Feb. 2, 1965 A. F. BAUER 3,168,081

ENGINE BLOCK ASSEMBLY

Original Filed April 11, 1961 2 Sheets-Sheet 1

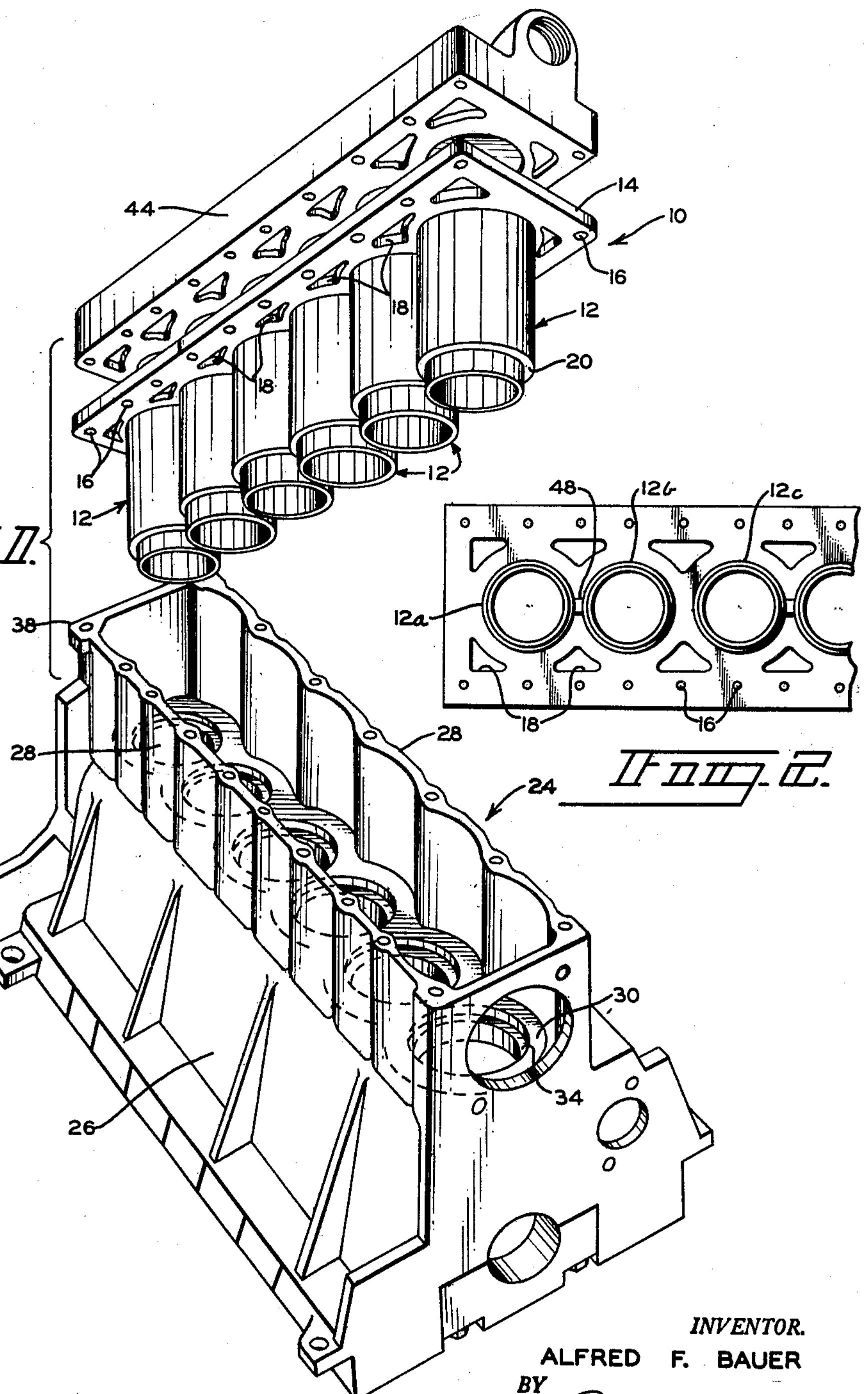

Fig. 1.

Fig. 2.

INVENTOR.
ALFRED F. BAUER
BY Owen + Owen
ATTORNEYS

ENGINE BLOCK ASSEMBLY

Original Filed April 11. 1961

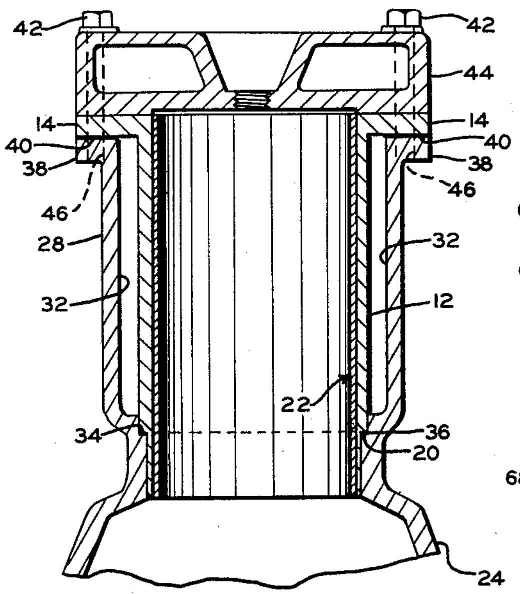

Fig. 3.

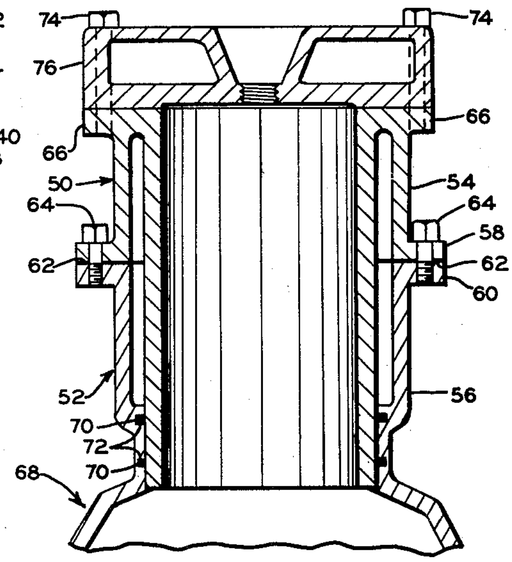

Fig. 4.

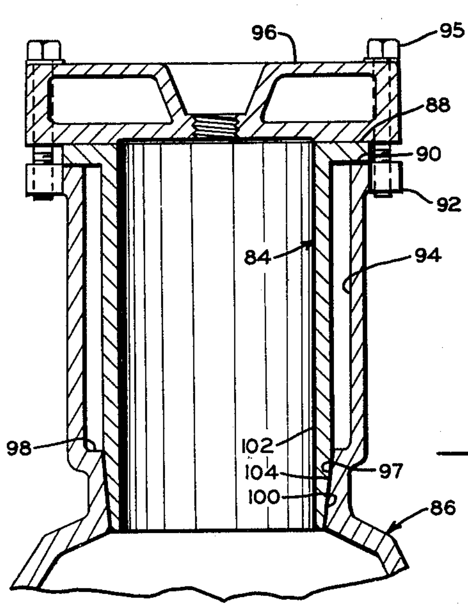

Fig. 5.

INVENTOR.
ALFRED F. BAUER
BY Owen & Owen
ATTORNEYS

United States Patent Office

3,168,081

Patented Feb. 2, 1965

1

3,168,081

ENGINE BLOCK ASSEMBLY

Alfred F. Bauer, Toledo, Ohio, assignor to National Lead Company, New York, N.Y., a corporation of New Jersey

Continuation of application Ser. No. 102,187, Apr. 11, 1961. This application Mar. 4, 1963, Ser. No. 262,780

2 Claims. (Cl. 123—41.74)

This application is a continuation of my application Serial No. 102,187, filed April 11, 1961, and now abandoned.

This invention relates to die-cast engine blocks for internal combustion engines, and is particularly directed to a two-piece structure which has certain advantages over present die-cast blocks.

Engine blocks for internal combustion engines made by the die-casting process have recently been introduced in this country. These blocks are made of an aluminum alloy in a single piece with cast-in gray iron cylinder liners and are assembled ultimately with a separate casting forming the cylinder head. The blocks are water-cooled and for this purpose are made with deep cavities around the cylinders extending from the top down to at least the lower limit of piston ring travel, and preferably somewhat below this point. In casting these blocks, the cylinder liners in the form of separate sleeves are initially placed over removable core pieces and then mounted on a fixture in the ejector half of the die. The cores that form the water passages are a part of the ejector die half and are necessarily long and thin because of the desired shape of the water passages in the finished casting.

The disposition of the core elements and the manner of forming the completed block as above set forth leads to several disadvantages which have heretofore not been corrected, but which are avoided by the present invention. First, the long, thin, core pieces for the water passages are difficult to extract and are subject to high thermal stresses and heat checking. These core pieces overheat easily and slow down the production because the heat poured into these water channel cores with every shot cannot dissipate fast enough through the thin steel sections. In the one-piece engine block with open-water jackets there is a compromise required between the thickness of the cores forming the water jackets which the die designer would like to make as strong and thick as possible, and the volume of the water jacket which the engine designer would prefer to have as thin as possible with good water circulation. If the die cores are widened or are made heavier to prevent overheating and premature failure of the die steel, then the volume of the cooling water in the jackets becomes so large that the engine heats up too slowly in cold weather. If the volume of the water jackets is made small, then the die cores become thin and weak and are subject to early failure from overheating and soldering. Production of the die-casting machine is thus reduced, and the die maintenance expense increases.

One of the most important disadvantages, however, of the one-piece engine block is that the space between Siamesed cylinders and the space at the open upper end of the water jacket around the cylinders is separated from the cylinders themselves only by a narrow surface equal in extent to the thickness of the liner plus the thickness of the aluminum wall cast around it, both of which are ideally made as thin as possible commensurate with an ability to resist the peak firing pressures encountered in the engine cylinders. The thin surface formed on the conventional one-piece engine block is subject on the inside to the peak firing pressures of the engine which are usually around 700 p.s.i., and on the outside to the low pressure

2

of the water jacket of only 10 or 15 p.s.i. The outer wall of the water jacket is, of course, at atmospheric pressure. As a result of the different pressures which the cylinder head gasket is called upon to retain, the gasket is made with different thicknesses to create higher sealing pressures at the narrow surfaces around the cylinder bores than at the surfaces at the outside of the water jacket. A so-called "interference gasket" has been developed which is, for example, 0.005" thicker in the areas of high pressure.

The us of interference gaskets and similar expedients has been found to cause a very substantial column loading on the walls of the cylinder barrels and to create a tensile stress in the outer walls of the casting. The loading on the cylinder barrels is sufficient to cause a decided out-of-round condition so that a cylinder honed round with the cylinder head removed is oval when the head is in place and tightened down. The axis of the oval reverses from the top to the bottom of the cylinder. The use of interference gaskets thus presents a number of undesirable effects.

The foregoing disadvantages of the present engine blocks are corrected by the present invention which provides a two-piece construction in which the ferrous alloy cylinder sleeves are die-cast integrally with a common deck plate. By this expedient the gasketed joint between the top of the engine cylinder and the water jacket disappears so that gas or water leakage cannot occur, and secondly the long, thin, core pieces needed to form the cooling passages of the present engine aluminum alloy blocks are replaced by massive cores which need form only the outer block walls. Thus the casting ejects readily from the die. If desired, the joint between the two pieces which form the engine block can be made to occur, not in the plane of the top of the engine cylinder, but a considerable distance below this plane at a point where gasketing becomes a very simple matter, and very extensive surfaces can be made available for gasketing purposes.

Further, the present invention makes it possible to utilize two different aluminum alloys, selected for different properties, in the formation of the engine block. The alloy for the cylinder barrels must be chosen for high wear resistance and best mechanical properties at elevated temperatures. The alloy for the crankcase may be selected for its castability, its high strength and resistance to distortion. In this way, it may become possible to eliminate the necessity for cast-iron liners, plating or similar treatment of the cylinder barrels and still retain all of the desirable characteristics of present die-cast blocks.

The primary object of the present invention, therefore, is to provide a die-cast engine block which is easier to manufacture, and which has characteristics which represent improvements over the known die-cast blocks.

Other objects and advantages of the invention will be apparent from the following detailed description of a preferred embodiment thereof, reference being made to the accompanying drawings, in which:

FIG. 1 is a somewhat simplified, exploded perspective view of a plurality of engine cylinders which are die-cast integral with a deck plate in accordance with the invention together with a cylinder head and a lower engine part;

FIG. 2 is a fragmentary, bottom view of the cylinders and deck plate of FIG. 1;

FIG. 3 is a fragmentary view in vertical cross section of the parts shown in FIGS. 1 and 2, when in assembled relationship;

FIG. 4 is a fragmentary view in vertical cross section similar to FIG. 3 but showing a modified connection between the upper and lower parts of an engine block assembly; and

FIG. 5 is a fragmentary view in vertical cross section similar to FIG. 3, but showing another modified connection between the upper and lower parts.

Referring to the drawing, and more particularly to FIG. 1, an upper cylinder assembly or engine part **10** includes a plurality of cylinder barrels **12** die-cast integrally with a deck plate **14** and extending outwardly from one side thereof. The deck plate **14** is formed with a plurality of bolt holes **16** and other openings **18** for cooling water, to allow the passage of push rods, etc. The cylinder barrels **12** have shoulders **20** near the lower ends thereof and can have internal cast iron liners **22** (FIG. 3), if desired.

The upper assembly **10** is assembled with an engine block shell or lower engine part **24** which includes an upper portion of a crankshaft housing **26** die-cast integrally therewith. An outer cooling chamber wall **28** extends upwardly from the housing **26**, and a bottom wall **30** extends across the upper part of the crankshaft housing **26** to form the lower extremity of a cooling chamber **32** (FIG. 3).

The joint between the cylinder barrels **12** and the lower engine part **24** can be made in various manners, depending to some extent on the light metal alloys chosen for the two castings. If the same alloy is used for each, so that the coefficient of thermal expansion is the same, an adhesive seal may be used between mating tapered surfaces as will be subsequently described. If the parts are subject to different rates of expansion, an annular seat **34** (FIGS. 1 and 3) may be formed in the bottom wall **30** for each of the cylinders **12** so that when the upper die-casting or part **10** is assembled with the lower die-casting or part **24**, the annular shoulders **20** of the cylinders **12** engage the annular seats **34** with a suitable seal such as a gasket **36** (FIG. 3) therebetween.

The deck plate **14** rests on a flange **38** of the cooling chamber wall **28** with a suitable gasket **40** therebetween. The sealing engagement at the two spaced portions of the cylinder wall **12** and the lower unit **24** thereby forms the cooling chamber **32**, the outer wall of which constitutes the cooling chamber wall **28** and the inner wall of which constitutes the cylinder wall **12**. The upper and lower walls of the chamber are formed by the flange **38** and the lower wall **30** of the part **24**. This arrangement will permit some differential expansion of the two castings **10** and **24** without danger of leakage from the cooling chamber.

The upper casting **10** can be maintained in engagement with the lower casting **24** by means of bolts or similar fasteners **42** which extend through a cylinder head diagrammatically indicated at **44** (FIG. 3) and threaded into holes **46** in the flange **38**. This connection enables close contact to be maintained between the flanges **38** and the deck plate **14** and between the shoulders **20** and the seats **34**. If desired, the upper casting **10** can be fastened to the lower casting **24** by suitable bolts or the like before the cylinder head **44** is attached.

Each of the cylinders **12** can be separate, such as the cylinders **12B** and **12C** of FIG. 2, or the cylinders can be cast in tandem or "Siamesed," such as the cylinders **12A** and **12B** which are joined by a web **48** in this instance. With two or more cylinders so joined, the mass of each, in effect, is added to the other to provide each cylinder with additional mass and stiffness which reduces engine noise.

A modified engine block assembly is shown in FIG. 4 with the joint between an upper engine die-casting **50** and a lower engine die-casting **52** made at a plane removed from the top of the engine cylinder. In this instance, the outer cooling chamber wall is divided into an upper section **54** and a lower section **56** having flanges **58** and **60** joined by a gasket **62** and a bolt **64**. The upper cooling wall section **54** depends from and is integral with a deck plate **66** in this instance and the lower section **56** is again integral with the crankshaft housing **68**, but being only half as high as the wall **28**. The joint at the lower end of the water jacket or cooling chamber or between the upper casting **50** and the lower casting **52** is, in the form shown, made by inserting spaced O-rings **70** in grooves **72** in the lower casting **52**. Thus the two castings can expand and contract longitudinally as the engine heats and cools in service and no strains will be set up in the engine cylinder. Bolts **74** join a cylinder head **76** to the deck plate **66**. By bringing the gasketed joint **62** between the upper and lower castings away from the top of the engine cylinder, it is possible to improve the cooling of the critical areas of the block by improving the heat transfer at the top. In this form the deck plate can be made thinner since it is stiffened by the depending side walls **54** and is thus less subject to warping.

In FIG. 5, a modified means for joining an upper die-casting **84** and a lower die-casting **86** is shown. In this instance, an upper connection between the units is similar to that shown in FIG. 3, a deck plate **88** being maintained in contact with a gasket **90** and a flange **92** of a cooling chamber wall **94** by means of bolts **95** which may be used also to fasten a cylinder head **96** to the block. In this instance, the deck plate **88** does not extend around the bolts **95** as does the deck plate **14** of FIG. 3, but is stopped short laterally of the clamping bolts. If the same aluminum or light metal alloy is used for both die-castings **84** and **86**, the lower connection between the castings may be provided by a tapered seat **97** formed on a bottom wall **98** and a similarly tapered shoulder **100** on a cylinder barrel **102**. Between the mating tapered surfaces **97** and **100** a plastic bonding agent **104** may be inserted which when cured provides a water-tight seal therebetween. This bonding agent preferably is epoxy resin which is cured under suitable heat and pressure after the upper and lower castings are assembled.

With any of the three forms of connection between the upper and lower castings as shown in FIGS. 3, 4 and 5, any leakage that may possibly occur at the upper connection will be outside the engine cylinders, because the deck plates are always integral with the cylinder walls, whether or not the latter are integral with part of the cooling chamber walls, as shown in FIG. 4. The upper connection is always made between at least part of a cooling chamber wall forming a portion of the lower casting and a portion of the upper casting, whether it be the deck plate or the downward extension of the deck plate forming an upper part of the cooling chamber wall as shown in FIG. 4. The lower connection is always made between a seat of the lower wall of the cooling chamber and the cylinder barrel extension of the upper casting. In either form of lower connection, leakage from the water jacket or cooling chamber is prevented, and this connection is relatively easy to make since it occurs at a point where thermal and mechanical stresses are not excessive.

Various modifications of the above described embodiments of the invention will be apparent to those skilled in the art, and it is to be understood that such modifications may be made without departing from the scope of the invention as defined in the appended claims.

What I claim is:

1. A die-cast light metal alloy engine block comprising: a lower die-cast section having an internal chamber with an open upper end and a bottom wall having an opening therein, said section having sidewalls which extend upwardly around said opening in said bottom wall and which terminate in a sealing surface surrounding said upper end of said internal chamber, a ferrous cylinder liner, an intermediate die-cast section of a light metal alloy having a deck plate with surfaces for effecting a seal with said upper sealing surface of said sidewalls and a depending generally cylindrical portion cast around and mechanically bonded to said cylinder liner, said depending generally cylindrical die-cast portion extending into said opening in said bottom of said lower die-cast section when said deck plate effects a seal with said sealing surface surrounding

said upper end of said internal chamber, and means effecting a seal between said generally cylindrical die-cast portion in said bottom wall when said deck plate effects a seal with said sealing surface, whereby efficient heat transfer from the inside of said ferrous liner is effected to a liquid cooling chamber which surrounds the liner and all portions of which chamber are of a non-rusting die-cast metal of high heat conductivity.

2. A die-cast light metal alloy engine block comprising: a lower die-cast section having an internal chamber with an open upper end and a bottom wall having spaced openings therein, said section having sidewalls which extend upwardly around the bottom wall having said openings there-through and which terminate in a sealing surface surrounding said upper end of said internal chamber; an intermediate die-cast section of a light metal alloy having a deck plate with surfaces for sealing engagement with said upper sealing surface of said sidewalls of said lower die-cast section, and a plurality of depending cylinders cast integrally with said deck plate and positioned to align with respective ones of said spaced openings in said bottom wall of said lower die-cast section, said intermediate die-cast section having vertically extending integral webs connecting said deck plate and adjacent sections of depending

cylinders to rigidify said intermediate die-cast section, the lower end of said depending die-cast cylinders extending into said openings in said bottom wall of said lower die-cast section, and means forming a water tight seal between the lower end of said die-cast cylinders in said bottom wall of said lower die-cast section whereby a rigid construction is provided and the clearance between said lower and intermediate die-cast sections forms a cooling chamber all portions of which are formed of a non-rusting die-cast metal.

References Cited by the Examiner

UNITED STATES PATENTS

867,075	9/07	Podhajsky	123—41.77
1,747,622	2/30	Daly	123—41.63
1,928,411	9/33	Cross	123—41.77
2,817,327	12/57	Brenneke	92—149
2,893,358	7/59	Bauer	92—149

FOREIGN PATENTS

342,240	10/21	Germany.

RICHARD B. WILKINSON, *Primary Examiner.*

KARL J. ALBRECHT, *Examiner.*