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METHOD AND APPARATUS FOR PRODUCING OIL WELLS

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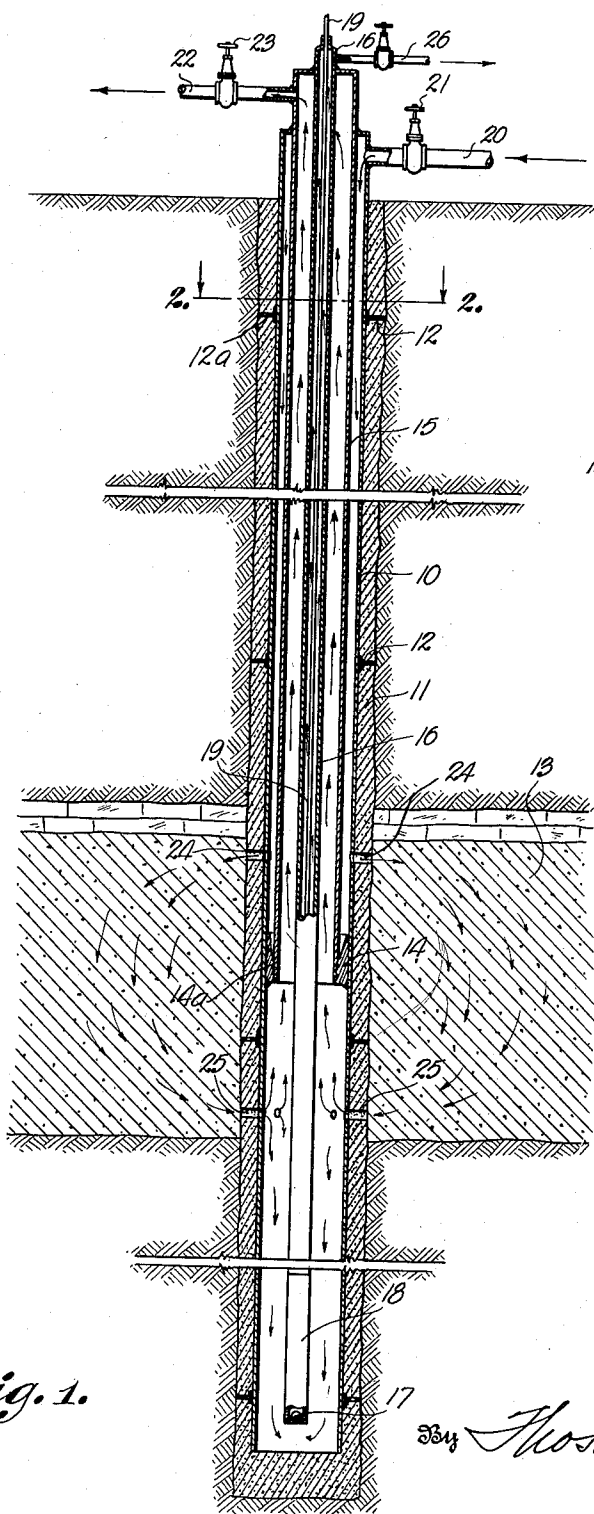


Fig. 1.

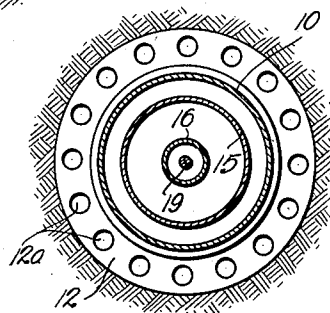


Fig. 2.

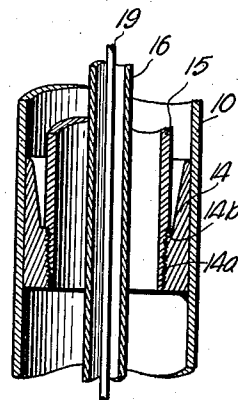


Fig. 3.

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METHOD AND APPARATUS FOR PRODUCING
OIL WELLS

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3 Claims. (Cl. 166—21)

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This invention relates to improvements in a method and apparatus for individually producing oil wells by fluid pressure supplied from the ground level in excess of the rock pressure of the oil sand and producing oil from each well to which pressure is supplied. The method is particularly adapted to secondary recovery operations where the rock pressure is insufficient to move the oil from the sand into the wells.

It is recognized that many types of recovery systems are employed utilizing fluids under pressure supplied from the surface but in these systems it is the usual practice to introduce or charge gas, air or water to the oil sand through one or more wells in order to cause the migration of the oil through the sand to one or more other wells from which oil to be recovered is pumped.

By the present method it is proposed to produce oil from an oil-producing sand by introducing the fluid pressure and producing the oil from the same well. This will eliminate uneconomic and wasteful practices of driving the oil through the producing sand horizontally from the pressure well to a recovery well. It will utilize to the fullest extent and most economically the natural and physical characteristics of the pressure fluid and liquid oil, besides reducing to a minimum the time interval between the commencement of operations and production from the same.

An object, therefore, of the invention is to provide a method by which fluid pressure, including gas, air, water, or other fluid, is supplied to the upper portion of the oil sand to be produced and liquid oil removed from the lower portion of the oil sand into the same well.

Another object is to provide a method for individually producing oil wells by supplying fluid pressure to a well and producing liquid oil from the same well and effecting the initial mixture of the pressure fluid and oil in the producing sand.

Another object is to provide a method for individually producing oil wells wherein the well casing is bonded to the oil sand throughout the producing area to prevent by-passing of the pressure fluid and assuring its passage into the oil sand as a pressure medium for moving the oil into the well.

A further object is to provide a method by which oil wells may be individually produced at relatively low cost by restricting the action of the pressure fluid within a relatively small area, and better control over the pressures applied to the formation.

Other objects will appear from the description which follows.

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In the accompanying drawings which form a part of the instant specification and are to be read in conjunction therewith, and in which like reference numerals indicate like parts in the various views, there is shown a well embodying the invention.

Fig. 1 is a cross sectional view of the well.

Fig. 2 is a view taken along the line 2—2 in Fig. 1 in the direction of the arrows.

Fig. 3 is an enlarged section taken through the joint of the primary or secondary casings located centrally of the producing sand.

The method, briefly stated, is one in which a primary casing 10 is run into the well and is cemented as shown at 11 from top to bottom to the wall of the well. To insure a uniform and satisfactory cementing job, centralizers 12 are used on the outside of the casing with abrading elements, not shown, and the casing is reciprocated during the cementing operation to cause uniform distribution of the cement or sealing substance 11. Midway of the oil producing sand 13 and fixedly attached to the inner wall of the casing 10 is a collar 14. This collar is internally threaded as shown at 14a and has a ground seat 14b at the top of the thread. Concentrically located within the outer primary casing is a secondary casing 15 which extends from above the ground level to the collar and at its lower end is threaded to screw into the threads of the collar. At the top of the threads the secondary casing is also machined to make a pressure-tight joint with the ground seat formed in the collar or a sealing gasket may be used. Details of this construction are best shown in Fig. 3. Within the secondary casing and extending from above the ground level to the bottom of the well is a tubing 16 at the lower end of which is a valve mechanism diagrammatically shown at 17. Above the valve and connected to the bottom of the tube is a conventional type pump 18 operated from the surface by means of sucker rod 19. The power source at the surface for operating the pump has been omitted to simplify the showing since the pump mechanism, including the tubing, pump, valve and power source at the surface, are conventional. Into the primary outer casing above the ground level is connected an inlet pipe 20 controlled by a valve 21 through which fluid pressure is introduced to the well and the oil producing sand. Connected into the secondary casing above the ground level is a pipe connection 22 controlled by valve 23 for relieving well pressure or creating reduced pressure conditions by imposing suction upon this pipe.

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Located in the upper and lower portions of the oil sand and extending from the oil sand through the annular column of cement and into the outer casing are radial passageways 24 and 25.

Before explaining the operation, brief mention should be made of the precautions taken in preparing the well for production. To begin with, the well is drilled in the conventional manner, but instead of drilling into or through the producing sand, the hole is extended below the producing sand for a considerable depth, as indicated in Fig. 1. The sump made in this manner may be of any desired depth of the order of 50 to 100 feet or more. The primary or outer casing 10 is run in the normal fashion, it being of the utmost importance, however, that it is centrally positioned within the well bore. To accomplish this, centralizers and abrading elements are used on the outside of the casing. The casing is preferably reciprocated during mud pumping operations and during the cementing operation to assure uniform distribution of the cement and central positioning of the casing within the well bore. The centralizers 12 in the drawing are shown in the form of horizontally positioned disks perforated as shown at 12a in Fig. 2 to permit free circulation of the mud and cement or sealing substance axially of the well bore. After the outer casing has been run, a cementing job is performed by which an annular column of cement, asphalt or other sealing substances is placed within the well bore outside the primary casing, as shown at 11. Methods used for placing the sealing substance around the casing are conventional, it being important to have a firm bond with both the wall of the well and with the outer periphery of the casing to form a seal wall to prevent by-passing of the pressure medium when it is introduced into the casing.

Prior to running the primary casing in the well there is affixed within a casing section a collar 14. Computations are made to locate the section containing the collar so the collar will be positioned centrally of the oil sand. This collar is preferably welded to the casing to form a pressure-tight joint. The cementing operation follows the running of the primary casing. Passageways 24 and 25 in the upper and lower portions of the oil sand are then shot through the primary casing and cement column. The inner or secondary casing 15 is then run into the well and screwed into the collar at its lower end to form a pressure-tight joint. Tubing 16 is then run with the pump at the bottom and the well head is capped above the ground level by welding the outer or primary casing to the secondary casing, and the secondary casing to the tubing, as shown in Fig. 1. Connections 20 and 22 are made into the primary and secondary casing respectively. A supply of pressure medium with suitable charging pumps, not shown, are connected to pipe 20. This pressure medium may be air, gas or other fluid medium. Suction pumps and a separate valve control relief connection, not shown, are connected to pipe 22. A power source, not shown, for reciprocating pump 18 is connected at the surface to sucker rod 19 or a bottom hole submersible pump may be used to raise the oil to the surface.

It will be noted that the passageways 24 communicate only with the oil sand and the annular space between casings 10 and 15 above collar 14, while passageways 25 provide com-

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munication between the oil sand and annular space between secondary casing 15 and tubing 16. Obviously then, the only communication between passageways 24 and 25 is through the oil sand.

With the producing equipment placed as indicated, pressure medium in the form of air, gas or liquid is supplied to pipe 20 from any suitable convenient source, not shown. This pressure medium is introduced at pressures in excess of the rock pressure in the oil sand, but controlled to enter the oil sand at a rate which will cause gradual migration of the fluid oil from the upper region to the bottom of the sand. Upon being charged through pipe 20, the pressure medium passes down through the annular space between the primary and secondary casings and is forced out of passageways 24 into the oil producing sand 13. If air is used, since it does not blend with the gas and oil in the formation as well as does natural gas, it will form in a pressure pocket surrounding the well bore and extending outward and downward causing the liquids in the sand to move ahead of it in all directions. This movement of fluids in the oil producing formation thus begun causes a general movement in the vicinity of the well downwardly, the pressure effect diminishing at increased radial distances from the axis of the well. As pressures are increased, movement of the fluids in the formation will likewise increase, both with respect to rapidity of movement and over areas influenced.

Egress from the sand other than that provided by the natural porosity of the sand is through perforations 25. These perforations permit liquid oil and gas to enter the bottom of the well, the liquids accumulating in the sump drilled below the producing sand, and the gases rising into the annular space between the tubing and secondary casing. The liquid oil is removed from the sump by pump 18 being discharged from the top of tubing 16 through pipe 26, where it is accumulated in storage, not shown.

To increase the pressure differential between the charged pressure medium and the discharge from the oil producing area, suction may be applied to pipe 22. To more widely distribute the effect of pressure applied to the oil sand through passageways 24, valve 23 may be partially or completely closed, resulting in the building up of pressures in the sump and then holding back fluids from entering through passageways 25. The manner of controlling the application of pressure introduced to the well, or the regulation of gas released from the secondary casing are factors which will be governed to a great extent by conditions which exist in the oil producing formation. In so far as the controls and equipment for applying pressure or relieving pressures are concerned, as well as methods for producing oil after it is accumulated in the well, these factors are all well known to the industry.

The invention, as indicated hereinbefore, resides primarily in running an outer primary casing into the well bore and through the producing formation to form a sump below the oil sand. This casing is bonded to the rock structure throughout the length of the casing by a sealing substance, preferably cement, it being of the greatest importance that the sealing wall or annular column of sealing substance have a satisfactory bond to the formation and casing throughout the depth of the oil sand. It is also important that the passageways through this seal wall into the primary casing are in the prox-

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imity of the top and bottom of the oil formation. The other essential feature to satisfactory operation of the method is the location of the seal joint collar 14 centrally of the oil sand within the outer primary casing and fastened at a pressure-tight joint with the lower end of the secondary casing.

The efficiency of a single well operation is multiplied when a number of wells properly spaced are installed in a producing area. The outward progression of the pressure areas around several wells produced according to the instant method will meet and form a pressure seal against further horizontal progression. To protect the operator against loss of energy and excessive capital expenditures necessary to charge large volumes of gas at high pressures to the producing sand, he may pull whatever vacuum is necessary to produce the pressure differential desired on wells around the rim of his lease to assure holding pressures within his immediately controlled property. In other words, wells individually operated according to the method described around the rim of the lease may utilize greater pressure differentials between the charged pressure medium and the withdrawn gas than those centrally located.

From the foregoing it will be seen that the invention is well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the method and apparatus. It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and sub-combinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the drawings is to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim:

1. An apparatus for producing an oil well which extends below the oil sand to be produced, comprising a primary outer casing extending from the ground level through the oil sand, an annular column of sealing substance in the space between the outer surface of the casing and the wall of the well bonded both to the casing and structure forming the well wall, said column at least spanning the producing sand, a secondary inner casing of lesser diameter than the primary casing and extending from the ground level to a location intermediate the upper and lower portions of the producing sand and connected by

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pressure tight joints to the outer primary casing above ground level and at its lower end to form a closed annular space between the casings, pipe connections into the primary and secondary casings above the ground level, pump tubing of lesser diameter than the secondary casing extending therethrough from the ground level into a sump in the well below the producing sand, passageways through the primary casing and sealing substance and positioned at the oil sand only near the top and bottom thereof, and means to supply pressure to the space between the outer and inner casings.

2. A method of producing oil wells individually in an oil-producing area by fluid pressure supplied from the surface, comprising the steps of cementing a primary casing which extends through the oil sand to form a seal between the casing and the oil sand, to the entire depth of the oil sand, perforating the primary casing and seal within the oil-producing sand adjacent the top and bottom thereof while leaving the casing sealed to the oil sand between the said perforations, positioning a secondary casing of smaller diameter within the primary casing and bonding the former to the latter at pressure-tight joints, one above the oil sand and the other centrally thereof, said last mentioned bond being located intermediate the upper and lower portions of the oil bearing sand, and intermediate the perforations in said casing and seal, introducing a pressure medium through the upper perforation of the primary casing and seal into the top of the oil-bearing sand in excess of the rock pressures existing therein, recovering fluid oil from the bottom of the oil sand, through said lower perforation of the primary casing and seal and through said inner casing.

3. A method as in claim 2 and in which the primary casing extends below the oil-bearing sand and forms a sump for the accumulation of liquid flowing into the primary casing through said lower perforation.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,816,260	Lee	July 28, 1931
1,886,820	Lee	Nov. 8, 1932
2,238,701	McCollum	Apr. 15, 1941
2,290,431	Hoffman	July 21, 1942
2,421,528	Steffen	June 3, 1947