April 15, 1924. 1,490,267

T. T. GREENWOOD

POWER PLANT

Filed April 1, 1922

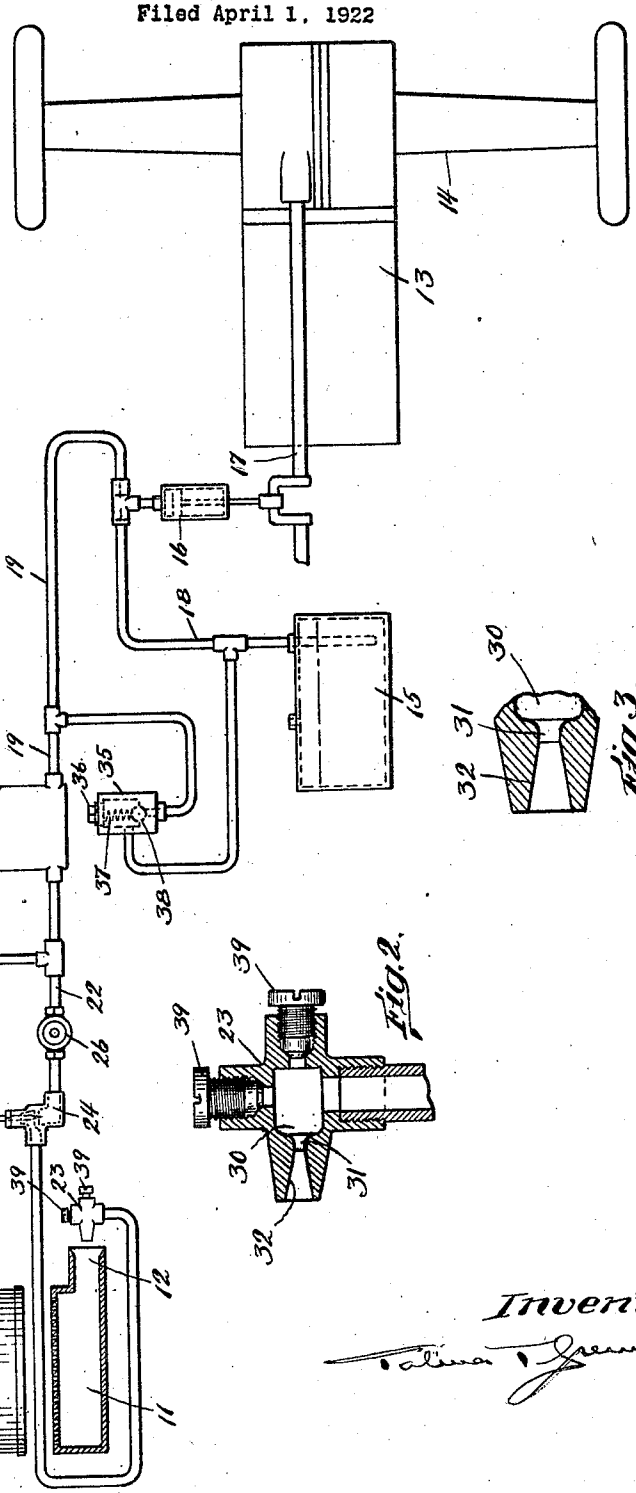


Fig. 1.

Fig. 2.

Fig. 3.

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UNITED STATES PATENT OFFICE.

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POWER PLANT.

Application filed April 1, 1922. Serial No. 548,764.

To all whom it may concern:

Be it known that I, TALMA T. GREENWOOD, a citizen of the United States, residing at East Templeton, in the county of Worcester and State of Massachusetts, have invented an Improvement in Power Plants, of which the following is a specification.

This invention relates to steam power plants for automobiles, and has particular reference to a system for supplying liquid fuel to be burned under the boiler to generate steam.

A typical steam power plant includes a boiler and a burner for vaporized liquid fuel disposed beneath the boiler. Liquid fuel is vaporized under elevated pressure and the vaporized fuel is discharged through an orifice into a mixing tube in which, by reason of its velocity, it draws in, and mixes with, air in proportions to form a suitable combustible mixture at about atmospheric pressure. The liquid fuel is supplied under high pressure by a pump driven from the rear axle of the automobile and consequently at a variable rate dependent upon the speed of the automobile. The flow of fuel to the burner is usually governed by a steam pressure controlled automatic valve which admits fuel to the burner when the steam pressure is low and cuts off the fuel when the steam pressure is high.

With the above arrangement a disagreeable whistling sound of loud intensity is set up whenever vaporized fuel flows from the nozzle into the mixing tube of the burner; and the whistle occurs intermittently and at unexpected intervals, as the automatic valve opens and closes to maintain constant steam pressure. The whistling sound is the more undesirable when contrasted with the otherwise relatively silent operation of the automobile.

An object of this invention is to provide a fuel supply system for the boiler in which the component parts thereof are so constructed and arranged that the vaporized fuel is supplied to the burner of the boiler without setting up an undue amount of noise, or consequently, in a practically noiseless manner.

Fig. 1 is a diagrammatic representation of the fuel supply system embodying the invention.

Fig. 2 is a sectional detail of the fuel nozzle.

Fig. 3 is an enlarged sectional detail illustrating the fuel passage in the fuel nozzle arranged in accordance with the invention.

As here shown diagrammatically, the steam power plant includes the boiler 10 and the burner 11 having the mixing tube 12 disposed beneath the boiler. Steam from the boiler is supplied, through a suitable pipe and throttle, not shown, to an engine 13 here shown as connected directly to the rear axle 14.

The fuel system includes the tank 15 in which fuel is carried at atmospheric pressure and the fuel pump 16. Said pump is here shown as driven from the rear axle by the shaft 17, and the pump operates to draw fuel from the tank 15 through the pipe 18 at a variable rate proportional to the speed of the automobile. The fuel is forced at high pressure through the pipe 19 into a pressure tank 20 against an air cushion whereby to equalize and render more uniform the supply of fuel to the burner. The pressure of fuel in the tank 20 is adapted to be relatively high, say in the vicinity of one hundred and fifty pounds gage, and a gage 21 may be placed in fluid communication with said tank to make known the fluid pressure therein.

Liquid fuel at high pressure is conducted through the pipe 22 to the burner 11 and passes between the boiler and the burner, or is otherwise arranged to receive heat from the burner to vaporize the fuel in the pipe. Said pipe 22 terminates in a fuel nozzle 23 disposed adjacent the mixing tube 12 of the burner, and the vaporized fuel issues at high velocity through said nozzle and entrains air, and the vaporized fuel and air mix and pass into the burner to be burned.

An automatic fuel valve 24 operated by steam pressure in the boiler 10 through the pipe 25 may be arranged in said high pressure fuel pipe 22 to control automatically the supply of fuel to the burner, whereby to maintain substantially constant steam pressure, and a manually controlled valve 26 may also be arranged in said fuel pipe.

I have found that the disagreeable noise set up by the fuel system is due in part, to the shape of the fuel passage in the noz-

zle. While said passage, as ordinarily constructed, may discharge vaporized fuel without undue noise or audible vibration at relatively low pressures, as for instance, pressures below thirty pounds per square inch gage it is extremely noisy for higher pressures, as for instance one hundred pounds gage.

I have found that a nozzle having a fuel passage shaped substantially in accordance with that illustrated in Figs. 2 and 3 is practically noiseless when the pressure of the vaporized fuel passed through it is maintained substantially constant and at some particular value found most suitable for the specific dimensions of the passage.

The fuel passage illustrated in Figs. 2 and 3 is characterized by the bowl 30, the edges of which are smoothly rounded into the throat 31, and the expanding passage 32. The cross-sectional area of the throat governs the amount of fuel vapor discharged by the nozzle in unit time. The expanding passage 32 should be gradually expanding, say at about a 10° angle, and the dimension of its exit cross-sectional area should be governed by the pressure of the fuel. Whereas, with the ordinary construction of said passage, the fuel vapor is expanded beyond the nozzle down to the pressure of the atmosphere, with consequent pronounced audible vibrations, or sound, it is a characteristic of the present nozzle that the fuel vapor is expanded to atmospheric pressure within the nozzle, and within the tapering portion 32 thereof, and consequently, the fuel vapor may flow from the nozzle in a smooth uniform stream without appreciable additional expansion beyond the nozzle and, consequently, without substantial noise.

By reason of the expanding portion 32 of the fuel passage, the velocity of the fuel vapor as it issues from the nozzle is materially greater than that resulting from the usual passage and, consequently, more air may be entrained with the fuel vapor, or the pressure of the mixture within the burner 11 may be greater, whereby to improve the efficiency of mixing and combustion and the rate of making steam.

The nozzle illustrated in Figs. 2 and 3 will operate in a substantially noiseless manner when supplied with fuel at a particular substantially constant pressure for which it is designed, but it may be somewhat noisy if the pressure of the fuel vapor departs abnormally in either direction from the designed value. It is a further object of the invention, therefore, to provide means to maintain a substantially uniform pressure of the fuel supplied to the nozzle. Said fuel pressure maintaining means may comprise the spring loaded relief valve 35 connected between the pressure pipe 19 and suction pipes 18 to by-pass fuel about the pump 16 when the fuel pressure in the pressure tank 20 becomes higher than the desired value. Said valve may be adjusted for the pressure suitable for noiseless operation of the fuel nozzle by the adjusting screw 36 which operates to vary the tension of the compression spring 37 as the valve member 38. While the specific form of fuel pressure maintaining means is no part of this invention, yet some means is desirable because of the variable effect of the fuel pump 16, and the variable demand for fuel.

The automatically actuated fuel valve 24 is preferably such that it opens rapidly to give full fuel pressure to the fuel nozzle and closes rapidly to cut off the fuel and without slowly reducing the fuel pressure, which might result in momentary noisy operation.

The nozzle 23 may be provided with clean-out screws 39, if desired. It will be noted that, by reason of the short length of the restricted portion, or throat 31, of the fuel passage, said passage is less liable to become fouled with carbon than is the usual long straight form of passage.

I claim:

1. A fuel supply system for the boiler of a steam power plant, comprising a burner having an air inlet passage, a fuel nozzle arranged to discharge fuel vapor into said passage, said nozzle characterized by having a reduced throat and an expanding portion extended from the throat, and means to maintain a predetermined substantially constant pressure of fuel at the fuel nozzle, whereby said nozzle may be practically noiseless in operation.

2. A fuel supply system for the boiler of a steam propelled automobile, comprising a burner having an air inlet passage, a fuel nozzle arranged to discharge fuel vapor into said passage, said nozzle characterized by having a reduced throat and an expanding portion extended from the throat, means to vaporize the fuel, a high pressure fuel tank in communication with said nozzle, a fuel pump in communication with said tank arranged to pump fuel in proportion to the speed of the engine of the automobile, means to vaporize the fuel supplied to said nozzle, and means to maintain such constant pressure of fuel vapor at said nozzle that the fuel vapor issues therefrom substantially at the pressure of the atmosphere.

3. A fuel supply system for the boiler of a steam propelled automobile, comprising a burner having an air inlet passage, a fuel nozzle arranged to discharge fuel vapor into said passage, said nozzle characterized by having a reduced throat and an expanding portion extended from the throat, means to vaporize the fuel, a high pressure fuel tank in commnication with said nozzle, a fuel

pump in communication with said tank arranged to pump fuel in proportion to the speed of the engine of the automobile, means to vaporize the fuel supplied to said nozzle, and means to maintain such constant pressure of fuel vapor at said nozzle that the fuel vapor issues therefrom substantially at the pressure of the atmosphere and means governed by the boiler pressure to control the flow of fuel vapor through said nozzle.

In testimony whereof, I have signed my name to this specification.

TALMA T. GREENWOOD.