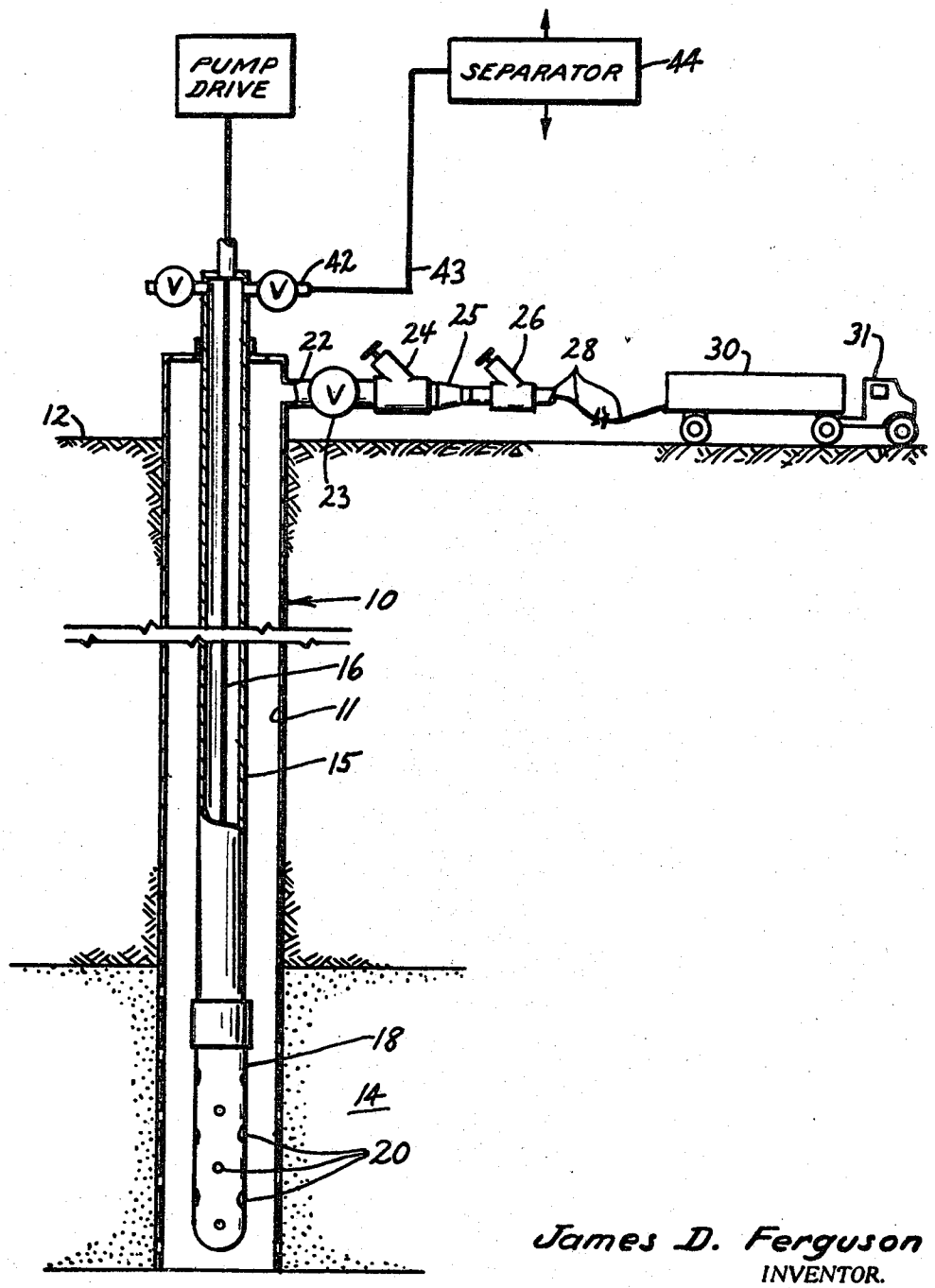
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WELL CLEANING WITH MIXED LIQUEFIED PROPANE AND BUTANE SOLVENT

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WELL CLEANING WITH MIXED LIQUEFIED PROPANE AND BUTANE SOLVENT

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ABSTRACT OF THE DISCLOSURE

The invention disclosed is a method for cleaning wells, primarily pumping wells, with specific mixtures of the liquefied petroleum gases, propane and butane, to remove paraffin and paraffin-sand mixtures, or the like, from the wells.

BACKGROUND OF THE INVENTION

Field of the invention

The field of the invention is the field pertaining to removal of paraffin and paraffin-sand mixtures, and other heavy materials tending to solidify and plug well formations, tubings, casings, and the like, with solvents.

SUMMARY OF THE INVENTION

The method for cleaning wells according to the invention involves forced (pumped) introduction of a solvent mixture down a well annulus to the bottom of the well, where the solvent mixture enters the formation, enters the production tubing, and admixes with the liquid petroleum of the formation. The solvent mixture, which consists of a specific mixture of liquefied propane and butane, dissolves paraffin, paraffin-sand mixtures, and like solid or near solid materials, from the formation and equipment in the well, while the well remains in production, with the pump continued in operation in the case of a well from which production is obtained by pumping, or with production flow uninterrupted in the case of a non-pumping well. It is possible to utilize the invention as well with interruption of production, by pressured introduction of the solvent mixture to displace other fluids from the well zone to be cleaned, e.g. drilling muds, liquid petroleum materials, water, gas, etc. The solvent mixture may be introduced through any flow route afforded as dictated by the equipment in place in the well.

BRIEF DESCRIPTION OF THE DRAWING

The drawing is a schematic representation showing a petroleum well in vertical cross section and accessory equipment connected therewith suitable for performance of a preferred embodiment of a method according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing, a well **10** has a casing **11** extending downward from the earth's surface **12** to extend through an oil-bearing formation **14**. A production pipe string **15** through casing **11** has therein a pump rod **16** extending down to a pump **18** carried at the lower end of string **15**. Rod **16** is reciprocated upwardly and downward by a pump drive to cause pumping of liquid petroleum to the surface through tubing **15**, the liquid petroleum entering the pump through pump perforations **20**.

The showing of the well and equipment is simplified, and the invention may be employed on any well of whatever form equipped in any suitable manner.

Casing **11** is equipped at the well head with a flow passage **22** flow to or from the casing-tubing annulus

through which is controlled by a wing valve **23**. To the wing valve there are connected in series a high pressure check valve **24**, a reducer **25**, a low pressure check valve **26**, and a conduit **28** leading from a tank **30** of tank vehicle **31**. Other control valves may be used. All or part of this flow connection may be included in the normal equipment of the tank truck, trailer, or the like. A non-vehicle mounted tank or supply may be used.

An outlet **42** at the upper end of tubing **15** is connected to a conduit **43** leading to a separator **44**.

A supply of mixed liquefied butane and propane is provided in tank **30**. It has been found that a more or less specific volume ratio of propane:butane results in very exceptional and superior cleaning of the wells, the volume ratio for optimum results being, propane:butane=60:40. A relatively small departure from this ratio will result in fairly good well cleaning, but not so good as closer to the optimum ratio. For example, the ratios, pronpane:butane=70:30 or 50:50 will clean the well only fairly well, and the ratios, propane:butane=65:35 or 55:45 will perform considerably better, but still below the optimum cleaning resulting from use of the optimal 60:40 ratio.

Of the liquefied gases, propane enhances penetration of the butane, which is of higher dissolving power, and maintains pressure at the area to be cleaned because of its higher vapor pressure. Butane, with its higher dissolving power, dissolves materials more quickly and thoroughly, so that optimum cleaning results. But, surprisingly, the butane and propane must be present in the proper mixture or the extremely efficient and thorough cleaning of paraffin, paraffin-sand, or the like does not result. The efficiency peaks rapidly, as the optimum volume ratio is approached from either side.

The liquefied propane-butane mixture is delivered (under pump pressure, or equivalent) from tank **30** through conduit **28**, through check valves **26** and **24**, through open wing valve **23** to the annulus between casing **11** and tubing **15**, and down therethrough to the bottom of the well. The pressure against which the propane-butane mixture is pumped must be overcome, either by the pump with which vehicle **31** is equipped, or by other suitable pump, not shown. In the area of Chambers County and Jefferson County, Tex., many pumping wells occur having pressures at the annulus of the order of 40 p.s.i.g., but somewhat lower pressures and much higher pressures occur where the invention may be employed. The pump must, in all cases, overcome the back pressure in order that the mixture may be introduced effectively.

The propane-butane mixture is preferably introduced without shutting down the well. The down-hole well pump remains in operation throughout, with well production continued. Similarly, with non-pumping wells, production continues during cleaning by the method afforded by the invention. Although the propane-butane mixture is preferably introduced without shutting down the well, the invention may of course be used while the well is shut down or flow is temporarily interrupted, by forcing the solvent mixture into the well to the paraffin area to be cleaned, through any flow paths present through the equipment in place in the well and displacing any fluids present in the well. These procedures may be used whether the well is a pumping or a non-pumping well. Pipelines and other equipment are also cleaned by the solvent mixture.

In a trial of the invention in Chambers County, Tex., a 4500 foot well, having an annulus pressure of 42 p.s.i.g. at the wellhead was cleaned by introducing by pumping 500 gallons of propane-butane, ratio 60:40 by volume, during a 15 minute period, to the bottom of the well in the described manner, with the well pump in continuous operation and with continued production. The mixture penetrated into the formation, and admixed with the

formation petroleum, and cleaned not only all of the equipment in the well, but the formation adjacent the well. In other tests, the ratio was varied from propane-butane=70:30 (by volume) to 50:50, and while cleaning to some extent resulted, it was far below the optimum cleaning resulting from use of the optimum ratio, and approached optimum cleaning as the optimum ratio was approached.

Another surprising advantage of the invention is that the cleaning lasts up to twice as long, or even longer, than when cleaning is accomplished by other methods. Also, the cleaning may be completed in a very short time, usually in 15 minutes or less, and certainly not exceeding 30 minutes in most cases.

The solvent mixture, of course, ultimately passes from the well through the production tubing with the oil produced, and is separated from the production at separator **44**.

While preferred embodiments of the invention have been described and shown, many modifications thereof may be made by a person skilled in the art without departing from the spirit of the invention, and it is intended to protect by Letters Patent all forms of the invention falling within the scope of the following claims.

What is claimed is:

1. Method for cleaning oil wells comprising introducing a mixture of liquefied propane and butane into the well to adjacent the well area to be cleaned to dissolve heavy hydrocarbons including paraffin from the well, said mixture being introduced at a pressure sufficient to overcome the well pressure, and removing said mixture from the well with the dissolved materials cleaned from the well, said mixture consisting of mixed liquefied propane and butane in a ratio, propane:butane=70:30 to 50:50, by volume.

2. Method according to claim **1**, said ratio, propane: butane=60:40, by volume.

3. Method according to claim **1**, the well being a pumping well.

4. Method according to claim **1**, the well being a non-pumping well.

5. Method according to claim **1**, said mixture being pressured for introduction as described by pumping.

6. Method according to claim **5**, said mixture being pumped into the well first through a low pressure check valve and then through a high pressure check valve, whereby escape from the well of said mixture is prevented and hazardous conditions are not created at the well.

7. Method according to claim **1**, the well having at least two flow paths therethrough between a petroleum-bearing formation and the surface, one of said flow paths serving to conduct petroleum from the formation to the surface, said mixture being introduced into the well through the other of said flow paths and returned to surface admixed with petroleum from the formation through said one of said flow paths.

8. Method for dissolving paraffin for removal thereof, comprising contacting the paraffin with a liquefied solvent mixture of propane and butane wherein the propane: butane ratio (by volume) is from about 70:30 to about 50:50 for a time sufficient to dissolve the paraffin, and withdrawing the solvent mixture while maintaining the solvent mixture liquefied to remove the paraffin therewith.

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