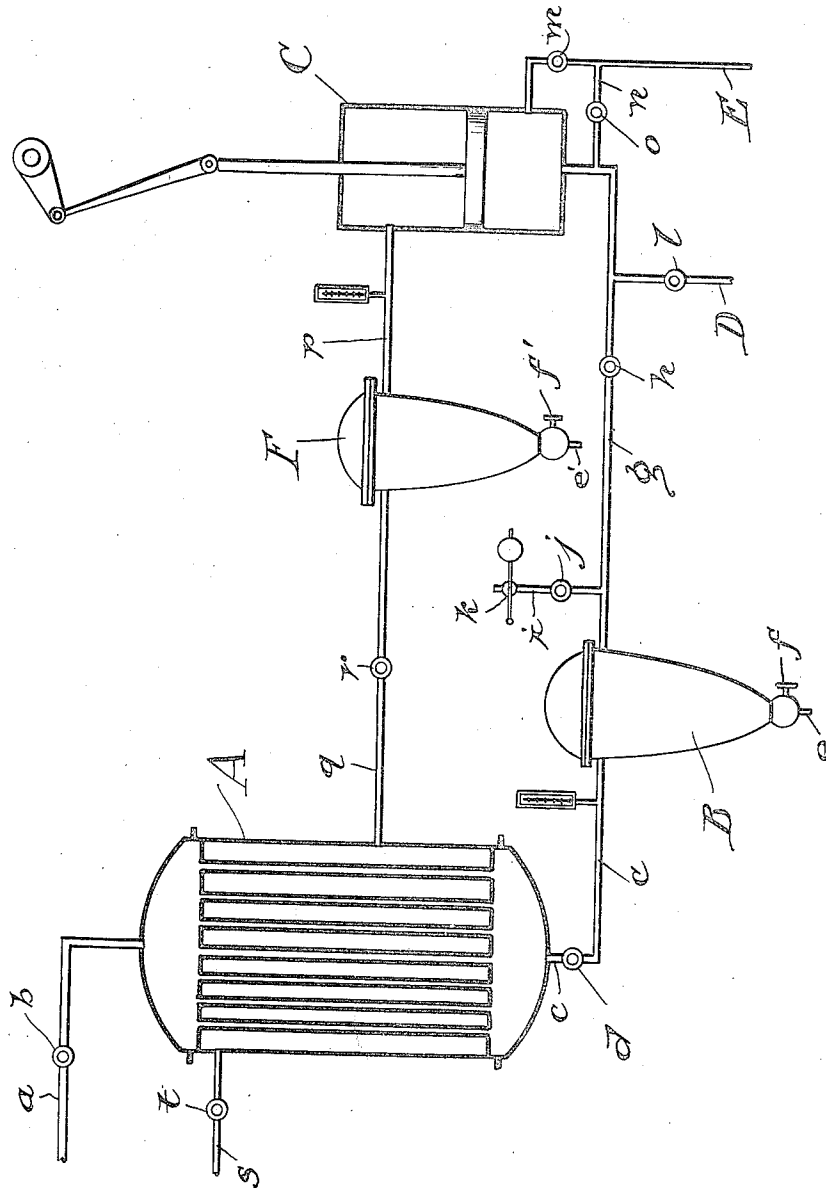


A. J. PARIS, JR.
METHOD OF PRODUCING LOW TEMPERATURES.
APPLICATION FILED MAY 25, 1916.

1,320,168.

Patented Oct. 28, 1919.



WITNESSES:

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AUGUSTE JEAN PARIS, JR., OF BRADFORD, PENNSYLVANIA.

METHOD OF PRODUCING LOW TEMPERATURES.

1,320,168.

Specification of Letters Patent.

Patented Oct. 28, 1919.

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To all whom it may concern:

Be it known that I, AUGUSTE JEAN PARIS, Jr., a citizen of the United States, residing in Bradford, county of McKean, and State of Pennsylvania, have invented a certain new and useful Method of Producing Low Temperatures, of which the following is a specification.

This invention is a method of producing low temperatures, and, speaking generally, the object of the invention is to cool a gas, or mixture of gases, or a mixed gas and vapor, for the purpose of condensing some agent or agents in the gas, or for liquefying the gas.

The invention is particularly applicable to the treatment of natural gas, casing-head gas, oil gas, and analogous gases, for the purpose of separating condensable hydrocarbons therefrom, such as gasolene and analogous products.

In practising the invention, the gas may be under pressure, either natural or artificial, in which case the gas is expanded in the presence of a lubricant which does not unduly congeal or solidify at the low temperature incident to the expansion. Moreover, in the event the gas contains aqueous vapor, the latter mixes with the lubricant and is thereby precluded from congealing or freezing. The thus refrigerated and expanded gas may be passed through condensers and employed to condense hydrocarbons or other condensable constituents of gases, while the latter are either under high pressure, or at substantially atmospheric pressure.

The accompanying drawing illustrates one form of apparatus wherein the method may be practised, but it will be understood that said method may be carried out in apparatus of distinctly different type from that herein shown.

Referring to the drawing, the single figure shows, diagrammatically, an apparatus which, in practice, has proved suitable for carrying out the method forming the subject matter of this application.

In the drawing, A is a condenser having a gas inlet *a*, provided with valve *b*, and a gas outlet *c*, provided with valve *d*. The gas outlet *c* leads to a separator B having a draw-off pipe *e*, provided with valve *f*, and a gas outlet *g*, provided with valve *h*, which leads from separator B to an expansion cylinder C. Pipe *g* is provided with a

gas outlet *i*, having a manually operated valve *j*, and an automatic relief valve *k*. Gas pipe *g* is connected with a high pressure gas main D, provided with valve *l*. E is a pipe for supplying a non-congealable lubricant of the character under consideration to the system, and particularly to the expansion cylinder C. Pipe E is provided with a valve *m* for controlling the supply of lubricant to the cylinder, but, if desired, such lubricant may be introduced into the gas, prior to its admission to the expansion cylinder, through pipe *n*, provided with valve *o*.

The expanded gas passes from the cylinder through pipe *p* into separator F, wherein certain constituents are trapped out, as hereinafter described, whence it enters through pipe *q*, provided with valve *r*, into the cooling chamber of condenser A, whereupon it passes out of the system through a pipe *s*, provided with valve *t*.

Having described the apparatus, from a structural standpoint, its mode of operation will now be detailed in connection with the treatment of natural gas by the method forming the subject matter of this invention.

Assuming the gas is under pressure, either natural or artificial, say from 50 to 300 pounds, it is allowed to enter pipe *a*, through valve *b*, into condenser A. The gas is subjected to a low temperature in condenser A, in the manner hereinafter described, whereupon it passes, through pipe *c*, controlled by valve *d*, into separator B. The effect of refrigerating the gas in condenser A is to liquefy, in whole or in part, any constituents in the gas condensable at the pressure and temperature which obtains under the particular conditions of operation. The constituents thus liquefied or condensed, are trapped out in separator B, and may be drawn off, as desired, through pipe *e*, containing valve *f*.

The comparatively dry gas passes off from separator B, through pipe *g* and enters expansion cylinder C. Either just before or after the admission of the gas to cylinder C, and before its expansion, a small quantity of a non-congealing lubricant is introduced into it from pipe E; in the former case through valve *o*, and in the latter through valve *m*. As the noncongealing lubricant, I may employ glycerin or turkey red oil, though for the low temperatures usually desired, I prefer to mix these agents with methyl or ethyl alcohol. The lubri-

cant which I have found most satisfactory in practising the process is a mixture of glycerin and methyl alcohol. Such lubricant not only lubricates the piston and other interior parts of the expansion cylinder, but performs the further important function of precluding the congelation or freezing of any aqueous constituent, if present, in the gas. Such congelation would, of course, clog the apparatus, particularly the valves, and render it inoperative. The temperature in the expansion cylinder may range from say 32 degrees F. down to 150 degrees below, or even lower. Moreover, the lubricant used not only mixes with the aqueous vapors and reduces its freezing point, as well as lubricates the metal parts of the mechanism employed, but also acts as a dehydrating agent for the gas in that it removes the aqueous vapor therefrom.

The gas having been expanded in cylinder E, it passes through pipe *p* into separator F, wherein the lubricant which it carries, as well as any further hydrocarbons separated, as the result of the refrigeration produced in expansion cylinder C, are trapped out and may, as desired, be drawn off therefrom through pipe *e'*, provided with valve *f'*. The lubricant, after separating therefrom the moisture or hydrocarbons, may be re-used.

The expanded gas passes out of separator F, through pipe *q*, into the cooling chamber of condenser A, and serves to refrigerate the compressed gas entering the condenser through pipe *a*. The result of the refrigeration in condenser A, is to liquefy or condense certain hydrocarbons in the gas, as previously described, and these are trapped out in separator B. Moreover, the introduction of the alcohol and glycerin combined with the refrigerating action of the expanding operation, alters the weight of the hydrocarbon vapors in the gas, and renders them more readily removable, and this is necessarily involved in the carrying out of the process.

In the event it is desired to utilize expanded gas to refrigerate gas at comparatively low pressure, the gas may be introduced into condenser A, as previously described, wherein it comes into indirect contact with the counter-current of expanded gas entering the condenser from separator F, through pipe *q*. The gas having been refrigerated, and its liquefiable constituents trapped out in separator B, the residual gas passes off through branch pipe *i*, manually operated valve *j* and automatic relief valve *k*, and may be used for any of its available purposes. In carrying out the operations thus described, it will be understood that valve *h* is closed.

When operating on the low pressure gas, as described, high pressure gas, under natu-

ral or artificial pressure, is introduced into the expansion cylinder from main D through valve 1. Its treatment with the noncongealing lubricant, and subsequent manipulation, preceding its introduction into condenser A, is the same as that previously described in operating on high pressure gas entirely.

The power generated in expansion cylinder C may be used for any purposes desired.

It will be understood that minor changes may be made in the specific processes outlined without departing from the spirit of the invention, the scope of which is commensurate with the appended claims.

The apparatus herein described also forms a part of my invention, and I reserve the right to file a divisional application thereon. It will be understood that a plurality of condensers, and likewise a plurality of separators may be used if desired, the present drawing showing one of each in the interest of simplicity.

I desire it understood, also, that the expanded, refrigerated natural, or other gas may be used not only to treat gases at substantially normal pressures, but, also, any other gas even at high pressure.

Having thus fully described the invention, what I claim as new, and desire to secure by Letters Patent, is:

1. The process of recovering hydrocarbons from hydrocarbon gases, which consists in condensing out the heavier hydrocarbon constituents by cooling the gas to a certain degree, thereafter expanding the gas to still further lower the temperature thereof for the purpose of condensing out the lighter hydrocarbons, and carrying on the expanding operation in the presence of a lubricant which prevents congelation of any of the aqueous constituents in the gas and dehydrates said gas.

2. The process of recovering hydrocarbons from hydrocarbon gases, which consists in condensing out the heavier hydrocarbon constituents by cooling the gas to a certain degree, thereafter expanding the gas to still further lower the temperature thereof for the purpose of condensing out the lighter hydrocarbons, carrying on the expanding operation in the presence of a lubricant which prevents congelation of any of the aqueous constituents in the gas and dehydrates said gas, and utilizing the frigid expanded gas for carrying out the first condensing operation on fresh gas passing through the process.

3. The process of removing hydrocarbons from hydrocarbon gases, which consists in cooling compressed hydrocarbon gas to condense certain liquefiable constituents therein, removing said liquefiable constituents, thereafter passing the gas through an expanding operation to remove additional liquefiable

constituents, and carrying on the expanding operation in the presence of a lubricant which prevents congelation of any aqueous constituents in the gas and dehydrates said gas.

4. The process of recovering hydrocarbons from hydrocarbon gases, which consists in expanding a hydrocarbon gas in the presence of a lubricant which prevents congelation of any aqueous constituents in the gas and dehydrates said gas, and subsequently separating the hydrocarbon products which become liquefied during the expanding operation.

5. The process of recovering liquefiable hydrocarbons from hydrocarbon gases, which consists in expanding a hydrocarbon gas to lower its temperature to a degree whereat liquefiable hydrocarbons will be condensed out of said gas, carrying on the expanding operation in the presence of a lubricant which prevents congelation of any aqueous constituents in the gas, dehydrates

said gas and simultaneously lubricates the machinery employed, removing the liquefied hydrocarbons and employing the gas thus treated as a refrigerating medium to lower the temperature of other hydrocarbon gas sufficiently to condense certain of the liquefiable hydrocarbon products therein.

6. The process of recovering liquefiable hydrocarbons from hydrocarbon gases, which consists in expanding the gas to lower the temperature thereof sufficiently to condense out the liquefiable hydrocarbons therein, and carrying on the expanding operation in the presence of a mixture of glycerin and alcohol, which serves to prevent the congelation of any aqueous constituents in the gas, dehydrates said gas, and simultaneously lubricate the mechanism employed.

In testimony whereof I have signed my name to this specification.

AUGUSTE JEAN PARIS, JR.