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(54) Title: PROCESS FOR THE REMOVAL IN THE WELL OF THE ACID COMPONENTS FROM HYDROCARBONS AND RELATED WELL

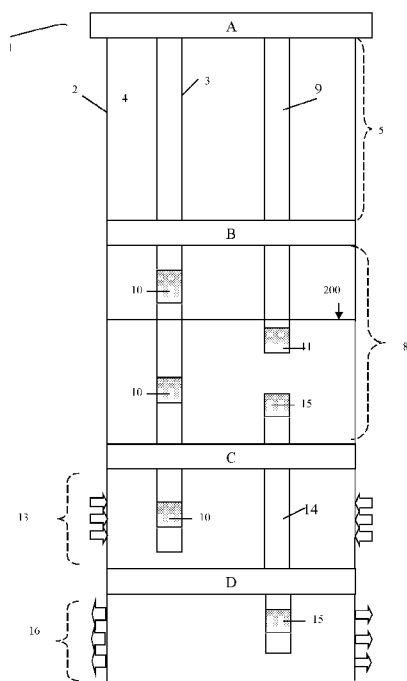


Fig. 1

(57) Abstract: The present invention relates to a process for the removal in the well of the acid components present in the hydrocarbons extracted from a production area of an oil reservoir. The process envisages a step in which at least one confined portion of an extraction well is flooded with an aqueous phase creating a finite control volume and a liquid head, in such a way that said control volume is only partially filled. The hydrocarbons containing acid components flow in countercurrent with respect to the aqueous phase while they are fed into the control volume, and into the area immersed in the aqueous phase. At least one acid component is removed from said hydrocarbons by direct contact between the aqueous phase and the hydrocarbons, at a pressure which varies from 50 to 300 bar, forming an aqueous stream containing said acid components and a hydrocarbon stream.



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PROCESS FOR THE REMOVAL IN THE WELL OF THE ACID COMPONENTS FROM HYDROCARBONS AND RELATED WELL

Description

The present invention relates to a process for the removal in the well of the acid components present in the hydrocarbons extracted from a production area of an oil reservoir; the present invention further relates to an extraction well comprising the means for making such separation take place.

In the present patent application, all the operating conditions included in the text must be considered as preferred conditions even if this is not specifically stated.

For the purpose of this text the term “comprise” or “include” also comprises the term “consisting in” or “essentially consisting of”.

For the purpose of this text the definitions of the intervals always comprise the extremes unless specified otherwise.

It is known that some extraction wells produce hydrocarbons whose gaseous component may contain contaminants, including acid gases. Said contaminants may comprise gaseous compounds such as carbon dioxide, nitrogen, hydrogen sulfide, helium, or liquid compounds such as water and heavy hydrocarbons. Acid gases mean hydrogen sulfide and carbon dioxide.

Various technological solutions have been proposed for separating said contaminants from the hydrocarbons produced; some solutions propose surface systems and others propose downhole systems.

Surface applications have a significant environmental and economic impact due to the occupation of the ground for the construction of the treatment plants, due to the production of residuals (in the case of hydrogen sulfide H₂S) which must be

appropriately stored, and due to the energy costs associated with the regeneration processes of any solvents used.

Some examples of these surface technologies are included in documents US 2004/0057886 and WO 2006/026417. Typically, surface separation technologies envisage the removal of the contaminants in absorption reactors, exploiting aqueous based mixtures with appropriate chemical compounds added, such as amines or other solvents, or the use of selective membranes for the individual chemical species.

The technologies used for the removal of contaminants in the well envisage the use of selective membrane systems for individual chemical components, which are also placed at a certain depth in the extraction well. Some examples of these downhole technologies are included in documents US 2003/0047309, US 2009/0151559, US 6,454,836, US 6,755,251.

Surface removal technologies that exploit absorption in water generally require high water flow rates to obtain acceptable contaminant removal levels. The addition of appropriate chemical compounds, for example amine-based, reduces the necessary water flow rate for absorption, but requires the presence of regeneration systems for the chemical components used and further appropriate separate treatment of the contaminant. Said subsequent treatments may include the re-injection in the reservoir of carbon dioxide (CO₂), the definitive storage or introduction onto the market of the derivatives.

Membrane separation technologies exploit the different permeability that the membranes may have to different gases. This leads to a significant loss of pressure and particularly significant energy costs.

Patent US 6,454,836 discloses a method and apparatus for separating contaminants from gaseous hydrocarbons in the well with a system that includes a first and a second

material selectively permeable to different compounds, preferably appropriately shaped membranes, stacked so that each one permeates a certain compound.

Patent US 6,755,251 discloses a method and apparatus for separating contaminants in the well from multi-component currents coming from a production area of a reservoir, with a modular system (at least one) in which each module is a membrane that has a feed side and a permeated side built into the production piping. The modules may be arranged in series or in parallel when there are various production pipes.

Patent US 2009/0151559 discloses a method and apparatus for the downhole separation of carbon dioxide from natural gas and simultaneous storage of the purified carbon dioxide produced in the reservoir. The separation takes place by means of a PSA technique and in particular Dual Reflex PSA using adjacent packed beds arranged in the production pipe. The carbon dioxide produced is sequestered with a separate pipe directly downhole in the sequestration layer.

Other separating techniques documented in literature, but less common, are adsorption on a solid matrix and cryogenic separation, the latter mainly being performed downhole with a significant energy cost. According to cryogenic separation, the cooling of the flow of gas to be treated is generally performed with expansions in nozzles which, when the pressure drops, cause a reduction to the temperature of the gas.

The applicant has now found a process for removing acid components from hydrocarbons in the well, coming from a production area of an oil reservoir, through separation by direct contact between water and hydrocarbon.

Therefore, the present invention relates to a process for the removal in the well of the acid components present in the hydrocarbons extracted from a production area of an oil reservoir, comprising:

- flooding with an aqueous phase, preferably water or sea water, at least one

confined portion of an extraction well by creating a finite control volume and a liquid head so that said control volume is only partially filled,

- feeding into said control volume, and into the area immersed in the aqueous phase, said hydrocarbons containing acid components, said hydrocarbons flowing in countercurrent with respect to the aqueous phase,
- removing at least one acid component from said hydrocarbons by direct contact between the aqueous phase and the hydrocarbons, at a pressure which varies from 50 to 300 bar, with a temperature preferably between 20 and 50 °C, forming an aqueous stream containing said acid components and a hydrocarbon stream.

The present invention further relates to an extraction well in a production area of an oil reservoir, said well comprising:

- at least one wellhead;
- at least one casing pipe of the well bore which delimits the well;
- at least one production pipe (tubing), internal to the casing pipe and connected to the wellhead; said production pipe forming an annular area with said casing pipe;

said extraction well being characterized in that it includes at least the following three sections:

- a. a first section connected to a wellhead that comprises means of pumping the aqueous phase coupled to at least a temperature control device of said aqueous phase; said first section being crossed by at least one transport pipe of the aqueous phase and at least one hydrocarbon production pipe;
- b. a second section in fluid communication with the first section and separated from the latter by at least a double packer; said second section:
 - being crossed by at least one of the production pipes along its entire length, said pipes being perforated so as to allow the entrance and the exit of the

hydrocarbons,

- being crossed by at least two distinct aqueous phase transport pipes, of which the first transport pipe is the extension of the transport pipe of the aqueous phase that crosses the first section, while the second distinct pipe is positioned in the lower part of the second section and is in fluid communication with a third section of said extraction well; said water transport pipes being perforated so as to allow the entrance and the exit of the aqueous phase which forms a control volume,
- c. a third section in fluid communication with the second section and with the hydrocarbon production area; said third section:
- being crossed for part of its length by at least one of the production pipes, said pipes being perforated so as to allow the entrance and exit of the hydrocarbons,
 - being crossed by at least one of the aqueous phase transport pipes along its entire length; said transport pipe of the aqueous phase not being perforated.

A packer in the oil industry is a device that can be inserted into a well, having a smaller initial external diameter which expands externally for sealing the well. Packers traditionally use flexible and elastomeric elements that expand. Types of packers are production packers, test packers and inflatable packers; they may be removable or permanent.

An advantage that derives from the present invention is that of allowing the localization in an extraction well of the parts of the system for removing the acid components present in the hydrocarbons extracted.

The direct consequence of this is a reduction in the space used on the surface as there

are fewer treatment plants.

The removal of acid components in the well has greater efficiency with respect to surface methods because operations are performed at high pressures inside the well. If surface separation were used, as well as having lower efficiency, it would mean a lower absorption capacity since operations would not be performed at the well pressures, and dimensional restrictions would be added, which would have to be complied with.

An advantage of the present invention is being able to use water or sea water in compatible quantities with the possibilities of direct re-injection into the extraction well. In fact, during the extraction of hydrocarbons there may be a need to pressurize the well to promote production (according to the EOR technique). The dislocation of the gas takes place by injecting water, or sea water, according to availability. The water used for the process according to the present invention is therefore the same as that used for re-injection.

Another advantage is being able to operate with a lower pressure differential, and therefore lower energy costs, with respect to what would happen if all the pumping devices worked at the wellhead. The feeding water is sent into the exchange area of material in the extraction well with the use of an immersion pump dislocated in the well itself, which exploits the lower pressure differential.

Another advantage of the present invention is that it does not require the use of a solvent regeneration system which, on the contrary, is typically used in treatments for the removal of surface acid gases, and which occupies significant volumes.

Another advantage of the present invention is that said invention may be made of modules arranged in series and/or in parallel, which may be appropriately connected according to the concentration of the acid components and the flow rate of the

hydrocarbons, leading to a reduction in the well completion costs.

Further objects and advantages of the present invention will appear more clearly from the following description and appended figures, provided by way of non-limiting example.

Figure 1 shows a vertical view of an extraction well according to the present invention.

Detailed description.

The invention according to the present patent application is based on the absorption of the acid components of a hydrocarbon by means of direct contact between an aqueous phase and the hydrocarbon in the operating conditions of an extraction well.

For the purpose of the present application the term acid components means carbon dioxide, nitrogen and hydrogen sulfide.

The absorption takes place directly inside the extraction well in the operating conditions of the well, i.e. at a pressure that varies from 50 to 300 bar and with a temperature preferably comprised between 20 and 50 °C.

In the well, at least one finite control volume is formed, flooding a volumetric portion of said well with an aqueous phase, preferably water or sea water. The flooded area does not coincide with the entire volumetric portion of the well, but fills it partially, forming a liquid head. The liquid head, within the control volume, may preferably vary between 50 meters and 300 meters as a function of the increasing concentration of acid gases and the type of acid gas.

Preferably, the control volume coincides with the annular area that is formed between the production pipe and the casing pipe that delimits an extraction well.

The hydrocarbons containing the acid components flow into said control volume in countercurrent with respect to the aqueous phase, hence creating direct contact between the aqueous phase and the hydrocarbon so that the aqueous phase absorbs

the acid components from the hydrocarbon. The removal is "bulk" type, where the objective is to pass from concentrations in the production step that are different according to the acid component. Preferably, the objective is to reduce the acid components in the hydrocarbon treated by at least 80% with respect to the initial concentration. For example, in the case of hydrocarbons containing up to 50% CO₂ the reduction will reach up to a maximum of 5% CO₂ in the hydrocarbon treated. In another example, in the case of hydrocarbons containing up to 30% H₂S the reduction will reach up to 95% with respect to the initial value.

Therefore, the present invention relates to a process for the removal in the well of the acid components present in the hydrocarbons extracted from a production area of an oil reservoir, comprising:

- flooding with an aqueous phase, preferably water or sea water, at least one confined portion of an extraction well by creating a finite control volume and a liquid head so that said control volume is only partially filled,
- feeding into said control volume, and into the area immersed in the aqueous phase, said hydrocarbons containing acid components, said hydrocarbons flowing in countercurrent with respect to the aqueous phase,
- removing at least one acid component from said hydrocarbons by direct contact between the aqueous phase and the hydrocarbons, at a pressure which varies from 50 to 300 bar, with a temperature preferably between 20 and 50 °C, forming an aqueous stream containing said acid components and a hydrocarbon stream.

To perform the removal of the acid components in the well, the applicant has designed an extraction well that has the following characteristics. Naturally, said well is positioned in a production area of an oil reservoir and comprises:

- at least one wellhead;

- at least one casing pipe of the well bore which delimits the well;
- at least one pipe (tubing) internal to the casing pipe and connected to the wellhead.

The production pipe forms an annular area with the casing pipe.

The extraction well described and claimed in the present patent application includes at least three sections. In each section of the well there may be safety valves and circulation valves.

A first section is connected to the wellhead and comprises pumping means of an aqueous phase coupled to at least one heat regulation device of said aqueous phase. Heat regulation is important because, by controlling the temperature of the water, it is possible to promote the separation capacity of the system which is more effective the lower the temperature. It is appropriate for the temperature not to drop below 20°C to prevent the formation of hydrates.

Said first section is crossed along its entire length by at least one pipe for transporting the aqueous phase free from acid components, and by at least one production pipe for the passage of the hydrocarbons with reduced acid component content.

A second section is in fluid communication with the first section and separated from the latter by at least a double packer.

Said second section is crossed by at least one of the production pipes along its entire length. The production pipes are perforated so as to allow the entry and exit of the hydrocarbons. In this section the control volume is generated through flooding with an aqueous phase, generating a liquid head; therefore, the perforations of the production pipes will be partly immersed in the liquid phase and partly above the liquid head.

During the operation of the present invention the hydrocarbons containing acid components, through the perforations, flow into the production pipe from a production

area of a reservoir. The hydrocarbons flow into the production pipe which travels along the different sections of the well and move towards the wellhead due to the effect of the float thrusts.

When they reach the level of the control volume, the hydrocarbons containing the acid components are spread towards appropriate perforations in the flooded area, in countercurrent with respect to the flow of the aqueous phase fed.

During direct contact with the aqueous phase, the hydrocarbons cool down and yield at least one acid component to the aqueous phase. The high turbulence that is created in the extraction well promotes the transfer of mass of the acid components which, once absorbed into the aqueous phase, given its higher density with respect to the hydrocarbons, are transported downhole.

The second section is, in fact, crossed by at least two distinct transport pipes for the passage of the aqueous phase: the first transport pipe is the extension of the transport pipe of the aqueous phase that crosses the first section, while the second distinct pipe allows the aqueous phase that has absorbed the acid components to flow towards the subsequent sections of the well. In fact, said second pipe is positioned in the lower part of the second section and is in fluid communication with a subsequent section, preferably a third or fourth section of said extraction well. The transport pipes of the aqueous phase, which cross the second section, are perforated so as to allow the entry and exit of the aqueous phase.

A third section is in fluid communication with the second section and with the hydrocarbon production area.

Said third section is crossed along part of its length by at least one of the production pipes, said pipes being perforated so as to allow the entrance and exit of the hydrocarbons containing acid components. Furthermore, said third section is crossed

by at least one of the aqueous phase transport pipes along its entire length, said pipes not being perforated.

Optionally, the well comprises a further section that is intended for the re-injection of the aqueous phase which contains the acid components in a different reservoir area from the production area. In this text said re-injection area will be called "injector level of the aqueous phase contaminated by acid components" or simply "injector level".

Said further section may be found either upstream or downstream of the third section of the extraction well.

When the further section is downstream of the third section, the latter is connected to the second section through a double packer, and a single packer connects the third section with said further section. When said further section is upstream of the third section, the latter is connected to the further section through a single packer; while the second section and the latter are connected through a double packer.

The production pipes are preferably perforated in different points and at different heights.

In the third section there may be a gas-liquid separation apparatus which separates the gaseous phase from the control volume and which is in fluid communication with at least one production pipe on the gas side. The liquid phase is subsequently re-injected into the reservoir with a further pipe.

The transport pipe of the aqueous phase in the point in which the flooding is formed may be covered with insulating material in order to reduce any heating of the water due to the passage of the extracted hydrocarbons.

Preferably, the aqueous phase fed is cooled at the wellhead before being injected into the well. The temperature of the aqueous phase for feeding is heat regulated with an appropriate heat regulation device placed at the wellhead. The heat regulation must

allow the cooling of the aqueous phase, as already explained, so that in the flooded portion its temperature is always greater than or equal to the condensation temperature of the hydrocarbons, and preferably no less than 15°C. The lower the temperature of the aqueous phase sent downhole, the more effective the exchange of material is between aqueous phase and the hydrocarbons, at the same flow rate.

According to the invention, there may be one aqueous phase transport pipe of the, or there may be numerous pipes, placed so that one allows the aqueous phase to flow and exit towards the control volume, and the other to allow the aqueous phase that has absorbed the acid components to flow towards the subsequent section of the well.

Preferably, in the third section of the extraction well, a pumping device can be found which sends the aqueous phase containing the acid components into an injector level.

In this way, the re-injection of the aqueous phase is performed at geological level, promoting Enhanced Oil Recovery (EOR) techniques. Any traditional or commercial pump is suitable for the purposes of the present invention.

According to the present invention, the second section may preferably comprise a redistribution means, preferably holes in the pipes, porous means or flow distributors, both of the aqueous phase and of the hydrocarbons. Said means can promote both the mixing and distribution of the two phases improving direct contact and therefore the separation of the contaminants.

In the extraction well according to the present invention, there may preferably be at least two introduction points of the aqueous phase placed at different heights along the extraction well.

Preferably, the flooded annular area may have a variable length between 100 m and 300 m. Preferably the flooded annular area may have a diameter of at least 0.1778 m, preferably of at least 0.2032 m.

The extraction well according to the present invention may be made of modules arranged in series and/or in parallel that can be appropriately connected as a function of the concentration of the contaminants and the flow rate of the hydrocarbons.

Each module corresponds to the second section of the well as described and claimed in the present text both in terms of structure and operation. In fact, the invention described and claimed in the present text may comprise more than one second section, at least two, these being arranged in series along the extraction well; or in parallel if there are various production pipes that create various annular areas in the extraction well. There may also be combinations in series and parallel simultaneously. In a further preferred embodiment, the process described and claimed is performed inside the extraction well which is also described and claimed in the present patent application.

We now refer to Figure 1 to describe a particular embodiment of the present invention. Figure 1 illustrates a diagram of the apparatus for the removal in the well of acid components contained in hydrocarbons extracted from the well.

The extraction well (1) is divided into 4 sections: a first section (5), a second section (8), a third section (13) and a fourth section (16). In the extraction well, there is a casing pipe of the well hole (2), an internal production pipe (3) which forms an annular area (4) with said casing pipe and a wellhead (A).

The production pipes are perforated in various areas of their surface (10) so as to allow the passage of the hydrocarbons. In Figure 1 it can be observed that the production pipe is not perforated in the first section (5), and it does not extend as far as to cross the fourth section.

The first section also comprises a first water transport pipe (9) free from perforations and that crosses it along its entire length.

The second section (8) is in fluid communication with the first section (5) and with the third section (13). The second section is connected with the first section and with the third section through a double packer (B, C).

The second section is flooded by an aqueous phase forming a control volume and a liquid head (200).

Said second section is crossed by a production pipe (3) and by a first and a second transport pipe of the aqueous phase (9, 14). Also in the second section, the production pipes are perforated (10) in different points, so as to allow the entry of the hydrocarbons containing acids where the perforations are below the liquid head, and so as to allow the exit of the hydrocarbons with a reduced content of acid components where the perforations are above the liquid head.

Likewise, the transport pipes of the aqueous phase are perforated (11, 15) so as to allow the entry and exit of the water.

The first transport pipe of the aqueous phase (9) is interrupted in the well portion in which the control volume is formed. Said transport pipe of the aqueous portion (9) is used to flood said well portion. The second transport pipe of the aqueous phase (14), positioned downstream of the first pipe (15), will be used to pump the aqueous phase containing the removed acid components in the opposite direction to the flow of hydrocarbons. Said second transport pipe of the aqueous phase must necessarily be located downstream of the perforations (10) of the production pipe (3). A system of pumps positioned downstream of said perforations pushes the aqueous phase containing the acid components into a third section (13).

The third section is in fluid communication with the second section (8) and with the fourth section (16), which is positioned downstream. The third and fourth section of the well are separated by a single packer (D).

Said third section (13) is in proximity to the hydrocarbon production area and is crossed by a production pipe (3). The first and the third section of the well are not flooded.

In the third section (13) the production pipe (3) is interrupted. Said production pipe has perforations that allow the hydrocarbons coming from the production area of the reservoir to flow into it towards the top of the well.

When the fourth section of the well (16) is downstream of the third section (13) of the well, the latter is also crossed by a transport pipe of the aqueous phase (14) which extends as far as the fourth section without having any perforations in the area in which it crosses the third section. In the fourth section the transport pipe of the aqueous phase is interrupted and has perforations (15) through which the aqueous phase that has absorbed the acid components releases said components in order to be re-injected into the injector level.

When the fourth section of the well (16) is upstream of the third section (13) of the well, said fourth section is crossed by a production pipe which extends as far as the third section without having any perforations in the area in which it crosses the fourth section. In the third section the production pipe is interrupted and has perforations that allow the hydrocarbons to flow through to reach the control volume.

In the fourth section the transport pipe of the aqueous phase (14) is interrupted and has perforations through which the aqueous phase that has absorbed the acid components releases said components in order to be re-injected into the injector level.

Claims

1. Process for the removal in the well of the acid components present in the hydrocarbons extracted from a production area of an oil reservoir, comprising:
 - flooding with an aqueous phase, preferably water or sea water, at least one confined portion of an extraction well by creating a finite control volume and a liquid head so that said control volume is only partially filled,
 - feeding into said control volume, and into the area immersed in the aqueous phase, said hydrocarbons containing acid components, said hydrocarbons flowing in countercurrent with respect to the aqueous phase,
 - removing at least one acid component from said hydrocarbons by direct contact between the aqueous phase and the hydrocarbons, at a pressure which varies from 50 to 300 bar, forming an aqueous stream containing said acid components and a hydrocarbon stream.
2. Process according to claim 1 in which the removal takes place by direct contact at a temperature between 20 and 50 °C.
3. Process according to claim 1 or 2 in which the aqueous phase is cooled in the flooded portion of the well to a temperature greater than or equal to the condensation temperature of the hydrocarbons.
4. Process according to claim 3 wherein the temperature of the aqueous phase in the flooded portion of the well is not less than 15 °C.
5. Process according to any one of claims 1 to 4 in which the aqueous phase after absorbing the acid components is re-injected at a geological level into an extraction well in an injector level.
6. An extraction well in a production area of an oil reservoir, said well comprising:
 - at least one wellhead;

- at least one casing pipe of the well bore which delimits the well;
- at least one production pipe, internal to the casing pipe and connected to the wellhead; said production pipe forming an annular area with said casing pipe;

said extraction well, being characterized in that it includes at least the following three sections:

- a. a first section connected to a wellhead that comprises means of pumping the aqueous phase coupled to at least a temperature control device of said aqueous phase; said first section being crossed by at least one transport pipe of the aqueous phase and at least one hydrocarbon production pipe;
- b. a second section in fluid communication with the first section and separated from the latter by at least a double packer; said second section:
 - being crossed by at least one of the production pipes along its entire length, said pipes being perforated so as to allow the entrance and the exit of the hydrocarbons,
 - being crossed by at least two distinct aqueous phase transport pipes, of which the first transport pipe is the extension of the transport pipe of the aqueous phase that crosses the first section, while the second distinct pipe is positioned in the lower part of the second section and is in fluid communication with a third section of said extraction well; said water transport pipes being perforated so as to allow the entrance and the exit of the aqueous phase which forms a control volume,
- c. a third section in fluid communication with the second section and with the hydrocarbon production area; said third section:

- being crossed along part of its length by at least one of the production pipes, said pipes being perforated so as to allow the entrance and exit of the hydrocarbons,
 - being crossed by at least one of the aqueous phase transport pipes along its entire length; said transport pipe of the aqueous phase not being perforated.
7. Well according to claim 6 in which the control volume coincides with the annular area formed between a production pipe and a casing pipe of an extraction well.
 8. Extraction well according to claim 6 or 7 which further includes a further section that is positioned upstream or downstream of the third section for re-injection in an injector level of the aqueous phase which has absorbed the acid components.
 9. Extraction well according to claim 8 wherein the third section is connected to the second section by means of a double packer, and is connected to the further section by a single packer.
 10. Extraction well according to claim 9 wherein in said further section the transport pipe of the aqueous phase is interrupted and has perforations, while the production pipe of the hydrocarbons is not present.
 11. Extraction well according to claim 8 wherein the further section is connected to the second section by means of a double packer, and is connected to the third section by means of a single packer.
 12. Extraction well according to claim 11 wherein in said further section the transport pipe of the aqueous phase is interrupted and has perforations while the production pipe extends along the entire length of said section and has no perforations.
 13. Extraction well according to any one of claims from 5 to 12 in which the transport

pipe of the aqueous phase is covered with insulating material.

14. Extraction well according to any one of claims from 5 to 13, wherein in the third section there is a gas-liquid separation device connected to the gas side production pipe.
15. Extraction well according to any one of claims from 5 to 14 wherein the second section comprises redistribution means.
16. Extraction well according to any one of claims from 5 to 15 which further comprises at least two input points of the aqueous phase at different heights.
17. Extraction well according to any one of claims from 5 to 16 wherein said second section is structured in modules arranged in series.
18. Extraction well according to any one of claims from 5 to 17 in which there are at least two production pipes and said second section is structured in at least two modules arranged in parallel, one for each production pipe.
19. Process for the removal in the well of the acid components present in the hydrocarbons extracted from a production area of an oil reservoir, comprising:
 - flooding with an aqueous phase, preferably water or sea water, at least one confined portion of an extraction well according to any one of claims from 6 to 18, creating a finite control volume and a liquid head in such a way that said control volume is only partially filled,
 - feeding into said control volume, and into the area immersed in the aqueous phase, said hydrocarbons containing acid components, said hydrocarbons flowing in countercurrent with respect to the aqueous phase,
 - removing at least one acid component from said hydrocarbons by direct contact between the aqueous phase and the hydrocarbons, at a pressure which varies from 50 to 300 bar, forming an aqueous stream containing

said acid components and a hydrocarbon stream.

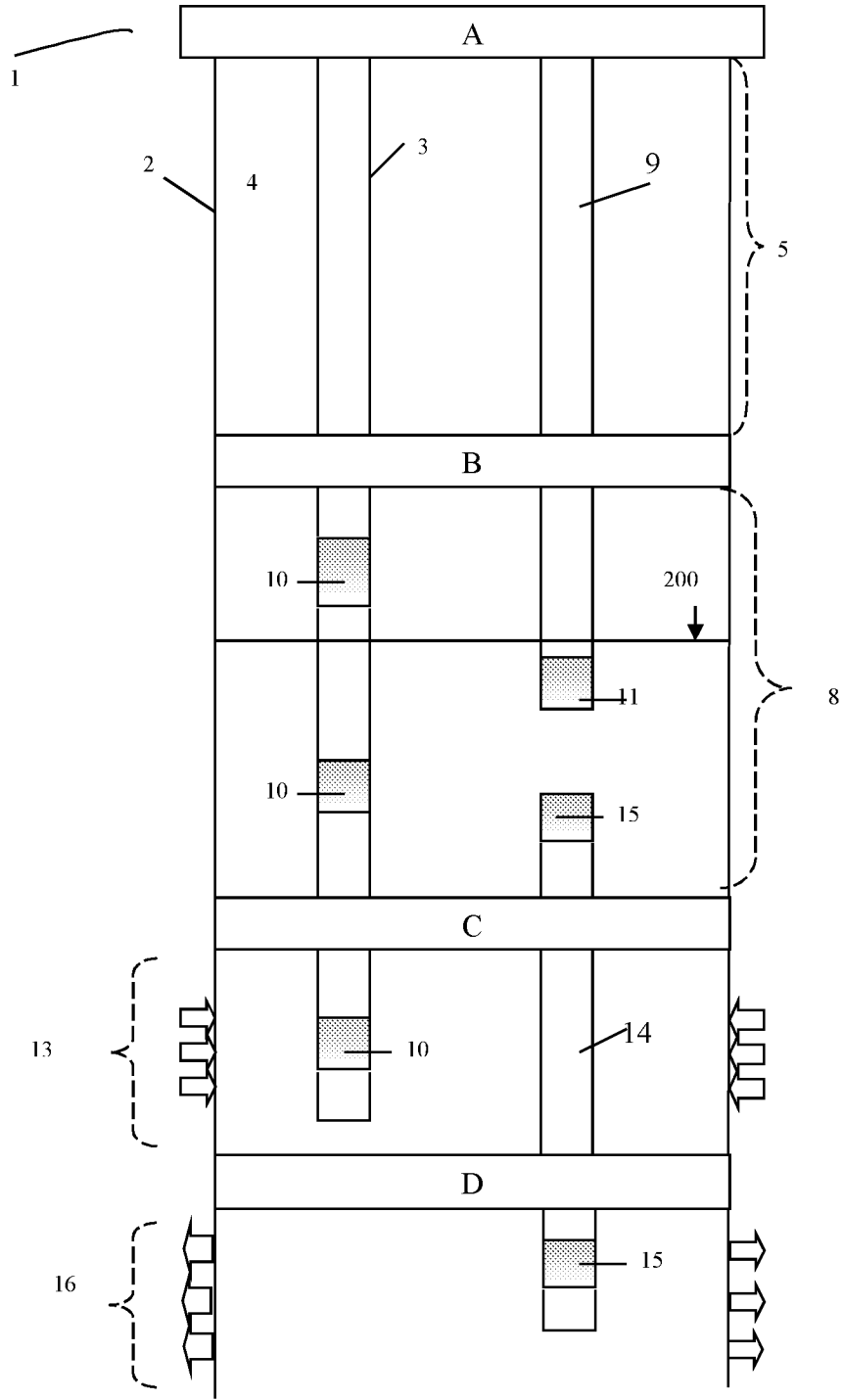


Fig. 1

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2017/052054

A. CLASSIFICATION OF SUBJECT MATTER
 INV. E21B43/00 C10G21/06 C10G31/08 C10L3/10
 ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E21B C10G C10L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2003/047309 A1 (THOMAS EUGENE R [US] ET AL) 13 March 2003 (2003-03-13) cited in the application paragraphs [0006], [0028], [0029], [0032], [0033], [0034]; figure 2 -----	1-19
A	US 2004/057886 A1 (PAULSEN DWIGHT C [US] ET AL) 25 March 2004 (2004-03-25) cited in the application paragraphs [0001], [0049] -----	1-19
A	US 6 454 836 B1 (KOELMEL MARK H [GB] ET AL) 24 September 2002 (2002-09-24) cited in the application column 1, line 63 - column 2, line 22 -----	1-19



Further documents are listed in the continuation of Box C.



See patent family annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2017/052054

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