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ART OF OBTAINING VOLATILE LIQUIDS FROM GASES.

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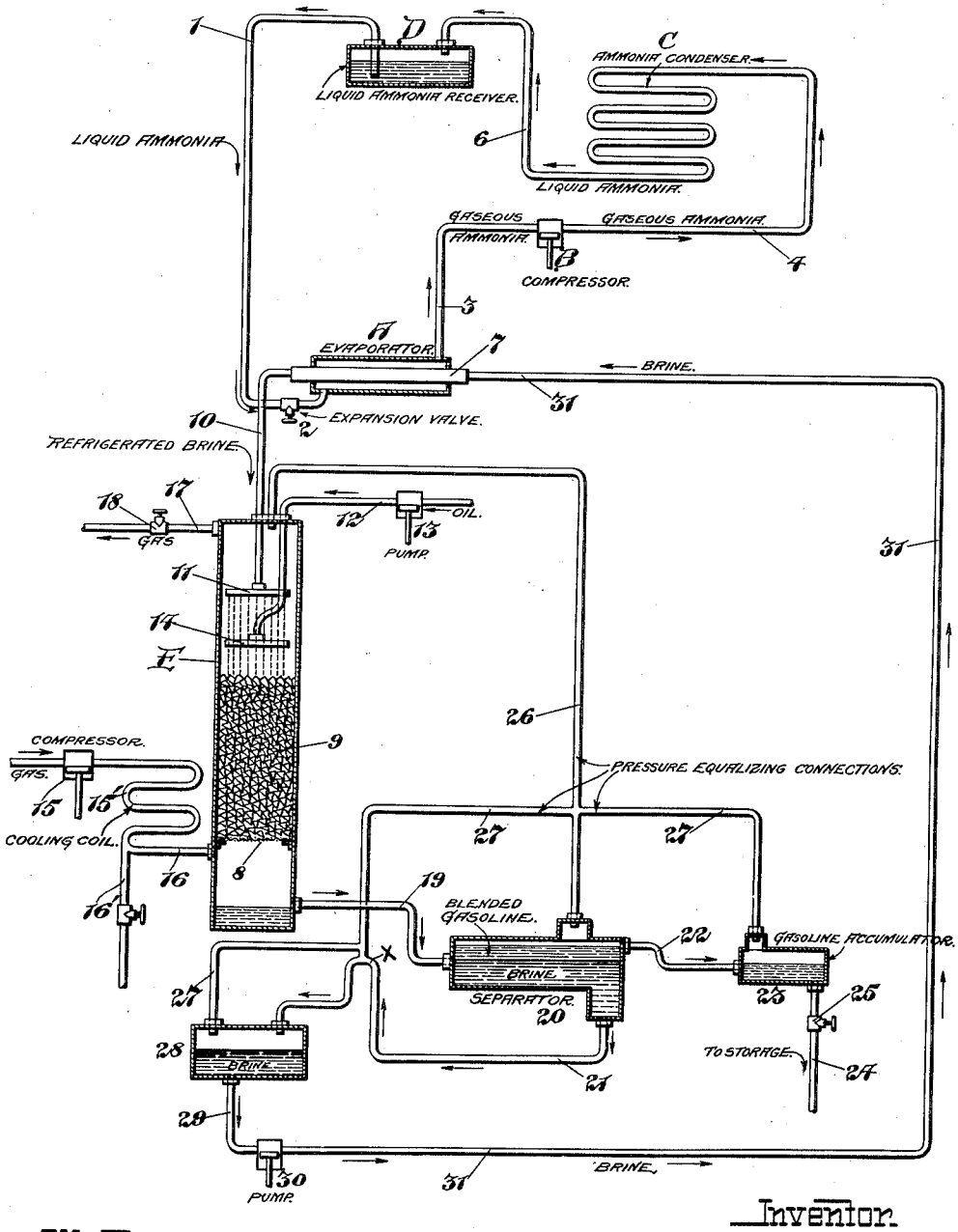
1,351,151. Patented Aug. 31, 1920.



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ART OF OBTAINING VOLATILE LIQUIDS FROM GASES.

1,351,151. Specification of Letters Patent. Patented Aug. 31, 1920.

Application filed October 11, 1917. Serial No. 196,005.

To all whom it may concern:

Be it known that I, LLOYD F. BAYER, a citizen of the United States of America, a resident of Tulsa, in the county of Tulsa, State of Oklahoma, have invented certain new and useful Improvements in the Art of Obtaining Volatile Liquids from Gases, of which the following is a full, clear, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

This invention relates to improvements in the art of obtaining volatile liquid from gases, the new method or process being particularly adapted for use in separating gasolene from natural gas, or casing-head gas; but it can also be followed in treating gases resulting from the distillation of petroleum hydrocarbons.

One of the objects of the invention is to increase the production of gasolene by recovering from gases, a large percentage of volatile fractions that cannot be liquified and retained in a liquid state by following the ordinary methods. A further object is to obtain this result in a simple and absolutely practicable manner, so that the greatly increased yield of volatile liquid can be obtained commercially, on a large scale, and at a reasonable cost.

At ordinary atmospheric temperatures, some of the constituents of hydrocarbon gases may be liquefied by confining the gas under a high pressure. If the gas is reduced to a very low temperature, some of its constituents will liquefy, or condense, under atmospheric pressure. The ideal condition is reached by the use of high pressures and low temperatures. These facts have been more or less generally recognized prior to the present invention. However, in so far as I am aware, they have not taught the public how to devise a commercially practicable method of recovering the maximum quantity of liquid from hydrocarbon gases. Merely confining the gas under high pressure and at a low temperature, produces desirable results, and this is contemplated in the present invention, but to obtain a more satisfactory solution of the problem, I accomplish this in a particular manner, and at the same time subject the gas to other conditions, so as to more effectively retain the volatile hydrocarbons in a liquid state.

In the preferred form of the invention the gas is compressed, if it is not already under the desired pressure, and forced into a chamber where it commingles with a hydrocarbon oil. The contents of this chamber are maintained under pressure. I preferably obtain the desired low temperature by refrigerating brine, or other fluid, and commingling the refrigerated fluid with the gas and oil. The temperature of the gas and oil is thus very effectively reduced by direct contact with the refrigerated fluid, and as a result, an unusually large percentage of the volatile liquid is recovered from the gas. This volatile liquid blends with the hydrocarbon oil to produce gasolene, or the like, and the blended hydrocarbons are afterward separated from the refrigerated liquid.

The drawing is a diagrammatical view of an apparatus adapted for use in carrying out the new method.

To illustrate the invention I have shown an ordinary refrigerating plant comprising an evaporator A, an ammonia compressor B, and ammonia condenser C, and a liquid ammonia receiver D. The liquid ammonia, under a high pressure, is forced from the receiver D, through a pipe 1 and expansion valve 2 to the evaporator A. The pressure of the ammonia passing through the expansion valve 2, is suddenly reduced, and as a consequence, the ammonia expands and evaporates in the evaporator A, thereby absorbing heat from the adjacent bodies and greatly reducing their temperature as is well understood in this art. The gaseous ammonia is conducted from the evaporator, through a pipe 3 to the compressor B, whereby it is compressed and forced through a pipe 4, to the condenser C. The liquid ammonia flowing from the condenser, passes through a pipe 6 to the receiver D.

A brine conductor 7 surrounded by the evaporator A is cooled by the expansion and evaporation of the ammonia. Although I have shown a conventional diagram of a refrigerating apparatus involving the use of ammonia and brine, it is to be understood that the invention is not limited to any particular method of refrigeration, nor to the use of any particular fluid in the refrigerating apparatus.

However, I preferably use brine, or other liquid, having a freezing point below that of water, and I also prefer to use a liquid of this kind having a density different from

the blended hydrocarbons, so that the refrigerating liquid can be easily separated from the hydrocarbon product.

E designates a cooling chamber provided with a screen 8 supporting a large number of small pieces of material 9, such for example, as coke, rocks or wooden slats, the object being to produce a multitude of irregular baffles and passageways in the cooling chamber. The refrigerated brine passing from the brine conductor 7 flows through a pipe 10 to a discharge device 11 in the cooling chamber. The chilled brine is thus showered onto the top of the baffle members 9 in the cooling chamber. An oil conductor 12, extending from an oil pump 13 to the interior of the cooling chamber, is provided with a discharge device 14 for the discharge of streams of hydrocarbon oil onto the baffle members 9. 15 designates a gas compressor whereby the gas, when not already under sufficient pressure, is compressed and forced through a cooling coil 15′ provided with a pipe 16 leading to the lower portion of the cooling chamber. The liquid condensing at the temperature in the coil 15′ is withdrawn through a pipe 16′ before the gas is subjected to the further cooling in the cooling chamber. The gas entering the cooling chamber below the baffles 9, rises between said baffles where it commingles with the fine streams, or films of hydrocarbon oil and brine, which fall slowly to the bottom of the cooling chamber. 17 designates a pipe through which the uncondensed gas is discharged from the upper portion of the chamber E. The contents of this chamber E are preferably maintained under a high pressure which may be regulated by adjusting a valve 18 in the pipe 17.

Gas already under pressure, either derived from its natural source or from its mechanical production at some other point, may be conducted directly to the cooling apparatus and introduced without compression into the cooling chamber in the manner already described.

By commingling the refrigerated brine with the hydrocarbon oil and gas, under pressure, as herein shown, the temperature of the oil and gas is very greatly reduced by direct contact with the cool brine, and a very large volume of volatile liquid is recovered from the gas. Owing to the pressure and low temperature, a large percentage of the gas is condensed in the cooling chamber, and this condensate blends with the hydrocarbon oil. In the manufacture of blended gasolene, a petroleum distillate is discharged through the pipe 12, and the blended product, mixed with the brine, passes through a pipe 19 to the separator 20. The brine settles in the lower portion of the separator and passes out through a pipe 21, while the gasolene, being lighter than the brine accumulates at a higher elevation and escapes through a pipe 22, to an accumulator 23, from which it may be discharged through a pipe 24 provided with a valve 25. A pressure equalizing pipe 26 leads from the top of the chamber E to the top of the separator 20, and this pipe is provided with branches 27 leading to the top of the accumulator 23 to the top of the liquid seal X, and to the top of the brine receiver 28. The pressure in the cooling chamber E, separator 20, accumulator 23, the liquid seal and the brine receiver are equalized, and all of these parts are preferably maintained under a high pressure.

Although any desired pressures and temperatures may be maintained in the system, I will state by way of example that desirable results in casinghead gasolene extraction where the gas is a residue from a compression plant may be obtained by cooling the brine to a temperature of about 20° F., and maintaining the contents of the cooling chamber under a pressure of about 250 pounds per square inch. It is to be understood, however, that the invention is not in any way limited to a particular pressure, nor to a particular temperature.

It should be noted that in this process the gas is cooled to a low temperature and the condensate is blended with a hydrocarbon oil. It is not an ordinary absorption process, in which constituents of the gas are dissolved or absorbed in a relatively large quantity of oil, from which the dissolved or absorbed fractions are usually subsequently separated by distilling. In this cooling process I preferably introduce only sufficient hydrocarbon oil to make a stable product of the desired gravity.

The brine passing from the separator 20, flows through a pipe 21 to a brine receiver 28, from which it is conducted through a pipe 29 to a pump 30, the latter serving as means for forcing the brine through a return conductor 31, to the brine pipe 7 in the evaporator A. The brine passing from the separator 20 accumulates in the pipe 21 so as to form a liquid seal, this liquid being permitted to overflow at X and pass to the receiver 28.

The preferred form of the method or process herein disclosed involves the use of a refrigerating fluid, a hydrocarbon gas and a hydrocarbon liquid, each coöperating with the others in a particular manner to increase the production of gasolene, or the like. It is a decided advantage to bring the refrigerating fluid into direct contact with the gas, but this alone would not accomplish the desired results. The temperature of the gas is reduced in an economical manner by direct contact with the refrigerating liquid, and a further advantage is gained by maintaining both of these fluids under a high

pressure. Owing to the high pressure and low temperature, a large volume of the gas is liquefied in the cooling chamber, but the resultant liquid is very volatile and some steps must be taken to prevent a large percentage of the light hydrocarbons from quickly returning to a gaseous state when exposed to atmospheric conditions. I, therefore, commingle the hydrocarbon blending liquid with the gas and refrigerated liquid so that the volatile hydrocarbons condensed from the gas will unite with the less volatile hydrocarbon liquid, instead of passing away freely in the form of gas under atmospheric temperature and pressure. By the preferred form of the invention I recover, in a commercially practicable manner, a large volume of volatile hydrocarbons which would otherwise remain in a gaseous state, and at the same time avoid losses by blending the volatile product with a hydrocarbon liquid to produce blended gasolene, or the like.

The volume of refrigerated liquid passing into the cooling chamber in a given period is preferably much greater than the volume of hydrocarbon oil introduced in the same period. The process of refrigeration is thus utilized most effectively by bringing the oil and gas into contact with a large volume of the very cold liquid. It will also be noted that the liquid used as a refrigerating agent can be readily separated from the blended hydrocarbons and returned to the refrigerating apparatus.

In some few cases, it may be possible that sufficient blending material will be required so that this hydrocarbon liquid can itself be refrigerated and used as both the cooling and blending agent. However, in most cases, the quantity of this hydrocarbon liquid is so small in comparison to the quantity of gas to be refrigerated that the initial temperature of the hydrocarbon liquid would be far below practicable temperature.

I claim:—

1. In the art of treating hydrocarbons, the method of obtaining volatile hydrocarbon liquid from gas, said method comprising commingling the gas with a hydrocarbon oil, confining said gas and hydrocarbon oil under pressure, at the same time artificially refrigerating another liquid and commingling the refrigerating liquid with the oil and gas, so as to refrigerate the oil and gas under pressure, thereby condensing volatile constituents of the gas and blending such condensate with the oil, and thereafter separating the refrigerating liquid from the blended hydrocarbons.

2. In the art of making blended gasolene, the method which comprises refrigerating a liquid and commingling it with a hydrocarbon liquid with which lighter hydrocarbons will blend under pressure, at the same time commingling hydrocarbon gas under pressure, with the refrigerated liquid and the hydrocarbon liquid, so as to condense volatile constituents of the gas and blend them with said hydrocarbon liquid, conducting the uncondensed gas from the blended hydrocarbons, and separating said blended hydrocarbons from said refrigerating liquid.

3. In the art of making blended gasolene, the method which comprises conducting brine through an artificial refrigerating cooler so as to refrigerate the brine, forcing the refrigerated brine into a cooling chamber, forcing a hydrocarbon distillate into the cooling chamber, compressing natural gas and commingling it, under pressure, with the refrigerated brine and hydrocarbon distillate in said cooling chamber, so as to blend constituents of the natural gas with the hydrocarbon distillate, conducting the brine and blended hydrocarbons away from the cooling chamber, separating the blended hydrocarbons from the brine, and returning the brine to said refrigerating cooler.

In testimony that I claim the foregoing I hereunto affix my signature.

LLOYD FELCH BAYER.