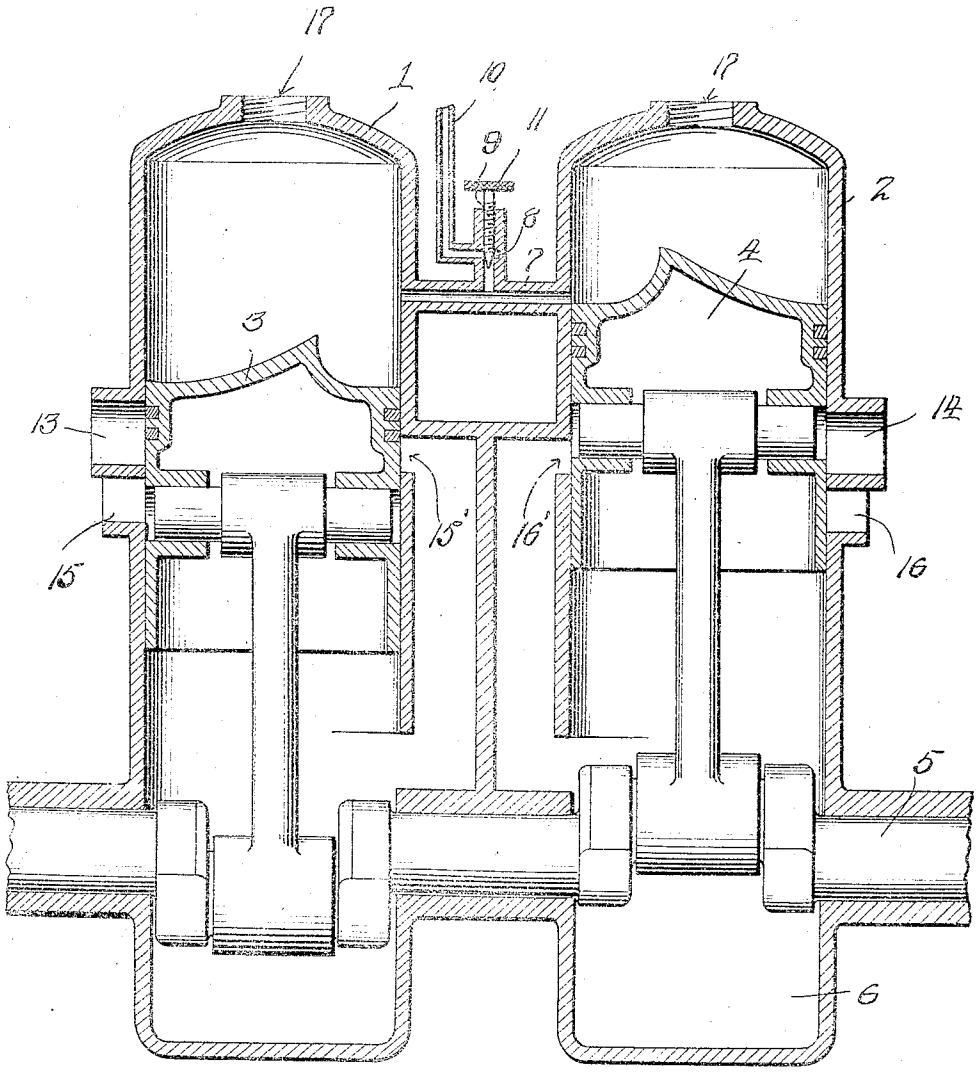
A. R. LONG.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED SEPT. 24, 1919.

1,394,850. Patented Oct. 25, 1921.



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ALBERT R. LONG, OF BALLSTON, VIRGINIA.

INTERNAL-COMBUSTION ENGINE.

1,394,850. Specification of Letters Patent. Patented Oct. 25, 1921.

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To all whom it may concern:

Be it known that I, ALBERT R. LONG, a citizen of the United States of America, residing at Ballston, in the county of Alexandria and State of Virginia, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

This invention relates to improvements in internal combustion engines, especially those of the two cycle type and it is an object of the invention to provide an engine of two cycle type with a novel form of fuel feed and vaporizing means whereby the fuel from which power is to be derived will be thoroughly vaporized and discharged into one of a pair of cylinders by functioning of the remaining cylinder and connection of the same thereto in a manner to permit the shunting of a portion of the burning gases in said remaining cylinder through the connection into the first cylinder, such shunted gas carrying with it a gaseous charge delivered thereunto.

Another important characteristic feature of the invention resides in manner in which a scavenging current of fresh air is delivered into the cylinders of the engine whereby to expedite exhaustion of spent or burnt gases from the same immediately subsequently to the completion of the power stroke of each cylinder and previous to the intake of the highly combustible vaporized gases thereinto.

Other features of the invention will be in part obvious and in part described hereinafter.

In order that the invention and the manner of its application may be readily understood by workers skilled in the art, I have in the accompanying illustrative drawings and in the following detailed description based thereon set out a preferred embodiment of the same.

In these drawings I have shown a vertical section through a pair of cylinders of a two-cycle engine, clearly indicating therein the relative positions of the pistons of the several cylinders.

Having more particular reference to the drawings in connection with which like reference characters will refer to corresponding parts throughout, 1 and 2 indicate the several cylinders of the engine having their respective pistons 3 and 4 mounted for operation therein and having connection through pitmen to a crank shaft 5 journaled in bearings and arranged within the engine crank case 6 in the usual manner. Said pair of cylinders 1 and 2 are connected by a fuel feeding conduit 7, the opposite ends of which discharge into the adjacent cylinders while its intermediate portion is formed with a valve seat 8 into which a needle valve 9 is turned; a fuel supply conduit 10 being connected to the valve and adapted to have the passage of fuel therefrom, into the conduit regulated to the desired degree by the same. Obviously, the needle valve 9 is provided with a knurled head 11 which is conveniently located to enable adjustment thereof with ease and despatch.

Below the connection of the conduit 7 with the cylinders 1 and 2, exhaust ports 13 and 14 are formed on the opposite sides of the walls of said cylinders, serving, as will be appreciated, as outlets for the spent gases. Other ports 15 and 16 are formed in the cylinders and are arranged thereabout in spaced relation, and afford means for permitting the intaking of fresh air to the crank case 6 in order that the scavenging of the cylinders subsequent to a working stroke of each, may be effected. Ports 15′ and 16′ are also formed in the adjacent walls of the cylinders and have communication with the particular compartments of the crank case of their respective cylinders, thus affording passages for the discharge of scavenging air currents into said cylinders at predetermined intervals.

Ignition means (not shown) are of course, engaged in the heads of the cylinders 1 and 2 through the openings 17 therein and serve to ignite the gases subsequent to compression.

When the piston 3 is on the lower center, piston 4 is on the upper center, in which relative positions the following functions occur: The exhaust port 13 is wide open and the burned gases are exhausting from cylinder 1. The air transfer port 15′ is open and air under pressure, (due to the down stroke of the piston 3) in the crank-case is passing into cylinder 1 as the exhaust gases pass out, supplying the cylinder 1 with a fresh charge of air for another power cycle. Piston 4 being on its upper center; port 16 is open and air is allowed to flow into the crank case replacing the partial vacuum caused by the up stroke of piston 4. Fuel conduit 7 is closed to the cylinder 2 by piston 4, and the

fuel passing by the adjusting needle valve 9, will collect in conduit 7, there being no force present aside from its own volume to carry it out. The ignition means has fired the charge in cylinder 2 above piston 4, which was compressed on the upstroke of piston 4, and this charge, due to its burning will rise to a much higher pressure than its compression pressure, therefore delivering to the piston a much higher pressure and giving to it a "working stroke" on its down motion.

Now, to complete any portion of the power stroke, which is less than a half stroke, such a position is shown in the drawings and the following are the conditions at this position:

Ports 13 and 15′ are closed by piston 3 in cylinder 1, and the compression begins and also a reduced pressure in crank case has begun to be set up. The piston 4 in cylinder 2 will have uncovered the small port to the fuel conduit and as the power stroke is less than half completed, the pressure in cylinder 2 is still high. Now as there is very little if any pressure in cylinder 1, the only thing separating the two cylinders through the small fuel conduit 7, is the fuel collected in the conduit while one end was cut off. Now as the pressure is cylinder 2 in several times that of cylinder 1, the fuel will be forced with great velocity into cylinder 1. Now, as either heat or velocity applied to a liquid fuel in space, (the fuel is suspended in space when it passes into the cylinder) will vaporize it, the fuel will be vaporized. It is understood that the working of one of the cylinders is identical with the other.

It will be noted that the moment piston 4 in cylinder 2 opens the port to fuel duct 7, piston 3 in cylinder 1 has only just closed its ports and there could be no pressure in cylinder 1. As the conduit 7 must be high enough above what is the mid stroke of the piston to insure opening enough to allow fuel to pass into cylinder 1, the piston 2 on its working stroke will not have made its half stroke before the conduit 7 is opened, and as the volume above the piston 4 is less and as the cylinders are filled with equal volumes of air the pressure would be higher in cylinder 2 and consequently there would be a flow through conduit 7 toward cylinder 1, thereby carrying the fuel into cylinder 1.

Now as to a portion of the expanding gases being forced into the other cylinder the size of the conduit 7 is so proportioned that the amount desired only will pass through the conduit. Furthermore it is desired that a small amount of the hot gases should pass from one cylinder to the other in order to clean the conduit of its fuel and add enough heat to the fuel to supply the latent heat of evaporation required to change the liquid to a gas.

To determine the size of the conduit 7 tests similar to those made in determining the size of a nozzle on the present day automobile gasolene engine carbureters of certain makes are made, in which case a proportion of 8000 to 1 in column of the liquid fuel and air is sought.

It will also be noted that the ratio of fuel to air to form a burning mixture is very limited, and as the ratio of fuel to air in the small conduit is many, many times too rich to support a flame, no flame can exist. Second, due to the "latent heat of evaporation," the fuel in being changed from a liquid to a gas absorbs a certain amount of heat without a rise in temperature and as this heat is taken from the hot gases forcing the fuel into the cylinder, these gases are cooled by that amount. Third, a flame cannot be supported through a small pipe unless the temperature of the pipe is held constant at the temperature of the flame. This, it will be remembered, was done in the first gas engines which were ignited by a hot tube heated by a Bunsen burner.

By regulating the valve 9 the amount of fuel introduced into the conduit 7, and in consequence into the cylinders 1 and 2 may be varied, such as conditions or preference may dictate.

Further, by the use of my novel form of fuel feeding means, I am enabled to employ with marked success, a very low or heavy grade of fuel and therefore, effect a material saving in cost of operating the engine provided therewith.

Manifestly, the construction shown, is capable of considerable modification, and such modification as is within the scope of my claims, I consider within the spirit of my invention.

What I claim is:

1. In a two cycle multiple cylinder engine, an unobstructed valveless fuel conduit connecting each pair of cylinders, a fuel supply means common to each pair of cylinders, exhaust means for the cylinders, and means in proximity to said exhaust means for supplying a scavenging current of air to said cylinders and partially exhausting the same therefrom, the fuel supply means and fuel conduit being so arranged and the pistons so timed in their cycle of operation that the pressure created by the explosion in one cylinder will act as the injection means for the fuel through said conduit into the other cylinder, when the pressure within the latter is near its minimum.

2. In a two cycle multiple cylinder engine, an unobstructed valveless fuel conduit connecting each pair of cylinders, a fuel supply means common to each pair of cylinders, regulating means coöperable with said supply means, and means in proximity to the exhaust means of the cylinders for supplying a

scavenging current of air thereto and partially exhausting the same therefrom, the fuel supply means and fuel conduit being so arranged and the pistons so timed in their cycle of operation that the pressure created by the explosion in one cylinder will act as the injection means for the fuel through said conduit into the other cylinder, when the pressure within the latter is near its minimum.

3. In a two cycle multiple cylinder engine, an unobstructed valveless fuel conduit connecting each pair of cylinders, a fuel supply means common to said cylinders, and operable upon opening of the exhaust ports of the cylinders for allowing a scavenging current of air to pass through said cylinders, the fuel supply means and fuel conduit being so arranged and the pistons so timed in their cycle of operation that the pressure created by the explosion in one cylinder will act as the injection means for the fuel through said conduit into the other cylinder, when the pressure within the latter is near its minimum.

4. In a two cycle two cylinder engine, an unobstructed valveless fuel conduit connecting each pair of cylinders, a fuel supply means common to said cylinders, and means in proximity to the exhaust ports of said cylinders for supplying a scavenging current of air to said cylinders and partially exhausting the same, the fuel supply means and fuel conduit being so arranged and the pistons so timed in their cycle of operation that the pressure created by the explosion in one cylinder will act as the injection means for the fuel through said conduit into the other cylinder, when the pressure within the latter is near its minimum.

5. In a two cycle multiple cylinder engine, an unobstructed valveless fuel conduit connecting each pair of cylinders. a fuel supply means common to each pair of cylinders, and communicating with the firing chambers thereof, means for regulating the passage of fuel through said supply means, said cylinders having air intake and exhaust ports therein in proximity to the gas exhaust ports thereof controlled by movement of the pistons in their cylinders, and positioned below the fuel supply means, the fuel supply means and fuel conduit being so arranged and the pistons so timed in their cycle of operation that the pressure created by the explosion in one cylinder will act as the injection means for the fuel through said conduit into the other cylinder, when the pressure within the latter is near its minimum.

6. In a two cycle multiple cylinder engine, an unobstructed valveless fuel conduit connecting each pair of cylinders, a fuel supply means common to each pair of cylinders, the exhaust ports of said cylinders being arranged below the supply means, and controlled by the pistons in said cylinders, said cylinders also having air intake and exhaust ports therein in proximity to said first exhaust ports adapted to be controlled by said pistons, the fuel supply means and fuel conduit being so arranged and the pistons so timed in their cycle of operation that the pressure created by the explosion in one cylinder will act as the injection means for the fuel through said conduit into the other cylinder, when the pressure within the latter is near its minimum.

In testimony whereof I affix my signature in presence of a witness.

ALBERT R. LONG.

Witness:

EDNA JAMES SHEEHY.