

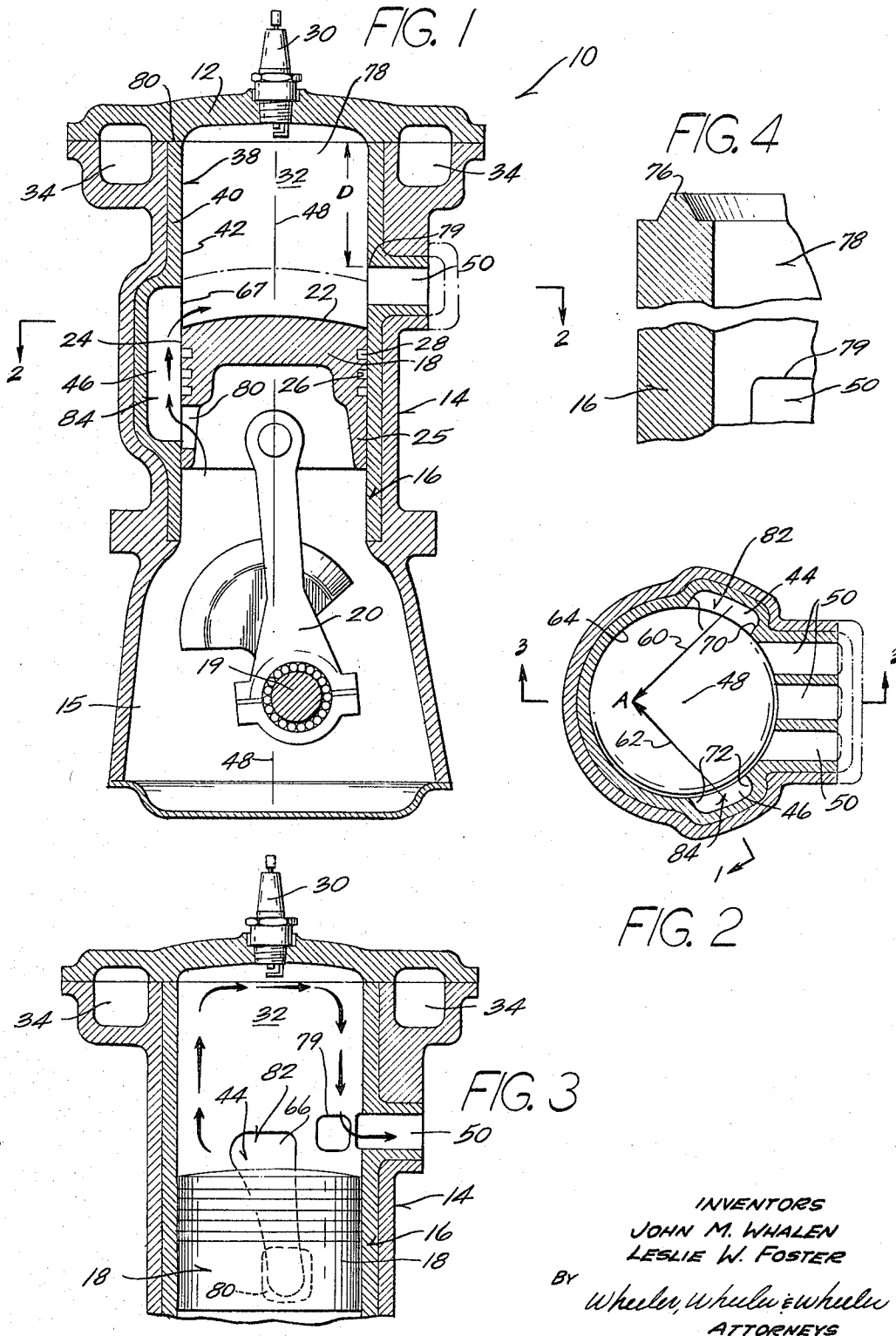
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ENGINE

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ABSTRACT OF THE DISCLOSURE

Disclosed herein is a cylinder liner having at least two depressions which are open only to the interior of the liner. The liner also includes, remote from the depressions, a circumferential projection or crush ring. The invention disclosed herein also includes the method of making an engine comprising the steps of die casting an engine block around a cylinder liner of the type described above, and machining the engine block and the liner to form a port wholly defined by the walls of the liner.

This invention relates to internal combustion engines and to methods of manufacturing internal combustion engines.

An object of the invention is to provide a method of manufacturing an internal combustion engine having a cylinder liner provided with a transfer passage therein communicable between the engine crankcase and the combustion chamber of the engine.

Another object of the invention is to provide an internal combustion engine having a cylinder liner provided with a hollow or depression which defines, in conjunction with a portion of the engine piston, a transfer passage.

Another object of the invention is to provide a cylinder liner for an internal combustion engine, which liner is formed with one or more depressions in the wall thereof.

Another object of the invention is to provide an efficient method of manufacturing die-cast multicylinder loop scavenged engines.

In accordance with the invention, the internal combustion engine is manufactured by fabricating a cylinder liner having therein a hollow or depression and a blind or closed exhaust port. A block member is then die cast around the liner, and the block and liner are machined to open the exhaust port.

An engine manufactured in accordance with the invention generally comprises an engine block defining a crankcase and including a cylinder liner communicating with the crankcase. The liner has an inner wall surface provided with an axially elongated hollow or depression. A piston is movably carried in the liner and includes means which, together with the elongated hollow in the liner, define a transfer passage communicable between the crankcase and the interior of the cylinder liner between the piston and the cylinder head.

Other objects, advantages and features will become apparent from the following description and accompanying drawings in which:

FIGURE 1 is a sectional view of a portion of an engine incorporating various of the features of the invention and taken along line 1-1 of FIGURE 2;

FIGURE 2 is a sectional view along line 2-2 of FIGURE 1;

FIGURE 3 is a fragmentary sectional view taken along line 3-3 of FIGURE 2; and

FIGURE 4 is a fragmentary sectional view of a portion of the engine shown in FIGURE 1.

Referring now to the drawings and more particularly to FIGURES 1 and 2, the engine 10 generally includes a cylinder head 12 connected to an engine block 14 which

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defines a crankcase 15 and which carries a cylinder liner 16. A piston 18 is movably carried in the cylinder liner for reciprocal movement axially of the liner by suitable means such as a crankshaft 19 and a connecting rod 20.

The crankshaft 19 is carried on the crankcase 15 by suitable bearings (not shown). The piston 18 generally includes a piston face 22 and a circular side wall 24 including a piston skirt 25. The side wall 24 has suitable grooves 26 to carry therein a plurality of piston rings 28 which sealingly engage the inner wall surface of the cylinder liner 16.

The cylinder head 12 is provided with a conventional spark plug 30 which extends into a combustion chamber 32 defined by the variable volume between the cylinder head 12 and the piston face 22. A water jacket 34 is formed in the crankcase 14 and cylinder head 12 and generally surrounds the combustion chamber 32 of the engine 10 to provide cooling thereof in a conventional manner.

The engine 10 is typically a two-stroke engine having one or more cylinders. For the purposes of illustration, a single cylinder two-stroke engine is shown. The engine 10 is manufactured by first fabricating the cylinder liner 16 with one or more hollows or depressions and one or more blind or closed exhaust ports extending from the interior surface of the liner. Such a cylinder liner 16 generally comprises a cylindrical member 38 having a wall 40 with an inner wall surface 42 having therein the one or more depressions or hollows which are open only to the interior of the cylinder liner. The depressions can be formed by protuberances in the wall of the liner 16, as shown in the illustrated embodiments.

In the preferred embodiment, two depressions 44 and 46 are provided which are elongated in the direction of the axis 48 of the cylindrical member 38 and which define, in part, transfer passages (to be hereinafter discussed). The other depressions 50, of which there are three, extend axially, as shown in FIG. 1, for less than one half the axial length of the depressions 44 and 46, are laterally aligned in a direction transverse to the cylinder axis 48 and serve as the blind exhaust ports or chambers which are open only to interior of the cylinder liner. It is noted also that the upper end of the recess 66 terminates at a point between the axially spaced ends of the recessed port chambers 50. During the die-casting operation, the blind exhaust ports 50 keep the molten metal from the interior of the cylinder liner and also interiorly provide for receipt of a locating dowel. The elongated depressions 44 and 46 are generally oppositely disposed, are angularly spaced about the cylinder axis 48 on opposite sides of the exhaust ports 50, and are partially axially co-extensive to a portion of the exhaust ports 50.

The elongated depressions 44 and 46 have centerlines 60 and 62 which intersect each other at a point A (FIGURE 2) located within the cylindrical member 38 and spaced from the axis 48. Specifically, the centerlines 60 and 62 intersect each other between the axis 48 and the cylindrical member wall portion 64 located diametrically opposite the exhaust ports 50. The centerlines 60 and 62 of the elongated depressions 44 and 46 are defined as the respective centerlines of the effective openings or intake ports 66 and 67 (FIGURES 1 and 3) which are defined by the end portions of the depressions 44 and 46 when the piston 18 is at bottom dead center (as shown in FIGURES 1 and 3). The centerlines 60 and 62 are generally parallel to the parallel sidewall portions 70 and 72 of the respective depressions 44 and 46.

After fabrication of the cylinder liner, in a manner as described above, the engine block 14 is die cast around the cylinder liner 16 to form the crankcase 15 which communicates with the interior of the liner 16. Any suitable

material for the engine block can be employed. In the preferred embodiment, aluminum is used.

To facilitate die casting of the engine block 14 around the liner 16 and to facilitate proper location of the depressions in the liner 16 relative to the block 14, the liner is provided at the upper end 78 thereof and remote from the depressions 44 and 46 (see FIGURE 4) with a circumferential projection or crush ring 76 which is effective to compensate for inaccuracies of die closing and cylinder liner length variation. During the die casting operation, the crush ring 76 is engaged by a portion of the die casting apparatus (not shown) to provide a seal therebetween to prevent molten metal from entering the interior of the liner 16. Also, during the die casting operation, the crush ring is crushed as required to afford control of the dimension between the top of the engine block 14 and the upper margins of one of the depressions 44 and 46, and 50. For example, the crush ring 76 can be employed to control the dimension D (FIGURE 1) between the top of the engine block 14 and the upper margins 79 of the exhaust ports 50.

After die casting the engine block around the liner, the block 10 and the liner 16 are machined to open the blind exhaust ports 50 (as shown by the phantom lines in FIGURES 1 and 2) so that the ports are wholly defined by wall surfaces of the liner.

An engine in accordance with the method described above, includes, in addition to the previously described structure, means on the piston 18 cooperating with the depressions 44 and 46 and defining in conjunction with the depressions 44 and 46 one or more transfer passages communicable between the crankcase 15 and the interior of the liner 16. In the preferred embodiment, such means comprises one or more apertures 80 in the piston skirt 25, which apertures 80 are communicable with the depressions 44 and 46 to form transfer passages 82 and 84. The transfer passages 82 and 84 are effective to afford communication between the crankcase 15 and the combustion chamber 32 during the time interval when the piston 18 is at a bottom dead center position (shown in FIGURES 1 and 3) and before the piston closes the transfer passages 82 and 84 from communication with the combustion chamber 32 (as shown by the phantom lines in FIGURE 1).

Of course, the axial distance or extent between the top of the apertures 80 and the portion of the piston 16 that affords closing of the transfer passages 34 (whether it be the top edge or corner 90 or one of the rings 28 of the piston) must be less than the axial extent of the elongated depressions 44 and 46 which form the transfer passages 82 and 84. Alternatively, said aforementioned means on the piston can comprise slots through the wall of the piston skirt 24 and extending to the bottom thereof, or blind slots in the skirt 25 to afford openings between the piston skirt and the liner wall which respectively communicate with the transfer passages 82 and 84, or the axial extent of the piston wall portions (namely, the distance between the piston wall portions which afford closing of the transfer passages and the bottom of the corresponding skirt portions) which are communicable with the depressions 44 and 46 can be less than the length of the depressions 44 and 46 to provide transfer passages between said piston wall portions and said depressions.

Upon completion of a power stroke with the piston at bottom dead center, as shown in FIGURE 3, the crankcase 15 communicates with the combustion chamber 32 through the transfer passages 82 and 84 to afford flow of combustion charge to the combustion chamber 32. As indicated by the arrows in FIGURES 1 and 2, the combustion charge flows through the transfer passages 82 and 84 and from the transfer passages through the effective intake ports 66 and 67 and to the combustion chamber 32. In the combustion chamber 32, the combustion charge flows across the piston face 22 and toward the cylinder liner wall portion 64. The orientation of the

transfer passages 82 and 84 (as previously described) affords loop scavenging and causes the combustion charge flow from each passageway 82 and 84 to converge at a point A (the point of intersection of the centerlines of the effective intake ports 66 and 67). Thereafter, the combustion charge impinges on the adjacent cylinder liner wall portion 64 and thereafter flows upwardly toward and then across the cylinder head 12 and down on the opposite side of the cylinder liner, expelling the burned gases out the exhaust ports 30 and filling the combustion chamber 32 with a fresh charge.

The method of manufacturing die cast engines disclosed by this invention eliminates the disadvantageous, costly, and very difficult casting of the transfer passage in the engine block. This is especially significant in loop scavenged multicylinder engines.

Various of the features of the invention are set forth in the following claims.

What is claim is:

1. A method of constructing an engine having therein a cylinder liner, said method comprising the steps of fabricating the cylinder liner with one or more depressions and with a closed port chamber extending from the interior surface of the cylinder liner, die casting an engine block around the liner to form a crankcase in communication with the interior of the cylinder liner, and machining the block and the liner to form a port wholly defined by the wall surfaces of the liner chamber.

2. A method in accordance with claim 1 wherein the engine block is a lightweight and/or corrosion resistant material.

3. A method of constructing an engine having therein a cylinder liner, said method comprising the step of fabricating the cylinder liner with a closed port chamber extending from the interior of the cylinder liner and with a pair of depressions angularly spaced about the cylinder liner axis and disposed on opposite sides of the exhaust port, said depressions being elongated in the direction of the liner axis and having centerlines which converge at a point spaced from the liner axis and between said axis and a portion of the interior wall of the cylinder liner located in generally diametrically opposed relation to said port chamber, die casting an aluminum block around the liner to form a crankcase in communication with the interior of the liner, and machining the engine block and the liner to form a port wholly defined by the wall surfaces of the liner chamber.

4. A method in accordance with claim 3 wherein the depressions and the closed port are formed by fabricating the liner with protuberances in the wall thereof.

5. A method of constructing an engine block including therein a cylinder liner, said method comprising the steps of fabricating the cylinder liner with an end having a crush ring of reduced wall thickness and with a depression having an upper margin and extending solely from the inner wall of the cylinder liner, die casting the engine block around an liner to form a crankcase communicating with the interior of the cylinder liner, and partially crushing the crush ring during die casting operation to control the dimension between the upper margin of the depression and the top of the engine block.

6. A method of constructing a two-stroke engine having an engine block including therein a cylinder liner and a piston movable in the cylinder liner, said method comprising the steps of fabricating the cylinder liner with a depression and with a closed port chamber extending from the interior surface of the cylinder liner, die casting the engine block around the liner to form a crankcase communicating with the interior of the liner, machining the engine block and the liner to form a port wholly defined by the wall surfaces of the liner chamber, and fabricating the piston with means thereon which communicate with the depression to provide a transfer passage communicable between opposite sides of the piston.

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7. A cylinder liner for an internal combustion engine, said cylinder liner comprising a cylindrical member having an inner wall surface, said inner wall surface including first, second and third depressions open only to the interior of said liner, said second and third depressions being elongated in the direction of the axis of said cylindrical member and having centerlines converging at a point spaced from said axis and between said axis and a portion of said inner wall surface located in generally diametrically opposed relation to said first depression, said first depression extending axially for less than one half the length of said second and third depressions.

8. A cylinder liner in accordance with claim 7 wherein said first, second and third depressions are formed by respectively associated protuberances in the wall of said cylindrical member.

9. A cylinder liner for an internal combustion engine, said cylinder liner comprising a cylindrical member having an inner wall surface, said inner wall surface including first, second and third depressions open only to the interior of said liner, said second and third depressions being elongated in the direction of the axis of said cylindrical member and having centerlines converging at a point spaced from said axis and between said axis and a portion of said inner wall surface located in generally diametrically opposed relation to said first depression.

10. A cylinder liner for an internal combustion engine, said liner comprising a cylindrical member having an outer wall surface with first and second protuberances and having an inner wall surface including a recess located in said first protuberance and open only to the interior of said member and a recessed port chamber located in said sec-

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ond protuberance and open only to the interior of said member, said recessed port chamber extending axially for less than the length of said recess, said recess having an end terminating at a point between the axially spaced ends of said recessed port chamber.

11. A cylinder liner for an internal combustion engine, said liner comprising a cylindrical member having an outer wall surface with first and second protuberances and having an inner wall surface including a recess located in said first protuberance and open only to the interior of said member and a recessed port chamber located in said second protuberance and open only to the interior of said member, said recessed port chamber extending axially for less than the length of said recess, said recess having an end terminating at a point between the axially spaced ends of said recessed port chamber and, said recessed port chamber being located angularly with respect to the axis of said cylindrical member at less than 180 degrees from said recess.

12. A cylinder liner in accordance with claim 10 wherein said recess and said recessed port chamber have center lines which intersect each other within said cylindrical member at a point spaced from the axis of said cylindrical member.

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