May 23, 1967 B. J. MITCHELL ETAL 3,320,940

ENGINE CYLINDER BLOCK

Filed June 16, 1965

4 Sheets-Sheet 1

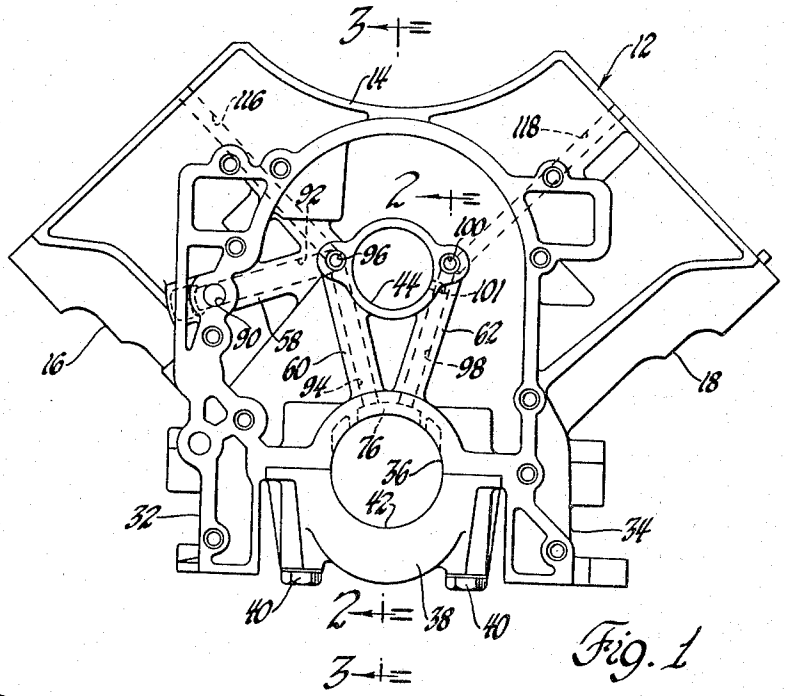


Fig. 1

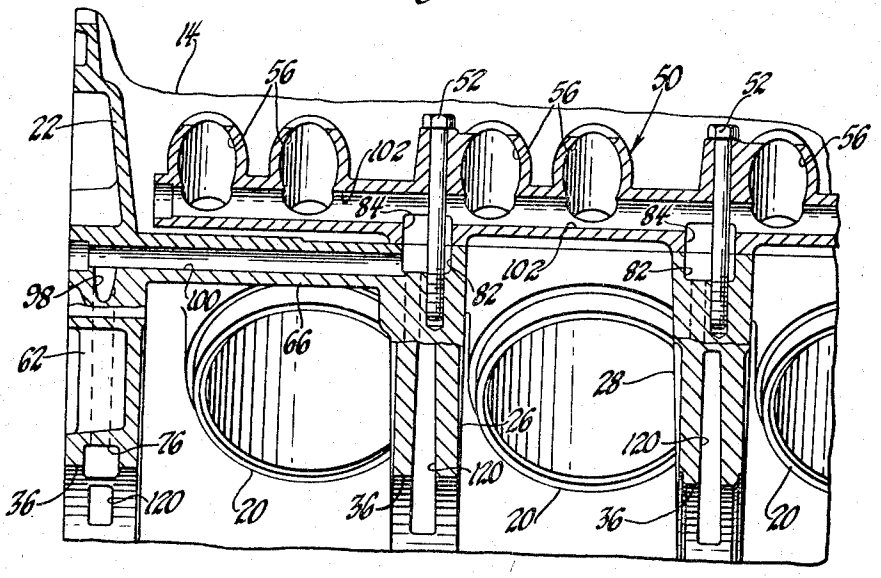


Fig. 2

INVENTORS
Boris John Mitchell,
Harry W. Bielicki, &
Maurice P. Roche
BY J. L. Carpenter
ATTORNEY

May 23, 1967 B. J. MITCHELL ETAL 3,320,940

ENGINE CYLINDER BLOCK

Filed June 16, 1965 4 Sheets-Sheet 3

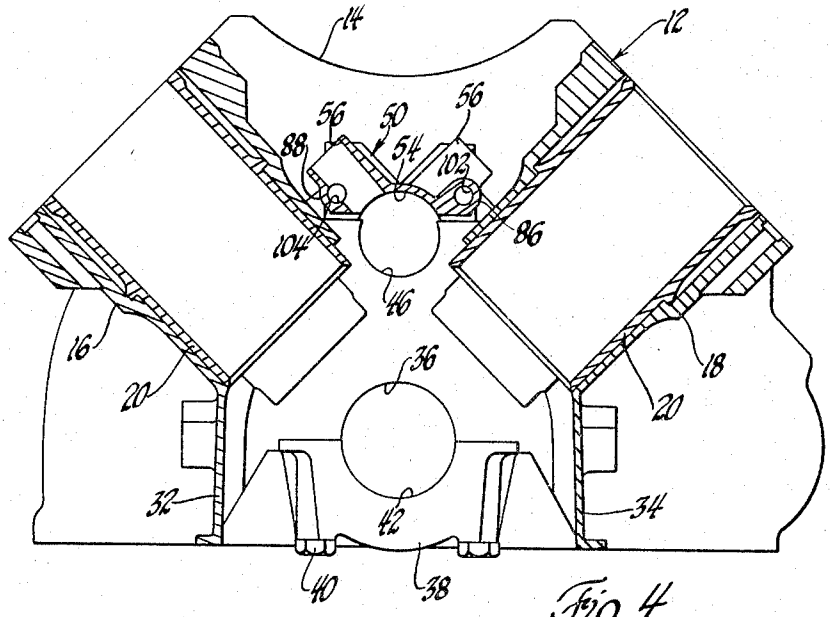


Fig. 4

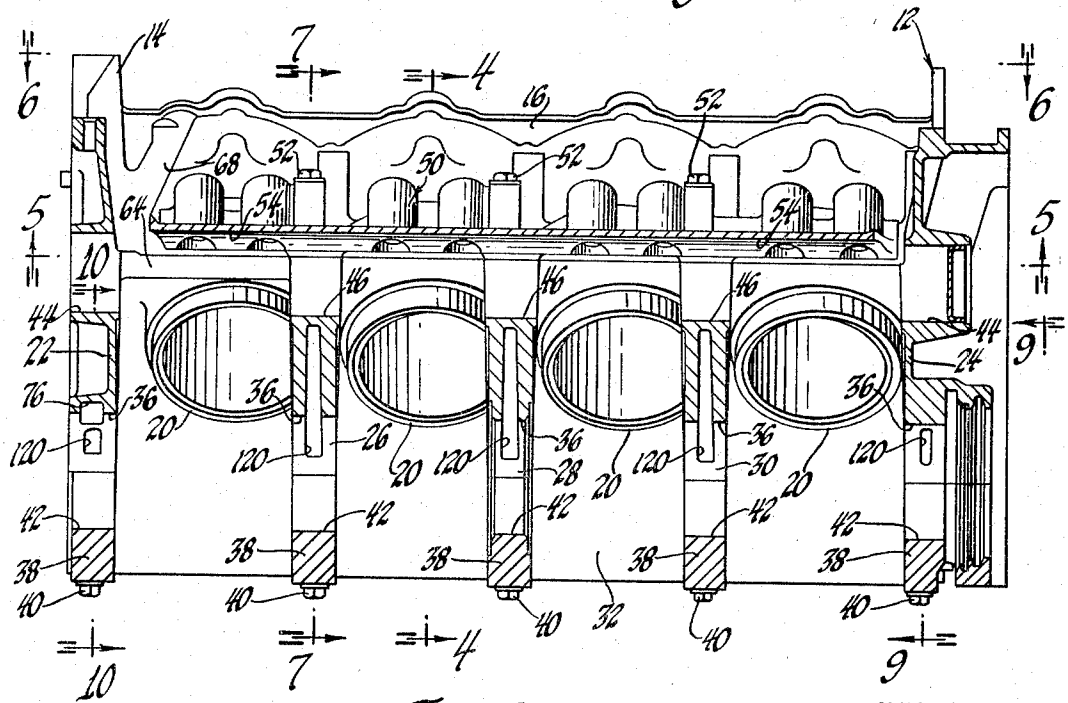


Fig. 3

INVENTORS
Boris John Mitchell,
BY Harry W. Bielicki, &
Maurice P. Roche
J. K. Carpenter
ATTORNEY

May 23, 1967 B. J. MITCHELL ETAL 3,320,940

ENGINE CYLINDER BLOCK

Filed June 16, 1965 4 Sheets-Sheet 3

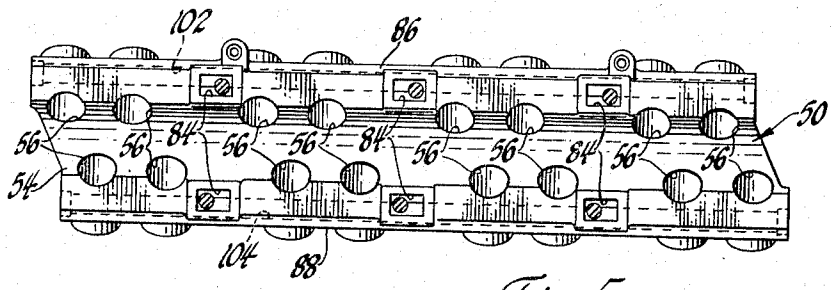


Fig. 5

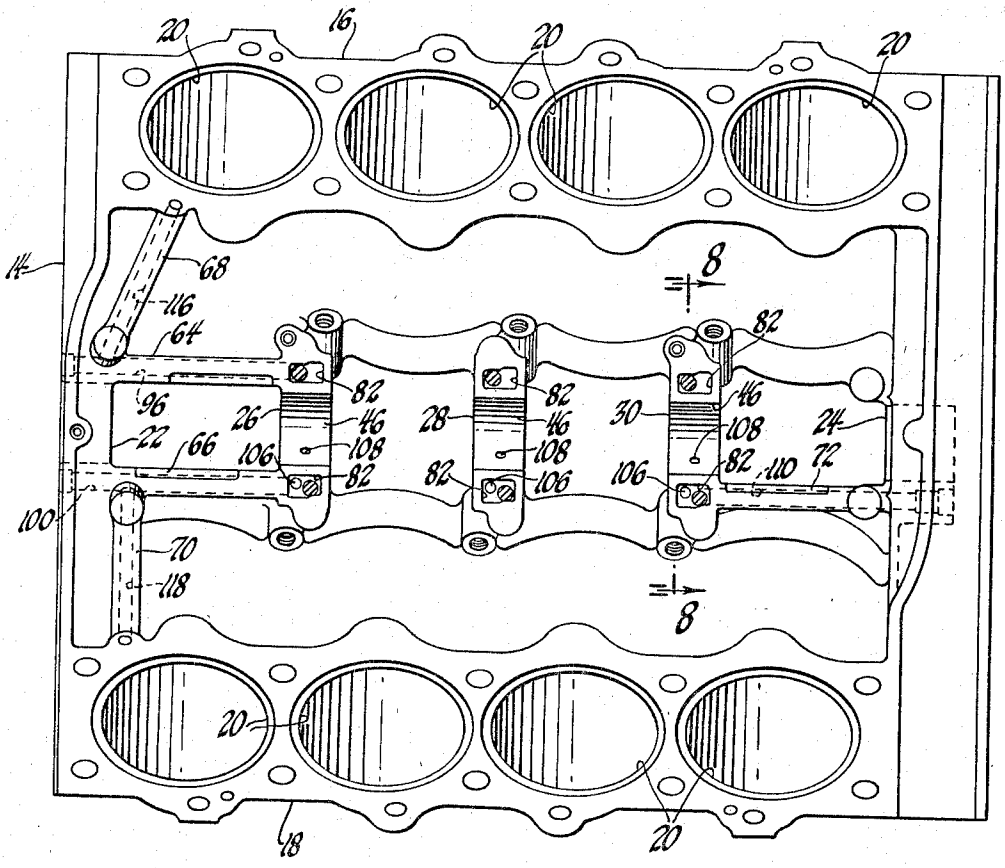


Fig. 6

INVENTORS
Boris John Mitchell,
BY Harry W. Bielicki, &
Maurice P. Roche
J. R. Carpenter
ATTORNEY

May 23, 1967 B. J. MITCHELL ETAL 3,320,940

ENGINE CYLINDER BLOCK

Filed June 16, 1965 4 Sheets-Sheet 4

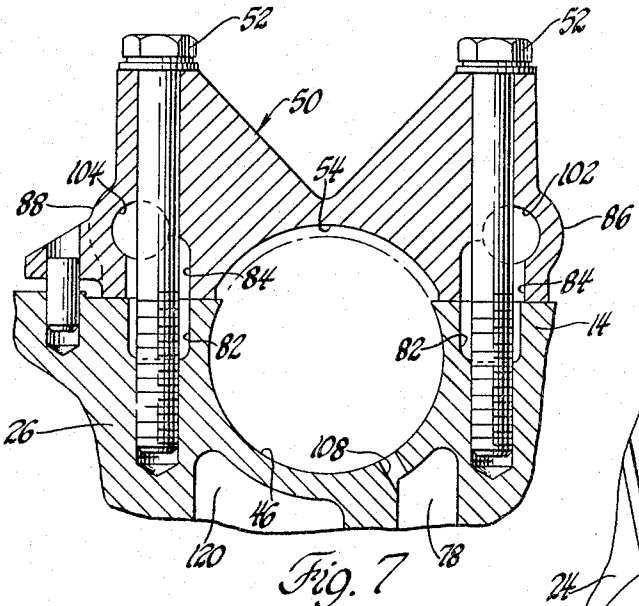


Fig. 7

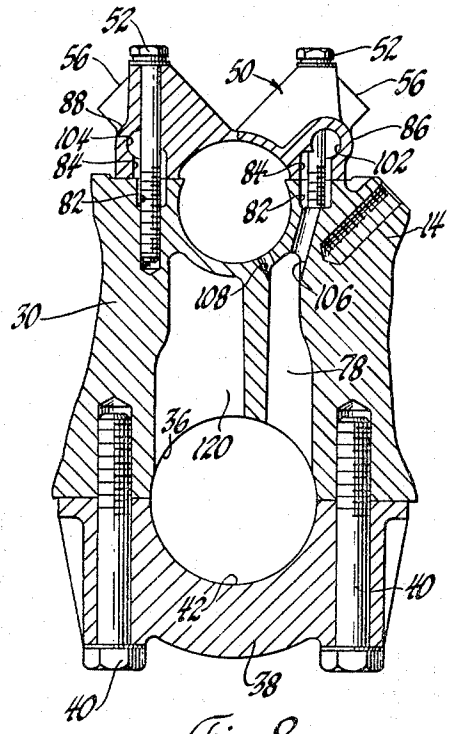


Fig. 8

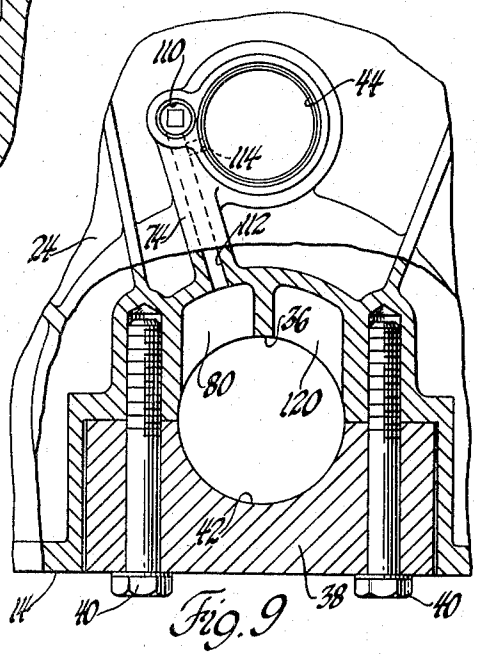


Fig. 9

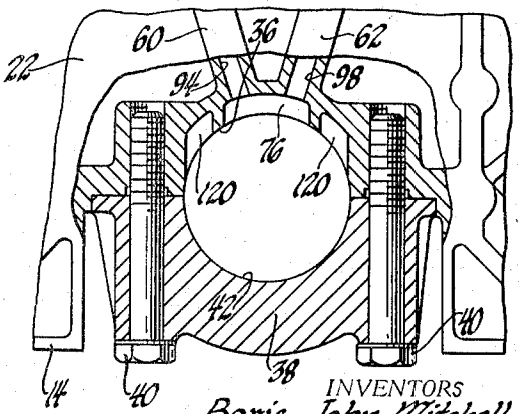


Fig. 10

INVENTORS
Boris John Mitchell,
Harry W. Bielicki, &
Maurice P. Roche
BY J. R. Carpenter
ATTORNEY

United States Patent Office

3,320,940

Patented May 23, 1967

3,320,940

ENGINE CYLINDER BLOCK

Boris John Mitchell, Beverly Hills, Harry W. Bielicki, Detroit, and Maurice P. Roche, Warren, Mich., assignors to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Filed June 16, 1965, Ser. No. 464,486
8 Claims. (Cl. 123—195)

This invention pertains to a cylinder block for an internal combustion engine and more particularly to a multi-piece cylinder block assembly comprising a die cast cylinder block and a removable tappet guide and having features which simplify the coring required for die casting the block.

In the past, various designs have been proposed for die casting engine cylinder blocks without requiring unnecessarily complex multi-piece cores. These proposals have included forming the block of several parts which are separately cast and then assembled into a unitary whole. In the main, such arrangements have suffered from the dimensional problems created in assembly of the parts and the need to provide additional structural support members to offset the forces tending to separate the various parts.

In the present invention, these problems are avoided by providing a V-type cylinder block assembly which is suitably arranged to permit die casting the main load carrying portions of the assembly as a single unit. This unitary casting, which is herein referred to as the cylinder block, includes receiving means for both the crankshaft and the camshaft as well as means for retaining cylinder sleeves in two angularly disposed banks. This permits the dimensional relationships of the major parts of the engine to be permanently fixed by the machining of the unitary structure.

The arrangement disclosed herein is especially unusual in that the support bearings for the intermediate camshaft journals are open along their upper portions to permit the entry of a unitary core during the die casting process. Machining of the support bearings, subsequent to the casting operation, undercuts the cored recesses, providing open topped bearings for supporting the camshaft journals over an arc of substantially greater than 180° so that positive retention of the camshaft within the support bearings is achieved. To permit the entry of cores into the support bearing area, a separate tappet guide is provided to carry the valve tappets which engage the camshaft lobes. The tappet guide is secured over the camshaft location and includes drilled passages to carry lubricant to the various tappets as well as to assist in its distribution to the various camshaft and crankshaft journals of the engine.

A detailed disclosure of a particular embodiment of an engine including the principles of the present invention is contained in the following description and drawings in which:

FIGURE 1 is a front elevational view of a cylinder block assembly according to the present invention;

FIGURE 2 is a fragmentary cross-sectional view taken generally along line 2—2 of FIGURE 1;

FIGURE 3 is a longitudinal cross-sectional view of the block assembly taken generally along the plane indicated by line 3—3 of FIGURE 1;

FIGURE 4 is a transverse cross-sectional view of the block assembly of FIGURE 1 taken generally along the plane indicated by line 4—4 of FIGURE 3;

FIGURE 5 is a plan view of the separately formed tappet guide viewed from underneath;

FIGURE 6 is a plan view of the machined cylinder block as viewed from above with the tappet guide removed;

FIGURE 7 is an enlarged fragmentary cross-sectional view of the camshaft supporting means and tappet guide taken generally along the plane indicated by line 7—7 of FIGURE 3;

FIGURE 8 is a fragmentary cross-sectional view of the central portion of the cylinder block assembly of FIGURE 1 and taken generally along the line 8—8 of FIGURE 6;

FIGURE 9 is a fragmentary rear view of the cylinder block assembly partially broken away as indicated by the line 9—9 of FIGURE 3; and

FIGURE 10 is a fragmentary front view of the cylinder block assembly partially broken away as indicated by the line 10—10 of FIGURE 3.

Cylinder block

Referring now to the drawings, FIGURES 1–4 and 7–10 illustrate a V-type engine cylinder block assembly generally indicated by numeral 12. The main component of the assembly is the cylinder block 14 which is formed as a unitary die casting and includes angularly disposed cylinder banks 16 and 18, each adapted to receive four longitudinally disposed cylinder sleeve inserts 20. The cylinder banks are connected together by front and rear end walls 22 and 24 respectively as well as by three transverse bulkheads 26, 28 and 30 spaced longitudinally between the end walls. Below the cylinder banks and connecting the outer edges of the end walls and transverse bulkheads are a pair of generally vertical side walls 32 and 34 which partially define the engine crank chamber.

Centrally located along the lower edges of the end walls and transverse bulkheads, crankshaft receiving means are provided which comprise downwardly opening semi-curcular recesses 36. Below each of the recesses 36, a bearing cap 38 is secured to the block casting by fastening means such as bolts 40. Each bearing cap includes an upwardly opening semi-circular recess 42 which combines with recess 36 to form a cylindrical opening for receiving the main bearing shell (not shown) which is adapted to carry a journal of the engine crankshaft.

Centrally located in each of the end walls and directly above the crankshaft receiving recesses 36 are a pair of cylinder openings 44 which are adapted to receive the outer journals of a camshaft (not shown). Provision for receiving three inner camshaft journals is made in the transverse bulkheads 26, 28 and 30 in the form of upwardly opening arcuate recesses 46. Centrally disposed at the top of each bulkhead and vertically aligned with the crankshaft recesses 36, the recesses 46 form an arc of substantially more than 180° so that the camshaft journals may be positively retained therein, but there is a sufficient opening at the top to provide for the entrance of a single piece core during the casting process. The undercut portions of the recesses are, of course, created by the final machining of the cylinder block. In the present arrangement the engine block is preferably an aluminum die casting and the camshaft journals may then run directly on the surfaces of openings 44 and recesses 46. However, if desired, it would be possible to install bearing inserts of other materials in these openings and recesses to carry the camshaft journals.

Tappet guide

Provision for camshaft actuated valve tappets is made in the present construction by using a separately formed tappet guide 50 which is preferably cast of any suitable material although it may be otherwise fabricated. The tappet guide is secured to the upper edges of the intermediate transverse bulkheads 26, 28, 30 by bolts 52 and extends longitudinally over the camshaft location, an arcuate recess 54 being provided which extends the length of the tappet guide and clears both the camshaft journals and the cam lobes and therefore need not be machined. The tap-

pet guide includes two angularly disposed rows of spaced cylindrical guide means **56** for carrying the various tappets.

Lubrication provisions

Provision for lubrication of the crankshaft and camshaft journals, as well as the valve tappets, is provided for in the disclosed engine cylinder block assembly by a combination of cored openings and drilled passages in the cylinder block and the tappet guide.

In the engine block a number of bosses for drilled oil passages are provided including three bosses **58**, **60** and **62** located on the front side of front wall **22**, an additional two bosses **64**, **66** extending longitudinally along the walls of the opposite cylinder banks between front wall **22** and transverse bulkhead **26**, a pair of bosses **68** and **70** extending upwardly from bosses **64** and **66** respectively to the upper surfaces of their respective banks, a single boss **72** extending along the left cylinder bank wall from transverse bulkhead **30** to rear wall **24** and a single boss **74** formed on the outer surface of rear wall **24**. A series of cored depressions are also provided in the block including depression **76** opening into recess **36** of the front wall **22**, three identical depressions **78** formed in bulkheads **26**, **28** and **30** and opening into the recesses **36** formed therein and a depression **80** formed in rear wall **24** and opening into the recess **36** formed therein. Pairs of cored recesses **82** are also formed on the upper edges of bulkheads **26**, **28** and **30** adjacent either side of camshaft receiving recesses **46**.

In the tappet guide, pairs of cored recesses **84** are formed which open into recesses **82** of the engine block and longitudinal bosses **86** and **88** extend on opposite sides of the tappet guide along the length thereof.

The lubricating oil distribution system of the engine block assembly includes an opening **90** in the face of front wall **22** which is adapted to receive lubricating oil from an outside source. Opening **90** connects with a drilled passage **92** in boss **58** which distributes oil both downwardly through drilled passage **94** in boss **60** and longitudinally through drilled passage **96** in boss **64**. Passage **94** opens into depression **76** through which the front crankshaft journal is lubricated and oil is fed therefrom up through drilled passage **98** in boss **62** to a connecting longitudinal drilled passage **100** in boss **66**. A short drilled passage **101** connects passage **98** with opening **44** to lubricate the front camshaft journal.

Passages **96** and **100** open into depressions **82** in bulkhead **26** from which oil is distributed to the corresponding depressions **84** of the tappet guide. These depressions are intersected by drilled passages **102** and **104** which extend longitudinally the length of the tappet guide through bosses **86** and **88**, respectively. Passage **102** intersects and distributes oil to all the cylindrical tappet guide means serving the cylinders in the left cylinder bank as well as connecting with all depressions **84** on the left side of the tappet guide. Passage **104** likewise connects with all the tappet guide openings serving the right bank cylinders as well as connecting with all the depressions **84** on the right side of the tappet guide.

Oil distributed to left side depressions **84** passes into depressions **82** of the cylinder block from which it is fed through drilled passages **106** into cored depressions **78** of the transverse bulkheads. Oil in these depressions feeds the crankshaft journals through holes provided in the bearing shells (not shown) and also feeds the camshaft journals through drilled passage **108** connecting with the camshaft receiving recesses **46**.

Oil from recess **82** on the left side of bulkhead **30** is also delivered through a drilled passage **110** in boss **72** to the rear wall **24** where it is carried downwardly through a drilled passage **112** into deperssion **80** for lubricating the rear crankshaft journal. An additional short drilled passage **114** intersects passage **112** and connects with opening **44** for lubricating the rear camshaft journal.

Lubrication of the valve gear in the cylinder heads is also provided for by drilled passages **116** and **118** which are located in bosses **68** and **70** respectively. Passage **68** carries oil from passage **96** up to connection with the right bank cylinder head while passage **118** carries oil from passage **100** up to connection with the left bank cylinder head.

In addition to the cored depressions utilized for lubrication purposes, the end walls and intermediate bulkheads also contain a number of depressions **120** which have the purpose of reducing section thicknesses to aid in die casting as well as to reduce the total weight of the structure.

It should be clear from the foregoing that the present arangement provides an engine cylinder block assembly, the main portion of which may be die cast as a single unit utilizing a minimum number of cores and avoiding, in all cases, multi-piece cores. This is accomplished by arranging the overall construction to avoid undercut portions or pockets and to provide positive draft on all cast surfaces. So far as coring for the cylinder bores, the exterior side walls, the lower internal cavity and the end walls is concerned, the application of known die casting design techniques was sufficient to develop a suitable coring arrangement. Such is not the case, however, so far as the upper portion of the engine between the cylinder banks is concerned since the necessity of providing for mounting of the camshaft and valve tappets normally would result either in a heavy concentration of metal which would be detrimental to the die casting operation or would necessarily require the use of a relatively complex coring arrangement. In the present instance, the formation of the tappet guide as a separate casting and the unique method of providing open topped camshaft bearing means in the intermediate bulkheads permits the use of a single piece core for the upper cavity of the main cylinder block casting. This is accomplished without the necessity of completely separating the camshaft mounting from the crankshaft mounting or the cylinder bores from either or from one another and thereby reduces dimensional as well as structural support problems which would otherwise be created.

In the case of the camshafts, it should be realized that the load thereon created by the valve gear is in a downwardly direction so that there is presumably no tendency of the camshaft to move vertically upwardly. Due to inertia forces or vibrations in operation, however, such a tendency could occur and the present construction provides sufficient bearing area in the undercut machined portion of the intermediate bulkhead camshaft recesses to restain any such tendency to move or vibrate vertically.

While the foregoing description has full described one embodiment of an engine block formed embodying the principles of the present invention, it should be apparent that various modifications and changes could be made within the scope of the invention as herein disclosed and there is, accordingly, no intent to restrict the scope of this invention except as defined in the following claims.

What is claimed is:

1. A cylinder block for a V-type internal combustion engine, said cylinder block having two banks of cylinders connected by a plurality of longitudinally spaced transverse bulkheads,

camshaft receiving means in at least one of said transverse bulkheads for carrying a camshaft intermediate the cylinder banks and longitudinally aligned therewith, said camshaft receiving means comprising an arcuate recess in the upper edge of said one transverse bulkhead, said recess being open at the top and subtending an arc of more than 180° to positively limit vertical movement of said camshaft.

2. A cylinder block as defined in claim **1**, said cylinder block being formed from a die casting characterized by the absence of any undercut portions.

3. A cylinder block for a V-type internal combustion engine, said cylinder block having two banks of cylinders

connected by a pair of end walls and at least one transverse bulkhead intermediate said end walls,

camshaft receiving means in said end walls and transverse bulkheads for carrying a camshaft intermediate the cylinder banks and longitudinally aligned therewith, said camshaft receiving means comprising

a pair of axially aligned cylindrical openings through said end walls and

an upwardly opening arcuate recess in the upper edge of said transverse bulkhead and axially aligned with said openings, said recess being open at the top and subtending an arc of more than 180° to positively limit vertical movement of said camshaft.

4. A cylinder block as defined in claim 3, said cylinder block being formed from a die casting characterized by the absence of any undercut portions.

5. A cylinder block assembly for a V-type internal combustion engine comprising a cylinder block and a separately formed tappet guide secured thereto,

said cylinder block having two banks of cylinders connected by a plurality of longitudinally spaced transverse bulkheads,

camshaft receiving means in said transverse bulkheads for carrying a camshaft intermediate the cylinder banks and longitudinally aligned therewith, said camshaft receiving means comprising a plurality of axially aligned arcuate recesses in the upper edges of said transverse bulkheads, said recesses being open at the top and subtending an arc of more than 180° to positively limit vertical movement of said camshaft,

said tappet guide being secured to said transverse bulkheads and overlying said camshaft receiving means, said tappet guide being recessed to clear the camshaft journals and including a plurality of guide openings for carrying valve tappets in engagement with said camshaft.

6. The combination of claim 5 wherein said cylinder block includes lubrication passages in said transverse bulkheads for distributing lubricant to said camshaft and said tappet guide includes lubrication passages connecting with the passages of said transverse bulkheads for distributing lubricant to said valve tappets and to the lubrication passages of certain of said transverse bulkheads.

7. A cylinder block as defined in claim 6, said cylinder block being formed from a die casting characterized by the absence of any undercut portions.

8. A cylinder block assembly for a V-type internal combustion engine comprising a cylinder block and a separately formed tappet guide secured thereto,

said cylinder block having two banks of cylinders connected by a pair of end walls and a plurality of transverse bulkheads spaced intermediate said end walls,

camshaft journal receiving means in said end walls and transverse bulkheads for carrying a camshaft intermediate the cylinder banks and longitudinally aligned therewith, said camshaft journal receiving means comprising

a pair of axially aligned cylindrical openings through said end walls and

a plurality of arcuate recesses in the upper edges of said transverse bulkheads and axially aligned with each other and with said openings, said arcuate recesses having open tops but subtending an arc of more than 180° to positively limit vertical movement of said camshaft,

said cylinder block being formed from a die casting characterized by the absence of any undercut portions and

said tappet guide being secured to said transverse bulkheads and overlying said camshaft receiving means, said tappet guide being recessed to clear the camshaft journals and including a plurality of guide openings for carrying valve tappets in engagement with said camshaft.

References Cited by the Examiner

UNITED STATES PATENTS

2,867,201	1/1959	Dolza et al.	123—195
2,902,021	9/1959	Leach	123—195
2,927,565	3/1960	Turner	123—195 X
2,996,050	8/1961	Caris	123—90
3,135,254	6/1964	Hulten	123—90

MARK NEWMAN, *Primary Examiner.*

WENDELL E. BURNS, *Examiner.*