Aug. 14, 1956 V. W. BALZER 2,758,580

INTERNAL COMBUSTION ENGINE

Filed March 8, 1951

6 Sheets-Sheet 1

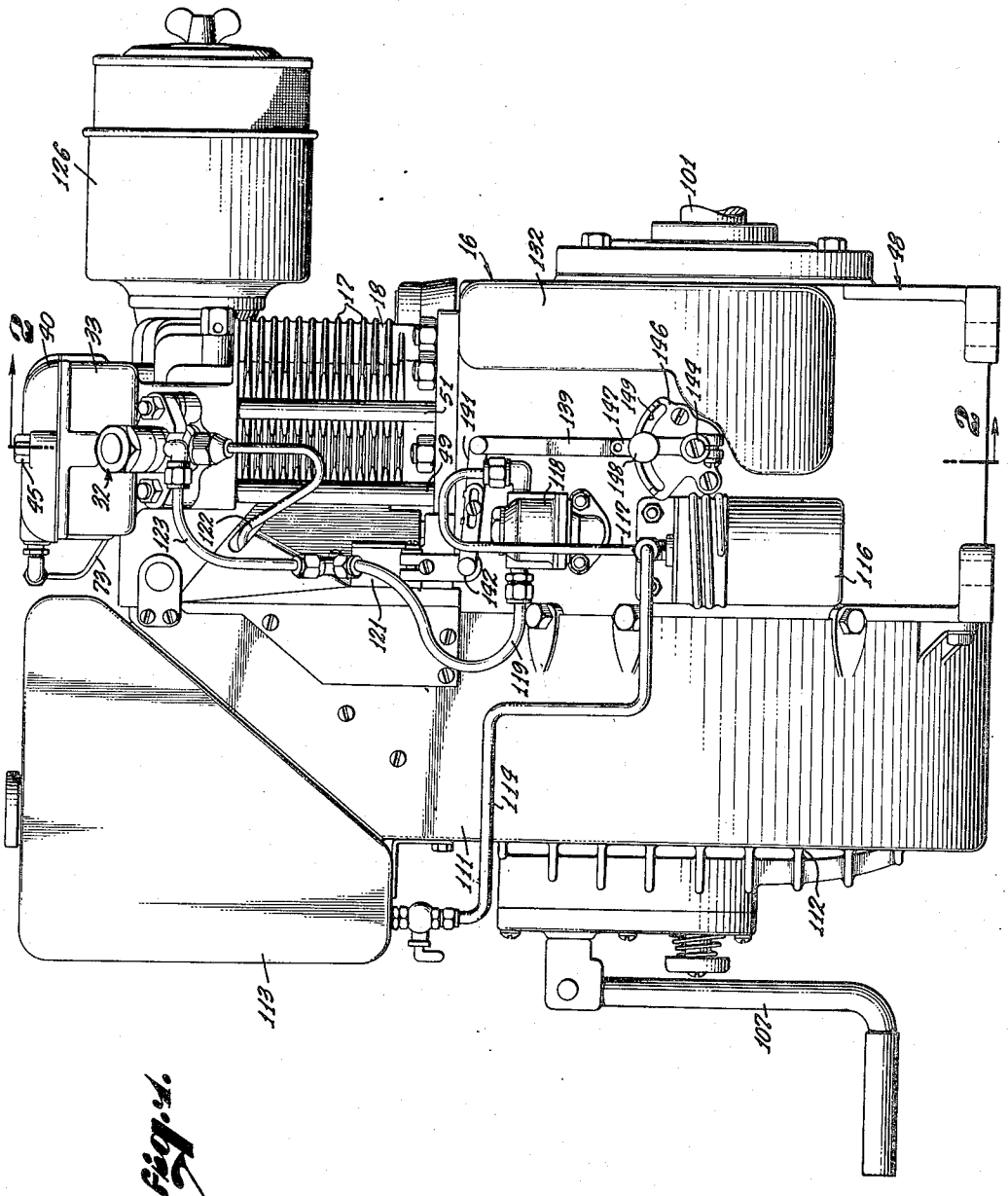


Fig. 1.

VERNON W. BALZER,
INVENTOR.

HUEBNER, BEEHLER,
WORREL & HERZIG,
ATTORNEYS.

BY Warren T. Jessup

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Fig. 2.

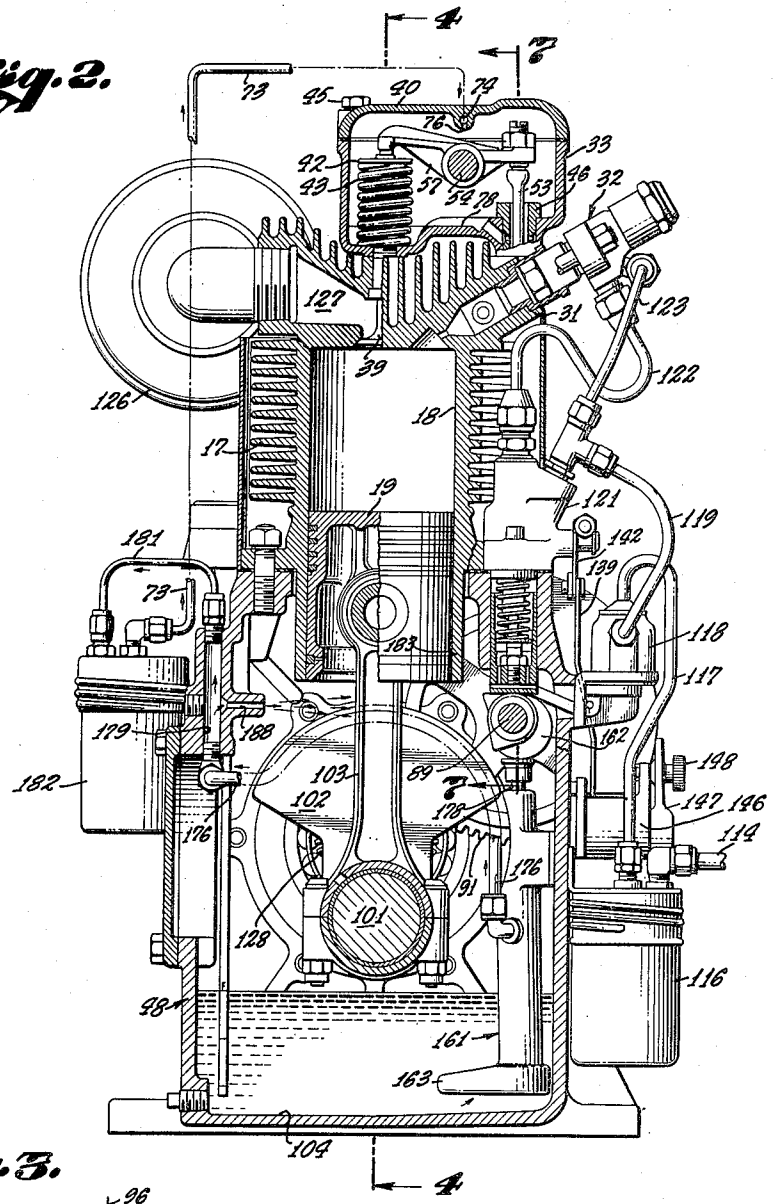
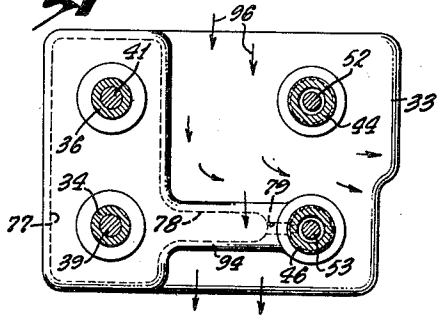


Fig. 3.



VERNON W. BALZER,
INVENTOR.

HUEBNER, BEEHLER,
WORREL & HERZIG,
ATTORNEYS.

BY Warren T. Jessup

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Fig. 5.

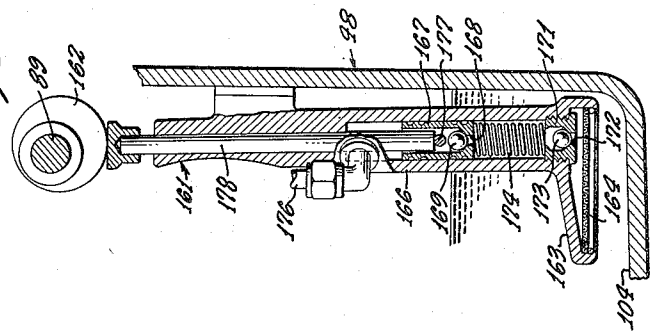
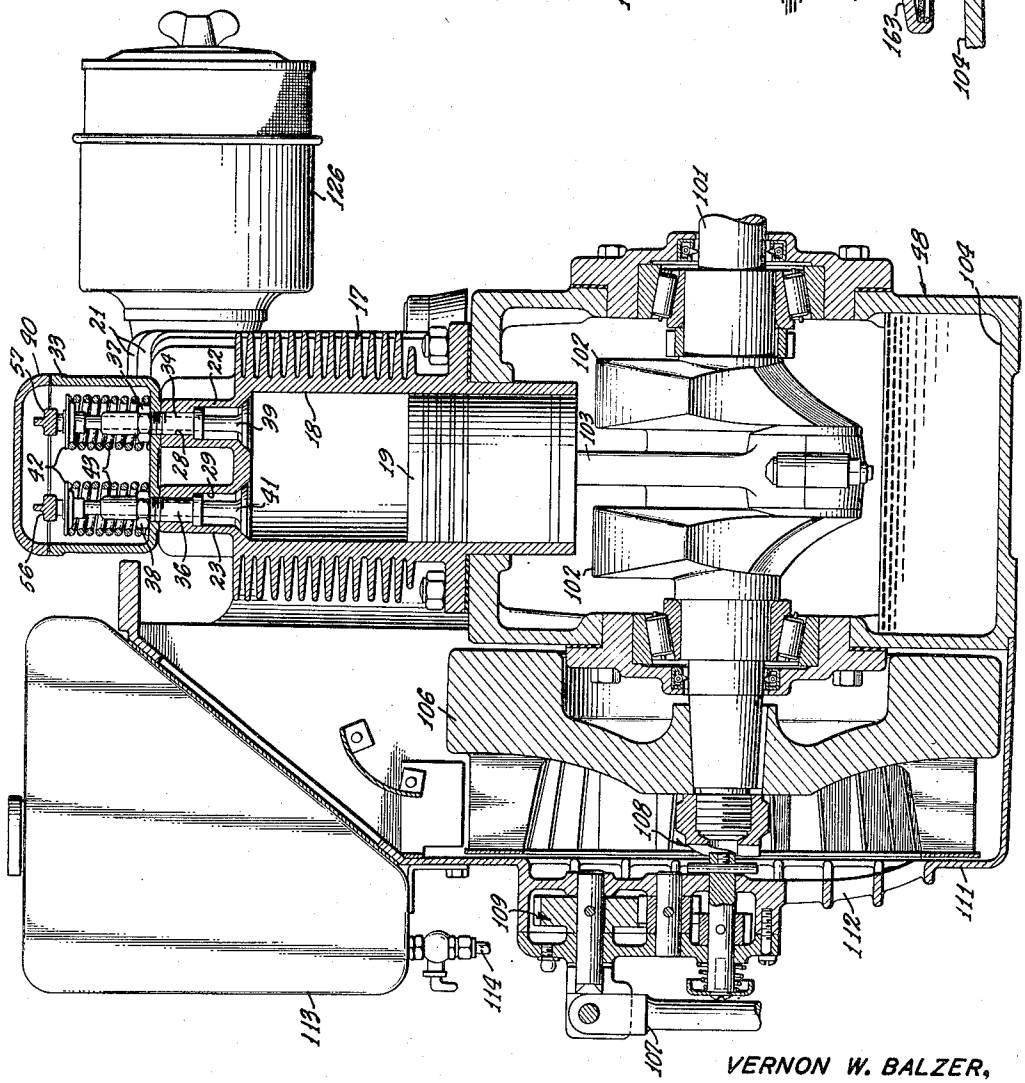


Fig. 4.



VERNON W. BALZER,
INVENTOR.

HUEBNER, BEEHLER,
WORREL & HERZIG,
ATTORNEYS.

BY Warren T. Jessup

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Fig. 5.

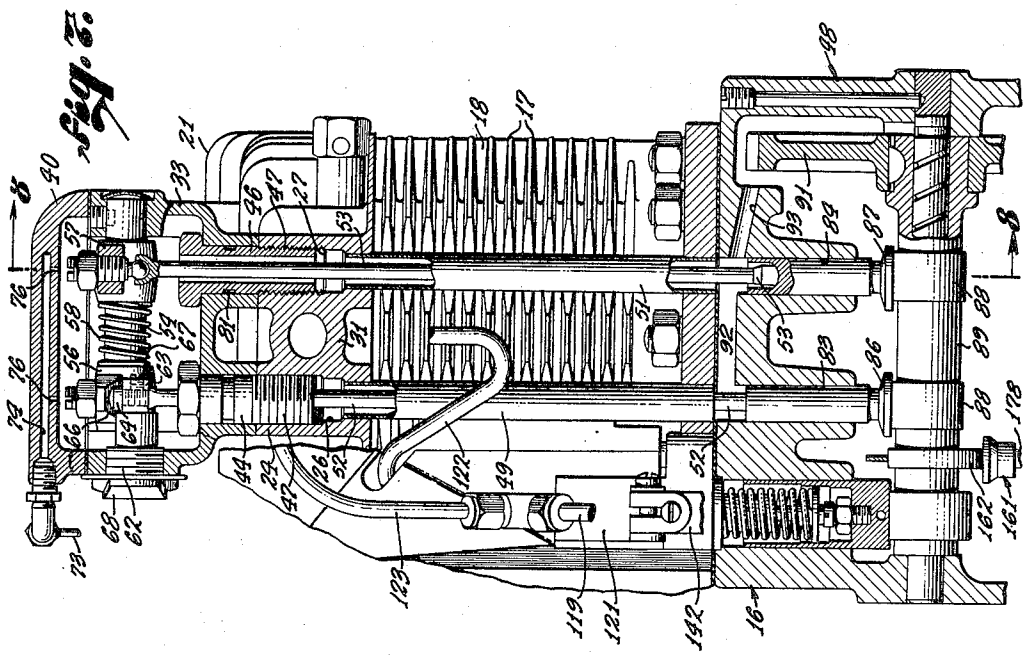
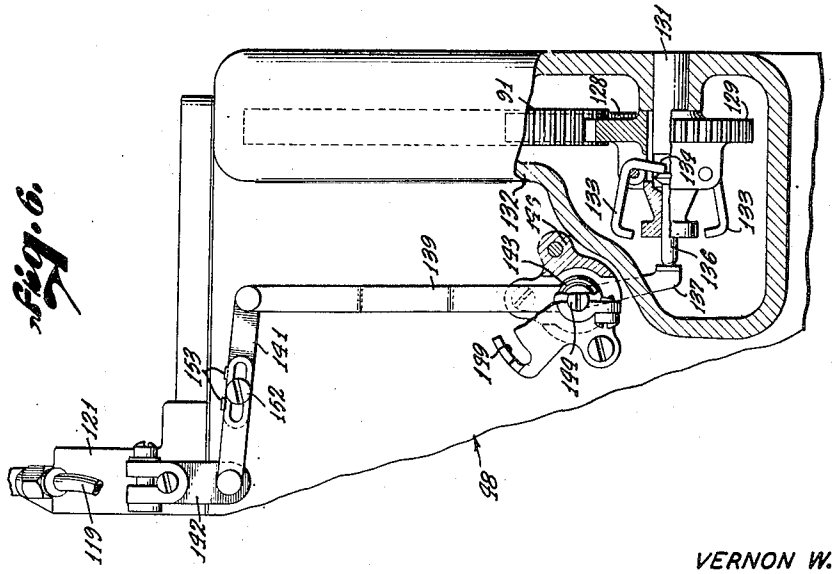


Fig. 6.



VERNON W. BALZER,
INVENTOR.

HUEBNER, BEEHLER,
WORREL & HERZIG,
ATTORNEYS.

BY Warren T. Jessup

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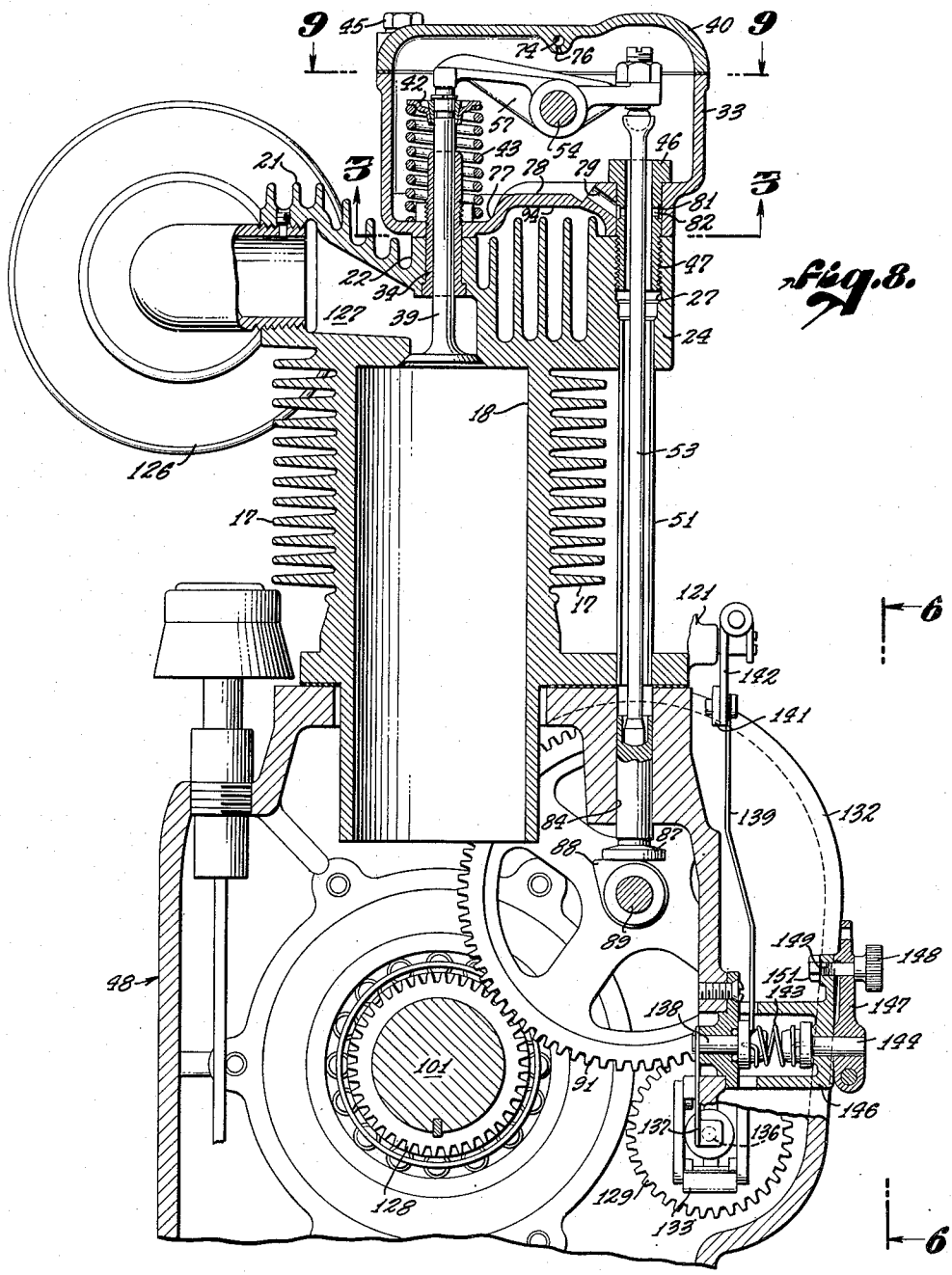


Fig. 8.

VERNON W. BALZER,
INVENTOR.

HUEBNER, BEEHLER,
WORREL & HERZIG,
ATTORNEYS.

BY Warren T. Jessup

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Fig. 10.

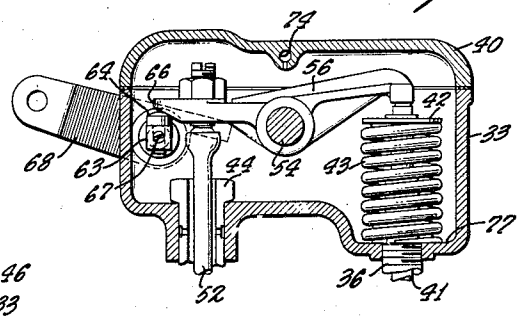


Fig. 9.

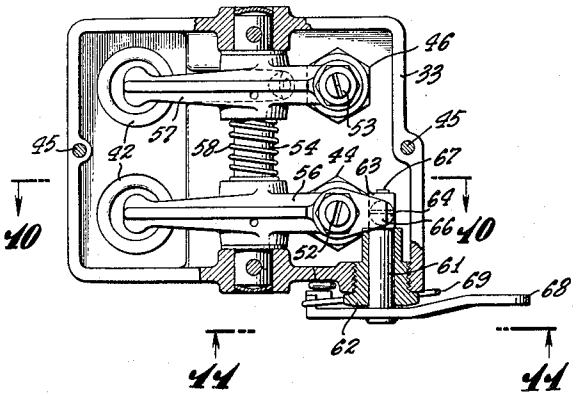


Fig. 11.

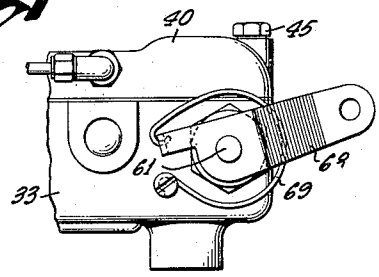


Fig. 12.

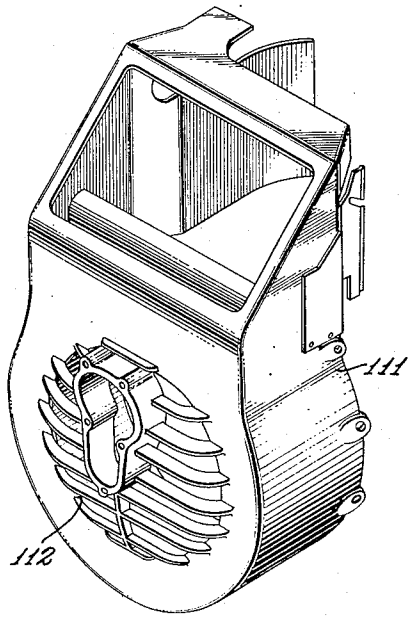
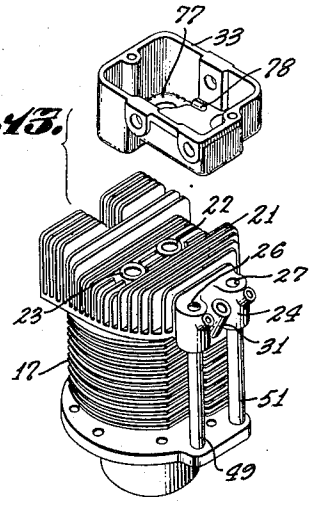


Fig. 13.



VERNON W. BALZER,
INVENTOR.

HUEBNER, BEEHLER,
WORREL & HERZIG,
ATTORNEYS.

BY Warren T. Jessup

United States Patent Office 2,758,580 Patented Aug. 14, 1956

2,758,580

INTERNAL COMBUSTION ENGINE

Vernon W. Balzer, Van Nuys, Calif., assignor to Hallett Manufacturing Company, Inglewood, Calif., a corporation of California

Application March 8, 1951, Serial No. 214,465

7 Claims. (Cl. 123—41.65)

This invention relates to an improved cooling and lubrication arrangement for an internal combustion engine, particularly for an air-cooled, overhead valve type of engine.

It is an object of this invention to provide a compact and efficient valve actuating arrangement for a valve-in head engine.

It is another object of this invention to provide simplified and improved lubrication for the valve actuating mechanism of an overhead, or valve-in head, engine.

It is a further object of this invention to provide simplified and improved means for mounting a rocker arm casing on an overhead valve engine.

It is a further object of this invention to provide improved means for assisting in the starting of an internal combustion engine.

It is a further object of this invention to provide an improved lubrication system for lubricating the connecting rod bearings and the wrist pin bearings in an internal combustion engine.

It is a further object of this invention to provide improved and simplified means for draining, or scavenging, oil from the rocker arm casing back to the oil sump of an internal combustion engine.

It is a still further object of this invention to provide an improved structure for enhancing and rendering more efficient the cooling action of a cooling fan in an internal combustion engine.

In accordance with these and other objects which will become apparent throughout the ensuing specification, this invention will now be described with reference to the accompanying drawings wherein:

Fig. 1 is a side elevation of the complete engine embodying the features of the instant invention.

Fig. 2 is a cross-section taken on line 2—2 of Fig. 1.

Fig. 3 is a view taken on line 3—3 of Fig. 8, looking upwardly on the bottom or floor of the rocker arm casing forming a feature of the instant invention.

Fig. 4 is a longitudinal section taken on line 4—4 of Fig. 2.

Fig. 5 is a cross-section of the lubrication pump illustrated in elevation in Fig. 2.

Fig. 6 is a fragmentary view partially sectioned, taken from the direction 6—6 in Fig. 8, showing the linkage mechanism by which the speed of the engine is automatically controlled by a governor.

Fig. 7 is a fragmentary enlarged cross-section taken on line 7—7 of Fig. 2.

Fig. 8 is a cross-sectional view taken on line 8—8 of Fig. 7.

Fig. 9 is a sectional view taken on line 9—9 of Fig. 8.

Fig. 10 is a fragmentary section taken on line 10—10 of Fig. 9.

Fig. 11 is a fragmentary elevation taken along the line 11—11 of Fig. 9.

Fig. 12 is a perspective view showing the housing which fits over the cooling fan located on the drive shaft exteriorly of the engine proper.

Fig. 13 is a perspective exploded view showing the manner in which the rocker arm casing or housing is mounted to the engine proper.

Referring to the drawings, 16 designates an internal combustion engine having external cooling fins 17 formed around the cylindrical cavity or cylinder 18 in which a piston 19 reciprocates. Fins 21 (Figs. 2 and 13) are also formed on the upper portion of the engine above the cylinder 18, and through this fin assembly extend upwardly a pair of hollow bosses 22 and 23 (Figs. 4, 8, and 13) embodying ports 28 and 29, respectively, communicating between the cylinder 18 and the exterior of the engine. Formed integral with the engine, and constituting in effect an enlarged fin, is an overhanging or ledge portion 24 through which pass vertical holes or ports 26 and 27 paralleling the ports 28 and 29 of the hollow bosses 22 and 23, respectively. The ledge portion 24 serves also to contain a fuel injector boss 31 in which is mounted a diesel type fuel injector 32 which jets atomized fuel into the cylinder 18.

Mounted atop the engine 16 is a rocker arm casing 33 having four ports in the floor thereof registering with the four ports 28, 29, 26, and 27, respectively, in the engine. Registration of the ports in this fashion provides a means for clamping the casing 33 to the engine 16, and also provides communication between the casing and the engine, since the clamping means used consists of hollow bolts or tubular bushings, as will be seen in the description immediately following.

Referring to Fig. 4, the bore of the ports 28 and 29 is of reduced diameter in the upper portion, thereby forming shoulders adapted to receive the head of a tubular or hollow bolt 34, in the port 28, and a similar bolt 36 in the port 29. These bolts extend through registering ports in the floor of the casing 33 and receive nuts 37 and 38, respectively, which serve to clamp the casing 33 firmly against the bosses 22 and 23 of the engine 16. The bolts 34 and 36 and nuts 37 and 38 are preferably made of brass or other good heat conducting material, so that heat may be readily transferred from the bosses 22 and 23 of the engine 16 to the casing 33 which thus serves as an extended cooling fin.

The hollow bolts 34 and 36 receive, in a snug sliding fit, reciprocating valve stems 39 and 41, respectively, one of which, 39, actuates the intake valve formed integral on the bottom thereof and the other of which, 41, actuates the exhaust valve. The upper ends of the valve stems 39 and 41 extend into the interior of the casing 33 and terminate in the usual valve keepers 42 which serve to retain compressed valve springs 43.

Mounting of the other end of the casing 33, at the ledge ports 26 and 27, is also effected by tubular or hollow bolts 44 and 46 (Fig. 7) screwed into the ledge ports 26 and 27, respectively, which are threaded for that purpose as shown at 47. The heads of the bolts as shown, bear against the floor of the casing 33 and serve to clamp it to the engine 16 at the ledge 24.

A cap 40 is bolted over the casing 33 by means of bolts 45.

As best seen in Fig. 8, the ledge 24 overhangs the crank case portion 48 of the engine 16, beyond the fins 17. Push rod tubes 49 and 51 are press fitted into the bottom portion of the ledge ports 26 and 27, respectively, and communicate downwardly with the crank case 48. Reciprocating loosely in the tubes 49 and 51 and the hollow bolts 44 and 46 are the respective push rods 52 and 53.

It will thus be seen that the tubular bolts 34, 36, 44, and 46, serve the triple purpose of: (*a*) clamping the casing 33 to the engine 16; (*b*) providing communication for the valve stems 39 and 41 and the push rods 52 and 53 between the casing 33 and the interior of the engine; and

(c) providing a good heat conducting bond for transferring heat from the engine block to the casing 33, which dissipates it to the air.

As best seen in Figs. 7 and 9, a rocker arm shaft 54 extends across the casing 33 and to it are oscillatably mounted a pair of rocker arms 56 and 57. Compressed between the arms 56 and 57 and circumjacent the shaft 54 is a spring 58, which presses the two rocker arms outwardly against thrust bearing surfaces formed on the casing 33. The rocker arms 56 and 57 serve, in conventional fashion, to transmit the motion of the push rods 52 and 53 to the respective valve stems 39 and 41. As seen in Figs. 9 and 10 the exhaust valve stem 41 is actuated downward by the rocker arm 56 upon each upward thrust of the push rod 53, while a similar relationship exists between the stem 39 and the rod 52.

One of the features of the instant invention is the provision for easier starting of the engine, achieved by the employment of cam means movably mounted to the casing 33 and actuable externally for pressing the rocker arm 56 clockwise (Fig. 10) against the bias of the valve spring 43 to hold the exhaust valve stem 41 in open position while the engine is being turned over by a hand crank or other external starter. In the instant invention this cam means includes a shaft 61 journalled in a bushing 62 threaded into the wall of the casing 33. The end of the shaft 61 is squared as shown at 63 and provided with an adjustable screw 64, the head of which constitutes a cam surface, bearing against a corresponding cam portion 66 of the rocker arm 56 which extends beyond the push rod 53. An axial set screw 67 in the end of the shaft 61 serves to anchor the adjustable screw 64 in place.

A handle 68 secured to the external end of the shaft 61 serves to hold the shaft in place and also provides a means for manually actuating the cam surface to press the rocker arm 56 down against the exhaust valve stem 41. A torsion spring 69 secured to the exterior of the casing 33 and linked to the handle 68 serves to bias the head of the cam screw 64 away from the cam portion 66 so as to preclude any danger of the cam means interfering with normal operation of the rocker arm 56.

It is another feature of the instant invention that the push rod bolts 44 and 46 have the still further function of scavenging lubricating oil from the casing 33 back to the crank case 48. This lubricating oil is conveyed to the casing 33 through a conduit 73 feeding a horizontal passageway 74 (Fig. 7) in the cap 40, which passageway is located directly over the push rod shaft 58, as best seen in Fig. 10. Two small bores 76 are provided communicating with the oil passageway 74, one over each rocker arm 56, so that a thin stream of lubricating oil continuously drips onto the center of each arm. This oil serves to lubricate the oscillating bearing of the arms themselves and also seeps onto the contact points between the arms, the valve stems, and the push rods.

The oil then drains to the bottom or floor of the casing 33 and collects in the recessed lower portion 77 immediately over the valve stem ports 28 and 29, where it extracts heat from the engine block through the bolts 34 and 36 and the bosses 22 and 23. The floor of the casing 33 is embossed downwardly adjacent the recess 77, as best seen in Fig. 8, to form a channel 78 communicating with the recessed portion 77. The other end of the channel communicates with a slanting passage or bore 79 drilled in the floor of the casing 33 and communicating with the casing port containing the push rod hollow bolt 46. An annular, peripheral groove 81 is provided around the bolt 46 spaced at such a distance below the head of the bolt that when assembled into the engine it will register with the passage 79. One or more radial holes 82 are drilled in the bolt 46 at the groove 81 communicating with the tubular or hollow interior thereof.

Oil in the casing sump or recess 77 is thus enabled to drain through the channel 78, passage 79, groove 81, and holes 82 into the interior of the bolt 46. From there the oil passes down the push rod tube 51 to the crank case 48.

The roof of the crank case 48 immediately under the ledge 24 (Fig. 7) has a pair of vertical bores 83 and 84 forming bearing surfaces for reciprocation of cam members 86 and 87, the upper portions of which are recessed to receive the lower ends of the push rods 52 and 53. The members 86 and 87 ride on cams 88 secured to a cam shaft 89 driven by a gear 91 keyed thereto, which is in turn driven from the engine itself, as will be explained hereinafter. Oil flowing down inside the push rod tube 51 falls onto the upper end of the cam member 87 and serves to lubricate it in its bore 84. As the member 87 reciprocates rapidly up and down it tends to splash some of the oil into a horizontal passage 92 communicating with the other bore 83 in which reciprocates the cam member 86 actuating the exhaust push rod 52. Excess oil drains off through a sloping passageway 93 into the interior of the crank case 48 itself.

The embossing of the floor of the casing 33 to form the channel 78 (Fig. 8) has an additional advantage best illustrated in Fig. 3. Whereas a channel (78) is formed on the interior of the casing floor, a baffle 94 is formed on the under or exterior surface of the casing 33 by the same embossing operation. This baffle serves to divert a portion of the cooling air flowing, as shown by the arrows 96, transversely to the right between the boss portions of the casing 33 in which are located the push rod ports. Air is thus directed across the ledge 24 and around the injector 32 and serves to cool the injector.

The engine includes a crankshaft 101 (Figs. 2 and 4) with an offset or crank portion 102 formed therein having a bearing surface to which a piston connecting rod 103 is secured. The upper end of the connecting rod carries the piston 19 through the intermediacy of a wrist pin, in conventional fashion. At the bottom of the crank case 48 is a sump 104 forming a reservoir for lubricating oil. To the forward end of the shaft 101 exteriorly of the crank case 48 is secured a fan 106 which blows air upward and back across the cooling fins 17 and 21 so as to cool the engine block. It is this air which is partially diverted by the embossed baffle 94 formed athwart the air flow.

A starting crank 107 may be engaged with the crankshaft 101 through a conventional pin-and-slot connection 108 and through suitable gearing 109. A housing 111 is mounted over the fan 106, to the exterior of which is mounted the gearing assembly 109 of the crank 107. A louvered opening 112 is provided in the housing 111 around the gearing assembly 109.

The upper portion of the housing 111 also serves to carry a fuel tank 113. Fuel is conveyed from the tank 113 through a pipe 114 to a filter 116 from whence it passes in a pipe 117 upwardly through a low pressure fuel pump 118 and thence in a pipe 119 to a high pressure fuel pump 121 (Fig. 2). From the high pressure pump 121, fuel flows in a pipe 122 to the injector 32 which atomizes it and shoots it into the cylinder 18. An air bleeder conduit 123 is provided from the injector 32 to the intake of the pump 121. Combustion air is drawn in through an air cleaner 126 and through the air inlet port 127 past the intake valve stem 39 into the cylinder 18.

Speed of the engine is controlled by a governor mechanism best seen in Figs. 6 and 8. A gear 128 keyed to the main shaft 101 meshes with the cam shaft gear 91 (described hereinbefore in connection with Fig. 7) which in turn meshes with a governor gear 129. The gear 129 is journalled on a fixed shaft 131 mounted in an auxiliary housing 132 into which the cam shaft gear 91 also extends. As best seen in Fig. 6, the gear 129 carries a pair of governor members 133 having arms 134

bearing against the head of a slidable, axially-mounted pin 136. As the gear 129 rotates, centrifugal force on the members 133 is transmitted through the arms 134 to urge the pin 136 outwardly of the governor assembly. Pin 136 bears against an arm 137 secured to a shaft 138 (Fig. 8) journalled in the wall of the crank case 48. To the exterior of the shaft 138 is secured a linkage arm 139, the upper end of which is connected, through an adjustable link 141, to a throttle actuating arm 142.

A torsion spring 143 is connected at one end to the shaft 138, and the other end is secured to an adjustable shaft 144 journalled in a frame 146 secured externally of the crank case 48. An arm 147 secured to the outer end of the shaft 144 is held adjustably in position by a knurled set screw 148 passing through an arcuate slot 149 in the frame 146 and secured by a nut 151. The torsion spring 143 constitutes a resilient bias against the force of the centrifugal governor members 133, which bias may be adjusted by changing the mounting of the spring through rotation of the arm 147. The sensitivity of the engine throttle to engine speed may be thus adjustably controlled.

Adjustment in speed setting is provided by the link 141 which is made in two parts having registering slots and a bolt-and-nut connection 152 by which the effective length of the link 141 may be altered. Tabs 153 on each portion of the link 141 tend to keep the link in a straight line during adjustment of the bolt connection 152.

A further feature of the lubrication system for internal combustion engines forming the subject of the instant invention is to be found in the forced jet lubrication now to be described.

Referring particularly to Figs. 2 and 5, a pump 161 is secured vertically within the crank case 48, with the lower, inlet end of the pump disposed beneath the oil level in the sump 104. The pump is driven by a cam 162 secured to the cam shaft 89. The bottom of the pump is formed as a foot 163 and the entire bottom of the foot 163 is open to form an intake port which may be spanned by a filter screen 164. Because of the large area of the "sole" of the foot 163 the screen 164 does not offer serious impedance to the oil flow.

The body of the pump 161 is formed of a vertical cylinder 166 made integral with the foot 163. Within the cylinder 166 is reciprocably mounted a cylindrical piston 167 open at the upper end and closed at the lower end by a transverse wall having a port 168 therein. A ball 169 rests on the port 168 forming in effect a check valve within the piston 167. At the bottom of the cylinder 166, where it joins the foot 163, is a bushing 171 having a port 172 therein on which rests a ball 173 forming another check valve in the pump. A compression spring 174 is placed between the bushing 171 and the piston 167 serving to bias the piston upwardly. The outlet port for the pump is at the top of the cylinder 166 and communicates with the pipe 176. A pin 177 spans the interior of the piston 167 and forms an abutment for a pump actuating rod 178, the upper end of which is engaged by the cam 162.

There is appreciable clearance between the rod 178 and the interior bore of the piston 167, so that oil may freely leave the interior of the piston and enter the upper portion of the cylinder 166.

In operation, each down stroke of the cam driven rod 178 brings it into engagement with the pin 177, and pushes down the piston 167 against the bias of the spring 174. Oil thus lifts the ball 169 and flows into the upper portion of the cylinder. When the cam 162 recedes from the rod 178, the spring 174 forces the piston 167 upwardly and pushes the oil into the pipe 176 leading upward to the engine and to the rocker arm casing. This spring action also draws in oil through the filter screen 164 and past the valve ball 173 into the cylinder chamber occupied by the spring 174.

It will be noted that the pump force is not the absolute or positive force of the cam driven rod 178 but is rather the predetermined, limited force of the compression spring 174. Thus, should the engine be driven very fast so that the potential output of the pump 161 exceeds the capacity of the oil conduit system, the piston 167 will be forced by the spring 174 only partially up its full stroke before the rod 178 again returns to push the piston down. The pressure deliverable by the pump 161 thus has a predetermined maximum.

The pipe 176 conveys the oil up to a vertical bore 179 formed in the crank case wall, from which it passes through a pipe 181, through an oil filter 182, and thence, in the pipe 73, to the lubrication passage 74 in the cap 40 of the rocker arm casing 33. As mentioned hereinbefore this oil drips down on the two rocker arms 56 and 57, and after lubricating the rocker arm assembly completely, drains through the downwardly embossed channel 78 into the interior of the hollow bolt 46 and thence down the push rod tube 51 to the passage 93 (Fig. 7) and back into the oil sump 104. In so traversing this path the oil also tends to carry heat away from the rocker arm assembly.

A feature of the instant invention comprises jet means in the form of a nipple 188 formed integral in the wall of the crank case 48 and communicating with the vertical bore 179. This jet means is directed horizontally inward against the connecting rod 103 just below the skirt 183 of the cylinder 18. The force of the jet emitted from the nipple 188 splashes it so violently against the connecting rod 103 that the oil is splashed upwardly to the interior of the piston 19 where it lubricates very effectively the wrist pin bearing surface between the rod 103 and the piston 19. Oil also flows down the rod 103 to lubricate the connecting rod bearing surface between the rod 103 and the crank 102 of the shaft 101.

While the instant invention has been shown and described herein in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is therefore not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent apparatus.

What is claimed is:

1. In an air-cooled engine, the combination including: an engine having a cylindrical cavity therein, cooling fins on the exterior thereof, and a pair of valve stem ports communicating between the cavity and the exterior of the engine; a cooling fan mounted to said engine for impelling cooling air past said fins; said engine having an overhanging or ledge portion and a pair of push rod ports passing through said ledge; a rocker arm casing mounted atop said engine and having four ports in the floor thereof registering with the two valve stem ports and the two push rod ports, respectively; hollow bolts in the form of externally threaded bushings passing through said engine and casing ports to secure said casing to the engine at the four casing ports; a pair of push rod tubes communicating, respectively, between said two push rod ports and the interior of the engine for draining lubricating oil from the casing to the engine; a passageway in the floor of said casing communicating through the respective threaded bushing with one of said push rod tubes; the floor of said casing being embossed downwardly, forming on the interior of said casing a channel conveying oil to said floor passageway for drainage through said push rod tube to said engine, and forming on the exterior of said casing a baffle transversely athwart the air flow from said fan thereby to divert a portion of the air flow to one side; valve stems passing through the bushings in said valve stem ports; push rods passing through the bushings in said push rod ports; and a pair of rocker arms oscillatably mounted within said casing and contacting the ends of said stems and push rods.

2. Rocker arm assembly for an internal combustion

engine, comprising an engine having a cylindrical cavity therein and a pair of valve stem ports communicating between the cavity and the exterior of the engine, said engine having an overhanging or ledge portion and a pair of push rod ports passing through said ledge, a rocker arm casing mounted on said engine and having four ports therein registering with the two valve stem ports and the two push rod ports, respectively, hollow bolts in the form of externally threaded bushings passing through said engine and casing ports to secure said casing to said engine at the four casing ports, valve stems passing through the bushings in said valve stem ports, push rods passing through the bushings in said push rod ports, and a pair of rocker arms oscillatably mounted within said casing and contacting the ends of said stems and push rods.

3. In an air-cooled engine, the combination including an engine having a cylindrical cavity therein and cooling fins on the exterior thereof, a cooling fan associated with said engine for impelling cooling air past said fins, a rocker arm casing mounted atop said engine and having a port in the floor thereof, a push rod tube communicating between the port in the floor of said casing and the interior of the engine for draining lubricating oil from the casing to the engine, a tubular bolt located in the port in the floor of said casing and threaded into said engine to clamp said casing to said engine, a passageway in the floor of said casing communicating with said port in the floor of the casing, the floor of said casing being embossed downwardly, forming on the interior of said casing a channel conveying oil to said floor passageway for drainage through said push rod tube to said engine, and forming on the exterior of said casing a baffle transversely athwart the air flow from said fan thereby to divert a portion of the air flow to one side.

4. In an air-cooled engine, the combination including an engine having a cylindrical cavity therein and cooling fins on the exterior thereof, a cooling fan associated with said engine for impelling cooling air past said fins, a rocker arm casing mounted to said engine, and a push rod tube communicating between said casing and the interior of the engine for draining lubricating oil from the casing back to the engine, the floor of said casing being embossed downwardly to form on the interior of said casing a channel conveying oil to said push rod tube for drainage from said casing, and forming on the exterior of said casing a baffle athwart the air flow from said fan thereby to divert a portion of the air flow transversely.

5. Rocker arm assembly for an internal combustion engine, comprising an engine having a ledge portion with a bore passing through said ledge portion, a push rod tube communicating from said bore to the interior of said engine, a rocker arm casing atop said engine, a tubular bolt threaded into said bore and serving to clamp said casing to said ledge, said bolt having an annular groove and a radial port communicating from said groove to the interior of said bolt, said casing having a passageway in the floor thereof communicating with the annular groove in said bolt whereby lubricating oil may drain from said casing through said floor passageway and said radial port down said push rod tube to return to the interior of said engine, and a push rod reciprocating in said tube and in said tubular bolt.

6. Rocker arm assembly for an internal combustion engine, comprising an engine, a casing mounted to said engine, a push rod tube communicating between the interior of said casing and the interior of said engine, a hollow bolt constituting an externally threaded tubular bushing disposed in alignment with said push rod tube and securing said casing to said engine, means for draining lubricating oil from said casing into said tube and thence to said engine, and a push rod disposed for reciprocation within said tube and bushing.

7. Rocker arm assembly for an internal combustion engine, comprising an engine, a rocker arm casing mounted to said engine, a passageway communicating between the interior of said casing and the interior of said engine, and a hollow bolt disposed in said passageway and screwed into said engine to clamp said casing thereto, said passageway serving to return lubricating oil from said casing to said engine.

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