FIG. 1

FIG. 2

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This invention concerns a novel method and apparatus for increasing the rate of production from petroleum wells. As disclosed and claimed herein, a novel technique is employed for heating the producing well and improving the production thereof. The heating units employed are preferably electrical heaters of substantial capacity. It is the particular concept of this invention that these heaters should be placed in the auxiliary boreholes adjacent to the producing well. In other words, by employing pucking arrangements, the heaters are placed in the auxiliary boreholes so that no heat is lost to fluid flowing through the boreholes in which the heaters are placed. The formation about the producing oil well is thereby effectively heated by conduction.

As a result of this heating technique the reservoir and oil in place about a producing well can be substantially heated; thereby the viscosity of the crude petroleum can be substantially reduced so as to increase the flow rate of this oil through the bottleneck region immediately about the producing well. The result is to increase the effective area of the producing well so as to substantially increase the rate at which oil can be produced therefrom.

In the accompanying drawings is shown a preferred embodiment of this invention utilizing three deviating boreholes from a central producing well bore. In these drawings:

Figure 1 is a plan view of the heating arrangement employed, and

Figure 2 is a cross-sectional elevation view along the line II—II of Figure 1.

It is assumed that a producing well bore identified by the numeral 2 has been drilled into the earth so as to penetrate an oil-bearing formation 3. In accordance with this invention, in order to increase the rate of oil production from borehole 2, a plurality of deviating offshoots are drilled from borehole 2. These deviating boreholes are identified by numerals 4. Standard technique may be used for drilling the desired number of offshoots. For example, at some level near the top of the producing formation or somewhat above the producing formation, a drill deflector 5 may be positioned. Deflectors of this suitable character that are commercially available may be adapted for use in this invention. For example, directional drilling tools of the character illustrated at page 2278 of the Composite Catalogue of Oil Field and Pipeline Equipment, 17th edition, may be employed. Tools of this character are adapted to be fixed at any position in a well bore to cause deflection of a drill bit so as to permit drilling the required deviating borehole. The deviating offshoots may all be drilled from the same level of the producing well bore as illustrated or if desired the deviating boreholes may be drilled from somewhat different levels of the producing well bore. In any case a number of these auxiliary boreholes are drilled so as to extend from the producing well at a substantial angle in a manner permitting separation of the auxiliary boreholes from the producing well by a distance of about 10 to 50 feet in the producing formation. While any desired number of auxiliary boreholes may be drilled, preferably at least three such auxiliary boreholes are employed.

Thereafter, heating units of the general character illustrated are inserted in each of the auxiliary boreholes. The heating units preferably constitute lowest resistance portions identified by numeral 6, which constitute the actual heating elements. For the purposes of this invention it is preferred that the heating elements constitute electrical heaters having a capacity of about 100,000 B. t. u.'s or greater. Immediately above each of the individual heating units is a packing element 7. These packers are adapted to expand in the borehole so as to prevent flow of fluid along the auxiliary boreholes 4.

Again suitable packers for use in this invention are known and commercially available. For example, packers of the character illustrated on page 535 of the Com-
posite Catalogue of Oil Field and Pipeline Equipment, 17th edition, may be employed. These packers are of the character depending upon an explosive charge to seat the packer in the borehole.

When the heating units have been placed in the auxiliary boreholes as described and illustrated, the deviating well plug 5 may be removed. It is convenient to accomplish this by simply dropping the plug to the bottom of the borehole so that the plug will not obstruct flow of fluid from the producing formation 3 into the producing well bore 2. Electrical current will then be supplied to each of the electrical heaters and normal production techniques from borehole 2 may then be carried out.

In the practical utilization of this invention it is convenient in drilling the required auxiliary boreholes to employ an oriented whipstock. A first offshoot may be drilled with this whipstock oriented in a first position. Thereafter, the whipstock may be rotated about 120° in the borehole and a second offshoot can be drilled. Finally, the whipstock can be turned another 120° in the borehole and the third offshoot can be drilled. By similarly rotating the whipstock as the electrical heating units are lowered into the borehole, these units will therefore be directed into each of the auxiliary boreholes.

It will be observed that in the use of this invention, heat dissipated in the heating elements is necessarily transferred directly into the producing formation in the general vicinity of a producing well. None of this heat is uselessly lost by heating of fluid in the auxiliary well bores, since the packers employed prevent any flow of fluid past the heating units. As a result the total heat input employed is effective in heating oil in the course of its flow to the producing well through the bottleneck region of the producing formation; thereby the rate of oil production from each individual producing well can be substantially increased with a corresponding improvement in the ultimate oil recovery which can be economically secured. It is apparent that this invention is of application during any stage of production including the so-called primary recovery and secondary recovery stages.

What is claimed is:

1. A well production arrangement which includes a plurality of auxiliary boreholes spaced about a producing well which penetrates a producing formation, a heating unit positioned in each of said auxiliary boreholes, a packing arrangement positioned within each said auxiliary borehole immediately above the heating unit and adapted to prevent the flow of fluid past the heating unit, each said auxiliary borehole being spaced from the producing well a distance such that heat emitted by the heating unit in each auxiliary borehole heats the producing formation in the immediate vicinity of the producing well.

2. A heating arrangement for a producing well penetrating a producing formation comprising in combination: at least three boreholes deviating and extending downwardly from said producing well at a substantial angle spaced about said producing well, a heating unit of substantial heating capacity positioned in each of said boreholes, a packing element positioned above each of said heating units in each of said boreholes adapted to prevent flow of fluid from said boreholes said bore holes being spaced from the producing well a distance such that the heating unit in each bore hole heats the producing formation in the immediate vicinity of the producing well.

3. The heating arrangement defined by claim 2 in which the said heating units constitute electrical heaters.

4. A method for increasing the rate of production of oil from a producing well that penetrates a producing formation which comprises drilling and spacing a plurality of auxiliary bore holes about the producing well and within the producing formation, introducing heat into the producing formation, introducing heat into the formation of each from each of said auxiliary bore holes while preventing flow of fluids within the auxiliary bore holes, spacing each auxiliary bore hole from the producing well a distance such that the part of the formation heated lies in the immediate vicinity of the producing well, and withdrawing oil from the formation through the producing well.

5. A method for increasing the rate of production of oil from a producing well that penetrates a producing formation which comprises drilling at least three downwardly inclined bore holes into the formation, the bore holes extending and deviating from the producing well, sealing each bore hole from the producing well to prevent fluid flow within the bore hole, introducing heat from each bore hole into the formation in the immediate vicinity of the producing well, and withdrawing oil from the formation through the producing well.

6. A method as defined in claim 5 in which each bore hole is extended about 10 to 50 feet within the producing formation.

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