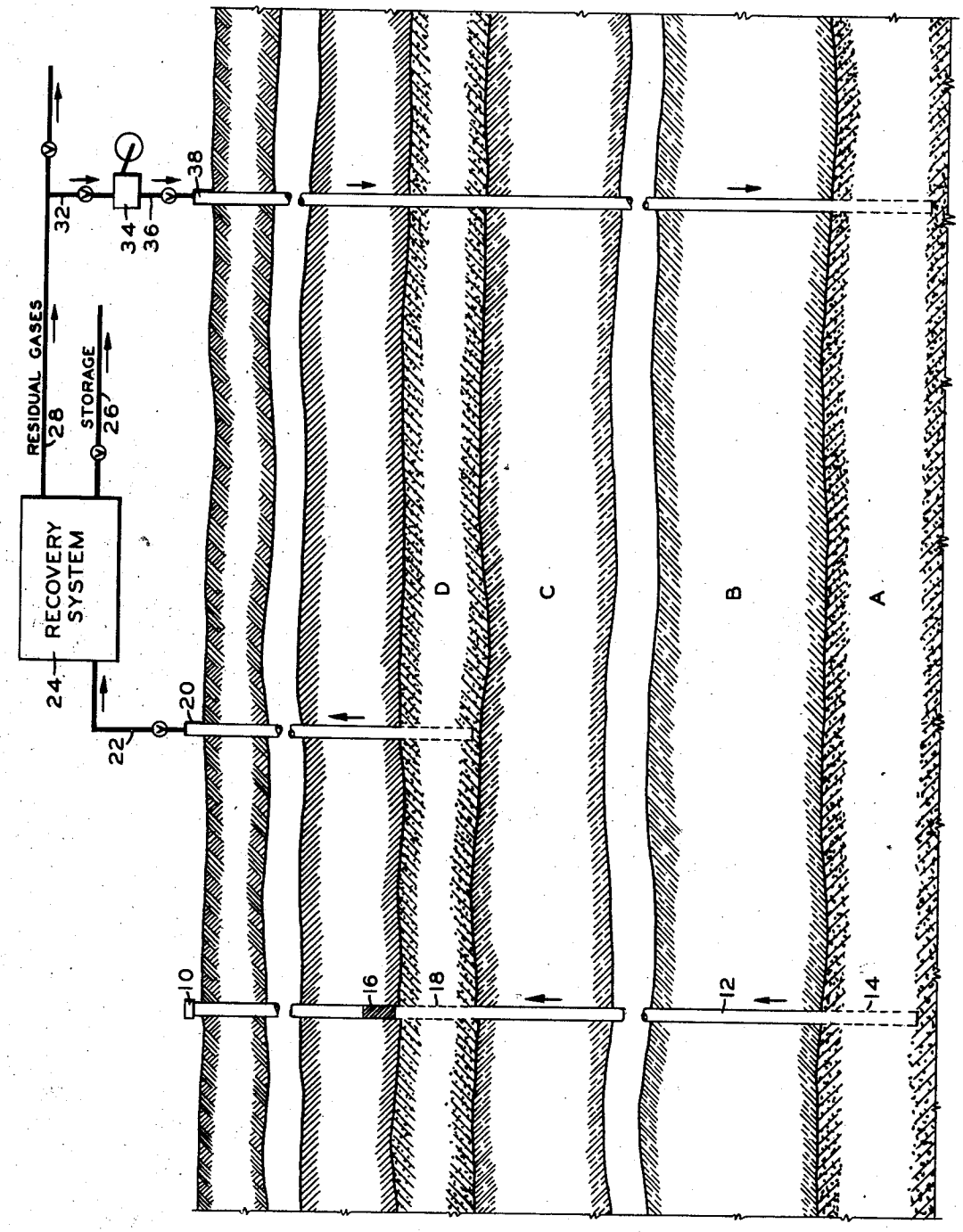
Sept. 5, 1944. C. F. TEICHMANN 2,357,703

DISTILLATE FIELD PPRODUCTION

Filed Oct. 31, 1942



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Patented Sept. 5, 1944 2,357,703

UNITED STATES PATENT OFFICE

2,357,703

DISTILLATE FIELD PRODUCTION

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Application October 31, 1942, Serial No. 464,118

6 Claims. (Cl. 166—21)

This invention relates to the production of hydrocarbons from underground formations and more particularly to a process for the production of a certain class of distillate or condensate formations.

It is now well-known that the hydrocarbons present in the producing formations of distillate or condensate fields exist therein the form of a single homogeneous phase. Distillate formations are usually found at extreme depths, often at depths ranging from 8,000 to 10,000 feet or more from the surface. The pressures and temperatures existing in distillate formations are high; for example, the pressures may range from 3,000 to 5,000 pounds per square inch and above, and the temperatures may range from about 200 to 250° F. and higher. Under these conditions it appears that the formation fluid constitutes a single homogeneous phase which is usualy substantially at the dew point. Thus, upon any reduction in temperature and/or pressure, condensation of hydrocarbons takes place. The condensation of hydrocarbons taking place upon a reduction in pressure is recognized as being due to the operation of the now familiar phenomenon of retrograde condensation.

When flowing a distillate fluid from the formation to the surface, the reduction in pressure and temperature that necessarily occurs is effective to cause the condensation of an important part of the liquefiable hydrocarbons contained in the distillate fluid. The liquid and gas phases formed in this way are generally composed predominantly of the same hydrocarbons, but the liquid phase contains a much higher proportion of the heavier hydrocarbons than was present in the original fluid, while the gas phase has a higher proportion of the lighter hydrocarbons. Accordingly, by controlling the condensation due to temperature drop and the condensation due to the retrograde phenomenon it is possible to accomplish a rough fractionation of the distillate fluid.

As the development of processes for synthesizing hydrocarbons for use in special motor fuels and other products has proceeded, certain of the hydrocarbons produced in oil fields and distillate fields have become increasingly valuable, while the other hydrocarbons have decreased in value for the time being. The less valuable hydrocarbons, therefore, have presented in many cases merely a storage problem. In the case of distillate fluids, in some localities, the pentanes, butanes, and propanes are valuable compounds for use in alkylation reactions and other processes, while the remaining hydrocarbons are distinctly less valuable. It would be desirable in these cases to produce only the valuable hydrocarbons and to leave the remaining hydrocarbons for later production. However, so far as known, no means for accomplishing this has been proposed.

As stated above, distillate formations are usually found at great depths. These formations may be located below partially or substantially depleted oil formations or oil formations containing an insufficient amount of oil to be produced efficiently. Oil formations of this type are referred to hereinafter, generically, as formations having a low content of oil.

The present invention is concerned with situations where there is a deep distillate formation and above the distillate formation a formation having a low content of oil. The principal object of the invention is to provide a process for the production of such a distillate formation by which desired lighter hydrocarbons may be recovered at the surface, and heavier hydrocarbons may be stored under conditions such that they may be produced at a later date.

With this object in view, the process of the invention comprises flowing the distillate fluid from the distillate formation to the upper formation having a low content of oil, depositing condensed heavier hydrocarbons in the oil formation, and removing lighter hydrocarbons of the distillate fluid from the oil formation. All or part of these lighter hydrocarbons may be used at the surface. Where no other means for maintaining pressures in the distillate formation are available, however, it is usually essential to separate the lightest hydrocarbons, such as the methane and ethane, and return these after compression to the distillate formation. The oil formation, therefore, is used as a combination separator and storage vessel, and the separated hydrocarbons may be produced from the oil formation by normal methods at any time this becomes desirable.

In order to carry out the present process there should be provided one or more producing wells bottomed in the distillate sands and having means such as perforated casing for conducting the distillate fluid from the interior of the distillate well bore into the upper oil sand. Also, there should be provided one or more wells equipped so as to produce only from the upper oil sands. Injection wells should also be provided so as to introduce a repressuring medium, usually residual gases, into the distillate formation. With this arrangement of wells the distillate fluid is permitted to flow up the distillate well to the oil sand, through the oil sand to the well producing from this sand, and thence up this well to the surface. At the surface the desired hydrocarbons may be recovered and those not utilized

may be compressed and returned through the injection well to the distillate formation.

It will be understood that the temperature and pressure of the fluid will be reduced in flowing from the distillate formation to the upper oil sand and that condensation of hydrocarbons will occur. Additional reduction in temperature and pressure, resulting in further condensation, will be accomplished in the passage from the distillate well through the oil sand. These condensed hydrocarbons will separate out in the oil sand and may be recovered later by the usual production methods.

In order to accomplish the objects of the present invention efficiently a number of factors should be taken into consideration. These factors are the pressure and temperature conditions in the distillate formation, the composition of the distillate fluid, the distance between the distillate formation and the upper oil sand, the temperature of the upper oil sand, the permeability of this sand, the distance between the distillate wells and the wells leading from the oil sand, and the rate of flow of the distillate fluid. These factors should be adjusted and controlled so as to obtain at the bottom of the well leading from the upper oil sand, temperature and pressure conditions at which the desired separation between liquid and gas phases may be accomplished. For example, in the case where the distance between the distillate formation and the upper oil sand is not as great as could be desired, this may be compensated for by locating the wells leading from the upper oil sand at a greater distance from the distillate wells. Thus, the drop in pressure in the oil sands will be increased so as to reach the desired pressure at the bottom of the wells leading from the oil sands. The temperature and pressure which should be obtained at the bottom of the wells leading from the oil sands cannot be stated for a particular case because of the varying characteristics of distillate fluids, and the fact that it may be desirable to accomplish different types of separation in different fields. It may be stated, however, that in general, where the process is to be operated so as to make a rough separation between the hexanes and heavier hydrocarbons and the pentanes and lighter hydrocarbons the pressure should lie within the range from about 1,500 to 3,000 pounds per square inch and the temperature within the range from about 100 to 200° F., the particular conditions within these ranges which are optimum in a given case being dependent upon the composition of the fluid.

In order that the invention may be understood more fully, reference should be had to the accompanying drawing in which the single figure represents in diagrammatic form a distillate field equipped to carry out the present process. A distillate formation is represented generally at A, and lying a substantial distance above this formation, separated by a number of other strata such as B and C, is an oil formation D having a low oil content. A well **10**, which is representative of a number of such wells, is shown bottomed in distillate formation A. This well is provided with a casing **12**. When carrying out the present process the distillate fluid flows through perforations **14** in casing **12** into well **10** and passes up the well to the oil formation D. Just above the oil formation there is preferably provided in the well **10** a means, such as packer **16**, adapted to prevent the flow of fluid up the well. Opposite the oil formation the casing **12** is perforated as shown at **18**. The fluid, therefore, flows through these perforations and into the oil formation.

Bottomed in the oil formation is another well **20**, which also is representative of a number of such wells. The distillate fluid, therefore, passes through the oil sand into well **20** and through this well to the surface. The hydrocarbons condensed due to the reduction in temperature and pressure between the distillate formation and the bottom of well **20** are separated from the remainder of the fluid and collect in the oil sands. The remainder of the distillate fluid which flows from the well **20** is passed into valved line **22** leading to a recovery system indicated generally at **24**. Since the particular method of recovering hydrocarbons does not form a part of the present invention no attempt will be made to describe this system in detail. In general, the system will preferably include an absorber in which the fluid is contacted with a suitable absorption oil, which removes therefrom the hydrocarbons to be recovered, preferably the pentanes, butanes and propanes. These hydrocarbons may be removed to storage through valved line **26**. The recovery system, of course, may also include steps whereby closer cut fractions are obtained.

When carried out in the usual manner the process will comprise removing residual gases, which are predominantly composed of methane and ethane and may comprise some propane, from the recovery system. As shown, these gases are removed from the system through a line **28** and pass into a valved line **32** leading to a compressor **34**. In this compressor the gases are raised to a sufficiently high pressure to permit their return to the distillate formation. At this pressure they are passed through a valved line **36** and through an injection well **38** to the distillate reservoir.

In order to disclose the invention more fully the following specific manner of carrying out the process of the invention will be described. In this case the process is used for the production of a distillate formation which is at a depth of about 10,000 feet and in which the pressure is about 4,800 pounds per square inch and the temperature about 235° F. The composition of the distillate fluid is such that these conditions of temperature and pressure are substantially those at the dew point for the fluid. When flowed at a normal rate from the distillate formation to the upper oil formation, which in this case is at a depth of about 3,000 feet, the pressure and temperature conditions of the fluid on entering the oil sands may be about 3,700 pounds per square inch and about 190° to 200° F. Under these conditions the distillate fluid is a two-phase product. The fluid enters oil formation D and passes to well **20**. Due primarily to the effect of friction, the pressure on the fluid is further reduced and in this case, on the assumption a rough fractionation to separate hexanes and heavier from the pentanes and lighter is desired, the distillate fluid is flowed at such a rate and the well **20** is placed at such a distance from the producing well **10** as to cause the fluid to enter the well **20** at a pressure of about 2,200 to 3,000 pounds per square inch. Since the oil formation may be at a temperature of about 135° F. additional cooling of the fluid will be produced by the passage through the oil formation.

Thus, the fluid passing up well **20** will consist largely of hydrocarbons containing five or less carbon atoms. This fluid is then flowed through

valved line 22 to the recovery system and treated as described above. The deposited hydrocarbons will flow by gravity slowly downwardly in oil formation D. These hydrocarbons may be recovered later by producing primarily from the lower portion of this formation.

Obviously many modifications and variations of the invention, as hereinbefore set forth, may be made without departing from the spirit and scope thereof, and therefore only such limitations should be imposed as are indicated in the appended claims.

I claim:

1. The process of producing a distillate formation located below a formation which has a low content of oil and which is at pressure and temperature conditions below the dew point of the distillate fluid, which comprises flowing said distillate fluid upwardly through a well tapping the distillate formation to a point opposite the oil formation, the conditions of temperature and pressure on the fluid at said point being lower than the conditions of temperature and pressure in said distillate formation, passing the distillate fluid through said oil formation to a well tapping the oil formation, separating out in said oil formation condensed hydrocarbons formed from said distillate fluid, and flowing the remainder of said distillate fluid to the surface through said well tapping said oil formation.

2. The process of producing a distillate formation located below a formation which has a low content of oil and which is at pressure and temperature conditions below the dew point of the distillate fluid, which comprises flowing said distillate fluid upwardly through a well tapping the distillate formation to a point opposite the oil formation, the conditions of temperature and pressure on the fluid at said point being lower than the conditions of temperature and pressure in said distillate formation, passing the distillate fluid through said oil formation to a well tapping the oil formation, separating out in said oil formation condensed hydrocarbons formed from said distillate fluid, recovering desired hydrocarbons from said remainder of said distillate fluid leaving residual gases, compressing residual gases, and returning said compressed residual gases to said distillate formation to maintain formation pressures.

3. The process of producing a distillate formation located a substantial distance below a formation which has a low content of oil and which is at temperature and pressure conditions below the dew point of the distillate fluid, which comprises flowing the distillate fluid from said distillate formation into a well tapping said formation and communicating with said oil formation, passing the distillate fluid up said well and into said oil formation, separating out in said oil formation condensed hydrocarbons formed in said distillate fluid due to the difference in the conditions of temperature and pressure on the distillate fluid in said distillate formation and in said oil formation, flowing the remainder of said distillate fluid into a well tapping said oil formation, passing said remainder of said distillate fluid through said well tapping said oil formation to the surface, and recovering desired hydrocarbons from said remainder of said distillate fluid, the location of said well tapping said oil formation being so selected in relation to the location of said well tapping said distillate formation as to produce temperature and pressure conditions on the distillate fluid in said oil formation adapted to accomplish a selected condensation of hydrocarbons from said distillate fluid.

4. A process in accordance with claim 3 in which residual gases comprising methane and ethane are separated from said remainder of said distillate fluid and said residual gases are compressed and returned to said distillate formation to maintain formation pressures.

5. The process of producing a distillate formation located a substantial distance below a formation which has a low content of oil and which is at temperature and pressure conditions below the dew point of the distillate fluid, which comprises flowing the distillate fluid from said distillate formation into a well tapping said formation and communicating with said oil formation, passing said distillate fluid up said well and into said oil formation, separating out in said oil formation condensed hydrocarbons consisting predominantly of hexanes and heavier hydrocarbons formed in said distillate fluid due to the difference in the conditions of temperature and pressure on said distillate fluid in said distillate formation and in said oil formation, flowing the remainder of the distillate fluid consisting predominantly of pentanes and lighter hydrocarbons into a well tapping said oil formation, passing said remainder of said distillate fluid through said well tapping said oil formation to the surface, and recovering desired hydrocarbons from said remainder of said distillate fluid, the location of said well tapping said oil formation being so selected in relation to the location of said well tapping said distillate formation as to produce temperature and pressure conditions on the distillate fluid in said oil formation adapted to accomplish selective condensation of hexanes and heavier hydrocarbons from said distillate fluid.

6. The process of producing a distillate formation located a substantial distance below a formation which has a low content of oil and which is at temperature and pressure conditions below the dew point of the distillate fluid, which comprises flowing the distillate fluid from said distillate formation into a well tapping said formation and communicating with said oil formation, passing said distillate fluid up said well and into said oil formation, separating out in said oil formation condensed hydrocarbons consisting predominantly of hexanes and heavier hydrocarbons formed in said distillate fluid due to the difference in the conditions of temperature and pressure on the fluid in said distillate formation and in said oil formation, flowing the remainder of the distillate fluid consisting predominantly of pentanes and lighter hydrocarbons into a well tapping said oil formation, passing said remainder of said distillate fluid through said well tapping said oil formation to the surface, and recovering desired hydrocarbons from said remainder of said distillate fluid, the location of said well tapping said oil formation being so selected in relation to the location of said well tapping said distillate formation as to produce a temperature of about 100° to 200° F. and a pressure of about 1,500 to 3,000 pounds per square inch on the distillate fluid in said oil formation adapted to accomplish selective condensation of hexanes and heavier hydrocarbons from said distillate fluid.

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