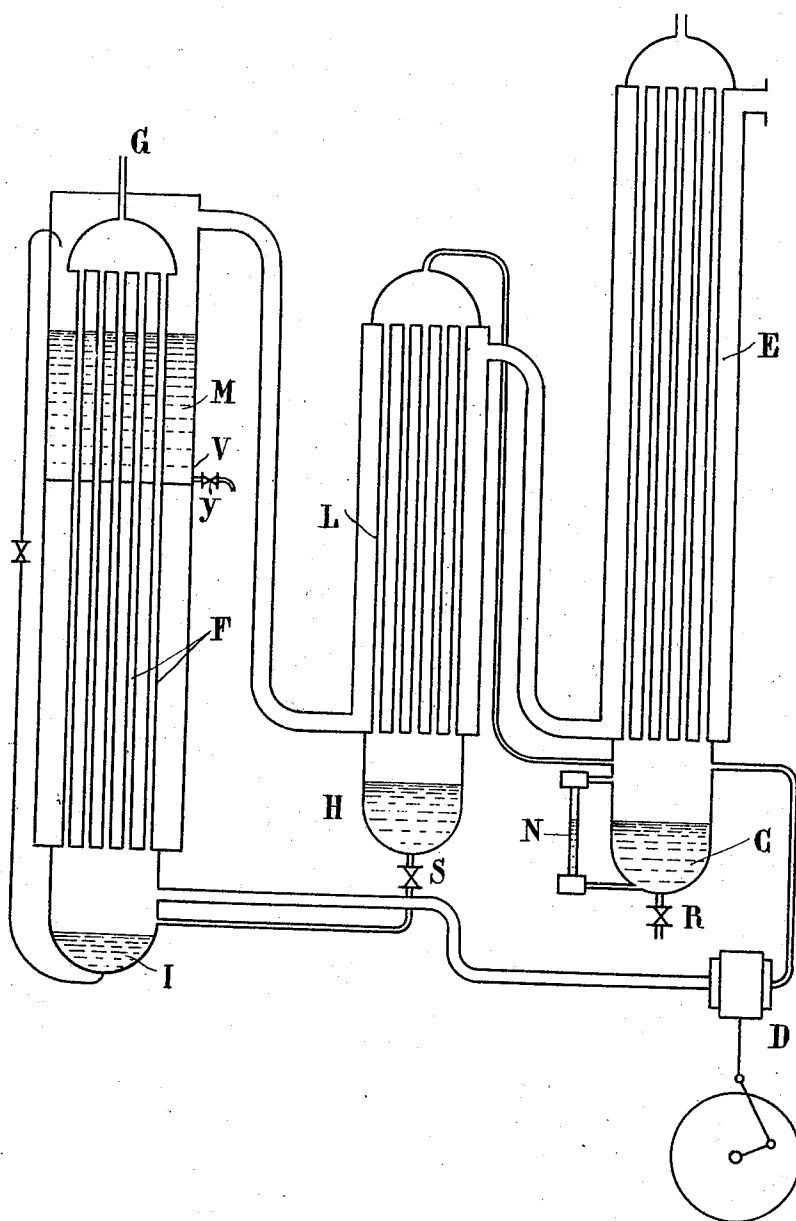


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G. CLAUDE ET AL
TREATMENT OF NATURAL GASES

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GEORGES CLAUDE, OF PARIS, AND EUGÈNE JORDAN, OF FRANCONVILLE, FRANCE,
 ASSIGNORS TO LA SOCIÉTÉ L'AIR LIQUIDE, SOCIÉTÉ ANONYME POUR L'ETUDE ET
 L'EXPLOITATION DES PROCÉDÉS GEORGES CLAUDE, OF PARIS, FRANCE.

TREATMENT OF NATURAL GASES.

Application filed August 10, 1921. Serial No. 491,285.

To all whom it may concern:

Be it known that we, GEORGES CLAUDE, a citizen of the Republic of France, and a resident of Paris, France (post-office address 48 Rue St. Lazare), and EUGÈNE JORDAN, a citizen of the Republic of France, and a resident of Franconville, Seine et Oise, France (post-office address Villa Les Rochers, Rue Philippe), have invented new and useful Improvements in the Treatment of Natural Gases, which improvements are fully set forth in the following specification.

The aim of the present invention is the treatment of natural gases or at least of those natural gases that consist essentially of a mixture of saturated hydrocarbons with a comparatively small proportion of nitrogen and a little helium, this treating being effected with a view to:—

1. Obtaining, in a liquid and portable condition, those hydrocarbons of this class which have a critical temperature higher than the surrounding temperature and also the more volatile hydrocarbons which they may hold in solution.

2. Obtaining a gaseous residue much richer in helium than the gases treated.

3. Sending to the service mains permanent combustible gases consisting essentially of methane.

These natural gases are often collected, as is known, under a considerable pressure, which may be as high as 30 to 50 atmospheres for example. It is this pressure, which, in the present process is taken advantage of, by means of a single expansion, with a view to obtaining the above results.

If however the natural pressure of the gases does not suffice to obtain these results, it will first be raised by means of compressors, and it will be possible, if the natural pressure is already comparatively high, to utilize for this purpose the work supplied by the single expansion just referred to.

The natural gases under pressure pass first of all into purifying apparatus which is intended to deprive them of their moisture and also of their impurities if any, such as carbon dioxide, sulphuretted hydrogen, etc. Then they are treated by adapting to them, in a form suitably modified in accordance with the present invention the process of liquefaction and separation employed in

the liquid air industry, which process combines expansion producing external work and progressive liquefaction with "backward return."

The single figure of the accompanying drawing shows, by way of example, a diagrammatic sectional view of one form of apparatus for carrying out this application. The natural gases under pressure reach a temperature-exchanger E, preferably consisting of a vertical nest of tubes, and while traversing it from top to bottom they meet therewith progressively decreasing temperatures. Under the simultaneous action of these temperatures and of the pressure the various saturated hydrocarbons become liquefied in succession but as these liquids are capable of mixing with one another and the temperatures are limited by the boiling point of methane, the lower limit of the system, to a value higher than the very low temperatures at which these liquids freeze, it is a single liquid mixture that reaches the bottom of the exchanger in the collector C, which is provided with a level-indicator N, and from which this liquid can be periodically withdrawn through the cock R.

In fact it is one of the achievements of the present process to remove immediately these liquids from the circuit without having to recover the cold therefrom, which would complicate the operations and render storage more difficult. The latter can in fact be effected very simply, by passing the liquid, under the pressure that it still supports, into special vessels, preferably cooled. However, if the proportion of the very volatile liquid hydrocarbons was very great, it would be possible to have, towards the middle or two-thirds of the nest of tubes E, a first collector, in which the less volatile hydrocarbons could be collected separately, while the more volatile hydrocarbons, condensed to a liquid state at the cold end of the exchanger, could be vaporized and heated in a special compartment of the exchanger, by traversing it in the direction opposite to that of the gases to be treated.

The uncondensed gases thus reaching the cold end of the exchanger are in this way freed from the majority of their least volatile constituents, and what remains of the latter will not be able to disturb the subsequent operations, if the expansion, which

is about to be referred to, is sufficiently efficacious (compound expansion if necessary). These uncondensed gases, chiefly consisting of methane, reach an expansion engine D, where they undergo an expansion which lowers both their temperature and their pressure and permits them to liquefy, with "backward return" in a nest of tubes F immersed in a bath M consisting essentially of liquid methane. The methane contained by these gases is liquefied, while the small quantities of gases that offer a stronger resistance to liquefaction, consisting essentially of nitrogen and helium, remain as a gaseous residue passing out at G, and may be either collected after heating in a special compartment of the exchanger or collected directly, if their proportion is low enough for it not to be worth while to recover their cold.

As for the liquefied methane, it is raised from the collector I into the external vaporizer V and there replaces what has evaporated. The latter, before returning to the exchanger, is sent to circulate around the tubes in the nest L, which is fed by part of the compressed gases leaving the bottom of the exchanger E. The liquid produced collected at H, is withdrawn in to the collector I through cock S.

The liquid methane formed is not absolutely pure. The higher terms of the saturated hydrocarbons exist therein in small proportions and might accumulate in the vaporizer V and disturb the phenomena. It is necessary to purge this liquid either in a permanent manner or in a discontinuous manner, through the cock Y, the latter method permitting the accumulation in the methane of a proportion of hydrocarbons sufficiently large to make this liquid permanent under pressure and which it will then be possible to pass through cock Y into metal bottles.

Having thus fully described the invention, what we claim as new and desire to protect by Letters Patent is:—

1. A method of treating compressed natural gas containing principally methane associated with rather small quantities of less volatile hydrocarbons and of nitrogen and with a very small proportion of helium, which consists in progressively cooling the compressed natural gas by indirect contact

with the vaporized methane resulting from the treatment, so as to condense the greatest part of the volatile hydrocarbons; collecting the condensed hydrocarbons; expanding the cold remaining gas with production of external work to further cool it; subjecting the expanded cold gas to liquefaction with downflow of the liquid in opposite direction to the gas, thereby obtaining liquefied gas consisting chiefly of methane; collecting the gaseous residue consisting chiefly of nitrogen and helium; using the liquefied gas for the above liquefaction of the expanded cold gas, thereby vaporizing the methane; and withdrawing from the liquefied gas a liquid portion containing hydrocarbons.

2. A method of treating compressed natural gas containing principally methane associated with rather small quantities of less volatile hydrocarbons and of nitrogen and with a very small proportion of helium, which consists in progressively cooling the compressed natural gas by indirect contact with the vaporized methane resulting from the treatment, so as to condense the greatest part of the volatile hydrocarbons; collecting the condensed hydrocarbons; expanding part of the cold remaining gas with production of external work to further cool it; subjecting the cold expanded gas to liquefaction with downflow of the liquid in opposite direction to the gas, thereby obtaining a liquefied gas consisting chiefly of methane; collecting the gaseous residue consisting chiefly of nitrogen and helium; using the liquefied gas for the above liquefaction of the expanded gas, thereby vaporizing the methane; using this cold vaporized methane to initially liquefy by indirect contact the part of the cold natural gas not subjected to expansion with production of external work, and subsequently to cool by indirect contact, the compressed natural gas; and withdrawing from the liquefied gas a liquid portion containing hydrocarbons.

In testimony whereof we have signed this specification in the presence of two subscribing witnesses.

GEORGES CLAUDE.
EUGÈNE JORDAN.

Witnesses:

FERNAND DUFOUR,
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