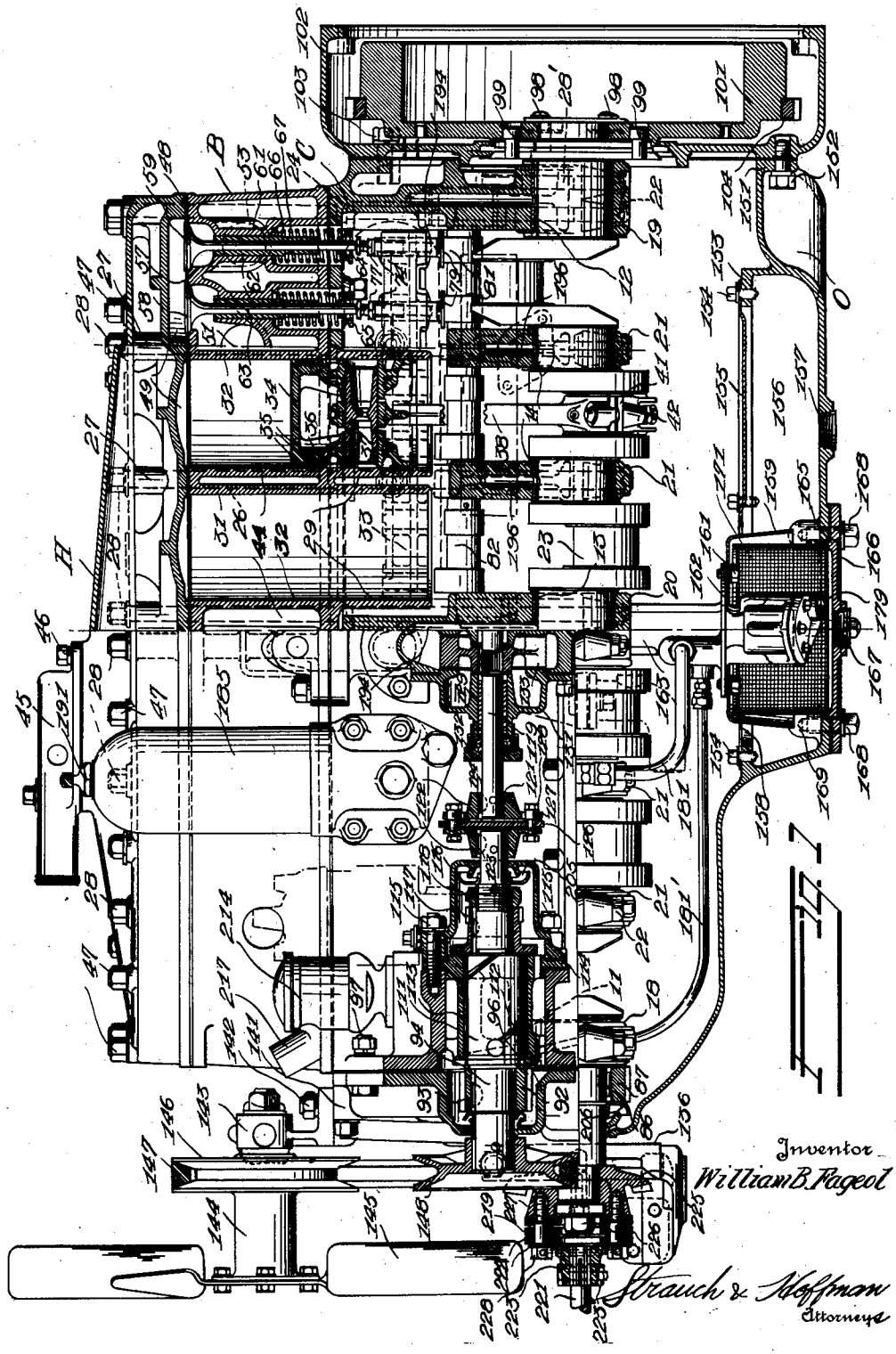
Nov. 15, 1932. W. B. FAGEOL 1,887,998

INTERNAL COMBUSTION ENGINE

Filed Oct. 21, 1929 5 Sheets-Sheet 1



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INTERNAL COMBUSTION ENGINE

Filed Oct. 21, 1929 5 Sheets-Sheet 2

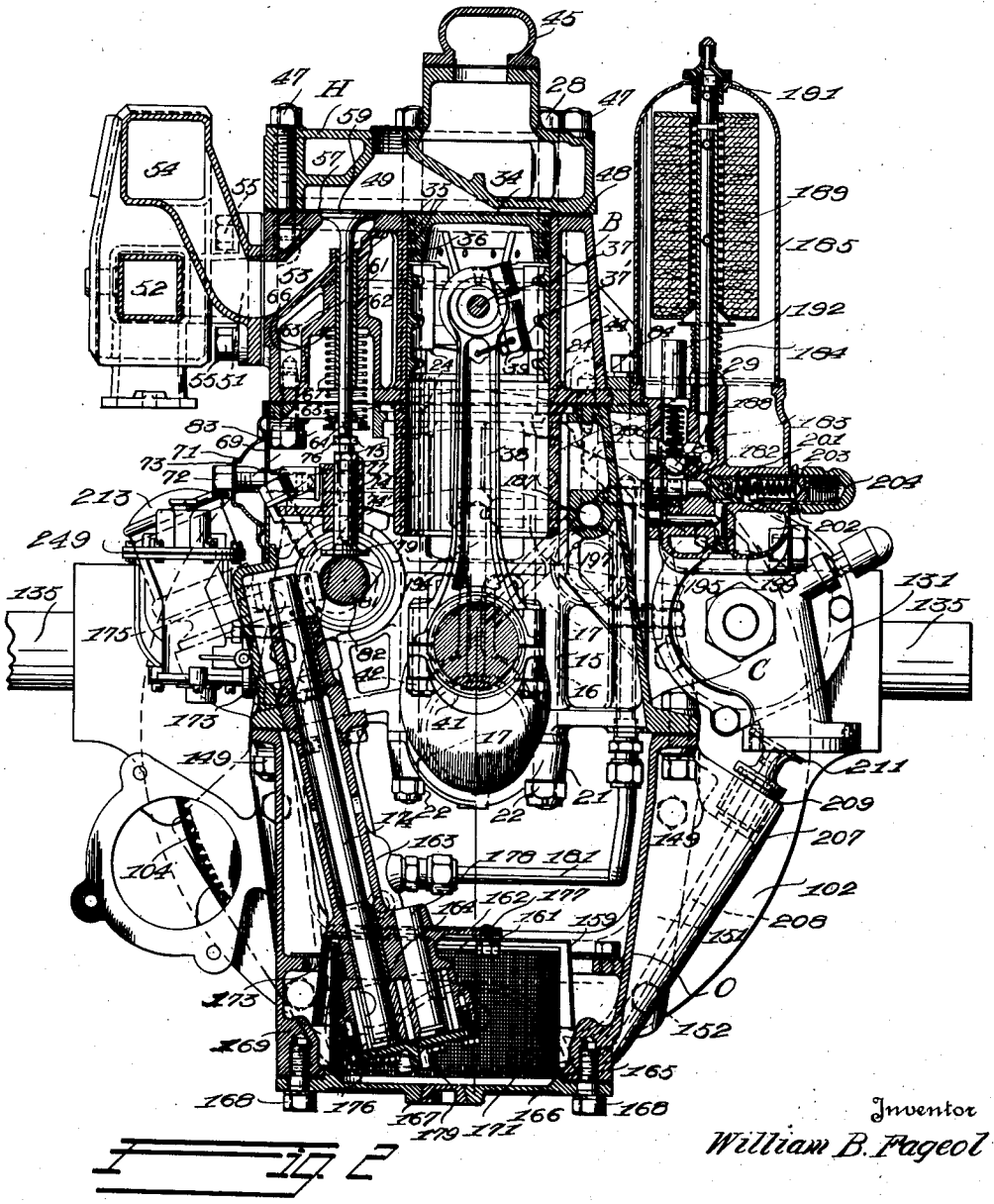

FIG. 2

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INTERNAL COMBUSTION ENGINE

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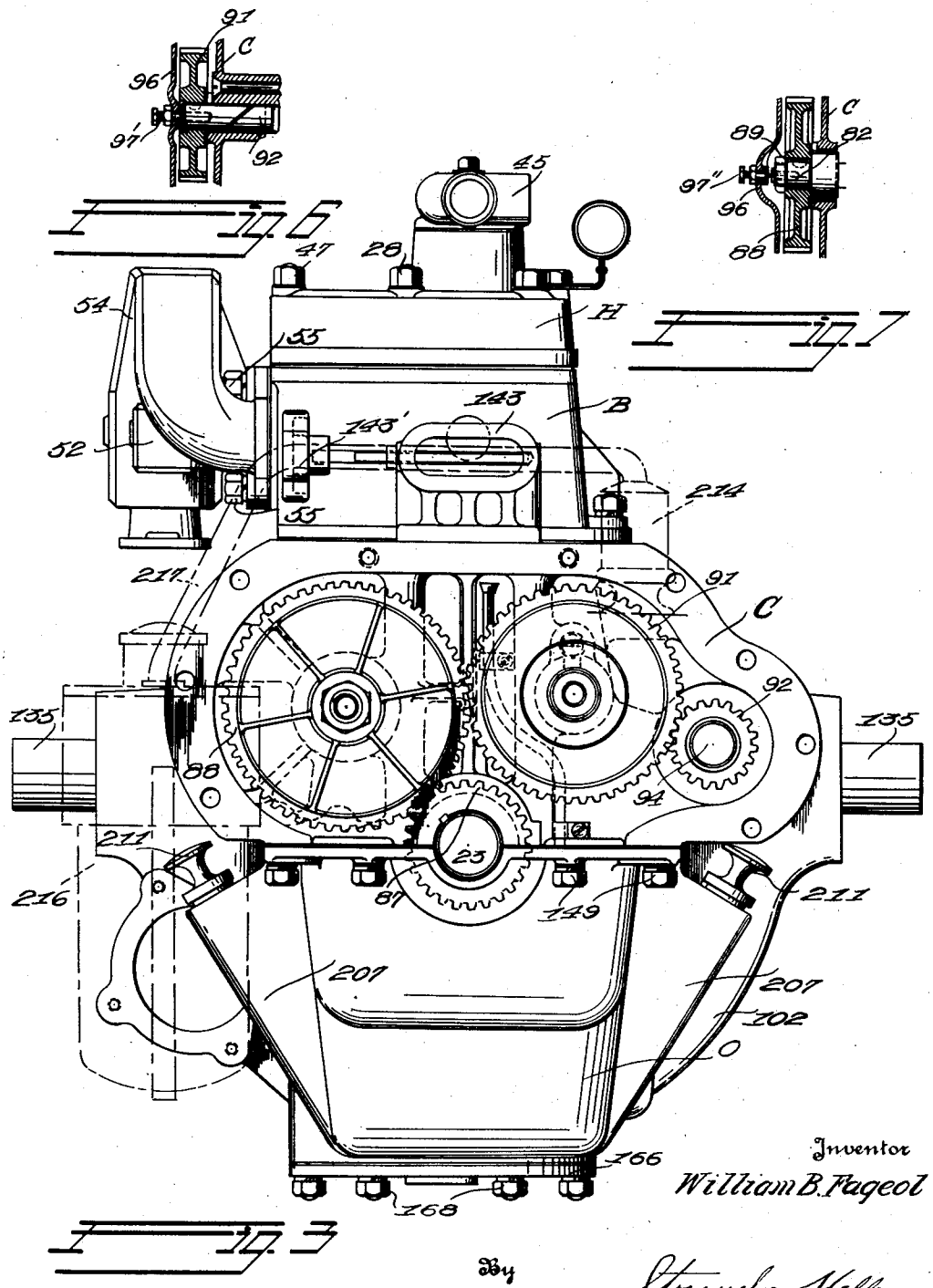

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INTERNAL COMBUSTION ENGINE

Filed Oct. 21, 1929 5 Sheets-Sheet 4

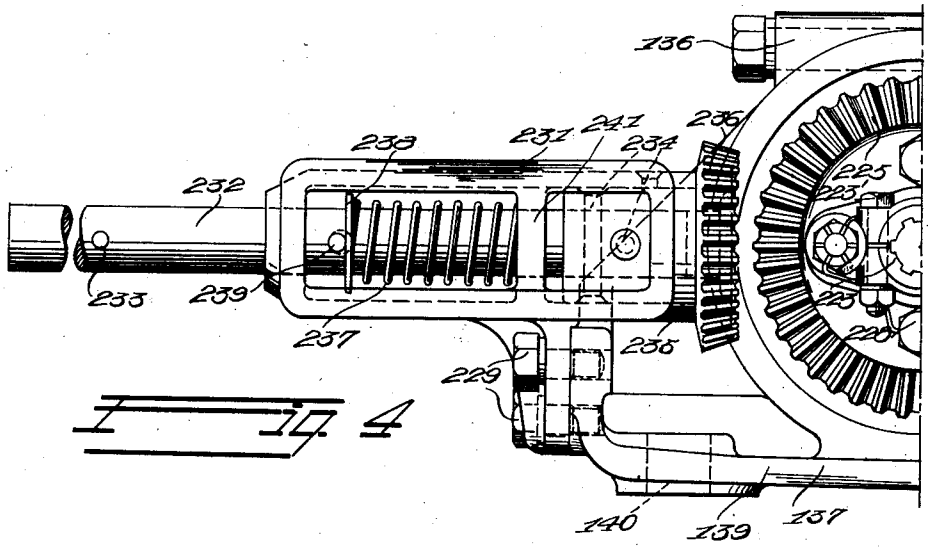

Fig. 4

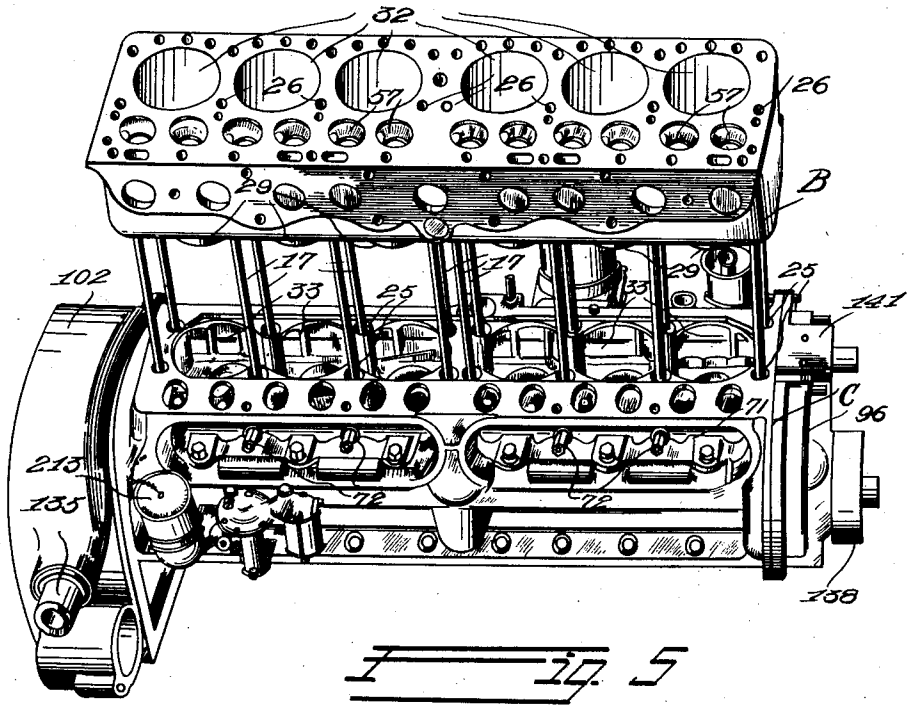

Fig. 5

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INTERNAL COMBUSTION ENGINE

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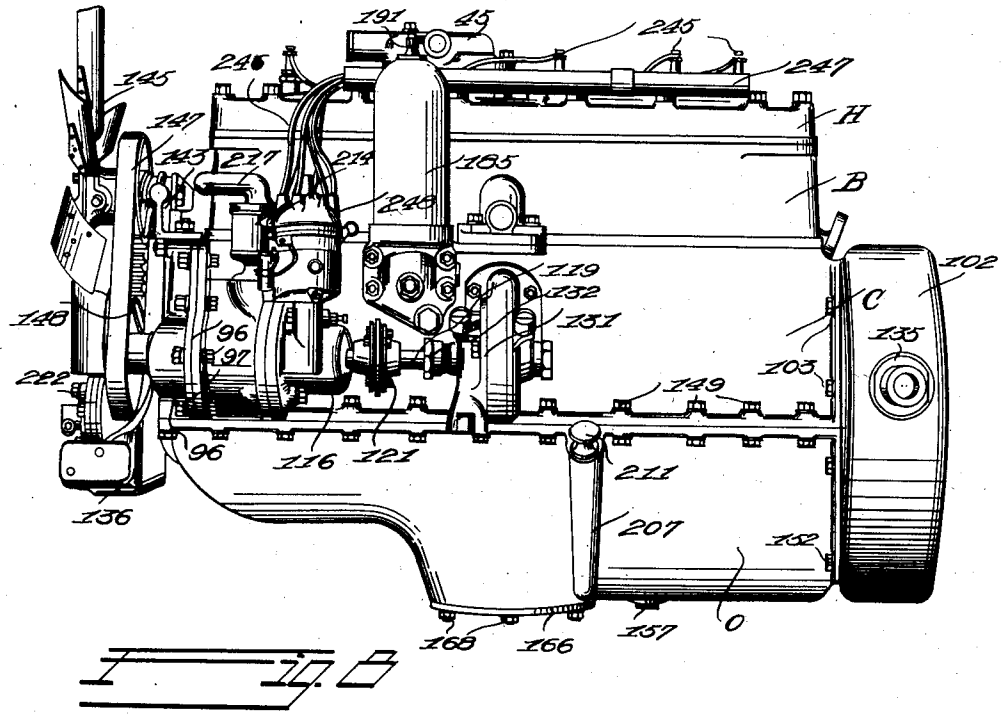

Fig. 8

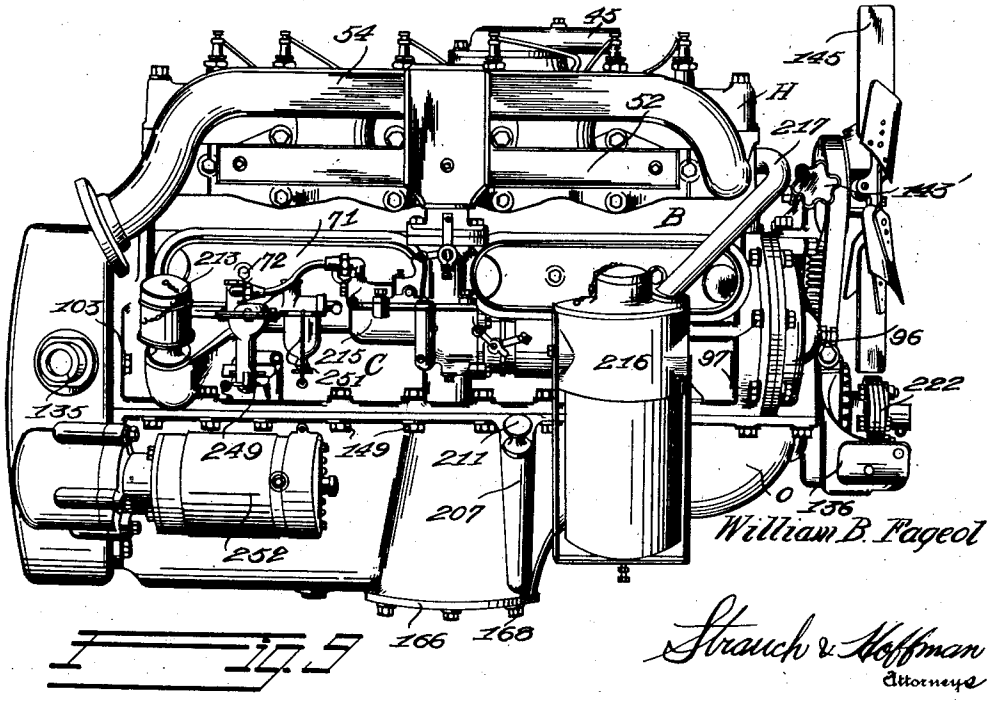

Fig. 9

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UNITED STATES PATENT OFFICE

WILLIAM B. FAGEOL, OF KENT, OHIO, ASSIGNOR TO TWIN COACH COMPANY, OF KENT, OHIO, A CORPORATION OF DELAWARE

INTERNAL COMBUSTION ENGINE

Application filed October 21, 1929. Serial No. 401,194.

The present invention relates to improved internal combustion motor.

Internal combustion motors as now constructed are of two general types relative to the valve mechanism, one of which embodies a construction in which the valves are carried by the cylinder block and the other of which embodies a construction in which the valves are carried by the cylinder head.

Prior motor constructions in which the valves were carried by the block necessitated grinding of the valves in the block in assembled relation with the crankcase or necessitated a laborious task of removing the block for grinding the valves at a bench.

While in the valve-in-head type of motors now constructed the valves can readily be ground as a bench job the present invention has as a primary object to provide a motor construction of the valve-in-block type wherein the block is readily removable for facilitating grinding of the valves for reboring the cylinders and in order to readily secure access to the pistons.

A further object of the present invention is to provide an internal combustion motor comprising a relatively light removable cylinder block provided with the valve mechanism.

A still further object of the invention is to provide an internal combustion motor comprising a relatively deep crankcase, a relatively shallow cylinder block supported on said crankcase for expeditious removal therefrom and assembly thereon, said crankcase and said cylinder block provided with interrelated alining means.

A still further object of the invention is to provide an internal combustion motor comprising a crankcase, a cylinder block removably supported on said crankcase, said cylinder block being provided with cylindrical extensions projecting into said crankcase, said cylindrical extensions alining with cylindrical bores in said cylinder block forming the cylinders, and said crankcase provided with receiving and centering means for said extensions.

A still further object of the invention is to provide an internal combustion motor comprising a crankcase embodying a plurality of main bearings, a crankshaft rotatably supported in said bearings by removable bearing caps, a cylinder block removably supported on said crankcase, a cylinder head removably supported on said cylinder block, and common means for maintaining said bearing caps, cylinder block and cylinder head in assembled relation.

A still further object of the invention is to provide an internal combustion motor comprising a crankcase, bearings supported in said crankcase, a crankshaft rotatably supported in said bearings by bearing caps, bolts projecting through said bearings and said caps and provided with nuts for holding said caps in operative position, a cylinder block removably supported on said crankcase, a cylinder head removably supported on said cylinder block, said cylinder block and said cylinder head being retained in assembled position by said bolts.

A still further object of the invention is to provide an internal combustion motor comprising a crankcase provided with crankshaft bearings, shouldered bolts projecting vertically through said bearings and above said crankcase, the inner ends of said bolts extending through bearing caps and provided with nuts for maintaining said bearing caps in position, a cylinder block and a cylinder head supported by said crankcase through both of which said bolts extend, and said bolts provided with nuts on the outer ends thereof for drawing said cylinder block and said cylinder head into assembled position.

A still further object of the invention is to provide an internal combustion motor comprising bearing pressure lubricating means, said means embodying lubricant passages so disposed relative to said bearings that the pressure feed of the lubricant to said bearings is aided by gravity.

A still further object of the invention is to provide an internal combustion motor comprising a crankcase and a carburetor, breather means associated with said crankcase for avoiding escape of fumes therefrom, said breather means embodying an air cleaner adjacent said carburetor whereby some of the warm air from the crank case is cleaned be-

fore discharge and the remainder drawn into said carburetor.

A still further object of the invention is to provide an internal combustion motor comprising a crankshaft, connecting means associated with said crankshaft for driving an auxiliary shaft in axial alinement with said crankshaft, and hand cranking means associated with said crankshaft adjacent said connecting means.

A still further object of the invention is to provide an internal combustion motor embodying supporting means whereby the motor is adapted for flexible support on a vehicle.

With the above objects in view as well as others that will become apparent during the course of the following disclosure, reference will be had to the accompany drawings forming part of same, and wherein:

Figure 1 is a view partially in side elevation and partially in longitudinal section on different planes of a motor constructed in accordance with a preferred embodiment of the invention.

Figure 2 is a vertical transverse sectional view of the motor, the section being taken on various planes.

Figure 3 is a front end elevational view of the motor with certain parts removed.

Figure 4 is a partial end elevational view disclosing the hand cranking mechanism.

Figure 5 is a perspective view of the crank case and cylinder block disclosing same in alined but disassembled relation.

Figure 6 is a longitudinal sectional view disclosing the connection of the idler gear.

Figure 7 is a similar view disclosing the connection of the cam shaft gear.

Figures 8 and 9 are perspective views of the motor as seen from the opposite sides thereof.

Referring to the drawings by reference characters, in which like characters designate like parts, the motor comprises a crank case C, a cylinder block B, a cylinder head H, and an oil pan O, the parts just described generally forming the motor frame work which support the various elements entering into the motor construction proper as well as the various accessories with which motors are provided.

The crankcase C is preferably, as in usual practice, a unitary casting of trough formation embodying in its construction crankshaft supporting means in the form of main bearings, which comprise a front main bearing 11, a rear main bearing 12, a central main bearing 13, and intermediate bearings 14 totalling seven in number. The crankcase further embodies integral portions 15 in transverse alinement with the main bearings, as more clearly indicated in Figure 2, which portions are provided with vertically disposed apertures 16 for the removable reception of the inner ends of long bolts 17 which bolts at the inner ends thereof extend through apertures in bearing caps 18, 19, 20 and 21 for the respective bearings 11, 12, 13 and 14, the bolts being provided on the inner ends thereof with nuts 22 for drawing the caps into engagement with shims interposed between same and the bearings as in usual practice for securing the crankshaft 23 in adjustable operative position. The bolts 17 are of substantial length and project vertically beyond the outer face of crankcase C and are provided adjacent said outer face with heads 24 (Fig. 2) seated in recesses 25 (Figure 5) opening through the outer face of the crankcase C whereby the bolts 17 are retained against downward movement so that the bearing caps may be drawn into position with the bolts in the position indicated in Figure 5.

The cylinder block B is detachably supported on the outer face of crankcase C and is provided with apertures 26 (Figures 1 and 5) for alinement with apertures 16 for the reception of bolts 17, which project upwardly from crankcase C.

The bolts 17 project outwardly of the outer face of block B, when in assambled position to traverse head H, said head comprises bosses 27 which are apertured for the reception of the outer ends of said bolts, which outer ends also project through head H and are provided with nuts 28 with or without suitable lock washers, for holding head H in position.

It will accordingly be seen from the foregoing that the crankcase C cylinder block B and cylinder head H as well as the bearing caps 18, 19, 20 and 21 are maintained firmly in removable position by means of through bolts 17 with nuts on the opposite ends thereof. The bolts may be provided in any number, 16 being shown, two for the front, rear and each of the intermediate bearings and four for the central bearing. The same size bolts may be employed throughout or, those in connection with the center bearing may be smaller than the other bolts, as is indicated in Figure 2.

It will be seen from an inspection of Figure 1 that the rear main bearing 12 projects rearwardly of block B. This construction permits the use of a pair of stud bolts 28′ in cooperation with a pair of bolts 17 for holding cap 19 in position.

The cylinder block B is provided with the valve mechanism and is adapted for removal as a unit from the crankcase C for grinding of the valves on a bench such removal being readily accomplished by removing the nuts from bolts 17 and separating the block from the crank case. With the exception of four cap screws hereinafter referred to, bolts 17 and their nuts are the sole means for holding block B in position on crankcase C. In order that block B may be

easily removed and transported, it is made relatively light in weight. This can be accomplished because the block is of a depth just sufficient to accommodate the valve mechanism hereinafter referred to. Block B being of relatively small depth, and insufficient for cylinders of the desired length, said block preferably is provided with skirts 29, the inner surfaces of which are co-extensive with cylindrical surfaces 31 provided in block B whereby cylinders 32 of the required length are provided in a block of minimum depth and weight.

While the block B, which is adapted for removal is of relatively small depth, the crankcase C is of relatively great depth and is provided, as is indicated in Figures 1 and 5, with cylindrically disposed rib formations 33, which receive the skirts 29 and serve as positioning and locating means for the block, thus greatly facilitating the accurate positioning of block B on crankcase C.

Reciprocably mounted in each of the cylinders 32 is a piston 34 which is preferably constructed of aluminum alloy and as in present preferred practice. Each piston may be provided with three compression rings 35 and an oil ring 36 of any approved form. Each piston 34 is further provided with a hollow pin 37, to which is secured by a clamp screw 37′, the outer end of a connecting rod 38, the screw 37′ being retained against inadvertent turning by a wire 39 engaged in apertures in screw 37′ and rod 38 as indicated in Figure 2. The heads of connecting rods 38 engage the crank arms of crankshaft 23 between the bearings, as indicated in Figure 1, and are maintained in operative position by connecting rod caps 41 removably secured to the connecting rod heads, as by bolts 42, suitable shims being interposed between the heads and caps, whereby proper adjustment may be readily secured.

The cylinder block B is provided with water circulating passages forming a jacket 44 around the cylinders 32, which passages are in communication with the hollow cylinder head H which has removably secured thereto a water outlet tube or header 45, as indicated at 46, for the detachable reception of the upper radiator hose connection.

While the head H is held in position by bolts 17, said bolts are preferably supplemented by a plurality of stud bolts 47, carried by block B and projecting through apertures in head H, whereby head H may be clamped in fluid tight engagement with a gasket 48 interposed between block B and head H at all points.

The head H is further provided with a plurality of relatively shallow combustion chambers 49, which, as indicated in Figure 2, are in communication respectively with all the cylinders 32. The head further contains passage from each cylinder in communication through six ports 51 with an intake manifold 52, and through six alternately disposed ports 53 with an exhaust manifold 54, the combined intake and exhaust manifold being preferably detachably secured to block B by stud bolts 55. The ports adjacent the outer face of block B are provided with valve seats 57 for seating engagement of intake and exhaust valves 58 and 59 in well known manner.

The block B, as is clearly indicated in Figures 1 and 2, is of hollow construction, and comprises valve guide receiving portions 61, in each of which is disposed a cylindrical valve stem guide 62, in which the valve stems 63 are disposed for vertical reciprocation. The valve stems 63 project inwardy of the inner face of block B and are provided adjacent the inner ends with pins 64 for limiting inward movement of seats 65, between which seats and shoulders 66 formed in portions 61, are disposed valve seating compression springs 67 which normally maintain valves 58 and 59 in engagement with seats 57.

The crankcase C is provided with openings 69 at one side thereof which are normally closed by valve cover plates 71 by means of screws 72 detachably engaged with lugs 73 integral with a push rod guide member 74, arranged immediately inwardly of opening 69, and in which is mounted, for vertical reciprocation, a plurality of push rods 74′ in each of which is threaded an adjusting screw 75, the head 76 of which in operation contacts the inner end of the respective valve stem 63. Each screw 75 may be provided with a lock nut 77. The inner ends of the push rods 74′ are provided with cam engaging heads 79 of suitable form for engagement of cams 81 carried by the cam shaft 82.

The block B may be additionally secured to crankcase C, separately from the bolts 17, by means of four readily accessible cap screws 83, which are immediately within opening 69 in crankcase C. At the opposite side of the motor block B said block and crankcase C are preferably alined by a pair of pins or projections 84 of any suitable form.

The crankshaft 23 projects forwardly of crankcase C and adjacent the front end of crankcase C has secured thereto, by means of a key 86, a gear 87, which as indicated in Figure 3, is in meshing engagement with a gear 88 secured to cam shaft 82 by means of a key 89, as indicated in Figure 7.

Gear 88 is in meshing engagement with an idler gear 91, which, as indicated in Figure 6, is keyed on a stub shaft 92 rotatably mounted in crankcase C. Gear 91 is in mesh with a gear 92 keyed, as indicated at 93 in Figure 1, to an accessories drive shaft 94. The gears 87, 88, 91 and 92 are concealed within a gear cover plate 96 removably secured to crankcase C by means of bolts 97. As indicated in

Figures 6 and 7, cover plate 96 is provided with thrust adjusting screws 97′ and 97″ for shafts 94 and 82 respectively.

The crankshaft 23 has secured to the rear end thereof by means of bolts 98 and pins 99 a fly wheel 101, which is rotatably disposed within a fly wheel housing 102 detachably secured to crankcase C by means of stud bolts 103. Carried by flywheel 101 is a ring gear 104 for meshing engagement with the gear of a suitable starting motor.

The shaft 94 adjacent gear 92 is enlarged as indicated at 111 and is provided with oil grooves 112. The enlarged portion 111 is rotatably mounted in a bushing 113, which is provided with a flange 114, which flange is held in position by bolts 115, which thread into case C and also through a gear housing 116 through which shaft 94 extends. Keyed to shaft 94 within housing 116 is a distributor drive gear 117 adjacent to which gear is a shaft adjusting nut 118 threadedly engaged with shaft 94.

Shaft 94 projects rearwardly of housing 116 and is connected to a water pump shaft 119 by means of a coupling 121. The coupling 121 comprises oppositely disposed hubs 122 keyed to shaft 94 and shaft 119, as indicated at 123 and 124 respectively. Interposed between hubs 122, as well as the adjacent ends of shaft 94 and 119 is a disk 126 to which flange portions 127 of hubs 122 are secured by bolts 128. Shaft 119 has bearing in a bushing 129 in a water pump casing 131 and a packing gland 132 is carried by casing 131 and through which shaft 119 extends. Keyed to shaft 119 within casing 131 is an impeller 133 for causing movement of the water through the engine cooling system.

The crankcase C is adapted for support from any suitable frame work, but the motor in accordance with the present invention is particularly adapted for service in coaches of the character disclosed in my co-pending application Serial Number 355,755 filed April 17, 1929, in which a pair of motors are utilized and are supported directly by the base of the vehicle body adjacent the sides preferably, by a three point suspension. However, the motor is not limited to such specific use, but is adapted preferably for a three point support in any location, such support providing a firm mounting.

Accordingly the motor in accordance with the present invention is provided with supporting means which preferably comprises laterally alined trunnions 135 preferably secured to or integral with fly wheel housing 102, and a third support 136 indicated in Figures 1 and 4 adjacent the front end of the motor. The trunnions 135 are intended for pivotal support within rubber insulating blocks, as disclosed in said co-pending application. The support 136 preferably comprises a casting 137 provided with a circular spring in which is rotatably journalled a cylindrical crank case extension 138, clearly indicated in Figure 5, whereby the motor is capable of movement about the longitudinal axis of crankshaft 23 relative to supporting casting 137. The casting 137 comprises a base portion 139 (Figure 4) provided with bolt openings 140 for the reception of bolts for securing casting 137 to a rubber insulating block.

The gear cover plate 96 is provided with a ledge 141 to which is detachably secured by means of bolts 142 a fan bracket 143 in which a fan shaft 144 provided with a fan 145 is journaled bracket 143 is adjustable by means of screw 143′. The shaft 144 is provided with a belt pulley 146 adapted to be driven by a fan belt 147 in driving engagement with a drive pulley 148 secured to shaft 94.

The oil pan O is removably secured to crankcase C by means of a plurality of studs 149, the rear end of pan O being flanged as indicated at 151 which flange is secured to housing 102 by bolts 152.

The oil pan O is also flanged adjacent the bottom thereof as indicated at 153 to which flange is secured by means of bolts 154 the margin of a baffle plate 155 providing a compartment 156 in the bottom of pan O. Said pan is provided with a drain plug opening 157. Baffle plate 155 is provided with an opening 158, in which is disposed a baffle shell 159 detachably secured by bolts 161 to a flange 162 of an oil pump casing 163. The casing 163, comprises a head portion 164 which is surrounded by shell 159 and which head portion rests in compartment 156. Pan O is provided with an opening 165 in the bottom thereof which is removably closed by a cap 166 provided with a drain plug 167 and removably secured to pan O by bolts 168 removably engaged in bosses 169 integral with pan O. The cap 166 has suitably secured thereto a cylindrical strainer 171, which is, in the form of a screen and which, as indicated in Figures 1 and 2, projects upwardly between head portion 164 and shell 159 into close proximity to flange 162. Rotatably journaled in bushings 173 in casing 163 is a drive shaft 174 to the outer end of which is secured a drive gear 175 in meshing engagement with a gear secured to cam shaft 82 whereby the rotation of shaft 82 is imparted to shaft 174. Secured to the inner end of shaft 174 is a pumping gear 176 in meshing engagement with a second pumping gear 177 keyed to an idler shaft 178 rotatably journaled in head portion 164. The head portion 164 is provided with an oil inlet 179 into which oil is drawn and forced to the various points hereinafter referred to by the action of gears 176 and 177.

Detachably secured to pump casing 163 is an oil feed line 181 through which oil is pumped by action of gears 176 and 177

through an angular line 182 which latter line communicates with a two way line 183, one end of which communicates with a line 184 of an oil filter assembly, 185 and the other end of which communicates with a line 186 which in turn communicates with a line 187 which is disposed within crank case C and longitudinally thereof. A spring pressed ball valve 188 is disposed in line 182 for admitting oil under a predetermined pressure part of which flows through line 184 for filtering through the filter disks 189 of filter assembly 185 which assembly is provided with an air relief valve 191 and has communicating therewith a return oil line 192 for return of filtered oil to the crankcase. Simultaneous with the passage of oil through line 184 under pressure an equal amount of oil is forced with equal pressure into line 186 and from thence into line 187. The main bearings heretofore enumerated are provided with oil ducts some of which as in the central and rear main bearing are relatively long as indicated at 194 and communicating with these ducts as well as with line 187 are lines 195. The ducts of the intermediate bearings indicated at 196 are relatively short and interconnecting these ducts with line 187 are lines 197. Oil is accordingly supplied to the main bearings under substantial pressure through lines 195 and 197 and due to the relatively short ducts 196, and the disposition of line 187, the lines 197, as is clearly indicated in Figure 2, are substantially inclined whereby the oil is not only supplied to the intermediate bearings by pressure initiated by the oil pump but is further aided by the action of gravity thereby providing a combined pressure and gravity oil feeding system.

In order to regulate the lubricant flow and bypass same upon a predetermined maximum pressure within line 181 a bypass line 199 is provided between which and line 182 a piston valve 201 is disposed and which is normally maintained seated by a helical spring 202 the pressure of which is adjustable by means of a screw plug 203 normally concealed by a cap 204. Thus upon adjustment of spring 202 by means of plug 203 the valve 201 will be seated under greater or less pressure upon excess of which pressure in line 181 valve 201 will unseat thus permitting a bypass of oil through bypass line 199 to the crankcase.

Further included in the oiling system is an oil thrower 205 within casing 116 and a similar oil thrower 206 adjacent gear 87 carried by crankshaft 23. The oil pump is provided with an overflow line 181'.

The oil pan O at each of the opposite sides thereof is provided with an outwardly disposed casing extension 207 for the reception of a bayonet oil gage comprising a rod 208 for insertion within pan O and an outer cylindrical portion 209 for seating engagement in the outer end of extension 207 and which cylindrical portion is provided with a gripping knob 211.

The motor includes a novel breather arrangement whereby not only are crankcase fumes avoided, which fumes may be injurious particularly with hot air heating arrangements taking the air from beneath the hood, but further provides effective warming of the air drawn into the carburetor. The breather arrangement is indicated in Figures 8 and 9 and in dot and dash lines in Figures 3 and comprises an air intake breather and filter 213 suitably secured to crankcase C at one side thereof and adjacent the rear end thereof which is in communication with the crankcase. A breather outlet 214, which may be of any well known form is secured to crankcase C at the opposite side and adjacent the forward end thereof.

The carburetor 215 which is located on the same side as breather 213 is in communication with an air cleaner 216 of the character disclosed in the copending application above referred to. The air cleaner 216 is in communication through a line 217 with outlet breather 214 whereby the expelled air from crankcase C is drawn through cleaner 216 in a preheated condition for the carburetor 215 which provides for more effective operation of the carburetor. The air expelled from the crankcase by vacuum from the intake through the cleaner and carburetor and finally discharged through the exhaust system eliminates the possibility of impurity-laden air getting inside the coach body.

The crankshaft 23 projects forwardly of gear 87 and has associated therewith a drive connection 219 which is also associated with a shaft 221 for driving an air compressor or an electrical generator. The drive connection 219 as more clearly indicated in Figure 1 comprises a plurality of coupling disks 222 to one of which is secured a drive spider 223 operatively connected with shaft 221. Spider 223 comprises mating sections secured together by bolts 223'.

By the provision of shaft 221 as a continuation of shaft 23 means are provided for manual cranking of the motor which in part comprises a bevel gear 225 secured to shaft 23 by a screw 226 and disks 222 are secured to the hub portion 227 of gear 225 by bolts 228.

Detachably secured to casting 137 by means of bolts 229 is a bracket 231 (Figure 4) in which is slidably and rotatably disposed a hand crankshaft 232 provided with a crank pin 233. Secured to shaft 232 by means of pins 234 and also slidably mounted as well as revolvably mounted in bracket 231 is the hub portion 235 of a pinion 236.

Surrounding shaft 232 is a coil spring 237 one end of which engages a washer 238 retained against outward movement on shaft

232 by a pin 239 and the opposite end of which engages a web 241 integral with bracket 231, the spring thereby forcing shaft 232 outwardly and normally holding pinion 236 out of operative engagement with gear 225.

When it is desired to crank the motor, a suitable crank is engaged with shaft 232 and upon inward movement of shaft 232 against the action of spring 237 pinion 236 is forced into meshing engagement with gear 225 and upon rotation of the crank and consequently shaft 232 gear 225 and consequently crankshaft 223 are rotated thus initiating the starting of the motor. It will be noted that pinion 236 is of substantially less diameter than gear 225, as a result of which comparatively little effort is required to impart rotation to crank shaft 23 for manually cranking the motor. The spring 237 will force shaft 232 outwardly upon starting of the motor.

The motor, in addition to the above described structure includes the various accessory devices essential in a motor construction embodying spark plugs 245 supplied by current through high tension wires 246 which are supported by a tube 247 on head H, and which are in connection with a distributor 248 which is operated by distributor gear 117. The motor further includes a carburetor feed device 249 having a filter 251 associated therewith. A starting motor 252 is also provided.

It will be seen from the foregoing disclosure that a motor is provided which is of a highly desirable construction in that it is readily adapted for assembly and disassembly with a minimum expenditure of time and effort and which further includes a highly effective oiling system and which is provided with a through drive from the crankshaft and also provided with hand cranking mechanism.

By the provision of the construction disclosed the valves 58 and 59 may be ground with much greater facility than has heretofore been possible with valve-in-block motors due to the fact that block B can readily be removed and due to its relative lightness it can be readily transported to a bench for grinding of the valves. All that is required to remove block B is to unscrew nuts 28 and 47 after which head H can be lifted off of block B leaving block B free to be raised vertically from bolts 17 projecting above crankcase C as indicated in Figure 5. It will be seen that all of the accessory parts are carried by the crankcase with the exception of the combined intake and exhaust manifold and this is readily removable upon releasing nuts 55. Thus it will be seen that block B is relatively light and consequently easily handled during the course of the valve grinding process.

When block B is removed the heads or shoulders 24 on bolts 17 will hold the bolts against vertical downward movement thus maintaining the bearing caps in position. On the other hand when it is desired to remove the bearing caps, bolts 17 will also remain in position. The bolts 17 may be removed, however, upon removing nuts 22 as well as the bearing caps retained thereby after which the bolts may be removed vertically upwardly without the removal of nuts 28.

In replacing block B, the skirts 29 which form portions of the cylinders readily center the block by engagement in cylindrical portions 33 in the crankcase thus making the assembly of the block quick and easy as compared with the present method in which it is necessary to accurately aline the bolt holes as well as the water passages without any alining means.

The oiling system included in the present construction is highly effective in that the main bearings are lubricated by force feed without any opposition of the effect of gravity as in prior lubricating systems.

By the provision of the hand cranking mechanism the motor is readily adapted for service in coaches of the character disclosed in said copending application wherein a through drive is utilized from the crankshaft for driving the generator or a compressor in which construction the crankshaft could not be manually rotated as in usual practice and furthermore by mounting the motors beneath the car body intermediate the ends thereof the crankshaft would not be accessible for cranking in the usual manner.

By the provision of the trunnions 135 and support 136 the motor is adapted for a highly flexible support on a vehicle frame.

The motor in accordance with the present invention is well adapted for service in vehicles and coaches in which hot air heating arrangements are used which utilize the heated air adjacent the motor due to the fact that the novel breather arrangement avoids the escape of crankcase fumes which breather arrangement is endowed with a further function of heating the air which enters the carburetor thus greatly facilitating the operation of the motor.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What I claim as new and desire to secure by United States Letters Patent is:—

1. An internal combustion motor comprising a crank case; a cylinder block provided

with intake and exhaust valves removably supported on said crank case; a cylinder head removably supported on said cylinder block; and common securing means for said crank case; cylinder block and cylinder head.

2. The combination defined in claim 1 in which said crank case and said cylinder block are provided with co-operating means for aligning said block and said case.

3. An internal combustion motor comprising a crank case; crank shaft bearings supported within said crank case; bearing caps removably secured to said bearings; a valve supporting cylinder block removably supported on said crank case; a cylinder head removably supported on said cylinder block; bolts extending through said bearing caps, cylinder block and cylinder head; and nuts threadedly engaged with the opposite ends of said bolts for removably securing said bearing caps, cylinder block and cylinder head in operative position.

4. The combination defined in claim 3 in which said bolts are provided with shoulders adapted for seating engagement in recesses in said crank case.

5. An internal combustion motor comprising a crank case; a cylinder block removably supported on said crank case; a cylinder head removably supported on said cylinder block; said cylinder block supporting intake and exhaust valve mechanism; and common securing means for removably maintaining said block in said crank case and said head on said block whereby upon removal of said head said block is free for removal from said crank case.

In testimony whereof I affix my signature.

WILLIAM B. FAGEOL.