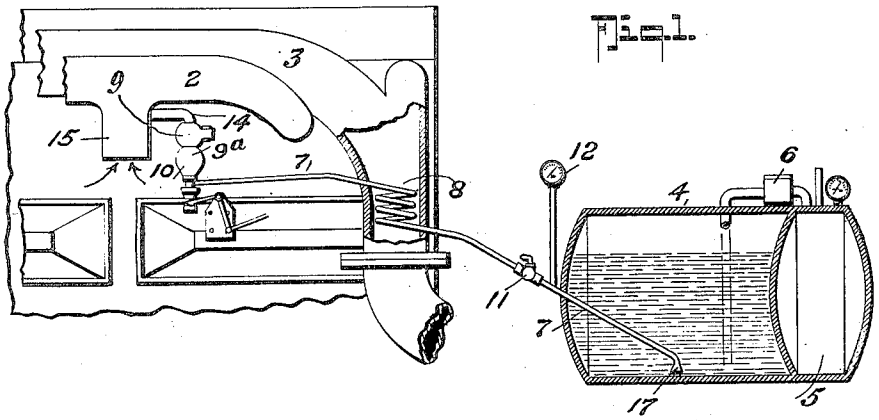
Oct. 9, 1923. 1,470,461

J. M. MACLEAN

MEANS FOR VAPORIZING LIQUID FUEL

Filed Jan. 5, 1921

Fig. 1.



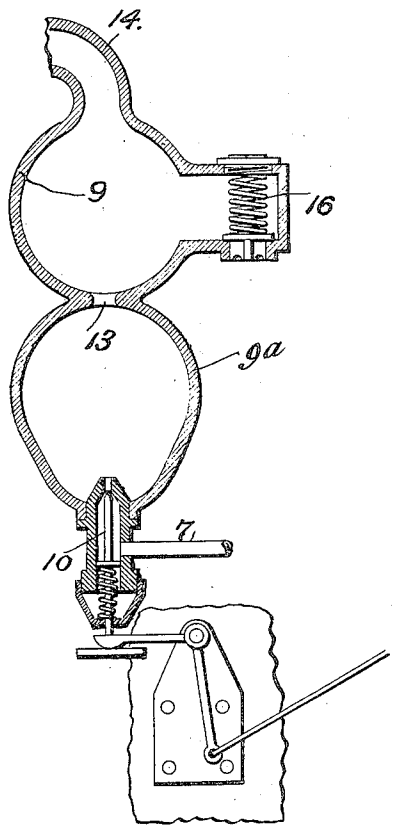
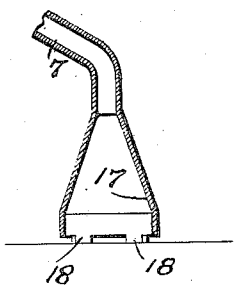


Fig. 2.

Fig. 2a.



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UNITED STATES PATENT OFFICE.

JAMES M. MACLEAN, OF VANCOUVER, BRITISH COLUMBIA, CANADA.

MEANS FOR VAPORIZING LIQUID FUEL.

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To all whom it may concern:

Be it known that I, JAMES M. MACLEAN, citizen of the Dominion of Canada, residing at Vancouver, in the Province of British Columbia, Canada, have invented certain new and useful Improvements in Means for Vaporizing Liquid Fuel, of which the following is a specification.

This invention relates to a means for vaporizing a liquid fuel for delivery to an internal combustion engine, whereby a more effective distribution of the fuel is attained through the air with which it is associated for combustion.

It further comprises the association of a combustible gas with the liquid fuel before delivery of it to the engine cylinders, whereby the ignition is more effectively distributed throughout the volume of the explosive mixture.

The invention is particularly described in the following specification, reference being made to the drawings by which it is accompanied, in which:

Fig. 1 is a side elevation generally illustrating the arrangement of the several parts of the apparatus.

Fig. 2 is an enlarged detail in vertical section of the end of the fuel delivery pipe within the oil reservoir.

Fig. 3 is an enlarged detail in vertical section of the mixing chamber and the fuel and air delivery thereto.

The device comprises the combination with the intake and exhaust manifolds 2 and 3 of an engine, of a fuel tank 4 wherein a liquid hydrocarbon is maintained under a fluid pressure of approximately sixty pounds per square inch. This pressure is maintained by connection of the upper part of the tank 4 with a tank 5 which preferably is a relatively smaller separate compartment of the tank 4, within which tank 5 air or a combustible gas, such as hydrogen, is maintained at a relatively higher pressure, say two hundred and fifty pounds per square inch.

In the connection between the tanks 5 and 4 is a reducing valve 6 that will maintain the pressure in the tank 4 substantially constant under fluctuations of the higher pressure in the tank 5. From the lower part of the fuel tank 4 a pipe 7 delivers the fuel through a vaporizing chamber 9^a to a mixing chamber 9, which pipe 7 passes in a coil 8 through the exhaust 3 of the engine or any convenient part of the exhaust manifold.

The lower end of the pipe 7 within the tank 4 is outwardly flared, as at 17, and has supports 18 to maintain its lower edge clear of the bottom of the tank.

In the delivery of the pipe 7 into the lower end of the vaporizing chamber 9^a is a needle valve 10. This valve 10 is not designed as a stop valve but merely as a control, and it is operated in any manner convenient to the driver of the engine. A stop valve 11 is introduced in the pipe 7 between the tank and the coil, which valve should also be operable from the position of the driver, and between this stop valve 11 and the tank 4 is a connection to a pressure gauge 12.

The expansion chamber 9^a—9 into the lower end of which the pipe 7 delivers through the control valve 10, is medially contracted as at 13, and the upper end is connected at 14 to the intake manifold 2 of the engine adjacent its air inlet 15. In the mixing chamber 9 is an air valve 16 under the driver's control admitting air by suction. The air chamber 16 under normal conditions remains closed so that normally air is excluded from the expansion chamber 9.

When the engine is running the fluid pressure on the surface of the fuel in the tank 4 forcibly delivers it through the pipe 7 and its coil 8 to the expansion chamber 9^a—9, the amount so delivered being regulated by the control valve 10, and the fuel is heated to a relatively high temperature by its passage through the coil 8 in the exhaust of the engine. The pressure under which the fuel is maintained is sufficient to prevent vaporization of the liquid fuel in the pipe 7 under the high temperature it is exposed to, and when it finds its exit into the vaporizing chamber 9^a the sudden release and free expansion of the heated liquid fuel causes it to disperse as an attenuated vapour, which action is again repeated to a somewhat less extent as it passes through the restricted aperture 13 into the mixing chamber 9. This vaporous condition is favourable to thorough admixture of it with the air indrawn at 16 before it is delivered at 14 into the intake manifold 2.

This maintenance of the liquid fuel under pressure, sufficient to prevent its volatilization, while it is being heated, is an es-

sential feature of the invention, as it insures thorough volatilization and dispersion of the vapour through the air it is associated with for combustion.

The subjection of the liquid fuel to fluid pressure within the tank 4 has a further advantage in that the fuel in its liquid state absorbs a substantial proportion of the gas which is in contact with it and by which the pressure is imposed. To further this object the pipe from the tank 5 may be carried down into the liquid in the tank 4, as shown by the dot and dash lines in Fig. 1. If this gaseous fluid is only ordinary air, it will on release assist the dispersion in the expansion chamber, but, if, as is intended, the gaseous fluid stored within the tank 5 is a combustible gas, such as hydrogen, the absorption of that gas by the liquid is of further advantage in that after delivery to the engine cylinders, it will facilitate ignition of the explosive mixture not only by virtue of its greater readiness to ignite but in the fact that it distributes the ignition throughout the volume of the charge.

I do not desire to be confined to the exact construction and arrangement of the parts as hereinbefore described and illustrated, as the same is only illustrative of the application of the essential features of the invention. These essential features are the subjection of the liquid fuel as such to an amount of heat favourable to volatilization, and at the same time to a gaseous pressure sufficient to prevent volatilization during subjection to the heat: The control of the delivery of the fuel into where it is mixed with the air for combustion, whereby I am enabled to maintain the required pressure in the delivery pipe and insure the forcible expression of the heated liquid fuel whereby it is dispersed in a spray that immediately volatilizes and mixes with the air necessary for combustion: And further the means by which the liquid fuel is impregnated with a combustible gas, such as hydrogen, to insure a more effective and general ignition of the charge.

Having now particularly described my invention, I hereby declare that what I claim as new and desire to be protected in by Letters Patent, is:

1. A means for vaporizing liquid fuel for delivery to an internal combustion engine, said means comprising the combination with the intake manifold of the engine, of an expansion chamber one end of which is connected to the manifold adjacent the air inlet thereto, a tank for liquid fuel, a pipe connecting the lower part of the tank to the other end of the expansion chamber, means for heating the pipe, a valve controlling delivery from the pipe into the expansion chamber, and means for imposing super-atmospheric elastic pressure on the liquid fuel in the tank sufficient to prevent volatilization of the liquid fuel in the pipe under the temperature to which it is exposed.

2. A means for vaporizing liquid fuel for delivery to an internal combustion engine, said means comprising the combination with the intake manifold of the engine, an expansion chamber one end of which is in communication with the intake manifold adjacent the air inlet, a tank for liquid fuel, a pipe connecting the lower part of the tank to one end of the expansion chamber, means for exposing the pipe to the heat of the exhaust from the engine, a valve controlling delivery from the pipe into the expansion chamber, and means for imposing a super-gaseous pressure on the liquid fuel in the tank sufficient to prevent volatilization of it in the pipe under the temperature to which it is exposed.

3. A means for vaporizing liquid fuel for delivery to an internal combustion engine, said means comprising the combination with the intake manifold of the engine, of an expansion chamber, one end of which is in communication with the intake manifold adjacent the air inlet, a tank for liquid fuel, a pipe connecting the lower part of the tank to the other end of the expansion chamber, a valve controlling the liquid fuel delivery into the expansion chamber, and means for imposing the liquid fuel in the tank to a gas under super-atmospheric pressure sufficient to prevent volatilization of the fuel in the pipe under the temperature to which it is exposed.

4. A means for vaporizing liquid fuel for delivery to an internal combustion engine, said means comprising the combination with the intake manifold of the engine, of an expansion chamber one end of which is in communication with the intake manifold adjacent the air inlet, a tank for liquid fuel, a pipe connecting the lower part of the tank to the outer end of the expansion chamber, said pipe passing through the exhaust of the engine, a valve controlling delivery from the fuel pipe into the expansion chamber, and means for exposing the liquid in the tank to a combustible gas under super-atmospheric pressure.

5. A means for vaporizing gaseous fuel for delivery to an internal combustion engine, said means comprising the combination with the intake manifold of the engine, of an expansion chamber one end of which is in communication with the intake manifold adjacent the air inlet, a tank for liquid fuel, a pipe connecting the lower part of the tank to the outer end of the expansion chamber, said pipe passing through the exhaust of the engine, a valve controlling delivery from the fuel pipe into the expansion chamber, and means for exposing the liquid in the tank to a combustible gas under super-

atmospheric pressure sufficient to prevent vaporization of the liquid fuel in the pipe at the heat it is exposed to.

6. Means for vaporizing a liquid fuel for delivery to an internal combustion engine, said means comprising an expansion chamber from which air is normally excluded, one end of which chamber is in communication with the intake of the engine, and means for delivering heated liquid fuel through a restricted aperture into the other end of the expansion chamber.

7. Means for vaporizing a liquid fuel for delivery to an internal combustion engine, said means comprising an expansion chamber from which air is excluded, one end of which chamber is in communication with the intake of the engine, and means for delivering heated liquid fuel through a restricted aperture into the other end of the expansion chamber under a super-atmospheric pressure that will prevent volatilization before delivery at the temperature to which it is exposed.

8. Means for vaporizing a liquid fuel for delivery to an internal combustion engine, said means comprising the combination with the intake of the engine, of an expansion chamber one end of which is in communication with the engine intake, a liquid fuel tank, a duct connecting the lower part of the tank to the other end of the expansion chamber, a valve controlling delivery through the duct, means for heating the fuel in the delivery duct, and means for imposing a super-atmospheric pressure on the liquid fuel in the tank sufficient to prevent volatilization of it in the duct at the temperature to which it is exposed.

9. Means for vaporizing a liquid fuel for delivery to an internal combustion engine, said means comprising the combination with the intake of the engine, an expansion chamber one end of which is in communication therewith, a liquid fuel tank, a pipe delivering fuel from the lower part of the tank through a restricted aperture into the other end of the expansion chamber, said pipe exposed to the heat of the exhaust from the engine, a valve controlling delivery from the pipe into the expansion chamber, and means for passing a gas under super-atmospheric pressure through the body of fuel in the tank, and means for retaining the pressure within the tank sufficient to prevent volatilization of the liquid fuel in the delivery pipe to the expansion chamber.

10. A means for vaporizing liquid fuel for delivery to an internal combustion engine, said means comprising the combination with the intake of the engine, of an expansion chamber, one end of which is in communication with the intake adjacent the air inlet thereto, a tank for liquid fuel, a duct delivering the fuel from the lower part of the tank through a restricted aperture in the other end of the expansion chamber, means for heating the duct, a valve controlling the delivery from the duct to the expansion chamber, and means for passing a soluble combustible gas through the fuel in the tank at a super-atmospheric pressure sufficient to prevent volatilization of the fuel in the duct under the temperature to which it is exposed.

11. A means for vaporizing liquid fuel for delivery to an internal combustion engine, said means comprising the combination with the intake of the engine, of an expansion chamber one end of which is in communication with the intake, a tank for liquid fuel, a pipe delivering fuel from the lower part of the tank through a restricted aperture into the other end of the expansion chamber, means for exposing the pipe to the heat of the engine exhaust, a valve controlling delivery of the fuel into the expansion chamber, and means for imposing a super-atmospheric pressure on the liquid fuel in the tank sufficient to prevent volatilization of it in the pipe at the temperature to which it is exposed, and means admitting air to the fuel vapour after its expansion in the chamber and before its delivery to the intake.

12. A means for vaporizing liquid fuel for delivery to an internal combustion engine, said means comprising an expansion chamber, one end of which is in communication with the intake of the engine adjacent the air inlet thereto, a liquid fuel tank, a pipe delivering the fuel from the lower part of the tank through a spraying nozzle into the other end of the expansion chamber, a valve controlling delivery through the nozzle, means for delivering a combustible gas under super-atmospheric pressure through the liquid in the tank, and means for retaining a super-atmospheric pressure in the tank sufficient to prevent volatilization of the fuel in the delivery pipe.

13. A means for vaporizing liquid fuel for delivery to an internal combustion engine, said means comprising in combination, an expansion and mixing chamber separated by a partition in which is an axial aperture, one end of which chamber is in communication with the intake of the engine, means for admitting air into this compartment of the chamber, and means for delivering heated liquid fuel through a restricted aperture in the other end of the other compartment at a super-atmospheric pressure, so that the fuel will not volatilize in the pipe.

In testimony whereof I affix my signature.

JAMES M. MACLEAN.