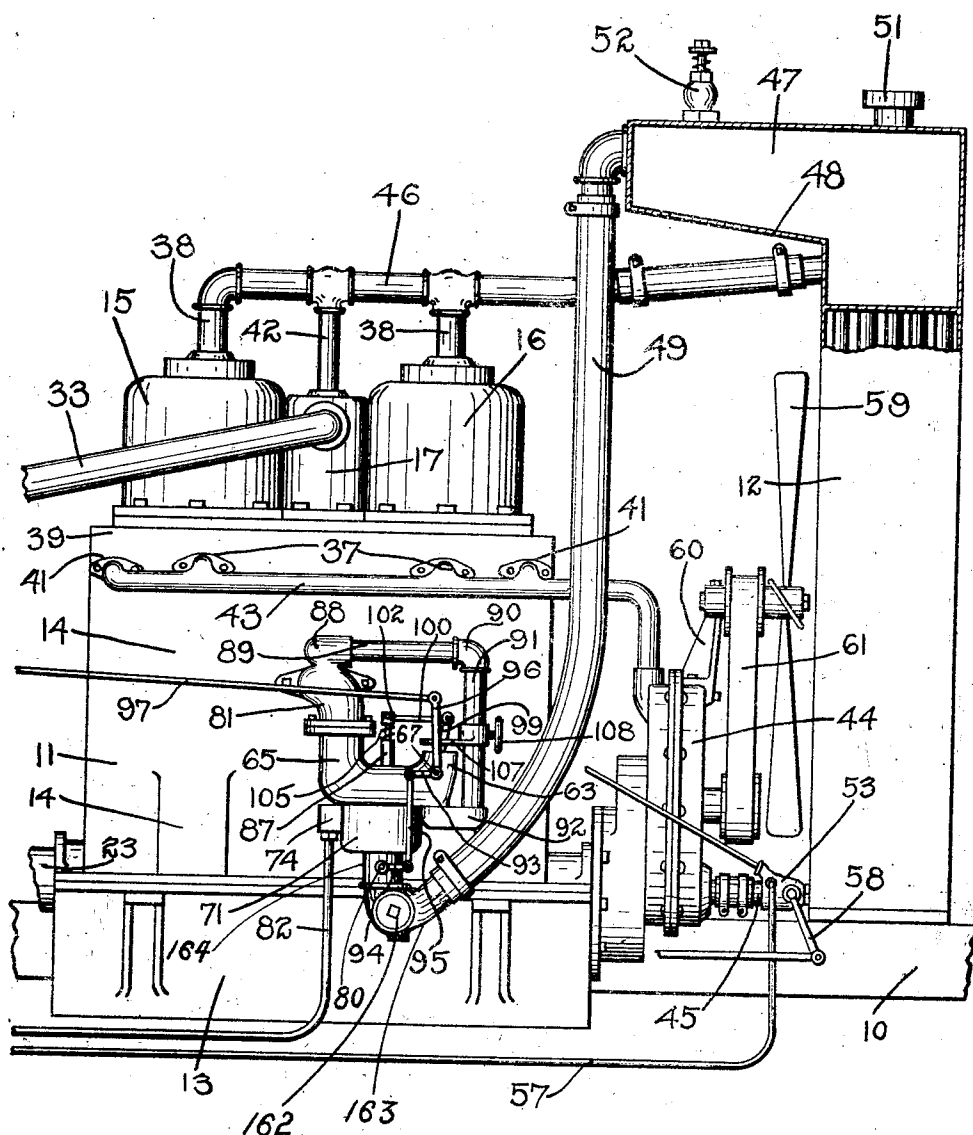


Fig. 1



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CARBURETING SYSTEM FOR INTERNAL COMBUSTION ENGINES.
APPLICATION FILED APR. 20, 1917.

Patented Feb. 17, 1920.

Fig. 2

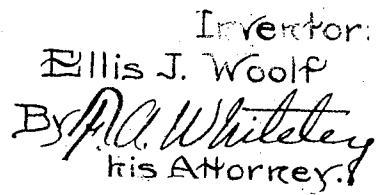
Fig. 4

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1,330,969.

3 SHEETS—SHEET 3.



UNITED STATES PATENT OFFICE.

ELLIS J. WOOLF, OF MINNEAPOLIS, MINNESOTA, ASSIGNOR OF ONE-HALF TO JAY F. WOOLF, OF MINNEAPOLIS, MINNESOTA.

CARBURETING SYSTEM FOR INTERNAL-COMBUSTION ENGINES.

1,330,969.

Specification of Letters Patent.

Patented Feb. 17, 1920.

Application filed April 20, 1917. Serial No. 163,501.

To all whom it may concern:

Be it known that I, ELLIS J. WOOLF, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Carbureting Systems for Internal-Combustion Engines, of which the following is a specification.

My invention relates to carbureting systems for internal combustion engines and has for its principal object to provide carbureting means whereby the air and the fuel are controlled in such manner that a highly efficient carbureting action is obtained so that heavy fuel oil such as crude oil, kerosene or motor spirits will be effectively carbureted. One of the means for carrying out the objects of my invention consists in the provision of primary and secondary air-inlet means and throttles therefor so located in respect to the carbureting chamber that the air admission alone, whether primary or secondary air, is controlled by the throttles, the amount of air being determined before it reaches the carbureting chamber. This prevents back pressure at the carbureting point and favors ready vaporization, with its attendant expansion of the gases formed from the liquid fuel. It is a further object of my invention to provide means associated with the carbureter and with the motor which is of the type shown and described in Patent No. 1,292,942, granted January 28, 1919, for admitting uncarbureted air to the crank case of the engine, from which it is propelled into the cylinder in the manner described in the aforesaid co-pending application. It is a further object of my invention to provide means associated with the carbureter and with the circulatory cooling system of the motor for vaporizing the fuel oil by the heat of said circulating system, said vaporized fuel being conveyed through the carbureter where it is mixed with air and with additional fuel before passing to the engine. In effecting the last-named object I inject into the cooling liquid the fuel oil, employing a cooling liquid which mixes readily therewith but vaporizes only at a temperature greatly in excess of that at which the fuel vaporizes.

The full objects and advantages of my invention will appear in connection with the detailed description thereof and are particularly pointed out in the claims.

In the drawings, illustrating the application of my invention in one form,—

Figure 1 is an elevational view of an engine and cooling system embodying my invention.

Fig. 2 is a view similar to Fig. 1 of the engine only showing some of the parts in section and drawn to a larger scale.

Fig. 3 is a vertical sectional view of the carbureter drawn to a larger scale.

Fig. 4 is a plan view of the carbureter shown in Fig. 3 with some of the parts removed.

Fig. 5 is a sectional detail view of the fuel-injecting device shown in Fig. 1.

My invention is preferably employed with explosive engines used on motor vehicles and is illustrated in the drawings in conjunction with a two-cycle engine, which will first be described. A frame 10 supports an engine 11, a cooling radiator 12 and other parts common to motor vehicles. The engine consists of a crank case 13 to which is rigidly bolted an intermediate casing member 14. A pair of engine cylinders 15 and 16 are secured to casing 14 in spaced relation to one another and a valve casing 17 is mounted on member 14 between said cylinders. Within cylinder 15 is positioned a piston 18 provided at its lower end with an expanded portion 19 slidable in a bore 20 formed in casing 14. A connecting rod 21 is pivoted to the piston 18 on a wrist pin 22 and drives a crank shaft 23 in the usual manner. A sliding sleeve valve 24 driven from the crank shaft 23 is adapted to cover and uncover an exhaust port 25 entering cylinder 15 slightly below the center of the same and an intake port 26 communicating with the crank case chamber through an annular passageway 27 and a vertical passageway 28 formed in the casing 14. A port 29 connects passageway 28 with the cylinder 15 somewhat below the exhaust port 25.

In operation, fuel mixture is drawn into the lower portion of the valve chamber 17 through an inlet 30 and from there on through a passageway 31 in the sleeve 24, and by way of port 26 and passageways 27 and 28 into the crank case chamber of the engine. As the charge of mixture in the cylinder proper is exploded, the piston descends and the mixture in the crank case chamber is compressed. When the piston passes port 25 the burnt gases are exhausted by way of this port through a passageway

32 formed in member 24 into the upper portion of valve chamber 17, and from there out through an exhaust pipe 33. After the piston passes port 29 the fresh mixture is admitted into the cylinder proper. Valve 24 is longitudinally divided into two portions which operate to control both the cylinders 15 and 16 in the same manner.

By employing the enlarged piston portion 19 in connection with the crank case pumping device, a greater pressure can be attained. To permit the air to enter and escape above portion 19, a port 34 is provided which communicates with the atmosphere through an opening 35 immediately above the intake 30. This port is so positioned that the crank case chamber communicates with the atmosphere when the piston reaches its uppermost position and said port is uncovered thereby, causing a small charge of fresh air to be drawn into the crank case after each charge of explosive mixture.

About the cylinders 15 and 16 are formed cooling jackets 36 which have inlets 37 and outlets 38, respectively, positioned as indicated in Figs. 1 and 2. A similar jacket 39, located at the upper part of casing 14, is connected with a jacket 40 positioned at the sides of and above the valve casing 17. This portion of the circulating system is provided with inlets 41 and an outlet 42. A manifold 43 connects all of the inlets 37 and 41 with the discharge end of a circulating pump 44 driven from the crank shaft 23 and secured to the engine proper. The bottom of radiator 12 is connected to the receiving end of pump 44 by means of a pipe 45, and the top of said radiator is connected to the various outlet pipes 38 and 42 by means of a header 46.

In my invention the cooling system just described is used to convert liquid fuel into a combustible gas as follows. At the upper portion of radiator 12 is formed an enlarged gas-receiving chamber 47 provided with a downwardly-sloping floor 48. A pipe or hose 49 is connected at one end with the rearward portion of chamber 47 and at the other end with a carbureter which will later be explained in detail. Chamber 47 is also provided with an air-tight closure member 51 and a safety valve 52. The cooling medium is placed into the radiator through the member 51 and the liquid fuel injected into the cooling medium through a casting 53 connected in pipe 45. This casting is formed hollow and is provided at 55 with a nozzle through which the liquid fuel passes. A hand-controlled needle valve 56 screwable in casting 53 serves to regulate the flow of liquid fuel from a pipe line 57 into the stream of cooling medium passing through the casting. Within the bore of this casting is positioned a valve 54 operated by a controlling lever 58 by means of which the flow of cool-

ing medium through the system can be regulated.

In operation pump 44 causes the cooling liquid to circulate throughout the system, said pump also drawing the liquid fuel from pipe line 57 and thoroughly mixing the same with the cooling liquid. As the mixture of cooling liquid and fuel is pumped about the hot portions of the engine, the fuel is vaporized and separated from the cooling liquid, which remains liquid throughout the operation of the engine. The mixture of cooling liquid and fuel vapor is then conducted through header 46 to the upper portion of radiator 12, where the vapor rises to the top in chamber 47 and the cooling liquid falls to the bottom with the rest of the cooling liquid and is again used for cooling purposes. Any liquid which reaches chamber 47 is deposited upon the inclined floor 48 and drains back to the radiator. If desired, a fan 59 may be employed for producing a draft through the radiator which fan is mounted in a casting or bracket 60 secured to the pump 44, and which is driven by means of a belt 61 from the pump shaft. The advantage of employing a cooling liquid distinctive from the fuel becomes evident, as the amount of fuel vaporized can be independently regulated without affecting the proper cooling of the engine. Again, the fuel is being heated from the time it is injected until it enters the gas chamber, thereby requiring the engine to be run at a degree of temperature only slightly in excess of the boiling temperature of the fuel. I prefer to use as a fuel any petroleum oil, such as kerosene or gasolene, and in such a case employ a lubricating oil which flashes at a very high temperature, at least double that of the fuel. Both kerosene and gasolene mix readily with the lubricating oil and are easily vaporized from it.

Although the above means of vaporizing liquid fuel through mixing the same with a cooling liquid and circulating it through the radiator may be employed with great advantage, such an arrangement is not essential to the operation of my improved carbureter and may be omitted when desired. To provide effective means for cutting off this action and admitting atmospheric air directly to the carbureter, a three-way valve 162 is journaled in the connection 163 from pipe 49 to the admission pipe 164 of the carbureter, which will hereinafter be described. The three-way valve is provided with three ports or openings 165, 166 and 167 which come together at the center of the valve. In one position of this valve direct communication is afforded from pipe 49 to carbureter pipe 164. In another position of the valve communication is effected from a port 168 in the member 163 to the intake pipe 164. When the valve is in the

first position fuel vapor may be drawn directly from the chamber 47 above the top of the radiator. When the valve is in the second position atmospheric air constituting the primary air of the carbureter will be drawn directly into and through the inlet pipe 164. This air, or the fuel vapor, if that is employed, as well as the secondary air, is controlled by the throttle valve mechanism located on the air intake side of the mixing or carbureting point in the carbureter, as will hereinafter more fully appear.

The form of carbureter which I prefer to employ in my invention is clearly shown in Figs. 3 and 4. The primary air inlet is through pipe 164. The secondary air inlet is through pipe 63, and the adjustable opening over the top of pipe 63. Within the opening 63 is a butterfly valve 66 mounted on the spindle 67 for controlling the amount of secondary air entering the carbureter, which secondary air will pass into the mixing chamber 64 positioned directly above the pipe 164, which is controlled by a butterfly valve 79 on a spindle 80, the valves 66 and 79 both being on the air-inlet side of the mixing chamber, so that the mixture going through the carbureter is throttled or controlled by the throttling of the air entering the carbureter before the absorption of fuel vapor thereby. This insures very much more effective throttling action and is, I believe, a new form of construction, for which reason I intend to claim the same broadly.

A tubular extension 68 of the casing 62 forms a chamber 170 in alinement with the inlet pipe 164, which inlet pipe is preferably cast integral with a member 71 which surrounds the tubular member 68, providing an oil-receiving chamber 72 in which is a float 73 which controls a needle valve 74 by which fuel is supplied to chamber 72 from a fuel supply pipe 82. Within the tubular portion 68 is positioned a fuel supply member 69 mounted on a cross arm 70 formed integral therewith and having a threaded extension 76 which receives a nut 75 that engages a perforated partition 77 cast integral with member 71, by means of which said member 71 is held assembled upon the primary casing 62. The fuel-supply nozzle or pipe 69 has an aperture 83 therein connected by an aperture 84 in the crossbar 70 with the bowl or chamber 72, and is provided with a fuel outlet 85 controlled by a needle valve 86, which needle valve is threaded into a boss 87 formed on casting 62. By turning of the needle 86 the size of opening at 85 is varied.

Means are provided for simultaneously controlling the needle valve 86 and the butterfly valves 66 and 79. The spindle 67 has fast thereon an arm 96 which is connected by a link 97 to a hand-controlled operating device not shown. The spindle 67 also has fast thereon a pair of arms 93 and 99, as shown

in Fig. 1. The arm 93 is connected by a link 95 with an arm 94 fast on spindle 80 of butterfly valve 79. The arm 99 is connected by a link 100 with an arm 101 having a head 102 slotted at 103, which receives a pin 104 fast on valve rod 86. The slot 103 of head 102 is held in engagement with said transverse pin 104 by a coil spring 105 surrounding the rod 86 and extending between the top of boss 87 and the head 102. When the link 97 is actuated it will simultaneously operate the spindles 67 and 80 with their butterfly valves 66 and 79 and also will rotate the valve 86, in this manner increasing or decreasing the supply of primary and secondary air to the mixing chamber and simultaneously increasing or decreasing the supply of fuel oil to the carbureter.

In supplying fresh air to the engine through port 34 I find it necessary simultaneously to throttle the combustible fuel mixture and the fresh air in order to maintain a constant ratio between the same. This I accomplish by means of a separate air passageway associated with the carbureter and drawing its air from the secondary air-inlet passageway 63 so as to be controlled by the one throttle 66. The cap piece 81, which forms the registering connection from the carbureter with inlet port 30, has an extension which has an opening registering with the air port 35. From the cap piece 88 extends a pipe passageway 89 connected by a union joint 90 with a pipe extension 91 which joins a passageway extension 92 of the supplemental casing 71, the extension 92 opening through a port 190 into the interior of casing 62 immediately below the secondary air passageway 63. In this manner the air supply to the engine through opening 35 is drawn through the same inlet pipe as the secondary air for the carbureter and is controlled by the same throttle. The air from this source may be additionally controlled by means of a plate 107 extending above the inlet pipe 63 and adjustably held by means of a screw member 108, thus positively regulating the maximum air-admission opening.

The operation of my carbureting mechanism is to a large extent intimately associated with and dependent upon the cycle of operations of the motor, which, as pointed out, is a two-cycle motor, and which is more specifically described and the features thereof, apart from the carbureter herein described, are particularly claimed in the afore-said patent.

The operation in general is as follows: The single valve casing 17 is provided with an exhaust chamber connected with exhaust port 33 and an inlet chamber connected with inlet port 30. The exhaust passageway 25 from the cylinder is controlled both by the sliding valve 24 and by the piston 18, it being understood that a single valve chamber

and valve controls both of the adjacent cylinders 15 and 16. The explosive mixture from the valve chamber passes through port 26 controlled entirely by the sliding valve 24 into passageways 27 and 28, from which it may pass through port 29 controlled entirely by the piston 18 into the interior of the cylinder. It is to be noted that during the upstroke of the piston explosive mixture will first be drawn into the passages 27 and 28 until the port 26 is covered by the movement of the sleeve valve, which occurs just before the port 34 is uncovered by continued travel of the piston. The explosive mixture drawn into the system will mostly be in the passages 27 and 28 and at the bottom of the crank case below the chamber 20, which will be filled with fresh air drawn in from the secondary air-inlet pipe 63 through connections 92, 91, 89, 88, opening 35 and port 34. There will, however, be compressed in the passage 29 and other passages in communication therewith in the same plane a small amount of air remaining from the air drawn in through port 34 of the last stroke. Upon the return of the piston the gases are compressed, first a strata of air substantially unmixed with explosive mixture, then the explosive mixture in the passages 28, and finally the charge of unmixed air behind the charge of explosive mixture. When the ports 29 are uncovered immediately after exhaust, the top stratum of air enters the cylinder first, in part scavenging and forming an outer film around the walls of the cylinder. This is followed by the charge of explosive mixture which goes to the center of the cylinder adjacent the spark plug 38, and finally a part of the unmixed air follows the explosive mixture, the other part remaining in the passages 28 and 29, where it is compressed during the return stroke after explosion. This stratifying of the explosive mixture with air around and below the same always insures an excess of air with the explosive mixture and, therefore, complete combustion; but the regulation of the air-supply in reference to the amount of carbureting mixture is essential and is effected by the carbureter mechanism.

I am aware that different forms of construction may be employed which fall within the scope of my invention, and I do not desire to limit myself to the precise form and arrangement of parts herein shown and described. A construction in accordance with this invention has been built and operated and tested as to the condition of the mixture which goes to the cylinder. It has been found from these tests that the charge in the cylinder at the time of explosion in fact comprises a film of air around the walls of the cylinder with little explosive mixture in it, a central body of explosive mixture immediately surrounding the spark plug and

a compressed layer of air with little mixture in it immediately above the head of the piston. Combustion of this charge of explosive mixture is therefore very complete and rapid. It is also true that the charge of air going into the cylinder in advance of the charge of explosive mixture insures that there shall be no waste of explosive mixture through the exhaust.

I claim:

1. A two-cycle explosive engine comprising a cylinder, a piston working in said cylinder, a crank case, a valve casing, means for admitting fuel mixture into said valve casing, a valve movable in said casing for controlling the admission of said fuel mixture to said casing, a port controlled by said valve for admitting the fuel mixture to said crank case, an air admission port for said crank case, a charging port for said cylinder in communication with said crank case, a carbureter having primary and secondary air inlet openings in communication with said charging port, and means for conducting uncarbureted air from said secondary air inlet opening to said air admission port.

2. A two-cycle explosive engine comprising a cylinder, a piston working in said cylinder, a crank case, a valve casing, means for admitting fuel mixture into said valve casing, a valve movable in said casing for controlling the admission of said fuel mixture to said casing, a port controlled by said valve for admitting the fuel mixture to said crank case, an air admission port for said crank case, a charging port for said cylinder in communication with said crank case, a carbureter having primary and secondary air inlet openings, each located on the air admission side of the carbureting chamber in communication with said charging port, and means for conducting uncarbureted air from said secondary air inlet opening to said air admission port.

3. A two-cycle explosive engine comprising a cylinder, a piston working in said cylinder, a crank case, a valve casing, means for admitting fuel mixture into said valve casing, a valve movable in said casing for controlling the admission of said fuel mixture to said casing, a port controlled by said valve for admitting the fuel mixture to said crank case, an air admission port for said crank case, a charging port for said cylinder in communication with said crank case, a carbureter having primary and secondary air inlet openings in communication with said charging port, means for conducting uncarbureted air from said secondary air inlet opening to said air admission port, and means for controlling the flow of air through said secondary air opening.

4. A two-cycle explosive engine comprising a cylinder, a piston working in said cylinder, a crank case, a valve casing, means

for admitting fuel mixture into said valve casing, a valve movable in said casing for controlling the admission of said fuel mixture to said casing, a port controlled by said
 5 valve for admitting the fuel mixture to said crank case, an air admission port for said crank case, a charging port for said cylinder in communication with said crank case, a carbureter having primary and secondary
 10 air inlet openings, each located on the air admission side of the carbureter chamber in communication with said charging port, means for conducting uncarbureted air from said central air inlet opening to said air ad-
 15 mission port, and means for controlling the flow of air through said secondary air opening.

5. A two-cycle explosive engine comprising a cylinder, a piston working in said cylinder, a crank case, a valve casing, means
 20 for admitting fuel mixture into said valve casing, a valve movable in said casing for controlling the admission of said fuel mixture to said casing, a port controlled by said
 25 valve for admitting the fuel mixture to said crank case, an air admission port for said crank case, a charging port for said cylinder in communication with said crank case, a carbureter having an incased chamber in
 30 communication with said charging port, an air passageway connecting said chamber with said air admission port, means for admitting air into the chamber for passage through the carbureter and through the air
 35 passageway, and common means for controlling the supply of air to the carbureter and to said air passageway.

6. A two-cycle explosive engine comprising a cylinder, a piston working in said
 40 cylinder, a crank case, a valve casing, means for admitting fuel mixture into said valve casing, a valve movable in said casing for controlling the admission of said fuel mixture to said casing, a port controlled by said
 45 valve for admitting the fuel mixture to said crank case, an air admission port for said crank case, a charging port for said cylinder in communication with said crank case, a carbureter having an inlet passageway in
 50 communication with said charging port, an air passageway in communication with said air admission port, means for admitting air into the carbureter and into said air passageway, and means for varying the rate
 55 of said admission to both the carbureter and the air passageway in the same ratio of variation for each thereof.

7. A two-cycle explosive engine comprising a cylinder, a piston working in said
 60 cylinder, a crank case, a valve casing, means for admitting fuel mixture into said valve casing, a valve movable in said casing for controlling the admission of said fuel mixture to said casing, a port controlled by said
 65 valve for admitting fuel mixture to said

crank case, an air admission port for said crank case, a charging port for said cylinder in communication with said crank case, a carbureter having an inlet passageway in
 70 communication with said charging port, an air passageway in communication with said air admission port, an air inlet pipe adapted to supply air both to the carbureter and to said air passageway, and a valve for controlling the rate of flow through said air
 75 inlet pipe.

8. A two-cycle explosive engine comprising a cylinder, a piston working in said cylinder, a crank case, a valve casing, means
 80 for admitting fuel mixture into said valve casing, a valve movable in said casing for controlling the admission of said fuel mixture to said casing, a port controlled by said valve for admitting the fuel mixture to said crank case, an air admission port for said
 85 crank case, a charging port for said cylinder in communication with said crank case, a radiator and circulatory system for a cooling liquid, means for conducting fuel oil into said cooling liquid so that said oil is
 90 caused to vaporize in passing through said circulatory system, a carbureter having a carbureting chamber, means for collecting the fuel vapor and conducting the same into the carbureting chamber, means for supplying
 95 air to the carbureting chamber, a valve mechanism for simultaneously and proportionately throttling the vapor supply to the carbureting chamber and the air supply to the carbureting chamber, and
 100 means connecting said carbureter to said charging port.

9. A two-cycle explosive engine comprising a cylinder, a piston working in said
 105 cylinder, a crank case, a valve casing, means for admitting fuel mixture into said valve casing, a valve movable in said casing for controlling the admission of said fuel mixture to said casing, a port controlled by said
 110 valve for admitting the fuel mixture to said crank case, an air admission port for said crank case, a charging port for said cylinder in communication with said crank case, a radiator and circulatory system for a cooling
 115 liquid, means for conducting fuel oil into said cooling liquid so that said oil is caused to be vaporized in passing through said circulatory system, a carbureter having a carbureting chamber, a collecting chamber for said fuel vapor located above the
 120 radiator, a pipe for conducting the fuel vapor from the collecting chamber to carbureting chamber, a valve mechanism for simultaneously and proportionately throttling the vapor supply to the carbureting
 125 chamber and the air supply to the carbureting chamber, and means connecting said carbureter to said charging port.

In testimony whereof I affix my signature.

ELLIS J. WOOLF.