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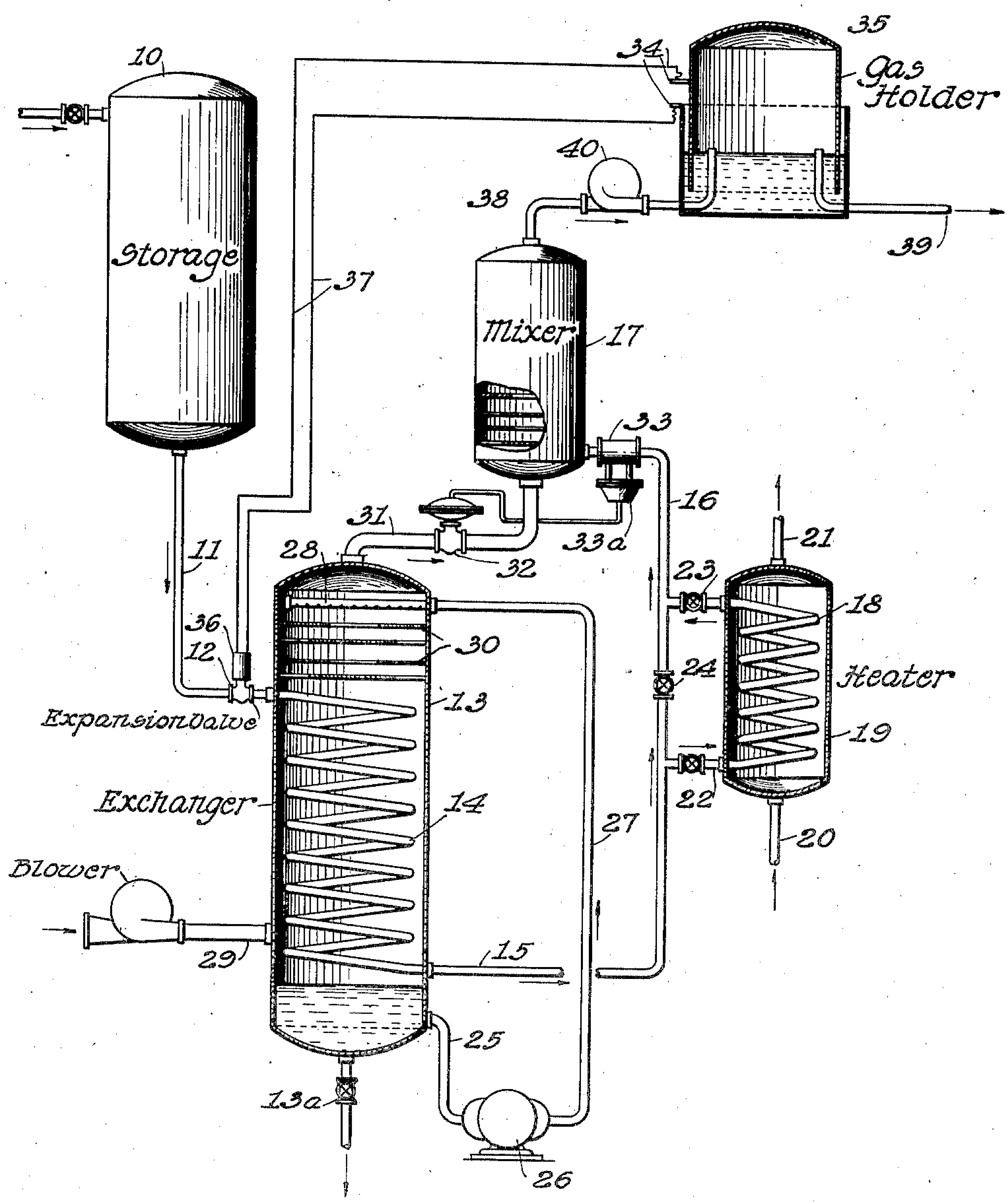
GAS MACHINE

Filed June 30, 1932



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GAS MACHINE

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This invention relates to the vaporization of relatively low boiling hydrocarbon fuels and the dilution of the resulting vapor with air or other gases to form a combustible mixture suitable for distribution thru pipe lines and consumption in the common gas-burning appliances. The invention is particularly applicable to those systems in which a paraffin hydrocarbon, such as butane recovered from petroleum, is vaporized and mixed with air for distribution in city gas systems.

The principal object of my invention is to effect the evaporation of liquid low boiling hydrocarbons with the greatest possible economy of heat.

Another object is to remove water vapor from the air to be mixed with the vaporized hydrocarbons so as to avoid subsequent condensation of water which would cause excessive corrosion in the gas distribution lines.

The invention will be described as applied to the carburetion of air with commercial butane in what is commonly called a butane-air gas plant. The general arrangement of equipment for such an operation is shown diagrammatically by the accompanying drawing, which shows an elevational view, partly in section, of the apparatus.

The low boiling liquid hydrocarbons to be vaporized are stored in the tank 10 and fed to the exchanger thru the conduit 11 and expansion valve 12. The exchanger may be of any suitable design, but preferably an upright, cylindrical chamber, as shown at 13. The vaporized hydrocarbons discharged from the expansion valve pass downwardly thru the helical coil 14, which is disposed in the chamber 13. The vaporized gases leave the coil thru the conduit 15 and pass thru the conduit 16 which lead to the mixer 17. If desired, the gases in conduit 15 may be bypassed thru the coils 18 which are disposed in the chamber 19, and heated, and any suitable heating medium such as steam may be passed thru the lines 20 and 21 for heating the coils 18. Valves 22, 23 and 24 are used to direct the flow of gas around or thru the heater.

A body of oil, or brine, or other suitable liquid is maintained in the lower part of the chamber 13 and circulated over the coils to increase the heat transfer from the air to the coil, prevent frosting, and provide refrigeration and drying of the air. It is withdrawn thru the conduit 25 by the pump 26 and forced thru the conduit 27 to the spray nozzle 28 which is disposed in the upper part of the chamber 13. Suitable brines and other fluid media are calcium chloride and/or sodium chloride solution, and glycol or glycerine. At the low pressure prevailing in the coils 14, which may be substantially atmospheric pressure, a pressure below the vapor pressure of the liquefied hydrocarbons or a pressure low enough to cause the liquefied hydrocarbons to vaporize, the butane discharged from the expansion valve 12 is largely vaporized, most of the heat of vaporization being supplied by the air passing thru the exchanger 13.

The air to be subsequently mixed with the vaporized hydrocarbons is forced into the exchanger thru the valved conduit 29 and passes up thru chamber 13 in contact with the cold helical coils and heat transfer medium, which may be brine, and which is being sprayed into the exchanger. The spray of brine passing downwardly thru the chamber 13, countercurrent to the upper flow of air, effectively chills the air and removes dust, extraneous materials and a substantial part of the water vapor therefrom. Baffles 30 are disposed in the upper part of the exchanger to effect good heat transfer between the cold air and circulating brine. The effluent air passes, or may be forced by a compressor, thru the conduit 31 to the mixer 17. A valved draw-off 13*a* is placed in the lower part of the exchanger 13 to remove the excess water or brine from said chamber.

A flow control valve 32 regulates the rate of flow of air that enters the mixer 17 in response to a flow meter device 33 and 33*a* which is actuated by the rate of flow of vaporized hydrocarbons that pass thru line 16. Any conventional flow meter such as an orifice flow meter device may be used to regulate the flow of air in response to the flow of vaporized hydrocarbons to the mixer, or vice versa. The flow control valve 32 is set to give a predetermined and constant ratio of air to vaporize hydrocarbons entering the mixer 17. An electrical contact means 34 is placed on the gas holder 35 and adapted to open the expansion valve 12 when the amount of gas within the holder reaches a predetermined low level. Any conventional electrical responsive device 36 may be connected to the electrical contact means 34 by the lines 37 for changing the setting of the expansion valve 12.

The mixture of gases pass from the mixer 17 thru conduit 38 to the gas holder 35 and then to the gas main 39. If desired, the blower 40 may be used to propel the gases from the mixer to the gas holder. Any suitable baffle means may be disposed in the mixer 17 to facilitate the mixing of the air and hydrocarbon vapors.

In operating a butane-air plant, liquid butane, under pressure, flows from the bottom of the storage tank 10, thru the expansion valve 12 and into the vaporizing system or helical coils 14. At the lower pressure prevailing in the coils 14 the butane is largely vaporized, most of the heat of vaporization being supplied by the brine which is sprayed into the chamber 13 by the spray head 28. The brine is collected in the lower part of the chamber 13 and recycled by the pump 26. Air is then introduced into the exchanger by the valved conduit 29 and allowed to pass upwardly and countercurrently to the spray of brine. The resulting chilled and partly dehumidified air is passed thru the conduit 31, flow control valve 32 and introduced into the mixer 17. The butane vapors leaving the lower part of the coils 14, pass thru the conduit 15, valve 24, conduit 16, and flow meter 33 to the mixer 17. If desired, the butane vapors may be by-passed thru the heater by the aid of valves 22, 23 and 24, and heated to a predetermined temperature to insure the vaporization of all the hydrocarbons before entering the mixer 17.

It is clear that the amount of water vapor which must be removed from the air passing thru the exchanger 13 will depend on the relative humidity and the temperature of the incoming air and also on the temperature to which the gas mixture is subjected. The amount of water removed is determined by the refrigerating effect of the butane expanding in the coil 14. The exchanger 13 is normally operated at atmospheric pressure and will deliver substantially saturated air at the temperature prevailing in the exchanger.

When the air entering chamber 13 is cold, it is evident that comparatively little heat can be absorbed from it and transferred to the butane in the coils 14. Under such conditions the necessity for dehumidification is small and very little water is removed. Under such circumstances, particularly when the quantity of butane passing thru the coils 14 is large, the amount of heat picked up by the butane in said coils may be insufficient to raise the butane vapor to the desired temperature. On this account the heater 19 is provided to insure complete vaporization of the butane and the heating of the vapors to the desired final temperature.

It is obvious that other controllers than those shown may be used in various parts of the system to control temperature, pressure or rate of flow to make the operation of the process as nearly automatic as possible. Various forms of apparatus other than those shown in the accompanying drawing may also be used without departing from the spirit of my invention.

Altho the invention has been described as applying to a butane-air gas generating plant, it should be understood that it is applicable to the expansion of any relatively volatile fuel such as propane or mixtures of butane and pentane, butane and propane or mixtures of these hydrocarbons with small amounts of higher and lower boiling hydrocarbons. Also, my apparatus is adapted to be used for simultaneously drying any gaseous medium with which the vaporized liquid is to be mixed, substantially in the manner shown with air.

I claim:

1. The process for carbureting air with normally gaseous hydrocarbons, which comprises evaporating liquefied normally gaseous hydrocarbons into a confined system, passing a liquid medium in heat exchange relation with said system, countercurrently passing air in heat exchange relation with said liquid medium and thereby partially dehumidifying said air, and combining said partially dehumidified air and vaporized hydrocarbons in a predetermined ratio.

2. The method for carbureting air, which comprises maintaining a body of normally gaseous hydrocarbons in a liquefied state, introducing a quantity of said liquid hydrocarbons into a confined system at a pressure below the vapor pressure of the liquefied hydrocarbons and thereby causing said hydrocarbons to vaporize, contacting an aqueous medium in heat exchange relation with said confined system and out of contact with said vaporized hydrocarbons, countercurrently contacting air in heat exchange relation with said aqueous medium and thereby partially dehumidifying the air at the temperature of said aqueous medium, and mixing said partially dehumidified air with the hydrocarbon vapors from the confined system in a predetermined volume ratio.

3. The method for carbureting air containing a predetermined amount of water vapor with hydrocarbon gases, which comprises, maintaining a body of normally gaseous hydrocarbons in a liquefied state, passing a quantity of said liquefied hydrocarbons through an expansion valve into a confined system, con-

tacting an aqueous medium in heat exchange relation with said system and out of contact with said vaporized hydrocarbons to provide part of the heat of vaporization for said liquid hydrocarbons, countercurrently contacting air in heat exchange relation with said aqueous medium and thereby substantially dehumidifying the air at the temperature of said aqueous medium, and mixing said air with the hydrocarbon vapors from the confined system in a predetermined volume ratio.

4. An apparatus for carbureting air with low boiling hydrocarbons, comprising in combination, a storage tank for normally gaseous hydrocarbons which are in a liquefied state, an enclosed system, an expansion valve for establishing communication between said tank and system, a container enclosing said system, means for passing an aqueous medium in heat exchange relation with said system, an air inlet in the lower part of the said container, an air outlet in the upper part of said container and communicating with a gas mixer, and a conduit for passing gases from said system to said gas mixer.

5. An apparatus for carbureting air with low boiling hydrocarbons, comprising in combination, a liquefied gas container, a vaporized coil, an expansion valve establishing communication between said container and said vaporizing coil for delivering gaseous hydrocarbons to said coil, a vessel enclosing said vaporizing coil, means for circulating an aqueous medium in heat exchange relation with said vaporizing coil, a means for passing air in heat exchange relation with said vaporizing coil and aqueous medium, means for withdrawing air from said vessel, means for withdrawing gases from said vaporizing coil, and means for combining said air and vaporized hydrocarbons.

6. The method for carbureting air, which comprises maintaining a body of normally gaseous hydrocarbons in a liquefied state, introducing a quantity of said liquid hydrocarbons into a confined system at a pressure below that required to keep the hydrocarbons in a liquid state, thereby causing said liquid hydrocarbons to vaporize, contacting a liquid medium in heat exchange relation with said confined system, countercurrently contacting air in heat exchange relation with said liquid medium and thereby partially dehumidifying the air at the temperature of said liquid medium, and mixing said partially dehumidified air with the hydrocarbon vapors from the confined system in a predetermined volume ratio.

7. The method for carbureting air containing a predetermined amount of water vapor with hydrocarbon gases, which comprises, maintaining a body of normally gaseous hydrocarbons in a liquefied state, passing said liquefied hydrocarbons through an expansion valve and into an expansion coil, contacting a liquid medium in heat exchange relation with said expansion coil, countercurrently contacting air in heat exchange relation with said liquid medium and thereby substantially dehumidifying the air, and mixing said air with the hydrocarbon vapors from the expansion coil.

8. The method for carbureting air containing a predetermined amount of water vapor with hydrocarbon gases, which comprises, maintaining a body of normally gaseous hydrocarbons in a liquefied state, passing said liquefied hydrocarbons through an expansion valve and into an expansion coil, contacting a liquid medium in heat exchange relation with said expansion coil, countercurrently contacting air in heat exchange relation with said liquid medium and thereby substantially dehumidifying the air, mixing said air with the hydrocarbon vapors from the expansion coil, and regulating the amount of air contacted with the liquid medium in response to the rate of flow of hydrocarbon vapors from said coils.

In witness whereof I have affixed my signature.

ROBERT E. WILSON.