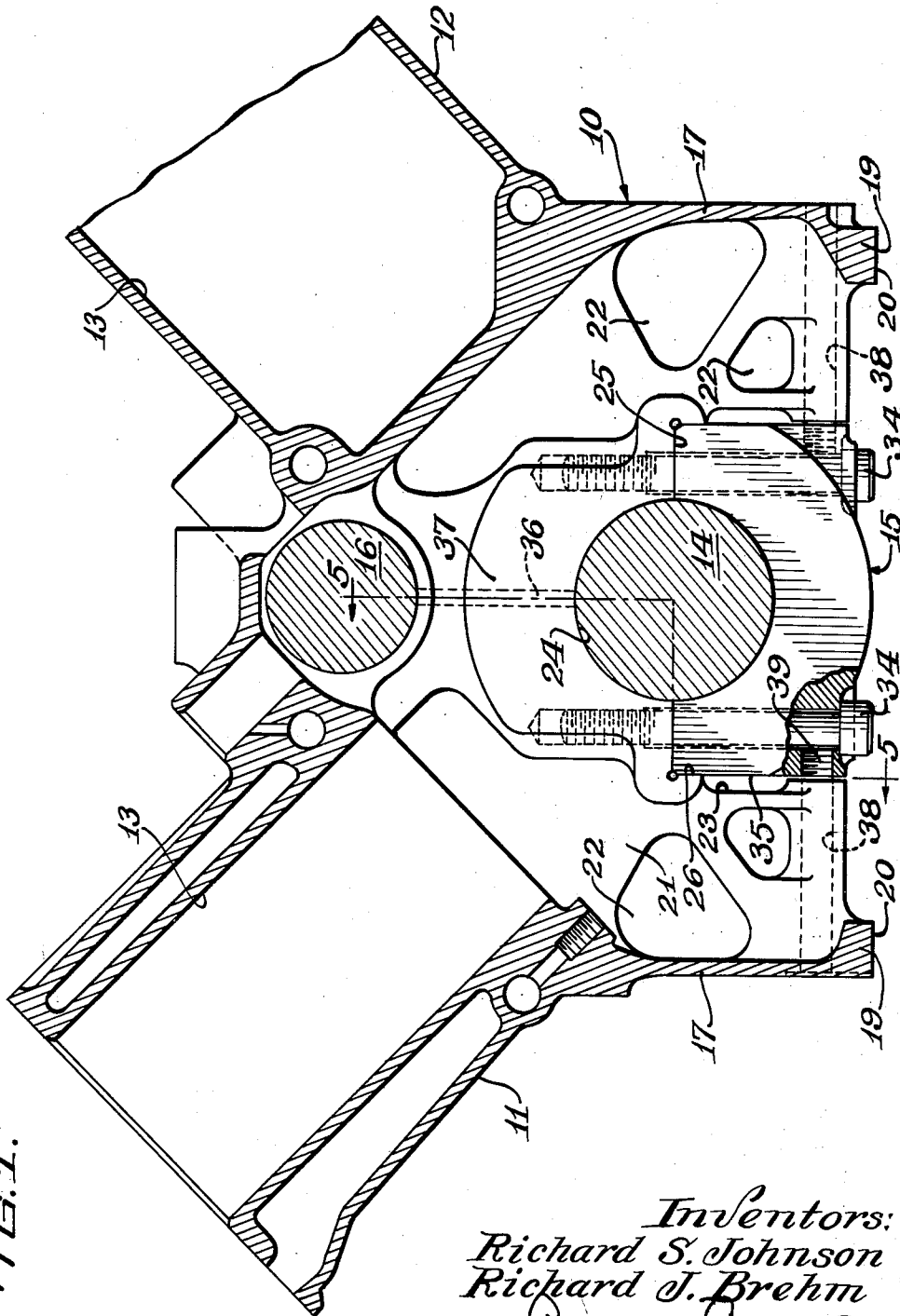


FIG. 1.

Inventors:  
Richard S. Johnson  
Richard J. Brehm  
Lawrence J. Brehm  
Atty.

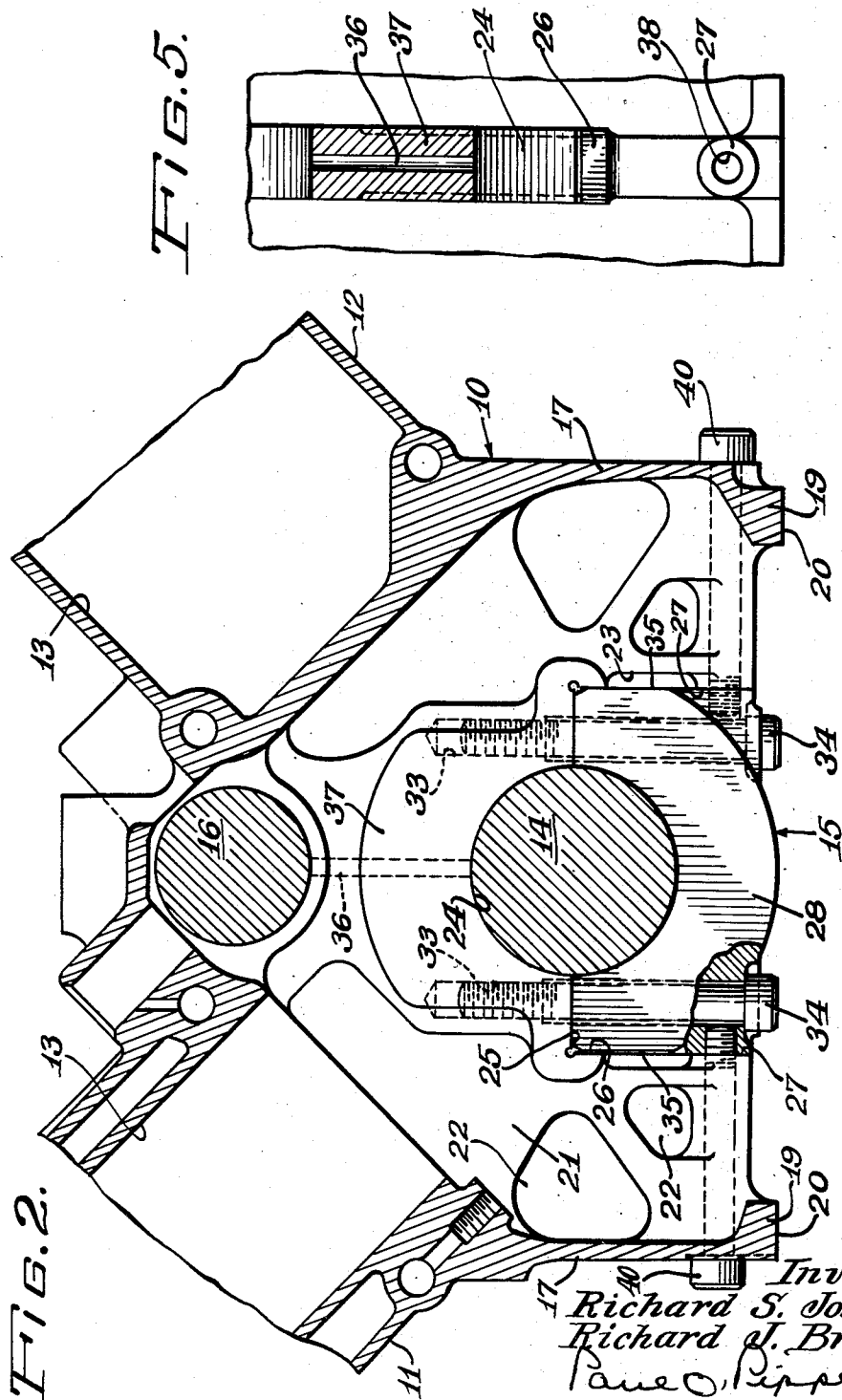
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FIG. 4.

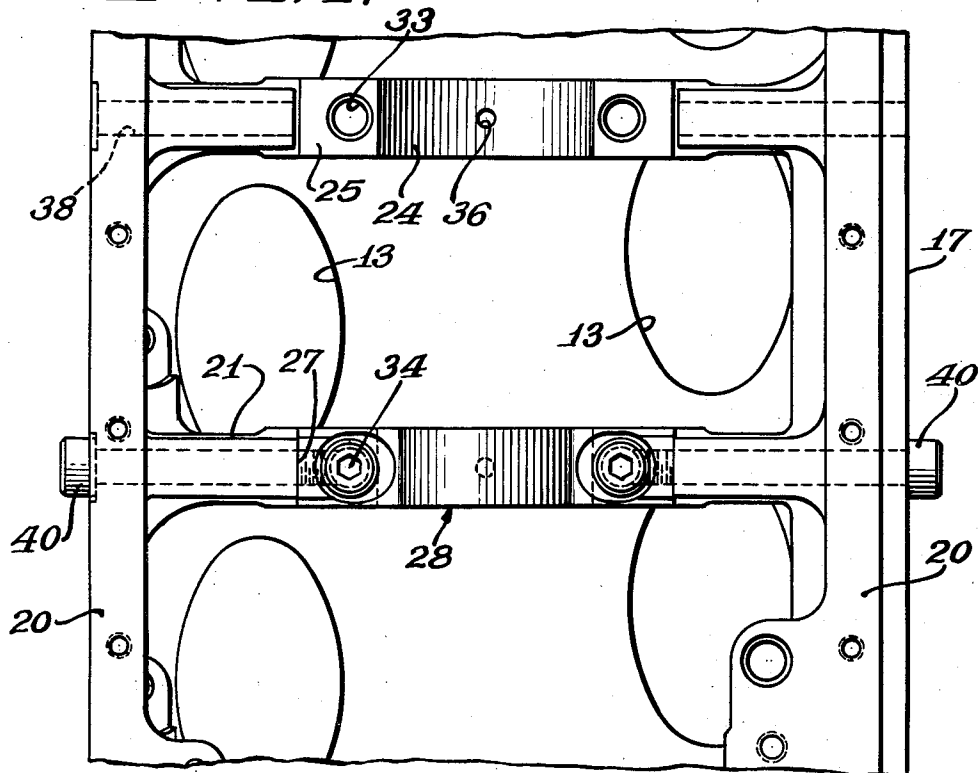
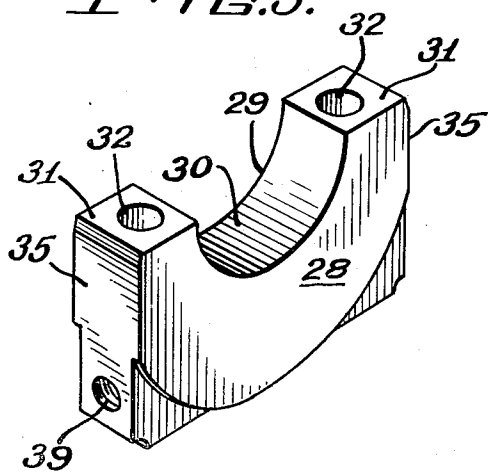


FIG. 3.



Inventors:  
Richard S. Johnson  
Richard J. Brehm  
Paul O. Rippel  
Atty.

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## INTERNAL COMBUSTION ENGINE

Richard S. Johnson and Richard J. Brehm, Fort Wayne, Ind., assignors to International Harvester Company, Chicago, Ill., a corporation of New Jersey  
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12 Claims. (Cl. 92-149)

This invention relates to internal combustion engines and more particularly to a new and improved crankcase or frame construction for V-type engines.

The engine crankcase or frame in the vast majority of V-type engines wherein the cylinders are arranged in two angularly related rows or banks is usually provided with a plurality of longitudinally spaced, transversely extending bulkheads or webs adjacent the normally lower end thereof. Each transverse bulkhead or web generally has a semi-cylindrical recess formed in the lower edge thereof which is registrable with a semi-cylindrical recess formed in a bearing cap, made of a material usually having a greater strength than the bulkhead material, to provide a main bearing support for rotatably supporting the engine crankshaft. Usually the engine camshaft is journaled in the crankcase and extends parallel to and is vertically spaced above the crankshaft. Vertically disposed oil passageways, drilled or otherwise formed in the crankcase transverse bulkheads or webs and extending between each main bearing and the camshaft bearings or oil gallery, are generally employed for supplying lubricating oil to the main bearings. Obviously, the areas or sections of the transverse bulkheads through which such oil passageways extend are structurally weakened by the presence of the passageways.

It is well known in the operation of a V-type internal combustion engine the explosions due to the burning of gas in the engine cylinders develop pulsating pressures of considerable magnitude which, in turn, create large forces which are applied to the engine crankshaft along the longitudinal axes of the cylinders. Because of the angular disposition of the cylinders of a V-type engine and the fact that the pressures developed in the engine cylinders are pulsating, the horizontal components of the large forces applied to the crankshaft tend to slide the bearing caps sideways or transversely first in one direction and then the other. The vertical components of the forces applied to the crankshaft tend to force the bearing caps vertically away from the lower edges of the transverse bulkheads or webs. The transverse bulkhead and side wall structure of the crankcase obviously must be strong enough to absorb the high stresses, which are primarily tension stresses along the axes of the cylinder bores, without fracturing. Heretofore, fractures frequently occurred in the weakened sections of the transverse bulkheads through which the main bearing oil passageways extend. Main bearing cap bolts utilized to secure the main bearing caps to the transverse bulkheads can readily be designed to hold the bearing caps properly in place against the action of the vertical components of force but the problem of restraining transverse cap bearing motion is more difficult and has not been efficiently solved heretofore. It is therefore a primary objective of the present invention to provide a simple yet effective means for efficiently restraining transverse movement of the main bearing caps of a V-type internal combustion engine under all operating conditions and for substantially increasing the strength of the crankcase and especially the sections of the transverse bulkheads through which the main bearing oil passageways extend without materially increasing the bulk thereof.

When assembling the main bearing caps on the transverse bulkheads, it is oftentimes the practice, in order to positively locate the bearing caps in a transverse direc-

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tion with respect to the transverse bulkheads and to allow for machine tool tolerances, to cause or pilot two parallel, and generally vertical surfaces, of each bearing cap to closely fit and engage cooperating surfaces of a respective transverse bulkhead. Normally the pilot fit is designed to be from zero to some degree of positive interference. It has been found that the degree of fit is very critical with regard to the ability of the bearing cap to withstand transverse motion during operation of the engine. It has been found that the higher the compressive pre-load on the bearing cap or the tighter the interference fit between the vertical mating surfaces of the bearing cap and transverse bulkhead, the greater the resistance will be to transverse motion of the bearing cap. However, the stresses in the main bearing bores at the transverse bulkhead sections through which the vertical oil passageways extend are increased as the interference fit becomes greater or tighter and such stresses are primarily tension stresses and since, as stated hereinbefore, the dynamic forces on the engine also tend to produce tension stresses in the same areas or sections, the transverse bulkheads are more prone to fracture during operation of the engine. It is therefore another object of the present invention to provide means for pre-stressing or pre-loading, in compression, the sections of the transverse bulkheads through which the main bearing oil passageways extend during assembly of the main bearing caps on the transverse bulkheads whereby the tension stresses produced in these same transverse bulkhead sections during operation are equalized or cancelled by the pre-load compression and thus the overall strength of the crankcase is increased.

The foregoing and other objects and desirable features inherent in and encompassed by the invention together with many of the purposes and uses thereof will become readily apparent from a reading of the ensuing description in conjunction with the annexed drawings in which:

FIGURE 1 is a transverse, vertical sectional view of a portion of an internal combustion engine crankcase embodying the invention, the main bearing cap is shown partially secured to a transverse bulkhead or web of the crankcase;

FIGURE 2 is a view similar to FIGURE 1 with the exception that the main bearing cap is shown fully assembled on a crankcase transverse bulkhead;

FIGURE 3 is a perspective view of a main bearing cap utilized to practice the invention;

FIGURE 4 is a bottom plan view of a portion of the internal combustion engine crankcase embodying the invention; and

FIGURE 5 is a vertical sectional view taken substantially along line 5-5 of FIGURE 1.

Referring to the drawings in detail, wherein like reference characters represent like elements throughout the various views, the crankcase or frame 10 of a V-type internal combustion engine is partially shown. The crankcase 10 has a pair of angularly related cylinder banks 11, 12 each of which has a plurality of longitudinally spaced cylinder bores 13 extending therethrough. The cylinder bores 13 receive reciprocating pistons (not shown) which are connected to a crankshaft 14 by means of connecting rods (not shown) in a well known manner. The crankshaft 14 is rotatably mounted in the crankcase 10 in a plurality of bearings designated generally by reference character 15. An engine camshaft 16 is mounted in suitable bearings provided in the crankcase 10 at the apex of the V formed by the cylinder banks 11, 12. It will be appreciated that the rotational axis of the camshaft is directly above and lies in the same vertical plane containing the rotational axis of the crankshaft 14 which vertical

plane is disposed midway between the cylinder banks 11, 12.

The crankcase 10 further includes a pair of transversely spaced, vertical side walls 17 which depend from the lower outer edges of the cylinder banks 11, 12 and a pair of end walls (not shown) extending transversely between the side walls 17. The bottom edges of the side walls 17 and end walls are defined by an enlarged rectangular flange 19 having a flat surface 20 lying substantially in a horizontal plane. An oil pan, not shown, is suitably secured to the flat surface 20 and serves as an oil sump for the engine lubricating oil.

Integrally cast or formed with the side walls 17 are a plurality of longitudinally spaced, transversely extending bulkheads or webs 21. Each of the bulkheads 21 extends transversely from the space between a pair of adjacent cylinder bores 13 in one bank 11 to the space between a pair of adjacent cylinder bores 13 in the other bank 12 and vertically from the apex of the V formed by the cylinder banks 11, 12 to the rectangular flange 19. In order to reduce the overall weight of the crankcase 10, the bulkheads or webs 21 are provided with a plurality of relatively thin sections 22 therethrough as shown.

The lower mid-portion of each bulkhead 21 is provided with a cavity 23 which is partially formed by a semi-cylindrical crankshaft bore extending longitudinally through the bulkhead 21 and which bore is defined by a semi-cylindrical bearing supporting surface 24. Extending transversely outwardly from each end of the semi-cylindrical surface 24 is a generally rectangular and horizontal flat surface 25. Extending perpendicularly or vertically from the outermost edge of each surface 25 is a rectangular bearing cap piloting surface 26. The piloting surfaces 26 of each bulkhead 21 are transversely spaced and in alignment and parallel with respect to each other. Each bulkhead 21 is further provided with a pair of generally vertical surfaces 27 disposed adjacent the lowermost or open end of the cavity 23 which is transversely spaced and in alignment and parallel with respect to each other. The vertical surfaces 27, as illustrated in FIGURE 2, are vertically spaced below the generally horizontal surfaces 25. The vertical surfaces 27 are transversely spaced with respect to each other a slightly greater and predetermined amount than the transverse distance between the piloting surfaces 26 for a purpose which will be pointed out hereinafter.

Each of the crankshaft bearings 15 includes a main bearing cap 28, the details of one is shown in FIGURE 3. The bearing caps 28 are made of a material having an equal or a greater strength than the material of the transverse bulkheads or webs 21. Each of the bearing caps 28 has an intermediate semi-cylindrical recess 29 on one end thereof which is registrable with a crankshaft bore of a respective bulkhead 21 to thereby provide a cylindrical support for a bearing bushing or the like, not shown, which, in turn, encircles and rotatably supports a respective section of the crankshaft 14. Extending from each end of the semi-cylindrical bearing supporting surface 30, defining the semi-cylindrical recess 29, is a surface 31 which is complementary to a respective bulkhead horizontal surface 25. The surfaces 31 of the bearing caps 28 are adapted to abut the bulkhead surfaces 25 when the bearing caps are assembled to the transverse bulkheads 21. Each bearing cap 28 is provided with a pair of parallel holes 32. Each hole 32 has one end opening into a respective bearing cap surface 31 and each pair of bearing cap holes 32 is alignable with threaded recesses 33 formed in the associated crankcase bulkhead 21. Extending through each hole 32 and threaded into the threaded recess 33 aligned therewith is a tension member 34. The tension members 34 are preferably in the form of a bolt and by tightening the bolts 34 and placing them in tension the bearing cap surfaces 31 are tightly compressed against the bulkhead surface 25. In this manner the bolts 34 serve to maintain the bearing caps 28 in assembled posi-

tion on the bulkheads 21. It is to be understood that the bearing cap bolts 34 are of sufficient strength to withstand the vertical components of the forces applied to the crankshaft 14 during operation of the engine tending to force the bearing caps 28 vertically away from the transverse bulkheads 21. Each bearing cap 28 is also provided with a pair of transversely spaced and parallel flat side surfaces 35. One end portion of each surface 35 is adapted to abut a respective bulkhead piloting surface 26 and the opposite or lower end portion thereof is adapted to abut a respective bulkhead surface 27 when the bearing caps 28 are fully assembled on the bulkheads 21.

Lubrication of the bearings 15, as in the case of the vast majority of V-type internal combustion engines, is effected through vertically extending oil ducts or passageways 36 formed in the transverse bulkheads 21. Each oil duct 36 is in fluid communication with a respective bearing 15 and the camshaft bearings or a suitable oil gallery. Hence, the sections 36 of the transverse bulkheads 21 through which the oil ducts or passageways 36 extend constitute structurally weak portions or sections 37 of the bulkheads and consequently bulkhead fractures are most apt to occur in these sections 37. The sections 37 of the bulkheads 21, as in all V-type internal combustion engines, are subjected to extremely high tension stresses during operation of the engine. The means for minimizing the effect of the high tension stresses developed in the sections 37 will be pointed out hereinafter.

As stated hereinbefore one of the most difficult problems confronting an internal combustion engine designer is the provision of adequate means for restraining transverse bearing cap motion during operation of the engine. Heretofore, many different methods and means have been proposed for solving the problem but all of them either did not afford the necessary bearing cap motion restraint required to operate the engine efficiently and/or involved machining operations and construction which were costly and thus commercially prohibitive. As was also stated hereinbefore, it has been determined that the higher the compressive pre-load on the bearing cap, or the tighter the interference fit between transversely spaced, and parallel mating surfaces of the bearing cap and transverse bulkhead, the greater the resistance will be to transverse motion of the bearing cap. However, it was also determined that the stresses developed in the bulkhead weakened sections 37 adjacent the crankshaft bores which are primarily tension stresses, also increase during the assembly operation of the bearing caps as the degree of interference fit between the mating piloting surfaces increases. Thus while the problem of adequately restraining transverse bearing cap motion can be solved by pre-loading the bearing caps in compression, such solution renders the bulkhead sections more prone to fracture especially when it is realized that the same bulkhead sections 37 are subjected to additional tension stresses caused by the explosions taking place in the engine combustion chambers during operation of the engine. In order to counteract the high tensile stress concentration in the bulkhead sections 36 and to reduce the tendency of the bulkheads 21 to fracture without adversely affecting the restraining action to transverse bearing cap movement afforded by the positive interference fit between the mating piloting surfaces 26, 35 of the bulkhead and bearing caps, respectively, a novel arrangement, disposition and relationship between the bearing cap surfaces 31, 35 and the bulkhead surfaces 25, 26 and 27 is utilized. The necessary compressive preload on each bearing cap 28 to impart the required bearing cap transverse movement resistance to the structure is obtained by making the transverse spacing between the end bearing cap end surfaces 35 approximately a few thousandths of an inch greater than the transverse spacing between the piloting surfaces 26 of an associated transverse bulkhead 21. It will be appreciated that if the transverse spacing of the bearing cap surfaces 35 is maintained slightly greater than the transverse spac-

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ing of the piloting surfaces 26, as noted above, and since the bearing cap 28 is made of a material considerably stronger than or equal to the bulkhead material, when the bearing caps 28 are assembled on the transverse bulkheads 21 with the uppermost portion of the bearing cap end surfaces 35 engaging the piloting surfaces 26 and the bulkhead surfaces 25 compressed against the bearing cap surfaces 31 by means of the tension members 34 being drawn up tightly, as illustrated in FIGURE 1, the bearing cap 28 will be preloaded in compression the desired amount necessary to resist transverse movement of the bearing caps 28. However, the inherently weakened wall sections 37 extending between the semi-cylindrical surface 24 and the camshaft 16 are prestressed in tension which as pointed out hereinbefore is undesirable.

In order to obviate undesirable prestressing of the bulkhead sections 37 in tension when the bearing caps 28 are prestressed in compression the vertical surfaces 27 of each bulkhead 21 are spaced a slightly greater transverse distance apart than the transverse spacing existing between the bearing cap piloting surfaces 26, as illustrated in FIGURE 1. Consequently, when the bearing caps 28 are assembled on the bulkheads 21 the lower end portion of each bearing cap end surface 35 is slightly spaced and substantially parallel to an adjacent respective bulkhead vertical surface 27. The transverse spacing between each vertical surface 27 and associated end surface bearing cap end surface 35 is in the neighborhood of a few thousandths of an inch. Each bulkhead 21 is provided with a pair of transversely aligned passageways 38. Each passageway 38 has one end opening into a respective side wall 17 and its opposite end opening into a respective vertical surface 27, as illustrated in FIGURE 5. The lower end portion of each bearing cap end surface 35 is provided with a threaded recess 39 which is substantially in transverse registration with a respective passageway 38 when the bearing caps 28 are assembled on the bulkheads 21, as illustrated in FIGURE 1. Extending through each passageway 38 and threaded into the threaded recess 39 aligned therewith is a tie bolt 40. When the tie bolts 40 are tightened sufficiently to effect transverse inward movement of the vertical surfaces 27 until they contact the lower end portions of the end surfaces 35, the preload in compression on the bearing caps 28 is increased over that which is present merely by providing an interference fit between the bearing cap piloting surfaces 26 and the end surfaces 35 of the bearing caps 28. Thus, the resistance to bearing cap transverse movement is increased also. In addition, the added frictional resistance obtained between the bearing cap end surfaces 35 and the vertical surfaces 27 counteracts the tendency of the bearing caps 28 to wobble fore and aft during operation of the engine. More importantly because of the application of the forces to draw the vertical surfaces 27 into engagement with the end surfaces 35 of each bearing cap 28 is along the longitudinal axes of the tie bolts 40 and hence is located at the lowermost end of the crankcase 10 and further because of the fact that the proportion of crankcase material below the bulkhead sections 37 is of a greater mass and consequently stronger than the bulkhead material above the sections 37. Each bulkhead 21 is in effect comparable to a pair of levers pivotally connected together at a point above or only slightly below the cam shaft 16. The bulkhead structure and the application and distribution of the stresses when the tie bolts 40 are tightened to cause the bulkhead vertical surfaces 27 to engage the bearing cap end surfaces 35 is analogous to a nut cracker with the "nut" being represented by the bearing cap 28 and the bulkhead sections 37. As stated hereinbefore the force cracking the "nut" of each bulkhead 21 is represented by the tie bolts 40. Consequently the "nut" associated with each bulkhead 21 is preloaded in compression when the bulkhead vertical surfaces 27 are drawn into frictional engagement with the bearing cap end surfaces 35 by the tie bolts 40 and such preload in compression counteracts the

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dynamic forces on the engine tending to produce tension in the bulkhead sections 37 and increases the overall strength of the engine crankcase 10. From the foregoing it will be appreciated that a simple yet effective means for efficiently restrained transverse movement of the main bearing caps 28 has been provided and further the strength of the crankcase 10 and especially the sections 37 of the transverse bulkheads 28 through which the main bearing oil passageways or ducts 36 extend has been substantially increased without materially increasing the bulk thereof.

The embodiment of the invention chosen for the purposes of illustration and description herein is that preferred for achieving the objects of the invention and developing the utility thereof in a most desirable manner, due regard being had to existing factors of economy, simplicity of design and construction, production methods and the improvements sought to be effected. It will be appreciated therefore, that the particular structural and functional aspects emphasized herein are not intended to exclude but rather to suggest such other adaptations and modifications of the invention as fall within the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. In an internal combustion piston engine of the V-type comprising an engine frame including a pair of angularly oriented longitudinally extending cylinder banks and a crankcase structure below said banks including a plurality of transversely extending longitudinally spaced and parallel bulkheads, each of said bulkheads being provided with a cavity extending on the lowermost edge thereof, the bottom of said cavity being partially defined by a central semi-circular bearing mounting surface, a flat substantially horizontal bulkhead surface extending transversely from each end of the semi-circular surface, a first pair of substantially vertical and parallel bulkhead surfaces, each of said vertical bulkhead surfaces having one end adjacent an end of a respective horizontal bulkhead surface, and a second pair of substantially vertical and parallel bulkhead surfaces vertically spaced below said first pair of vertical bulkhead surfaces and extending from the lowermost edge of the bulkhead, said second pair of vertical bulkhead surfaces being transversely spaced a greater distance than said first pair of vertical bulkhead surfaces; a plurality of bearing blocks, the sides of each of said bearing blocks being defined by flat, substantially vertical surfaces, said vertical side surfaces being transversely spaced a lesser distance than said second pair of vertical bulkhead surfaces, and the uppermost surface being provided with a semi-cylindrical recess, each of said bearing blocks being insertable in the cavity of a respective bulkhead with the semi-cylindrical recess thereof in registry with the semi-circular surface of the bulkhead and with the uppermost surface abutting said horizontal bulkhead surfaces and with portions of said bearing block vertical side surfaces abutting said first pair of vertical bulkhead surfaces; a plurality of first tension means for securing each bearing block to a respective bulkhead and for compressing the bearing block uppermost surface into abutting engagement with the horizontal bulkhead surfaces; and a plurality of second tension means for compressing each of said second pair of vertical bulkhead surfaces into abutting engagement with portions of said bearing block vertical side surfaces.

2. In an internal combustion piston engine of the V-type as set forth in claim 1, wherein, said plurality of first tension means are vertically disposed, and said plurality of second tension means includes a plurality of transversely extending, horizontally disposed tie bolts.

3. In an internal combustion engine of the piston type comprising, an engine frame having a transverse bulkhead, said bulkhead being provided with a cavity extending from the lowermost edge thereof, said cavity being partially defined by a central semi-circular bearing mounting surface, a flat substantially horizontal bulkhead surface extending transversely from each end of the semi-

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circular surface, a first pair of substantially vertical and parallel bulkhead surfaces, each of said vertical bulkhead surfaces having one end adjacent an end of a respective horizontal bulkhead surface, and a second pair of substantially vertical and parallel bulkhead surfaces vertically spaced below said first pair of said vertical bulkhead surfaces and extending from the lowermost edge of the bulkhead, said second pair of vertical bulkhead surfaces being transversely spaced a greater distance than said first pair of vertical bulkhead surfaces; a bearing block, the sides of said bearing block being defined by flat, substantially vertical surfaces, said vertical side surfaces being transversely spaced a lesser distance than said second pair of vertical bulkhead surfaces, and the uppermost surface being provided with a semi-cylindrical recess, said bearing block being insertable in the cavity of said bulkhead with the semi-cylindrical recess thereof in registry with said semi-circular surface of the bulkhead and with the uppermost surface abutting said horizontal bulkhead surfaces and with portions of said bearing block vertical side surfaces abutting said first pair of vertical bulkhead surfaces; first tension means for securing said bearing block to said bulkhead and for compressing the bearing block uppermost surface into abutting engagement with said horizontal bulkhead surfaces; and second tension means for compressing said second pair of vertical bulkhead surfaces into abutting engagement with portions of said bearing block vertical side surfaces,

4. In an internal combustion engine of the piston type as set forth in claim 3, wherein said second tension means includes a pair of tie bolts, each of said tie bolts extending transversely through a respective one of said second pair of vertical bulkhead surfaces and the portion of said bearing block vertical side surface in abutting engagement therewith.

5. An internal combustion engine of the piston type comprising, an engine frame having a transverse bulkhead, said bulkhead being provided with a cavity extending from the lowermost edge thereof, said cavity being partially defined by a central semi-circular bearing mounting surface, a flat substantially horizontal bulkhead surface extending transversely from each end of the semi-circular surface, a first pair of substantially vertical and parallel bulkhead surfaces, each of said vertical bulkhead surfaces having one end adjacent an end of a respective horizontal bulkhead surface, and a second pair of substantially vertical and parallel bulkhead surfaces vertically spaced below said first pair of said vertical bulkhead surfaces and extending from the lowermost edge of the bulkhead, said second pair of vertical bulkhead surfaces being transversely spaced a greater distance than said first pair of vertical bulkhead surfaces; a bearing block, the side of said bearing block being defined by flat, substantially vertical surfaces, said vertical side surfaces being transversely spaced a lesser distance than said second pair of vertical bulkhead surfaces, and the uppermost surface being provided with a semi-cylindrical recess, said bearing block being insertable in the cavity of said bulkhead with the semi-cylindrical recess thereof in registry with the semi-circular surface of the bulkhead and with the uppermost surface abutting said horizontal bulkhead surfaces and with portions of said bearing block vertical side surfaces abutting said first pair of vertical bulkhead surfaces; vertically disposed tension means for securing said bearing block to said bulkhead and for compressing the bearing block uppermost surface into abutting engagement with said horizontal bulkhead surfaces; and transversely extending, horizontally disposed tension means for compressing said second pair of vertical bulkhead surfaces into abutting engagement with portions of said bearing block vertical side surfaces.

6. In an internal combustion engine of the piston type comprising, an engine frame having a transverse bulkhead, said bulkhead being provided with a cavity extending from the lowermost edge thereof, said cavity being

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partially defined by a central semi-circular bearing mounting surface, a first pair of substantially vertical and parallel bulkhead surfaces, and a second pair of substantially vertical and parallel bulkhead surfaces vertically spaced below said first pair of vertical bulkhead surfaces and extending from the lowermost edge of the bulkhead, said second pair of vertical bulkhead surfaces being transversely spaced a greater distance than said first pair of vertical bulkhead surfaces; a bearing block, the sides of said bearing block being defined by flat, substantially vertical surfaces, said vertical side surfaces being transversely spaced a distance at least as great as the transverse distance between said first pair of vertical bulkhead surfaces and being transversely spaced a lesser distance than the transverse distance between said second pair of vertical bulkhead surfaces, and the uppermost surface of said bearing block being provided with a semi-cylindrical recess, said bearing block being insertable in the cavity of said bulkhead with the semi-circular recess thereof in registry with said semi-circular surface of the bulkhead and with portions of said bearing block vertical side surfaces abutting said first pair of vertical bulkhead surfaces; and transversely extending, horizontally disposed tension means for compressing said second pair of vertical bulkhead surfaces into abutting engagement with other portions of said bearing block vertical side surfaces.

7. In an internal combustion engine of the piston type comprising, an engine frame having a transverse bulkhead, said bulkhead being provided with a cavity extending from the lowermost edge thereof, said cavity being partially defined by a central semi-circular bearing mounting surface, a first pair of substantially vertical and parallel bulkhead surfaces, and a second pair of substantially vertical and parallel bulkhead surfaces vertically spaced below said first pair of vertical bulkhead surfaces and extending from the lowermost edge of the bulkhead, said second pair of vertical bulkhead surfaces being transversely spaced a greater distance than said first pair of vertical bulkhead surfaces; a bearing block, the sides of said bearing block being defined by flat, substantially vertical surfaces, said vertical side surfaces being transversely spaced a lesser distance than said second pair of vertical bulkhead surfaces, and the uppermost surface being provided with a semi-cylindrical recess, said bearing block being insertable in the cavity of said bulkhead with the semi-cylindrical recess thereof in registry with said semi-circular surface of the bulkhead and with portions of said bearing block vertical side surfaces abutting said first pair of vertical bulkhead surfaces; and transversely extending, horizontally disposed tension means for compressing said second pair of vertical bulkhead surfaces into abutting engagement with other portions of said bearing block vertical side surfaces.

8. In an internal combustion engine substantially as set forth in claim 7, wherein said tension means includes a pair of tie bolts, each of said tie bolts extending through a respective one of said second pair of vertical bulkhead surfaces and the said other portion of said bearing block vertical side surface in abutting engagement therewith.

9. In an internal combustion engine of the piston type comprising, an engine frame having a transverse bulkhead, said bulkhead being provided with a cavity extending from the lowermost edge thereof, said cavity being partially defined by a central semi-circular bearing mounting surface, a first pair of transversely aligned bulkhead surfaces, and a second pair of transversely aligned bulkhead surfaces vertically spaced below said first pair of vertical bulkhead surfaces, said second pair of vertical bulkhead surface being transversely spaced a greater distance than said first pair of vertical bulkhead surfaces; a bearing block having a semi-cylindrical recess in one surface thereof insertable in the cavity of said bulkhead with the semi-cylindrical recess thereof in registry with said semi-circular surface of the bulkhead, said bearing block having side wall surface portions abutting said first pair

of vertical bulkhead surfaces and other side wall surface portions transversely spaced from and aligned with said second pair of bulkhead surfaces; and tension means for compressing said second pair of bulkhead surfaces into abutting engagement with said other bearing block side wall surface portions of said bearing block.

10. In an internal combustion engine of the piston type as set forth in claim 9, wherein said tension means includes a pair of tie bolts, each of said tie bolts extending transversely through a respective one of said second pair of bulkhead surfaces and the said other bearing block side wall surface portion in abutting engagement therewith.

11. In an internal combustion engine of the piston type comprising, an engine frame having a transverse bulkhead, said bulkhead being provided with a cavity extending from the lowermost edge thereof, said cavity being partially defined by a central, semi-circular bearing mounting surface, a first pair of transversely aligned bulkhead surfaces, and a second pair of transversely aligned bulkhead surfaces vertically spaced below said first pair of bulkhead surfaces; a bearing block having a semi-cylindrical recess in one surface thereof insertable in the cavity of said bulkhead with the semi-cylindrical recess thereof in registry with said semi-circular surface of the bulkhead, portions of said bearing block partially defining the side wall surfaces thereof abutting said first pair of bulkhead surfaces and being transversely spaced a distance at least as great as the transverse spacing between said first pair of bulkhead surfaces, other portions of said bearing block partially defining the side wall surfaces thereof being transversely aligned with said second pair of bulkhead surfaces and being transversely spaced a lesser distance than said second pair of bulkhead surfaces; and tension means for compressing said second pair of bulkhead surfaces into abutting engagement with said other portions of said bearing block side wall surfaces.

12. In an internal combustion engine of the piston type comprising, an engine frame having a transverse bulkhead, said bulkhead being provided with a cavity extending from the lowermost edge thereof, said cavity being partially defined by a central, semi-circular bearing mounting surface, a first pair of transversely aligned bulkhead surfaces, a second pair of transversely aligned bulkhead surfaces, vertically spaced below said first pair of bulkhead surfaces; a bearing block having a semi-cylindrical recess in one surface thereof insertable in the cavity of said bulkhead with the semicylindrical surface thereof in registry with said semi-circular surface of the bulkhead, portions of said bearing block partially defining the side wall surfaces thereof abutting said first pair of bulkhead surfaces and being transversely spaced a distance at least as great as the transverse spacing between said first pair of bulkhead surfaces, other portions of said bearing block partially defining the side wall surfaces thereof being transversely aligned with said second pair of bulkhead surfaces and being transversely spaced a lesser distance than said second pair of bulkhead surfaces; and tension means for drawing said second pair of bulkhead surfaces toward the said other portions of said bearing block side wall surfaces a predetermined amount.

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