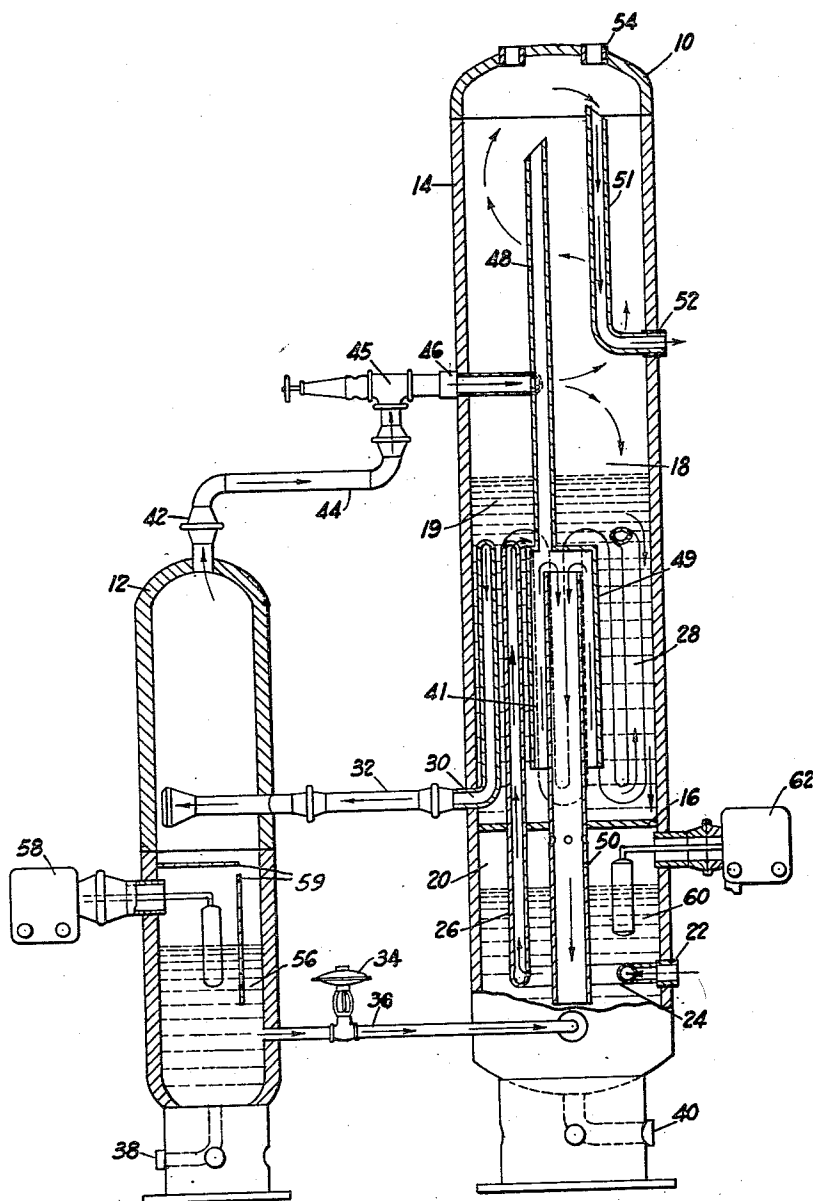


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DEHYDRATION OF NATURAL GAS STREAMS AND COLD
SEPARATION UNITS THEREFOR
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DEHYDRATION OF NATURAL GAS STREAMS AND COLD SEPARATION UNITS THEREFOR

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This invention relates to improvements in dehydrating natural gas streams and more particularly, but not by way of limitation, to a method of dehydrating natural gas streams in a manner to prevent loss of liquid bath due to control failure, and loss of heat exchange due to deposits of mud or paraffin on the heating coil.

Presently available natural gas stream dehydrating methods have certain operating difficulties in practical operation. Two of the basic problems encountered in these systems are loss of the liquid bath utilized therein by control failure, and loss of heat exchange through the coil as a result of deposition externally thereon of mud and paraffin usually present in the gas stream.

The present invention contemplates a novel cold separation unit specifically designed to overcome these detriments. The operation of the unit in general follows the pattern disclosed in United States Letters Patent No. 2,528,028 issued to A. F. Barry on October 31, 1950. The present apparatus, however, comprises a vessel having a horizontal baffle disposed therein to form two compartments for separating the distillate from the liquid bath for assuring that no paraffin or mud will come into contact with the heating coil disposed within the bath. It will be apparent that this arrangement will preclude any deposition of paraffin or mud on the heat exchange coil, thereby increasing the efficiency of the apparatus in operation.

It is, therefore, an important object of this invention to provide a cold separation unit for removing hydrates from a natural gas stream normally containing mud and paraffin that will prevent deposition of these impurities on the exterior of the heat exchange coil of the unit, thereby increasing the overall efficiency of the operation thereof.

It is another object of this invention to provide a cold separation unit for removing hydrates from a natural gas stream in a manner to provide an efficient control of the liquid bath utilized in the separation process in order to prevent loss thereof in operation.

It is still another object of this invention to provide a cold separation unit for dehydrating a natural gas stream which is simple and efficient in operation and is of an economical construction.

Other objects and advantages of the invention will be evident from the following detailed description, read in conjunction with the accompanying drawings, which illustrate my invention.

In the drawings:

The figure is a vertical sectional view of a cold separation unit embodying the present invention.

Referring to the drawings in detail, reference character 10 refers generally to a cold separation unit comprising a first stage tank 12 and a second stage tank 14. The second stage tank 14 is preferably substantially cylindrical in configuration and is disposed in an upright vertical position. The tank 14 is provided with a horizontally disposed baffle 16 for separation thereof into an upper chamber 18 and a lower chamber 20 for a purpose as will be hereinafter set forth. The lower compartment 20 is provided with an inlet 22 in communication with a lower coil 24. The lower coil 24 connects to and is preferably an integral part of an upstanding passageway or pipe 26 which extends upward through the baffle 16 into the upper compartment 18.

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The pipe 26 is in direct communication with an upper heat exchange coil 28 disposed entirely within the upper chamber 18. A liquid bath 19 surrounds the coil 28 for a purpose as will hereinafter be set forth. The upper coil 28 terminates at an outlet 30 which connects with a pipe 32 for communication with the first stage tank 12. The tank 12 is similar in shape to the tank 14 but is preferably of a smaller size. A suitable valve 34 connects with a line 36 at the lower portion of the tank 12 to permit discharge of liquid and residue from the tank 12 as will be hereinafter set forth in detail. Any suitable drain 38 is provided in the tank 12. The line 36 provides communication between the first stage tank 12 and the lower compartment 20 of the second stage tank 14. A drain 40 is disposed at the bottom of the compartment 20 to permit discharge of residue therefrom. An outlet 42 is provided at the top of the tank 12 for cooperation with a line 44, a choke 45, and an inlet 46 to communicate gases from the tank 12 to the upper chamber 18 of the tank 14. An equalizer pipe 48 extends upwardly within the chamber 18 and has a lower portion 49 of larger diameter in communication with an upstanding passageway 50 extending downwardly through the partition 16 and into the chamber 20 for a purpose as will be hereinafter set forth. An angled pipe 51 cooperates with an outlet 52 disposed in the upper portion of the chamber 18 for permitting the discharge of gases therefrom. The chamber 18 may be further provided with a plurality of safety outlets 54 if desired.

Operation

A natural gas stream containing a mixture of hydrocarbons and water components in both the vapor and liquid phases initially enters the inlet 22 in the second stage tank 14 from a high pressure distillate oil well (not shown). The gas is usually at a high temperature and pressure as it enters the tank and flows through the coil 24, wherein heat is given up to liquids within the chamber 20 as will be hereinafter set forth. The influent stream travels upward through the passageway 26 to enter the coil 28. The temperature of the gas is only slightly reduced as it passes through the coil 24. It will, therefore, be apparent that the heat of the gas passing through the heat exchange coil 28 will maintain the liquid bath 19 in chamber 18 at a high temperature for a purpose as will be hereinafter set forth. The temperature of the gas is greatly reduced by its passage through the heat exchange coil 28, thus substantially reducing the dew point of the gas. The gas passes from the coil 28 for discharge at the outlet 30 through the line 32 into the first stage tank 12. Paraffin and mud will not precipitate from influent gas at high temperatures. Thus the hot gas stream passing through the coil 28 will not permit any accumulation of paraffin or mud therein. As the gas is cooled, however, and enters the tank 12, the paraffin and mud will be precipitated with the water in liquid form. The liquid or distillate will fall by gravity to the bottom of the tank 12 as shown at 56. The valve 34 coacting with any suitable liquid level control means 58 will maintain a desired liquid level within the tank. Suitable baffles 59 may be provided within the tank 12 for protection of the level control means 58 from the pressure of the influent gas stream entering the vessel thereabove. Upon opening of the valve 34 the distillate will be transported into the lower chamber 20 wherein a reservoir 60 is maintained to surround the coil 24. All the paraffin and mud in the flow stream will be carried in this liquid precipitate. It will be particularly noted that this liquid precipitate is never in contact with the exterior of the coil 28, there-

by precluding any possibility of deposition of paraffin or mud thereon to hinder the operation of the unit 10. It will also be apparent that the heat given up by the gas stream passing through the coil 24 as previously mentioned will prevent freezing of the reservoir liquid 60, particularly in the winter months to maintain an efficient operation of the apparatus at all times. The liquid level within the chamber 20 may be controlled by means of any suitable level control 62, cooperating with an outlet valve (not shown) similar to the valve 34 in tank 12.

The gases or vapor components remaining within the upper portion of the tank 12 will flow through the outlet 42 and line 44 to the choke or reducing valve 45 wherein the pressure of the gas is substantially reduced. The temperature of the gas will have been greatly reduced during its travel through the coil 28, and the pressure reduction process lowers the temperature an even greater amount. The hydrates remaining in the gas as it is discharged into the chamber 18 will, therefore, condense from the gas and will gravitate into the liquid bath 19 within the chamber 18. The temperature of the liquid bath is maintained sufficiently high by the coil 28 as hereinbefore described to melt the hydrates falling from the gas stream. The liquid bath 19 will circulate downward around the heat exchange coil 28 and then upward through the annulus 41 between the riser 50 and the lower extension 49 of the pipe 48 where it travels downward through the riser 50 for discharge into the chamber 20.

Substantially dehydrated gas will remain in the upper portion of the chamber 18 after the hydrates have condensed into the liquid bath 19. This gas will be delivered through line 51 and outlet 52 to a transmission line (not shown) for passage to a storage tank, or the like. It will be noted that if failure of the liquid control valve 62 in the lower chamber 20 occurs, the liquid bath 19 will be maintained and surround the coil 28 so that the hydrates falling therein will be melted and the gas will be discharged from the outlet 52 in the normal manner. During this period some gas will flow down the equalizer line 48 into the chamber 20, but this is not critical as a small orifice type choke nipple (not shown) may be installed downstream of the outlet valve (not shown) within the chamber 20 to limit the gas flow.

From the foregoing, it will be apparent that the present invention provides an efficient separation unit for the dehydration of natural gas streams. The gas stream containing hydrocarbons and water components in the vapor and liquid phases at high pressure and temperature is passed through a second stage separator to transfer heat to the liquid bath, thereby maintaining it at a sufficiently high temperature to melt the condensed hydrates falling therein. The gas enters the first stage separator from the heat exchange coil at a reduced temperature which causes precipitation of the water components containing any mud and paraffin present in the gas stream. The cooled gas leaves the first stage tank to pass through a pressure reducing choke and is transferred into the upper portion of the second stage tank. The reduced temperature and pressure condition of the gas causes condensation of the hydrates contained therein. The hydrates will, therefore, fall into the liquid bath to be melted therein. The temperature of the liquid bath is maintained sufficiently high to melt the hydrates by heat transfer from the coil disposed therein. All the paraffin and mud is removed from the gas stream before it reaches the liquid bath, thereby preventing any deposition thereof on the heating coil. In this manner, an efficient heating of the liquid bath is maintained. The quantity of liquid in the bath is adequately controlled to assure an efficient operation of the separation unit.

Changes may be made in the combination and arrangement of parts as heretofore set forth in the specification and shown in the drawings, it being understood that any

modification in the precise embodiment of the invention may be made within the scope of the following claims without departing from the spirit of the invention.

I claim:

1. A method of dehydrating a natural gas stream having impurities therein, consisting of passing the stream through a heat exchange coil surrounded by a liquid bath to transfer heat to the bath and cool the stream, maintaining the liquid bath within a second stage vessel, discharging the cooled stream into a first stage vessel remote from the liquid bath, removing the impurities from the gas stream for precipitation and accumulation within the first stage vessel, directing the removed impurities into the lower portion of the second stage vessel, maintaining the removed impurities out of contact with the liquid bath, withdrawing the remaining vapor components of the gas stream from the first stage vessel, reducing the pressure and further cooling the vapor components of the gas stream to substantially hydrate forming condition, discharging the further cooled gas stream into the upper portion of the second stage vessel, precipitating the hydrates into the liquid bath for melting the hydrates, substantially precluding loss of the liquid bath, and withdrawing the dehydrated gas from the upper portion of the second stage vessel.

2. In a cold separation unit for dehydrating a natural gas stream comprising a first stage tank and a second stage tank, said second stage tank having a baffle secured therein providing an upper and a lower chamber, an inlet means disposed within the lower chamber, a heat exchange coil in the upper chamber surrounded by a liquid bath, communication between the inlet means and the heat exchange coil and the first stage tank, means within the first stage tank to transfer precipitates from the gas stream to the lower chamber of the second stage tank, means to conduct gas from the first stage tank into the upper chamber of the second stage tank, means to reduce the pressure of the stream to permit hydrates to precipitate into the liquid bath, means for precluding loss of the liquid bath, and means in the upper chamber of the second stage tank for withdrawing the dehydrated gas therefrom.

3. A cold separation unit for dehydrating a natural gas stream normally containing water, mud and paraffin and comprising a first stage vessel and a second stage vessel, said second stage vessel having a substantially horizontal baffle member secured therein to form an upper and a lower compartment, an inlet disposed in the lower compartment, communication means between the inlet and a heat exchange coil within the upper compartment, a liquid bath provided in the upper compartment and completely surrounding the coil to receive heat therefrom, communicating means between the heating coil and the first stage vessel for directing the cooled gas stream thereto for precipitation of water, mud and paraffin from the stream, means for transferring the precipitate to the lower compartment of the second stage vessel for storage remote from the heat exchange coil, means for directing the released gas in the first stage vessel through a pressure reducing means and into the upper compartment of the second stage vessel where the expanded gas condenses the hydrates contained therein to the liquid bath for melting the hydrates, means for substantially precluding the loss of the liquid bath, and means provided in the upper chamber of the second stage vessel for withdrawing the dehydrated gas therefrom.

References Cited in the file of this patent

UNITED STATES PATENTS

2,528,028 Barry ----- Oct. 31, 1950

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Campbell et al.: Petroleum Refiner, vol. 32, No. 1, 75 January 1953, pages 138-142.