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GAS SEPARATION

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This invention relates to the separation of C_2 hydrocarbons from gaseous mixtures containing the same. One aspect of this invention relates to an improved distillation-absorption process for the recovery of a fraction rich in C_2 hydrocarbons from a gaseous mixture containing the same. Another aspect of this invention relates to the use of such a process in the recovery of ethylene.

Gases containing substantial quantities of C_2 hydrocarbons are obtained from many processes involving treating or conversion of hydrocarbons such as catalytic cracking, naphtha reforming, desulfurization and many other thermal and catalytic processes. These gases frequently contain, in addition to C_2 hydrocarbons, other lighter and heavier normally gaseous hydrocarbons as well as low boiling gases such as oxygen, nitrogen, carbon monoxide, hydrogen, etc. These gases frequently contain substantial quantities of ethylene which it is highly desirable to recover; however, the large amounts of other material present may make it undesirable to process the entire quantity of gas for the recovery of ethylene by successive distillation steps in the usual manner. In such cases, it may be desirable to treat the gaseous mixture in question for the separation of a fraction rich in C_2 hydrocarbons from which the major portion of the lighter hydrocarbons and other lower boiling components has been removed. The C_2 -rich fraction can then be further treated by conventional distillation processes for the recovery of ethylene of whatever purity may be desired. Natural gas may also be treated according to this invention. Any of the conventional methods for recovering ethylene may be used for recovering ethylene from the C_2 -rich fraction. If the C_2 -rich fraction is not subjected to an ethylene recovery process, it may be used or disposed of in any other desired manner. Heavier hydrocarbons and other materials such as CO_2 or H_2S which may be present in the gaseous feed mixture may be removed separately if desired but this may be unnecessary in view of the relatively small quantities of these various materials involved. These materials may sometimes be removed during the treatment of the C_2 -rich fraction for recovery of ethylene.

It is an object of this invention to provide an improved process for the separation of normally gaseous hydrocarbons.

It is another object of this invention to provide an improved process for the separation of C_2 hydrocarbons from gaseous mixtures containing the same and methane.

Another object of this invention is to provide an improved process for the recovery of an ethylene-rich fraction from a gaseous mixture containing the same.

A further object of this invention is to provide an improved absorption-distillation process for the recovery of a fraction rich in C_2 hydrocarbons from a gaseous mixture containing the same.

It is another object of this invention to provide an improved absorption-distillation process for the recovery of a fraction rich in C_2 and C_3 hydrocarbons from a nor-

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mally gaseous mixture containing the same, methane and inert gases.

Other objects and advantages of this invention will become apparent to those skilled in the art from the following description and disclosure.

According to one aspect of this invention, a gaseous feed mixture containing methane and C_2 hydrocarbons is passed to a first absorption zone in which it is contacted with a first absorption medium which is adapted to absorb C_2 hydrocarbons in preference to methane. This results in the formation in the first absorption zone of a liquid phase containing absorption medium and substantially all of the C_2 hydrocarbons and a vapor phase containing methane and entrained absorption medium. The vapor phase from the first absorption zone is withdrawn and passed to a second absorption zone where it is contacted with a second absorption medium adapted to preferentially absorb the first absorption medium. This results in the formation, in the second absorption zone, of a vapor phase substantially free of both first and second absorption mediums and a liquid phase comprising said first and second absorption mediums. The liquid and vapor phases thus formed are separately withdrawn from the second absorption zone. The liquid and vapor phases withdrawn from the second absorption zone may be treated or disposed of in any desired manner; however, it is usually advantageous to treat the liquid from the second absorption zone for recovery of the first and second absorbents so that they may be used again, if desired. The liquid phase in the first absorption zone containing the first absorption medium and substantially all of the C_2 hydrocarbons is withdrawn and passed to a distillation zone where it is fractionated into a vaporous overhead fraction preferably containing substantially all of the C_2 hydrocarbons and a liquid bottoms fraction comprising said first absorption medium. The bottoms fraction comprising the first absorption medium is withdrawn from the distillation zone and passed to the first absorption zone while the overhead fraction from the distillation zone is withdrawn as a product of the process.

The normally gaseous feed mixture used in practicing this invention contains C_2 hydrocarbons including ethylene and also contains methane. In addition, the feed mixture may contain other normally gaseous materials such as C_3 and C_4 hydrocarbons, hydrogen, H_2S , CO_2 , oxygen, nitrogen, carbon monoxide, etc. These gases may be found in varying quantities in the feed mixture; however, this invention is particularly applicable where the relative quantity of C_2 hydrocarbons present is appreciable but does not constitute a majority of the gaseous materials in the mixture. Gases, such as tail gases from catalytic cracking processes, which contain appreciable quantities of ethane and ethylene but in which there are also large quantities of other gases such as oxygen, nitrogen, carbon monoxide and methane are particularly well suited for use in practicing this invention.

Any suitable absorbents may be used in practicing this invention so long as the first absorbent is capable of absorbing C_2 hydrocarbons in preference to methane while the second absorbent is capable of recovering substantially all of the first absorbent which may be entrained in the fraction containing methane which is obtained as a result of treating the feed with the first absorbent. Hydrocarbon absorbents are particularly well adapted for use in accordance with our invention. Light hydrocarbons such as propane, butane or gasoline may be used as the first absorbent while the second absorbent may be any hydrocarbon oil of lower volatility than the first absorbent. Preferably however, the first absorbent is butane while the second absorbent is a hydrocarbon oil heavier than the first absorbent. Absorbents lighter than

butanes are not entirely satisfactory as the first absorbent because of the difficulty of preventing excessive loss of such absorbents with the overhead product of the distillation zone. Absorbents heavier than butanes are not entirely satisfactory as the first absorbent because of the excessive temperatures needed for the separation of such absorbents from the fraction containing C_2 hydrocarbons in the distillation zone. Generally, it is preferred that the second absorbent be as light as possible consistent with proper absorption of the first absorbent and the prevention of excessive loss of either absorbent with the overhead from the second absorption zone. Hydrocarbon oils having an API gravity between about 25 and about 40° are found to be well suited for use as the second absorbent.

The butanes and hydrocarbon oil which are preferred for use as absorbents may conveniently be products of a process for the catalytic cracking of hydrocarbon oils to produce gasoline and naphtha fractions although other suitable absorbents may, of course, be used. The butane and hydrocarbon oil absorbents may be obtained from the total product of the cracking process by any suitable means such as distillation, absorption, or a combination thereof. If the absorbents used are products of such a cracking process, it is frequently both convenient and economical to return the liquid phase from the second absorption zone to a suitable point in the product recovery system of the cracking process so that the first and second absorbents may be recovered. By returning the liquid phase containing the first and second absorbents to the product recovery system, these absorbents can be recovered for use as described above or otherwise without the use of any extraneous equipment.

Pressures between about 300 and about 600 p. s. i. g., more usually between about 400 and about 500 p. s. i. g. are preferably maintained in the absorption and distillation zones while practicing our invention. It frequently happens that when low boiling gases such as oxygen, hydrogen, nitrogen or carbon monoxide are present in the feed gas, a substantial quantity of these gases are entrained by the absorbent in the first absorption zone and are withdrawn from the first absorption zone in the liquid phase. If desired, such entrained gases may be removed by passing the liquid phase from the first absorption zone to a zone of reduced pressure. This zone of reduced pressure is preferably maintained at pressures of at least about 50 p. s. i. below the pressure maintained in the first absorption zone. In this zone of reduced pressure, substantial quantities of entrained low-boiling gases such as oxygen, nitrogen and CO are released from the liquid phase by reason of the reduced pressure and can be withdrawn from the zone of reduced pressure as vapors. The gases so withdrawn may, if desired, be recombined with the feed or may be disposed of in a more direct manner. If such a zone of reduced pressure is used, the liquid phase containing absorbing medium and rich in C_2 hydrocarbons may be withdrawn from it and passed to the distillation zone through a pump which serves to repressurize the liquid phase prior to its entry into the distillation zone.

The first absorption zone is preferably maintained at a temperature of between about 90 and about 120° F. for the liquid phase and between about 90 and about 120° F. for the vapor phase when the preferred pressure conditions are maintained. The second absorption zone is preferably maintained at a temperature between about 100 and about 130° F. for the liquid phase and between about 90 and about 120° F. for the vapor phase when the preferred pressure conditions are maintained. Under the preferred pressure conditions the bottoms temperature of the distillation zone is preferably between about 260 and about 280° F. while the temperature at which the C_2 -rich fraction is recovered from the process is preferably between about 50 and about 120° F. If desired, in order to produce reflux for the distillation zone con-

veniently, the overhead fraction may be withdrawn from the distillation zone at a higher temperature than the temperature at which it is desired to recover the C_2 -rich fraction. If this is done, the overhead fraction is preferably withdrawn from the distillation zone at a temperature between about 125 and about 135° F. and is then cooled to the temperature at which it is desired to remove the C_2 -rich fraction. This further reduction in temperature of the overhead fraction condenses remaining absorbent which may then be used as reflux to the distillation zone and allows the withdrawal of the C_2 -rich fraction substantially free of absorbent.

For a better understanding of our invention, reference should be had to the accompanying drawing which is a diagrammatic illustration in elevation of a suitable arrangement of apparatus for carrying out a preferred embodiment of our invention.

In the drawing, feed gas having the composition shown in Table I enters through conduit 11, at the rate of 37,408 lbs./hr.

TABLE I
Feed composition

Component:	Lb./hr.
O_2 , N_2 , CO	11,746
CO_2	2,056
H_2	576
C_1 hydrocarbons	6,780
C_2 hydrocarbons	8,285
C_3 hydrocarbons	5,280
C_4 hydrocarbons	1,364
C_5 hydrocarbons	28
H_2S	1,045
H_2O	248
	37,408

This feed is the tail gas which remains after the product of a catalytic cracking process has been treated by distillation and absorption for the removal of less volatile constituents. The feed in conduit 11 passes through valve 12 into a drum 13 where it is combined with low boiling gases from conduit 14 obtained as described below. The combining of gases from conduit 14 with the feed is for convenience only and it is entirely within the scope of our invention to dispose of these gases in any other convenient manner. By recombining the low boiling gases from conduit 14 with the feed in drum 13, these gases can be removed from the process, together with other low boiling components of the feed as hereinafter described. From drum 13, the feed passes through conduit 16 to a compressor 17 where it is compressed to a pressure of 445 p. s. i. g. and has a resulting temperature of 265° F. Compressor 17 is driven by a turbine 18. From compressor 17 feed passes through conduit 19 to a cooler 21 where it is cooled to a temperature of 105° F. The feed then continues from cooler 21 through conduit 19 to an absorber 22, which is an absorption column operated at a pressure of 435 p. s. i. g. Absorber 22 is maintained at a bottom temperature 108° F. and a top temperature of 110° F. In absorber 22, the feed is contacted with butane absorbent which enters absorber 22 through conduit 23. This butane absorbent comprises butane product from a catalytic cracking process and has a density of 4.90 lb./gal. The butane absorbent enters the process through conduit 23 and a pump 26 at a temperature of 177° F. at the rate of 19,131 lb./hr. The butane absorbent is cooled to a temperature of 105° F. in a cooler 28 and then passes via pump 29 to absorber 22 through conduit 23. Additional butane absorbent obtained as explained below enters conduit 23 from conduit 27 so that the total amount of butane absorbent passing into absorber 22 from conduit 23 is 194,559 pounds per hour.

Overhead vapor having the composition shown in

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Table II is withdrawn from absorber 22 through conduit 31 at the rate of 37,439 pounds per hour and a temperature of 110° F.

TABLE II

Composition of vapor phase from absorber 22

Component:	Lb./hr.
O ₂ -N ₂ -CO	11,310
CO ₂	431
H ₂	551
C ₁ hydrocarbons	4,882
C ₂ hydrocarbons	648
C ₃ hydrocarbons	913
C ₄ hydrocarbons	18,465
C ₅ hydrocarbons	163
H ₂ S	6
H ₂ O	70
	37,439

The vapor in conduit 31 passes to an absorption tower 32 where it is contacted with a second absorbent for the recovery of butanes. Absorber 32 is maintained at a pressure of 430 p. s. i. g. The second absorbent used in this case is a 28.0° A. P. I. light cycle oil which is a product of a catalytic cracking process and has been separated from the total product by distillation. The cycle oil enters through conduit 33 at the rate of 110,000 pounds per hour and a temperature of 440° F. and passes via pump 34 through a cooler 36 where its temperature is reduced to 221° F. From cooler 36 the cycle oil continues through conduit 33 to a cooler 37 where its temperature is reduced to 105° F. and then continues through conduit 33 to absorber 32. From absorber 32 a vaporous phase is withdrawn through conduit 38 at a temperature of 108° F. at the rate of 17,441 pounds per hour. The vaporous fraction in conduit 38 comprises gases having lower boiling points than C₂ hydrocarbons and has the composition shown in Table III.

TABLE III

Composition of overhead fraction from absorber 32

Component:	Lb./hr.
CO, O ₂ -N ₂	10,974
CO ₂	330
H ₂	545
H ₂ S	3
C ₁ hydrocarbons	4,562
C ₂ hydrocarbons	483
C ₃ hydrocarbons	251
C ₄ hydrocarbons	235
H ₂ O	58
	17,441

The vaporous fraction in conduit 38 passes from the process through a valve 39 to be used as fuel gas or to be disposed of in any other suitable manner.

A side stream is withdrawn from the lower portion of absorber 32 through conduit 41 at a temperature of 129° F., passed through a pump 42 to an intercooler 43 where it is cooled to a temperature of 105° F. and is then returned to absorber 32 through conduit 41. Intercooler 43 serves to remove the heat of absorption created by the condensation of the butanes which are absorbed by the light cycle oil in absorber 32. Water which is present in absorber 32 is withdrawn through conduit 44 and valve 46 at the rate of 12 pounds per hour. A 41.0° A. P. I. liquid phase comprising butane and light cycle oil absorbents and having the composition shown in Table IV is withdrawn from absorber 32 through conduit 47 at the rate of 129,986 pound per hour at a temperature of 120° F.

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TABLE IV

Composition of liquid phase withdrawn from absorber 32

Component:	Lb./hr.
O ₂ -N ₂ -CO	336
CO ₂	101
H ₂	6
H ₂ S	3
C ₁ hydrocarbons	320
C ₂ hydrocarbons	165
C ₃ hydrocarbons	662
C ₄ hydrocarbons	18,230
C ₅ hydrocarbons	163
Heavier than C ₅ hydrocarbons	110,000
	129,986

The liquid in conduit 47 passes through a pressure reducing valve 48 where it is partially vaporized and its temperature is reduced to 118° F. and then continues through conduit 47 to heat exchanger 36 where it is heated and further vaporized. From heat exchanger 36 the fluid in conduit 47 continues to a separation drum 49 which is maintained at a pressure of 200 p. s. i. g. and a temperature of 300° F. Vapor is withdrawn from drum 49 through conduit 51 and passes from the system through valve 52 while liquid is withdrawn from drum 49 through conduit 53 and passes from the system through valve 54. The vapor and liquid withdrawn through conduits 51 and 53 may be returned to a suitable point in the recovery section of the catalytic cracking process, separately treated for recovery of the butanes and light cycle oil or may be disposed of in any other suitable manner. Preferably, the vapor and liquid from drum 49 are recombined with product of the catalytic cracking process at appropriate points in the recovery system so that the various valuable components contained therein may be recovered as part of the product fractions of the cracking process, reused as absorbents or otherwise disposed of. The liquid phase from absorber 32 need not, of course, be treated in the manner described but may be disposed of in any other suitable manner without departing from the scope of our invention.

A liquid phase is withdrawn from absorber 22 through conduit 56 and passes through a pressure reducing valve 57 to a separating drum 58 which is maintained at a pressure of 335 p. s. i. g. and a temperature of 106° F. Water from absorber 22 is withdrawn at a rate of 178 pounds per hour through conduit 59 and valve 61. The liquid phase withdrawn through conduit 56 has the composition shown in Table V.

TABLE V

Composition of liquid phase from absorber 22

Component:	Lb./hr.
O ₂ -N ₂ -CO	953
CO ₂	1,827
H ₂	61
H ₂ S	1,090
C ₁ hydrocarbons	2,419
C ₂ hydrocarbons	8,244
C ₃ hydrocarbons	8,136
C ₄ hydrocarbons	171,872
C ₅ hydrocarbons	3,951
	198,553

The reduced pressure in separator drum 58 allows low boiling gases such as O₂, N₂ or CO which are entrained in the liquid phase to be separated therefrom by reason of the reduced pressure and the gases which are thus separated are withdrawn from drum 58 through conduit 14 at the rate of 4,203 pounds per hour and pass through valve 63 and conduit 14 to drum 13, as previ-

ously described. If desired, because of the small quantities of such gases present, or for other reasons, pressure reduction valve 57 and separator drum 58 may be eliminated from the process without departing from the scope of our invention.

Liquid from separator drum 58 is withdrawn through conduit 64 and passes via a pump 66 to a heat exchanger 67 where it is heated to a temperature of 190° F. From heat exchanger 67 the liquid in conduit 64 continues to a fractionator 68 which is a distillation tower. The liquid entering fractionator 68 from conduit 64 has the composition shown in Table VI.

TABLE VI

Composition of liquid entering tower 68 through conduit 64

Component:	Lb./hr.
O ₂ -N ₂ -CO -----	436
CO ₂ -----	1,625
H ₂ -----	25
H ₂ S -----	1,039
C ₁ hydrocarbons -----	1,898
C ₂ hydrocarbons -----	7,637
C ₃ hydrocarbons -----	7,910
C ₄ hydrocarbons -----	169,850
C ₅ hydrocarbons -----	3,930
	194,350

In fractionator 68, this liquid is fractionated in order to separate the butane absorbent from the C₂-rich product fraction. Fractionator 68 is maintained at a pressure of 435 p. s. i. g. A liquid bottoms fraction comprising butane absorbent having a density of 4.90 pounds per gallon is withdrawn from tower 68 through conduit 27 at a temperature of 270° F. at the rate of 175,428 pounds per hour. The liquid in conduit 27 passes through heat exchanger 67 where its temperature is reduced to 166° F. and then is combined with the butane absorbent in conduit 23 as previously described. A side stream is withdrawn from fractionator 68 through conduit 69 at a temperature of 265° F. heated to a temperature of 270° F. in a reboiler 71 and returned to fractionator 68 through conduit 69. Heat for reboiler 71 is supplied by steam which enters through conduit 72 and leaves through conduit 73.

An overhead fraction is withdrawn from fractionator 68 at a temperature of 127° F. through conduit 74 at the rate of 136,369 pounds per hour and passes through a reflux condenser 76 to a separating drum 77 which is operated at a pressure of 420 p. s. i. g. and a temperature of 65° F. Liquid from drum 77 is returned as reflux to fractionator 68 through conduit 78 via pump 79. A C₂-rich vapor fraction is withdrawn from drum 77 through conduit 81 and passes from the system through a valve 82 as the product of the process. The vapor withdrawn through conduit 81 has the composition shown in Table VII.

TABLE VII

Composition of product withdrawn through conduit 81

Component:	Lb./hr.
O ₂ -N ₂ -CO -----	436
CO ₂ -----	1,625
H ₂ -----	25
H ₂ S -----	1,039
C ₁ hydrocarbons -----	1,898
C ₂ hydrocarbons -----	7,637
C ₃ hydrocarbons -----	5,210
C ₄ hydrocarbons -----	1,052
	18,922

Other aspects and embodiments of our invention as

well as modifications and alterations of the preferred embodiment described above will become apparent from the above disclosure. Those skilled in the art will recognize that numerous changes and modifications, particularly as respects operating conditions and equipment, can be made without departing from the scope of our invention.

We claim:

1. The method for separating C₂ hydrocarbons from a gaseous feed mixture containing the same and methane which comprises: passing said mixture to a first absorption zone, in said first absorption zone contacting said mixture with a first absorption medium comprising a compound selected from the group consisting of C₃ and C₄ paraffins adapted to preferentially absorb C₂ hydrocarbons to form a liquid phase containing said first absorption medium and C₂ hydrocarbons and a vaporous phase containing methane and entrained absorption medium, withdrawing said vaporous phase containing entrained absorption medium from said first absorption zone and passing same to a second absorption zone, in said second absorption zone contacting said vaporous phase from said first absorption zone with a second hydrocarbon absorption medium of lower volatility than said first absorption medium and adapted to preferentially absorb said first absorption medium to form in said second absorption zone a vaporous phase and a liquid phase comprising said first and second absorption media, withdrawing said vaporous and liquid phases from said second absorption zone, from said first absorption zone withdrawing the liquid phase containing said first absorption medium and C₂ hydrocarbons and passing the same to a distillation zone to form a vaporous overhead fraction containing C₂ hydrocarbons and a liquid bottoms fraction comprising said first absorption medium, withdrawing said bottoms fraction from said distillation zone and passing the same to said first absorption zone, and withdrawing said overhead fraction from said distillation zone as a product of the process.

2. The method for separating C₂ and C₃ hydrocarbons from a gaseous feed mixture containing the same and methane which comprises: passing said mixture to a first absorption zone, in said first absorption zone contacting said mixture with a first absorption medium comprising a C₄ paraffin adapted to preferentially absorb C₂ and C₃ hydrocarbons to form a liquid phase containing said first absorption medium and substantially all of said C₂ and C₃ hydrocarbons and a vaporous phase containing methane and entrained absorption medium, withdrawing said vaporous phase containing entrained absorption medium from said first absorption zone and passing the same to a second absorption zone, in said second absorption zone contacting said vaporous phase from said first absorption zone with a second hydrocarbon absorption medium of lower volatility than said first absorption medium and adapted to preferentially absorb said first absorption medium to form in said second absorption zone a vaporous phase substantially free of said first and second absorption media and a liquid phase comprising said first and second absorption media, withdrawing said vaporous and liquid phases from said second absorption zone, from said first absorption zone withdrawing the liquid phase containing said first absorption medium and substantially all of said C₂ and C₃ hydrocarbons and passing the same to a distillation zone wherein the liquid phase from said first absorption zone is fractionated into a vaporous overhead fraction containing substantially all of said C₂ and C₃ hydrocarbons and a liquid bottoms fraction comprising said first absorption medium, withdrawing said bottoms fractions from said distillation zone and passing the same to said first absorption zone, and withdrawing said overhead fraction from said distillation zone as a product of the process.

3. The process of claim 2 in which the first absorption medium comprises butane.

4. The method for separating a fraction rich in C₂

and C₃ hydrocarbons from a gaseous mixture containing the same, methane and lower boiling components which comprises: passing said mixture to a first absorption zone, in said first absorption zone contacting said mixture with a first absorption medium comprising a C₄ paraffin adapted to preferentially absorb C₂ and C₃ hydrocarbons to form a liquid phase containing said first absorption medium and substantially all of said C₂ and C₃ hydrocarbons and a vaporous phase containing methane, entrained absorption medium and at least a portion of said lower boiling components, withdrawing said vaporous phase containing entrained absorption medium from said first absorption zone and passing the same to a second absorption zone, in said second absorption zone contacting said vaporous phase from said first absorption zone with a second hydrocarbon absorption medium of lower volatility than said first absorption medium and adapted to preferentially absorb said first absorption medium to form in said second absorption zone a vaporous phase substantially free of said first and second absorption media and a liquid phase comprising said first and second absorption media, withdrawing said vapor and liquid phases from said second absorption zone, from said first absorption zone withdrawing the liquid phase containing said first absorption medium and substantially all of said C₂ and C₃ hydrocarbons passing the same to a distillation zone wherein the liquid phase from said first absorption zone is fractionated into a vaporous overhead fraction containing substantially all of said C₂ and C₃ hydrocarbons and a liquid bottoms fraction comprising said first absorption medium, withdrawing said bottoms fraction from said distillation zone and passing the same to said first absorption zone, and withdrawing said overhead fraction from said distillation zone as a product of the process.

5. The method for separating C₂ and C₃ hydrocarbons from a gaseous mixture containing the same, methane and lower boiling components which comprises: passing said mixture to a first absorption zone; in said first absorption zone contacting said mixture with a first absorption medium comprising a C₄ paraffin adapted to preferentially absorb C₂ and C₃ hydrocarbons to form a liquid phase containing said first absorption medium and substantially all of said C₂ and C₃ hydrocarbons, at least a portion of said lower boiling components being entrained in said liquid phase, and a vaporous phase containing methane and entrained absorption medium; withdrawing said vaporous phase containing entrained

absorption medium from said first absorption zone and passing the same to a second absorption zone; in said second absorption zone contacting said vaporous phase from said first absorption zone with a second hydrocarbon absorption medium of lower volatility than said first absorption medium and adapted to preferentially absorb said first absorption medium to form in said second absorption zone a vaporous phase substantially free of said first and second absorption media and a liquid phase comprising said first and second absorption media; withdrawing said vapor and liquid phases from said second absorption zone; from said first absorption zone withdrawing the liquid phase containing said first absorption medium and substantially all of said C₂ and C₃ hydrocarbons and having at least a portion of said lower boiling components entrained therein and passing the same to a zone of reduced pressure to form therein a vaporous phase comprising said lower boiling components and a liquid phase containing said first absorption medium and substantially all of said C₂ and C₃ hydrocarbons; withdrawing from said zone of reduced pressure the vaporous phase thus formed therein; withdrawing from said zone of reduced pressure the liquid phase thus formed therein and passing the same to a distillation zone wherein the liquid phase from said zone of reduced pressure is fractionated into a vaporous overhead fraction containing substantially all of said C₂ and C₃ hydrocarbons and a liquid bottoms fraction comprising said first absorption medium; withdrawing said bottoms fraction from said distillation zone and passing the same to said first absorption zone; and withdrawing said overhead fraction from said distillation zone as a product of the process.

6. The process according to claim 5 in which the components lower boiling than methane include nitrogen, carbon monoxide, and hydrogen, and the first absorption medium comprises butane.

7. The process of claim 1 in which the first absorption medium comprises propane.

8. The process of claim 1 in which the first absorption medium comprises butane.

References Cited in the file of this patent

UNITED STATES PATENTS

2,250,925	Babcock	July 29, 1941
2,321,666	Felbeck	June 15, 1943
2,765,635	Redcay	Oct. 9, 1956
2,771,149	Miller et al.	Nov. 20, 1956