90.38 CROSS REFERENCE SEARCH ROOM

V. L. EMERSON.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED APR. 6, 1916.

1,198,334.

Patented Sept. 12, 1916.

6 SHEETS—SHEET 1.

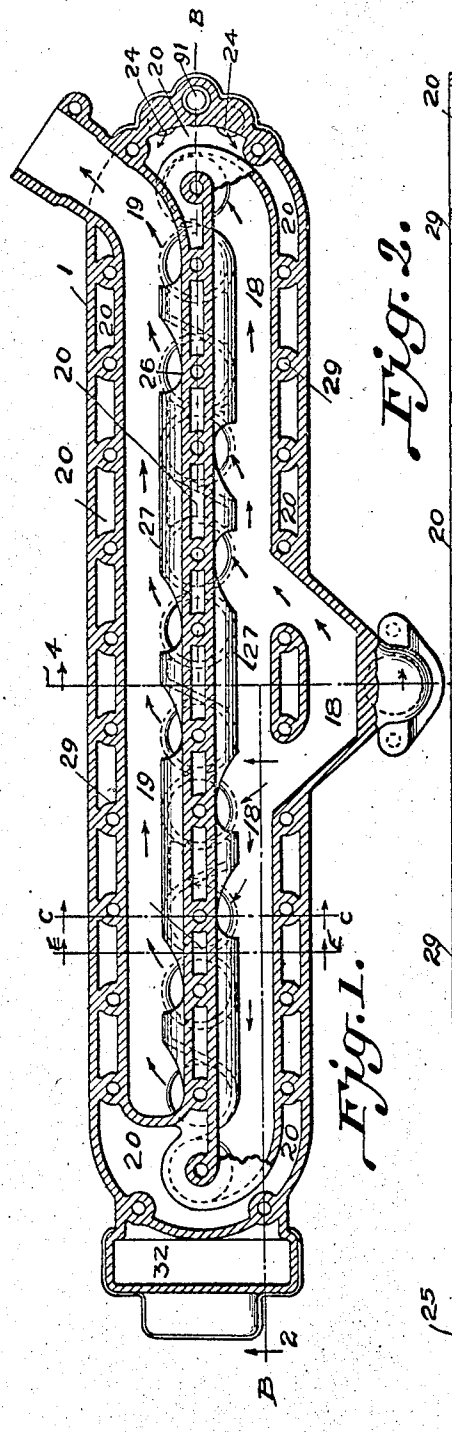


Fig. 1.

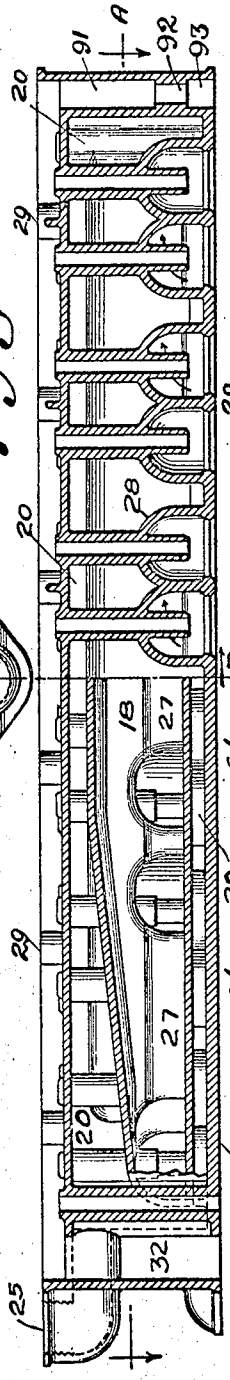


Fig. 2.

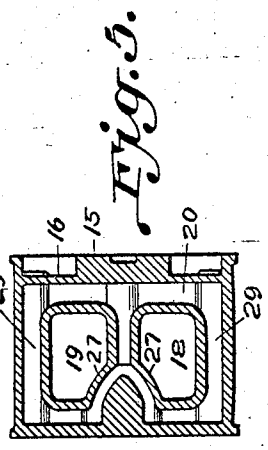


Fig. 5.

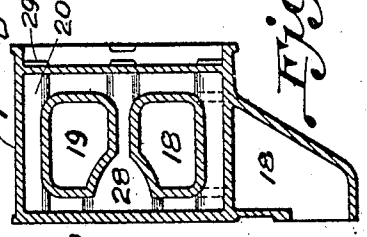


Fig. 4.

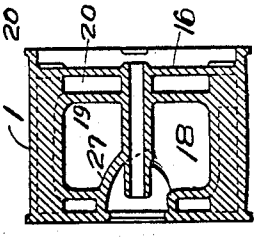


Fig. 3.

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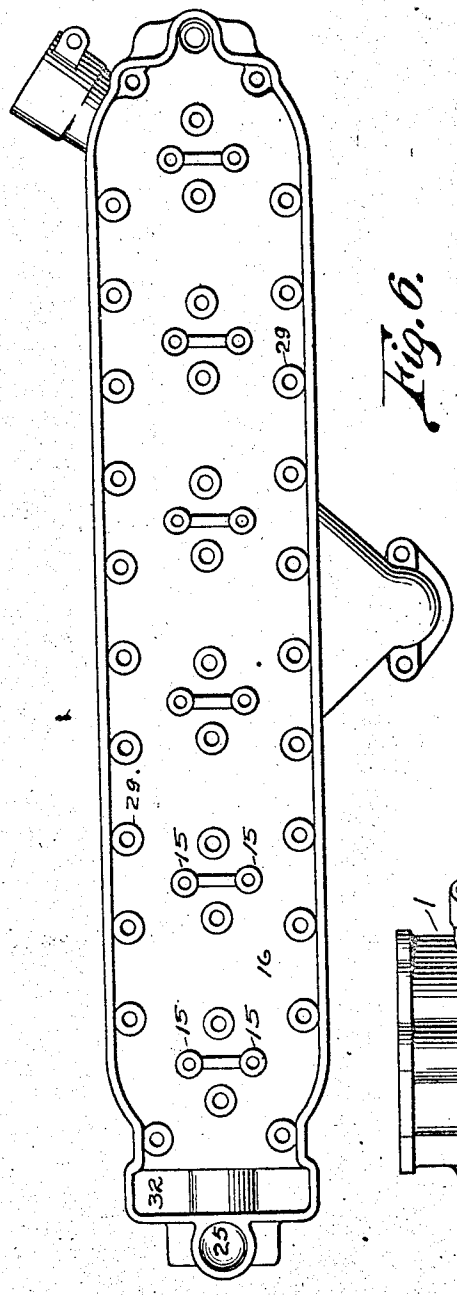


Fig. 6.

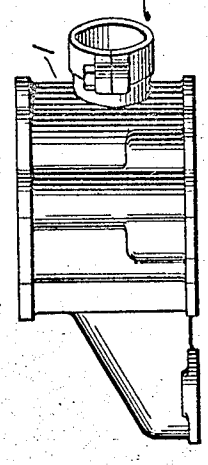


Fig. 8.

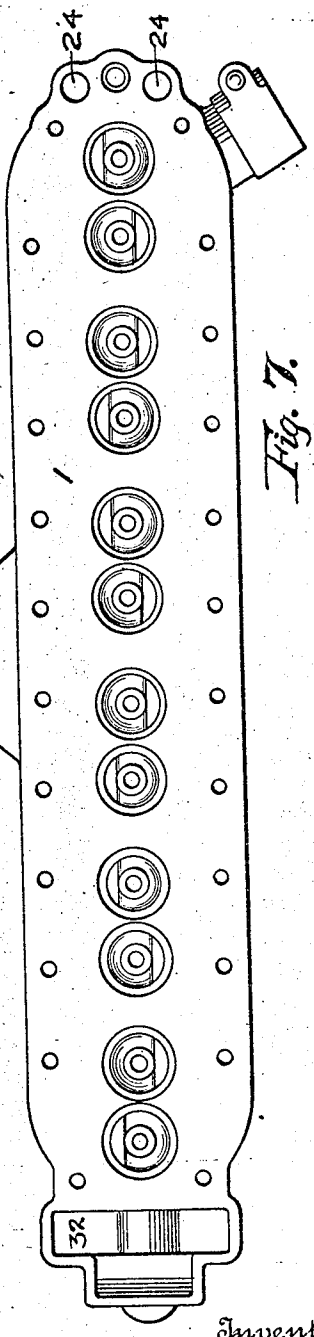


Fig. 7.

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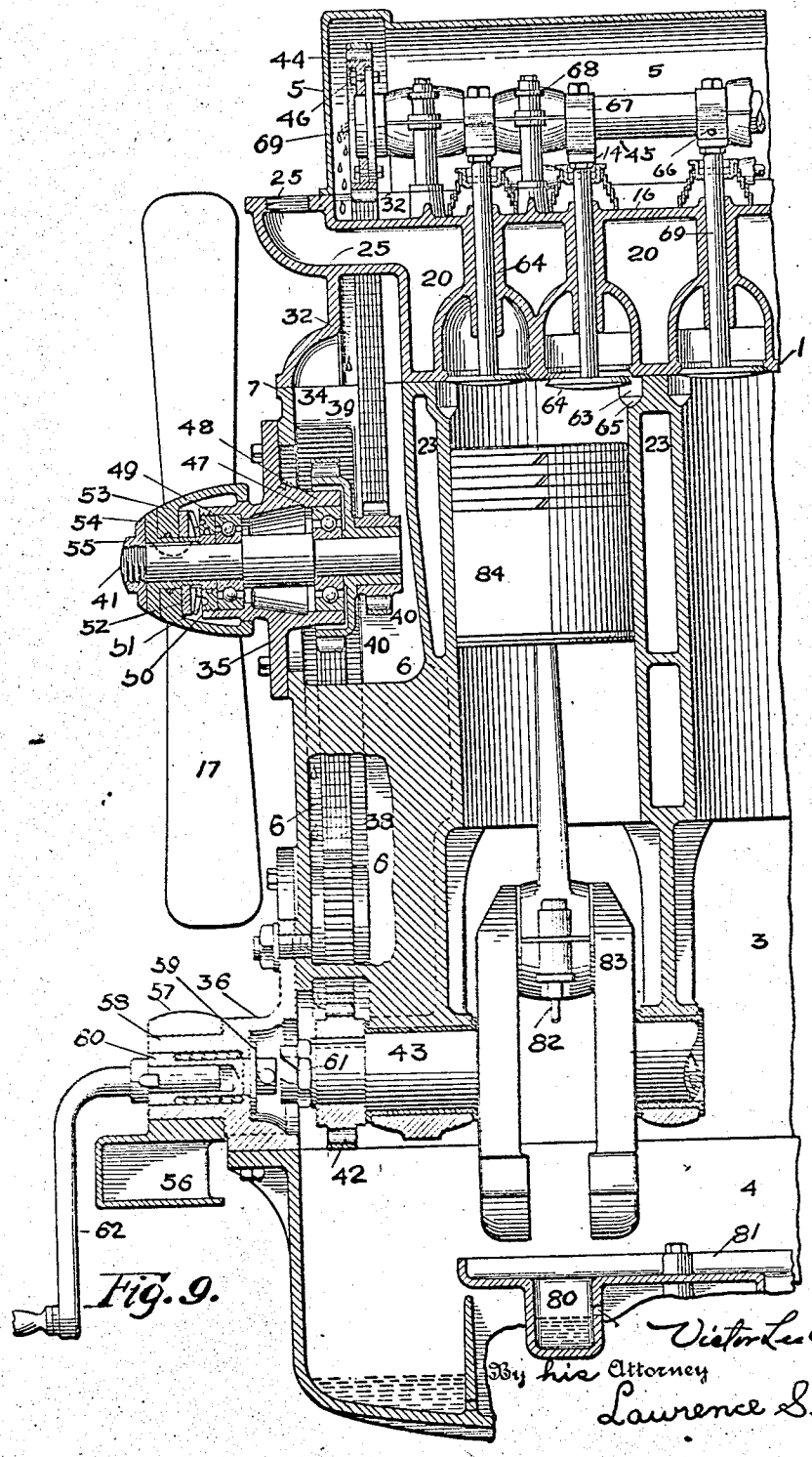


Fig. 9.

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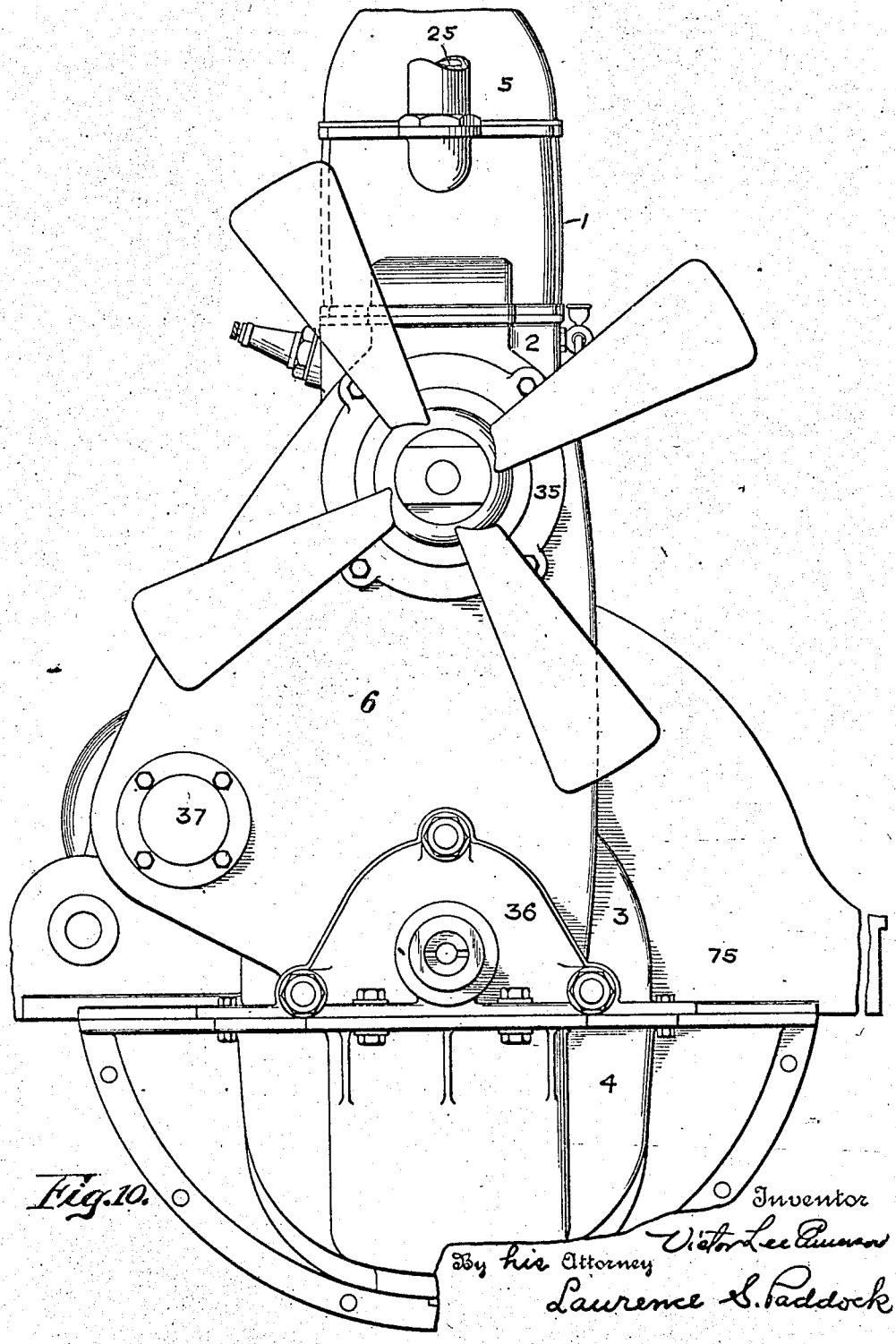


Fig. 10.

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6 SHEETS—SHEET 5.

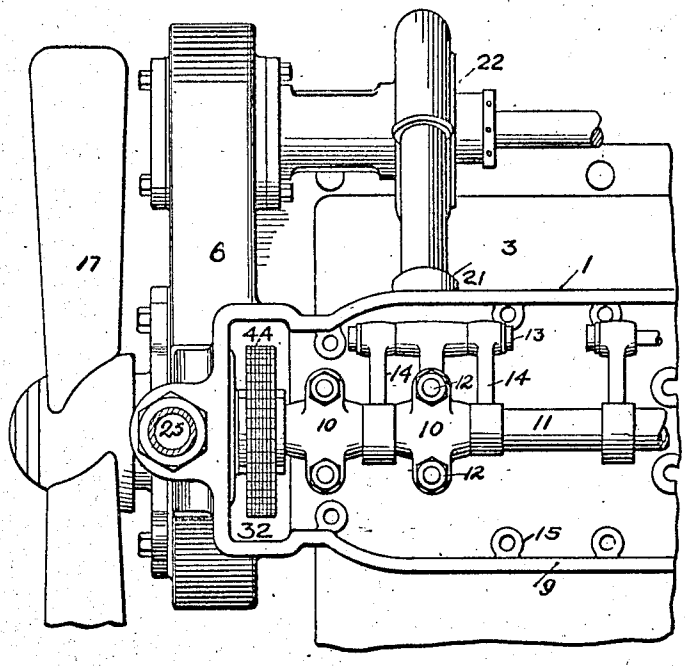


Fig. 12.

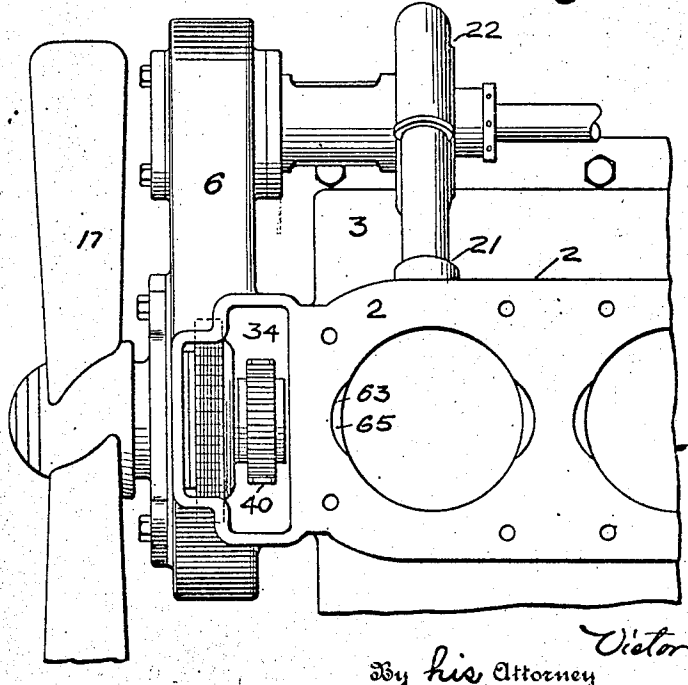


Fig. 11.

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6 SHEETS—SHEET 6

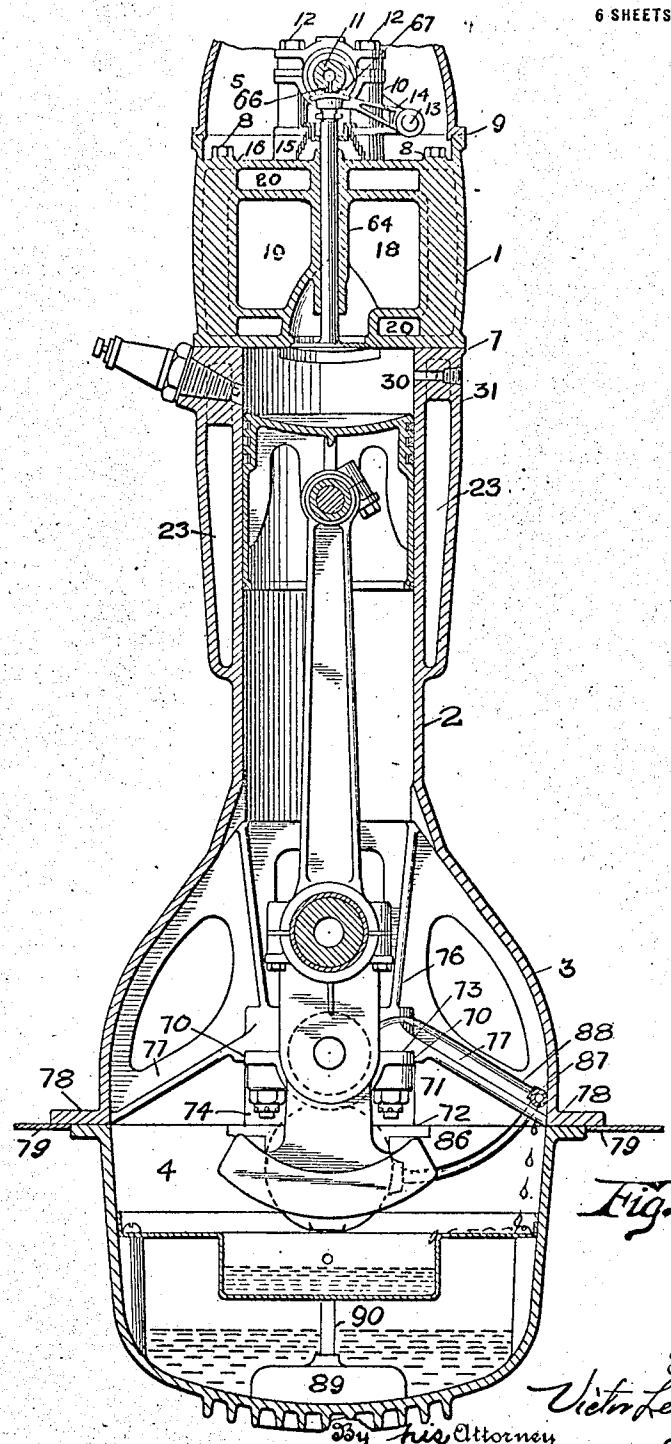


Fig. 13.

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UNITED STATES PATENT OFFICE.

VICTOR LEE EMERSON, OF ALEXANDRIA, VIRGINIA, ASSIGNOR TO THE EMERSON ENGINEERING COMPANY, A CORPORATION OF DELAWARE.

INTERNAL-COMBUSTION ENGINE.

1,198,334. Specification of Letters Patent. Patented Sept. 12, 1916.

Application filed April 6, 1916. Serial No. 89,444.

To all whom it may concern:

Be it known that I, VICTOR LEE EMERSON, a citizen of the United States, residing at 21 Rosemont avenue, Alexandria, Virginia, have invented a new and useful Improvement in Internal-Combustion Engines, of which the following is a specification.

Among the objects of my invention are: To minimize the amount of machining, lessen the number of joints that are usually necessary by having the intake and exhaust manifolds casted integral with the engine, and so located as to have the shortest possible passages from the valves to the manifolds in order to reduce friction and back pressure.

To have the manifolds fully water-jacketed so that they will not be subjected to unequal expansion and the surfaces exposed to the explosion chamber finished, and the manifolds form an arched bridge to resist the pressure in the cylinders. I also bring each member in such relation to each other as to make a compact structure and reduce the length of the valves and size of the operating parts so that inertia of the moving parts will be small which is favorable for high speeds.

To have the valves and operating mechanism together with the intake and exhaust manifolds comprise a unit so that they can be conveniently removed together for the purpose of seating the valves or removing carbon from the cylinders without the necessity of taking the cylinders off the base. When this unit is removed the pistons and connecting rods may be removed from the top of the engine without further disassembling. With this construction the cams and valve stems can be adjusted in a convenient manner. The top of the valve chamber is formed so as to constitute an oil pan which collects the lubricating oil and causes it to be constantly supplied to the valves. The water-jackets are so arranged that the flow of water is directed around the cylinder barrels first and then over the intake and exhaust manifolds and valves in the head.

The arrangement of the inlet and exhaust manifolds in the head is such that the low temperature of the inlet manifold, due to the chilled vapors passing therethrough and the high temperature of the exhaust manifold, due to the exhaust gases passing therethrough, tend to neutralize their effect upon the water surrounding the same. In this construction the water around the cylinder barrels is not affected by the cooling action of the inlet manifold since the water passes over the cylinder barrels before it reaches the inlet manifold.

My design is such that the bolts that hold the head to the cylinders extend through a column of metal from top to bottom of the head, which column of metal is water-jacketed so that the bolts are kept at an even temperature with the casting and will have a substantially equal expansion therewith and will not become loose when heated and cooled, thus avoiding the use of elastic packing, or a packing of any description between the head and the cylinders. By passing the bolts through a solid column of metal the springing of the casting when the bolts are tightened down to attach the head to the cylinders is avoided.

On account of the manifolds being arranged in a head separated from the cylinders the casting is much easier and less expensive to make than if they were integral with the cylinders. The head and manifolds being separated from the cylinders the loss of a casting carrying the manifolds, in the foundry, or otherwise, is but slight when compared with the loss of the cylinders and head and manifolds if they were all cast integral. By making the cylinder head and cylinders separate and manifolds cast integral with the head a great advantage is obtained in the machining of the cylinder, by having both ends of the cylinder barrels open, thus offering flat machine surfaces to operate on and allowing the valves to be seated with great ease in the head and providing a means whereby the valves can be inserted when the head is removed without the use of cages that cannot be cooled. Every part of the valve seats and guides in my engine can be amply cooled and the valve gear can be mounted on the head without being subjected to undue heat. Also a relatively high temperature in the cylinder jackets is maintained which cannot be done if the intake manifold was not separated from the body of the water which surrounds the cylinder barrel. By keeping a relatively high temperature around the cylinder barrels the loss of heat through the water jacket is greatly reduced, thus adding to the available heat energy for power pur-

poses. By bringing the heated water of relatively high temperature from the jackets surrounding the cylinder barrels into contact with the walls of the intake manifold, which is at a relatively low temperature, the liquid globules that come in contact with the surface of the intake manifold, which is at a higher temperature than the combustible mixture passing therethrough, due to the heated water surrounding said manifold, are converted into vapor. A more uniform and better mixture is the result with the lessening of the carbon deposits in the cylinders. All the working parts are thoroughly oiled and can be inspected and adjusted while the engine is in motion, thus offering great convenience in assembling, not possible with other forms. I also effect a great reduction in weight and produce an engine of about one-half the width occupied by other types, which have projecting hot and cold manifolds. By casting the manifolds integral with the head I avoid the breaking of the packing between the manifolds and the engine by uneven expansion and removal of the same. In my construction the engine is kept at a substantially even temperature and at no time becomes sufficiently hot to affect the exterior finish, whereas the exhaust manifolds of the usual construction become extremely hot at times which is both disagreeable and injurious.

An important feature of my invention is the supporting of the surfaces against the pressure of combustion in the cylinders by bringing the manifolds in close proximity to the valves and over the combustion chambers in a line parallel with the cylinders and preferably between the hold down bolts so that the head can be attached to the cylinder in such a manner as to resist the strains due to the pressure of combustion and also maintain a tight joint between the cylinder and the head, by utilizing the strength of the manifolds, which are in a form to offer the greatest resistance to pressure.

Another feature of my invention is the location of the joint in the base where it joins the bottom section below the center of the shaft and the lower half of the internal bearing box, cap and bolts, so that, in the machining and assembling of the engine, the bolts and box will not come in contact with the cutter for milling off the surfaces, or the surfaces on which the engine is supported when it is being assembled. The line of the bottom section of the base is brought below the trunnion at the forward end of the engine and also below the main bearing at the fly wheel end so as to form an oil tight partition between the fly wheel and the crank case. If the front main bearing at the fly wheel end was split through the center thereof, as in the usual construction, the oil would continuously work its way through the bearing. In my construction there is no chance for the oil to escape through loose packings as in the ordinary construction. It is my object in the construction of the head and the cylinder to provide a means whereby the dropping oil from the cam shaft and working parts of the same will be caught in a receptacle, forming part of the head and return to the base through a cast opening on the forward end of the engine, the casting surrounding such opening furnishes a mount for the fan and a housing for the cam shaft driving means. The cylinders and housing for the driving mechanism are formed integral, making a rigid and less expensive structure than where they are machined as a separate cover plate and bolted on.

In the accompanying drawings, Figure 1 is a plan view taken on line A—A in Fig. 2, looking in the direction of the arrows and show the manifolds, water-jacket and valve openings. Fig. 2 is a sectional elevation taken on line B—B on Fig. 1, showing a section through the intake manifold and through the intake and exhaust valves. Fig. 3 is a section on line C—C on Fig. 1. Fig. 4 is a section taken on line D—D. Fig. 5 is a section taken on line E—E on Fig. 1. Fig. 6 is a plan view of the top of the cylinder head. Fig. 7 is a bottom view of the cylinder head. Fig. 8 is an end view of the head at the exhaust end. Fig. 9 is a side elevation partly in section through the forward end of the engine, showing the arrangement of the cam shaft, valves, head, cylinders, driving means, housing, fan mount, trunnion for supporting the engine, part of the lower half of the base, and the oil pan. Fig. 10 is an elevation of the forward end of the engine. Fig. 11 is a plan view of the forward end of the engine with the head removed. Fig. 12 is a view of the forward end of the engine with the head in place and the dust cover removed. Fig. 13 is a sectional elevation through the center of the cylinder and intake valve.

Referring to the drawings, 1 indicates the head, 2 the cylinder casting and 3 the upper section of the base.

4 indicates the lower section of the base and 5 the cover over the engine head.

6 indicates a housing at the end of the cylinders formed integral therewith.

7 is the point at which the head joins the cylinders. The head 1 is held to the cylinders by bolts 8. The line of the top and the head is shown at 9 on which head are the mounts 10 for the cam shaft 11. The cam shaft mounts 10 are secured to the head by bolts 12.

At 13 are shown the pivots for the rocker arms 14 which are carried by the mounts

10. The shaft mounts 10 are positioned on bosses 15 in a pan 16 which catches the surplus oil from the working surfaces and returns the same to the base 4 through the housing 6. The oil is cooled while passing through housing 6 by coming in contact with the walls thereof, which are cooled by a blast of air coming from the fan 17.

At 18 is shown the intake manifold and at 19 the exhaust manifold, cast integral with the head and surrounded by water passages 20. The water enters the cylinder jackets at 21 from the pump 22 and circulates through the cylinder jacket 23, whereupon it enters the cylinder head 1 at openings 24 and is discharged from said head at 25. It will be seen that the water traverses a defined path around the cylinder barrels where it absorbs heat before it is circulated through the head. When the water reaches the head it comes in contact with the intake manifold 18 and the exhaust manifold 19 at the hottest end thereof. The inlet manifold 18 is kept at a relatively low temperature by the cool medium circulating therethrough. The water then flows through the passages 20 of the head which surrounds the manifolds and valves and discharges into the radiator through the outlet 25. Thus the water in its flow acts as a transmitter of heat from the cylinders and heated exhaust manifold to the intake manifold and converts into vapor a certain portion of the fuel therein that is condensed into liquid owing to the fall in temperature, due to the cooling action of evaporation. Thus is produced a highly explosive and uniform mixture which is not possible without complete gasification of the liquid fuel. If this condensed liquid fuel were not gasified it would be drawn into the cylinders in a liquid state where perfect combustion could not take place on account of the liquid condition of the fuel.

It is desirable to have the body of the water surrounding the cylinder barrels as near the boiling point as possible to avoid excessive absorption of heat by the water from the cylinders. With this object in view it is desirable to cause the water to pass evenly over the cylinders before it reaches the head where it is subjected to the cooling influence of the inlet manifold.

In Fig. 1 the arrows in the intake manifold 18 represent the direction of the flow of the fuel mixture therein and the arrows in the exhaust pipe represent the flow of the heated exhaust gases. The greatest amount of heat is nearest the exhaust end of the head where it meets the flow of water through opening 24. The openings from the exhaust valves 26 open at an angle in the direction of the flow of the gas and the valve stems are protected from the direct action of the gases by a curved arch 27. The openings in the intake manifold are the same as those in the exhaust manifold with the exception of the angle being reversed. In the construction of the intake manifold the valves are so laid out that there are intake valves at the extreme ends of the head in distinction from the ordinary practice, in which the inlet valves do not over-reach the line of exhaust valves as it is ordinarily desirable to make the inlet manifold as short as possible. In the present invention the inlet manifold performs a very important function within the head and in order to perform this function the form of manifold herein disclosed is preferable. Both the intake and outlet manifolds are substantially square in cross section, with the lower corners forming an arch over certain portions of the valves so as to give great structural stiffness against the combustion pressure in the cylinders. As the manifolds are located partially over the valves, the pressure in the cylinders is quickly relieved when the exhaust valves are opened, the gases escape into the manifold through direct passages. The inward flow of gas is also made easier by the same construction, thus the resistance to the flow of gas in both cases is reduced. Both the manifolds 18 and 19 and valve chambers 28 which are practically surrounded by water so that they are not affected by unequal expansion as in the case of partially cooled or uncooled parts, which rapidly deteriorate and cause undue strains to be set up.

The bosses 15 for carrying the cam shaft mounts 10 are brought up to a line with the top edges 9 of the head so that they can be machined on the same cutting line.

The bolts 8 that secure the head 1 to the cylinder casting pass through columns 29 at intervals as shown. The columns 29 prevent distortion of the head when it is tightened down. The bottom of the bolts 8 enter the top of the cylinder casting 2 between the cylinder barrels 30 and the water jacket 31 so that both the jacket and cylinder take the load due to the pressure of combustion in the combustion chamber.

An extension of the head 1 forms a housing 32 through which passes the overflow pipe 25. The housing 32 connects with the opening 34 in the housing 6 which is cast integral with the cylinders. The bottom of the housing 6 is closed by the bottom section of the base 4 and the top of the housing 34 is closed by the cover 5.

The fan mount 35 and supporting bracket 36 are mounted on the rigid housing 6 together with bearings 37 for operating the pump and igniting device.

The chain drive 38—39 is assembled through either the opening from the top or bottom of the housing 6 or both. By this construction the weak and expensive sep-

arate cover plate with packing joints that are liable to leak is obviated.

A strong and rigid base to mount the supporting bracket 36 on, and a rigid seating for the entire driving system and fan mount 35, which carries the reduction gears 40 on shaft 41, are provided. One of these reduction gears on the counter shaft 41 is in line with a gear 42 on the crank shaft 43 and another gear on the counter shaft is mounted in line with the gear 44 on the cam shaft 45. The gear 44 is adjustable by means of bolts 46. A bearing 47 is carried by an extension 48 on the mount 35. The bearing 47 in extension 48 is located near the center line of chain 38. The bearing 49 which controls the position of the bearing 47 is held by a screw collar 50 having a threaded engagement with the mount 35, which provides lateral adjustment. The bearing 47 floats on the shaft 41.

At 51 is shown a spring which exerts a pressure against a friction collar 52 which has a splined connection with a sleeve and a friction member 54 which is keyed to shaft 41. The friction member 54 is held in place by a lock nut on shaft 41. The friction collar 52 and member 54 allow the fan 17 to slip without causing undue strain on the chains 38—39 when undue force is exerted, either from sudden starting of the engine or by accidental obstruction of the fan.

56 is a cross section member of a frame carrying a bearing 57 on which trunnion 58 swivels.

At 59 is a collar fitted on a hollow shaft 60 which has a longitudinal movement so that a pin in the end of the shaft will engage with a grooved nut 61 on the crank shaft, thus providing means whereby the crank shaft may be rotated by the crank 62. When the end thrust is released from the crank 62 a coil spring surrounding the member 60 will bring the member 60 to its initial outward position and the collar 59 will come against a shoulder located on the bracket 36 and shut off any leakage of oil and prevent shaft 60 from rotating and disengage shaft 60 from the crank shaft 61. A bore and cross slot in member 60 receives the crank 62 and causes member 60 to rotate with the crank. The crank 62 may be removed from the member 60 when not in use.

Recesses 63 within the cylinder bore give clearance to the valves 64 and by this construction permit a much larger valve to be used than could be accommodated within the circular dimensions of a cylinder of the usual construction. The shoulder 65 prevents the valve from dropping into the cylinder should the stem break or come loose. The cam shaft is hollow and has an opening indicated at 66 in each cam which allows the oil to pass to the working surfaces of the cams 67, bearings 68 and valve stems. The rocker arms are supported by members 10 and also carry cam shaft 11, and the action of cams 67 on the rocker arms 14 give the proper timing and motion to the valves 64. The surplus oil is caught in pan 16 and discharged into housing 32 together with the overflow through the end of the cam shaft at 69 where the chains 38—39 are oiled together with all the bearing surfaces, and the temperature of the oil is reduced by coming in contact with the surfaces of the housing 6 and is then delivered into the base 4.

At 70 is shown a recess in the hangers 76 in which the lower half of the crank shaft bearings 71 are set. At the fly wheel end this recess extends from the base line 72 to the center of the shaft line 73, so that the box cap 74 joins the base line 72, thus preventing escape of oil through the engine base 4 into the fly wheel housing 75. Hangers 76 are cast integral with the cylinder casting as shown in Fig. 13 and have angular braces 77 connecting with the flanges of the base 78. The flanges 78 on the base of the cylinders are made of greater width than the flanges on the bottom section of base 4 so that the edges of the dust pan 79 will be supported by the flanges 78.

At 80 is shown a well in the oil pan 81 in which the pipe 82 on the connecting rods dips at each revolution, which forms an auxiliary oiler to the crank 83 and piston 84 by reason of the oil passing by the pipe 82 to the crank connecting rod bearing and being splashed upon the piston. The opening 85 is an overflow of oil for oil from the receptacle 80 to maintain a certain depth of oil therein. There is a receptacle 80 provided for each cylinder and the oil is kept to the level of the opening 85 by an oil circulating pump 86 that is connected with pipe 87 which supplies oil to the receptacles 80 and to the shaft bearings through pipe 88. The oil is drawn through a filter 89 and pipe 90. At 91 is shown an opening through which the oil pipe leading from the base of the engine to the cam shaft passes.

I prefer that the water be circulated around the cylinder barrels from the pump entrance 21 to the back end of the engine and enter the cylinder head through openings 24 where the exhaust end of the manifold 19 is the hottest, when the engine is in operation, and then have the water circulated around the exhaust and intake manifold from the rear end and discharge at 25 because by this means there is less complication in taking care of joints between the cylinder and the head and a better control of the temperatures can be obtained. The system could, however, be modified within the scope of my invention by forming a multiplicitiy of passages between the water jackets of the cylinder barrels and the head

and restricting such passages sufficiently to cause the desired difference in temperature between the water in the head and the water in the cylinder barrels. The object here sought is to bring the highly heated water from the cylinder jackets, where it is desirable to maintain them at the highest temperature, in contact with the intake manifold which is conveying combustible gases at very low temperature so as to utilize the efficiency obtained by bringing the highest and lowest temperatures together as the interchange of heat is greatest when the temperatures are the most extreme. If the manifolds were to be incased within the cylinder jackets a neutralizing effect would take place before the water left the cylinder jackets and the wide range of temperatures necessary to my invention could not be maintained between the cylinders and the cylinder head, nor maintain the cylinder barrels at the desired temperature.

Having described my invention what I claim is:

1. In an internal combustion engine, in combination, a cylinder unit, a head unit adapted to mate with said cylinder unit, a line of bolts holding said head unit to said cylinder unit, and exhaust and intake manifolds within said head unit located within the line of bolts.

2. In an internal combustion engine, in combination, a cylinder unit, a head unit adapted to mate with said cylinder unit and having valve gear mounted thereon, a housing on said cylinder unit having an integral outer face, a projection on said head unit covering the upper end of said housing, and means within said housing and projection to transmit motion to said valve gear.

3. In an internal combustion engine, in combination, a cylinder unit, a head unit adapted to mate with said cylinder unit, a housing integral with said cylinder unit, having an integral outer face, a hollow projection on said head covering the upper end of said housing, a shaft mounted at the lower end of said cylinder unit and having a driving member located thereon in said housing, valve gear mounted on said head and means in said housing and projection connected with said driving member and valve gear for operating the same.

4. In an internal combustion engine, in combination, a cylinder unit, a head unit, a housing integral with said cylinder unit having an integral outer face, valve gear mounted on said head, a crank shaft having a driving gear thereon, said gear being within said housing, a shaft mounted on said housing and projecting into the same, a gear thereon within said housing, a driving member between the gear on said crank shaft and the gear on said second mentioned shaft, a second gear on said second mentioned shaft within said housing, valve gear on said head and a driving member between said second gear on said second mentioned shaft and said valve gear.

5. In an internal combustion engine, in combination, a cylinder unit, a head unit, valve gear mounted on said head unit, a housing integral with said cylinder unit having an integral outer face, a crank shaft extending into said housing, a gear on said crank shaft within said housing, a fan shaft mounted on said housing and having a pair of gears thereon within said housing, driving means between the gears on said crank and fan shafts and said valve gear.

6. In an internal combustion engine, in combination, a cylinder unit, a head unit mounted on said cylinder unit, said head unit having a raised portion extending around the perimeter of the top thereof, so as to form a receptacle on said top for surplus oil, bosses on said head extending to the level of said raised portion, shaft mounts positioned on said bosses and a cam shaft held in said mounts.

7. In an internal combustion engine, in combination, a cylinder unit, a head unit mounted on said cylinder unit, a plurality of columns cast integral with said head, bolts passing through said columns and bearing on the same for attaching said head to said cylinder unit.

8. In an internal combustion engine, in combination, a cylinder unit, said cylinder unit having a bore extending to the upper end thereof, a head unit mounted thereon, valves mounted in said head unit so as to overlap the cylinder bore in said cylinder unit, recesses cut in the walls of said cylinder bore to permit said valves to move below the end of said cylinder bore.

9. In an internal combustion engine, in combination, a cylinder unit comprising manifolds cast integral therewith, valves mounted in said head, said manifolds being so located as to overlap said valves, and passages from said manifolds to said valves.

10. In an internal combustion engine, in combination, a head unit comprising inlet and exhaust manifolds cast integral therewith, valves centrally mounted in said head, said manifolds being substantially rectangular in cross section and overlapping said valves, said inlet manifold extending beyond said exhaust valves, and passages extending from said manifolds to said valves.

11. In an internal combustion engine, in combination, a cylinder unit, a head unit, manifolds cast integral with said head unit and extending longitudinally over the cylinder bores in said cylinder unit and forming a pressure resisting bridge.

12. In an internal combustion engine, in combination, a cylinder unit, a head unit, manifolds cast integral with said head unit,

the lower adjacent portions of said manifolds being curved so as to form an arch, whereby a pressure resisting bridge is formed over the cylinder bores.

13. In an internal combustion engine, in combination, a head unit therefor, inlet and exhaust manifolds cast integral therewith and within said head, exhaust and inlet valves centrally located in said head, said manifolds being so located as to overlap said valves and passages extending from said manifolds to said valves at an angle to said manifolds.

14. In an internal combustion engine, in combination, a head unit therefor, inlet and exhaust manifolds cast integral with and inside said head, exhaust and inlet valves having stems passing between said manifolds, and valve actuating mechanism mounted on said head for operating said valves.

15. In an internal combustion engine, in combination, a cylinder unit, a housing on said unit, a fan shaft mounted on said housing and extending into the same, a crank shaft, gears on said crank and fan shafts, a driving chain between said gears, a fan mounted on said fan shaft, and a friction connection between said fan and fan shaft.

16. In an internal combustion engine, in combination, a cylinder unit, a housing on said cylinder unit, a fan shaft adapted to be mounted on said housing, a detachable mount for said fan shaft, adjustable bearings between said mount and fan shaft, a fan mounted on said fan shaft and a friction connection between said fan and fan shaft.

In testimony whereof I, VICTOR LEE EMERSON, have signed my name to this specification in the presence of two subscribing witnesses, this 5th day of April, 1916.

VICTOR LEE EMERSON.

Witnesses:

LAURENCE S. PADDOCK,

H. H. FITZ.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."