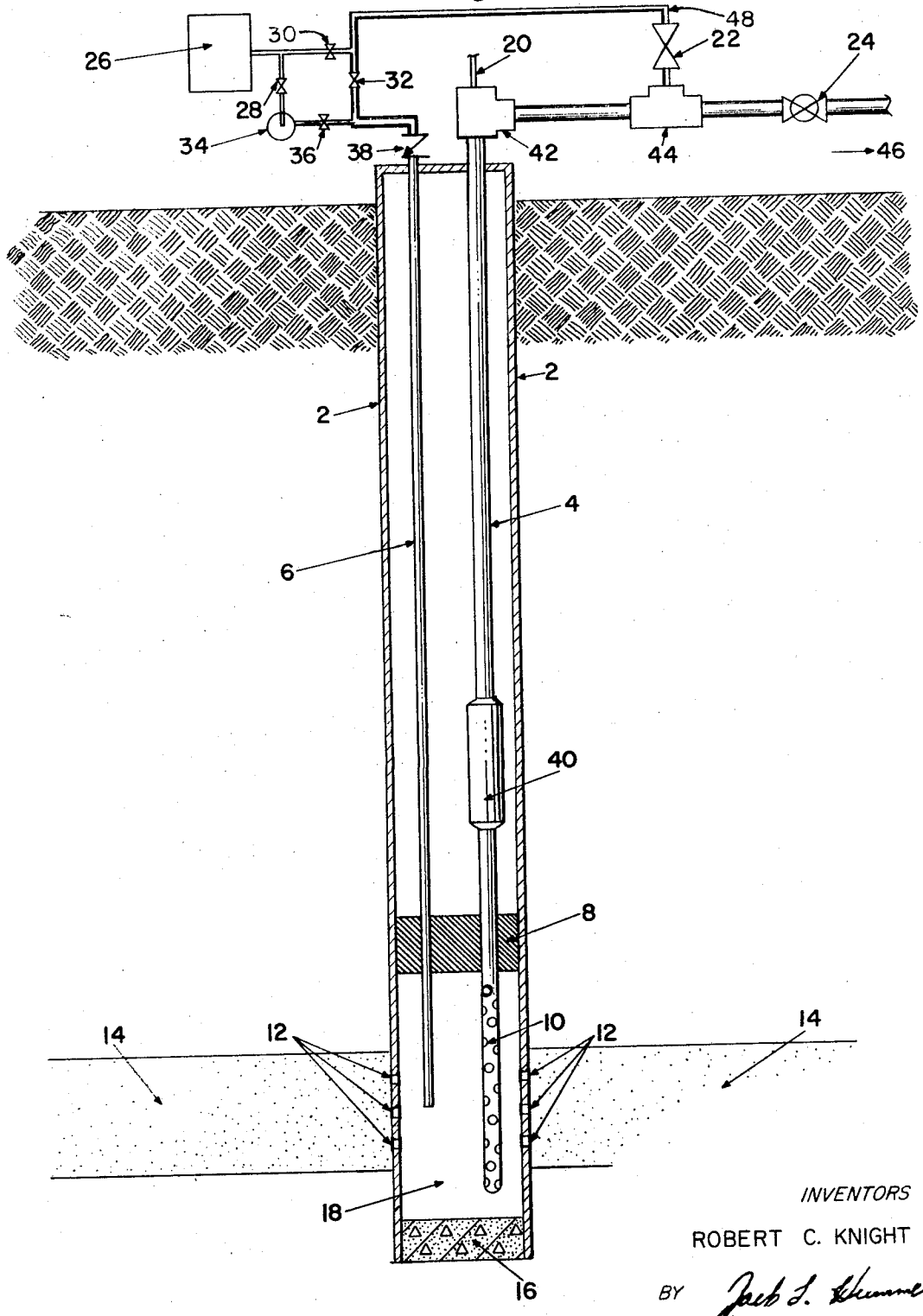
July 15, 1969 R. C. KNIGHT 3,455,394

REMOVAL OF HIGHLY VISCOUS CRUDE PETROLEUM FROM WELL BORES

Filed Aug. 2, 1967



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United States Patent Office 3,455,394 Patented July 15, 1969

3,455,394

REMOVAL OF HIGHLY VISCOUS CRUDE PETROLEUM FROM WELL BORES

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Filed Aug. 2, 1967, Ser. No. 657,915
Int. Cl. E21b 43/00
U.S. Cl. 166—314 4 Claims

ABSTRACT OF THE DISCLOSURE

Hydrocarbon is removed from a well bore by:

(1) injecting into the bottom of a well bore a micellar solution to substantially reduce the hydrocarbon in the well bore, and then

(2) continuously injecting into the bottom of the well bore a small quantity of a micellar solution to prevent build-up of hydrocarbon in the well bore.

Background of the invention

Production of high viscosity crudes presents many problems. After the initial production of crude oil, the crude oil viscosity can increase to a point whereby said oil cannot be lifted from the subterranean formation by mechanical means. In some cases, heat is required to facilitate the movement of crude oil from the formation to the surface and to keep the oil fluid at surface conditions. Also, some high viscosity crude oils must be mixed with a low viscosity crude oil to reduce the high viscosity and facilitate collection of the crude. And, in some cases, transportation systems such as pipelines and transport tanks must be heated to facilitate the movement of the crude oil.

United States Ptaent No. 2,050,931 teaches a process of removing waxy bodies from a well bore by injecting into the well bore a sodium petroleum sulfonate dissolved in water. After the sulfonate is adsorbed into the waxy hydrocarbon, the well bore is flushed with water to remove the emulsified waxy hydrocarbon.

United States Patent No. 2,356,205 teaches a process of removing waxy hydrocarbons and mud barriers from a well bore by washing said well bore with "transparent" emulsions.

United States Patent No. 3,241,614 teaches a process of removing heavy hydrocarbons from a well bore by contacting the hydrocarbon with a mixture of a hydrocarbon solvent and a surfactant and then flushing the well bore with water. This patent also teaches that such a process can be effected periodically to remove accumulated heavy hydrocarbons.

Description of the invention

Applicant has discovered that the removal of hydrocarbons from a well bore is facilitated by:

(1) injecting into the bottom of the well bore a sufficient quantity of a micellar solution to substantially fluidize the hydrocarbon in the well bore, and then

(2) continuously injecting into the bottom of said well bore a small but sufficiently quantity of micellar solution to prevent build-up of non-fluid hydrocarbon in the well bore.

FIGURE 1 of the attached drawing illustrates a method of effecting the invention. Miceller solution in container **26** is fed through valve **28** into pump **34** and then pumped through valve **36** and check valve **38** (valves **30** and **32** are closed) into injection tubing **6** and then into well bore area **18**. Viscous hydrocarbon or crude oil is produced from subterranean formation **14** and flows through perforations **12** in casing **2** into well bore area **18**.

Packing **8** contains the hydrocarbon and other fluids within well bore area **18** and keeps these fluids from flowing outside of production tubing **4**. The bottom of the well bore is blocked off by cement **16**. Micellar solution contacts the hydrocarbon within the well bore area **18** and reduces the viscosity of, or dissolves the hydrocarbon. Tubing **4** has perforations **10** in the bottom thereof to permit the flow of hydrocarbon therethrough and pump **40** attached to tubing **4** lifts the hydrocarbon from well bore area **18** through perforations **10** into tubing **4** and then to hydrocarbon storage **46**. Well bore area **18** can be flushed before producing the well by closing valve **24**, opening valves **22** and **30** and circulating micellar solution by pump **34** through well bore area **18**. This can be accomplished with or without the help of pump **40**, or pump **34** can be bypassed and pump **40** used to circulate micellar solution through well bore area **18**. Pump **40** is actuated by pump actuating means **20**. Examples of pump means **40** can be a tubing pump or an insert pump. During continuous production of the hydrocarbon from the formation through production tubing **4**, a portion of the hydrocarbon may be directed through valve **22** by "choking" the flow of fluid through valve **24**, through tubing **48**, valve **30** being partially open to permit the flow of micellar solution from container **26** into tubing **48** (valves **28** and **36** may be closed), and valve **32** being open to permit the flow of hydrocarbon plus the added portion of micellar solution to pass through check valve **38** into injection tubing **6** and then into well bore area **18**. By this latter method, continuous production can be effected while maintaining a small solution injection rate into the bottom of the well bore to facilitate the removal of hydrocarbon from said well bore to the surface. Continuous production can also be effected by pumping a sufficient quantity of micellar solution by pump **34** through injection tubing **6** and producing the hydrocarbon through production tubing **4** with valve **22** closed and valve **24** opened.

The term "micellar solution" as used herein is meant to include "microemulsions" [Schulman and Montagne, Annals of the New York Academy of Sciences, 92, pages 366–371 (1961)], oleopathic hydromicelles [Hoar and Schulman, Nature, 152, page 102 (1943)], "transparent" emulsions, Blair, Jr., et al., United States Patent No. 2,356,205, micellar dispersions and micellar solutions defined in United States Patent Nos. 3,254,714 and 3,275,075. Micellar solutions are generally transparent when they do not contain colored impurities and when not transparent, are translucent. The equilibrium of the micellar solutions tend toward further dispersion of the internal phase rather than toward coalescence of this phase. For purposes of this invention, the systems defined in United States Patents Nos. 3,163,214 and 3,126,952 can be equated with the "micellar solutions" of this invention.

The micellar solution is composed essentially of a hydrocarbon (e.g. sweet crude oil, straight-run gasoline such as lower hydrocarbon fractions equal to or greater than at least pentane, light crude column overhead, etc.), an aqueous medium such as water and a surfactant sufficient to impart micellar solution characteristics to the mixture. Examples of useful surfactants include alkyl aryl sulfonates, more commonly known as petroleum sulfonates or as alkyl aryl naphthenic monosulfonates. Examples of useful sulfonates can be defined by the empirical formula $C_nH_{2n-10}SO_3M$ wherein n is an integer from about 25 to about 30 and M is a monovalent cation, such as sodium, potassium, ammonium, etc. In addition, the micellar solution can contain a co-surfactant such as an alcohol, amide, ester, ketone, etc. containing up to about 16 carbon atoms, e.g. isopropanol, amyl alcohols, and p-nonyl phenol to give desirable characteristics to the micellar solution. Electrolytes, such as inorganic bases, inorganic acids, inorganic

salts, organic bases, organic acids, and organic salts, e.g. sodium hydroxide, sodium chloride, sodium sulfate, acetic acid, organic amines, etc., can be added to the micellar solution to impart desirable characteristics thereto. Also, brine, i.e. salty water, can be added to the micellar solution in place of the water and in certain cases this may be desirable.

An example of a useful micellar solution contains from about 30 up to about 55% or more of a hydrocarbon, from about 30 up to about 60% of water and at least about 8% of a surfactant. Also, where the hydrocarbon within the subterranean formation has a particular characteristic, such as a high water content, the micellar solution can be "tailored" to be more compatible with the hydrocarbon and thus be capable of limited uptake of said water.

The amount of micellar solution required is dependent upon the viscosity of the hydrocarbon in the formation. For example, up to about 50% of low viscosity micellar solution may be needed to remove a highly viscous type crude oil whereas only about 2% may be required to remove a crude of less viscosity, the percents based on weight of the crude. An example of a highly viscous crude is a Green River formation crude from Utah's Uintah Basin (pour point within the range of about 60–130° F.); from about 10% up to about 25% of the micellar solution is needed to remove this type of crude from the well bore. In the past, it has been necessary to mix a lighter crude such as Rangely crude, with the Green River crude to move this hydrocarbon through the well bore and pipelines.

During continuous production, down to about 2% or less of the micellar solution may be required to facilitate the crude removal. However, where the well bore is being "flushed" by circulating the micellar solution therein, amounts up to about 50% of the solution may be required with a highly viscous crude.

It is contemplated within this invention that equivalent changes can be made within the process to accomplish the same result that this invention achieves. Also, modification of the micellar solution composition, etc. is to be considered within the scope of the invention as disclosed within this application and appended claims.

What is claimed is:

1. A method of facilitating the removal of hydrocarbons from the well bore of a producing well comprising

(1) injecting into the bottom of the bore a sufficient quantity of a micellar solution to fluidize substantially all the hydrocarbon in the bottom of said well bore, and then

(2) continuously injecting into the bottom of said well bore a small but sufficient quantity of a micellar solution to facilitate the continuous removal of hydrocarbon from said well bore.

2. The method of claim **1** wherein the micellar solution is comprised of a hydrocarbon, water, and an alkyl aryl naphthenic monosulfonate.

3. A method of facilitating the removal of hydrocarbon from the well bore of a producing well comprising:

(1) injecting into the bottom of the bore and mixing in the bore a sufficient quantity of a micellar solution to substantially reduce the viscosity of the hydrocarbon so that the hydrocarbon can be removed from the well bore, and

(2) continuously injecting into the bottom of the bore a small but sufficient quantity of a micellar solution to facilitate the continuous removal of hydrocarbon from the well bore.

4. A method of facilitating the removal of a highly viscous hydrocarbon from a well bore comprising

(1) injecting into the bottom of the bore a sufficient quantity of a micellar solution to substantially reduce the viscosity of the hydrocarbon,

(2) circulating the micellar solution and the hydrocarbon through a producing tubing to the surface and then back down into the bottom of the bore, and

(3) producing the hydrocarbon while continuously injecting into the bottom of the well bore a small but sufficient quantity of a micellar solution to facilitate the removal of the hydrocarbon from said well bore.

References Cited

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3,275,075	9/1966	Gogarty et al.	166—9

STEPHEN J. NOVOSAD, Primary Examiner

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,455,394 Dated September 4, 1969

Inventor(s) Robert C. Knight

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 3, lines 9 and 10 should be amended as follows:

Delete: "about 30 up to about 55% or more of a hydrocarbon, from about 30 up to about 60% of water".

Insert: --about 30 up to about 60% of a hydrocarbon, from about 30 up to about 55% or more of water--.

SIGNED AND
SEALED

DEC 2 - 1969

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents