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CRANKSHAFT SUPPORTING ARRANGEMENT FOR INTERNAL COMBUSTION ENGINES

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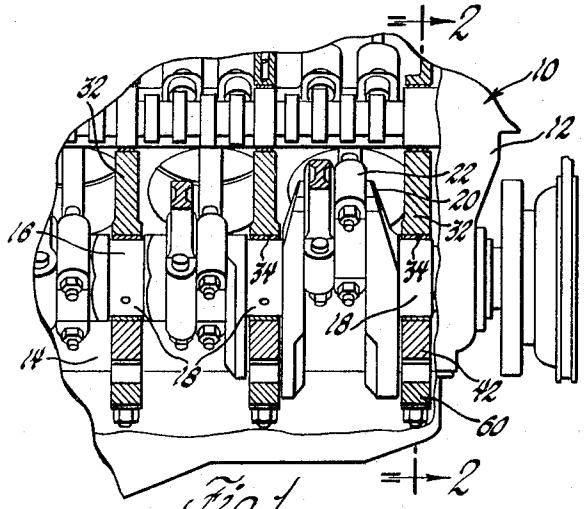


Fig. 1

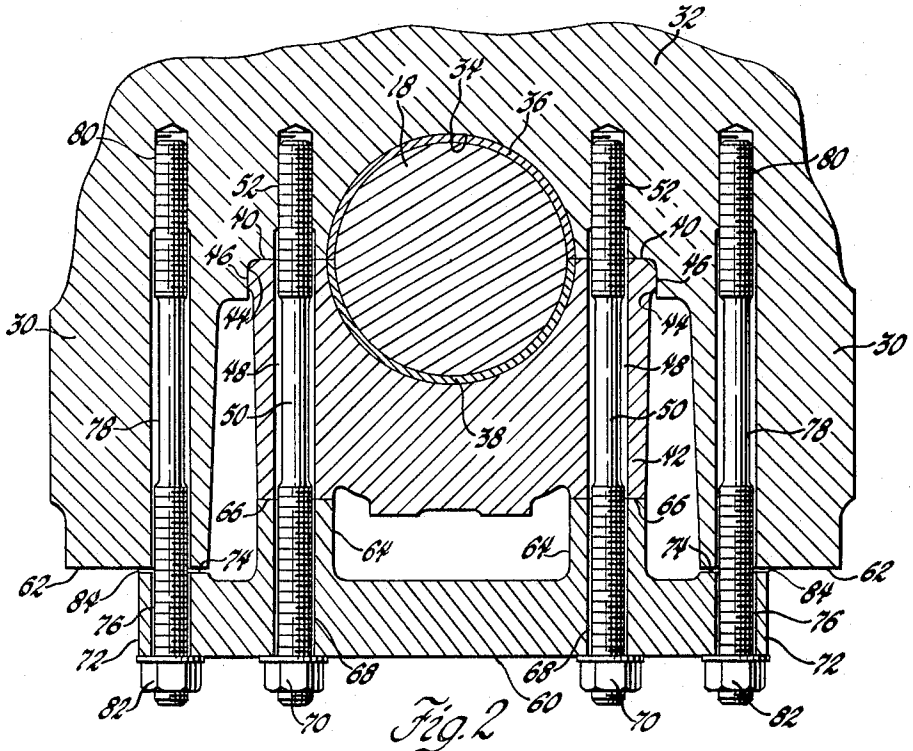


Fig. 2

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CRANKSHAFT SUPPORTING ARRANGEMENT FOR INTERNAL COMBUSTION ENGINES

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This invention relates to internal combustion engines and, more particularly, to the cylinder block and crankshaft supporting portions thereof.

Specifically, the invention contemplates an improved crankshaft supporting arrangement including a resilient bridge member which is effective to reduce the cyclic stresses at the main bearing seat area by transferring a substantial portion of tensile loads normally imposed by the main bearing cap retaining means from the bearing seat area to the adjacent side walls of the cylinder block. The invention thereby permits the reduction of main bearing web size from what would otherwise be required for a given main bearing load or, alternatively, the substitution of lower strength materials in the bearing web may be permitted without substantially changing the engine design. For example, such an arrangement has made possible substitution of aluminum as the cylinder block material in place of cast iron without a reduction in the engine rated output where such a reduction would have otherwise been required.

Further objects and advantages of the invention will be apparent from the following description and drawings in which:

FIGURE 1 is a side elevational view partially in cross-section of an engine embodying the invention; and

FIGURE 2 is a cross-sectional view of the engine of FIGURE 1 taken generally along the plane indicated at 2—2.

Referring now to the drawings, there is shown in FIGURE 1 an engine generally indicated by numeral **10** having a cylinder block **12**, the lower portion of which defines a crankcase cavity **14** in which is rotatably carried a crankshaft **16**. The crankshaft includes a plurality of main journals **18** longitudinally spaced along its length, between which are located eccentric throws **20**, carrying the lower ends of connecting rods **22**. The connecting rods are connected at their upper ends with the usual pistons (not shown) which are reciprocable in their respective cylinders (not shown) of the cylinder block **12**.

Referring now to FIGURE 2, the lower portion of cylinder block **12** includes two longitudinally extending spaced side walls **30** which partially define crankcase cavity **14**. Extending transversely across the crankcase cavity **14** and in lateral alignment with each crankshaft journal **18** is a web or bulkhead **32** which connects with opposite side walls **30** and may be integrally formed therewith. Centrally located at the lower edge of each web **32** is a semi cylindrical bearing recess **34** which is adapted to receive the upper of a pair of main bearing shells **36** and **38** in which the respective crankshaft journal **18** is retained.

Adjacent each side of bearing recess **34** is a horizontal machined face **40** against which the legs of a main bearing cap **42** are retained, thereby securing lower bearing shell **38** in place beneath journal **18**. Bearing cap **42** may additionally be provided with vertical shoulders **44** which are attached to fit closely between complementary vertical shoulders **46** formed in web **32** which serves to transversely position the bearing cap with respect to cylinder block **12**. A pair of drilled holes **48** are provided, one extending through each leg of main bearing cap **42**, and are adapted to receive securing means such as studs **50** which are threaded into complementary tapped holes **52** in web **32**.

In conventional engine construction, nuts would be placed on the outer ends of studs **50** in engagement with main bearing cap **42** thereby directly securing the cap to web **32**. As a consequence, the combustion and reciprocating forces carried by main bearing cap **42** would be transferred entirely to studs **50**, requiring the metal surrounding tapped holes **52** to absorb relatively high tensile stresses while the metal immediately therebelow adjacent surface **40** is exposed to high compressive stresses. In order to withstand these stresses, in what may be termed the main bearing seat area, a relatively sturdy web construction is called for and a relatively high strength material, such as cast iron, is commonly used.

There are occasions, however, when it is desirable to reduce the thickness of the main bearing web structure in order to produce a more compact engine. In addition, it is sometimes advantageous to produce an engine having an aluminum block from a design and on tooling intended for a cast iron block engine. Such an engine may be made lighter in weight and, therefore, would have an advantage for some purposes if the rated output could be maintained at a substantially high level. Unfortunately, the change to thinner wall sections in the crank case web, or the substitution of aluminum for cast iron in such a construction, would result in a lessening of the ability to absorb stresses in the main bearing seat area.

In order to accomplish such design changes as those above suggested without substantially reducing the rated output, of which an engine would be otherwise capable, the present invention introduces an additional load carrying structure in the form of a bridge support **60**. This member comprises a resilient metal beam which is arranged to extend underneath bearing cap **42** and outwardly into overlapping spaced relation with the adjacent lower faces **62** of side walls **30**. Projecting bosses **64** are provided which engage laterally spaced seats **66** formed on the lower faces of bearing cap **42** surrounding holes **48**, and complementary holes **68** are drilled through support **60** to receive the ends of studs **50**. Member **60** is retained in engagement with bearing cap **42** by the application of nuts **70** to the ends of studs **50** and this construction thereby retains bearing cap **42** against web **32**.

The outer ends **72** of support **60** include finished surfaces **74** which are adapted to engage lower faces **62** of the respective side walls **30**. Furthermore, ends **72** are provided with drilled holes **76** through which additional stud members **78** extend from complementary recessed tapped holes **80** located in the side walls **30** of cylinder block **12**. The depth of recessed holes **80** is completely a function of the engine structure, the threaded portion of the holes being located at a point in the side walls at which maximum stress concentration will be acceptable. Nuts **82** are provided at the outer ends of studs **78** to force support ends **72** toward side walls **30**.

The construction of the bridge support **60** is such that before nuts **82** are tightened, a predetermined clearance **84** exists between the surfaces **74** of the support ends and lower faces **62** of the side walls. Upon tightening of nuts **82** a sufficient torque value, support member **60** is caused to bend until clearance **84** is closed and finished surfaces **74** come into contact with lower faces **62**. This causes a predetermined force to be exerted by bosses **64** on bearing cap **42** increasing the force with which it is held in its position against web **32** without adding to the tensile stresses in the main bearing seat area. The stresses accounting for the additional force are, in effect, transferred to the side walls in the area of tapped holes **80** which are a much less critical area

than the main bearing seat area around tapped holes **52** and machined faces **40**. It should be understood that more or less stress can be transferred from the main bearing seat area to the side walls as may be required by the demands of the particular situation.

The force exerted by a particular bridge support member is dependent upon a number of variables including those of the structure and material of which the support member is formed and the dimensional relationships existing with the associated engine components. Of particular importance is the amount of clearance **84** which is provided in the untightened state between the finished surfaces **74** at the outer ends of the support member and the lower faces **62** of the side walls. The amount of this clearance can, of course, be varied as desired but it is limited by reasonable manufacturing tolerances and the bending yield strength of the bridge support member.

It should now be clear that the present invention has provided a structure which is effective to transfer a desired portion of cylinder block stresses, occasioned by retention thereon of a main bearing cap, from the critical main bearing seat area to the less critical side walls of an engine cylinder block, which thereby allows the use of lighter and lower strength materials in the block for equivalent main bearing loads or allows the use of smaller cross-sectional areas in the main bearing webs.

The invention provides the additional advantage of lending lateral and longitudinal support to the main bearing caps by connecting the outer ends of the caps with the lower edge of their associated cylinder block side walls. In this regard, the invention is similar to certain embodiments of the construction shown in United States Patent 3,046,954, Hoffman et al., which is applicable to engines of the general type shown herein. The present invention is unique, however, in providing an arrangement capable of reducing stresses in the main bearing seat area by transferring a portion of the main bearing cap securing forces to the cylinder block side walls.

It will be obvious to those skilled in the art that various changes might be made in the invention as disclosed without departing from its spirit and scope as defined in the following claims.

What is claimed is:

1. Crankshaft supporting means comprising;
- a block having a crankshaft receiving portion;
- a crankshaft retaining cap engaging the block on opposite sides of and adjacent the crankshaft receiving portion;
- securing means engaging the block adjacent the crankshaft receiving portion and exerting a force holding the cap against the block;
- a resilient beam extending between and secured to spaced portions of the block outboard of the cap and clamped against the cap at a point generally between the spaced portions; and
- means resiliently deforming said beam so as to exert an additional force on said cap additive to that of said securing means to thereby assist in holding the cap in engagement with the block.

2. In an internal combustion engine, crankshaft supporting means comprising;
- a cylinder block having spaced side walls, said cylinder block having at least one transverse web extending between the side walls and including a crankshaft receiving portion;
- a crankshaft retaining cap held against the web and supporting a crankshaft between the side walls and in the crankshaft receiving portion;
- securing means engaging the web on opposite sides of and adjacent the crankshaft receiving portion, said securing means exerting a positive force holding the cap against the web;
- a resilient beam extending between and secured to the side walls and engaging the cap at a point generally between the side walls; and
- means resiliently deforming said beam so as to exert an additional force on said cap additive to that of said securing means to thereby assist in holding the cap in engagement with the block.

3. In an internal combustion engine, crankshaft supporting means comprising:
- a cylinder block having two spaced and longitudinally extending side walls, said cylinder block having at least one crankshaft supporting web extending transversely between the side walls;
- a crankshaft supporting cap member, mateable with the web;
- a resilient bridge support member extending transversely into overlapping spaced relation with the side walls and including means mateable with the cap member, said bridge support member maintaining in the undeformed condition a predetermined clearance from the side walls; and
- means secured to the side walls and bending the bridge support member into engagement therewith, causing a predetermined seating force to be exerted on the cap member.

4. In the combination set forth in claim **3**, securing means engaging the web and exerting a positive force holding the cap member against the web, the holding force exerted on the cap by the securing means being less than the total force holding the cap in engagement with the web.

5. In an internal combustion engine of the type having;
- a cylinder block including spaced side walls and at least one transverse web extending between the side walls, such transverse web having a crankshaft receiving portion therein;
- a main bearing cap engaging the web and retaining a crankshaft between the side walls and in the crankshaft receiving portion; and
- stressed securing means engaging the web, adjacent the crankshaft receiving portion, and urging the main bearing cap thereagainst; the improvement comprising
- means for apportioning the main bearing cap seating loads between the web, adjacent the crankshaft receiving portion, and the side walls, said apportioning means including a resilient bridge support secured to and extending between the side walls and engaging the main bearing cap threbetween and means, resiliently deforming said bridge support so as to assist in urging the main bearing cap against the web.

6. In an internal combustion engine, crankshaft supporting means comprising;
- a cylinder block having two spaced and longitudinally extending side walls;
- said cylinder block including a plurality of crankshaft supporting webs, spaced longitudinally and extending transversely between the side walls, each such web having a hemispherical crankshaft receiving portion and adjacent thereto a pair of diametrically disposed laterally spaced surfaces, each surface surrounding one of a pair of threaded holes formed in the web;
- a plurality of crankshaft supporting cap members, each engaging the respective laterally spaced surfaces of an associated one of the webs and including a pair of drilled holes aligned with the threaded holes of the web, each cap member further including at its outer surface a pair of laterally spaced seats, each seat surrounding one of the pair of drilled holes;
- a plurality of resilient bridge support member each having portions extending transversely into overlapping relation with the side walls, each such support member being mateable with an associated one of the cap members and including a pair of laterally spaced bosses engaging the corresponding pair of laterally spaced seats of the associated cap member and a pair of drilled holes aligned with the holes in the associated cap member;

a first pair of threaded securing means retained in each pair of threaded holes of the web and extending through the aligned holes in each associated cap member and bridge support member whereby to exert a positive force retaining these members in assembled relation and seating each bearing cap against its associated web;

each said bridge support member further including a pair of finished surfaces, one formed on each portion of the bridge support overlapping the respective side walls and in predetermined spaced relation therewith, and a pair of drilled openings associated one with each finished surface;

said side walls being provided with a plurality of pairs of recessed threaded holes, one pair aligned with the drilled openings of each bridge support member; and

a second pair of threaded securing means retained in each pair of recessed threaded holes and extending through the respective drilled openings of each bridge support member, said second securing means being adapted to bend the associated bridge support member, causing the finished surfaces to engage the respective side walls and resulting in a predetermined seating force being exerted on each bearing cap by the associated bridge support member;

whereby the seating force exerted by each said first pair of threaded securing means is less than the total seating force exerted on each associated bearing cap.

7. In an internal combustion engine, crankshaft supporting means comprising;

a cylinder block having two spaced and longitudinally extending side walls, said cylinder block having at least one crankshaft supporting web extending transversely between the side walls:

a crankshaft supporting cap member, mateable with the web;

a resilient bridge support member extending transversely into overlapping spaced relation with the side walls and including means mateable with the cap member, said bridge support member maintaining in the undeformed condition a predetermined clearance from the side walls;

means secured to the side walls and bending the bridge support member into engagement therewith, causing a predetermined seating force to be exerted on the cap member; and

additional means through said bridge support member and said cap and secured in said web, said additional means urging said bridge support member into engagement with said cap member thereby causing an additional seating force to be exerted by said bridge support member on said cap member above the said predetermined seating force caused by the bending of said bridge support member into engagement with said side walls.

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