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[54] METHOD OF TREATING ASPHALTIC TYPE RESIDUES

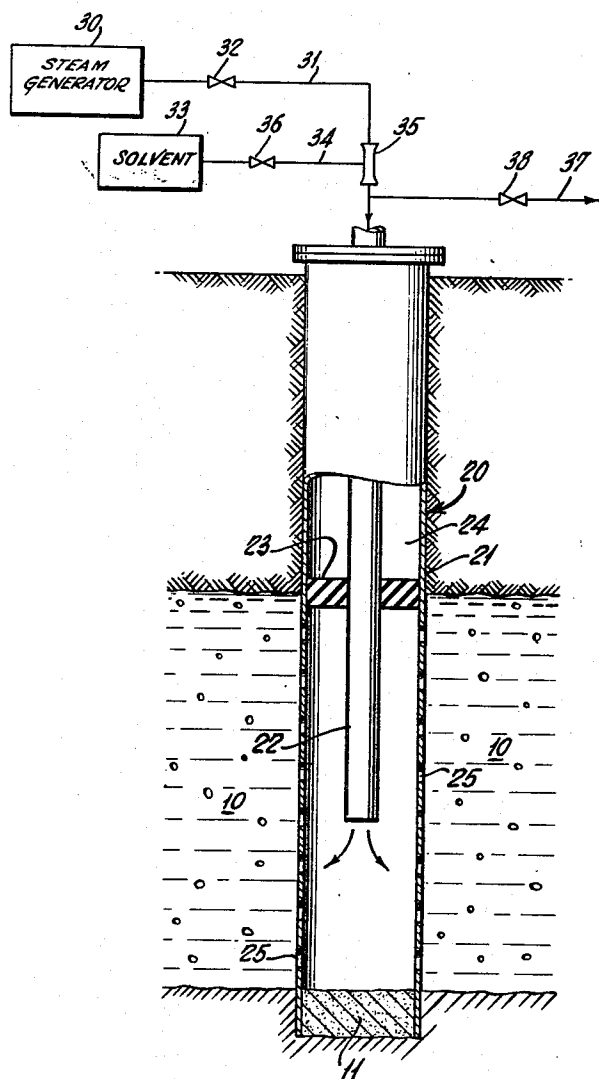
16 Claims, 1 Drawing Fig.

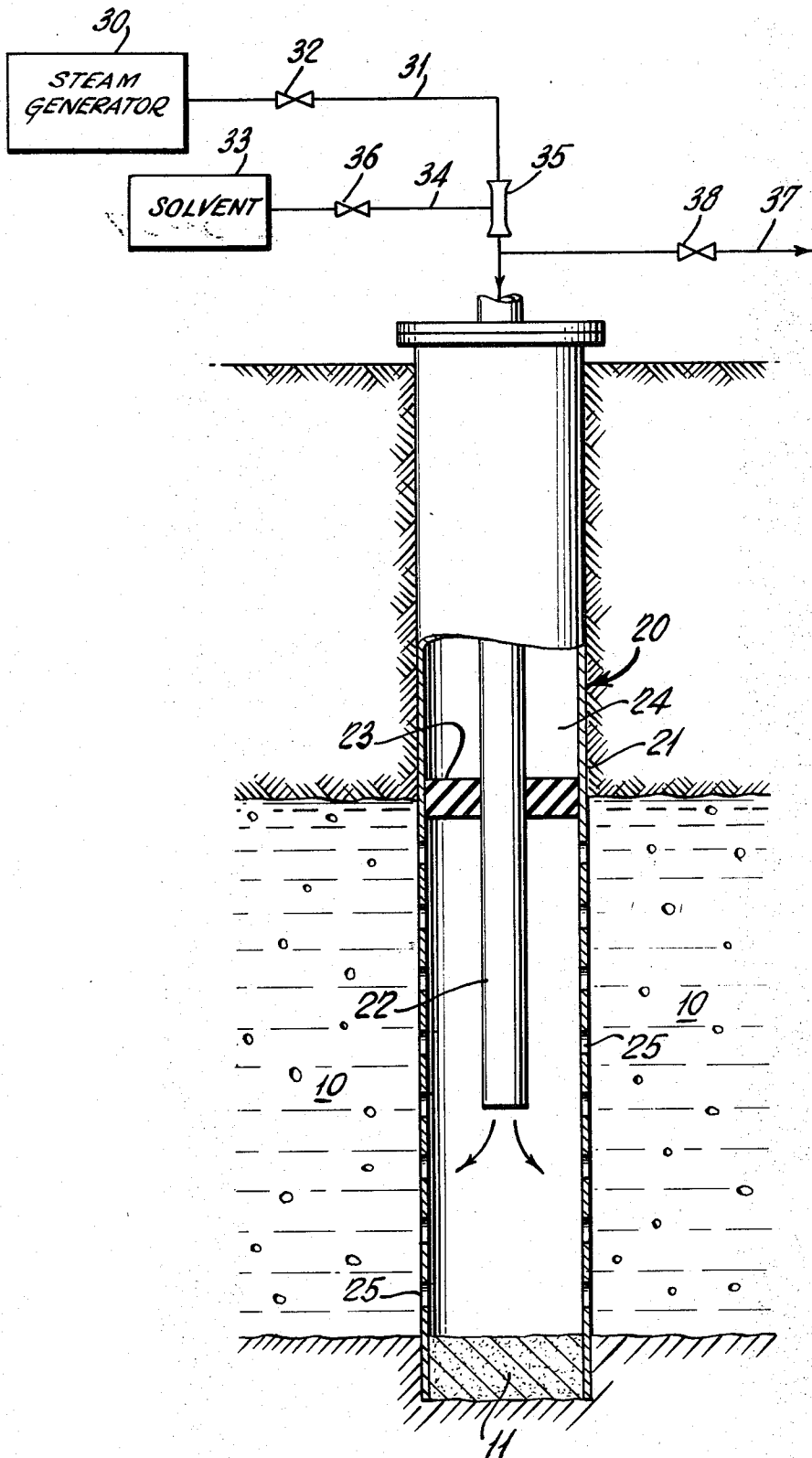
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| [50] | Field of Search..... | 166/263,
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ABSTRACT: Treatment of a well penetrating a hydrocarbon-bearing formation having asphalt-containing deposits therein, and the formation surrounding the well to remove asphaltic-type blockages is accomplished by injecting an aromatic solvent into the formation and thereafter circulating steam in combination with an aromatic solvent in vapor phase therethrough. Thereafter, the asphaltic residues are brought to the surface or dispersed into the formation by continued injection and circulation of the steam and aromatic solvent.





METHOD OF TREATING ASPHALTIC TYPE RESIDUES

BACKGROUND OF THE INVENTION

This invention relates to a method of treating asphalt containing residues in a well and the surrounding formation. More particularly, a method is provided wherein steam in combination with an aromatic solvent is utilized to disperse and/or dissolve the asphalt containing deposits in the formation adjacent the well.

During the production of hydrocarbons from a subterranean formation, the productivity rate may decline or be reduced substantially because of the accumulation and deposit of residues either in the well or in the formation adjacent thereto. These residues generally consist of waxes, gums, resins, asphalts or paraffins which were originally contained in the hydrocarbon-bearing formation. As the rate of production decreases progressively because of the accumulation of deposits, the formation must be cleaned of the residues contained therein to restore an economical productivity rate.

Various techniques have been applied in order to clean the well and surrounding formation of these deposits. These methods have met with varying degrees of effectiveness and include mechanical scraping of the well, injecting or circulating solvents therethrough, contacting the residues with heated liquids and with exothermic compounds. The application of any of these methods is both expensive and time consuming, thereby increasing overall production costs.

SUMMARY OF THE INVENTION

The invention disclosed herein provides an improved method of treating a well and/or stimulating a formation containing blockages caused by the deposit of asphaltic residues. The asphalt containing residues are contacted with pressurized steam containing an aromatic solvent in the vapor phase thereof for a time sufficient to render the residue mobile. The asphaltic deposits are then either brought to the surface by means of circulating the injected fluids through the well or dispersed into the formation. Stimulation of a formation wherein the production has declined is accomplished by means of dispersing the asphaltic residues while in a mobile state into the formation and maintaining their mobility to permit recovery thereof along with the hydrocarbons in the formation.

The principal advantage made possible by the method of this invention over prior art methods is that an effective method is provided for revitalizing a heretofore unproductive formation. By injecting steam in combination with an aromatic solvent, means are provided for dissolving any asphaltic blockages and maintaining them in a mobile state for a time sufficient to allow dispersion thereof. Utilizing these two fluids in combination with each other permits dissolution of the blockage and free flow of the hydrocarbons contained in the formation.

Accordingly, it is a primary object of this invention to provide an effective method for removing asphaltic deposits from a formation adjacent a production well.

A further object of this invention is to provide an improved method of stimulating a formation wherein the productivity has declined primarily because of the accumulation of asphaltic deposits adjacent a production well.

These and other objects, advantages and features of the invention will become more apparent from the following description of one embodiment to the invention.

BRIEF DESCRIPTION OF THE DRAWING

The drawing depicts an elevation view, partly in cross section, of a well penetrating an underground hydrocarbon-bearing formation and containing means for injecting steam and an aromatic solvent therein.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The objects of the invention are accomplished by injecting into the well and/or the formation steam containing an aromatic solvent in the vapor phase thereof, or by injecting the above fluids sequentially, or by a combination thereof.

With reference to the drawing, an underground hydrocarbon-bearing formation 10 is penetrated by a well 20, having a well casing 21 and contained therein, a tubing string 22. This tubing string provides a means for injecting liquids into the formation 10. Packer 23 is placed in the well 20 to close the annular space 24 between the casing 21 and the tubing string 22. The bottom of the well 20 may be closed by conventional means, e.g. cementing, 11, in order to direct injected fluid into the formation 10. The casing 21 has perforations 25 to permit injected fluid to penetrate the hydrocarbon-bearing formation 10. At the surface of the well 20, a steam generator 30 is provided to generate a wet steam and contains a steam line 31, with a control valve 32 interposed therein. An aromatic solvent supply, indicated at 33, is connected by line 34 to a venturi 35, which provides a means for mixing the aromatic solvent into the vapor phase of the generated steam. A control valve 36 is provided to regulate the amount of aromatic solvent to be mixed into the vapor phase of the steam injected into the formation. It should be noted that alternative means may be provided wherein the aromatic solvent is injected into the formation through the annular space 24 in lieu of being combined with the vapor phase of the steam prior to injection. It is also noted that the control valves 32 and 36 permit either steam or the aromatic solvent to be injected into the formation separately via the tubing string 22. A production line 37 containing a control valve 38 is provided to allow production of the hydrocarbons from the underground hydrocarbon-bearing formation.

When the method of this invention is utilized to remove asphalt-containing deposits from the surfaces of the well casing 21, or the tubing string 22, the packer 23 is released. The steam containing the aromatic solvent in the vapor phase thereof is injected via the tubing string 22 and contacts the asphalt containing residues. The injected fluids are circulated through the well 20 and may be blown to waste or recirculated. The process is continued until the asphaltic residues previously blocking the formation and preventing the production of the hydrocarbons contained therein are removed and/or dispersed. As the injected fluid is circulated through the well 20, the heat contained in the steam and the aromatic solvent render the previously immobile asphaltic residues mobile. The injected fluids carry therewith these now mobile asphaltic residues and remove them from the well. When reference herein is made to an aromatic solvent, the preferred solvent is one obtained from reformer bottoms, rich in bicyclic aromatics, i.e., over approximately 90 percent by volume, and having a boiling range between 400° and 650° F. When the asphalt containing residue also contains paraffins, it is desirable to mix a quantity of kerosene with the aromatic solvent.

Frequently, the asphaltic deposits are located throughout the formation 10 in addition to the surfaces of the well casing 21. In this instance, it is desirable to inject the solvent and steam into the formation under pressure and allow the fluids to soak for a predetermined period of time. Deeper penetration of the injected fluids into the formation may be provided by the subsequent injection of an inert gas.

Generally, the stimulation of a subterranean hydrocarbon-bearing formation containing asphaltic deposits may be accomplished by this invention by injecting an aromatic solvent in predetermined amounts into the formation and thereafter injecting steam containing an aromatic solvent in the vapor phase into the formation. By choice, the initial injection of steam containing the aromatic solvent may be blown to waste after circulation through the well, to warm the well. Subsequent to the injection of the steam containing the aromatic solvent, the well is shut in to permit the dissolving and

dispersing of the asphaltic deposits. The well is thereafter opened for production of the hydrocarbons in the formation.

Practice of the method disclosed herein in the stimulation of a subterranean hydrocarbon-bearing formation containing asphaltic deposits therein is best explained by the following example. In a field in Trinidad, a well, in which the rate of production declined to approximately 5 BOPD, was treated in accordance with the method disclosed herein. The well was warmed initially for approximately 4 hours, by injecting therein steam containing an aromatic solvent in the vapor phase thereof. The steam was blown to waste after it had been circulated through the well. 500 gallons of an aromatic solvent were subsequently injected into the formation by means of the tubing string with the well being closed. After this injection, steam with an aromatic solvent in the vapor phase thereof was continuously injected into the formation for a period of approximately three days. The well was then shut in for approximately 12 hours and subsequently 1,000 gallons of an aromatic solvent were injected into the formation. After approximately 48 hours of soaking, the well was opened for production. After a period of time, the productivity gradually increased until it peaked at 95 BOPD. This illustrates the improvement in production achieved by the method disclosed herein. It is noted that the times specified in the above example are merely exemplary and more lengthy or shortened periods may be provided for any particular phase.

Thus, there has been shown and described a method of removing asphalt-containing deposits from a formation adjacent a production well and to improve the productivity thereof.

We claim:

1. A method of treating a well for the removal of asphalt-containing deposits therein which comprises initially contacting said asphalt-containing deposits with a predetermined quantity of aromatic solvent and thereafter contacting said asphalt-containing deposits with steam containing an aromatic solvent in the vapor phase thereof for a period of time sufficient to dissolve said asphalt-containing deposits, and removing said deposits from said well.

2. The method of claim 1 wherein said aromatic solvent contains over 90 percent by volume bicyclic aromatics and is characterized by having a boiling range between 400° and 650°F.

3. The method of claim 1 wherein said asphalt-containing deposits contain quantities of paraffin therein and said aromatic solvent includes therein a quantity of kerosene for solution thereof.

4. The method of claim 1 wherein said steam containing said aromatic solvent is injected into said well at a predetermined pressure, said well then being closed to allow the injected steam and solvent to soak into said formation and disperse said asphalt-containing deposits.

5. The method of claim 1 wherein said steam containing said aromatic solvent is injected into said well and circulated therethrough until substantially all of said asphalt-containing residues are dissolved and removed with said steam from said well.

6. A method of stimulating a subterranean hydrocarbon-

bearing formation which comprises injecting into said formation a predetermined quantity of aromatic solvent, injecting into said formation pressurized steam containing an aromatic solvent in the vapor phase thereof, and recovering hydrocarbons from said formation.

7. The method of claim 6 which includes a second injection of said aromatic solvent into said formation subsequent to said injection of said steam containing said aromatic solvent in said vapor phase thereof.

8. The method of claim 7 wherein said well is closed subsequent to said injection of said second injection of said aromatic solvent for a predetermined period of time thereby permitting said steam and said aromatic solvent to soak into said formation.

9. The method of claim 7 which includes the additional step of injecting an inert gas subsequent to said second injection of said aromatic solvent for providing a deeper penetration of said steam and said aromatic solvent into said formation.

10. The method of claim 6 wherein said asphalt-containing deposits contain quantities of paraffin therein and said aromatic solvent includes therein a quantity of kerosene for solution thereof.

11. A method of stimulating a subterranean hydrocarbon-bearing formation traversed by a well wherein said well and said formation contain asphalt-containing deposits therein which comprises the steps of:

- a. contacting said asphalt-containing deposits in said well with steam containing an aromatic solvent in the vapor phase thereof for a predetermined period sufficient to remove said asphalt-containing deposits therein;
- b. injecting into said formation a predetermined quantity of aromatic solvent;
- c. injecting into said formation steam containing an aromatic solvent in the vapor phase thereof; and
- d. recovering hydrocarbons from said formation.

12. The method of claim 11 which includes a second injection of said aromatic solvent into said formation subsequent to said injection of said steam containing said aromatic solvent in said vapor phase thereof.

13. The method of claim 12 wherein said well is closed subsequent to said second injection of said aromatic solvent for a predetermined period of time thereby permitting said steam and said aromatic solvent to soak into said formation.

14. The method of claim 12 which includes the additional step of injecting an inert gas into said formation subsequent to said second injection of said aromatic solvent thereby providing a deeper penetration of said steam and said aromatic solvent into said formation.

15. The method of claim 11 wherein said steam containing said aromatic solvent is injected into said well and circulated therethrough until substantially all of said asphalt-containing residues are dissolved and removed with said steam from said well.

16. The method of claim 11 wherein said asphalt-containing deposits contain quantities of paraffin therein and said aromatic solvent includes therein a quantity of kerosene for solution thereof.

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