

June 29, 1943.

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INTERNAL COMBUSTION ENGINE CONSTRUCTION

Filed Nov. 27, 1937

3 Sheets-Sheet 1

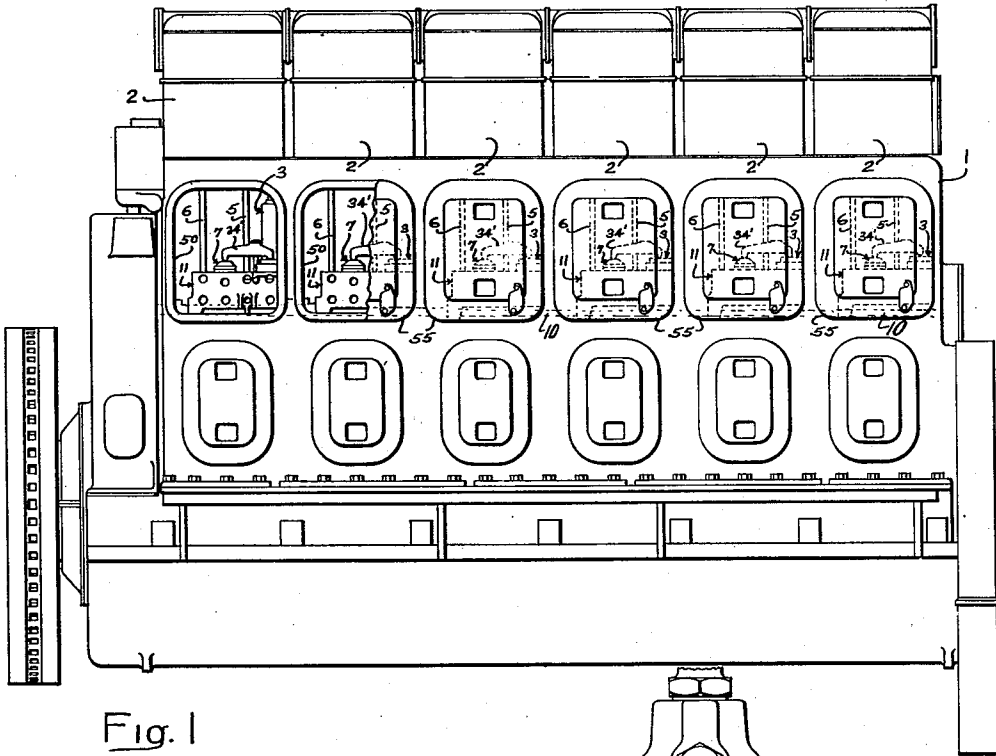


Fig. 1

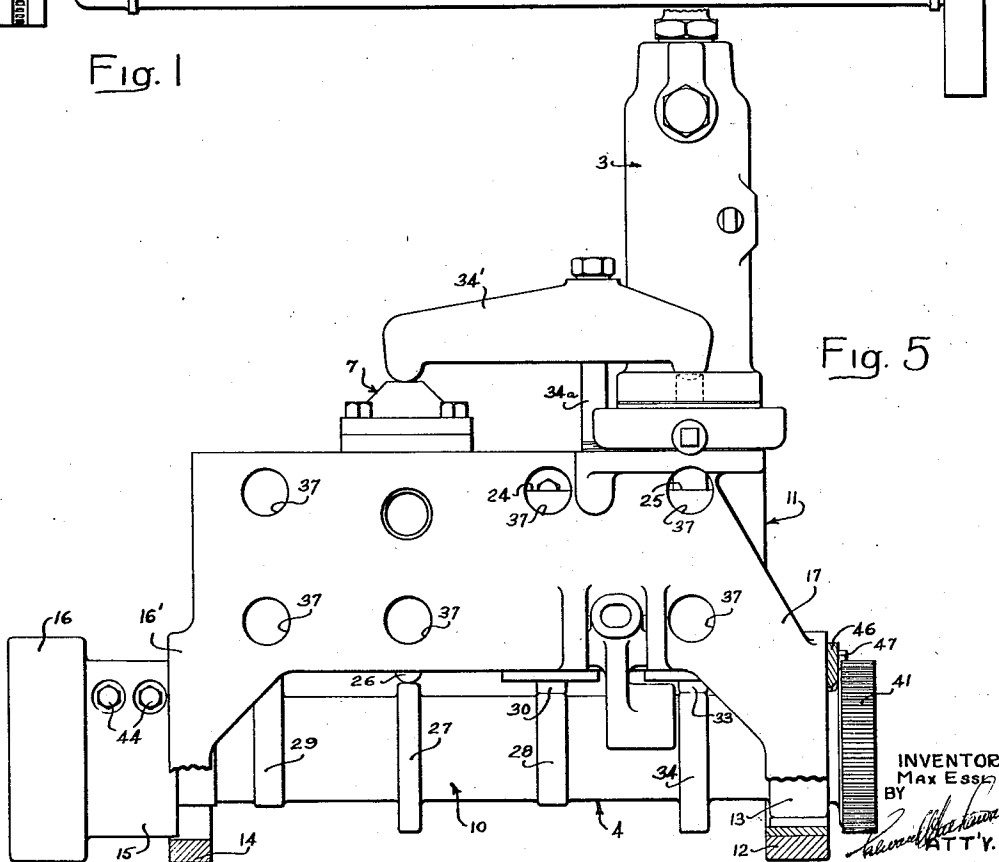


Fig. 5

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Fig. 4

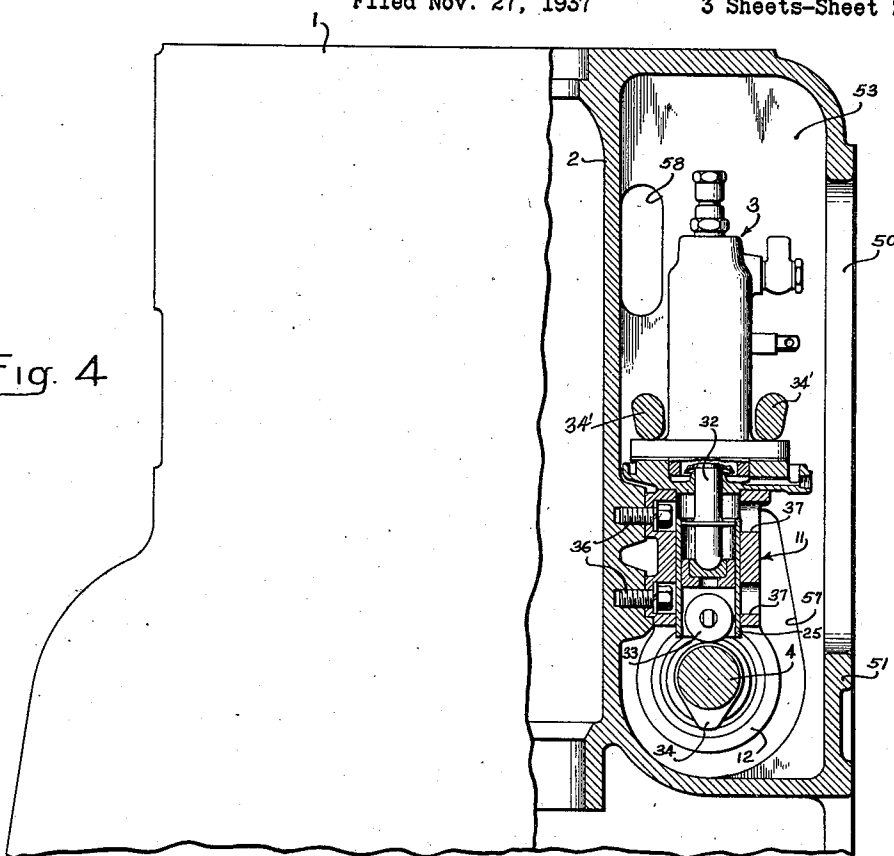
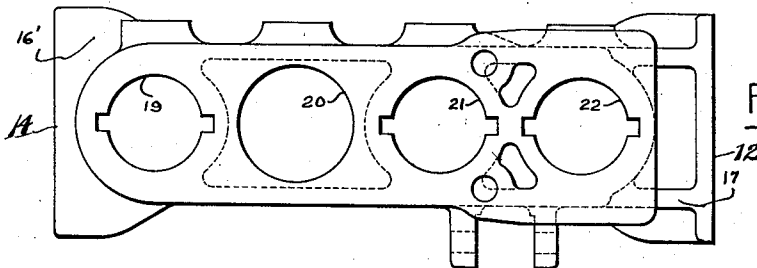


Fig. 2

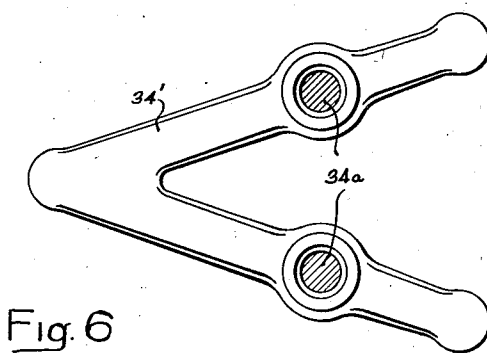


Fig. 6

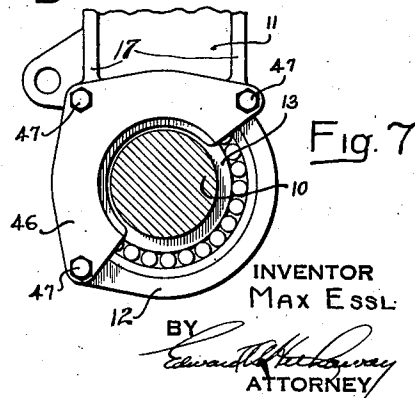


Fig. 7

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INTERNAL COMBUSTION ENGINE
CONSTRUCTION

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Application November 27, 1937, Serial No. 176,872

12 Claims. (Cl. 123—90)

This invention relates generally to internal combustion engines, especially of the Diesel type, and more particularly to an improved camshaft and cam follower arrangement.

In internal combustion engines of relatively large power such as is common with Diesel engines, it is highly desirable that the engine frame should be as stiff as possible consistent with minimum weight and economical manufacture of the engine together with having various operating parts of the engine readily accessible and removable for inspection, repair and assembly. The desirable result of a stiff frame has heretofore been accomplished but only at the expense of incurring disadvantages in other respects, especially when the most desirable form of usual stiffening means is employed. Such usual means, incorporated in the frame disclosed herein to illustrate the applicability and advantages of my invention, includes a series of ribs extending vertically alongside of and integrally with the cylinders and joining an outer longitudinal wall. This structure is usually employed to enclose various operating elements such as the camshaft, cam followers, fuel pumps and other operating parts. It is the construction and arrangement of these various elements and their accessibility for removal and replacement or original assembly that have heretofore suffered by reason of the frame stiffening means.

It is an object of my invention to provide an improved camshaft and cam follower arrangement that is relatively simple and economical in construction, operation and maintenance and is readily applicable to engines of any number of cylinders while at the same time allowing the engine frames to be stiffened in the manner above described but without incurring the disadvantages incident thereto.

Another object is to provide an improved structural unit, for a camshaft and cam follower as well as other elements operated by the camshaft, that is highly compact and will permit not only a high degree of flexibility of application of a standardized unit to engines of various sizes and numbers of cylinders but will also permit any damaged or worn portion of the camshaft or elements actuated thereby to be laterally removed from the engine without disturbing other portions of the camshaft or engine. A further object is to provide an improved unit of the foregoing type having an improved arrangement and means for allowing removal from the unit of several elements such as a fuel pump, an air starting pilot valve and roller guides for the push rods.

In one specific aspect of the invention I have accomplished the foregoing and other objects of my invention by providing a series of very com-

pact identical units, one for each of several engine cylinders in line with each other, each unit having a supporting bracket carrying, in self-contained relation therewith, a camshaft section, a fuel pump and push rod guides together with relatively simple, positive and effective means for connecting the camshaft sections together in a predetermined timed relation while at the same time permitting any one of the units to be laterally removed from their connection with each other.

Other objects and advantages will be more apparent to those skilled in the art from the following description of the accompanying drawings in which:

Fig. 1 is a side elevation of a six cylinder engine embodying my invention;

Fig. 2 is a plan view of the camshaft and cam follower bracket with all operating elements removed;

Fig. 3 is an enlarged fragmentary side elevation of an engine partly broken away to disclose my invention which in turn is partially in section to show certain details of construction;

Fig. 4 is a fragmentary transverse section through the engine taken substantially on the line 4—4 of Fig. 3 with part of the cylinder structure shown in elevation;

Fig. 5 is a side view of an assembled unit including a supporting bracket, a camshaft section, a fuel pump, and starting air valve;

Fig. 6 is a plan view of a Y-shaped clamp for holding a fuel pump and an air pilot valve in position;

Fig. 7 is a fragmentary transverse section on line 7—7 of Fig. 3.

The particular embodiment of the invention, such as is disclosed herein merely for the purpose of illustrating one specific form among possible others that the invention might take in practice, is shown in Fig. 1 as applied to a conventional type of six cylinder internal combustion engine 1 of the reciprocating piston and cylinder crankshaft type. The engine is preferably of the Diesel type and in accordance with my invention may have any desired number of cylinders 2 in line with each other. Each cylinder is provided with its own fuel pump 3, as is now customary in this art, driven from a camshaft generally indicated at 4 which also actuates intake and exhaust valve push rods 5 and 6 or other elements such as the starting air pilot valve 7. The camshaft is driven in any suitable manner, well known in the art, from and in timed relation to the engine crankshaft.

In my invention the camshaft 4 is made in as many individual, but identical, sections 10 as there are numbers of cylinders. Each camshaft section is supported by its own individual bracket

or block generally indicated at 11 having at one of its ends a depending annular bearing 12 in which an enlarged camshaft collar 13 is journaled. The other end of the bracket has a depending annular guide ring 14 in which the hub 15 of a coupling 16 is loosely received to maintain the camshaft in assembled relation to the bracket. The end rings 12 and 14 are supported by the main body of bracket 11, in slightly axially offset relation thereto, by pairs of inclined arms or webs 16' and 17, the arms of each pair being located respectively at the front and back of the bracket. The bracket as specifically shown is provided with four vertical cylindrical bores 19, 20, 21 and 22 in which are disposed usual cylindrical roller guides 23, 24 and 25 and a starting air pilot valve assembly 7 whose valve stem 26 is operated by cam 27. Intake and exhaust cams 28 and 29 operate guides 23 and 24 through suitable rollers 30 and 31 carried thereby. The fuel pump 3 is of any conventional type in which its plunger stem 32 is operated by guide 25 through a roller 33 and a cam 34. The fuel pump 3 and pilot valve 7 are held in position by a Y-shaped clamp 34', the single leg thereof pressing down on valve 7 and the double legs, passing on each side of push rod 5, engaging the base of fuel pump 3. A pair of bolts 34a are threaded into the bracket to hold the clamp. Hence removal of clamp 34' and of push rods 5 and 6 allow upward removal of the pilot valve assembly and fuel pump as well as the roller guides. Various piping connections for the fuel and air are omitted for sake of clarity as these specific connections do not constitute a part of my present invention.

Each bracket 11 is, as shown in Fig. 4, independently secured by bolts 36 to bosses formed on the side of each cylinder 2. The holes for bolts 36 are placed in transverse alignment with bores 19, 20, 21 and 22 whereby upon removing the roller guides from bracket 11, as just above described, the bolts 36 are inserted or removed through outer openings 37 aligned with the bolt holes in the back side of the bracket. The foregoing arrangement of bolting the bracket to the cylinders permits the same to have maximum compactness lengthwise of the camshaft inasmuch as no additional axial space is required for the bolts.

To connect the camshaft sections together and also to allow any one of the assembled units to be independently laterally removed from or assembled with the engine without disturbing any other units, I have provided connecting means, generally indicated at 40, located between adjacent ends of the camshaft. Specifically this means includes an external gear 41 secured to one end of each camshaft section while the adjacent end of the next camshaft section has an internal coupling gear 16 which receives the teeth of gear 41 thereby to provide a direct driving connection therewith. The hub 15 is keyed to the camshaft and releasably held thereto by a pair of transverse bolts 44 although other suitable clamping means may be employed. Hub 15 is preferably axially split on one side to permit the same to be tightly clamped to the camshaft or, upon removal of bolts 44, to be axially moved to the right to separate the coupling connection. When this connection is broken, the camshaft is maintained in its normal axial position with respect to bracket 11 by a segmental retaining collar 46 disposed in the annular space between bearing collar 13 and gear 41 and secured by

bolts 47, Figs. 5 and 7, to the end of bracket 11. The left end of the camshaft is prevented from sagging, when uncoupled, by hub 15 being wholly received in guide ring 14.

The foregoing unitary arrangement of the camshaft section and bracket, together with the associated elements thereof including the coupling gears 41 and 16, is adapted to be laterally removed from the engine while the other corresponding units remain in position on the engine. This is accomplished merely by removing bolts 36, Fig. 4, as previously described and removing coupling bolts 44 of the unit to be removed together with removal of the corresponding coupling bolts of the adjacent right hand unit, the internal gear elements 16 of these two units then being moved to the right. Thereupon the camshaft and cam follower unit may be bodily laterally removed through suitable openings 50, Fig. 4, in the engine side wall 51 and similarly an assembly unit may be placed in position and bolted to the cylinder wall 2. This removal or insertion of the assembly units may be made at any one of the cylinders as shown in Fig. 1. Suitable plates 55 cover the openings 50.

The foregoing arrangement not only facilitates standardized manufacture of the identical assembly units and the assembling of the same with the engine as well as expediting the inspection, repair and replacement of any one of the units without in any way requiring removal or adjustment of the remaining units, regardless of which unit may be laterally removed from the engine, but in addition the series of vertical frame stiffening ribs 53 which connect cylinders 2 with an outer frame wall 51 can be used with complete freedom from incurring any of the usual disadvantages resulting therefrom. The partition walls 53 and outer wall 51 add considerable rigidity and stiffness to the engine frame as these ribs are preferably formed as continuations of reinforcing crankcase ribs 56, Fig. 3. Suitable openings 57, Fig. 4, are formed in ribs 53 through which the camshaft extends while any other suitable openings 58 may also be formed in ribs 53 to allow pipes of various kinds extending there-through.

From the foregoing disclosure it is seen that I have provided an extremely simple, effective and cooperative arrangement of elements that is conducive not only to minimum cost of production consistent with insuring quality workmanship but is also conducive to expeditious assembly, repair and replacement, all of which is additionally conducive to allowing an engine frame structure to be employed for insuring maximum stiffness consistent with minimum weight.

It will of course be understood that various changes in details of construction and arrangement of parts may be made by those skilled in the art without departing from the spirit of the invention as set forth in the appended claims.

I claim:

1. The combination with an internal combustion engine having a frame with a multiplicity of cylinders in line with each other, of a plurality of similar camshaft and supporting bracket assembly units, each unit including a bracket having a bearing in which its camshaft is journaled, axial thrust means carried by said bracket for maintaining its camshaft in a predetermined axial position, means for removably supporting the brackets by the engine frame so that the unit camshafts are in axial alignment with each other, removable coupling means for connecting adja-

cent ends of said camshafts and adapted upon disconnection to allow lateral removal of the assembly unit while allowing the other units to remain in position, and a guide carried by said bracket to support a unit camshaft when removed from the engine.

2. The combination with an engine frame having a multiplicity of cylinders in line with each other, of a plurality of similar camshaft and supporting bracket assembly units in which each bracket has a single bearing at one end for rotatably supporting its camshaft and a guide at the other end for maintaining the shaft substantially in operative relation to the bracket when removed from the engine, means for laterally removably securing said bracket to the engine, and coupling means for removably connecting adjacent ends of the unit camshafts whereby upon disconnection of the couplings and bracket the assembly unit may be laterally removed from the engine.

3. The combination with an engine frame having a multiplicity of cylinders in line with each other, of a plurality of camshaft assembly units one for each of said cylinders, each unit including a supporting bracket having a camshaft section and a plurality of bores whose axes are substantially normal to the camshaft axis, push rod guides disposed in said bores for operation by the camshaft section, means for supporting said unit brackets by said frame so that the unit camshafts are in axial alignment, and coupling means for removably connecting adjacent ends of the unit camshafts whereby any given unit may be laterally removed from the engine upon disconnection of the supporting means and of the couplings at opposite ends of the camshaft of that given unit.

4. The combination set forth in claim 3 further characterized in that said brackets have transversely aligned openings whose axes intersect at least certain of said bores and said bracket supporting means includes bolts adapted upon removal of the push rod guides to be moved through said transverse openings for attachment to or removal from the engine frame.

5. The combination with an engine frame having a multiplicity of cylinders in line with each other, of a plurality of camshaft assembly units each having a bracket provided with a plurality of bores, a camshaft journaled in said bracket with its axis substantially normal to the axes of said bores, push rod guides disposed in certain of said bores and a fuel pump guide supported in another of said bores, said guides being actuated by said camshaft, and a fuel pump supported on said bracket so as to be operated by the fuel pump guide.

6. The combination with an engine frame having a multiplicity of cylinders in line with each other, of a plurality of camshaft assembly units each having a supporting bracket and a plurality of bores, a camshaft journaled in said bracket with its axis substantially normal to the axes of said bores, push rod guides in two of said bores, and a fuel pump and an air starting pilot valve associated with the other of said bores and arranged in alternate relation with the bores containing the push rod guides, and means pressing down on to said fuel pump and on to said pilot valve for holding the same in position on said bracket.

7. The combination set forth in claim 3 further characterized in that said unit brackets comprise a body portion in which said plurality of bores are disposed, and a bearing supported by and depending from said body portion for journalling the camshaft section.

8. The combination set forth in claim 3 further characterized in that said brackets include a body portion having a bearing dependently supported from one end thereof for journalling a camshaft section, and a camshaft guide dependently supported from the other end of said body portion.

9. The combination set forth in claim 3 further characterized in that said brackets include a body portion having a bearing dependently supported from one end thereof for journalling a camshaft section, and a camshaft guide dependently supported from the other end of said body portion, said camshaft guide having a bore of such size as to telescopically receive a portion of said coupling means upon disconnection thereof from the next adjacent camshaft section.

10. The combination with an engine frame having a multiplicity of cylinders in line with each other, of a camshaft, a plurality of substantially similar camshaft and push rod brackets each constituting an individual unit bodily separable from each other and from said frame, each bracket being provided with a plurality of bores whose axes are substantially normal to the camshaft axis and in which push rod guides are slidably disposed for operation by the camshaft, push rods having free swivel connections with said guides whereby the axes of said bores and the respective push rods may be angularly misaligned relative to each other while still maintaining a completely normal operative relation between the rods and their respective guides, means for individually removably supporting each of said brackets on said frame whereby each bracket independently of one another and of said push rods may be supported and positioned on said frame, and each bracket having as a self-contained rigid part thereof a single bearing for supporting said camshaft, the bracket overhanging said bearing so that substantially all portions of the bracket are in overhanging relation to the bearing whereby the axis of any bearing and its bracket may be angularly misaligned relative to the other brackets and bearings to the extent that the clearance of the single bearings allows twisting of their respective brackets relative to the camshaft.

11. The combination set forth in claim 10 further characterized in that the means for supporting said brackets includes a surface on said frame and a cooperating surface on each bracket, said surfaces of the frame and brackets lying in a plane normally parallel to the camshaft axis.

12. The combination set forth in claim 10 further characterized in that the means for supporting said brackets includes a surface on said frame and a cooperating surface on each bracket, and said surfaces of the frame and brackets being flat and extending longitudinally of the frame and lying in a plane normally parallel to the camshaft axis.

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