March 6, 1973 W. F. STEWART 3,719,178

INTERNAL COMBUSTION ENGINE

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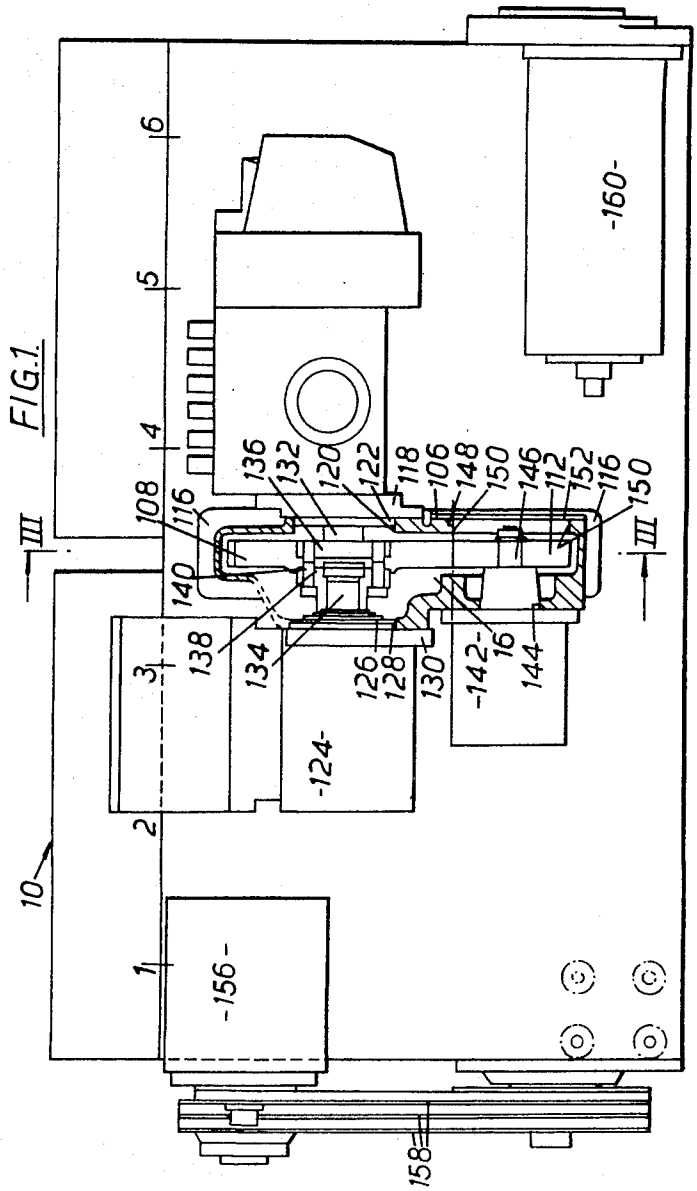
FIG. 1.



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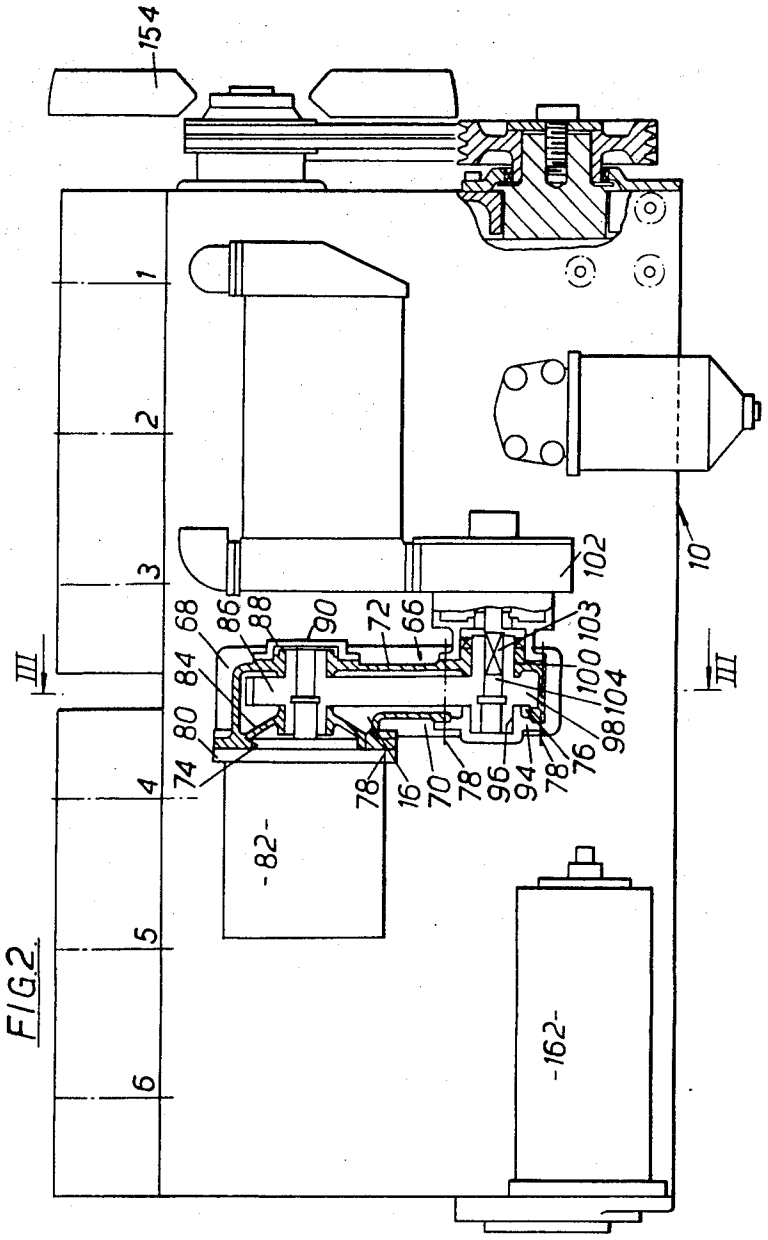

FIG.2

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FIG.3

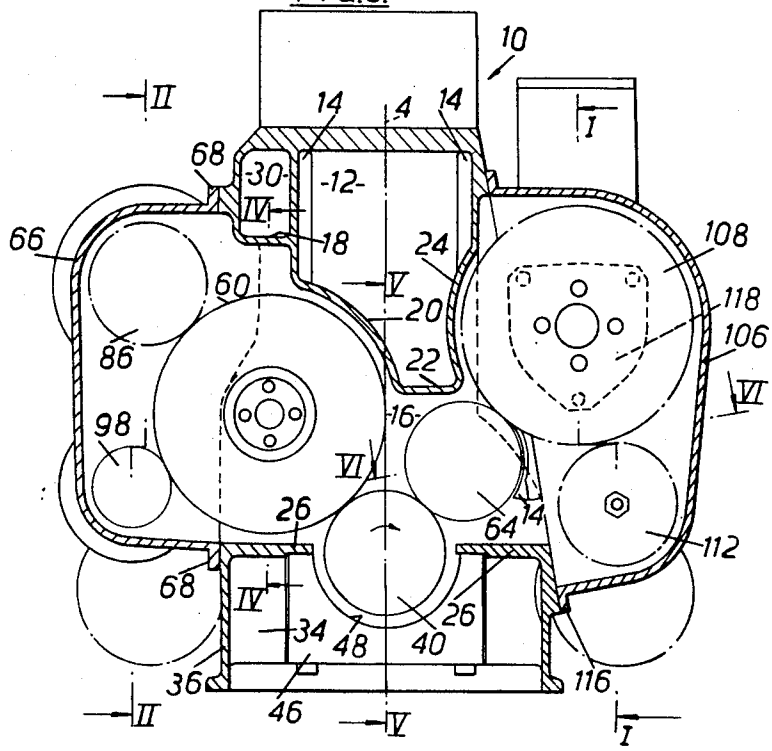
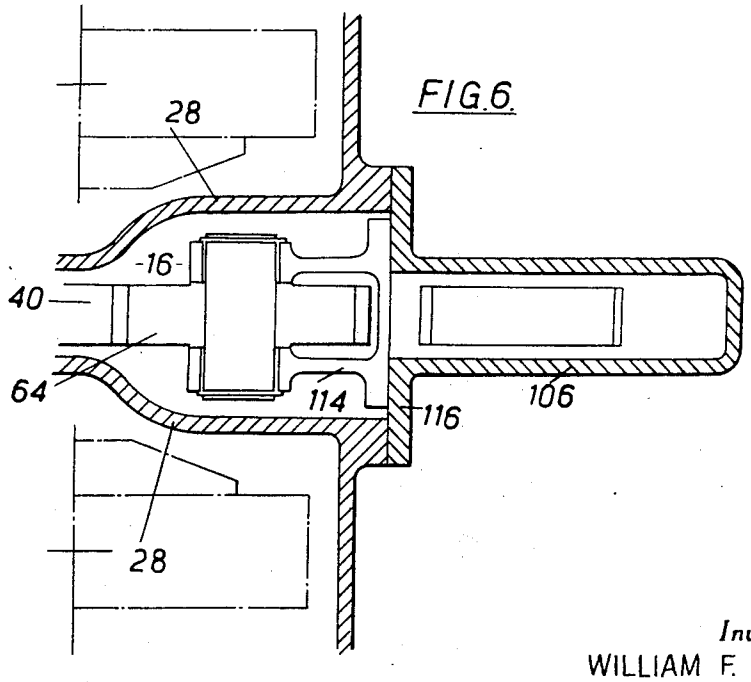


FIG.6



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INTERNAL COMBUSTION ENGINE

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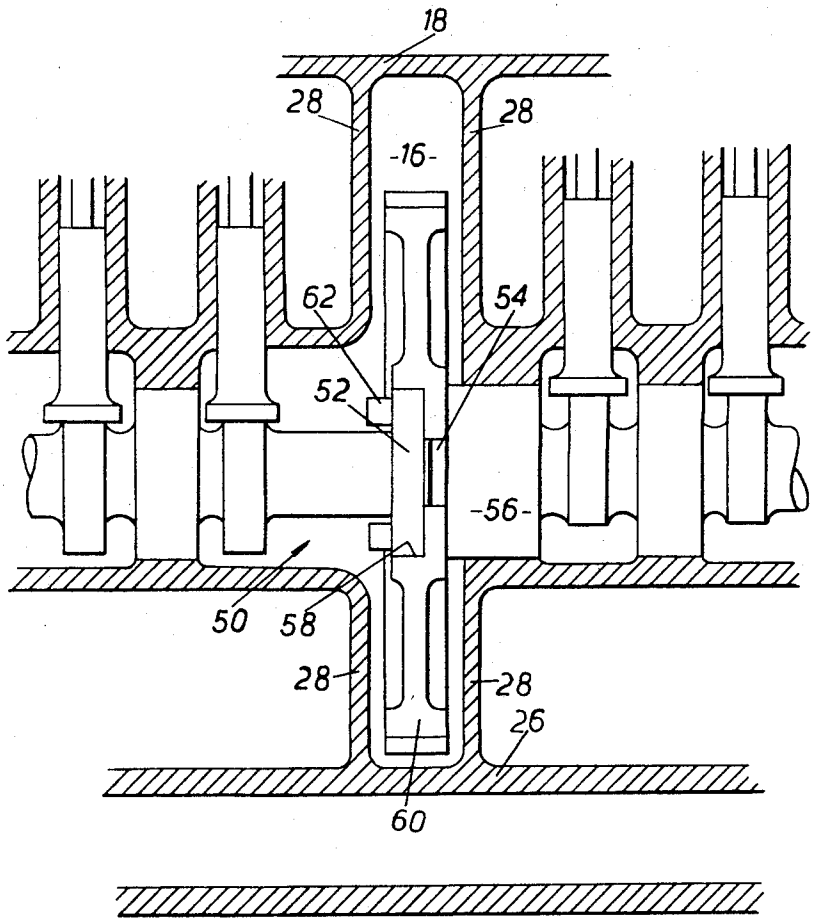
FIG.4



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INTERNAL COMBUSTION ENGINE

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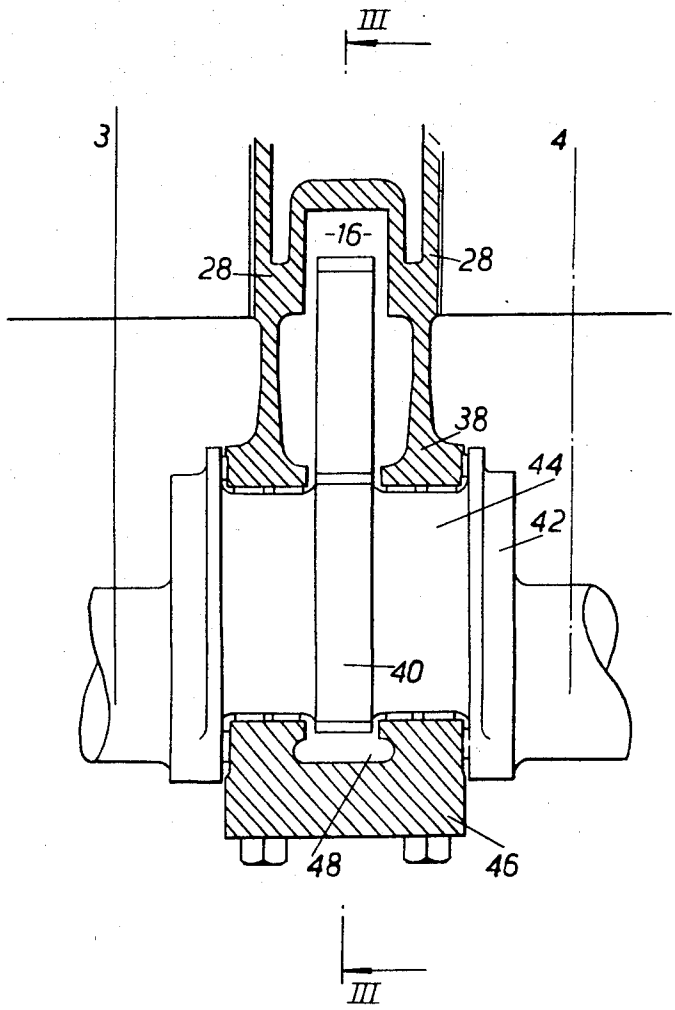
FIG 5



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INTERNAL COMBUSTION ENGINE

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Int. Cl. F02f 7/00
U.S. Cl. 123—195 A 12 Claims

ABSTRACT OF THE DISCLOSURE

An improved internal combustion engine consists of a unitary crank case having a cavity cast at the middle of its length to house the timing drive and a drive to auxiliary equipment. The cavity has openings and the auxiliary equipment is mounted on load bearing covers which close these openings.

This invention relates to engines having a plurality of cylinders each housing a reciprocable piston. Such engines will hereinafter and in the appended claims be referred to as "reciprocating engines." In particular the invention relates to internal combustion reciprocating engines which are liquid cooled.

It has been known to provide a multicylinder engine in which the timing drive gears are located at the centre of the length of the engine. In some cases these gears have been worm and wheel gears driving a jackshaft which in turn drives a camshaft and/or electrical distributor. In other cases the gears have been spur gears mounted in a cavity formed by the two halves of a two piece crankcase of an air cooled engine.

It is an object of this invention to provide a multicylinder engine in which the timing drive is located between cylinders in a unitary crankcase. A further object of the invention is to provide a drive from between the cylinders to auxiliary apparatus mounted externally of the crankcase. Yet a further object of the invention is to make provision for easy driving attachment of a range of auxiliary equipment.

In accordance with these objects, this invention consists of a reciprocating engine comprising a crankcase defining a timing gear cavity located between adjacent cylinders thereof, a crankshaft and a camshaft supported by the crankcase, crankshaft and camshaft timing wheels mounted on their respective shafts and drivingly connected with each other at least partially within said cavity, wherein said cavity is open on at least one side of the crankcase and the cavity opening is closed by a load bearing cover member on which is supported at least one auxiliary device drive wheel which is drivably connected to the crankshaft and to an auxiliary device.

Preferably said auxiliary device is driven from the crankshaft through an intermediary drive member. The intermediary drive member may be constituted by the camshaft timing wheel or by a further wheel mounted on the cover member.

Preferably also, the wheels comprise gearwheel and in the case a V-engine the opening can occur at the top side between the cylinder banks. Also the cover can be arranged so that a driven wheel drives two auxiliary devices. Provision is made to drive auxiliary devices on two spaced axes passing through each cover.

Further objects and features of this invention will become more readily apparent upon reference to the following detailed description of the attached drawings wherein:

FIG. 1 is one side elevation of an engine according to the invention partially sectioned at one place on the line I—I in FIG. 3;

FIG. 2 is the opposite side elevation of the engine of FIG. 1 section on the line II—II in FIG. 3;

FIG. 3 is a cross sectional view on the line III—III of FIG. 1;

FIG. 4 is a partial sectional view on the line IV—IV of FIG. 3;

FIG. 5 is a partial sectional view on the line V—V in FIG. 3;

FIG. 6 is a partial sectional view on the line VI—VI in FIG. 3.

Referring now to FIGS. 1, 2 and 3, an engine **10** consists of a monoblock crankcase containing six cylinders **12** in line and adapted, by the provision of cooling passages **14** around the cylinders **12**, to be cooled by a liquid. The cylinders **12** are not shown in detail but their centre lines are shown numbered in the conventional manner from 1 to 6 from the front of the engine. In this case, the front of the engine is defined as the end which carries the fan. The spacing between the cylinders **3** and **4** is larger than that between other adjacent cylinders so as to accommodate a cavity **16** cast into the crankcase, which cavity **16** contains the timing gears for the engine. The cavity **16** is defined by walls **18**, **20**, **22**, **24** and **26**, as seen in FIG. 3 and by walls **28** as seen in FIGS. 4, 5 and 6. The wall **18** separates the cavity **16** from a longitudinal coolant gallery **30**. The walls **20**, **22** and **24** separate the cavity **16** from the general coolant passages **14** surrounding the cylinders **12**. The wall **26** is part of a center main bearing support rib **34** which is buttressed from a crankcase skirt **36**.

The walls **26** and **28**, and **18** and **28**, merge as seen in FIG. 4.

In FIG. 5 the wall **28** separates the cavity **16** from the interiors of cylinders **3** and **4** and, lower down, from the crankcase space **36**. The walls **28** merge into the upper center main bearing support **38** which is split to accommodate a crankshaft gearwheel **40** secured to the crankshaft **42**, for example by electron beam welding, at the center of the center main bearing journal **44**. The center main bearing cap **46** is recessed at **48** to accommodate the gearwheel **40**.

FIG. 4 shows a two-part camshaft **50**, one part having a flange **52** and the other a spigot **54** protruding from a bearing **56**. The flange **52** fits into a recess **58** in a cam gearwheel **60** and screws **62** hold the flanges **52**, gearwheel **60** and bearing **56** together for mutual rotation.

As seen in FIG. 3 the crankshaft gearwheel **40** meshes with cam gearwheel **60** and with an idler gearwheel **64**.

The cavity **16** opens on the left hand side of the engine, with respect to FIG. 3, and the opening is closed by a load bearing cover member **66** which is bolted to the crankcase around a peripheral flange, as seen in FIGS. 2 and 3. As seen in FIG. 3 the cover member **66** is ear shaped and has two apertures in each of two laterally extending walls **70** and **72**, FIG. 2. The apertures in the rear lateral wall **70** are at **74** and **76** and are both flanged and provided with threaded holes to receive fastening screws. Only the center line **78** of the screw is shown on the accompanying drawings—both the screw and the screw holes are left out of all aperture cover members for the sake of clarity. A flange **80** of an auxiliary device in the form of a hydraulic pump **82** butts against the flanged wall **70** of the cover **16** and an outrigger **84** supports a bearing for one trunnion of an auxiliary device drive gearwheel **86**. The other trunnion is supported directly on a bearing **88** set in the wall **72**. A splined shaft **83** of the pump **82** engages internal splines on the gearwheel **86**. The bearing **88** is covered by a plate **90**.

The lower aperture **76** in the wall **70** is closed by a plate **94** which carries a bearing **96** in which is supported one trunnion of a second auxiliary device drive gearwheel **98**. The other trunnion of the gearwheel **98** is carried on a bearing **100** directly in the flanged wall **72**. An auxiliary

device in the form of a water pump **102** is fastened to the wall **72** by screws, not shown, and its shaft **103** makes driving engagement with the gearwheel **98** by means of a square and entering a square hole **104**.

Both gearwheel **86** and **98** engage and are driven by the crankshaft through the crankshaft gearwheel **40** and an intermediary drive member in the form of the cam gearwheel **60**.

The mounting of gearwheels on the cover member **66** is exemplary in that a gearwheel can be mounted in part by an auxiliary device and in part by the cover member **66** itself. Also, it is clear that by removing the cover **90** and substituting a further auxiliary device, the gearwheel **86** could drive both the hydraulic pump **82** and the new device. Similarly, the gearwheel **98** could drive an additional device, provided it had an outrigger bearing incorporated in it, or as an adaptor, which would be substituted in place of the plate **94**. Thus, the cover member **66** would be capable of mounting four auxiliary devices to be driven by two gearwheels.

Turning now to the right hand side, with respect to FIG. 3 of the engine, which is shown in FIGS. 1 and 2, the cavity **16** opens to that side also and a second cover member **106** is provided. The cover **106** carries three gearwheels, namely an auxiliary device in the form of an injection pump **110**, the idler gearwheel **64** and an auxiliary device drive gearwheel **112**. The idler gearwheel **64** forms an intermediary drive member and is mounted, as best seen in FIG. 6 on a pedestal **114** fastened to the attachment flanges **116** of the cover member **106**.

As distinct from the gearwheels **86** and **98** on the opposite side of the engine it will be seen that the gearwheels **108** and **112** are carried in quite a different manner. The pump **110** is supported by the cover member **106** on its mounting flange **118**, FIG. 1, by screws, not shown, and is located very accurately in a circular aperture **120** by a spigot **122**. Likewise an auxiliary device in the form of a compressor **124** is carried by a spigot **126** in an aperture **128** and is held fast to the cover by screws through a flange **130**. During manufacture, the apertures **120** and **128** are bored at the same time and on the same jig fixture. Thus, the shafts **132** and **134** of the injection pump **110**, and the compressor **124** are axially aligned within very close tolerances and the gearwheel **108** is sandwiched between two flanges **136** and **138** which are through-fastened together by screws **140**. The flange **136** is fastened to the shaft **132** either integrally or by a key or the like. The flange **138** is splined internally to receive the splined shaft **134**. Thus, the gearwheel **108** is not carried directly by the cover member **106** at all.

An auxiliary device in the form of steering pump **142**, which is a small hydraulic pump, is flange mounted on the cover member **106** and spigotted through an aperture **144**, and carries the gearwheel **112** cantilever mounted on its shaft **146**. No support is required from the opposite wall designated at **148** and an aperture **150** in the wall is covered by a plate **152**.

Clearly, the number of auxiliary drives which may be accommodated on the engine described above is eight. Other auxiliary devices which may be needed in other installations are an electric generator, an exhauster or vacuum pump for the vehicle brakes, a supercharging compressor, and any other power-take-off even though it may require a drive through a universally jointed shaft or flexible shaft to a location remote from the engine. A tachomter drive may also be easily accommodated.

There are numerous advantages in the above arrangement, for example, both ends of the engine are unencumbered by the presence of timing gears and hence provision can be made for assembling the fan and alternator drives on either end. The fan **154** and the alternator **156** are driven by a pulley and a V-belt **158** from the crankshaft. Furthermore, the starter motor can be assembled on either side of the engine as shown at **160** in FIG. 1 and at **162** in FIG. 2. The presence of the cavity in the crankcase enables two cylinder heads to be used, the advantage being mainly that the smaller cylinder head can be made more easily and is less prone to thermal distortion. Further, the presence of the cavity can be turned to advantage in that coolant can be fed into the coolant gallery **30** at the mid-point of the engine thus leading to more uniform cooling of the cylinders than if the coolant were fed in at one end. Also, the coolant can be drawn off at this point.

Some of the other advantages that result from the present invention are as follows. At least some of the noise generated by the timing gears will be generated within the engine block and the stiff surrounding engine structure will reduce the propagation of such noise. Noise generated by meshing of gears will tend to be radiated from the covers but these are easily adaptable to detail designing aimed expressly at reducing their noise radiation and are easily covered with sound absorbing material. The multiplicity of auxiliary devices that can be driven without changing the basic engine structure and simply by changing the devices on the covers, or by changing the covers only, is extremely advantageous when engines are to be supplied for a multiplicity of different applications.

While the invention has been described above with reference to an embodiment utilising gearwheels, clearly any other form of drive transmission means could be utilized e.g. friction drive wheels, worm gears, friction belts and pulleys. However, for convenience in the appended claims the term "wheels" has been utilized to define all such drive transmission means.

The embodiment described above relates to reciprocating engine in which the cylinders are arranged in a single bank clearly the invention is equally applicable to multibank engines such as, for example, those having their cylinders arranged in a V-formation. In such a case the cavity **16** is preferably arranged so that it opens into the top side of the engine, that is, in the angle between the banks of cylinders.

I claim:

1. A reciprocating engine comprising a crankcase defining a timing gear cavity located between adjacent cylinders thereof, a crankshaft and a camshaft supported by the crankcase, crankshaft and camshaft timing wheels mounted on their respective shafts and drivingly connected with each other at least partially within said cavity, wherein said cavity is open on at least one side of the crankcase and the cavity opening is closed by a load bearing cover member on which is supported at least one auxiliary device drive wheel which is drivably connected to the crankshaft and to an auxiliary device.

2. An engine according to claim **1**, wherein said auxiliary device is driven from the crankshaft through an intermediary drive member.

3. An engine according to claim **2**, wherein said intermediary drive member is constituted by said camshaft timing wheel.

4. An engine according to claim **2**, wherein said intermediary drive member is constituted by a further wheel mounted on said cover member.

5. An engine according to claim **1**, wherein the auxiliary device drive wheel is supported on the cover by the auxiliary device being directly supported by the cover member.

6. An engine according to claim **5**, wherein said auxiliary device drive wheel is drivably connected with the camshaft timing wheel.

7. An engine according to claim **6** wherein a further auxiliary device drive wheel is provided which is in mesh with the camshaft timing wheel, is supported on the cover member and drives a further auxiliary device.

8. An engine according to claim **1**, wherein the cylinders thereof are arranged in a V-formation and said cavity opens into the top side of the engine, that is in the angle between the banks of cylinders.

9. An engine according to claim **1** wherein the cylinders thereof are arranged in a single bank and said cavity opens on both lateral sides of the engine and both openings are

closed by load bearing cover members on each of which is supported at least one auxiliary device each drivable by an auxiliary device drive wheel supported within the pertinent cover member.

10. An engine according to claim **1**, wherein at least one of the auxiliary device drive wheels supported by one said cover member drives two auxiliary devices supported on said cover members.

11. An engine according to claim **1** wherein the cavity is located approximately at the mid-point of the length of the engine and in which said cylinders are arranged in banks, each bank of cylinders being provided with two cylinder heads.

12. An engine according to claim **1**, wherein said crankshaft gear is secured to the crankshaft by electron beam welding.

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