Nov. 24, 1942. H. SCHRECK 2,303,093

INTERNAL COMBUSTION ENGINE

Filed July 29, 1940 4 Sheets-Sheet 1

FIG. 2.

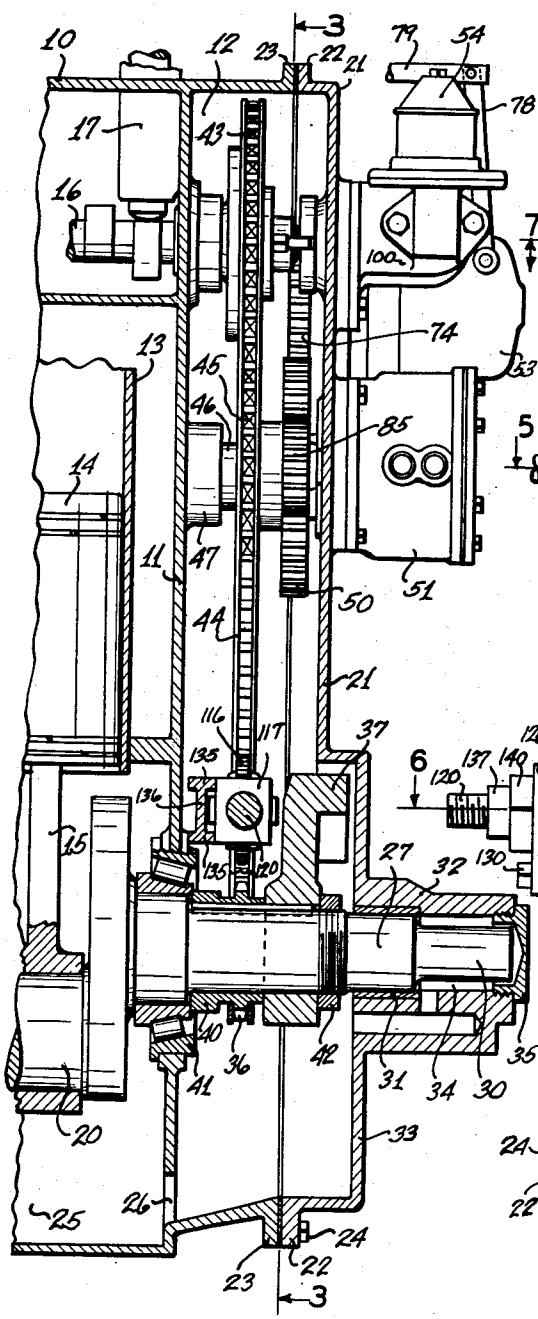
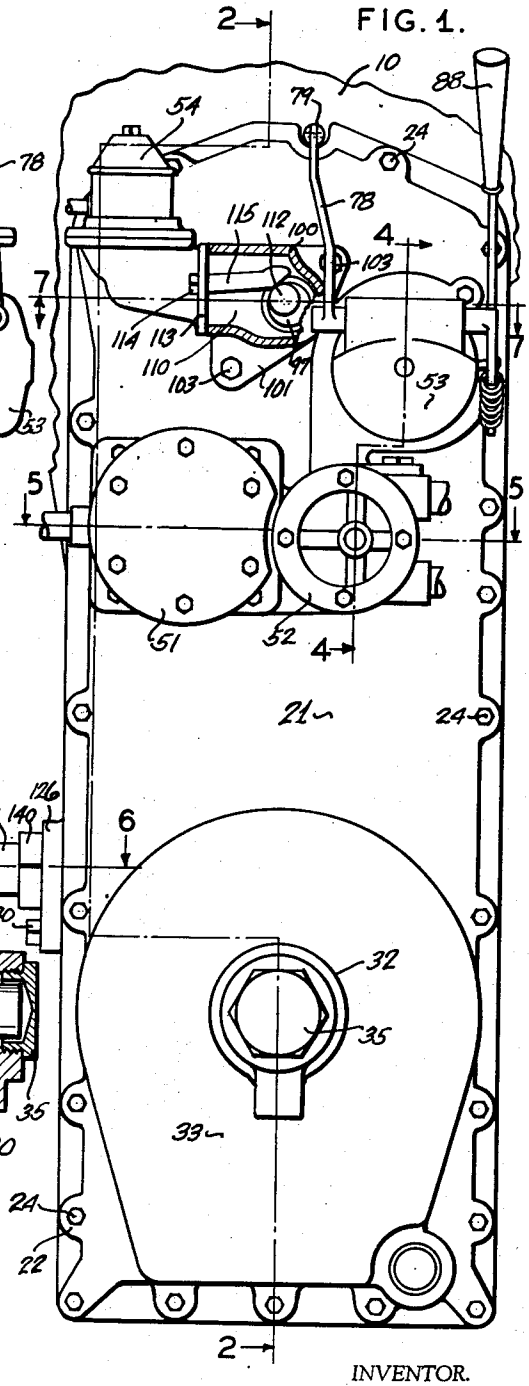


FIG. 1.



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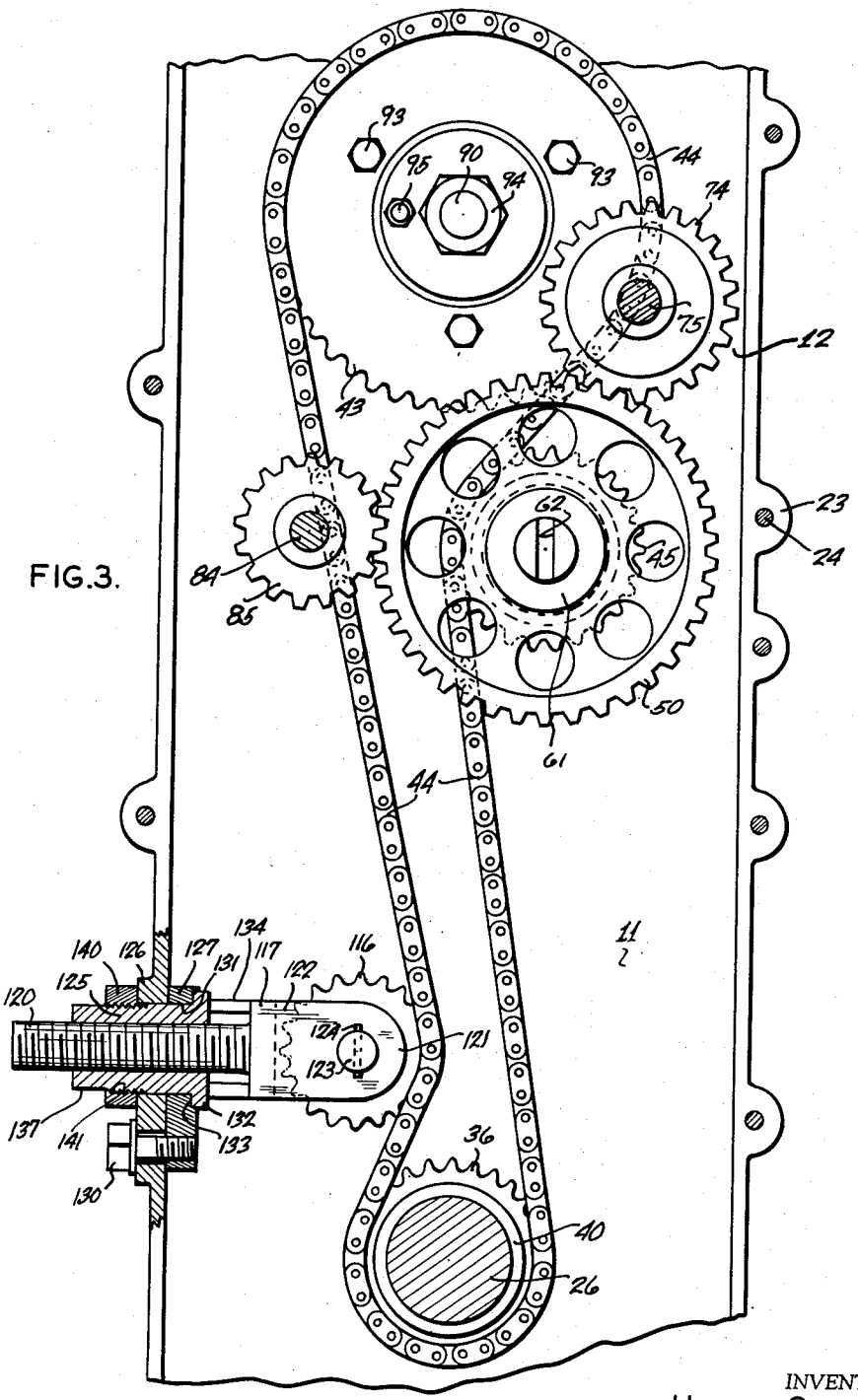
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Nov. 24, 1942. H. SCHRECK 2,303,093

INTERNAL COMBUSTION ENGINE

Filed July 29, 1940 4 Sheets-Sheet 2

FIG.3.



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Nov. 24, 1942. H. SCHRECK 2,303,093

INTERNAL COMBUSTION ENGINE

Filed July 29, 1940 4 Sheets-Sheet 3

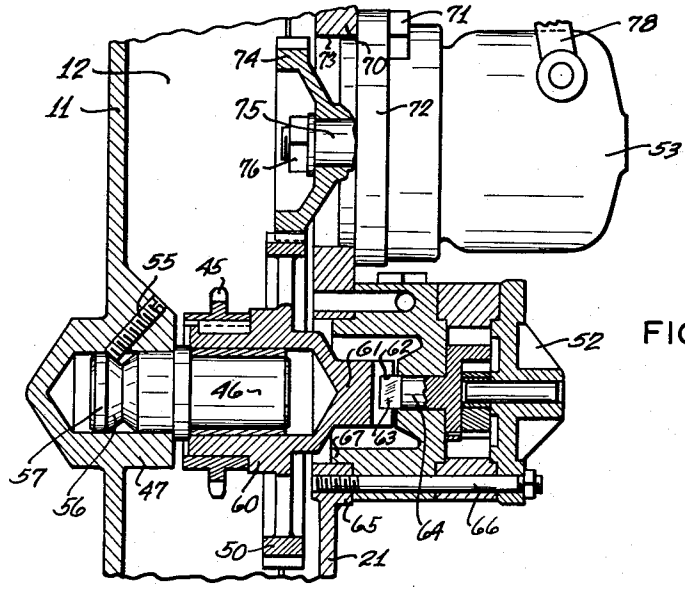


FIG. 4.

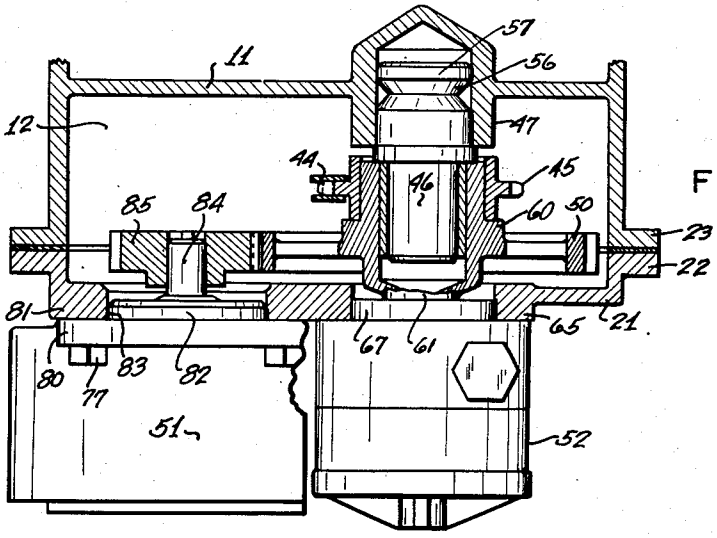


FIG. 5.

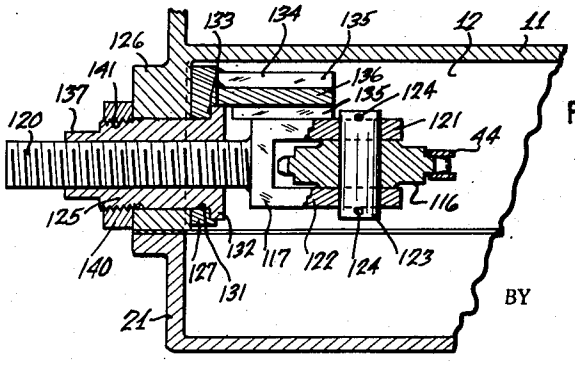


FIG. 6.

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Nov. 24, 1942. H. SCHRECK 2,303,093

INTERNAL COMBUSTION ENGINE

Filed July 29, 1940 4 Sheets-Sheet 4

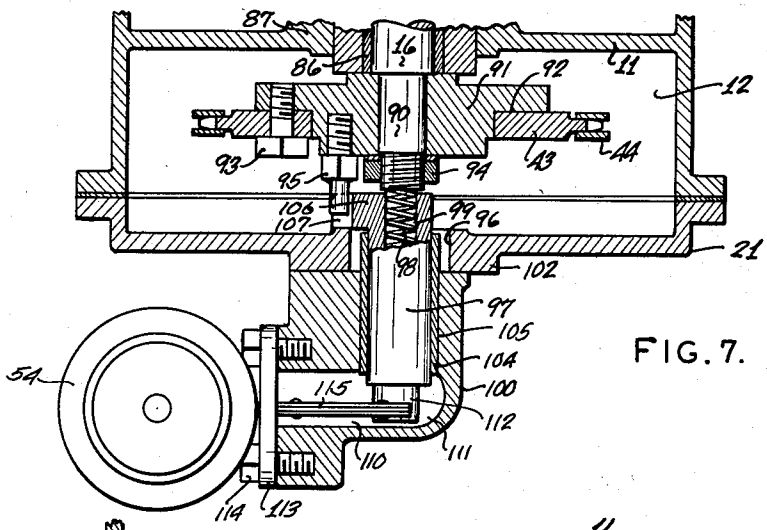


FIG. 7.

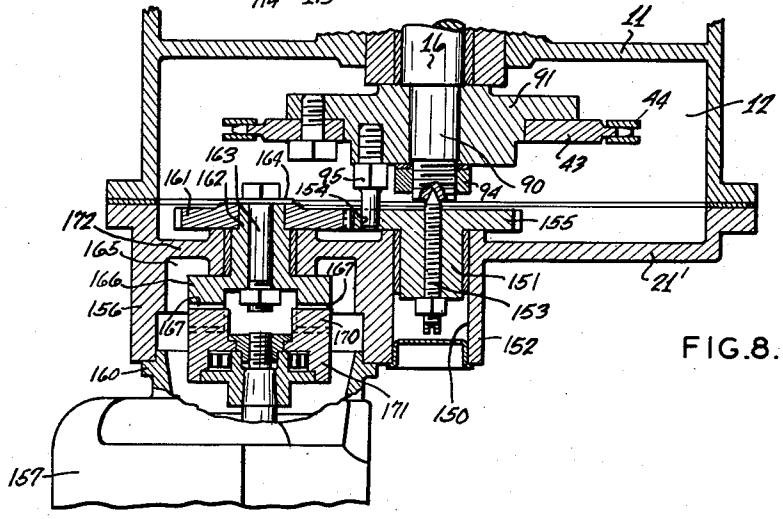


FIG. 8.

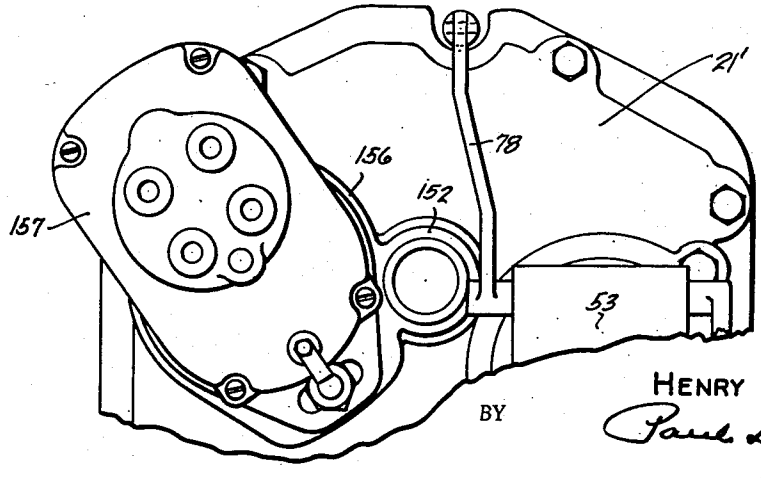


FIG. 9.

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Patented Nov. 24, 1942 2,303,093

UNITED STATES PATENT OFFICE

2,303,093

INTERNAL COMBUSTION ENGINE

Henry Schreck, Beloit, Wis., assignor to Fairbanks, Morse & Co., Chicago, Ill., a corporation of Illinois

Application July 29, 1940, Serial No. 348,141

2 Claims. (Cl. 123—195)

This invention relates to internal combustion engines generally, and in greater particularity to improvements in certain parts and structural features of the engine frame and side plate elements; the improvements permitting the incorporation of standardized operating accessories and a more centralized location and aggroupment of such engine accessories, all for the greater advantages to be hereinafter noted.

Accordingly, an object of this invention is found in the improved arrangement and form of certain engine frame members and detachable plate elements therefor such that the usual engine accessories, viz., governor, oil pump, water pump, fuel supply pump, and optionally, suitable filter elements, may be more advantageously grouped, to the end that assembly, repair and adjustment operations may be more readily cared for.

A further object of the present invention resides in an improved manner of mounting the several engine accessories upon a detachable plate or bracket member, the plate member forming a part of the general engine frame, so that each of the said accessories may be assembled or removed independently of the others.

Another object of the present invention appears in the improved manner of centralizing the location of the engine accessories, such that the provisions for actuating the accessories may be more accurately coordinated and timed to the better operation of the engine generally, and further, so that the actuating provisions, per se, may be reduced to a minimum of parts and elements of great simplicity.

Yet another object of the present invention is found in the provisions of a unitary driving member for imparting to the engine accessories the required rotational movement; the unitary driving member, in turn, receiving its driving actuation from the engine crankshaft through a suitable driving connection operatively carried thereby.

Still another object of this invention resides in the improved manner of mounting the driving member for the engine accessories, in an enclosed recess at one end of the engine frame, and for so mounting certain of the accessory actuating elements and parts that the chamber closure plate, which forms the plate or bracket member upon which all the accessories are carried, may be readily removed without disturbing the driving member and its associated elements in any manner or requiring the removal or change of position of any or all of the said accessories.

Still another object of the present invention is found in an improved means for regulating and maintaining the tension of a flexible driving member common to the several operative engine adjuncts or accessories; the tensioning means being carried by the main engine frame and so located as to permit ready adjustments of the tension in said member from the exterior of the enclosing chamber for the member.

Yet a further object of the present invention resides in the provision for locating a crankshaft counter-balancing weight within the enclosed side chamber and further, for mounting the said weight outwardly of the accessory driving means so that counterbalancing adjustment may be had without dismantling the engine to any great extent.

Other objects and advantages will be hereinafter pointed out as the following description proceeds, and when considered in conjunction with the accompanying drawings, in which:

Fig. 1 is an end elevational view of the detachable end plate member showing the assembled location of the accessories and general arrangement thereof; Fig. 2 is a sectional side elevation of the engine frame and parts showing assembly details as viewed along line 2—2 in Fig. 1; Fig. 3 is a greatly enlarged but fragmentary end elevation of the engine frame with the bracket or mounting plate for the accessories removed, and showing the chain drive means in relation to the geared accessories, as well as the chain tensioning member, when viewed along line 3—3 in Fig. 2; Fig. 4 is an enlarged fragmentary sectional elevation showing the manner of detachably gearing the oil pump and engine governor and also operatively connecting the sprocket wheel shaft to the oil pump shaft, when viewed along line 4—4 in Fig. 1; Fig. 5 is an enlarged fragmentary plan view, partly in section, showing the provision for independently mounting and gearing the oil and water pumps, this view being taken at line 5—5 in Fig. 1; Fig. 6 is a further fragmentary sectional view of the chain tensioning member, as taken at line 6—6 in Fig. 1; Fig. 7 is a fragmentary sectional view of the fuel pump and actuating provisions therefor, when taken along line 7—7 in Fig. 1; Figs. 8 and 9 are modifications of Fig. 7, showing the necessary changes for mounting a magneto in the place of the fuel pump, as an alternative accessory in the event that the engine is to be operated on gaseous or vaporous fuels, in which latter case an electric ignition system is required to initiate combustion.

Referring now to the drawings and to Figs. 1 and 2 in particular, there is shown thereby the general arrangement of engine parts and elements consisting of a main frame 10, an integral vertical end wall 11, and an open end chamber or recess 12, the latter being formed by the extension of the integral side, top and bottom wall members of the frame 10, projecting beyond the vertical wall 11. The purpose for providing this end chamber or recess 12 will be pointed out hereinafter in more detail. Enclosed in the main body of the engine frame 10 is the cylinder-forming sleeve 13, the piston 14 and connecting rod 15, the overhead cam shaft 16 and associated fuel feeding device 17, and the crankshaft 20. As shown in Fig. 2, the camshaft 16 and crankshaft 20 are supported, at one end, in suitable bearing elements carried by the vertical wall 11. To complete the general frame structure, the chamber or recess 12 is adapted to be closed by an end plate or bracket 21, which constitutes a partial closure for recess 12, and is of shallow dished form. The end plate 21 is secured to the recess side walls by means of a suitable bolt flange 22 formed thereon, and mating with a similar bolt flange 23 formed on the side walls of the recess 12. Bolts or screws 24 retain the flanges 22 and 23 in engagement in the usual manner. The bottom of the chamber 12 communicates with the engine crankcase 25 through an aperture 26 provided in the vertical wall 11, so that excess oil supplied to certain bearings and other parts in the chamber 12 may drain into the oil sump of the crankcase 25.

The crankshaft 20 is provided with an overhanging intermediate end portion 26 of reduced diameter, a bearing portion 27 of further reduced diameter and a projecting tip or end 30 which is adapted to be engaged by a hand crank (not shown). The bearing portion 27 of the crankshaft is received in and supported by a sleeve or bushing 31 which, in turn, is secured in a suitable housing or elongated boss 32 formed on the cover plate 21. The cover plate 21 in the zone of the crankshaft is recessed or enlarged, as at 33, so that certain elements carried on the shaft portion 26 may have sufficient space in which to operate. The end 30 is also housed in the boss 32, as shown in Fig. 2, and a sufficient annular space 34 is provided to permit the insertion of a hand crank member (not shown) to engage the shaft end 30 for cranking the engine. A cover or cap 35 closes the open end of the boss 32 when the crank is removed.

Mounted on the shaft portion 26 and secured thereto in fixed position, as by a suitable key element, is a sprocket wheel 36 and a crankshaft balancing or counterweight member 37. The sprocket wheel 36 is preferably integrally formed on a sleeve 40 which is adapted to slide onto the shaft portion 26, and abut the bearing 41 for the crankshaft 20, so that the sprocket wheel 36 will be properly spaced from the bearing 41. The counterweight 37, also slidably mounted upon and keyed to the shaft portion 26, abuts the outer end of the sleeve 40 and thereby attains its proper axial position with respect to the sprocket wheel 36. A retaining collar 42 is then provided to hold these members in position, and to prevent any axial movement thereof. The collar 42 is positioned on a threaded portion of the shaft 26 between the bearing surface 27 and the shaft portion 26, as clearly seen in Fig. 2. The counterweight 37 is positioned to rotatively operate partly in the chamber space 12 and partly in the cover plate recess constituted by pocket 33.

The overhead camshaft 16 has a portion of its shaft, the details of which will be pointed out hereinafter in connection with certain of the engine accessory actuating means, projecting into the chamber 12, and operatively carried thereon is a sprocket wheel 43 which is positioned in a plane common to the sprocket wheel 36 carried on the crankshaft portion 26. A sprocket chain 44 of silent or other suitable type, engages and rides upon the sprocket wheels 36 and 43 respectively, and upon rotation of the crankshaft 20 an actuating force is transmitted through the chain 44 to the camshaft 16.

Operatively arranged between the upper and lower sprocket wheels 43 and 36 respectively, is a third sprocket wheel member 45 (Figs. 3 and 4) which provides, through suitable parts and elements later to be described, a power take off point for certain of the engine accessories. The sprocket wheel 45 is mounted upon a shaft 46, and the shaft 46 is rigidly supported in a boss 47 formed on the wall 11. Cooperating with the sprocket wheel 45 and operatively associated therewith in fixed spaced relation, is a gear 50. This gear 50 rotates in unison with the wheel 45 and is retained on the end of shaft 46. Thus, it may be seen that the chain 44 driven by the crankshaft wheel 36 serves to transmit a rotating motion to the sprocket wheels 45 and 43, respectively; these latter means serving as power takeoff points and from which points the engine accessories may receive their driving actuation. The parts and elements thus far pointed out and described are mounted upon the engine frame members or carried by the crankshaft and camshaft, the whole assembly being conveniently positioned in the chamber or recess 12 formed in greater part by the engine frame. The cover plate or bracket 21, adapted to complete the closure of chamber 12, is thus entirely free of any duty to support the various elements thus far described, except for the bearing support 31 which receives the crankshaft outboard bearing 27. The cover plate 21 may be removed or assembled with entire freedom of any interference with the crankshaft balance member 37 or the chain driven camshaft 16 and the intermediate power takeoff provisions of the engine accessories, now to be described in detail.

Referring briefly to Fig. 1, the engine accessories are mounted upon the cover plate 21 and are conveniently grouped at the upper zone of the plate in close proximity to the power takeoff points, before noted. These accessories include a rotary pump 51, an oil pump 52, which may be of gear type, a governor 53, for example of centrifugal fly ball type, though other suitable types may be employed, and a fuel supply pump 54, the pump illustrated being of diaphragm type. The arrangement of these accessories is such that the water pump 51, oil pump 52 and governor 53 receive their actuating power from the gear 50 (Fig. 3), while the fuel pump 54 is actuated from the camshaft through suitably arranged means hereinafter described, it being noted that the fuel pump of the present example requires a reciprocating motion for its operation.

Turning now to Fig. 4 of the drawings, the details of the driving means for the lubricating oil pump 52 and governor 53 are clearly indicated. The stub shaft 46 mounted in the boss 47 on wall 11, is retained therein by means of an angularly directed set screw 55, threaded through

the wall of the boss 47 and engaging a suitable notch 56 formed adjacent the butt end 57 of shaft 46. A gear 50 is rotatively mounted upon the shaft 46 as by means of an integrally formed hub 60 of considerable axial extent. The sprocket wheel 45 is then rigidly mounted on the hub 60 between the gear 50 and the face of boss 47, as can be seen. The opposite end of the hub 60 is necked down to provide a solid portion 61 and the outward end face thereof is slotted at 62 for the reception of a mating key element 63 formed on the end of the oil pump shaft 64. The oil pump 52 is mounted on a suitable boss or face 65 of the cover plate 21, and holding bolts 66 detachably retain the pump in position. The boss 65 is centrally apertured to receive the projecting annular lip 67 formed on the body of the oil pump 52. The stub shaft 46, gear hub 60 and oil pump shaft 63 are positioned in axial alignment so that assembly of these parts will be faciliated. It will also be noted that the gear 50 is positioned so that it may rotate with a desirable clearance of the rear face of the cover plate, and yet be entirely clear of the drive chain 44 which meshes with the sprocket wheel 45.

Mounted on a boss or face 70 on plate 21 above the oil pump 52 and slightly to one side thereof is the governor 53. The governor 53 is detachably secured to this face 70 by means of bolts 71 passing through bolt holes in the flange 72 thereof. The boss 70 is centrally apertured, as at 73, to receive the governor actuating gear 74 mounted upon the shaft 75 and secured thereto by the hold nut 76. Gear 74 projects into the chamber 12 and meshes with the gear 50. It will be noted that the governor may be removed from, and operatively installed in place, without interfering with the oil pump 52 or the driving gear 50 in any way, and it is also clear that the oil pump 52 may be mounted or removed in like manner.

The governor 53 is adapted to control the setting of the fuel metering pumps 17 through the arm 78, and a connected rack member 79 operatively associated with pinion gears (not shown) carried by the fuel pumps 17. A hand control lever 88, carried by the governor 53, provides the necessary instrumentality for predetermining the extent of governor actuation of the fuel metering pumps 17. The governor linkage and control lever arrangement is well known in the art and needs no further explanation, and the same is true of the fuel metering pumps 17.

Continuing to Fig. 5, there is shown the assembly of the water pump 51 in relation to the lubricating oil pump 52 and the driving gear 50 therefor. The water pump 51 is positioned at one side of the oil pump 52 and slightly thereabove, and is secured to the cover plate 21 by means of bolts or screws 77 passing through the flange 80 and threaded into the face of boss 81 on plate 21. The base of the water pump body is provided with an annular lip 82 which is received in aperture 83 in boss 81. The shaft 84 of the water pump 51 projects into the chamber 12 and carried a gear 85 secured thereto by means of a key element (not shown), or in any other convenient manner. Aperture 83 is made sufficiently large to receive the gear 85 so that the water pump and gear therefor may be bodily removed when desired or the occasion demands. Gear 85 meshes with gear 50 in the same manner that gear 74 on the governor shaft meshes with gear 50, so that upon rotation of the gear 50 the oil and water pumps as well as the governor are actuated.

From an inspection of Figs. 4 and 5, it will be noted that each of the accessory elements or operating engine adjuncts, may be independently assembled onto or removed from the plate or bracket 21, and thus operatively related to the other accessories there-adjacent, or, optionally, the accessories may remain on the plate 21, and this plate be removed from the engine frame, as desired. When the cover plate is removed the engine stands revealed in two parts easily accessible. The cover plate with all its accessories can be placed on a work bench and completely serviced without any adjustments being made upon re-assembling to the engine. The remaining engine block stands inside open with all parts revealed and within easy reach.

Proceeding now to a detailed description of the fuel supply pump 54 and the drive therefor, reference will be had to Fig. 7. The overhead camshaft 16 is bearingly supported in a sleeve or bushing 86 carried in a boss 87 on the wall 11. The end of the camshaft 16 projects into the chamber 12 and provides a shaft portion 90 of reduced diameter. Keyed or otherwise fixedly secured to shaft 90 is a member 91 having an annular recess 92 formed in one face thereof. Seated in this recess 92 is the sprocket wheel 43, before referred to, and a series of spaced bolts 93 secure the member and wheel in fixed relation, so that upon rotation of the sprocket wheel 43 through the chain means 44, the member 91 and the camshaft are both rotated. The member 91 is retained on the shaft 90 by the holding nut 94 engaging the threaded end of the shaft 90. The member 91 also carries a pin element 95 in its outer face and positioned eccentrically with respect to the axis of shaft 90. An aperture 96 provided in the cover plate 21 and in axial alignment with the shaft 90, is adapted to receive a shaft element 97, the shaft 97 being carried in a housing 100. The housing 100 is suitably attached to the cover plate 21 by a bolt flange 101 (Fig. 1) held against the face of boss 102 on cover plate 21. Bolts or screws 103 (Fig. 1) engage the cover plate 21 and press the flange 101 against the face of boss 102. The shaft 97 is received in a bushing 104, which bushing is retained in the passage 105 of housing 100. The end of shaft 97, adjacent the shaft 90, is formed to provide an arm 106 extending at right angles to the axis thereof and the end of the arm 106 is formed to provide a notch or recess 107 which is engaged by the pin 95, and the engagement of pin 95 with the notch 107, upon rotation of the member 90, provides the means for imparting rotation to shaft 97. A resilient member or spring 98, carried in a centrally located recess or bored pocket 99 in shaft 97, is adapted to abut the end of camshaft portion 90 and thereby retain the shaft 97 in its intended axial position, without end lash.

A housing member 100 is also provided with a second channel or passage 110 which extends in a direction normal to passage 105 and the junction of passages 105 and 110 forms a pocket 111. A cam surface 112 formed on the end of shaft 97 is located in the pocket or recess 111. The fuel supply pump 54, flange mounted on the side face of housing 100 by means of flange 113 and bolts or screws 114, has an arm element 115 which extends into passage 110, and the end of arm 115 is adapted to engage and ride upon the cam surface 112 (see Figs. 1 and 7). Arm 115 is given

an oscillating motion by rotation of cam 112 and the fuel pump mechanism (not shown) is thereby effectively actuated. Assembly or removal of the fuel pump 54 is seen to be a very simple matter by reason of the mounting or housing member 100 as shown by Fig. 7. It is also possible to remove the cover plate or bracket 21 without first having to remove any of the adjunctive engine accessories, as the operative connection between the pin 95 and notch 107 is readily made or broken, as will be obvious upon inspection.

Referring now to Fig. 3, there is shown the chain drive assembly as seen when cover plate 21 has been removed from the engine frame. The gear 85 for the water pump and the gear 74 for the governor are, for clearness of understanding, shown in their normal, operative positions with respect to the gear 50; however, in practice, the gears 85 and 74 are removed when cover plate 21 is removed. The rest of the gears and other parts are retained in the chamber 12, and remain therein upon removal of the cover plate 21. As shown, the chain 44 receives its actuating force from the sprocket wheel 36, carried on the crankshaft portion 26, and transmits this force to sprocket wheels 45 and 43. The sprocket wheel 45 carries with it the gear 50, as before explained in connection with Fig. 4, and thereby imparts rotation to gears 74 and 85. The sprocket wheel 43 actuated the camshaft 16 (Fig. 7) and also the fuel supply pump 54 through the engagement of pin 95 with the arm 106 on the shaft 97. To maintain the desired and proper driving tension in chain 44, an adjustable idle wheel 116 is positioned adjacent the lower or driving sprocket wheel 36. This idler wheel 116 can be adjusted, through means later to be described, in a horizontal direction toward or away from the line of travel of the chain 44 so that the amount of slack in the loose side of the chain 44 may be regulated as desired.

The adjustable chain tensioning device illustrated in Figs. 3 and 6 in detail and shown as to certain details in Figs. 1 and 2, consists of the idler sprocket wheel 116 freely mounted upon a forked or bifurcated spindle member 117. This member 117 has a threaded shank 120 and a bifurcated end portion 121 formed to provide relatively wide, flat arms 122. The wheel 116 is mounted in the space between these arms 122, upon a stub shaft 123 carried by the arms 122, as shown. Locking or cotter pins 124 retain the shaft 123 in position. The threaded shank 120 is carried in an internally threaded bushing member 125 which, in turn, is mounted in an aperture of the boss 126 carried on the side wall of chamber 12. The adjustment of the tensioner device 117 is obtained by rotation of the bushing member 125 which acts through the threaded contact with shank 120 to move the device 117 and associated idler wheel 116 toward or away from the chain 44. It is important that the spindle 120 and wheel 116 be prevented from rotation, as it is the rotation of bushing member 125 relative to the spindle 120 which is utilized to effect lateral movement of the device 117. To preclude rotation of the device 117, a plate 127 is bolted to the inside of the frame wall by means of bolts or screws 130. Plate 127 is apertured at 131 to receive the bushing member 125 and a flange 132 formed on this bushing is adapted to seat in an annular recess 133 in plate 127, so that outward movement of bushing member 125 is prevented. Carried on plate 127 is a cross-head or arm member 134, provided with a pair of side elements 135 which abut the flat side of the inner one of the arms 122. Elements 135 are connected by a web 136 so that in cross-section (Fig. 2) the arm member 134 forms a wide letter H. By forming the arm 134 in this manner, it becomes apparent that the side elements 135 abut the face of arm 122 upon each side of the center line of the device 117 and thereby positively prevent rotational displacement thereof, yet allowing a sliding movement for adjusting chain tension.

The outer end of bushing member 125 is formed to provide a tool engaging face 137 so that rotation thereof may be readily effected. A locking or jam nut 140, threaded on the bushing member 125 and engaging threaded portion 141 thereof, securely holds the bushing member 125 from further rotation once the device 117 is positioned as desired. Adjustments of the device 117 can be made only when lock nut 140 is backed off so that rotation of member 125 may be readily effected. This construction of variable chain tensioning agency is simple and yet sufficiently rugged to resist engine vibrations which tend to loosen the threaded connections thereof. Adjustments may be made on the device 117 from the exterior of the engine, and without removal of the cover plate 21.

The preceding description of the engine, and the improvements in grouping and mounting the accessories therefor, have been principally directed to a Diesel engine, the main objective being the design and construction of a relatively compact engine which lends itself well to mass production methods. It is also very desirable, especially with small engines, to provide for utilization of different fuels, so that a single engine of standardized design may be readily converted at low cost, from operation on fuel oil to the usage of gas as fuel, or conversely.

In view of the foregoing, it is contemplated that the Diesel engine referred to hereinbefore, be readily and easily converted to a gas engine. The simplicity of such conversion is indicated in Figs. 8 and 9, wherein a magneto has been substituted for the fuel oil supply pump 54 of Fig. 7, as some form of ignition means is required for the gaseous fuel mixture, as distinguished from the compression-ignition system of the oil or Diesel engine. As shown in Fig. 8, the camshaft driving sprocket wheel 43, and the shaft mounting means therefor are identical with the showings of Fig. 7, and therefore further reference to such features and parts will not be had as they have been heretofore described. A change in the accessory carrying or supporting means formed on cover plate 21 is necessary as a rotary motion is required for the magneto drive. Accordingly, a modified cover plate or bracket 21' is formed to provide a shaft-receiving aperture 150 for an integrally formed shaft and gear member 151. Aperture 150 is formed in the outwardly projecting boss 152 and is in axial alignment with shaft 90. A centering pin 153 serves to maintain the member 151 in proper coaxial relation with the shaft 90 so that the driving pin 95 will be engaged in an eccentrically located aperture 154 in member 151. Aperture 154, which provides the driving connection for the member 151, is carried in the gear-forming portion 155 of the member 151.

A cup shaped boss or extension 156 formed integrally with plate 21' serves to receive and carry a magneto 157. The magneto is preferably flange mounted, as indicated generally at 160.

The driving connection for the magneto 157, consists of a gear 161 meshing with gear 155 and secured on a shaft member 162 by means of an axially located bolt 163 which acts through a washer or plate 164 to hold gear 161 on the shaft 162. The opposite end of shaft 162, positioned in the upper space 165 of part 156, provides an enlarged member 166 having axially directed, radially disposed recesses 167, which are adapted to receive the lugs 170 formed on the magneto impulse coupling 171. This is the usual means for connecting a magneto and conformity to standard practice may be taken as illustrative. The gear 161, shaft 162 and member 166 are carried by the wall 172 of the plate 21' as will be clear from inspection of Fig. 8. It is also clear now that the magneto 157 may be removed from the cover plate 21', without necessitating removal of any of the other parts associated therewith, or the magneto 157 may remain in place and the cover plate 21' be removed from the engine frame; the removal of the plate serving to effect an interruption of driving engagement between the driving pin 95 and the aperture 154 in gear disc 155. Fig. 9 indicates the position of the magneto 157 when assembled to the cover plate 21'.

The above noted arrangement of magneto drive means carried by the detachable bracket or plate 21', permits the magneto 157 to be timed to the engine operating cycle while the plate 21' is removed from the engine frame 10. The cyclical coordination or bench timing of the magneto 157 is best carried out in the following manner: The angular position of pin 95, carried by the camshaft driving member 90, is determined so that the valves are set for a power stroke in a selected one of the cylinders. The magneto 157 is then set, through rotation of gear 161 and the associated connection between member 166 and impulse coupling 171, to correspond with the selected cylinder so that a spark is produced in the igniter means or spark plug associated with that cylinder. Gear 155, previously disengaged from gear 161, is then rotated until the aperture 154 therein, assumes an angular position corresponding to that of pin 95. Gear 155 then may be positioned in engagement with gear 161 and the adjacent gear teeth or the point of engagement between these gears 155 and 161 punch-marked or otherwise indicated. Thereafter the plate 21' may be placed on the engine frame with the assurance that pin 95 will be received in aperture 154, thus completing the driving connection for the magneto 157. Subsequent timing operations, as for instance after removal of the magneto or the driving gears therefor, may be made by matching the gear marks and then rotating either gear 155 or camshaft 16 so that pin 95 and aperture 154 is positioned for engagement, as before noted.

It will be apparent now that the foregoing description of the various parts and elements indicates the preferred manner of grouping and correlating the vital parts of the engine to achieve the objectives previously pointed out. An engine constructed according to the above principles is greatly simplified and desirable as it conforms well to prevailing mass production schedules, is quickly and easily assembled or dismantled, reduces the time and amount of work necessary to effect any sort of repair, as each element or part susceptible of a functional fault or liability to wear, may be individually removed, serviced, or replaced as found necessary, and, by providing a single plate member upon which all the accessories are carried, the close cooperation and timed relation of each accessory may be most advantageously attained. In the case of a need for an engine capable of utilizing a gaseous fuel, the above engine construction provides an immediate possible conversion from the standard Diesel engine by the simple operation of interchanging the cover plate member 21 or bracket, for a cover plate 21' having provision for mounting an ignition device, such as a magneto, in the place of a fuel supply pump.

The unification and simplicity of the accessory driving means, indicated as being consolidated at one end of the engine frame, and contained in a shallow, fully accessible chamber or recess, enhances the engine operation and performance, as a positive drive is obtained, which is free of slippage or the possibility of incorrect timing. It is also possible, through the drive tensioning means, herein preferred, to regulate the driving means for the engine accessories to the end that excessive wear or slippage will be positively precluded.

The condition of engine balance, as governed and controlled by the application of a counterbalancing weight means, is expeditiously provided for in that the counterweight means provided herein may be assembled and rigidly positioned after all rotating elements have been assembled on the crankshaft. The position of the counterweight outwardly of the engine accessory driving means, facilitates accessibility for balancing adjustments, and importantly, places the weight means at a point where the balancing effect is most advantageously attained.

The foregoing description covers solely a preferred embodiment of the principal objectives to be attained in the construction and assembly features of a single type of Diesel engine. It is to be understood that many modifications are possible, and therefore the present description is not to be taken as limiting the invention, except as to any limitation imposed thereon by the appended claims.

I claim:

1. In an internal combustion engine of generally vertical type, a crankshaft, a camshaft, a driving sprocket on the crankshaft, a driven sprocket on the camshaft, a timing chain connecting said sprockets, a shallow, generally vertical casing at one end of the engine, formed of a pair of mating casing sections, a plurality of engine accessory or auxiliary devices, independently and individually removably mounted on an outer one of said sections, the last said casing section being readily detachable as a unit from its companion section with the several auxiliary or accessory devices mounted thereon, a plurality of gears operatively arranged substantially in a single plane close and parallel to the plane of centers of the said sprockets and chain, said gears including a master gear on an axis relatively close to the camshaft sprocket, a third sprocket operable and coaxial with the master gear and exteriorly engaging the timing chain close to and beneath the camshaft sprocket whereby to maintain a wrap of the timing chain on the camshaft sprocket substantially in excess of 180 degrees, said plurality of gears further including a pair of accessory-drive gears, respectively arranged on opposite sides of and powered by said master gear, the axes of the accessory

drive gears being located below the outer portions of the camshaft sprocket, whereby to minimize the required width of casing to accommodate the accessory drive assembly, and all of said plurality of gears being arranged with their axes located vertically between the axes of the crankshaft and camshaft, whereby to minimize the vertical casing dimension necessary to accommodate the accessory and timing drive assembly.

2. In an internal combustion engine of generally vertical type, a crankshaft, a camshaft, a driving sprocket on the crankshaft, a driven sprocket on the camshaft, a timing chain connecting said sprockets, a shallow, generally vertical casing at one end of the engine, formed of a pair of mating casing sections, a plurality of engine accessory or auxiliary devices, independently and individually removably mounted on an outer one of said sections, the last said casing section being readily detachable as a unit from its companion section with the several auxiliary or accessory devices mounted thereon, a plurality of gears operatively arranged substantially in a single plane close and parallel to the plane of centers of the said sprockets and chains, said gears including a master gear, on an axis relatively close to the camshaft sprocket, a third sprocket operable and coaxial with the master gear and exteriorly engaging the timing chain close to and beneath the camshaft sprocket, whereby to maintain a wrap of the timing chain on the camshaft sprocket substantially in excess of 180 degrees, said plurality of gears further including a pair of accessory-drive gears, respectively arranged on opposite sides of and powered by said master gear, the axes of the accessory drive gears being located below the outer portions of the camshaft sprocket, whereby to minimize the required width of casing to accommodate the accessory drive assembly, and all of said plurality of gears being arranged with their axes between the axes of the crankshaft and camshaft, whereby to minimize the vertical dimension of the casing necessary to accommodate the accessory and timing drive assembly, the accessories carried by said outer casing section including one thereof mounted in the region of the camshaft sprocket, a drive pin for the last said accessory, eccentrically rotatable with the camshaft sprocket, and elements operatively connecting the drive pin to the last said accessory, including a recessed element detachably overlying the pin so as to derive a rotary movement therefrom.

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