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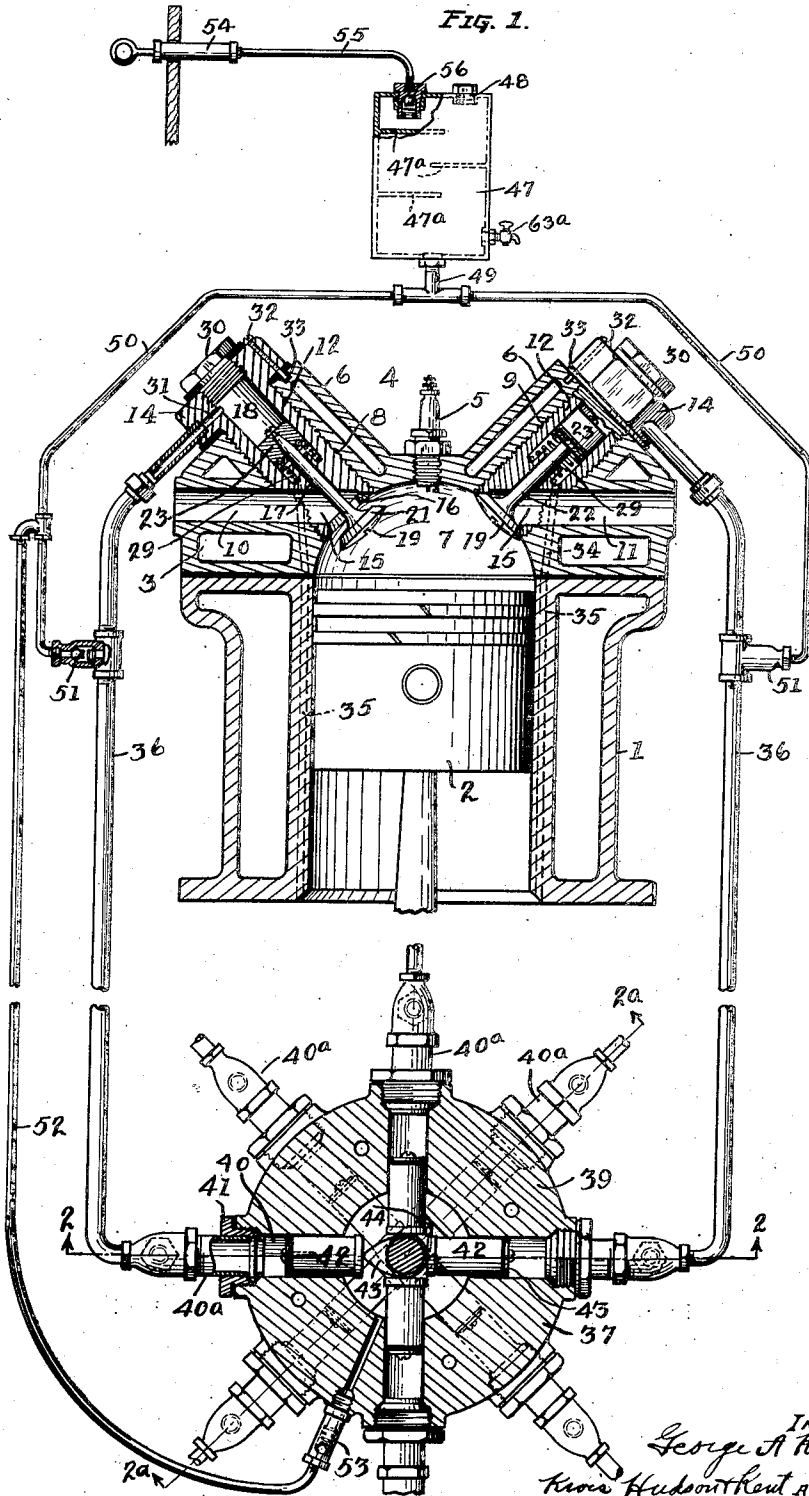
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G. A. KOLB

INTERNAL COMBUSTION ENGINE

Filed Aug. 3, 1925

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FIG. 2.

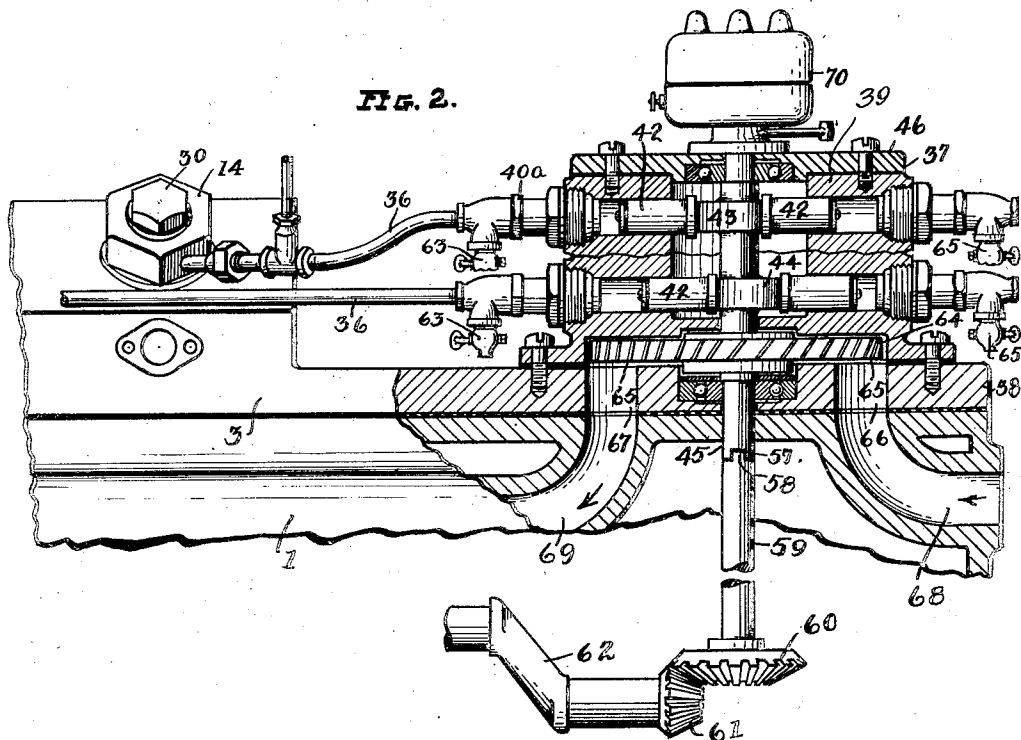
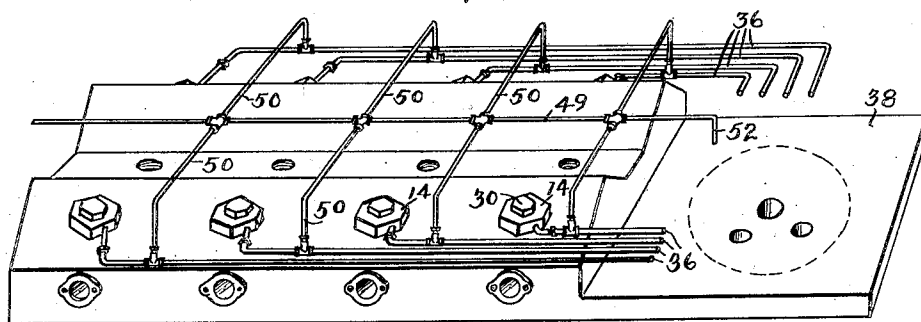


FIG. 3.



INVENTOR

George A. Kolb.

Kerr Hudson & Kent ATTORNEYS

Nov. 27, 1928.

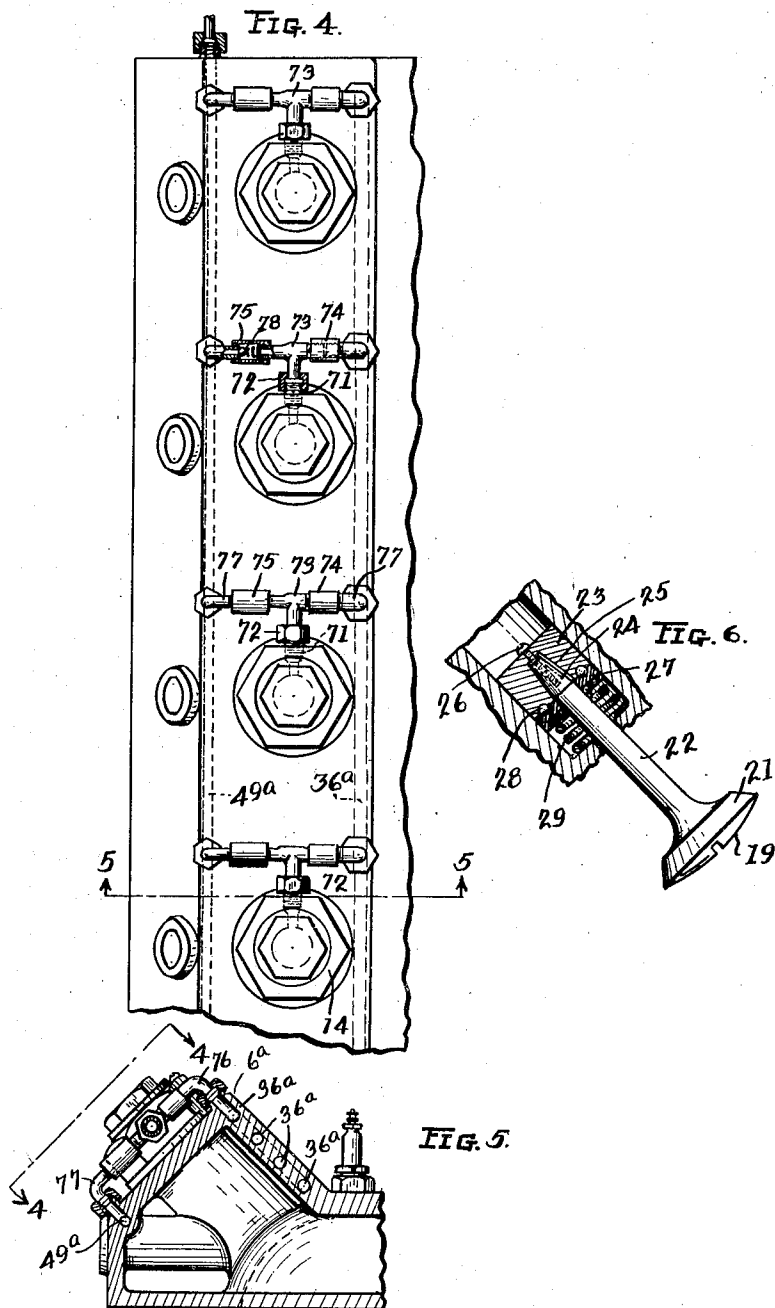
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George A. Kolb INVENTOR
Kewis Hudson & Kent ATTORNEY

UNITED STATES PATENT OFFICE.

GEORGE A. KOLB, OF BEDFORD, OHIO.

INTERNAL-COMBUSTION ENGINE.

Application filed August 3, 1925. Serial No. 47,775

The present invention relates to internal combustion engines and more particularly to the mounting of inlet and exhaust valves, the valve operating mechanism and the mounting thereof upon the engine.

Among the most important of its objects, the present invention aims to provide an engine in which the operation of the valves is rendered noiseless, in which the wear on the valve operating cams and parts engaged thereby is automatically taken up without affecting the operation of the valves and in which the valves and valve seats are readily accessible for inspection, cleaning, repair or replacement.

A further object of the present invention is to simplify the valve actuating mechanism and to so position the entire mechanism that it is readily accessible for inspection and repair.

A further object is to provide an engine in which the valves and valve operating mechanism are carried by the head and are removable therewith.

A further object is to reduce the number of cams required to operate the valves.

A further object is to provide a construction in which both the valves and valve seats are embodied in units readily removable from the head without removing the same from the cylinder block so that the valves may be easily removed for cleaning or grinding or a worn valve unit may be replaced by a new unit.

A further object is to provide a hydraulic valve operating system in which there is a minimum loss of oil due to leakage and in which any oil which leaks from the system is utilized for lubricating purposes.

A further object is to utilize a vertical shaft at the end of the engine which is driven from the engine crank shaft for actuating the valves and further to utilize said shaft for operating the water pump of the engine cooling system and the distributor for controlling the firing of the cylinders.

A further object is to provide an engine in which the valve actuator, water pump and distributor are mounted as a unit upon the engine.

A further object is to provide a driving connection between the mechanism on the head and the engine drive shaft which will permit said mechanism to be lifted with the head in its removal from the cylinder block.

With the above and other objects in view, the invention may be said to comprise the engine and parts thereof, as illustrated in the accompanying drawings hereinafter described and particularly set forth in the appended claims, together with such variations and modifications thereof as will be apparent to one skilled in the art to which the invention appertains.

Reference should be had to the accompanying drawings, forming a part of this specification, in which Fig. 1 is a vertical section through the engine head and cylinder block showing the inlet and exhaust valves for one cylinder and showing diagrammatically the hydraulic valve actuating mechanism, the cam casing forming part of the valve actuating mechanism being shown in horizontal section; Fig. 2 is a side elevation of the forward portion of the engine head, a portion of the actuating unit casing being broken way and shown in axial section, the upper portion of the casing being shown on the section line indicated at 2-2 in Fig. 1 and the lower part thereof on the section line indicated at 2^a-2^a of Fig. 1; Fig. 3 is a perspective view of the head, showing the piping to the valve units on the head; Fig. 4 is a top plan view of one side of the head showing a construction in which the main oil passages are formed in the head; Fig. 5 is a section taken on the line 5-5 of Fig. 4; and Fig. 6 is an enlarged sectional detail view showing the attachment of the valve stem to the valve actuating piston.

Referring to the accompanying drawings, the cylinder block of the engine is indicated by the numeral 1 and the piston shown in Fig. 1 is indicated by the numeral 2. The cylinder block 1 is water jacketed as a common practice in the art and has detachably mounted thereon a water jacketed head 3 which has a depressed central portion 4 in which the spark plugs 5 are mounted and raised side portions 6 extending along opposite sides thereof. The inner side of the head 3 is formed to provide a spherical concavity 7 at the upper end of each of the cylinders, the cavity 7 forming an extension of the chamber above the piston into which the inlet and exhaust valves and the spark plug project, the valves being located upon opposite sides of the concavity and the spark plug at the center thereof.

The head 3 is also provided with inlet and exhaust passages 10 and 11, these passages

extending from the opposite sides of the head toward the center thereof and being connected with inlet and exhaust manifolds (not shown) on opposite sides of the head. An inlet and exhaust port is provided for each cylinder and these ports are located in alignment on opposite sides of the cylinder.

The inlet and exhaust valves are preferably in the form of units comprising a valve cage and valve removable bodily from the head. Each of the valve units is identical with the others and a description of one will suffice for all. The valve cage is in the form of a threaded plug 12 which screws into any one of the inclined openings formed in the raised portions 6 of the head. The plug 12 is provided with a head 14 which engages against the outer side of the engine head when the plug is screwed into place, the head 14 being of polygonal form so that it can be engaged by the wrench for screwing into or out of the opening. At the inner end thereof, the plug 12 is provided with a port 15 which opens at the end thereof and at one side, the port 15 being adapted to be aligned with either of the passages 10 or 11 of the head, depending on whether the plug is positioned on the inlet side or the exhaust side.

The inner end of the plug has a conical valve seat 16 formed therein around the port 15 and outwardly of the port 15 the plug is provided with an axial bore 17 and a counterbore 18 extending from the outer end thereof into which the bore 17 opens. A valve 19 is mounted in the plug and is provided with a conical seat 21 adapted to fit upon the conical seat 16 at the inner end of the plug when the valve is in closed position. The valve 19 has a stem 22, which extends through the bore 17 into the counterbore 18 and is connected, at its outer end, to a piston 23 which has a sliding fit in the counterbore 18. The valve stem 22 has a tapered outer end 24 which fits in a tapered socket in the piston 23 and the tapered portion of the stem is provided with a key 25 which engages a groove in the tapered socket of the piston 23 to hold the piston against rotation with respect to the valve stem, the piston being secured to the valve stem by means of a tap bolt 26 extending through the piston from the outer side thereof into the outer end of the valve stem.

As shown in Fig. 6, a packing disk 27 fits loosely on the stem 22 at the inner side of the piston 23 and a ball bearing 28 is interposed between the piston and the disk to permit the piston and valve to rotate freely with respect to the disk. The piston 23 and valve 19 are pressed outwardly to normally hold the valve in closed position by means of a coil spring 29 which is interposed between the packing disk 27 and the shoulder at the inner end of the counterbore 18. The mounting of the valve on the freely rotatable piston permits free rotation of the valve during its operation so

that the valve and valve seat are subjected to uniform wear throughout and the conical engaging surfaces thereon.

The outer end of the counterbore 18 is closed by a threaded plug 30 and the outer portion of the counterbore 18 forms a pressure chamber adapted to receive fluid pressure through a lateral inlet bore 31 in the head 14 of the plug for shifting the piston 23 and valve 19 inwardly to open the port 15 at the inner end of the plug 12. Since the plugs 12 are identical and interchangeable, any valve unit will serve to control either the inlet or exhaust port of the engine cylinder, the valve 19 controlling the inlet or exhaust through the port 10 or 11. In order to accurately position the plugs 12 with the ports 15 thereof, in alignment with the ports 10 or 11 of the head, the head 14 of each plug carried a screw 32 which is adapted to be screwed inwardly into engagement with a socket 33 in the head, the screw 32 and socket 33 being so positioned with respect to the ports 15 of the plug and 10 or 11 of the head that when the screw 32 is in alignment with a socket 33, the port 15 is in alignment with either the port 10 or the port 11, accordingly as the plug is mounted on the inlet or exhaust side.

The pistons 23 and valves 19 are preferably actuated in opposition to the springs 29 by hydraulic pressure, oil being preferably used to transmit the pressure to the piston. In order to dispose of any oil which may leak to the inner side of the piston, there is provided a drain passage 34 in the engine head which leads from a port at the inner end of the counterbore 18 and communicates with a passage 35 formed in the cylinder block which extends downwardly to the base of the block and opens into the engine crank case so that any oil leaking past any of the pistons 23 is drained off into the engine crank case.

An oil conduit 36 extends from the port 31 of each plug 12 to a cylindrical casing 37 which is detachably mounted in vertical position on an extension 38 at one end of the head. The case 37 is in the form of a casting having integral bottom and side walls, the side walls 39 being relatively thick and having formed therein, upper and lower sets of radially disposed cylinders 40. The cylinders 40 of each set are regularly spaced and correspond in number to the number of inlet or exhaust valves in the engine, the pressure cylinder of each valve unit being connected to one of the cylinders 40 and the inlet valve units being connected to one set of cylinders 40 and the exhaust valve units being connected to the other set.

Each oil conduit 36 has an enlarged portion 40^a which has an outwardly flared end clamped in fluid tight engagement in an enlarged outer portion of the cylinder 40 by the gland nut 41. A piston 42 is mounted in each

of the cylinders 40 and each piston bears, at its inner end, against one of the cams 43 or 44 which are fixed to a vertical shaft 45 which is positioned axially of the casing 37.

5 A body of oil is confined between each of the cam pistons 42 and the piston 23 in the valve actuating cylinder which is in communication with the cylinder 40 in which the said piston 42 is located. Outward movement of the piston 42, by one of the cams 43 or 44, causes pressure to be exerted upon the corresponding piston 23 to move the valve carried thereby to open position. The vertical shaft 45 is constantly driven at a predetermined speed causing the cams 43 and 44 to successively open the inlet and exhaust valves in proper timed relation.

Means is provided for maintaining a predetermined volume of oil at a predetermined minimum pressure between each cooperating pair of pistons 42 and 23 so that the extent of movement of the valves will not be varied by reason of variations in the volume of liquid interposed between the co-operating pistons. The casing 37 is provided with a cover plate 46 forming a fluid tight chamber in which the cams 43 and 44 are enclosed and means is provided for keeping the cam chamber full of oil to thoroughly lubricate the 30 cams, and to make the operation thereof noiseless.

A supply tank 47, which may be mounted on the dash of an automobile on which the engine is mounted, is provided for supplying oil to the conduits 36 and to the casing 37. This supply tank 47 is provided with a filling opening 48 and with an outlet pipe 49 communicating with the bottom thereof which has branches 50 leading to each of the conduits 36, each branch 50 having therein a check valve 51 which permits oil to flow into the conduit 36 to which the branch is connected, but prevents escape of oil from the conduit 36. Communication is established between the interior of the casing 37 and the oil supply tank 47 through a conduit 52 which is in communication with the interior of the casing 37 and which is provided with a valve 53 which permits oil to flow into the cam chamber but prevents reverse flow.

An air pump 54, which may be mounted on the instrument board of the automobile, is provided for creating air pressure above the level of the oil in the supply tank 47, the pump 54 being connected by a pipe 55 with the upper portion of the tank 47. The air inlet to the tank is provided with a check valve 56 which permits air to be forced into the tank but prevents escape thereof. A low air pressure is preferably maintained in the upper portion of the tank 47, this air pressure being sufficient to cause the instant replacement of any oil lost from the system by leakage but not sufficient to overcome the pressure of the springs 29, holding the valves in

closed position. In order to prevent splashing of oil within the tank 47, the interior of the tank may be provided with suitable baffle plates 47^a which act to retard the movements of the body of oil within the tank.

The shaft 45 has a detachable driving connection at its lower end formed by a transverse groove 57 across the lower end thereof and a tongue 58 across the upper end of an aligned shaft 59 which has a bevel gear 60 at its lower end meshing with a bevel gear 61 on the crank shaft 62 of the engine. The bevel gear 60 preferably has just twice the number of teeth on the bevel gear 61 so that the shaft 45 is driven at one-half the speed of the engine crank shaft which is the correct speed for the timing of the inlet and exhaust valves.

To drain the oil from the system each of the conduits 36 may be provided with a drain cock 63 and in order to determine the presence or absence of oil in the tank 47, the tank may be provided, adjacent the bottom, with a drain cock 63^a.

The bottom of the casing 37 is hollowed out to form, with the upper face of the head to which it is attached, a pump casing 64 in which is mounted a turbine rotor 65 which is fixed to the shaft 45. The extension 38 of the head is provided with spaced ports 66 and 67, which communicate with the pump chamber 64 and with inlet and outlet passages 68 and 69 formed in the cylinder block. The passage 68 communicates with the lower portion of the radiator and the passage 69 leads to the water spaces in the cylinder block and head. A distributor 70 is mounted upon the upper end of the shaft 45 to control the passage of current to the spark plugs for igniting the fuel charge in the engine cylinders.

The pump, the valve operating cams and the distributor are thus mounted as a compact unit at one end of the cylinder head and are all readily accessible for inspection or repair. Furthermore, upon removal of the engine head, the entire valve operating mechanism, the water pump and distributor are removable with the head and when the head is replaced upon the cylinder block, operative connection is made between the mechanism on the head and the engine crank shaft, by the engagement of the shaft 45 with the shaft 59.

Figs. 4 and 5 show slightly modified constructions in which the oil passages extend through the engine head longitudinally thereof. In this modification, each raised portion 6^a of the head has passages 36^a formed therein along the inner side thereof, the passages 36^a extending from the forward end of the head adjacent the cam casing to points adjacent the valve plugs, the lowermost passage 36^a extending the rearmost plug, the uppermost passage extending to the forward plug and the others to intermediate plugs. Along the outer side, the head has a longi-

tudinal passage way 49^a formed therein and this passageway is connected at one end by a short pipe to the oil supply tank and the other end by a short pipe to the cam casing.

5 Adjacent each of the valve plugs the passage 49^a is connected to one of the passages 36^a and with the interior of the valve plug. This last-mentioned connection is made by short detachably connected pipe sections, the valve
10 plug having a short nipple 71 projecting from the inlet port thereof, which is connected by a union 72 with a T-fitting 73 which is in turn connected by threaded sleeves 74 and 75 with
15 elbow sections 76 and 77, which are detachably secured to the head in communication with the passages 49^a and 36^a. Each of the connecting sleeves 75 has a check valve 78 therein which permits flow of oil from the supply passage 49^a to the valve plug cylinder
20 and to the passages 36^a leading therefrom to the cylinders in the cam casing but which prevents the oil from being forced back into the supply passage 49^a.

The modification above described, differs
25 from the modification first described, only in that a considerable portion of the piping is eliminated by forming the passages in the body of the head.

In the operation of the engine, the inlet and
30 exhaust valves 19 are operated in proper timed relation by the cams 43 and 44 which are driven at the proper speed from the engine crank shaft. Proper pressure being maintained on the oil interposed between the
35 cam engaging pistons 42 and valve pistons 23 by means of the air pump 54 which may be operated whenever it is desirable to increase the air pressure acting on the oil in the tank 47. By reason of the fact that the
40 cams 43 and 44 and the pistons 42, which engage the cams, are immersed in oil, the operation of the cams will be practically noiseless. By reason of the fact that the pistons 42 are held against the cams with a definite pressure, due to the pressure of air on the oil in
45 the supply tank 47, any wear between the cams and pistons will be automatically compensated for and there will be no knocking or hammering of the piston faces due to imperfect engagement with the cams. By
50 mounting the valve plugs in oppositely inclined positions, as shown, the plugs are made readily accessible so that they can be easily removed. The location of the valves 19 op-
55 posite each other at the upper end of the cylinder and the provision of aligned horizontal inlet and exhaust ports, is advantageous for the reason that the gaseous fuel mixture flowing into the cylinder through the inlet port strikes against the exhaust valve and has a
60 cooling action thereon.

If any valve is in need of repair it can be readily removed without removing the head by unscrewing the valve plug 12 in which
65 it is mounted. The valve can be readily re-

moved from the plug by unscrewing the plug 30 at the outer end thereof and then unscrewing the bolt 26 which holds the valve stem 22 to the piston 23. The grinding of the seats 16 and 21 of the plug and valve
70 is a very simple matter when the parts are detached and a new valve or a new valve unit may be very quickly substituted for an old valve or valve unit whenever desired.

Having thus described my invention, I
75 claim:

1. In an internal combination engine having a plurality of cylinders arranged side by side and provided with inlet and exhaust valves and a crank shaft extending beneath
80 the cylinders, a shaft geared to the engine crank shaft and having a pair of cams thereon, means operated by one cam for actuating the inlet valves successively, and means operated by the other cam for actuating the ex-
85 haust valves successively.

2. An internal combustion engine having a cylinder block with a series of cylinders therein, a head having inlet and exhaust ports communicating with the cylinders, valves carried
90 by the head for opening and closing said ports, a vertical shaft journaled in the head at one end thereof and geared to the crank shaft of the engine, a pair of cams fixed to said shaft, and means operated by the cams for
95 opening and closing said valves in timed relation.

3. An internal combustion engine having a cylinder block with a series of cylinders therein, a head having inlet and exhaust ports
100 communicating with the cylinders, valves carried by the head for opening and closing said ports, a vertical shaft geared to the crank shaft of the engine, a pair of cams on said vertical shaft, and means interposed between the
105 cams and valves for operating the valves.

4. An internal combustion engine having a cylinder block with a plurality of cylinders therein, a crank shaft beneath the block, a head having inlet and exhaust ports communicating with the cylinders, poppet valves
110 carried by the head for opening and closing said ports, a vertical shaft geared to the crank shaft of the engine and extending from the crank shaft to the head, a cam on said shaft, a plurality of movable members engaging the cam at circumferentially spaced points, and means interposed between each one of said
115 members and one of the valves for actuating the valves.

5. An internal combustion engine having a cylinder block with a plurality of cylinders therein, a head having inlet and exhaust
120 ports communicating with the cylinders, poppet valves carried by the head for opening and closing said ports, valve actuating and timing mechanism mounted on the head at one end thereof, means for actuating said mechanism from the crank shaft, and fluid
125 pressure actuating means interposed between

said mechanism and each of said valves for operating the valves.

6. An internal combustion engine having a plurality of cylinders, inlet and exhaust valves associated with the cylinders, a vertical shaft mounted on the engine and geared to the crank shaft, cams on said shaft, means interposed between the cams and valves for actuating the valves, a casing through which the shaft extends, said casing being connected with the engine water cooling system, and a pump fixed to the shaft within the casing.

7. The combination with an internal combustion engine having a block with a plurality of cylinders therein and a head having inlet and exhaust valves associated with the cylinders, of a pump casing on the head at one end thereof and connected with the engine cooling system, a vertical shaft geared to the crank shaft, and extending through said casing, means for operating the valves including cams on said shaft adjacent said pump casing, and a pump on said shaft within said casing.

8. The combination with an internal combustion engine having a block with a plurality of cylinders therein and a head having inlet and exhaust valves associated with the cylinders, of a pump casing on the head at one end thereof which is connected with the engine water cooling system, a vertical shaft geared to the crank shaft and extending through said casing, means for operating the valves including cams on said shaft beneath said pump casing, a pump on said shaft within said casing, and a distributor at the top of said casing and operated by said shaft for controlling the ignition of fuel in the engine cylinders.

9. An internal combustion engine having a plurality of cylinders and inlet and exhaust valves associated with the cylinders, said engine having an extension at one end, a vertical shaft mounted in said extension, means for driving said shaft from the engine crank shaft, cams on said shaft, an actuating piston associated with each of said valves each actuating piston being connected to a valve, a second set of pistons grouped around said shaft and adapted to be successively engaged by said cams, and means for confining a body of liquid between each valve actuating piston and a piston of said second set.

10. In an internal combustion engine having a plurality of cylinders arranged side by side, inlet and exhaust valves associated with each cylinder, a cam driven by the engine crank shaft, circumferentially spaced radially disposed actuating pistons bearing on said cam, and means for confining a body of liquid between each of said pistons and a valve for actuating the valve.

11. In an internal combustion engine having a plurality of cylinders, arranged side by side, inlet and exhaust valves associated with

each cylinder, a vertical shaft driven by the engine crank shaft, a pair of cams on said shaft, circumferentially spaced radially disposed actuating pistons bearing on each cam, means for confining a body of liquid between each actuating piston bearing on one cam and an inlet valve for actuating the same, and means interposed between the actuating members bearing on the other cam and the outlet valves for actuating the same.

12. In an internal combustion engine having a plurality of cylinders, inlet and exhaust valves associated with each cylinder, a separate fluid pressure actuating means for each valve, a vertically disposed shaft carried by the engine and geared to the crank shaft thereof, and means connected to said shaft for imparting pressure to actuating means for the individual valves successively.

13. An internal combustion engine having a plurality of cylinders and a head, an inlet and an exhaust valve for each cylinder, said valves being mounted in the head, a piston connected to each valve, each piston being movable in a cylinder formed in the head, a vertical shaft carried by the head and geared to the engine crank shaft, a casing surrounding the shaft and having a series of radially disposed cylinders, cams on the shaft, a piston in each of the radially disposed cylinders bearing on one of the cams, and pipes connecting each cylinder in the head with a cylinder in said casing.

14. An internal combustion engine having a plurality of cylinders and a head, an inlet and an exhaust valve for each cylinder, said valves being mounted in the head, a piston connected to each valve, each piston being movable in a cylinder formed in the head, a vertical shaft carried by the head and geared to the engine crank shaft, a pair of cams on said shaft, a casing surrounding said cams and having a set of radially disposed circumferentially spaced cylinders surrounding each cam, pistons in said radially disposed cylinders which bear upon said cams, and means for confining a body of liquid between each cam engaging piston and a valve piston.

15. In an internal combustion engine having inlet and exhaust valves, a piston connected to each valve, valve actuating cams driven by the engine crank shaft, pistons bearing on said cams, means for confining a body of liquid between each valve piston and one of the cam engaging pistons, and means for maintaining a predetermined volume of liquid in each body so confined comprising a supply tank communicating with each confined body of liquid, check valves preventing return flow to the tank, and means connected with the tank for supplying air under pressure to the tank above the body of liquid therein.

16. In an internal combustion engine having inlet and exhaust valves, springs for normal-

ly holding the valves closed, hydraulic means
for opening the valves comprising a confined
body of oil for each valve, a pair of pistons
between which each body of oil is interposed,
5 one piston of each pair being connected to a
valve, a cam engaging the second piston of
each pair, a fluid tight casing enclosing the

cams, and means for supplying oil under
pressure to each confined body of oil and to
said cam casing.

In testimony whereof, I hereunto affix my
signature.

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GEORGE A. KOLB.