APPARATUS FOR PREPARING HYDROCARBON MIXTURES FOR COMBUSTION

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The invention relates to an improvement in apparatus for preparing hydrocarbon mixtures for combustion. The present application relates more particularly to an improvement in the apparatus disclosed in my co-pending application Serial No. 142,170, filed October 15, 1928.

The apparatus of the present invention has been developed as a result of experiments seeking to produce a more efficient and economical apparatus for preparing liquid hydrocarbon mixtures for combustion in household or similar service. There is an increasing demand for apparatus of this character in localities not supplied with natural or manufactured gas, and many efforts have been made to satisfy the demand. But the apparatus thus far produced or proposed have not been altogether satisfactory, either because they have been expensive to manufacture and maintain or because they have required the application of external artificial heat to secure the proper gasification of the liquid hydrocarbon mixture. The term "hydrocarbon mixtures" includes those hydrocarbons of which the ingredients are of different degrees of volatility. The hydrocarbon mixture is transported from the place of production to the point of consumption in the liquid state. In this state the various ingredients of the mixture are substantially uniformly mixed. When, however, the liquid mixture is admitted into the space or chamber in which it is caused to pass into the gaseous state, the more volatile ingredients gasify first, whereas the less volatile ingredients tend to remain in the liquid state and accumulate in the bottom of the chamber. It is for this reason that it has been common practice to apply artificial heat externally to the bottom of the chamber to cause the heavier liquid hydrocarbons to gasify and mix with the more volatile. The gas naturally accumulates in the upper part of the chamber and is withdrawn therefrom to the point of consumption. In some instances provision is made for drawing from the bottom of the chamber such heavy ingredients or tail ends of the ingredients as will not gasify.

In my copending application, I provide an apparatus for preparing liquid hydrocarbon mixtures for combustion in which the discharge orifice of the gasifying chamber is located relatively close to the bottom of the chamber and consequently the gas escaping from the chamber picks up or entrains any liquid hydrocarbon accumulating on the bottom of the chamber. By means of this arrangement the necessity for applying external artificial heat to the gasifying chamber is eliminated. In that apparatus the gas escaping from the gasifying chamber is passed through a baffle arrangement to assure the complete gasification of any liquid hydrocarbon which has been entrained by the gas escaping from the gasifying chamber. The object of the present invention is to improve and simplify apparatus of this character for preparing hydrocarbon mixtures for combustion by so constructing and arranging the gasifying chamber that when the gaseous mixture leaves the gasifying chamber it is in condition for immediate combustion without further treatment. To this end the invention consists in the improved apparatus hereinafter fully described and particularly pointed out in the appended claims.

In the accompanying drawings illustrating the preferred form of the invention, Fig. 1 is a diagrammatic representation of the complete apparatus for preparing hydrocarbon mixtures for combustion, with the various devices comprising the apparatus shown in longitudinal section; and Fig. 2 is a transverse section taken on the line 2—2 of Fig. 1.

The liquid hydrocarbon mixture to be treated or prepared for combustion in the burner 3, which may be of any usual type suitable for burning manufactured or natural gas, is contained in a tank 4 which may be located at any convenient point on the premises in which the apparatus is installed. The tank 4 is a closed receptacle provided at its top end 5 with a filling inlet 6 controlled by a ball check valve 7. The tank 4 is filled to substantially the top end 5 with the liquid hydrocarbon mixture through the inlet 6. When the tank has been filled the liquid immediately begins to gasify and as the gas...
accumulates at the top of the tank its pressure is sufficient to close the ball valve 7 against the opening 8 and thereby seal the tank. The liquid hydrocarbon is drawn from the tank 4 through a valve controlled pipe 9 arranged vertically and centrally in the tank and having its inlet opening 10 arranged relatively close to the bottom end 11 of the tank. The vapor tension generated in the space 12 by the evaporated liquid hydrocarbon is utilized to force the liquid in the bottom of the tank upwardly through the pipe 9. By drawing the liquid hydrocarbon mixture from the bottom of the tank and preparing it for combustion rather than utilizing the vapor generated at the top of the tank the various ingredients of the mixture are prevented from separating out and accumulating in the bottom of the tank.

For combustion the liquid hydrocarbon mixture drawn from the bottom of the tank 4 the first step is to reduce its pressure and thereby cause it to pass into the gaseous state. Assuming that the liquid hydrocarbon mixture in the tank 4 develops a vapor tension of seventy pounds at 70°F., this being the vapor tension of a typical hydrocarbon mixture to be treated and prepared for combustion by the apparatus of the present invention, it has been found advantageous in order to secure the complete gasification of the liquid in a single unit to first reduce the pressure of the mixture to about two pounds or less. At this pressure substantially all the liquid hydrocarbon drawn from the tank 4 will readily gasify under normal climatic conditions at all seasons of the year. The extension 14 of the pipe 9 feeds the liquid hydrocarbon mixture into a reduction valve 15, which is of usual construction and comprises an offset valve member 16 adapted to coact with and open and close the contracted outlet orifice 17 of the pipe section 14. The valve member 16 is provided with a stem 18 secured to the center of a flexible diaphragm 19 extending across the valve 15 and dividing it into the chamber 20 and the chamber 21. The diaphragm 19 is held in position between the part 22 of the valve and the dome-shaped part 23 thereof. The outer side of the diaphragm is provided with a spring 24, one end of which bears against the diaphragm and the other end of which bears against a collar mounted on the inner end of an adjusting screw 26 provided with a handle 27. The tension of the spring 24 is so adjusted that the pressure in the chamber 20 of the valve 15 is substantially two pounds or less.

The liquid hydrocarbon mixture which escapes from the orifice 17 into the chamber 20 at the reduced pressure begins to boil and pass into the gaseous state. To promote complete gasification of the mixture at a single step I introduce it into a specially constructed heat absorption chamber or radiator, generally indicated at 29, connected with the reduction valve 15 by means of the pipe 30. Although the reduction valve 15 and the gasifying chamber 29 may have any desired or required location relatively to each other, the arrangement shown in Fig. 1 is convenient and compact. The reduction valve 15 is located immediately above the gasifying chamber 29 and discharges its contents through the pipe 30 into the top of the chamber.

The improved heat absorption or gasifying chamber 29 comprises a vertically arranged cylindrical housing 31 closed at its upper end by the cap 32 and at its lower end by the cap 33. To increase the heat absorption of the chamber 29 the exterior surface of the cylindrical housing 31 is provided with a series of equally spaced, radially extending vanes 34. As the hydrocarbon mixture enters the upper part of the chamber 29 from the reduction valve 15 it strikes a deflecting plate 35 located a short distance below the discharge orifice of the pipe 30 in the cover 32. The deflecting plate 35 is formed as the upper end of a cylindrical guard member 36 open at its lower end 37 and supported within the cylindrical housing 31 and coaxially thereof by the brackets 38. In order to cause any liquid hydrocarbon entering the top of the chamber 29 to pass through or take a long circuitous path before it reaches the bottom of the chamber, thereby permitting it to gasify by the time it reaches the bottom of the chamber, a coil of wire in the form of an elongated spiral 39 surrounds the cylindrical guard member 36. The diameter of the wire is substantially equal with the space separating the exterior surface of the cylindrical guard member 36 and the interior surface of the cylindrical housing 31 and thereby prevents liquid hydrocarbon from traveling vertically down the surfaces of these members to the bottom of the chamber 29.

The gasified hydrocarbon mixture finds its exit from the chamber 29 up through the open lower end of the guard member 36. Located within the guard member is a discharge pipe 40, the inlet end 41 of which is located in the upper end of the guard member a short distance below the deflecting plate 35. Assuming a supply of uniform hydrocarbon mixtures and uniform operating conditions there will be no accumulation of liquid on the bottom of cover 33, providing the heat absorbing surface of outer chamber 31 is sufficient to completely gasify a given hydrocarbon mixture at a given rate of flow. The desideratum is, however, to utilize a fuel which is not necessarily uniform and to prepare this fuel for combustion under such varying conditions and rates of flow as may be encountered in the ordinary course of domestic cooking. To accomplish this purpose it is necessary to provide means whereby the apparatus will, while operating under ideal conditions (under a...
very light load) pick up and re-absorb any liquid which may have accumulated in chamber 29 while operating under a heavy load. While operating under a heavy load there may, and probably will be a slight accumulation of liquid in chamber 29. Under a light load all of the liquid entering chamber 29 will be completely gasified. In changing from a liquid state to a gaseous state hydrocarbons of the series here dealt with expand approximately at a 300 to 1 ratio and the amount of heat absorbed is proportional to the expansion. This gas can not reach outlet 41 without passing through and coming into intimate contact with any liquid which may have accumulated on cover 33, and thereby entraining the liquid which expands and converts into gas mingling with the gas which has entrained it. Every moment of operation under ideal conditions is thus utilized to completely clear inner chamber 37 of any liquid accumulations. The outlet orifice 42 of the pipe 40 discharges into the chamber 44 of a reduction valve 45 which reduces the pressure of the gaseous hydrocarbon mixture to the degree suitable for combustion in the burner 3. The reduction valve 45 may have the same construction and mode of operation as the reduction valve 15. The outlet orifice 42 cooperates with an offset valve member 46 mounted on a valve stem 47 secured to a diaphragm 48. The pressure within the chamber 44 is controlled by a spring 49 regulated by the screw 50. The gaseous hydrocarbon mixture is discharged from the chamber 44 through the valve controlled pipe 43 and is then conducted to the burner 3.

By means of the novel construction and arrangement of the parts of the heat absorption or gasifying chamber 29 liquid hydrocarbon mixtures containing both relatively high volatile and relatively low volatile ingredients can be successfully gasified for burning in an ordinary gas burner without the application of external artificial heat to the chamber 29. Thus the combustion of liquid hydrocarbon mixtures for household use is facilitated and the apparatus of the present invention provides a cheap and efficient means for that purpose.

Having thus described the invention what I claim as new is:

1. In an apparatus of the character described including a tank for containing a liquid hydrocarbon mixture, and a reduction valve connected with the tank, a gasifying chamber comprising a vertically arranged housing into the top part of which the reduction valve discharges, a vertically arranged tubular guard member located within the housing, said guard member being closed at its upper end and open at its lower end at the bottom of the housing, the upper end of the housing serving to deflect hydrocarbon entering the housing, and a discharge pipe for the chamber having its inlet orifice within the guard member and relatively close to the top thereof.

2. In an apparatus of the character described including a tank for containing a liquid hydrocarbon mixture, and a reduction valve connected with the tank, a gasifying chamber comprising a vertically arranged housing into the top part of which the reduction valve discharges, a vertically arranged tubular guard member located within the housing, said guard member being closed at its upper end and open at its lower end at the bottom of the housing, the upper end of the housing serving to deflect hydrocarbon entering the housing, and a discharge pipe for the chamber having its inlet orifice within the guard member and relatively close to the top thereof.

3. In an apparatus of the character described including a tank for containing a liquid hydrocarbon mixture and a reduction valve connected with the tank, a gasifying chamber comprising a vertically arranged housing with the top end of which the reduction valve is connected, said housing being provided with heat absorption means, a vertically arranged tubular guard member located within the housing, said guard member being closed at its upper end and open at its lower end at the bottom of the housing, means interposed between the outer surface of the tubular part of the guard member and the inner surface of the housing for forming a tortuous passageway between the upper end of the housing and the lower end thereof, and a discharge pipe for the chamber having its inlet orifice located within the upper part of the guard member.

4. In an apparatus of the character described including a tank for containing a liquid hydrocarbon mixture and a reduction valve connected with the tank, a gasifying chamber comprising a housing into the top part of which the reduction valve discharges, a guard member located within the housing, said guard member being open at its lower end at the bottom of the housing and closed at its upper end and serving to deflect the hydrocarbon entering the top part of the housing, means located between the outer surface of the guard member and the inner surface of the housing and forming a tortuous passageway between the top and bottom of the housing, and a discharge pipe leading from within the upper end of the guard member through the bottom of the housing.

5. In an apparatus of the character described including a tank for containing a liquid hydrocarbon mixture and a reduction valve connected with the tank, a gasifying chamber comprising a vertically arranged cylindrical housing into the top part of which the reduction valve discharges, a series of vanes secured to the outer surface of the housing, a cylindrical guard member located within the housing, the lower end of the
guard member being open at the bottom of the housing and the upper end of the guard member being closed and located in position to deflect the hydrocarbon entering the housing, a spirally arranged wire interposed between the outer surface of the guard member and the inner surface of the housing and constituting a spiral passageway from the top to the bottom of the housing, and a discharge pipe for the chamber vertically arranged within the guard member with its inlet orifice relatively close to the top of the guard member.

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