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ENGINE FRAME CONSTRUCTION

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2 Sheets-Sheet 1

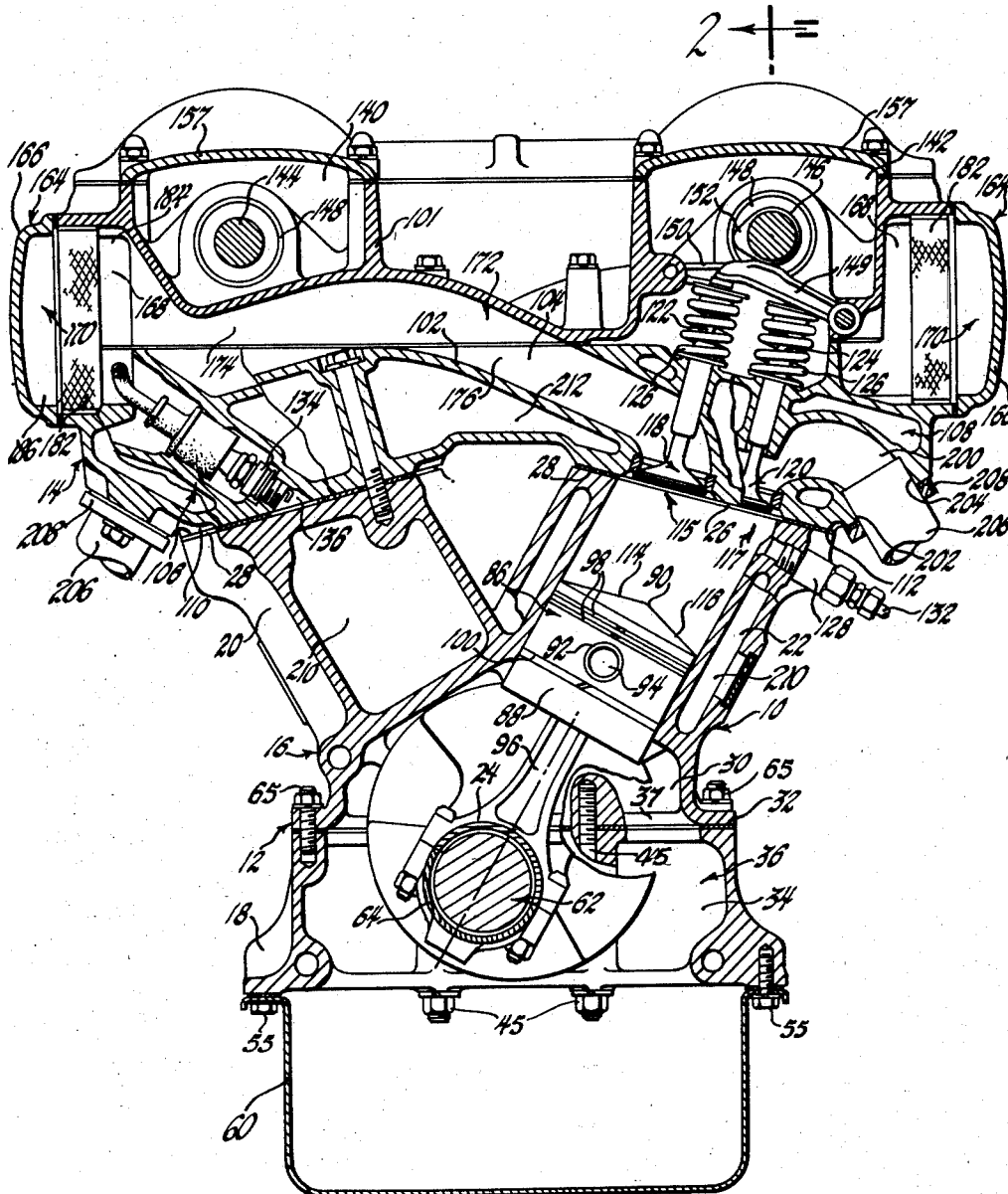


Fig. 1

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2 Sheets-Sheet 2

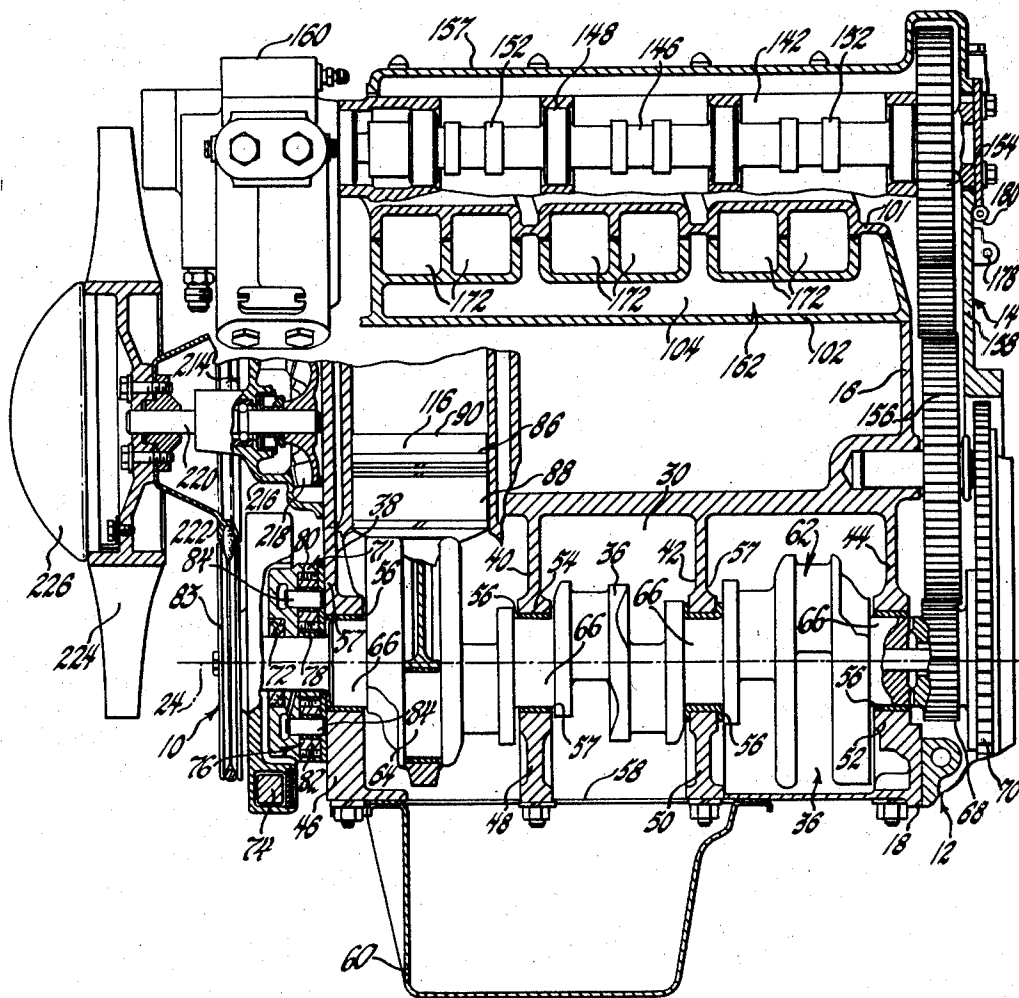


Fig. 2

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ENGINE FRAME CONSTRUCTION

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2 Claims. (Cl. 121—194)

The present invention relates to engines and more particularly to internal combustion engines.

In the past internal combustion engines have employed a single casting that forms a cylinder block having one or more cylindrical passages extending therethrough. Pistons are then disposed in these cylinders and one or more cylinder heads may be secured to the cylinder block for closing the open ends of the cylinders and also cooperate with the upper ends of the pistons to form combustion chambers. The opposite ends of the cylinders may open into a crankcase that is formed by a recess extending longitudinally along the bottom of the block. A sheet metal pan is then normally secured to the block to form a crankcase that encloses a rotating crankshaft driven by the pistons. A plurality of bulkheads on the block may then extend transversely across the recess to divide it into one or more compartments. Bearing caps are secured to the bottoms of these bulkheads to cooperate with recesses in the bulkheads and form the main bearings for supporting the crankshaft. Although this form of construction has been satisfactory in the past, there are many objections thereto when it is employed in a high compression light-weight engine. For instance, this requires excessively heavy castings, the engine is not a basically rigid mounting for the crankshaft, it is difficult to assemble and it is not well adapted for light-weight alloys.

It is now proposed to provide an engine in which the cylinder block includes an upper member and a lower member which may be cast so each one is in and of itself very rigid. Thus when they are secured together, they will form an integral structure which is very rigid. The upper member may have a plurality of cylinder passages extending therethrough so the inner ends open into a recess extending along one of the sides of this block. A plurality of transverse bulkheads may extend across this recess to divide it into separate compartments. The lower member may have a longitudinally extending recess similar in shape to that in the upper member with bulkheads also dividing it into separate compartments. The bulkheads on the two members may be positioned so that the bulkheads on one member will be in the same plane as those on the other member so that the adjacent bulkheads will have abutting edges.

The upper and lower members are preferably separated along a plane including the axis of the crankshaft. Thus the abutting edges of the bulkheads may have a semi-cylindrical bearing. When the two members are secured together, the semi-cylindrical bearings will form the main bearings for the crankshaft and these recesses will form a crankcase for enclosing a crankshaft. It will thus be seen that each of the members may be a rigid box-like structure reinforced by transverse bulkheads. Consequently, when both of the members are secured together, they will form a very rigid structure that will maintain the crankshaft properly positioned at all times. If desired, an opening may be provided in the bottom of the lower member to allow excess lubricants to flow from

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the crankcase. A stamped sheet metal pan may be secured to the lower member to close this opening and form a sump for the engine lubricant. When the engine is to be employed in an automobile in which road clearance is a problem, the opening may be confined to the higher end of the engine so that the downwardly projecting pan will not materially lower the road clearance.

The cylinder heads and the intake manifold heretofore have comprised several separate pieces. This is particularly true in so-called V-type engines in which a separate cylinder head is usually provided for each bank of cylinders and an intake manifold is disposed therebetween. Heretofore, each of these members have been separately handled and individually assembled onto the engine thus presenting numerous problems in sealing and securing the members together. In addition, since there are several members, there may be relative movement between the banks of cylinders. As a result there have been numerous attempts to devise an integral cylinder head and manifold structure especially for V-type engines that will reinforce the engine and also simplify manufacturing. However, to date, these structures have resulted in complex structures that present numerous manufacturing problems such as requiring complicated coring, etc.

It is now proposed to provide a cylinder head and intake manifold assembly which incorporates the advantages of a one piece cylinder head and manifold structure without being subjected to all of the problems involved in the manufacture of the previous structures. This structure is especially adapted for use on V-type engines and it includes a lower member and an upper member. The lower member includes a pair of angularly disposed faces that are adapted to seat on similarly disposed surfaces on the cylinder block. This lower member will thereby extend all the way across the top of the engine to act with the cylinder banks to form a rigid triangular structure. These faces are also adapted to close the upper ends of the cylinders and thus form the combustion chambers. The intake and exhaust valves may be mounted on the head portions of the lower member so that they may be preassembled thereon. The upper member may include mountings for the valve actuating means such as the camshafts, rocker arms, etc., so that they may be preassembled thereon. Both the upper and lower members may include mating recesses that are adapted to cooperate in forming the induction passages when they are secured together. It may thus be seen that a simplified head and manifold structure has been provided which will act as a structural member in rigidifying the engine structure.

It should also be noted that since the induction passages are formed by mating recesses, the recesses will be open and allow the use of simplified coring when casting these members. It may be seen that this simplified coring of the parts will allow the use of any form of manifolding desired.

The induction system may include one or more longitudinally extending ducts that project forward from the engine so as to form one or more inlets. These inlets may be positioned to take advantage of the ramming effect created by the air flowing past the engine. However, the intake is preferably disposed outside of the blast of heated air resulting from the cooling of the coolant in the radiator. These ducts may terminate in one or more chambers that extend along the opposite sides of the engine and be connected to the cylinders by induction passages. These passages may be adapted to resonate at some predetermined operating condition so that there will be a ramming of air into the engine for a "supercharging" of the cylinders at this condition. In the present instance the invention is adapted for use on a V-type engine and so there are separate compart-

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ments disposed on the opposite sides of the engine. Each of these compartments is connected to the cylinders on the opposite side of the engine by means of "ram" pipes. These ram pipes extend transversely of the engine and are tuned to resonate at some particular engine speed. If desired, suitable air cleaning means may be employed for cleaning the air before it enters the combustion chamber. In the present instance this includes air filter elements in the compartments and on the intakes.

In the two sheets of drawings:

Figure 1 is a transverse cross sectional view of an engine embodying the present invention.

Figure 2 is a longitudinal cross sectional view of the engine of Figure 1.

Referring to the drawings in more detail, the present invention may be embodied in any suitable engine 10. In the present instance this engine 10 is of the so-called V-type having a cylinder block 12 and a head and manifold assembly 14. The block 12 may include an upper member 16 and a lower member 18. The upper member 16 may include two banks 20 and 22 of aligned cylinders 1, 2, 3, 4, 5 and 6. The axes of these cylinders are downwardly convergent to intersect along an axis 24 extending longitudinally along the bottom of the upper member 16. The cylinders in each bank 20 or 22 may extend diagonally through the upper member 16 to form a series of openings 26 in the plane surfaces 28 extending above each bank 20 and 22 of cylinders along the opposite edges of the upper member 16. A longitudinally extending recess 30 may be provided in the bottom of the upper member 16 so that the mouth of this recess 30 will form a mounting flange 32. The lower ends of the cylinders may open into this recess 30.

The lower member 18 may also include a recess 34 and is adapted to be secured to the flange 32 on the bottom of the upper member 16. The recess 34 in the lower member 18 may be similar in shape to that in the upper member 16 and be positioned to register therewith to form a crankcase 36.

A plurality of bulkheads 38, 40, 42 and 44 may be provided on the upper member 16 and bulkheads 46, 48, 50 and 52 on the lower member 18 to extend transversely of the crankcase 36 and divide it into one or more compartments. The bulkheads on one member may be disposed coplanar with a bulkhead on the other member so they will have abutting edges 37. Each pair of these abutting edges may be provided with registering semi-cylindrical recesses 54. These recesses 54 are adapted to receive suitable bearing inserts 56 to form a plurality of substantially cylindrical main bearings 57 concentric with the axis 24.

An opening 58 may be provided in the bottom of the lower member 18 to allow any excess lubricant that may collect in the crankcase 36 to drain therethrough. A stamped sheet metal oil pan 60 may be secured to the bottom of the lower member 18 to close this opening 58 and collect the lubricant draining through the opening and thereby form a sump. Although the entire bottom of the lower member 18 may be open, it has been found that by confining the opening 58 to the higher end of the engine 10, the oil pan 60 will not have to extend the full length of the engine. Thus if the downwardly projecting oil pan is confined to the higher end of the engine and the engine is employed in an automotive vehicle, the road clearance will be increased.

Bolts 55 extend through flanges formed on the oil pan 60 and the edges of said lower member 18 around the opening 58 to secure the oil pan 60 to the lower member 18 for closing the opening 58. Bolts 65 also extend through flanges in the lower edges of the upper member 16 and into the upper edges of the lower member 18 for securing the upper member 16 and the lower member 18 rigidly together. Bolts 45 also extend through the bulkheads 38, 40, 42 and 44 in the upper member 16 and into bulkheads 46, 48, 50 and 52 in the lower mem-

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ber 18 and on opposite sides of the recesses 54 receiving the inserts 56 forming the bearings 57 for securing the members 16 and 18 rigidly together at the bearings 57 for rigidly supporting the crankshaft 62 within the block 12.

Any suitable crankshaft 62 may be disposed in the crankshaft 36 so as to be supported on the main bearings 57 for rotation about the axis 24. In the present instance this crankshaft 62 employs three pairs of throws 64 which are separated by main journals 66 riding on the bearings 57 in the bulkheads. The throws 64 in each pair are disposed at 60° to each other. The pairs of throws are angularly disposed with respect to each other and the crankshaft is counterweighted to balance the primary forces and couples and the secondary forces. The rear intermediate bearing 57 has shoulders to engage shoulders on the crankshaft and oppose any axial thrust which may be imposed on the crankshaft 62.

The after end of the crankshaft 62 may be provided with a timing gear 68 and a flywheel 70 or other means suitable for connection to a load such as a vehicle transmission or drive shaft. The forward end of the crankshaft 62 which is supported by the bearing 57 may project through the forward bulkheads 38 and 46 and through a housing 71 secured to the exterior of the forward bulkheads. A seal 72 may be provided in the front end of this housing 71 so as to be in wiping contact with the crankshaft 62 and prevent the loss of any lubricants from the crankcase 36. A viscous type torsional vibration dampener 74 may be secured to the front end of the crankshaft 62 for absorbing any such vibrations in the crankshaft 62. The lubricant may be circulated through the engine by means of a gear type pump 76 which is disposed in the housing 71. This pump 76 may include a drive gear 78 and a pair of planetary gears 80 and 82 that are mounted on the pins 84. This pump 76 may include a single inlet in the sump and two separate outlets. Thus the pump may draw lubricant from the sump and discharge the lubricant from one outlet into the engine lubricating system and from the other outlet into the transmission. A drive pulley 83 may also be provided on the end of the crankshaft.

A lubricant cooler may be provided on the cylinder block for cooling the oil before it is returned to the lubricating system or the transmission. The present cooler is disposed in heat exchanging relation with the engine cooling system adjacent the point where the coolant enters the block 12 and is coolest to provide the most effective cooling of the lubricant. If desired, this cooler may carry the entire amount of oil flowing through the pump 76 and thus cool all of the lubricant flowing to both the engine and the transmission.

Each of the cylinders may have a piston 86 of suitable design disposed therein. In the present instance the pistons 86 are of the so-called "slipper" type having a skirt 88 and a domed head 90 that has a surface adapted to form a portion of the combustion chamber wall. A pair of diametrically aligned pin bosses 92 may be provided in the skirts 88 for receiving the opposite ends of wrist pins 94. The centers of the wrist pins 94 may receive a bearing in the upper ends of the connecting rods 96 which have the lower ends thereof secured to journals on the various throws of the crankshaft 62. In order to seal the clearance spaces provided between the pistons 86 and cylinder walls, each piston 86 may have a pair of compression rings 98 seated in annular grooves extending around the upper end of the skirt 88. These compression rings 98 are preferably disposed between the upper end of the piston 86 and the wrist pin 94. In addition, an oil ring 100 may be provided on the lower end of the skirt 88 for wiping excess oil off of the cylinder walls. This oil ring 100 is preferably disposed below the wrist pin 94.

The head and manifold assembly 14 may be provided on top of the engine 10 so as to extend the full width thereof. This assembly 14 includes an upper member

101 and a lower member 102 having a center portion 104 and a pair of angularly disposed head portions 106 and 108 on the opposite sides thereof. These head portions 106 and 108 may include plane faces 110 and 112 that seat on the plane surfaces 28 on the upper sides of the cylinder block 12. These faces 110 and 112 will close the open ends of the cylinders and together with the upper ends 90 of the pistons 86 will form the combustion chamber. If the plane surfaces 28 on the block 12 are oblique to the axis of the cylinders, the angle between the two faces may be materially decreased. This in turn may reduce problems in the manufacturing of the lower member that might result in machining the faces and/or warping of the member. In addition the entire combustion chamber will be contained inside of the cylinders.

The upper end of each piston 86 may include a pair of angularly disposed plane surfaces 114 and 116. One of these surfaces 114 on each piston 86 is preferably substantially parallel to a face 110 or 112 of the head portion 106 or 108 while the other surface 116 may be angularly disposed with respect thereto. It will thus be seen that when the piston 86 approaches top dead center, there will be a thin "quench" or "squish" zone 115 formed between the face 110 or 112 and surface 116 and a compact firing zone 117. As a result when the piston 86 is traveling upwardly, the gases in the "squish" zone will be more rapidly compressed than those in the firing zone and consequently, there will be a blast of gases that will flow from the "squish" zone into the firing zone thereby creating a very turbulent flow of gases in the firing zone.

The intake and exhaust valves 118 and 120 which control the ingress and egress of gases into and out of the cylinder may be disposed in the head portions 106 and 108. In the present instance the valves 118 and 120 are reciprocally disposed in valve guides that extend through the head portions of the lower member 102 so that the valve stems 122 and 124 will project from the top of the lower member 102. Cup shaped spring seats may be provided on the upper ends of the stems 122 and 124 so that one or more springs 126 may bias the valves 118 and 120 closed. Thus when the valves 118 and 120 are mounted on the lower member 102 they will be secured in position to allow the lower member to be handled as a single unit.

The intake valve 118 allows air to flow through the induction system directly into the combustion chamber where the fuel is sprayed into the air by means of a nozzle 128. This nozzle 128 may be screwed into a threaded passage that extends through the block to form an opening in one of the cylinder walls. Thus the nozzle 128 may spray fuel into the firing zone where it will mix with the air therein. The fuel is supplied to this nozzle 128 by means of a tube 132 which communicates with a fuel pumping and metering mechanism. In order to ignite the charge formed in the chamber, a spark plug 134 may be threadably mounted in the head portion 106 or 108 so that the electrodes will be disposed in a pocket 136 communicating with the firing zone. Thus when a discharge occurs across the spark plug electrodes, the charge will be ignited in the compact firing zone. A large majority of the charge will be rapidly burned in this space 117 which has a large volume-to-surface ratio. After this is completed the "end gases" will be burned in the "quench" zone 115 formed between the piston 86 and the head 106 and 108. This "quench" zone 115 may have a very large surface-to-volume ratio that will tend to absorb heat from the unburned end gases and prevent premature ignition thereof.

A valve actuating mechanism may be provided for opening and closing the intake and exhaust valves and thereby control the flow of gases into and out of the combustion chamber. In the present instance the opposite sides of the upper member 101 may include camshaft galleries 140 and 142 that extend longitudinally of the engine above each bank 20 and 22 of cylinders. A cam-

shaft 144 and 146 may be rotatably mounted in bearings 148 formed in each gallery so as to extend the length of the gallery 140 and 142. A plurality of rocker arms 149 and 150 may be pivotally mounted on the upper member 101 so as to extend transversely of the camshaft gallery 140 and 142 so that the middle of each rocker arm will ride on one of the cams 152. Since all of the intake and exhaust valves 118 and 120 are not disposed in a common plane, the rocker arms 149 for the intake valves 118 are pivoted on one side of the gallery 140 and 142 and those 150 for the exhaust valves 120 are pivoted on the opposite side so that the ends thereof will engage the ends of the valve stems 122 and 124. It can thus be seen that when the rocker arms 149 and 150 and camshaft are mounted on the upper member 101, this assembly 14 can be handled as a single member.

The rear end of each camshaft 144 and 146 may have a gear 154 mounted thereon which meshes with a gear train 156 driven from the timing gear 68 at the rear end of the crankshaft 62. Thus rotation of the crankshaft 62 will cause rotation of the camshafts 144 and 146 with a consequent opening and closing of the valves 118 and 120. Gallery covers 157 may be secured to the upper member 101 to close each gallery 140 and 142 and thereby conceal and protect the camshafts 144 and 146, etc., and also to prevent the loss of lubricants therefrom. In addition, a timing cover 158 may be secured to the rear of the engine for enclosing the timing gear train 156.

The forward end of one camshaft 144 and 146 may project from the front of the engine 10 so as to drive a distributor 160 for timing the electrical discharges through the spark plug electrodes. The forward end of the other camshaft 144 and 146 which is on the opposite side of the engine 10 may be adapted to drive the fuel pump for discharging fuel through the injector nozzles 128.

In order to deliver air to the cylinders, an induction system 162 may be provided. In the present instance this system 162 includes a pair of longitudinally extending ducts 164 which project forwardly from the front of the engine 10 to form intakes. These intakes may be disposed on the opposite sides of the engine and outside of the flow of hot air passing through the radiator and fan. The rear ends of these ducts 164 may enlarge and flatten out so as to form covers 166 that may be secured to the sides of the head and manifold assembly. Each of these covers 166 may fit over a pair of communicating recesses 168 in the edges of the upper and lower members 101 and 102 to thereby form chambers 170 on the opposite sides of the engine. These chambers 170 may be interconnected with the various cylinders by means of induction passages. In the present instance these induction passages form ram pipes 172 that extend from the chamber 170 on one side of the engine 10 to the cylinders in the bank on the opposite side of the engine. If so desired these ram pipes 172 may be shaped to resonate at some particular engine operating condition. As a consequence when the engine 10 is operating at this condition and the pipes 172 are resonating, there will be a "ramming" of the air into the cylinders which will tend to produce a supercharging of the engine. In addition the air flow may be such as to produce a very high volumetric efficiency even though the engine 10 is not operating at that particular condition.

Each of these ram pipes 172 is formed by a pair of registering recesses 174 and 176 in the upper and lower members 101 and 102 respectively. When the members are secured together these recesses 174 and 176 will cooperate with each to define the walls of the pipes 172. The outer ends of these pipes form openings in the sides of the recesses 168 so as to communicate with one of the chambers 170 and the inner ends form the seats for the intake valves 118. It should be noted that these recesses 168, when the upper and lower members 101 and 102 are separated, one side thereof will be open to the atmosphere and will thus permit a considerably simpler

coring arrangement thereby reducing the cost of manufacture and enabling a freer choice of manifold designs.

In order to control the flow of air into the engine, a throttle valve may be disposed in each of the intakes so as to rotate about the axis of a shaft. These shafts may have an arm that is connected to a linkage extending along the outer sides of the cylinder banks. This linkage may be connected to a cross shaft that extends across the back of the engine and is actuated by a common accelerator control. Although the linkage may be adapted to adjust the relative positions of the throttle valves, there may be structural variations or other means that will produce differences in the amount of air flowing into the two separate chambers. As a result a balance tube 180 may extend around the rear end of the engine 10 to allow a balancing of the air in the two chambers 170.

In order to prevent any foreign matter in the atmosphere entering the engine, air cleaners may be provided on the intakes and/or filter elements 182 may be disposed inside of the chambers. These elements 182 may divide the chambers 170 into inner and outer compartments 184 and 186 with the air entering the outer compartment 186 and leaving from the inner compartment 184. The inner compartment 184 may enclose the spark plugs 134.

An exhaust system may be provided for discharging the exhaust gases from the combustion chambers into the atmosphere. This system may include an exhaust passage 200 for each cylinder that will extend from the exhaust valve 120 outwardly through the head portions 106 and 108 to form exhaust ports 202 in the outsides of the head portions. The outer portion 204 of each exhaust passage may be relieved to receive the end of an exhaust pipe 206 that will extend through the exhaust port 202. This will allow the interior of the exhaust pipes to be in substantial alignment with the interior of the exhaust passage and thereby form a smooth streamline continuation thereof. A collar 208 may be provided on the exterior of the exhaust pipe 206 to form a flange that can be secured to the exterior of the head member. The exhaust pipes 206 from each bank 20 and 22 may converge into a common chamber. Each of these chambers may in turn be connected to a muffler for silencing the exhaust gases before they are discharged into the atmosphere.

In order to obtain the maximum discharge of exhaust gases from the cylinder, it has been found advantageous to shape the exhaust pipes so that they will resonate at some engine operating condition. Thus if the engine is operating at this condition and these pipes resonate, the surging of the gases will tend to produce a vacuum adjacent the exhaust valves which will greatly improve the discharge of the exhaust gases from the cylinder.

In order to prevent overheating of the various parts of the engine a cooling system may be provided. In the present instance this system includes a cooling jacket 210 that is disposed in heat exchanging relation with the walls of the cylinders and the walls of the combustion chamber. In addition the jacket 210 may include passages 212 that permeate the head and manifold assembly 14 so as to be in intimate heat exchanging relation with the valve seats and the walls of the ram pipes 172. A coolant pump 214 may be provided for forcing the coolant through the various passages in the cooling jacket. This pump 214 may include a housing 216 and an impeller 218 which is carried on a rotating shaft 220 that projects from the front end of the housing. In the present instance this

pump 214 is of the centrifugal type having a forwardly curved vane. Although the pump does not have a diffuser, an integrally cast rib in the housing 216 prevents swirling of the coolant thereby reducing the cavitation effect. The outer end of the shaft 220 may be provided with a pulley 222 which is driven by a belt on the lower pulley 83. If desired a cast fan 224 may be provided which has the hub bolted to the pulley 222 so as to rotate therewith. A spinner 226 may be placed over the hub of the fan so as to provide a smooth surface and also conceal the bolts, etc. This pump may draw coolant from a radiator and discharge into the cooling system adjacent the oil cooler.

What is claimed is:

1. A cylinder block for an internal combustion engine having a plurality of cylinders and comprising, upper and lower support members, said support members having recesses extending therein and being adapted to be secured together at the edges around said recesses to form a crankcase for said engine, bulkheads extending transversely of said upper and lower support members and dividing said recesses into separate crankcase compartments, said separate crankcase compartments each having a cylinder opening therein through said upper support member, said bulkheads having edges formed to provide bearings for supporting the crankshaft of said engine, and bolts extending from one of said support members to another and securing said support members rigidly together, certain of said bolts extending through said bulkheads adjacent each side of said bearings and securing said bearings rigidly together for supporting said crankshaft within said support members, other of said bolts extending through said support members at said edges around said recesses.

2. A cylinder block for an internal combustion engine as defined by claim 1 and in which an opening is formed in the lower wall of said lower support member and at one end of said lower support member, said opening communicating with one of said separate compartments in said crankcase, an oil pan disposed over said opening and extending downwardly from said support member beneath said lower wall and said opening, bolts securing said oil pan to the edges of said lower support member around said opening, the other end of said lower support member and another of said separate crankcase compartments being closed by said lower wall of said lower support member.

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