W. E. VER PLANCK.

FUEL VAPORIZER FOR INTERNAL COMBUSTION ENGINES.

APPLICATION FILED FEB. 21, 1914.

1,256,186.

Patented Feb. 12, 1918.

3 SHEETS—SHEET 1.

Fig. 1.

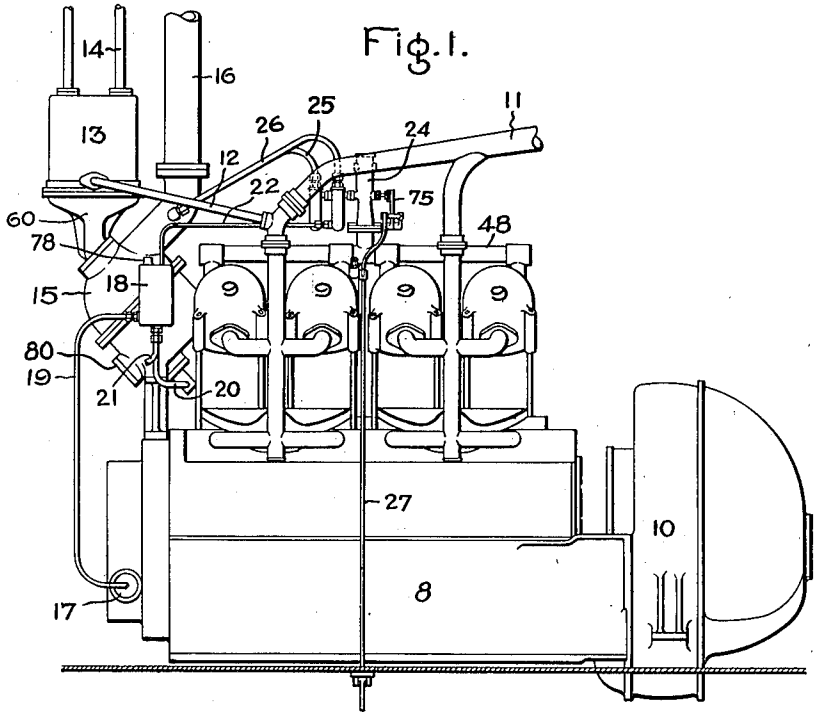
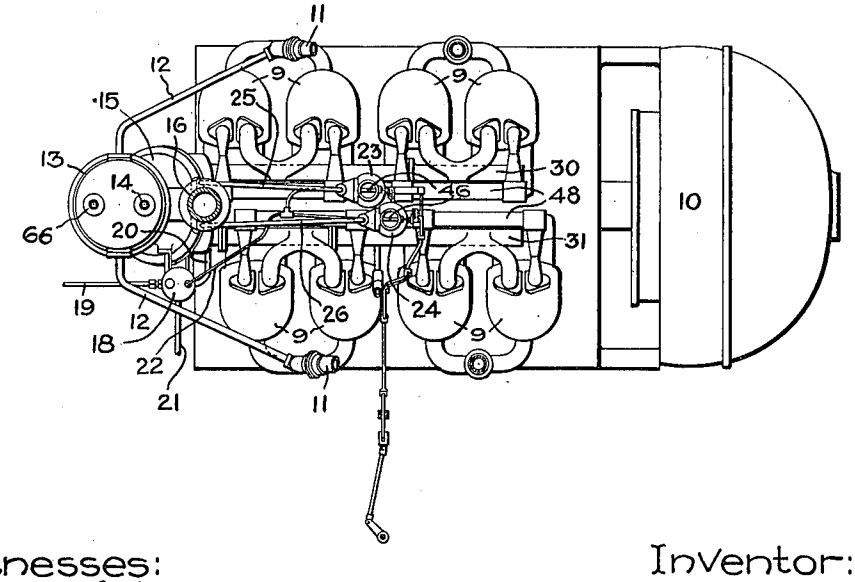


Fig. 2.



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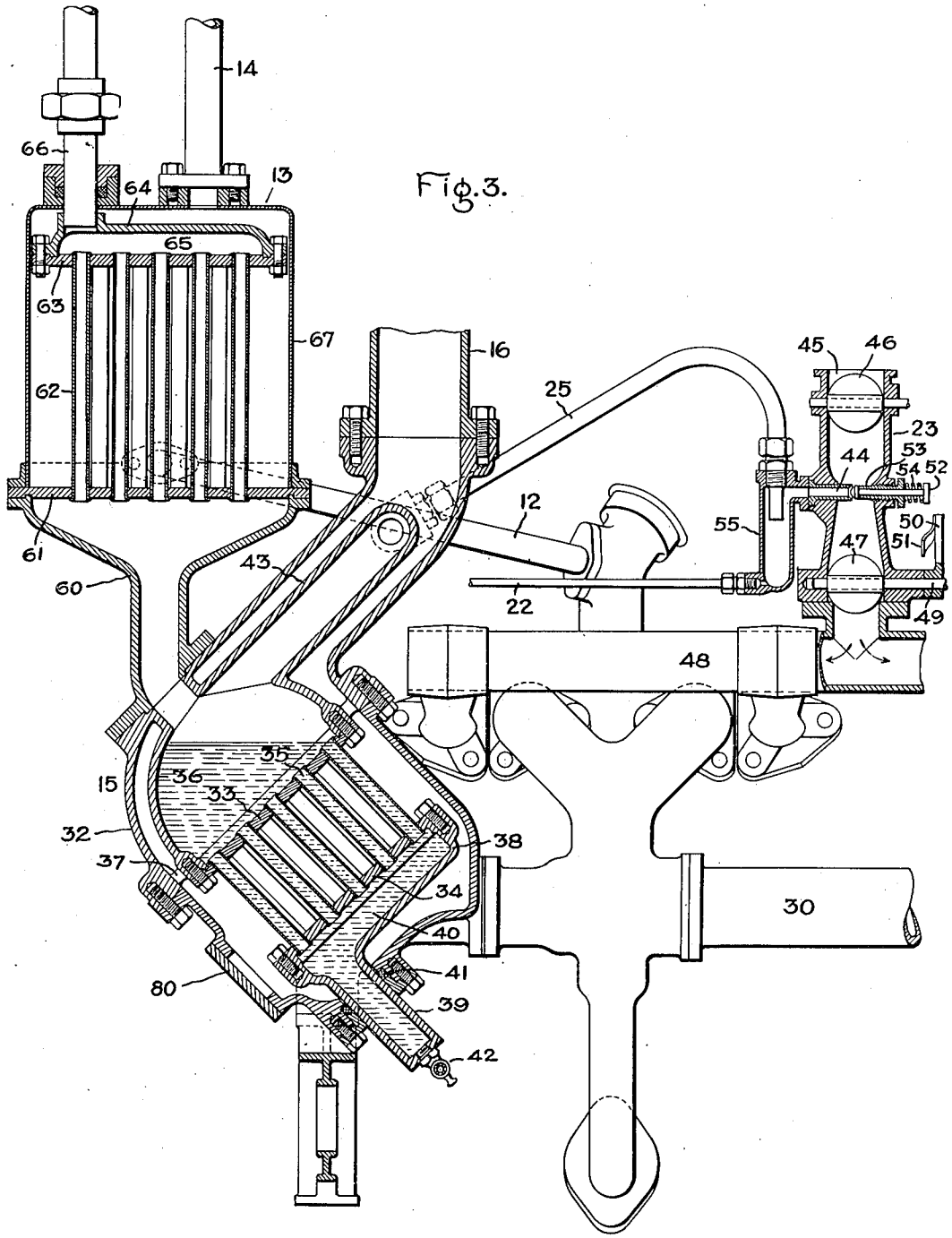
3 SHEETS—SHEET 2.

Fig. 3.



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3 SHEETS—SHEET 3.

Fig.4.

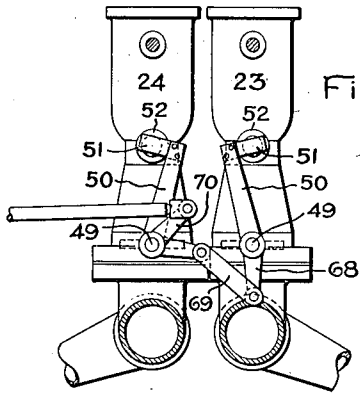
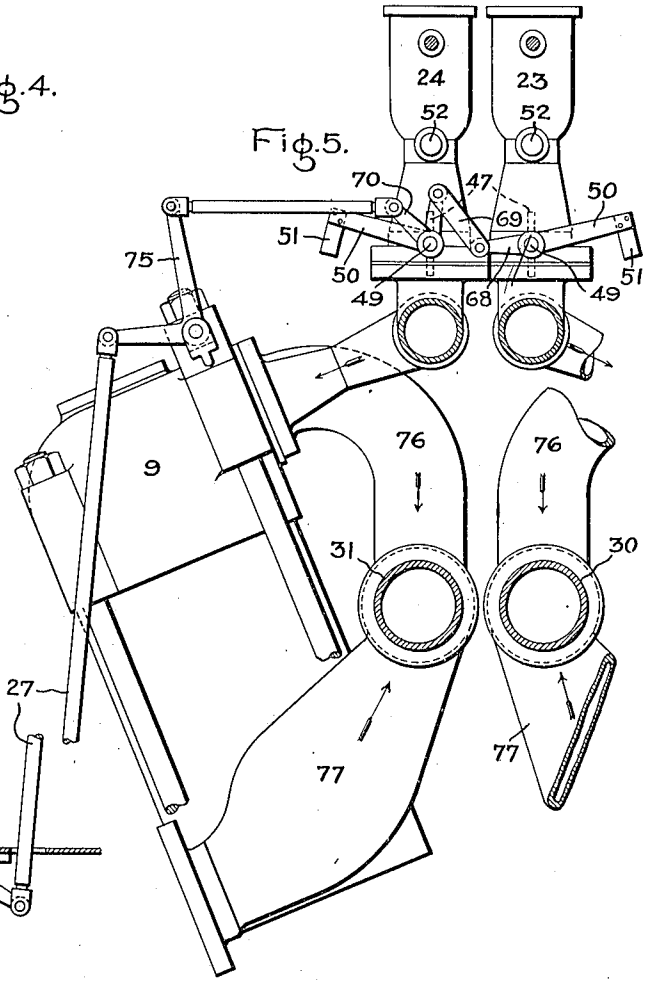


Fig.5.



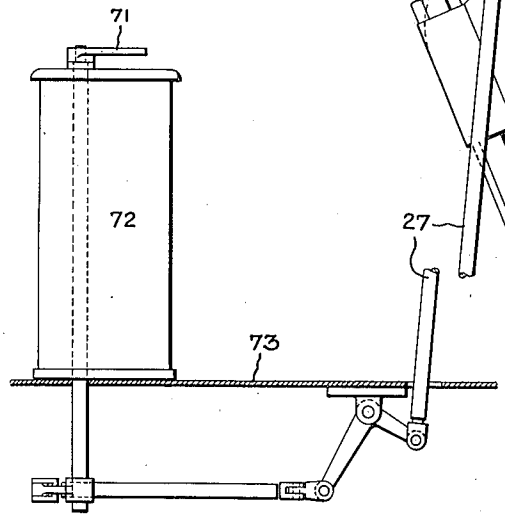


Fig.6.

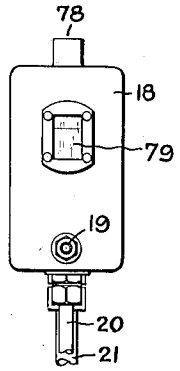
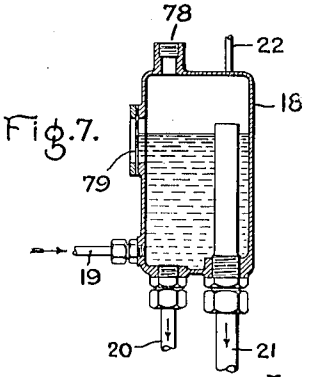


Fig.7.



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UNITED STATES PATENT OFFICE.

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FUEL-VAPORIZER FOR INTERNAL-COMBUSTION ENGINES.

1,256,186. Specification of Letters Patent. Patented Feb. 12, 1918.

Application filed February 21, 1914. Serial No. 820,318.

To all whom it may concern:

Be it known that I, WILLIAM EVERETT VER PLANCK, a citizen of the United States, residing at Erie, county of Erie, State of Pennsylvania, have invented certain new and useful Improvements in Fuel-Vaporizers for Internal-Combustion Engines, of which the following is a specification.

The present invention relates to fuel vaporizers for internal combustion engines, and especially to those designed for vaporizing kerosene and similar fuels, the vapor when formed being delivered to a carbureter in which it is mixed with air and from which the mixture flows to the engine cylinders.

The object of my invention is to provide a fuel vaporizer of simple and improved construction which can be applied to existing, as well as to new engines, and which utilizes the exhaust gases of the engine as a source of heat, the parts being so constructed and arranged as to avoid the necessity of varying the amount of heat supplied by the exhaust gases as the load conditions vary. To state the matter in another way, I aim to provide an arrangement whereby the engine can be regulated by a throttle valve subject to hand or governor control as is the case with ordinary gasolene engines, the vaporizer supplying enough vapor to meet all load requirements, any excess vapor being condensed and returned to the source of supply for further use.

For a consideration of what I believe to be novel and my invention, attention is directed to the accompanying description and claims appended thereto.

In the accompanying drawings which illustrate one of the embodiments of my invention, Figure 1 is a view in side elevation of a multi-cylinder engine; Fig. 2 is a plan view of the same; Fig. 3 is a detailed view, chiefly in section, of the vaporizer, condenser and carbureter; Fig. 4 is a detail view in elevation showing the arrangement of the carbureters; Fig. 5 is an enlarged view of the same showing the controlling mechanism; Fig. 6 is a view in elevation of the overflow tank supplying fuel to the vaporizer, and Fig. 7 is a vertical section of the same.

8 indicates the base of the engine and 9 the cylinders therefor. These cylinders are arranged in sets of four each, each set being supplied with fuel from its own carbureter. The engine is designed to operate on vapor derived from kerosene, but the invention is not limited thereto since other fuels may be employed. For example, I may use some of the crude oils, alcohol, or other fuels. The engine is arranged to drive an electric generator 10 of any suitable construction. 11 indicates a pipe of which there are two for conveying cooling water to the engine jackets. From each pipe is a branch pipe 12 conveying water to the condenser 13 from which it escapes by the pipe 14. 15 indicates the vaporizer which is heated by the exhaust gases from the engine cylinders. After passing through the vaporizer the gases escape by the exhaust pipe 16. The casing of the vaporizer forms in effect a part of the exhaust conduit, as will appear more fully hereinafter. 17 indicates a pump of any suitable construction for pumping fuel into the overflow tank 18. This tank is arranged to maintain a constant liquid level in the vaporizer, the excess being returned to the source of supply. Fuel from the pump enters the tank by the pipe 19. 20 indicates the pipe which supplies fuel to the vaporizer at some point outside of the direct path of the exhaust gases to prevent carbonization of the fuel. 21 indicates the overflow pipe for returning excess fuel from the tank to the source of supply. 22 indicates a pipe which conveys any condensed fuel from the carbureter to the tank 18. The carbureters 23 and 24 receive vapor from the vaporizer by the pipes 25 and 26, Fig. 2. The valves of the carbureters are connected together as will appear more fully hereinafter and are actuated by a rod 27 and connected parts, as will appear more fully in connection with Figs. 4 and 5.

Referring more particularly to Fig 3, 30 indicates the exhaust manifold of one set of cylinders and 31, Fig. 2, the exhaust manifold of the other set of cylinders. Both of

these manifolds are connected to and discharge exhaust gases into the vaporizer. In this manner all of the exhaust gases are utilized to furnish heat for vaporizing the fuel. 32 is a casing for the vaporizer and it forms the connecting link between the manifolds 30 and 31 and the exhaust pipe 16. Inside of this casing is a vaporizer comprising tube sheets 33 and 34. Extending through these sheets and riveted over at their outer ends are tubes 35 which contain the fuel to be vaporized. The tube sheet 33 is secured to the wall 36 of the vapor receiver and superheater, said wall being supported from the casing 32 by a number of lugs 37 having spaces between for the passage of exhaust gases. The lower tube sheet 34 is attached to a member 38 which is provided with a tubular projection 39 that extends through a wall of the casing 32. This projection is hollow and communicates with a chamber 40, the latter containing fuel to be vaporized. Where the projection passes through the wall of the casing it is provided with a suitable packing means 41. It will be noted that the vaporizer is really supported by the tube sheet 33 and that the parts are free to expand and contract due to temperature changes, the projection 39 moving slightly as this action takes place. The projection has a double purpose. It enables the liquid fuel to be admitted at a point which is relatively cold, said projections being outside of the path of the hot gases, thus preventing carbonization of the fuel. It also forms a pocket for the collection of foreign matter. It can be drained by the stop cock 42. The tubes 35 are inclined to a vertical plane since I have found in practice that such an arrangement will insure a more definite circulation of the fuel in the vaporizer, and hence be a more efficient vapor producer than where the tubes are vertically arranged. The receiver is provided with a chamber for the vapor and extending therefrom is a superheater 43, the latter being surrounded by the casing 32 and heated by the exhaust gases after they have passed through the vaporizer. At the highest point in the superheater vapor is discharged by the pipes 25 and 26, Figs. 2 and 3, to the carbureters. The construction of the carbureters is the same in both cases, and hence a description of one of them will be sufficient. The carbureter comprises a vertical casing, Fig. 3, having a central passage made in the form of a venturi. Projecting into the throat of the venturi is a nozzle 44 through which vapor enters the carbureter and is mixed with a certain amount of air entering the opening 45. Between the air opening and the nozzle is located a butterfly valve 46 which may close when the engine is started so as to supply a very rich mixture to the engine cylinders. Located at the discharge end of the venturi is a butterfly valve 47, by means of which the admission of fuel mixture to the gas manifold 48 leading to the cylinders can be controlled. The carbureter being situated between the cylinders gas flows in both directions therefrom. The butterfly valve 47 is provided with a spindle 49, the latter having an arm 50. On the arm is a flat spring 51 which is arranged to engage the head of the valve 52 when it is desired to stop the engine. This, or an equivalent valve, is desirable because of the accumulation of vapor in the vaporizer. Surrounding the valve is a screw-threaded member 53 which by its position determines the extent of opening of the valve. Between the member and the valve head is a spring 54 which normally tends to open the valve to the maximum extent. 55 indicates a pocket formed in a casing attached to the vaporizer. The pipe 25 conveying vapor to the carbureter opens into this pocket and any vapor which may condense collects in the pocket and is returned to the overflow tank 18 by the pipe 22 as described in connection with Fig. 1. The other carbureter is similarly provided with a pocket for the same purpose. This has the advantage of preventing any fuel in liquid form from being carried into the engine.

In an apparatus of this character it is evident that if the vaporizer is so designed as to furnish the maximum of vapor required at any time that it will furnish more than enough when the engine is running under less than full load. Of course, as the load is decreased the heating effect of the exhaust gases will be decreased to a greater or less extent, but it will not bear a direct relation to a change in output, and furthermore there will be a considerable time lag in the action of the vaporizer with respect to that of the engine. In order to compensate for these changes and also to avoid the necessity of carefully regulating the amount of heat admitted to the vaporizer the condenser 13 is provided which is in free communication with the vapor receiving chamber of the vaporizer, the point of connection being lower than the point of discharge of the vapor from the superheater 43. The construction of the condenser is best shown in Fig. 3 in which 60 indicates a hollow support that is mounted on the casing 32, the chamber therein being in free communication with the vapor space of the vaporizer. Mounted on the casing is a tube sheet 61 containing tubes 62 for condensing the fuel vapor. The upper ends of the tubes are located in a tube sheet 63, and above the latter is a head 64 so that a chamber 65 is provided. This chamber opens into a pipe

66 which is in free communication with the atmosphere. This pipe forms a vent to prevent the accumulation of pressure in the condenser. Usually this pipe will not be provided with valves of any sort, but they can be provided if desired. Surrounding the tubes and headers is a casing 67 to which cooling water from the engine is admitted by the pipes 12, there being two such pipes each leading from a set of engine cylinders. The cooling water is discharged through the pipe 14. As the fuel is condensed it runs down the inner surfaces of the tubes through the chamber in the casing 60 into the vaporizer. Under some conditions there may be a good deal of fuel returned to the vaporizer, and at other times very little. In any event the circulating system should be of sufficient capacity to condense any and all fuel vapor entering the condenser. It is important to separate the entrance to the condenser from the point or points where the vapor enters the pipes 25 and 26 to prevent liquid fuel from being carried along with the vapor into the engine where it would give rise to irregular running and a smoky exhaust.

Referring principally to Figs. 4 and 5, the carbureters are provided with butterfly valves 47 shown in dotted lines. The spindles 49 of these valves are connected by arms 68 and link 69 so that when one spindle is moved by the arm 70 the other spindle and its valve will be correspondingly moved. As shown, the valves are wide open, but when they are turned to close the valves the springs 51 on the arms 50 will engage the heads of the valves 52 and press them against their seats as described in connection with Fig. 3. In order to control the throttle valves 47 a hand lever 71 is provided that is mounted on the controller 72 which controls the supply of current from the electric generator 10 to the motors, not shown. The engine and generator are intended for driving motor cars by motors receiving current from the generator. Where the engine and generator are intended for other purposes the controlling means will be correspondingly modified to suit the conditions of service. 73 indicates the floor of the cab containing the engine and generator. Motion from the handle 71 is imparted through a spindle and a series of levers and links to the connecting rod 27, the latter being connected to the bell crank lever 75. One arm of this lever is connected to the arm 70 on the valve spindle of one of the carbureters. By means of this arrangement a single handle 71 serves to control the admission of fuel vapor to both sets of engine cylinders.

Fig. 5 also illustrates the exhaust manifolds 30 and 31 and the conduits leading thereto. In this type of engine there is a conduit 76 leading from the main exhaust valve and another conduit 77 leading from the auxiliary exhaust.

In Figs. 6 and 7 is shown the tank 18 which receives fuel from the pump by the conduit 19. Fuel from the tank to the vaporizer flows by the pipe 20. Inside of the tank is a stand pipe forming a continuation of pipe 21, which acts as a dam to maintain a constant level of liquid in the tank. When the level rises above the top of the standpipe or dam the excess returns by pipe 21 to the source of supply. Condensed fuel from the carbureters is returned to the tank by the pipes 22 which are joined together as shown in Fig. 2. This tank is also provided with a vent 78 to prevent an accumulation of pressure. On one side of the tank is a glass plate 79 through which the operator can see the level of the fuel.

At the start and until the engine is heated I may use some lighter fuel, such as gasolene for example, and admit it to the carbureters. In order to start with a fuel which must be vaporized I provide the casing 32 with a door 80, Fig. 3, which when open permits the insertion of a torch for heating the tubes 35 of the vaporizer to a sufficient temperature to form vapor. After this is done the engine may be turned over by any suitable means, and fuel vapor admitted to the cylinders by valves 52 and throttle valves 47.

It is evident that certain of the features of my improved construction may be used with engines of a different character and with those having a different number of cylinders.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is only illustrative, and that the invention can be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. In combination, an internal combustion engine, an exhaust conduit therefor, a fuel vaporizer through which the exhaust passes from the conduit, a receiver that is located in the exhaust conduit and rises above the level of the liquid in the vaporizer, a conduit for conveying vapor from the receiver, and a condenser into which vapor from the vaporizer is free to flow and from which condensed fuel is free to return to the vaporizer at a point below the outlet of the receiver.

2. In combination, an internal combustion engine, an exhaust conduit therefor, a fuel vaporizer through which gases from the conduit pass, a fuel pump, an overflow tank which receives fuel from the pump and delivers it by gravity to the vaporizer, a con-

duit conveying excess fuel from the tank to the source of supply, a condenser into which vaporized fuel is free to pass and from which condensed fuel is free to return to the vaporizer, a vapor receiver that rises above the point of communication between the condenser and vaporizer, means for heating the receiver, and a conduit that conveys vapor from the receiver.

3. In combination, an internal combustion engine, an exhaust conduit therefor, a fuel vaporizer, a casing therefor which forms a part of said conduit, a receiver which is located within the casing and rises above the level of the liquid in the vaporizer and is heated by the exhaust gases, and a condenser which condenses the excess vapor generated by the vaporizer and returns the same in liquid form to the vaporizer at a point below the outlet from the receiver leading to the carbureter.

4. In combination, an internal combustion engine, an exhaust conduit therefor, a fuel vaporizer, a casing therefor which is interposed in and forms a part of the exhaust conduit, vaporizing tubes located in and supported by the casing, a receiver in which vapor is heated as it flows to the engine, said receiver being located within the casing and heated externally by the exhaust gases, a condenser that receives excess vapor from the vaporizer and returns condensed fuel to the source of supply, and means for cooling the condenser.

5. In combination, an internal combustion engine, an exhaust conduit therefor, a fuel vaporizer, a casing therefor that is attached to and forms a part of the conduit, vaporizing tubes in the casing that are heated by the exhaust gases, a support for one end of the tubes carried by the casing, a member for supporting the other end of the tubes which is provided with a chambered extension, the latter extending through a wall of the casing and being free to move independently thereof.

6. In combination, an internal combustion engine, an exhaust conduit therefor, a casing which forms a portion of the conduit, vaporizing means carried by the casing which are inclined to the vertical to increase the fuel circulation within the casing, a conduit for conveying vapor from the vaporizing means to the engine, and a condenser located above and connected directly to the vaporizing means which receives vapor therefrom and returns liquid thereto, the return of the condensed vapor being effected by gravity.

7. In combination, an internal combustion engine, an exhaust conduit therefor, a casing that communicates with the conduit and through which exhaust gases pass, a vaporizing means located within the casing which is provided with an extension that projects through a wall of the casing and forms a pocket which is located out of the path of the hot gases, and a conduit for feeding liquid fuel into said pocket adjacent its lower end and at a point outside of the casing.

8. In combination, an internal combustion engine, an exhaust conduit therefor, a casing that communicates with the conduit and through which exhaust gases pass, a vaporizing means located within the casing which comprises a plurality of vaporizing tubes inclined to the vertical to increase the circulation of fuel in the casing, a liquid container that is in communication with the tubes and has an extension that projects outwardly through a wall of the casing and out of the path of the hot gases, and a conduit for supplying liquid fuel to said extension at a point outside of the casing.

9. In combination, an internal combustion engine, an exhaust conduit therefor, a casing that forms a part of the conduit, fuel vaporizing means located in the casing and inclined to the vertical to increase the circulation of the liquid fuel, a chambered means that projects outwardly through a wall of the casing, communicates with the vaporizing means and contains liquid fuel, a receiver for the vapor that rises above the level of the liquid in the vaporizer and is located within the casing, an outlet for the vapor in the receiver, and a condenser that communicates with the vapor chamber of the vaporizer, condenses excess vapor and returns the condensed fuel to the vaporizer.

10. In combination, an internal combustion engine, an exhaust conduit therefor, a fuel vaporizer through which gases from the conduit pass for heating the same, a receiver that rises above the level of the liquid in the vaporizer and from which the vapor is delivered to the engine, a tank containing a dam to limit the level of the liquid therein, a pipe connecting the tank and vaporizer, a pump for delivering fuel to the tank, and a condenser communicating with the vaporizer for condensing the vapor generated by the vaporizer in excess of the requirements of the engine and returning it in liquid form back to the vaporizer.

11. In combination, an internal combustion engine, an exhaust conduit therefor, a fuel vaporizer through which gases from the conduit pass for heating the same, a receiver that rises above the level of the liquid in the vaporizer and from which the vapor is delivered to the engine, a tank for feeding liquid fuel to the vaporizer, a vent therefor, a pump delivering liquid fuel to the tank, a condenser in uninterrupted communication with the vaporizer at a point below the vapor discharge orifice, and a vent for the condenser that is always open.

12. The combination with the exhaust

conduit of an engine, of a fuel vaporizer for supplying fuel to the engine which is heated by exhaust gases from the engine, said fuel vaporizer comprising a casing, means connected therewith for maintaining a constant level of fuel therein, a receiver located above the casing which is also heated by the exhaust gases, a condenser connected with the casing at a point below the receiver, and cooling means for the condenser.

In witness whereof, I have hereunto set my hand this 13th day of February, 1914.

WILLIAM EVERETT VER PLANCK.

Witnesses:
O. T. FOUCHE,
MARTHA L. MCDONALD.