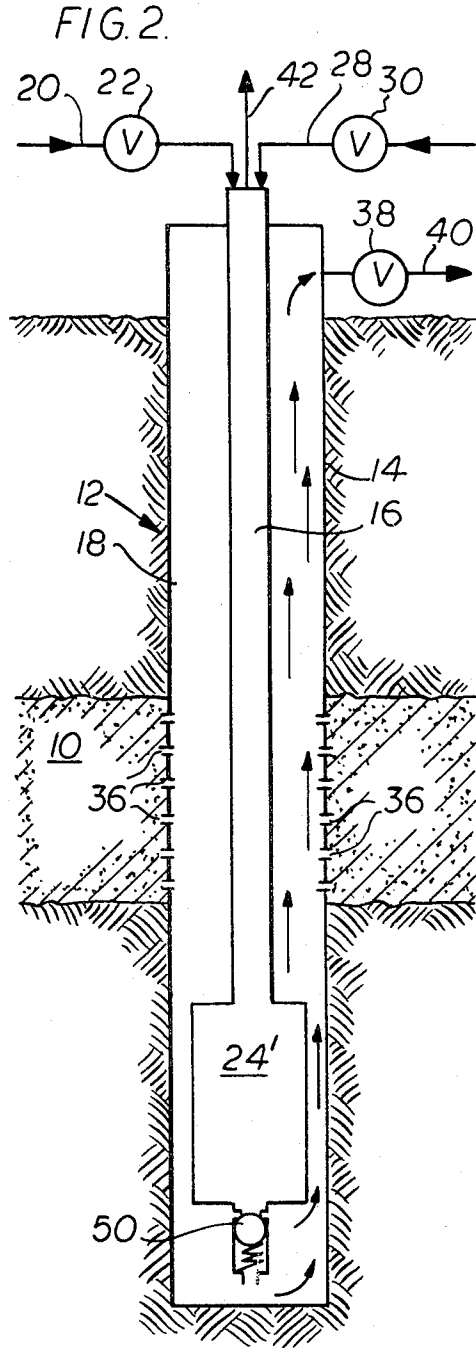
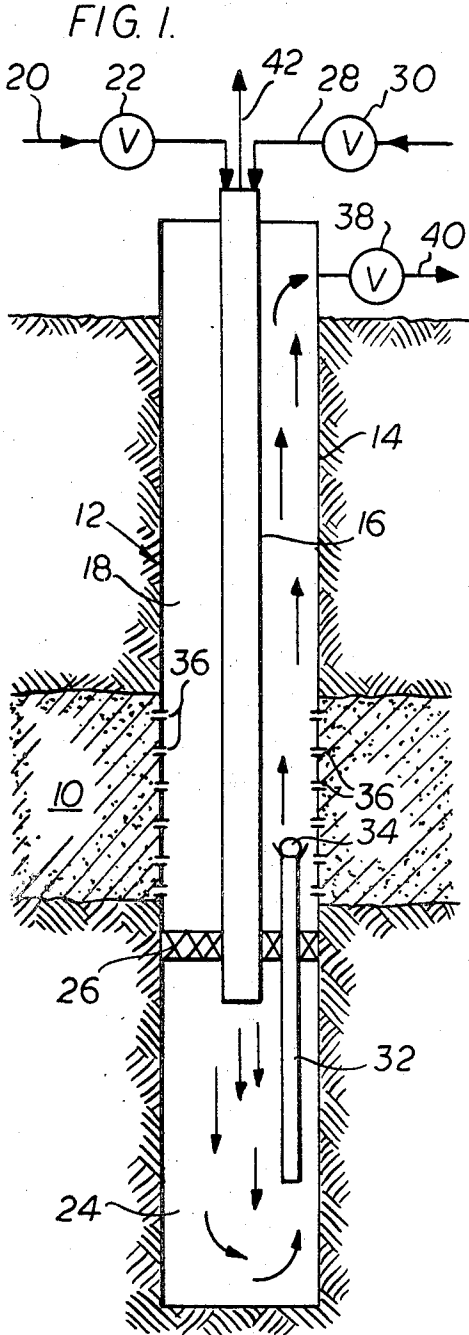


July 14, 1970

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METHOD OF PRODUCING OIL USING STEAM CONDENSATE
TRAPPED IN STORAGE ZONE
Filed Oct. 28, 1968

3,520,367



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METHOD OF PRODUCING OIL USING STEAM CONDENSATE TRAPPED IN STORAGE ZONE

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Filed Oct. 28, 1968, Ser. No. 770,956

Int. Cl. E21b 43/24

U.S. Cl. 166—302

4 Claims

ABSTRACT OF THE DISCLOSURE

Production of oil by injecting steam at low temperature into a tubing string of an oil well, trapping the steam condensate in a condensate storage zone and discharging the trapped condensate from said zone by means of gas into the annulus of the oil well wherefrom condensate and oil are produced.

This invention relates to the recovery of oil from a subterranean oil-bearing stratum.

Steam is frequently employed in producing oil from oil-bearing formations containing low gravity viscous crude oils. Thus, steam at high temperatures such as 600–700° F. or higher can be introduced through a tubing string so as to render the oil in the surrounding formation less viscous and cause it to flow into the well. Due to high formation pressures in deep wells such as those drilled to a depth of 2000 or 3000 feet or more, high temperature steam is introduced under relatively high pressures. In so doing the well casing and tubing string are subjected to excessive heat and suffer damage in a manner commonly referred to as "cratering." In such wells casing and/or tubing must be rerun which, of course, is costly and time consuming.

Accordingly, it is a principal object of this invention to provide a process for producing oil in an oil-bearing subterranean stratum using steam at temperatures and pressures which minimize damage to tubing and casing.

The process of the present invention involves injecting steam at relatively low temperatures and pressures into a tubing string of an oil well to heat the oil in the production zone. The steam condensate is trapped in a storage zone. Gas is then introduced into the tubing string and into the condensate storage zone so as to build up a pressure sufficient to discharge condensate into the oil production zone wherefrom both oil and condensate are lifted to the surface. These operations can be repeated at such intervals of time as is desired for efficient oil production. The steam which is introduced into the well is at a relatively low temperature such as temperatures on the order of 300–400° F.

The present invention is further described in connection with the accompanying drawings in which:

FIG. 1 is a schematic elevation of an oil well showing one arrangement of apparatus for practicing the invention.

FIG. 2 is a schematic elevation of an oil well showing another arrangement of apparatus for practicing the invention.

Referring to FIG. 1, a viscous oil-bearing stratum 10 is penetrated by well 12 which is provided with a casing 14. The casing 14 and tubing string 16 form annulus 18. Steam at a temperature of say 350 to 400° F. and at a pressure of say 135 p.s.i.a. is introduced into tubing 16

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through conduit 20 which is provided with cut-off valve 22. A steam boiler or generator is employed to furnish steam which, as it passes through tubing 16, heats the viscous oil in the production zone rendering it less viscous. The low temperature steam is injected into the tubing until the condensate storage zone 24 formed by means of packer 26 is filled with hot water. At this time, injection of steam is terminated and gas is injected into the tubing via conduit 28 which is provided with cut-off valve 30. The gas is injected at a pressure sufficient to discharge the condensate in zone 24 up through tubing 32 and through check valve 34 into annulus 18 above packer 26. There the condensate mixes with the oil which drains from the formation into annulus 18 through perforations 36 in casing 14. Finally, cut-off valve 38 in production line 40 is opened allowing the formation gas to lift the heated oil and condensate to the surface and to be recovered by means of production line 40. If desired or necessary, the oil and condensate can be pumped through line 40. Gas can be vented from tubing 16 through vent line 42.

FIG. 2 represents a system wherein use of a packer is eliminated. In this system steam condensate storage zone 24' is formed by an enlarged section on the lower portion of tubing 16. An upwardly biased check valve 50 is disposed within the tubing below condensate storage zone 24'. Thus, when the condensate storage zone is substantially full and high pressure gas is introduced into the tubing the condensate is forced out through valve 50 and into the annulus 18. In this embodiment of the invention cyclic injection of low temperature steam and gas and production of oil is carried out as described with reference to FIG. 1.

In a well producing approximately 1000 barrels per day of liquid and 2,000,000 standard cubic feet of gas, approximately 135 barrels per day of water is required to be injected cyclically into the tubing as saturated steam at a temperature of 350° F. to 400° F. to raise the temperature of the well to 350° F. When the formation pressure in the production zone is on the order of 1100 p.s.i.a. steam can be injected at a pressure of approximately 135 p.s.i.a. Thus, it is seen that a small amount of steam at low temperature and pressure can be effectively used for heating the oil in the formation in accordance with this invention.

Those modifications and equivalents which fall within the spirit of the invention and the scope of the appended claims are to be considered part of the invention.

We claim:

1. A process for producing oil from an oil-bearing stratum through a well therein provided with a casing and a tubing string which together form an annulus communicating with said stratum, which process comprises the steps of:

- (a) injecting steam into said tubing string at a relatively low temperature,
- (b) trapping steam condensate in a storage zone within the well and isolated from said annulus, discontinuing said injection of steam,
- (c) introducing gas into the tubing string to discharge steam condensate from said storage zone into the annulus, and
- (d) removing oil and steam condensate from the annulus of said well.

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2. The process of claim 1 wherein steam is injected at a temperature of from about 300° F. to about 400° F.
3. The process of claim 1 wherein said stratum bears a low gravity viscous crude oil.
4. The process of claim 1 which is carried out a number of successive times.

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U.S. Cl. X.R.

166—311