

Sept. 18, 1951

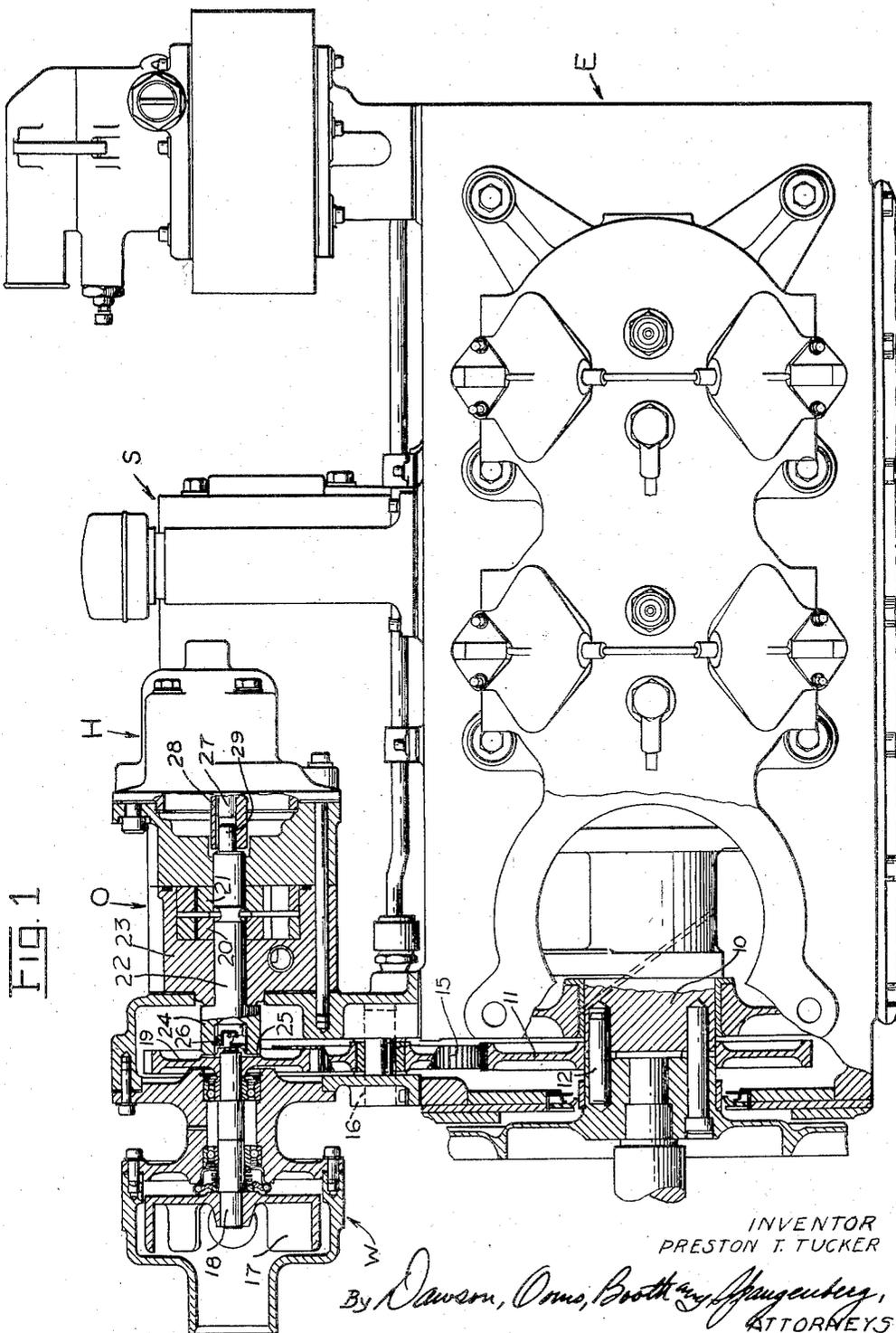
P. T. TUCKER

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COMBINATION INTERNAL-COMBUSTION ENGINE AND ACCESSORIES

Filed Nov. 18, 1947

4 Sheets-Sheet 1



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COMBINATION INTERNAL-COMBUSTION ENGINE AND ACCESSORIES

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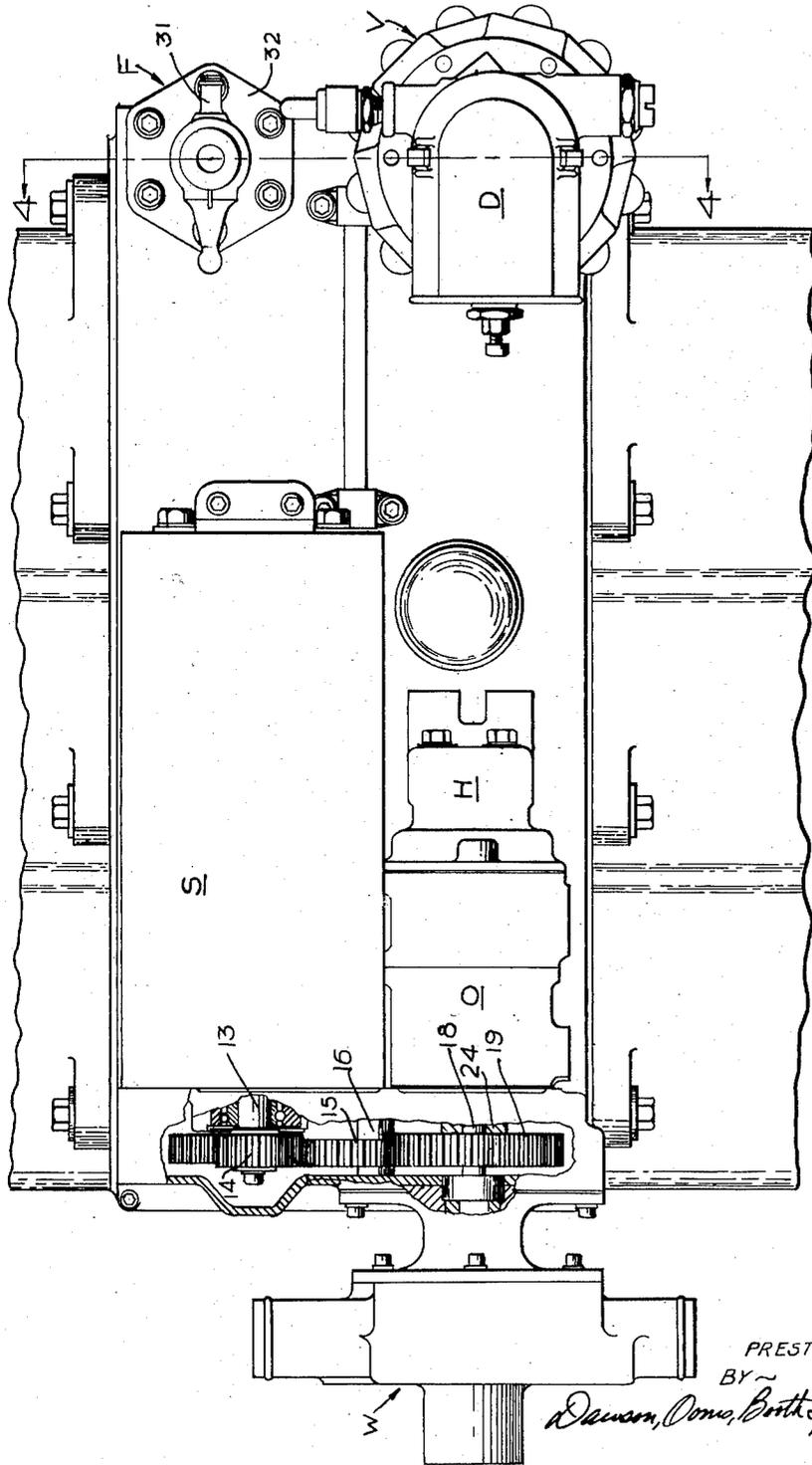


FIG. 2

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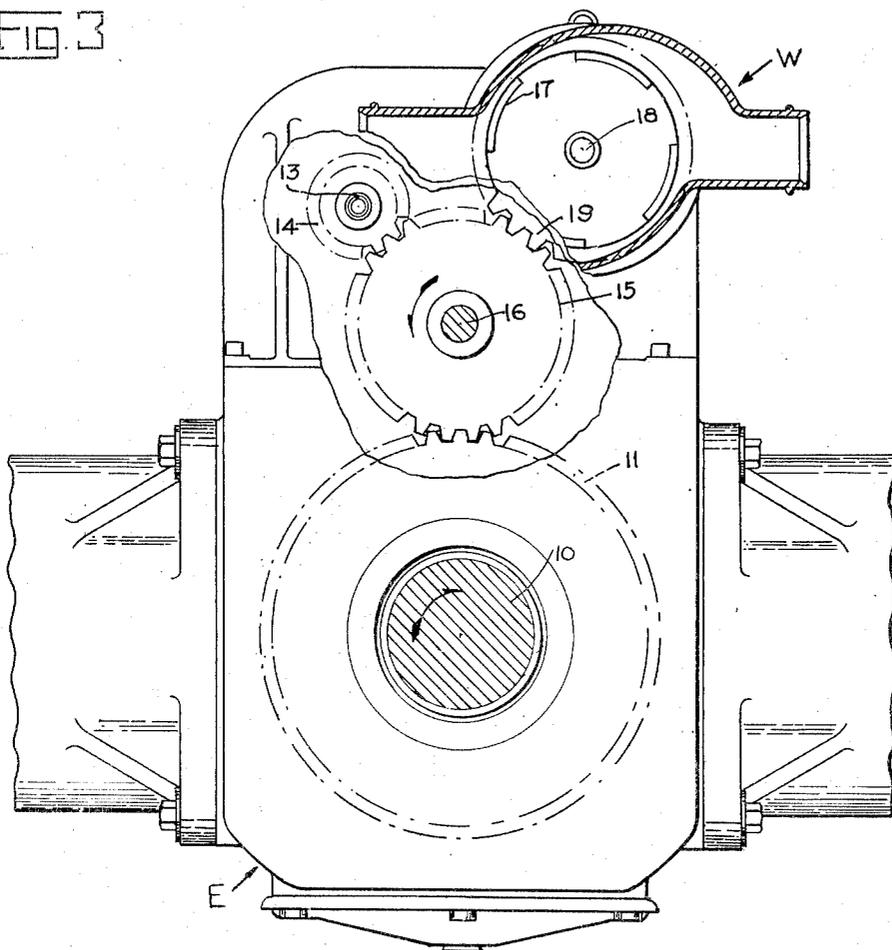
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FIG. 3



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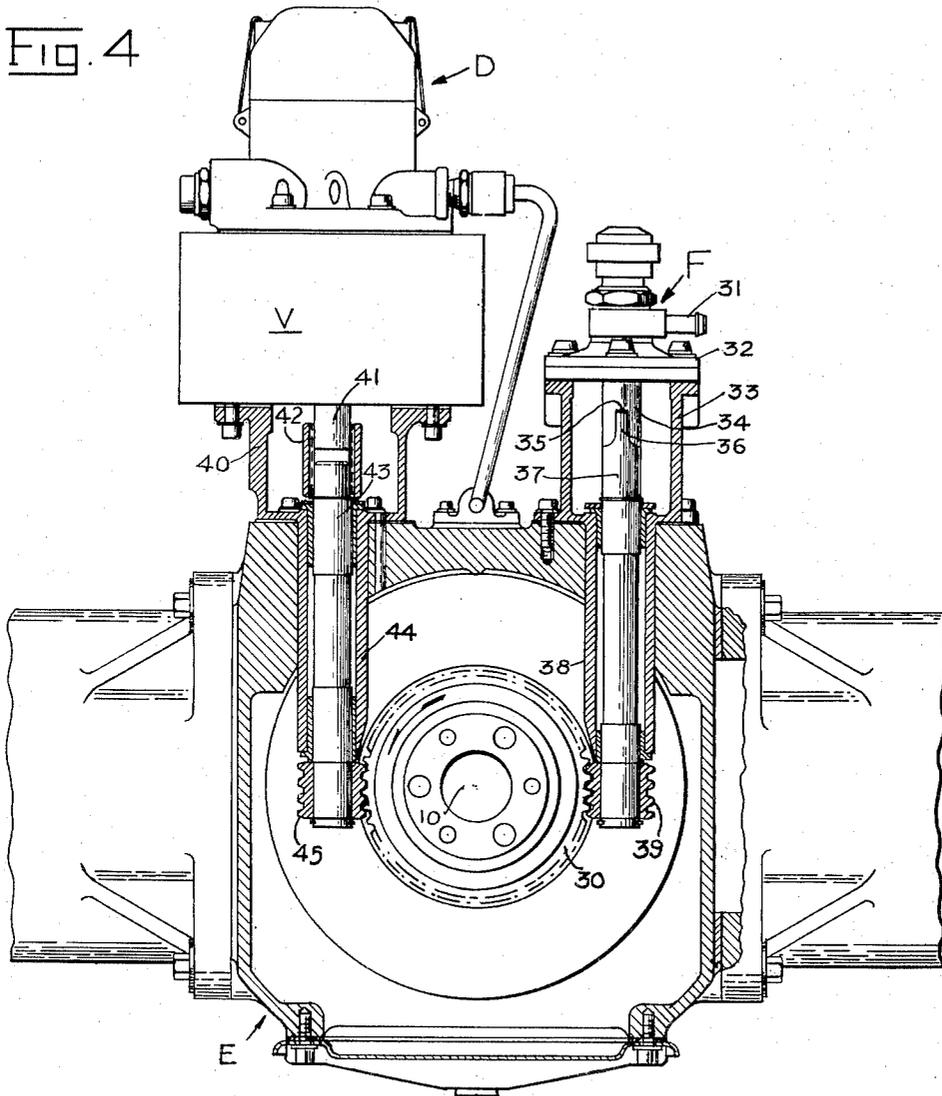
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COMBINATION INTERNAL-COMBUSTION ENGINE AND ACCESSORIES

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4 Sheets-Sheet 4

FIG. 4



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UNITED STATES PATENT OFFICE

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COMBINATION INTERNAL-COMBUSTION ENGINE AND ACCESSORIES

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Application November 18, 1947, Serial No. 786,723

12 Claims. (Cl. 123—195)

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The present invention deals with internal combustion engines and is concerned primarily with a novel assembly of an internal combustion engine with accessories which are operatively associated therewith.

There has recently been proposed in the automobile industry an automobile which includes an engine that is mounted in the rear of the car, rather than at the front. This engine is of the so called "flat" type, that is, in an engine of this kind, the cylinders are arranged flat with three being opposed to three.

An engine of this particular type is illustrated and described in the co-pending application of Preston T. Tucker, Serial No. 769,727, filed August 20, 1947, and entitled "Internal Combustion Engine for Automobiles," now abandoned.

An internal combustion engine of the character aforesaid must have associated therewith certain accessories or operating mechanisms, which, in turn enter into the operation of the engine itself. Accordingly, the invention has in view as its foremost objective, the provision of an internal combustion engine of the flat type together with accessories which are essential to its operation, and which are combined therewith in a novel manner.

Inasmuch as an internal combustion engine of the type with which this invention is concerned embodies a circulatory cooling system, it is necessary to provide a pump for circulating the cooling medium. As this cooling medium is water, this pump is identified as the water pump.

An engine with which the present invention is concerned, also includes a lubricating system through which lubricating oil must be circulated and kept at a required pressure. The circulation of this oil also functions as a scavenging operation. Thus, this oil pump is another accessory which is essential to an engine of this type.

Every conventional present day automobile includes a starter for the engine and a generator for the electrical system of the entire car. In accordance with the present invention, the starter and generator are combined as a single unit. A further and yet, highly important object of the invention is the provision of an internal combustion engine of the type indicated, which has a starter-generator unit operatively associated therewith, and which unit is availed of as a means for driving the water and the oil pumps.

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Most present day automobiles include a transmission of some type, and there have been proposed certain hydraulic systems for operating such transmissions. A further object of the present invention is to associate with an internal combustion engine a high pressure pump which is employed for building up a required fluid pressure in the hydraulic actuator system for transmissions.

A more detailed object of the invention is to operatively associate this high pressure pump with the starter-generator unit so that it is driven thereby.

While many of the internal combustion engines which are presently included in automobiles carburet the fuel before it is supplied to the cylinders, an engine of the type with which the present invention is primarily concerned, operates under the fuel injection principle, that is, the fuel is delivered to the cylinders under pressure. With such a fuel injection system it is necessary to provide a mechanical unit for building up the required pressure in the fuel. Thus, another important object of the invention is to combine with an internal combustion engine of the character aforesaid, a fuel injector pump which preferably is driven from the crankshaft of the engine.

Every internal combustion engine includes valves which control the admission of fuel to cylinders and the scavenging of exhaust gases therefrom. Thus, some means for actuating the valves is an essential requirement. In accordance with the present invention, the valves are hydraulically actuated, and another highly important object lies in the provision of an internal combustion engine which includes a valve actuating system that is operated hydraulically. This valve actuating system is also driven from the crankshaft of the engine.

Internal combustion engines of the type with which this invention is concerned, also include as an essential element an ignition system. An ignition system in turn, must include a distributor, and in accordance with the precepts of this invention, this distributor is driven from the crankshaft of the engine.

Various other more detailed objects and advantages such as arise in connection with carrying out the above noted ideas in a practical embodiment, will in part become apparent and in

part be hereinafter stated as the description of the invention proceeds.

The invention, therefore, comprises an internal combustion engine of the flat type, and which has a starter-generator unit operatively associated therewith, a water pump, oil pump, and a high pressure pump for a hydraulic gear shifting system all driven from the starter-generator unit. A fuel pump, valve actuator, and distributor are associated with the engine and driven from the crankshaft.

For a full and more complete understanding of the invention, reference may be had to the following description and accompanying drawings, wherein:

Figure 1 is an end view mostly in elevation but with parts broken away and shown in section of an internal combustion engine having accessories combined therewith in accordance with the precepts of this invention;

Figure 2 is a top plan view of that portion of the engine with which this invention is concerned. In this view parts are also broken away and shown in section to more clearly bring out details of the mechanism;

Figure 3 is an end view looking from the end which carries the water pump and showing the latter in section and certain of the gears in broken lines;

Figure 4 is a vertical section taken about on the plane represented by the line 4-4 of Figure 2.

Referring now to the drawings wherein like reference characters denote corresponding parts, an engine is shown in each of the figures and referred generally to by the reference character E. While the construction and size of the engine E may be varied in many respects, the invention has particularly in mind an engine of the flat type in which three cylinders are opposed to three. The engine E will also provide for a comparatively large cylinder displacement, and it is intended that it be operated at a low speed and low compression. These comparative terms are referred to the present day automobile engine as a basis of comparison.

The engine E includes a crankshaft designated 10, and driveably connected to the forward end of the shaft 10 is a gear 11. Pins shown at 12 may be employed as the means of establishing the driving relation.

A starter-generator unit is depicted somewhat diagrammatically in Figures 1 and 2 and identified generally as S. As the name implies, this is an electrical unit which may be employed as a motor when it is necessary to start the engine, but which reverses its operation to become a generator after the engine has been started, and under which condition it is driven by the engine. Regardless of whether the unit S is functioning as a starter or a generator, it includes a main drive shaft 13 which carries at its free end a pinion 14.

An idler gear 15 is rotatably mounted on the shaft 16 and the gear 15 meshes with both the pinion 14 and the gear 11, thereby completing the drive from the starter-generator shaft 13 to the crankshaft 10 of the engine.

A water pump is referred to in its entirety by the reference character W. The pump W includes a rotor 17 that is driveably mounted on a pump shaft 18. Non-rotatably carried by the latter is a gear 19 which meshes with the idler gear 15 from which it is driven. Thus, it is evident that the water pump W is driven from the

starter-generator unit S through the shaft 13, pinion 14, idler gear 15 and gear 19.

An oil pump is designated O and is shown as comprising rotors 20 and 21 that are driveably carried by a shaft 22 and enclosed within a housing 23. The shaft 22 at one end carries a hub-like member 24 having an inner key-way 25. A sleeve 26 is keyed to this member 24 and also to a projection extending from the gear 19. Thus, the oil pump O is also driven from the starter-generator S through the driving connections comprising drive shaft 13, pinion 14, idler gear 15, gear 19, and sleeve 26. The oil pump O builds up the necessary pressure and provides the scavenging action in the lubricating system of the engine to which it is conductably connected.

If the automobile in which the engine E is included has a transmission that is hydraulically actuated, it will be necessary to build up pressure in this hydraulic system. For this purpose, a high pressure pump is shown diagrammatically at H. This high pressure pump H, includes a main pump shaft 27 to which is keyed a sleeve 28. The latter is also keyed to an extension 29 formed on one end of the shaft 22. Thus, the high pressure pump H is driven from the starter-generator unit S, through the drive shaft 13, pinion 14, idler gear 15, gear 19, shaft 22 and sleeve 28.

Referring now more particularly to Figure 4, which will be considered in conjunction with Figures 1 and 2, the end of the crankshaft 10, remote from the gear 11, carries a worm gear 30.

A fuel injection pump is designated F, and like the other accessories, is represented largely diagrammatically. A conduit 31 extends to the fuel system of the engine. The pump F is carried on a base 32 which is anchored to a pedestal 33 upstanding from the engine. The pump F includes a main operating shaft (not illustrated) carrying an extension 34 which is formed at the recess 35, that receives a tongue 36, that upstands from a shaft 37. The shaft 37 is journaled in a sleeve 38m which is carried by the engine block, and at its lower end driveably carries a worm gear 39, which is complementary to and meshes with the worm 30 on the crankshaft 10. Thus, it is evident that the fuel pump F is driven from the main crankshaft 10 of the engine through worm gears 30 and 39, shaft 37, tongue and recess connection 36 and 35, and extension 34.

It is intended that the valves of the engine E be hydraulically actuated. Thus, the pump for building up pressure in the valve actuating system is represented diagrammatically at V. The latter is shown as mounted on a pedestal 40 which is carried by the engine E. The pump V includes a main drive shaft 41, which extends down into the pedestal 40. A sleeve 42 is keyed to the shaft 41 and also to a vertically extending shaft 43 that is journaled in a sleeve 44. At its lower end, the shaft 43 carries a worm gear 45 that is complementary to and in mesh with the worm gear 30. Thus, it is evident that the pump V is driven from the engine crankshaft 10, through the medium of the worm gears 30 and 45, shaft 43, sleeve 42 and shaft 41.

The distributor for the ignition system is shown at D as being mounted above and carried by the valve actuator mechanism V. Inasmuch as the distributor must operate in synchrony with the valves, the distributor D will be driven from the crankshaft 10, through the same connections above described for the valve actuator V. The

drive from the latter to the distributor is direct as the two must operate in direct synchrony.

Operation

While it is believed that the manner in which the several mechanisms associated with the engine operate, it may be noted that when the engine is to be started, the starter-generator unit S is caused to function as a starter. Thus, through the pinion 14, idler 15, and gear 11, the crankshaft 10 of the engine E is rotated so as to start the engine. At the same time, the gear 19 is driven from the idler gear 15 so as to operate the water pump W, the oil pump O and high pressure gear shifting pump H and all of these accessories are thereby brought into proper effective operation.

After the engine E gets started, the operation of the unit S takes on the character of a generator. One mechanism for causing this transformation is illustrated and described in the co-pending application of Kenneth E. Lyman, Serial No. 736,143, filed March 21, 1947. With the unit S running as a generator, the shaft 13 is still driven and is effective to drive the water pump W, oil pump O, high pressure pump H.

As the crankshaft 10 is brought into operation and is rotated either by the starter-generator S or the engine itself, the fuel pump F, valve actuator V and distributor D are driven in the manner above described.

While a preferred specific embodiment of the invention is hereinbefore set forth, it is to be clearly understood that the invention is not to be limited to the exact construction illustrated and described, because various modifications of these details may be provided in putting the invention into practice within the purview of the appended claims.

What is claimed is:

1. In combination, an internal combustion engine including a crankshaft, a starter-generator unit, a gear on the crankshaft, a gear on the starter-generator unit, gear means permanently in mesh with the gears on the crankshaft and on the starter-generator unit permanently drivably connecting them, a fluid pump to supply fluid for operation of the engine, and a permanent driving connection from the pump to the gear means.

2. In combination, an internal combustion engine including a crankshaft, a starter-generator unit, driving connections between said unit and crankshaft, a shiftable transmission, hydraulic means to shift the transmission, a high pressure liquid pump to supply liquid to the hydraulic means, and means connecting said high pressure pump to said starter-generator unit to drive the pump from the unit.

3. In combination, an internal combustion engine including a crankshaft, a circulatory cooling system, and a lubricating system, a starter-generator unit, driving connections between said unit and said crankshaft, a water pump for said cooling system, means for driving said water pump from said unit, an oil pump for said lubricating system, and means for driving said oil pump from said unit.

4. In combination, an internal combustion engine including a crankshaft, a circulatory cooling system, and a lubricating system, a starter-generator unit, driving connections between said unit and said crankshaft, a water pump for said cooling system, an oil pump for said lubricating system, and common means for driving said water

pump and oil pump from said starter-generator unit.

5. In a combination, an internal combustion engine including a crankshaft, a circulatory cooling system, and a hydraulic gear shifting system, a starter-generator unit, driving connections between said unit and said crankshaft, a water pump for said cooling system, means for driving said water pump from said unit, a high pressure pump for said hydraulic gear shifting system, and means for driving said high pressure pump from said unit.

6. In combination, an internal combustion engine including a crankshaft, a circulatory cooling system, and a hydraulic gear shifting system, a starter-generator unit, driving connections between said unit and said crankshaft, a water pump for said cooling system, a high pressure pump for said hydraulic gear shifting system, and common means for driving said water pump and said high pressure pump from said starter-generator unit.

7. In combination, an internal combustion engine including a crankshaft, a circulatory cooling system, a lubricating system, and a hydraulic gear shifting system, driving connections between said unit and said crankshaft, a water pump for said cooling system, an oil pump for said lubricating system, a high pressure pump for said hydraulic gear shifting system, and common means for driving said water pump, oil pump, and high pressure pump from said starter-generator unit.

8. In combination, an internal combustion engine including a crankshaft, a fuel system and a valve actuating system, a fuel pump for said system, a valve actuator for said valve actuating system, a worm gear on said crankshaft, and driving connections between said worm gear and said fuel pump and valve actuator respectively.

9. In combination, an internal combustion engine including a fuel system, a valve actuating system, and an ignition system, a fuel injection pump for said fuel system, a valve actuator for said valve actuating system, a distributor for said ignition system, a worm gear on said crankshaft, driving connections between said worm gear and fuel injection pump, and driving connections common to said valve actuator and distributor for driving them from said worm gear.

10. In combination, an internal combustion engine including a crankshaft, a circulatory cooling system, and a fuel system, a starter-generator unit, driving connections between said unit and said crankshaft, a water pump included as a part of said cooling system, means for driving said water pump from said unit, a fuel injection pump for said fuel system, and means for driving said fuel injection pump from said crankshaft.

11. In combination, an internal combustion engine including a crankshaft, a circulatory cooling system, a lubricating system, and a fuel system, a starter-generator unit, driving connections between said unit and said crankshaft, a water pump for said cooling system, an oil pump for said lubricating system, common means for driving said oil pump and said water pump from said starter-generator unit, a fuel injection pump for said fuel system, and means for driving said fuel injection pump from said crankshaft.

12. In combination, an internal combustion engine including a crankshaft, a circulatory cooling system, a lubricating system, a hydraulic gear shifting system, a fuel system, and a hydraulic valve actuating system, a starter-generator unit,

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driving connections between said unit and said crankshaft, a water pump for said cooling system, an oil pump for said lubricating system, a high pressure pump for said hydraulic gear shifting system, common means for driving said water pump, oil pump and high pressure pump from said starter-generator unit, a fuel injection pump for said fuel system, a valve actuator for said valve actuating system, and common means for driving said fuel injection pump and said valve actuator from said crankshaft.

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