APPARATUS FOR AND METHOD OF PRODUCING VISCID OIL

FIG. 1

FIG. 3

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APPARATUS FOR AND METHOD OF PRODUCING VISCID OIL

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ABSTRACT OF THE DISCLOSURE

A dual type packer is run into a well bore on the depending end of a tubular pumping string for communi-
cating with the well bore below the packer. A fluid pump is installed in this first string of tubing. A second string of tubing is run into the well through the packer and pro-
vided with a check valve below the packer. Hot gases are then injected into the well bore or circulated through the second string of tubing to dilute viscoid oil, which is removed from the well by the action of the pump in the first string of tubing.

The present invention relates to the oil industry and more particularly to a method and means for recovering viscoid oil from individual wells.

This invention is an improvement over United States Patent No. 3,016,833, issued to me Jan. 16, 1962, for Apparatus for and Method of Producing Heavy Oil.

It was well understood by those skilled in the production of oil that certain types of wells contains petroleum known as heavy asphaltic oils which is too thick to be recovered from the producing zone in a conventional manner by crude oil pumping equipment. Furthermore, these oils are frequently impregnated with sand which, by its abrasive qualities, repeatedly wears out the pump and tubing. Such oils, however, can be pumped when diluted or heated to a fluid state. Some of the problems encountered in an effort to heat dilute the viscoid oil is that the producing zone also produces a relatively large quantity of water which hampers heating the oil in the producing zone and results in a high proportion of water, when endeavoring to recover the oil, thus rendering the operation uneconomical.

This invention is an improvement over the above referred to patent in that it provides a method for diluting viscoid oil within the annulus of a casing and in the oil sand reservoir rather than within a cylindrical chamber positioned in the casing.

It is, therefore, the principal object of this invention to provide an apparatus and set forth a method for recovering viscoid oil from the oil producing reservoir tapped by individual wells.

Another important object is to provide an apparatus and method of controlling the viscosity of viscoid oil by injection of heat, diluent or gases within a well and the adjacent oil reservoir in order that production of the viscoid oil may be continuous as long as the supply to the well from the oil reservoir is constant.

Another object is to provide an apparatus and method for increasing the volume of production of viscoid oil to an extent that it will result in a profitable operation when compared with present conventional means of producing such oil.

Another object is to provide an apparatus by which viscoid oil may be both heated and diluted within the bore hole of a well and the surrounding area of the oil sand reservoir.

Further objects are to provide an apparatus and method of trapping well fluids in a well bore below a predeter-
determined depth, removing the well fluids from the well bore above the predetermined depth and inserting a pair of tubular strings into the well bore for diluting the oil below the predetermined depth by the use of steam, gases or circulation of hot oil and recovering the diluted oil from the production zone.

The present invention accomplishes these and other objects by running a dual-type packer into a well bore on the depending end of a tubular string including a check valve equipped perforated tube connected in depending relation with the packer and thereafter providing means for heating and diluting the oil below the packer and moving the fluid oil to the surface of the earth.

Other objects will be apparent from the following description when taken in conjunction with the accompanying two sheets of drawings, wherein:

FIGURE 1 is an elevational view, partially in cross section, diagrammatically illustrating the apparatus in operative position in one embodiment of the invention;
FIGURES 2 and 3 are fragmentary cross-sectional views illustrating the manner of removing fluid normally present in a cased well; and,
FIGURES 4 and 5 are fragmentary vertical cross-sectional views illustrating alternative embodiments of operation.

Like characters of references designate like parts in those figures of the drawings in which they occur.

In the drawings:

Referring to FIG. 1, the reference numeral 10 indicates the apparatus, as a whole, which includes a conventional oil well pumping mechanism, indicated generally by the numeral 12 and operatively connected to a string of primary or pumping tubing 14 containing a bottom hole fluid oil pumping means 15 and installed in a drilled well 16. The well 16 is illustrated in simplified form having a casing 18 extending from adjacent the surface of the earth 20 downward toward the bottom of the well as is conventional. The casing 18 is provided with apertures 21 in the oil bearing zone. The upper end portion of the casing supports a slip equipped tubing head 22 which in turn supports the conventional string of tubing 14. The lower end portion of the tubing 14 is positioned at a predetermined depth and is provided with a conventional hold down shoe 26 for receiving the conventional bottom-hole top-hold-down type oil well pump 15 having a reciprocating plunger. A string of rods 28 is connected with the pump plunger and the bridle 30 carried by the pumping unit walking beam 32. The pumping unit 12 includes a motor 34 operatively connected with the walking beam 32 through a counterbalanced gear train 35 to impart reciprocating movement to the suction and pump plunger. The above described pumping equipment is conventional and forms no part of the instant invention other than to set forth a description of a typical oil well being produced by pumping equipment which is used in combination with the hereinafter described method and apparatus.

Referring also to FIGS. 2 and 3, a conventional dual packer 36, having a latch mechanism, has been run into the casing 18 on the depending end of a well string, not shown, and set at a predetermined depth, for example, above the perforations 21 in the production zone. Prior to running the packer, the latter is provided with a depending tubular tail pipe 38 provided with a fluid sealing diametrically reduced portion 40, intermediate its ends, and equipped with a float or vertical check valve 42. That portion of the tail pipe depending below the check valve 42 is provided with a plurality of wall ports 44. The tubing string 14 is then run into the casing and latched onto the packer 36 to close the packer and seal off communication of well fluids through the packer in combination with the check valve 42. The tubing string 14 is then unlatched from the packer and positioned so that its depending end is slightly above the packer 36.
Thereafter any fluid 46, normally within the casing 18 above the packer 36, is removed through the tubing 14, as by a swab 48, an air lift pump 50 or by inserting the pump 15 and sucker rods 28 into the tubing. This results in a dry annulus for the casing in that area of the annulus above the packer 36. The tubing 14 is then provided with a slip-joint 14A and is latched onto the packer 36 for communication therethrough and used for removing fluid from below the packer.

Prior to starting the pumping operation, fluid 52, such as steam, hot water or hot oil, is injected into the casing 18 from a reservoir 54 through tubing 56. If oil is used as a diluent it is heated to approximately 560° F. by a heat exchanger 58 and forced into the well by a pump 60. The fluid passes downwardly into the annulus of the casing through the packer 36, tail pipe 38, check valves 42 and out through the tail pipe ports 44. The hot fluids thus reduce the viscid oils to a fluid state while simultaneously diluting the sand content thereof.

Referring more particularly to FIG. 4, the casing annulus above the packer 36 is left in its dry state obtained by removal of the fluid 46 as described hereinabove. A second string of tubing 60, equipped with a slip or expansion joint 62, is run into the casing 18 and latched onto the packer 36 in communication with the tube 38. The dry annulus of the casing 18, above the packer 36, thus serves as an insulating shield so that hot fluids may be injected from the reservoir 54 into the production zone of the well below the packer through the tubing 60. This injection of hot fluids may comprise steam, hot water, hot oil or other fluid as a diluent for blending the crude oil and diluting the sand content. This tubing string 60 has been used in the field for injecting heated nitrogen and carbon dioxide gas at the ratio of 9 to 1 into a well for a selected duration of time. Nitrogen is preferred for its non-corrosive properties while the carbon dioxide gas reduces the viscosity of viscous crude oils. The pump 15 and sucker rods 28 were then operated to recover the well fluids through the tubing 14.

Referring now to FIG. 5, the similarly numbered components illustrated and described for FIG. 4 are installed in the well 16 and a third string of tubing 70 of smaller diameter is concentrically positioned within the tubing 60. The depending end portion of the tubing 70 is connected with a plunger 72 which is cooperatively received in fluid sealing relation by the tube 38. The tubing 70 is provided with a plurality of wall ports 74 adjacent its connection with the plunger 72 in downwardly spaced relation with respect to the packer 36. The purpose of the tubing string 70 is to permit circulation of any of the above named fluids from the reservoir down the tubing 60, out through the ports 74 and to the surface of the earth through the annulus of the tubing 60. The direction of circulation may be obviously reversed, if desired. This circulation of fluid through the tubings 60 and 70 results in a more positive flow of the hot fluids to transfer heat therefrom to the well fluids surrounding the tube 38.

Operation

In operating the apparatus and carrying out the method, the dual packer 36, having the tube 38 attached thereto, is run into the well and set within the casing 18 at a selected position above the oil producing zone. Excess fluid in the annulus of the casing above the producing zone is removed as by bailing or swabbing. The tubing 14 is run into the well and connected with the packer for communication with the well annulus below the packer. The pump 15 is installed within the tubing 14. Hot fluids or gases, as disclosed hereinabove, are then pumped into the annulus of the casing from the surface of the earth to pass downwardly through the packer and tube 38 for diluting viscous oils within the casing and oil sand. In actual practice the casing 18 was provided, at the surface of the earth, with a well head, not shown, and hot nitrogen and carbon dioxide gas, at the ratio of 9 to 1, was pumped into the casing 18 under 1,000 pounds of pressure per square inch for 24 hours. Thereafter the packing mechanism 12 was started for operating the pump 15 while simultaneously continuing the injection of nitrogen and carbon dioxide. In those wells having a relatively low normal fluid level it has been found that the packer 36 and tube 38 may be omitted and the nitrogen and carbon dioxide gas injected into the well and thereafter the diluted viscous oils are removed by the pumping string 15.

Installing the tubing string 60, as illustrated in FIG. 4, results in a reduction in the quantity of gas needed as well as minimizing its temperature loss before coming in contact with the viscous oil in the well producing zone. Obviously the invention is susceptible to some change or alteration without defeating its practicability, and I therefore do not wish to be confined to the preferred embodiment shown in the drawings and described herein, further than I am limited by the scope of the appended claims.

I claim:

1. An apparatus for pumping viscous oil from individual oil wells in an oil producing reservoir, said oil wells having a casing penetrating the oil producing reservoir, comprising: a latch-type dual packer adapted to be run into the oil well and set in said casing adjacent the upper limit of the oil producing reservoir; a tube connected at one end with said packer in depending relation; a check valve in said tube preventing upward movement of fluid therethrough; means for injecting oil diluting fluid into said oil reservoir through said tube; a primary string of tubing adapted to be run into the well and connected with said packer and extending from the surface of the earth to a point in the oil reservoir below said packer; oil pumping means installed in the primary string of tubing; oil well power pumping mechanism connected with said oil pumping means, a secondary string of tubing extending from the surface of the earth within said oil well and connected at its depending end with said tube through said packer; and, a third string of tubing coextensive with and coaxially received by said secondary string of tubing, said secondary string of tubing having a plunger at its depending end sealing fluid tight with the inner wall of said tube above said check valve, said third string of tubing having ports in its wall at its depending end portion above said plunger and below said packer.

2. Structure as specified in claim 1 in which the oil diluting fluids comprises nitrogen and carbon dioxide gases at the ratio of 9 to 1.

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