

United States Patent

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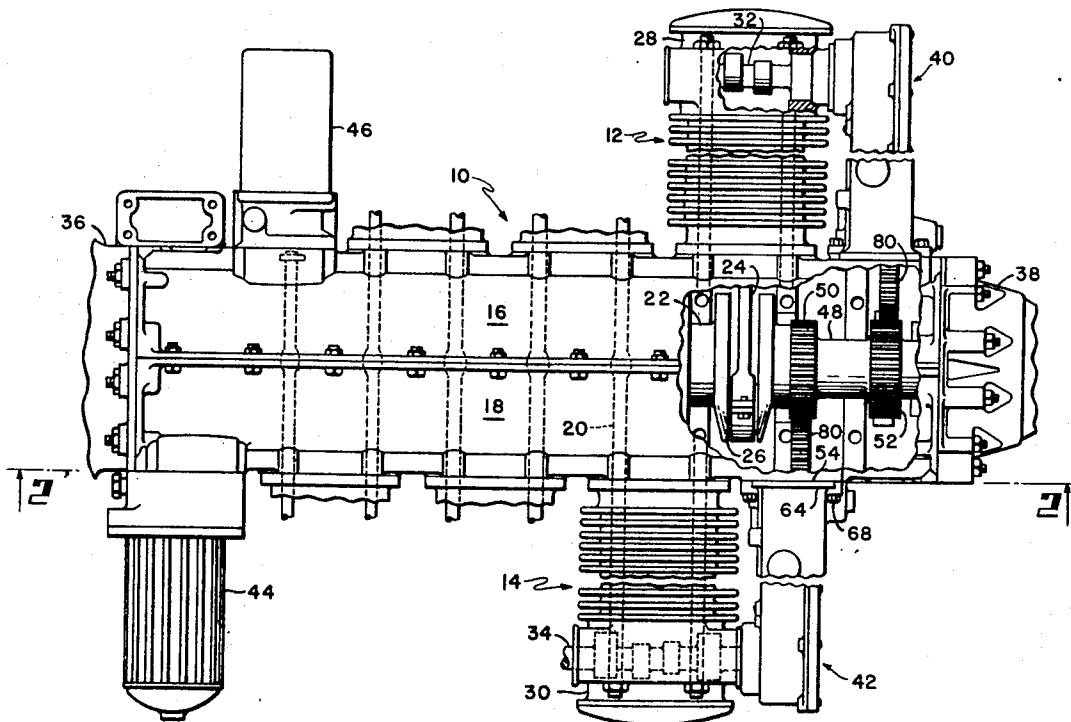
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[54] **MODULE-TYPE ENGINE STRUCTURE**
7 Claims, 4 Drawing Figs.

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123/90, 123/195, 123/196
 [51] Int. Cl..... **F02b 75/24,**
F01I 1/00
 [50] Field of Search..... **123/90.10,**
56A, 56A1, 56A2, 56A3, 56B, 56B1, 56B2, 56B3,
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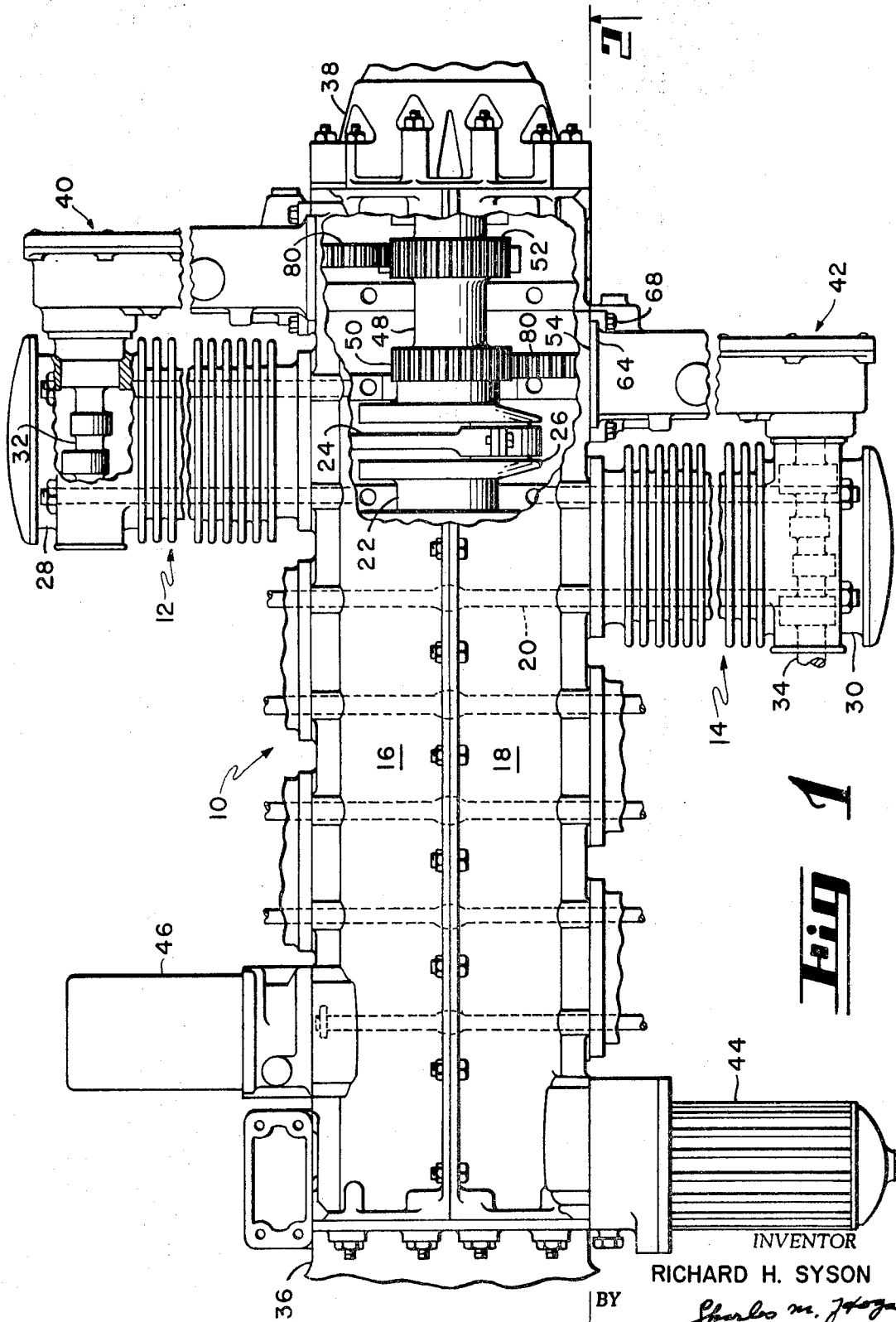
ABSTRACT: The disclosure illustrates an opposed multicylinder aircraft engine having a construction which permits the use of module-type auxiliary units such as camshaft drive mechanism, oil cooler, and oil pressure regulating and filter assemblies. Additionally, the engine is constructed so that the camshaft drive assemblies are interchangeable.



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Sheet 1 of 4



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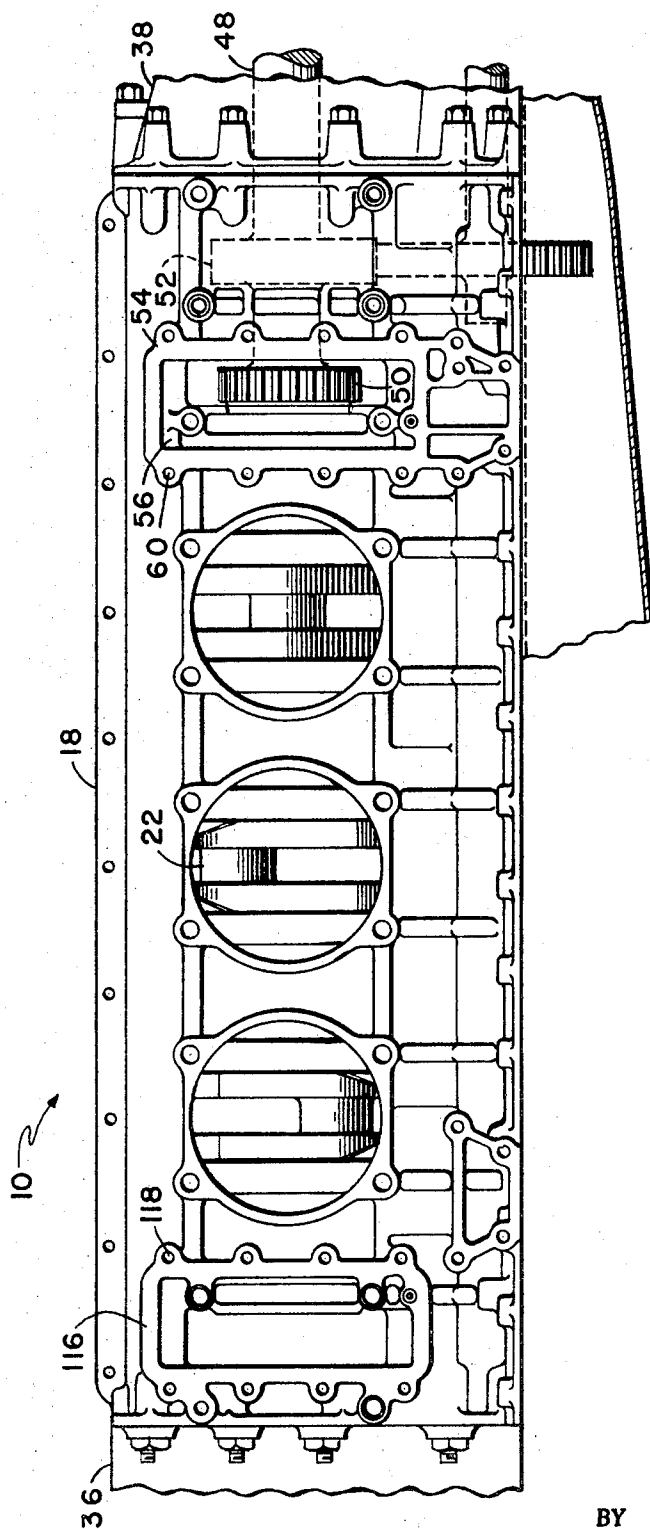


Fig. 2

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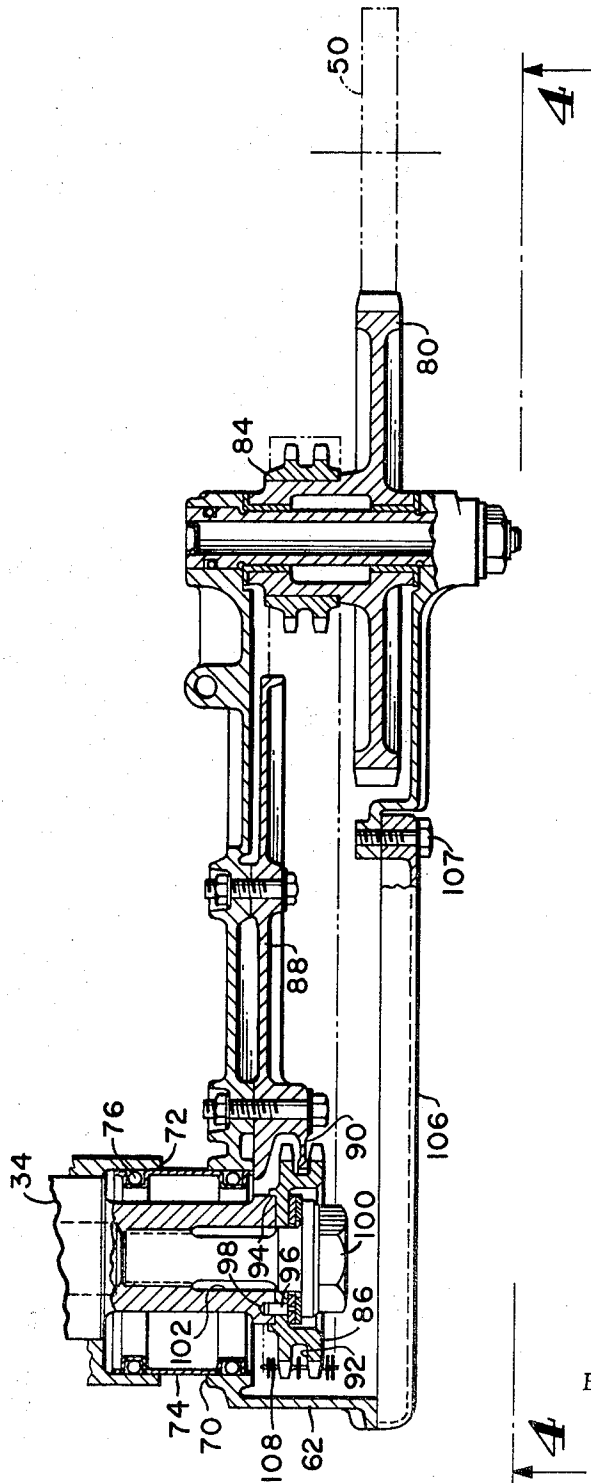
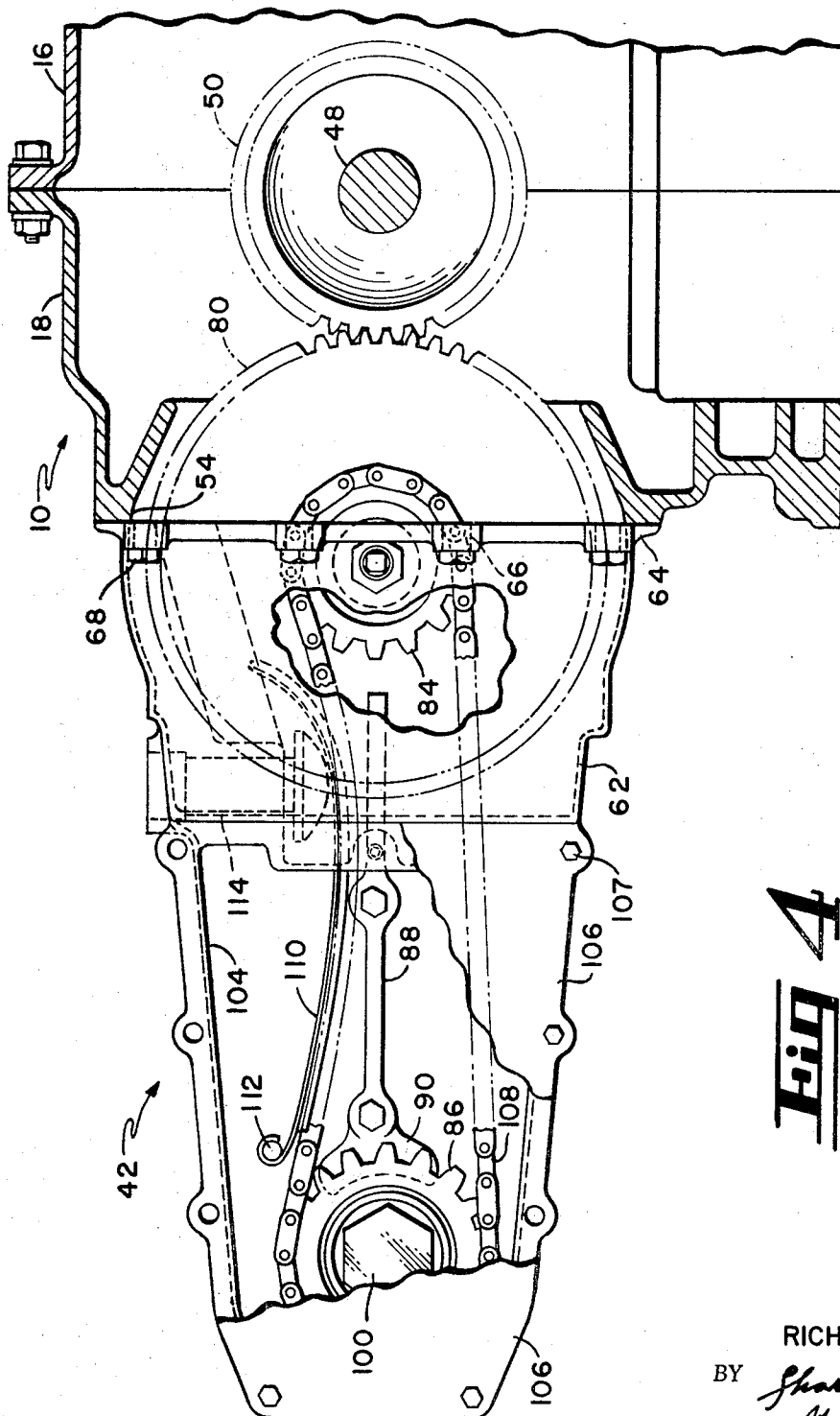


Fig. 3

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MODULE-TYPE ENGINE STRUCTURE

The present invention relates to internal combustion engines and more particularly to their type of construction.

The opposed-cylinder, air-cooled internal combustion engine has long been used for aircraft propulsion. However, several economic problems detract from its otherwise outstanding performance. The first of these problems is the high cost of manufacturing because the engine components must be cast and machined to a high degree of tolerance. This first problem is solved by the copending U.S. Pat. application entitled "Internal Combustion Engine Structure" in the names of Richard H. Syson and John W. Eckert, Ser. No. 767,780, filed Oct. 15, 1968, and assigned to the same assignee as the present invention.

A second economic problem confronting the user of these engines is the high amount of time which must be spent on routine maintenance. Maintenance time is expensive, not only in the direct costs paid for maintenance, but in the loss of income where the aircraft powered by an engine is used in a business operation. Many of the maintenance problems stem from the fact that auxiliary equipment is frequently buried within a mass of external piping or mounted in the interior of an engine crankcase, thereby making it necessary to disassemble a major portion of the engine to gain access to a relatively simple component. This disassembly to gain access to the part is substantially greater than the time needed to repair or replace the individual part and generates an unnecessary cost. Furthermore, since auxiliary equipment for opposed engines generally are manufactured in right or left-hand units, problems arise when there is a lack of units for one side and an excess for the other.

Accordingly, it is an object of the present invention to provide a construction for an engine of the above general type which minimizes the time to gain access to auxiliary components and provide a high degree of interchangeability between the auxiliary components.

The above ends are achieved by providing a novel construction for an internal combustion engine having opposed rows of cylinder assemblies which include valve mechanism and head portions at the outer ends of each row of cylinder assemblies. The valve mechanism is actuated by camshafts positioned adjacent each row of cylinder head portions and equidistant from the centerline of the engine.

The engine comprises a crankcase for mounting the inner ends of the cylinder assemblies and a crankshaft journaled for rotation in the crankcase. A drive gear means is positioned in the crankcase and driven by one end of the crankshaft.

Identical detachable mounting means are symmetrically positioned on opposite sides of the crankcase and in line with the drive gear means. A drive means is provided for each of the camshafts and it comprises a matched housing having an inner end adapted to be secured to both of the identical detachable mounting means on the crankcase and an outer end extending to the camshaft. A gear means is journaled in the inner end of the matched housing so that the gear means extends beyond the inner end of the housing for engagement with the drive gear means in the crankcase. A chain drive means having an input sprocket connected to the input gear means has an output sprocket journaled in the outer end of the housing and in line with the camshaft. A means is provided for detachably securing the output sprocket of the chain drive means to the camshaft, the camshaft detachable mounting means being detachable in a direction away from the camshaft. As a result, the camshaft drive means may be detached from the engine by removal of the camshaft mounting means and the crankcase mounting means, and the camshaft drive means may be interchanged between opposite sides of the engine.

The above and other related objects and features of the present invention will be apparent from a reading of the description of the disclosure shown in the accompanying drawings and the novelty thereof pointed out in the appended claims.

In the drawings:

FIG. 1 is a plan view of an opposed, multicylinder internal combustion engine embodying the present invention;

FIG. 2 is a view taken on lines 2-2 of FIG. 1;

FIG. 3 is an enlarged detailed view of a component shown in FIG. 1; and

FIG. 4 is a view taken on line 4-4 of FIG. 3.

Referring particularly to FIG. 1, there is shown an internal combustion engine 10 having opposed rows of cylinders 12 and 14 (only two are shown), respectively. The cylinder assemblies 12, 14 are mounted to crankcase halves 16, 18 by a series of bolt assemblies 20. A crankshaft 22 is journaled for rotation within the crankcase halves. The crankshaft 22 is in line with the parting line between the crankcase halves which also forms the midpoint of the engine 10. The crankshaft is rotated by reciprocation of piston assemblies (not shown) in cylinder assemblies 12, 14. The piston assemblies each have connecting rods 24 (only one of which is shown) that extend to throws 26 on the crankshaft 22 for this purpose. Each of the cylinder assemblies 12, 14 have head assemblies 28, 30 mounted to their outer ends. The head assemblies 28, 30 house inlet and exhaust valve mechanism (not shown) which sequentially permit a combustible charge to enter the cylinder assembly, where it is ignited, and permit burned gases to be discharged. This operation of a four-cycle internal combustion engine is well known to those skilled in the art.

The valve mechanism for each row of cylinders is actuated by camshafts 32 and 34, respectively, which extend through and are journaled in the head assemblies 28, 30 for each row of cylinder assemblies. It should be noted that the camshafts 32 and 34 are parallel to and positioned equidistant from the midpoint of the engine 10.

While the basic elements of an internal combustion engine embodying the present invention have been described, it is apparent that there are many auxiliary components necessary for operation. One such auxiliary component would be an ignition and electrical generating unit which may derive its power from the engine crankshaft via an auxiliary gear train housed in an auxiliary gear box 36. Another component is an output gear train, described in detail later, which is housed in an output gear box 38 and provides a prime output connection to an aircraft propeller or a vehicle drive wheel. The gear train has an input gear 52 on one end of a shaft 48 splined over the end of crankshaft 26. Another gear 50 is secured to the opposite end of shaft 48.

Additional auxiliary components are camshaft drive units, generally indicated by reference characters 40, 42 which drive the camshafts 32, 34 from the crankshaft 26. The engine also requires an oil system which includes an oil cooler assembly 44 and an oil filter and pressure regulating assembly 46. These latter components are frequently subjected to removal for a routine inspection or replacement. In accordance with the present invention, maintenance and access to these assemblies is facilitated by constructing these elements in a module-type arrangement as described below.

Referring particularly to FIG. 2, each of the crankcase halves (18 is illustrated) is provided with a mounting pad 54 surrounding an opening 56 in line with gear 50 for crankcase half 18 and in line with gear 52 for crankcase half 16. The mounting pads 54 on each of the crankcase halves have threaded bores 60 in the mounting pads in identical patterns which are symmetrical about the midpoint of the pad. The mounting pads 54 are adapted to receive camshaft drive assemblies 40 or 42, since each of these assemblies are constructed to be used for driving camshaft 32 or 34, as described below.

Referring now to FIGS. 3 and 4, there is illustrated in detail the camshaft drive assembly 42 for camshaft 34. It should be noted, however, that the description of this assembly will serve for the assembly 40 because the two are identical in construction.

The drive assembly 42 comprises a housing 62 having a flange 64 on its inner end adapted to abut mounting pad 54. A number of holes 66 are provided in the flange 64 so that they match the threaded bores 60 in the mounting pad 54. Screws

68 detachably hold the flange 64 against pad 54 (FIG. 1). The outer end of housing 62 has an opening 70 in line with the forward end of the camshaft 34 which extends through an opening 72 in the cylinder head 30. A sleeve 74 is telescoped into openings 70 and 72 and has sealing rings 76 to form a sealed connection between cylinder head 30 and the interior of housing 62.

An input gear 80 is journaled at the inner end of housing 62 on a shaft 82. The teeth of the gear 80 extend beyond the inner end of housing 62 so that they mesh with gear 50 or 52 depending on which side of the engine the housing 62 is mounted. A double chain sprocket 84 of a chain drive assembly is fixed on the gear 80.

A double chain output sprocket 86 is positioned adjacent the opening 70 and in line with the axis of the camshaft 34. The output gear sprocket 86 is held loosely in alignment with the input sprocket 84 by a support member 88 bolted to the housing 62 and having an arcuate flange 90 adapted to be received in an annular groove 92 adjacent sprockets of the chain sprocket 86. The output sprocket 86 is positioned on the forward end of the camshaft 34 in a recess 94. An offset pin 96 extending into a bore 98 and a bolt 100 threaded into a bore 102 in the camshaft 34 detachably secure the sprocket 86 to the camshaft. A plate 106 is secured by screws 107 over an opening 104 in the housing 62 to provide a sealed housing and to enable ready access to the bolt assembly 100 on the outer sprocket 86.

A double chain 108 is trained over sprockets 84 and 86. A shoe 110, pivotally mounted to the housing 62 by a bolt 112 is urged against the chain 108 by a suitable plunger device 114 actuated by hydraulic or spring means.

It is apparent from the preceding description that the camshaft drive assembly 42 is a self-contained unit or module that may be readily installed on the engine as follows. The inner side of the housing 62 is placed against mounting pad 54 at an angle so that input gear 80 projects into the crankcase 18 and the outer side of the housing 62 clears the end of camshaft 34. During this operation the output sprocket 86 is held in position by the member 88.

The housing 62 then is pivoted towards the camshaft 34 so that the sleeve 74 is received in opening 70 and flange 64 completely abuts mounting pad 54. Bolt 100 is threaded into the end of camshaft 34 to secure sprocket 86 and flange 64 is secured to mounting pad 54 by screws 68. Cover 106 is secured over opening 104 to enclose the camshaft drive mechanism and enable it to be lubricated from a suitable source.

The camshaft drive assembly is removed from the engine generally in the reverse order.

The module approach to this type of engine assembly is preferably utilized in the mounting of the oil filter and pressure regulating assembly 46 and the oil cooler assembly 44. For this purpose the crankcase halves 16 and 18 each have an identical mounting pad 116 having threaded bores 118 therein. Each of the assemblies 44 and 46 are adapted to interchangeably mount to one of the mounting pads 116. It should be noted that if the engine crankcase halves 16 and 18 are constructed in accordance with the teachings in the copending patent application entitled "Internal Combustion Engine Structure", referred to above, the mounting pads 116 are identical to the mounting pads 54 so that each assembly may be interchangeably mounted on any of the mounting pads.

The invention described above provides significant advantages in the maintenance of an internal combustion engine since the various accessory components are quickly detached as modules by the removal of a relatively small number of bolts. This feature substantially reduces the maintenance time on the engine since a replacement component may be maintained in readiness to install as soon as the component on the engine is removed.

The module-type construction enables significant advantages in connection with the maintenance of the camshaft

drive units. What heretofore was a complicated and involved operation is reduced to a few quickly performed steps and the camshaft drive module may be replaced by a single unit.

Because the camshafts 32 and 34 are equidistant from their associated mounting pads 54, and the flanges 64 can be mounted on either pad, the camshaft drive assemblies may be interchanged. As a result, there need be only a standard camshaft unit provided for either row of cylinders, thereby reducing manufacturing costs.

It should also be noted that since the gear 52, besides serving as a drive gear for camshaft drive assembly 40, serves as an input gear for the output gear assembly of the engine, thereby minimizing the parts to the manufactured for the engine.

While the preferred form of the present invention has been described, it will be obvious to those skilled in the art that changes may be made without departing from the spirit of the present invention. Accordingly, its scope should be determined solely by the appended claims.

I claim:

1. An internal combustion engine having opposed rows of cylinder assemblies including valve mechanism and head portions positioned at the outer ends of each row of cylinder assemblies, said valve mechanism being actuated by a camshaft positioned adjacent each row of cylinder head portions and equidistant from the center line of said engine, said engine comprising:

a crankcase for mounting the inner ends of said cylinder assemblies;

a crankshaft journaled for rotation in said crankcase;

drive gear means positioned in said crankcase and driven by one end of said crankshaft;

identical mounting means on opposite sides of said crankcase in line with said drive gear means;

drive means for said camshafts, each of said camshaft drive means comprising:

a matched housing having an inner end adapted to be interchangeably secured to both of said identical detachable mounting means on said crankcase, an outer end extending to said camshaft;

means for detachably mounting said matched housing to said mounting means on opposite sides of said crankcase;

input gear means journaled in the inner end of said matched housing, said input gear means being positioned so that said input gear means extends beyond the inner end of said housing for engagement with the drive gear means in said crankcase;

a chain drive means having an input sprocket connected to said input gear means at one end thereof and an output sprocket journaled in the outer end of said housing and in line with said camshaft;

means for detachably securing the output sprocket of said chain drive means to said camshaft, said camshaft securing means being detachable in a direction away from said camshaft; and

whereby said camshaft drive means may be detached from said engine by removal of said camshaft securing means and said housing detachable mounting means and further whereby said camshaft drive means may be interchanged between opposite sides of said engine.

2. An internal combustion engine as in claim 1 wherein the opposite rows of cylinder assemblies and the crankcase detachable mounting means on opposite sides of the crankcase are staggered with respect to one another, said engine further comprises a speed reduction gear unit driven by said crankshaft to provide a lowered speed ratio output and wherein:

said drive gear means positioned in said crankcase comprises a gear assembly journaled in said crankcase and splined to one end of said crankshaft, said gear assembly comprising a first pinion gear having a sufficient tooth width to transmit the primary power output of said crankshaft to said speed-reducing gear assembly, said first

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gear meshing with and providing an input for said speed-reducing gear assembly, said first gear being oppositely positioned in line with said detachable mounting means on one side of said crankcase; and

a second gear having a tooth width sufficient to transmit auxiliary power from said crankshaft to said camshaft drive means axially positioned from said first gear and in line with the detachable mounting means on the opposite side of said crankcase for engaging the camshaft gear means on that side.

3. An internal combustion engine as in claim 2 wherein said crankcase comprises a pair of matched crankcase halves adapted to be used interchangeably on opposite sides of the engine centerline, and wherein said engine further comprises:

a second pair of identical detachable mounting means on opposite sides of said crankcase and positioned longitudinally with respect to said first-mentioned identical detachable mounting means so that when said second pair of mounting means are positioned adjacent the said one end of the crankshaft the mounting means are in line with said drive gear assembly;

a first oil system component having a base adapted to be secured to either of said identical detachable mounting means adjacent the aft end of said crankshaft;

a second oil system component having a base adapted to be secured to the identical detachable mounting means on the opposite side of said crankcase adjacent the aft end of said crankshaft; and

whereby said camshaft drive means and said oil system components may be interchanged and removed as units.

4. An internal combustion engine as in claim 3 wherein: said first oil system component comprises a pressure regulating flow control valve and an oil cooler; and

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said second oil system component comprises an oil filter assembly.

5. An internal combustion engine as in claim 4 wherein said crankcase detachable mounting means comprises:

a mounting pad having threaded bores in a predetermined pattern and bolts adapted to be threaded into said bore;

said camshaft drive means and said oil system components have an inner base end including a base surface adapted to abut said mounting pad and openings therein through which said bolts extend to detachably secure said camshaft drive means and said oil system components to said crankcase;

said output sprocket detachable securing means comprises a splined connection for receiving and driving said camshaft and a bolt means for detachably securing said output sprocket to said camshaft; and

said camshaft drive means further comprises means for maintaining said output sprocket in line with said input sprocket when said output sprocket is detached from said camshaft.

6. An internal combustion engine as in claim 5 wherein said housing is adapted to provide a chamber for lubricating fluid for said chain drive assembly and said camshaft drive means housing includes an opening in line with said output sprocket and the bolt for detachably securing said output sprocket to said camshaft and said housing further comprises a cover adapted to be detachably secured over said opening.

7. An internal combustion engine as in claim 6 wherein said camshaft drive means further comprises means secured to said camshaft drive means housing for adjusting the tension of said chain drive means.