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SEPARATION BY LIQUEFACTION OF COMPLEX GASEOUS MIXTURES

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Fig. 1.

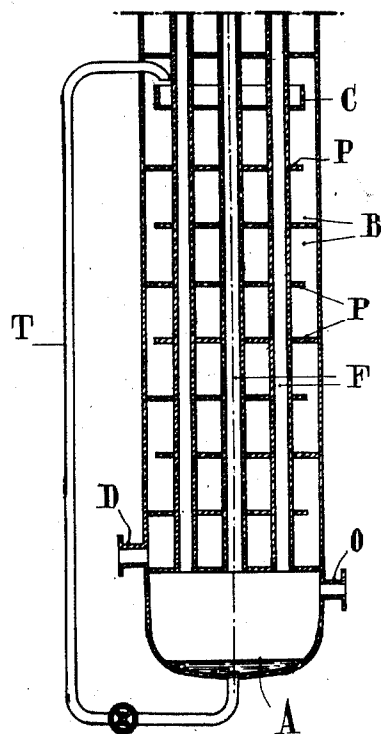
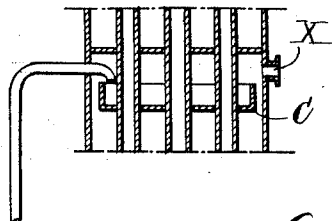


Fig. 2.



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GEORGES CLAUDE, OF PARIS, FRANCE, ASSIGNOR TO LA SOCIÉTÉ L'AIR LIQUIDE, SOCIÉTÉ ANONYME POUR L'ÉTUDE ET L'EXPLOITATION DES PROCÉDÉS GEORGES CLAUDE, OF PARIS, FRANCE.

SEPARATION BY LIQUEFACTION OF COMPLEX GASEOUS MIXTURES.

Application filed July 16, 1925, Serial No. 44,006, and in France August 7, 1924.

This invention relates to improvements in the separation, by the liquefaction method, of the constituents of certain complex gaseous mixtures, such for example as water gas, ordinary lighting gas, coke oven and analogous gases.

One of the usual methods of treating these gases consists in condensing certain of their liquefiable constituents by passing them into a single bath of these same constituents, which have been previously condensed, such bath boiling under a lower pressure than the gaseous mixture treated. If however this mixture has not previously been suitably freed from its more condensable constituents, or if this elimination has not been complete, these more liquefiable constituents are condensed at the same time as those which liquefy afterwards, and if their vapor tension is not sufficient they will accumulate in the bath previously referred to, and will thus progressively raise its boiling temperature to an extent which may be detrimental to the efficiency of the condensation.

Furthermore the use of such a large bath of considerable height presents with certain liquids, and in particular with methane which froths abundantly when boiling, the disadvantage of frequently leading to overflowing which is prejudicial to the working.

The present invention has for its object to overcome these two disadvantages at one and the same time. For this purpose, according to the present invention, a method for the separation of the constituents of gaseous mixtures by liquefaction in which the liquid which has been condensed in the tubes of the tube system of the vaporizer of the liquefaction apparatus is discharged outside the said tube system, consists in circulating the said liquid, together with the gases resulting from its vaporization, in contact with the tube system and down to the end of the said system opposite to that at which the liquid is delivered thereinto by means of a series of suitable baffles, and then withdrawing from the vaporizer at the end of the tube system the whole of the aforesaid gases together with any residual liquid. The said gases and residual liquid, if any, may be delivered either to another compart-

ment where the same operation recommences with other and more liquefiable constituents, or to the temperature exchangers where the more condensable constituents (which are thus eventually eliminated without having been able, owing to the means adopted in accordance with the invention, to accumulate) are again vaporized without having impaired the working of the process. The elimination of these products is furthermore facilitated if the exchanger to which they are delivered is such that their circulation therein takes place from the top to the bottom.

The present process moreover renders unnecessary the use of a bath containing a considerable quantity of liquid which is subject to the disadvantage of overflowing, as previously mentioned.

The process is independent of the direction of the circulation of the gases treated in the tube system.

Further if desired the present process can be modified by circulating if need be only a part of the gases resulting from the vaporization together with the liquid, the more volatile gases remaining being collected separately.

In order that the said invention may be clearly understood and readily carried into effect, the same will now be described more fully with reference to the accompanying drawing, which illustrates diagrammatically and by way of example, in Figure 1, an apparatus for carrying out the process for the treatment of ordinary lighting or coke oven gas for the purpose of extracting the hydrogen contained therein. Figure 2 is a fragmental view of an apparatus for carrying out the modified process just described.

The compressed gas to be treated, previously cooled, is admitted through the inlet O to the lower part of the tube system F which constitutes, for example, the lower part of the apparatus proper for the liquefaction and extraction of the hydrogen. A large part of the methane of the gas is condensed in the interior of the nest of tubes F, and the liquid methane collected in the reservoir A, whence it is delivered through the tube T outside the nest of tubes F into the com-

partment B. The liquid which ascends through the tube T is first of all discharged into a collector C, thereby forming a reserve of liquid, which by overflowing falls from the collector C upon the successive plates P. The gases formed by the boiling of the methane cannot escape at the upper part of the compartment B and are forced to escape wholly, with maybe a certain quantity of liquid, through the outlet D at the lower part of the compartment B.

These gases, which may be mixed with liquids, are sent to the temperature exchangers; if these latter are such that the circulation of the mixture takes place from the top to the bottom, the elimination of the impurities contained therein is facilitated.

The form of apparatus shown in Fig. 2 is exactly the same as that illustrated in Fig. 1, with the exception that it is provided with an outlet X for the more volatile gases to permit their separate collection.

I claim as my invention:

1. A method of vaporizing a liquid containing easier liquefiable elements in the liquefaction of gaseous mixtures, such as the liquids rich in methane containing ethylene and similar impurities in the liquefaction of gaseous mixtures containing hydrogen, which comprises discharging such liquid toward the upper part of a chamber; circulating it in said chamber in contact with surfaces at a higher temperature, together with the gases resulting from its vaporization; and withdrawing the aforesaid gases, together with any residual liquid, from the chamber, at substantially the lowest part thereof.

2. A method of vaporizing a liquid containing easier liquefiable elements in the liquefaction of gaseous mixtures, such as the liquids rich in methane containing ethylene and similar impurities in the liquefaction of gaseous mixtures containing hydrogen, which comprises discharging such liquid into an open receptacle situated toward the upper part of a chamber; circulating it from said receptacle through the chamber in contact with surfaces at a higher temperature, together with the gases resulting from its vaporization; and withdrawing the aforesaid gases, together with any residual liquid, from the chamber, at substantially the lowest part thereof.

3. A method of vaporizing a liquid containing easier liquefiable elements in the liquefaction of gaseous mixtures, such as the liquids rich in methane containing ethylene and similar impurities in the liquefaction of gaseous mixtures containing hydrogen, which comprises discharging such liquid toward the upper part of a chamber; circulating it in said chamber in contact with surfaces at a higher temperature, together with part of the gases resulting from its vaporization; separately collecting the more volatile part

of said gases; and withdrawing the other part of the gases resulting from the vaporization, together with any residual liquid, from the chamber, at substantially the lowest part thereof.

4. A method of vaporizing the liquid which has been condensed and collected in the liquefaction of complex gaseous mixtures such as those containing hydrogen, which comprises discharging such liquid toward the upper part of a chamber; circulating it in successive layers in said chamber in contact with surfaces at a higher temperature, together with the gases resulting from its vaporization; and withdrawing the aforesaid gases, together with any residual liquid, from the chamber, at substantially the lowest part thereof.

5. A method of separating gaseous mixtures containing methane and ethylene and similar impurities, which comprises liquefying said gases by bringing the gaseous mixture under pressure in heat-exchanging contact with one surface of a substantially vertically extending heat exchanger, collecting the liquefied gases and causes them to flow downwardly and under a lower pressure in heat-exchanging relation with the other surface of said exchanger, and removing the thus-formed vapors together with any unevaporated liquid at the end of said flow.

6. A method of separating gaseous mixtures containing methane and ethylene and similar impurities, which comprises liquefying said gases by bringing the gaseous mixture under pressure in heat-exchanging contact with one surface of a substantially vertically extending heat exchanger, collecting the liquefied gases and causing them to flow downwardly and under a lower pressure in heat-exchanging relation with the other surface of said exchanger, and removing the thus-formed vapors partly toward the beginning of said flow and partly together with any unevaporated liquid at the end of said flow.

7. A method of separating gaseous mixtures containing methane and ethylene and similar impurities, which comprises liquefying said gases by bringing the gaseous mixture under pressure in heat-exchanging contact with one surface of a substantially vertically extending heat exchanger, collecting the liquefied gases, discharging them under a lower pressure in a receptacle and in heat-exchanging relation with a part of the other surface of said exchanger and causing them to flow downwardly in heat-exchanging relation with the remaining part of said surface, and removing the thus-formed vapors together with any unevaporated liquid at the end of said flow.

8. A method of separating gaseous mixtures containing methane and ethylene and

similar impurities, which comprises liquefy-
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unevaporated liquid at the end of said flow. 15

In testimony whereof I affix my signature.

GEORGES CLAUDE.