

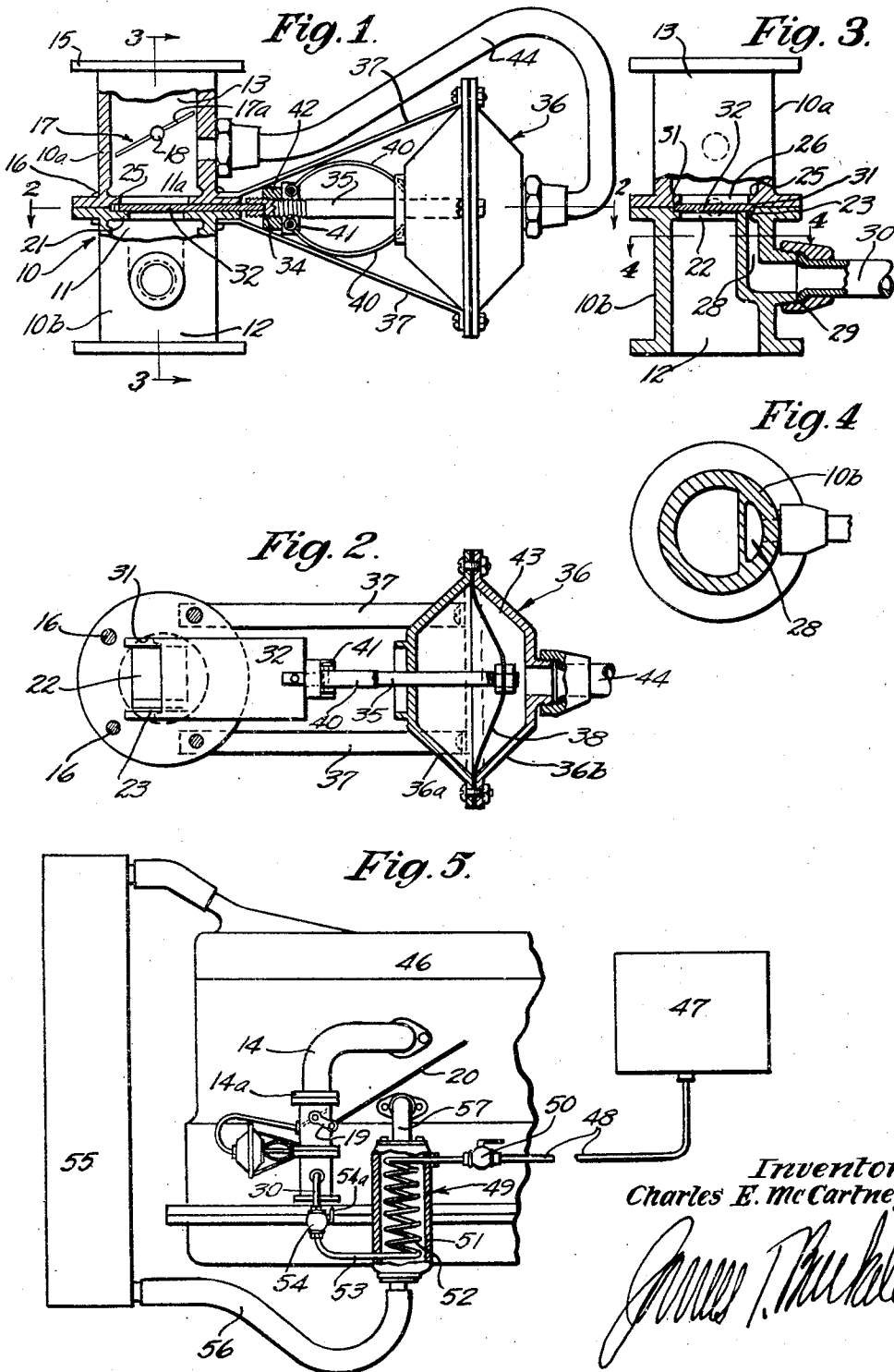
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VOLATILE HYDROCARBON VAPORIZING AND FUEL SUPPLY SYSTEM

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VOLATILE HYDROCARBON VAPORIZING
AND FUEL SUPPLY SYSTEM

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3 Claims. (Cl. 123—120)

This invention deals generally with fuel vaporizing and supply systems, and particularly with such systems utilized for feeding gaseous or vaporized fuel to internal combustion engines.

5 The present application is divisional of my co-pending application, Ser. No. 607,581, filed April 26, 1932, on Carbureting apparatus.

Within comparatively recent years, a volatile hydrocarbon fuel consisting mainly of ethane, propane and butane fractions has come extensively into use for domestic heating and lighting purposes, and also as fuel for internal combustion engines. This fuel, being volatile at normal atmospheric temperatures, is handled and shipped in pressure containers within which the fuel is confined at a pressure of around 50 to 60 lbs. per sq. in. gage, its vapor pressure at average atmospheric temperatures. Various difficulties have been encountered in attempting to utilize this fuel for operating internal combustion engines, by reason of its extreme volatility and the extreme cooling effect resulting from expansion of the liquid fuel vapor phase. The reason has been primarily that the volatile characteristics of the fuel prevent its being satisfactorily vaporized and fed to the engine with known types of fuel supply or carbureting apparatus designed for the less volatile fuels, such as gasoline and heavier oils. It is accordingly my chief object to provide a system for vaporizing and supplying under substantially constant pressure, vaporized fuel consisting essentially of ethane, propane and butane fractions, and in so doing to overcome the limitations of supply systems designed for heavier fuels.

In accordance with the invention, the liquid fuel is taken from the pressure container to a heater wherein the fuel is substantially completely vaporized. However, instead of effecting the entire vaporization by means of heat supplied to the heater, I accomplish a partial vaporization by dropping the fuel pressure at some suitable point between the pressure container and the heater, for reasons which will hereinafter appear more fully. Then, after the fuel is completely vaporized in the heater, I preferably then again reduce the pressure of the fuel in a vapor line leading from the heater to a connection with a carburetor, engine manifold or other point of use. The fuel pressure thus is reduced in two stages, from the second of which the fuel is fed at a constant and predetermined pressure, around or somewhat below atmospheric, depending upon the conditions of the installation.

55 The various aspects of the invention, as well

as various features and objects, will be more fully understood from the following detailed description. For the purpose of setting forth a complete operative engine supply system, I will describe also a gas carburetor which meters the fuel flowing to the engine and which receives vaporized fuel from the system briefly described above. The scope of the present application, however, includes only the fuel supply system. Throughout the description, reference is had to the accompanying drawing, in which:

Figure 1 is a view, partially in vertical section, showing the fuel and air metering and mixing part of the apparatus;

Fig. 2 is a section on line 2—2 of Fig. 1;

Fig. 3 is a section on line 3—3 of Fig. 1, the outlet end of the mixing passage being shown in elevation;

Fig. 4 is a section on line 4—4 of Fig. 3; and

Fig. 5 is a fragmentary conventional elevation showing the apparatus in connection with an internal combustion engine, the fuel heater and vaporizer being shown in vertical section.

Referring first to Fig. 1, the fuel and air mixing part of the apparatus comprises a body, generally indicated at 10, containing an air passage 11 having an inlet 12 and an outlet 13. The latter connects with the engine manifold, as shown in Fig. 5, by way of pipe 14, the flanged end 14a of which is bolted to flange 15 on the outlet end of the body 10. The body is made in two sections 10a and 10b attached together by means of bolts 16. Body section 10a contains a throttle 17, shown typically as a simple butterfly valve 17a carried on shaft 18, the latter being operated by way of arm 19 and rod 20, see Fig. 5. An internal flange 21 is formed at the upper end of body section 10b, and opening through this flange is a pair of orifices 22 and 23, see Figs. 2 and 3, the former being comparatively large and passing air from inlet 12 to the outlet 13; orifice 23 being comparatively small and passing fuel from the fuel supply source, hereinafter described, into the air passage. Section 10a also has an interior flange 25 forming an opening 26 registering with aperture 22, and being preferably of somewhat greater width as viewed in Fig. 1.

As a simple expedient for maintaining the relative sizes of the orifices substantially constant while allowing changes in their individual sizes, I form the orifices 22 and 23 rectangularly in shape, the widths of the orifices, in the direction of valve movement, being substantially uniform. Since the individual widths of the orifices in the direction of valve movement remain the same for all positions of the valve, it follows that the rela-

tive areas will, for all positions of the valve, remain constant. As shown most clearly in Fig. 3, the fuel passing orifice 23 is supplied with fuel by way of passage 28 within body section 10b and connecting at 29 with a line 30 leading from the fuel vaporizer, hereinafter described.

The engaging flanged ends of body sections 10a and 10b are provided with transversely extending ways 31 to receive a gate valve 32 which operates 10 to control the passage of fuel and air through the orifices. As shown in Fig. 1, valve 32 in closed position overlaps flange 21 at the left to completely close both orifices. The valve extends through the side of the body and is connected as 15 at 34 with a valve operating rod 35. As shown in Fig. 2, a diaphragm containing body 36 is supported on the body 10 by means of members 37. Body 36 comprises a pair of hollow sections 36a and 36b between which a flexible diaphragm 38 20 is clamped. Rod 35 extends through section 36a and is attached to the diaphragm as shown. A spring is provided for exerting a constant closing force on the valve, the spring being of a constant tension type comprising a pair of resilient bows 25 40 carried on nut 41 and bearing against the diaphragm case. Nut 41 is threaded on rod 35 and is therefore capable of longitudinal adjustment to regulate the tension of the spring, lock nut 42 holding the spring carrying nut in adjusted position. 30 tion.

Chamber 43 within the diaphragm body section 36b is connected with the air passage 11 at a point between valve 32 and the throttle, by way of tube 44. The function of tube 44 is to communicate to 35 the diaphragm the pressure within portion 11a of the air passage between the throttle and orifice control valve, and to allow the diaphragm to move in response to variations in pressure at 11a. At closed position of the throttle, the pressure in 11a 40 will more closely approach that of the atmosphere, at which time no substantial depression may be communicated to the diaphragm. Valve 32 will therefore remain in closed position under the influence of spring 40. Upon opening movement 45 of the throttle, the manifold suction or depression is communicated past the throttle to space 11a and thence through tube 44 to the diaphragm, causing the diaphragm to deflect to such position as shown in Fig. 2, and valve 32 to open.

If it be assumed that with the parts in the positions shown in the drawing, the engine is operating at a medium speed, the immediate effect produced by opening the throttle to accelerate the engine, will be to create a temporarily increased depression in 11a, which depression is 55 communicated to the diaphragm to cause valve 32 to open wider. Opening movement of the valve, however, increases the size of the air passing orifice, so that the depression in 11a returns to its normal value. The converse of these operations, of course, occurs upon closing movement of the throttle, retardation of the engine speed resulting in the maintenance, after uniform operating conditions have become established, of 60 the same constant depression in 11a.

The fuel feed system with which the invention is more particularly concerned is shown in Fig. 5, and is provided for the purpose of converting the highly volatile liquid fuel to vapor, and for 70 supplying the vaporized fuel to the fuel mixing apparatus at substantially constant predetermined pressure. The apparatus is shown to be attached to an engine 46 supplied with fuel from a tank 47, the latter containing volatile liquid 75 hydrocarbon under its normal vapor pressure at

the existing temperature conditions. Fuel is fed from the tank 47 through line 48 to a heater generally indicated at 49, there being a pressure reducing valve 50 placed in the line between the tank and heater. In the broader aspects of the invention, any suitable apparatus may be provided for heating and vaporizing the fuel. As 5 typical of such apparatus, I have shown a shell 51 containing a coil 52 connecting with line 48 and communicating through pipes 53 and 30 with space 28 and the fuel supply orifice in body 10. A pressure reducing valve 54 is also placed between lines 53 and 30. Coil 52 within shell 51 may be heated by any suitable means, as for example by water from the engine radiator 55 circulated 15 through the shell by way of pipes 56 and 57.

The pressure in tank 47 and line 48 up to the pressure reducing valve 50, will be determined in accordance with the vapor pressure of the fuel. Using a fuel consisting of such low boiling 20 fractions as ethane, propane and butane, the pressure in tank 47 may be in the neighborhood of 60 lbs. per square inch gage. Valve 50 preferably will be set to reduce the pressure in the heating coil to in the neighborhood of 5 lbs. per square inch gage, thereby bringing about a certain amount of vaporization by virtue of the pressure reduction alone. In the heater, the fuel is converted entirely to vapor which passes 30 through lines 53 and 30 to the fuel supply orifice. Pressure reducing valve 54 is set to maintain a constant pressure on the fuel being supplied to orifice 23, this pressure being comparatively low and in the neighborhood of say from minus 2 to minus 5 inches of water, gage pressure. 35

Particular advantages are gained by the installation of pressure reducing valve 50 at the inlet side of the heater, and also by the provision of the two pressure reducing valves at opposite sides of the heater. Difficulties in starting operations that would otherwise occur, are obviated 40 by subjecting the high volatile liquid fuel to an initial pressure drop before entering the heater. In the absence of valve 50, before the engine is started and before the fuel heater is brought up to normal temperature, the fuel filling pipes 48, 53 and the heater coil 52, would for the most part be liquid. Then, as the engine is started, a pressure drop from substantially tank pressure to some pressure around atmospheric would occur 50 at valve 54, and by reason of the comparatively great pressure differential, there would result a corresponding cooling effect and rapid accumulation of frost on and freezing within valve 54. By providing valve 50, and thereby taking the 55 total pressure drop in two stages, sufficient volatilization may take place at the expansion side of this valve that even at low starting temperature conditions within the heater, ample vaporized fuel will be fed to the engine until temperature conditions throughout the system are brought up to normal.

I prefer to use engine circulating water as the heating medium for the reason that, normally, the water is comparatively uniform in temperature, and for that reason conditions of corresponding uniformity are maintained within the fuel vaporizing and supply system. Moreover, it is assured that under no conditions will the temperatures in the heater exceed the boiling 70 temperature of water, a matter of importance considering the extreme volatile characteristics of the fuel.

From the foregoing, it will be seen that the system operates to supply vaporized fuel at a 75

constant predetermined pressure. If for any reason it becomes desirable to vary the fuel richness in the combustible mixture being fed to the engine, such variations may be accomplished by varying the pressure of fuel fed to the fuel passing orifice through regulation of valve 54, the latter being of any well known type capable of adjustment, as by means of lever 54a.

I claim:

1. In apparatus for supplying gaseous fuel to an engine via a throttle controlled carbureter suction passage into which the fuel is drawn through a fuel inlet in accordance with the depression existing in said passage; the combination comprising, a pressure container for fuel that is volatile at atmospheric temperatures and pressure, a heater for heating and vaporizing the liquid fuel, a fuel supply line connecting said container with the heater, a pressure reducing valve in said line operating to substantially reduce the pressure of the fuel being fed to the heater, a vapor line leading from said heater to the carbureter fuel inlet, and a pressure reducing valve in said vapor line operating to deliver fuel to said fuel inlet at substantially constant pressure.

2. In apparatus for supplying gaseous fuel to an engine via a throttle controlled carbureter suction passage into which the fuel is drawn through a fuel inlet in accordance with the depression existing in said passage; the combination comprising, a pressure container for fuel that is volatile at atmospheric temperatures and

pressure, a heater for heating and vaporizing the liquid fuel, a fuel supply line connecting said container with the heater, a pressure reducing valve in said line operating to substantially reduce the pressure of the fuel being fed to the heater, a vapor line leading from said heater to the carbureter fuel inlet, and a pressure reducing valve in said vapor line operating to deliver fuel to said fuel inlet at substantially constant sub-atmospheric pressure.

3. In apparatus for supplying gaseous fuel to an engine via a throttle controlled carbureter suction passage into which the fuel is drawn through a fuel inlet in accordance with the depression existing in said passage; the combination comprising, a pressure container for fuel that is volatile at atmospheric temperatures and pressure, a heater for heating and vaporizing the liquid fuel, a fuel supply line connecting said container with the heater, a pressure reducing valve in said line operating to partially vaporize and substantially reduce the pressure of the fuel being fed to the heater, a vapor line leading from said heater to the carbureter fuel inlet, and a pressure reducing valve in said vapor line operating to deliver fuel to said fuel inlet at substantially constant subatmospheric pressure, the first mentioned pressure reducing valve being set to reduce the fuel pressure through a substantially greater differential than the last mentioned valve.

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