

June 28, 1927.

J. F. RYAN

1,634,085

OIL WELL REGULATION METHOD AND MEANS

Filed July 13, 1925

2 Sheets-Sheet 1

Fig. 1.

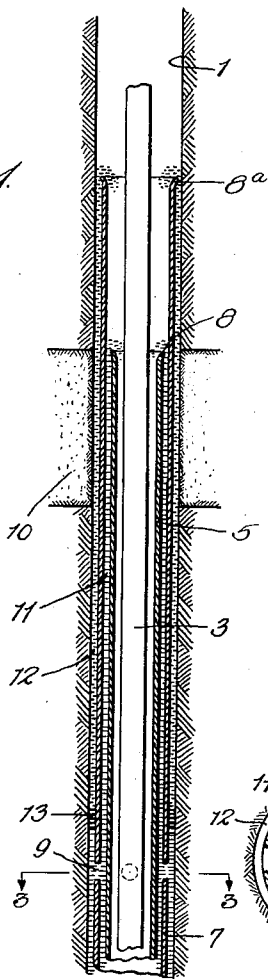


Fig. 3.

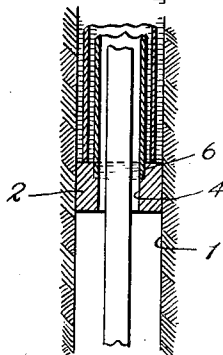
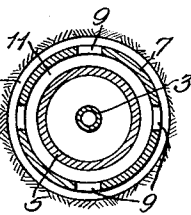
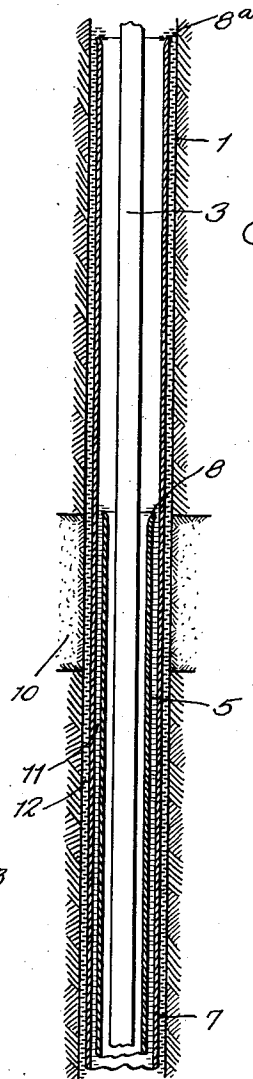


Fig. 4.



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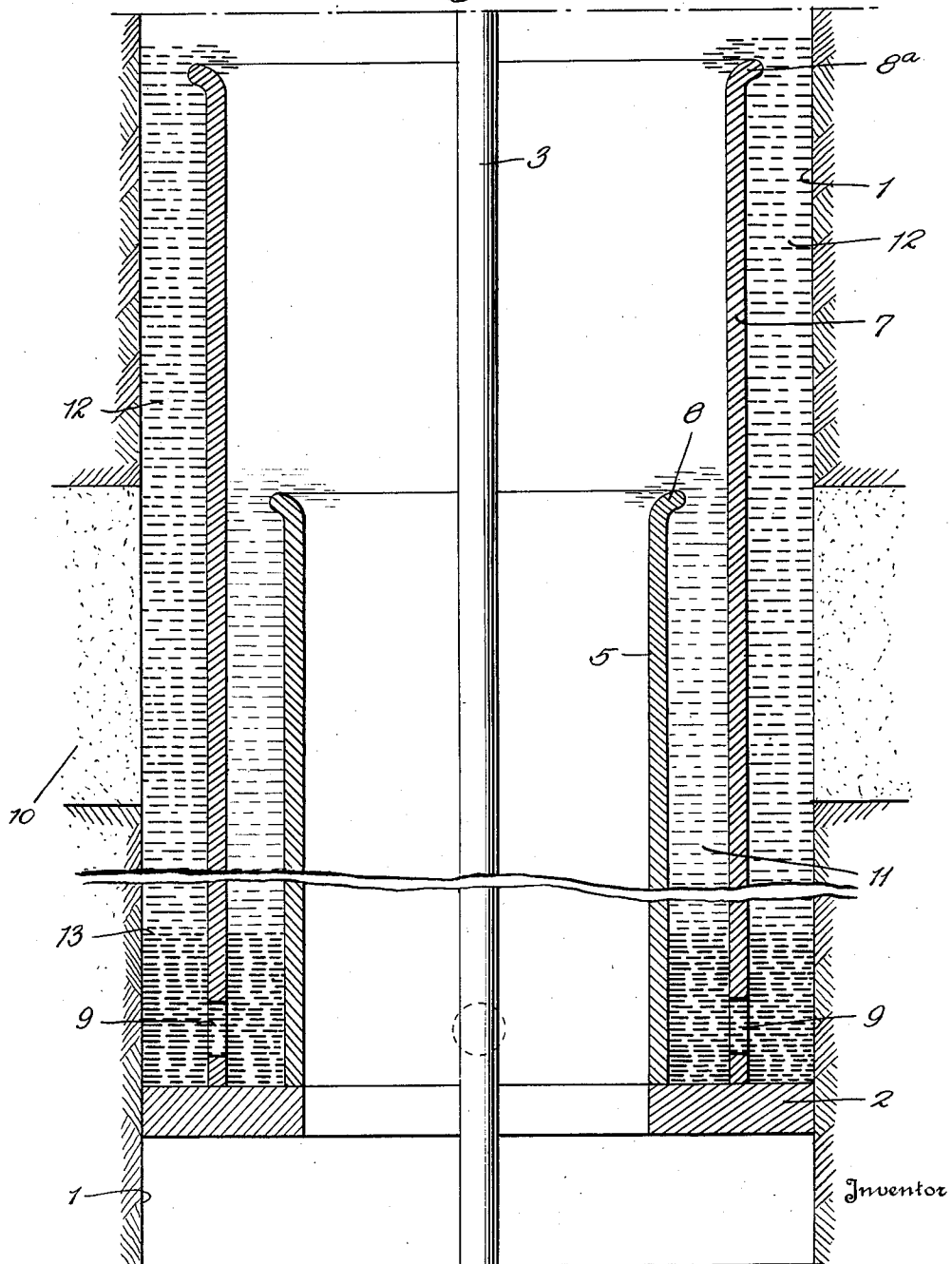
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2 Sheets-Sheet 2

Fig. 2.



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UNITED STATES PATENT OFFICE.

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OIL-WELL-REGULATION METHOD AND MEANS.

Application filed July 13, 1925. Serial No. 43,350.

The invention relates to a method and apparatus for regulating the flow of oil from oil wells and relates more particularly to oil wells which produce by pumping, and under conditions where the oil flow is likely to be impeded and obstructed by reason of the accumulation of water within the well from the producing sand or strata or other sources.

The invention contemplates as a principal object the provision of a method and apparatus whereby a material extent of the surface of the oil producing area constituting the wall of the well is protected from the water by a continuously maintained column of oil; and the protective oil column is maintained adjacent the oil producing surface by means of a separate and independent column of water which cooperates with the oil column.

The invention contemplates further the utilization of the marked variance in the specific gravity between water and the crude oil (about 25% in Pennsylvania crude oil) as a means of maintaining the aforementioned separate and independent oil and water columns.

A further object of the invention is to provide an apparatus or device which is designed to continuously maintain the face of the producing strata covered with oil to prevent the strata from drying up, and to thereby maintain a pressure against the producing strata in order to prevent the too rapid escape of gas. In this manner the producing strata is rendered capable of producing oil with the proper gas pressure until the strata has been completely exhausted of its oil content.

A further object of the invention is to provide an apparatus of the character described by means of which oil producing levels or strata of varying thickness may be continuously covered with oil.

A further object of the invention resides in the provision of an apparatus for carrying out the improved process, which is composed of a minimum of parts, capable of economical manufacture, and which may be conveniently assembled and positioned at any desired and practicable level in an oil well. After the devices have been assembled and positioned within the well, the same may be conveniently removed for inspection and replacement, and are continuously operative without attention to obtain the improvements and advantages desired.

It will be understood that by the invention a double purpose is effected, namely, the oil producing strata in the well is protected and prevented from drying up, and the gas which is an active factor in producing oil is prevented from escaping too rapidly, the flow of gas being such that the maximum amount of oil is carried thereby to the surface of the producing sand.

In oil wells which produce by pumping, it is important and desirable to maintain the oil producing strata or sand completely covered with oil at all times. This is for the reason that otherwise the paraffine will solidify and clog the pores of the sand, thereby impeding the passage therethrough of the oil. It is also important and desirable to prevent water from standing on the producing sand for the reason that the tendency of the water is to penetrate the sand and drive the oil away as well as entrapping the oil in the sand. It has heretofore been found impracticable to obtain oil from two different levels in the same well for the reason that the upper level is exposed and therefore will rapidly dry up. The present invention provides a method and means for keeping the face of the producing sand constantly covered with oil, thereby preventing water from accumulating on the sand, and is further of such nature that the same may be employed on different oil levels in the same well, thereby preventing the uppermost level from drying up as heretofore, and enabling oil to be obtained simultaneously from a plurality of levels.

With the above stated objects in view, as well as other advantages which may be incident to the use of the improvements, the invention consists in the parts and combinations thereof hereinafter set forth and claimed, with the understanding that the several necessary elements constituting the same may be varied in proportions and arrangement without departing from the nature and scope of the invention.

In order to make the invention more clearly understood there are shown in the accompanying drawings means for carrying the same into practical effect, without limiting the improvements, in their useful applications, to the particular constructions and procedure which, for the purpose of explanation, have been made the subject of illustration. In the said drawings:—

Fig. 1 is a vertical sectional view of a pre-

ferred embodiment of the invention as positioned within an oil well shot hole.

Fig. 2 is a similar view somewhat enlarged and diagrammatic in character to better illustrate the principle of the invention.

Fig. 3 is a horizontal sectional view on line 3—3 of Fig. 1.

Fig. 4 is a view similar to Fig. 1 and illustrating a slight modification of the invention.

Referring to the drawings, 1 indicates an oil well shot hole or boring having frictionally or otherwise suitably positioned therein at the desired level the usual packer 2. The pump rod is shown at 3 and may be a tubular member extending downwardly into the well and through a central aperture 4 in the packer. The pump rod tubing 3 and packer 2 form no part of the present invention and are of standard types employed in pumping oil wells of the type in which the present invention is designed to be used. The packer 2 is generally employed for installing a "liner" in an oil well and is lowered to the desired position by means of tubing which is employed to set the packer after which the tubing is released and removed from the well. The packer is held solidly in place by its tendency to expand against the walls of the hole. A usual form of packer is about three to four feet in length and is of an expanding nature. When it is lowered in the hole a turn of the tubing releases a support at the top of the packer and the top is then compressed against the bottom by letting the weight of the tubing or casing down upon it. The rubber casing of the packer grips the wall of the hole and sets itself so firmly that it is generally removed by destroying the rubber.

An inner tubular casing or member 5 is supported by the packer 2, and preferably the lower end of the casing 5 is threaded into the packer as shown at 6. The casing 5 is of a diameter sufficient to provide ample clearance between the same and the pump rod tubing 3. An outer casing is provided and is indicated at 7. As illustrated, the outer casing 7 is of larger diameter than the inner casing 5 and is also preferably of greater length. The outer casing is designed to surround the inner casing, and its lower end may rest loosely on the packer 2 to be supported thereby. The upper ends of the inner and outer casings are suitably flared outwardly as shown at 8, 8^a, to facilitate the insertion therethrough of the pump rod tubing 3; and it will be further apparent that the outward flaring of the top of the inner casing 5 assists in spacing the casing within the walls of the outer casing 7, while the outward flaring of the top of the outer casing 7 assists in spacing the latter within the walls of the well or boring 1.

The wall of the inner casing member 5 is illustrated as smooth and unbroken, but the outer casing member 7 is provided with

a plurality of circumferentially disposed spaced apertures 9 which may be of any desired or preferred number. The distance between the apertures 9 and the packer 2 may vary depending upon working conditions encountered in practice. In Fig. 1 the apertures are located at a considerable distance above the packer, in order that any considerable quantity of loose sand from the shot hole will drop below these apertures and between the latter and the packer 2 to avoid clogging or obstructing the apertures. In Fig. 4 the openings or apertures are located comparatively close to the packer 2, and this latter arrangement may be employed where there is little or no loose sand in the shot hole likely to drop down and obstruct the openings 9.

An oil producing sand or stratum is indicated at 10 and the devices described are so positioned within the well and supported by the packer 2 in such manner that the upper end of the outer casing 7 extends for some distance above the upper limits of this oil producing area. The water accumulating in the well, and which may originate from the zone 10 or from the water producing zones above the packer 2, by reason of its greater density (approximately 25% heavier than Pennsylvania crude oil), passes through the apertures and builds up a column 11 between the inner and outer concentrically disposed casings 5 and 7. The oil exuding from the oil producing sand or zone 10, by reason of its specific gravity of approximately 25% less than water, accumulates within the well on the exterior of the outer casing 7 and forms a column 12 which is supported by the hydrostatic pressure of the water column 11. The respective dimensions of the inner and outer casings 5 and 7 are such that the lower extremity 13 of the oil column 12 is maintained by the water column 11 above the line of the apertures 9, and oil is thereby prevented from entering said apertures into the space between the casings occupied by the water column 11. The excess of water accumulating within the well above the packer is discharged over the upper edge 8 of the inner casing 5 into the bottom of the well, while the excess of oil accumulating on the outside of the outer casing is discharged over the upper edge 8^a thereof into the well.

It will be apparent from the foregoing that by means of the described arrangement of the apparatus, a continuous and uninterrupted column of oil is maintained against the entire extent of the oil producing sand, and the access of water thereto is thereby prevented. The protective covering of oil on the face of the producing sand prevents the water from entering the same to drive away the oil, by reason of the greater density of the water, and this pro-

5 tective oil covering further prevents oil from being entrapped by the water within the sand of the producing strata.

10 The oil flowing over the rim of the outer casing into the well is or may be pumped out by means of the pump tubing 3 according to known and established methods. It is to be understood that the proportions of the inner and outer casings 5 and 7 and the locations of the apertures 9 in the outer casings with respect to the packer, may be varied according to conditions encountered in the operation of the wells, and by increasing the length of the respective casings, the entire surface of oil producing strata of varying areas may be completely and continuously covered with oil.

15 The protective oil covering over the surface of the oil producing sand results in a more even and uninterrupted flow of oil from the sand, as well as rendering the oil strata capable of producing to its utmost extent until the entire supply of oil is exhausted. The protective covering effectively prevents water from entering the sand and trapping a certain proportion of the oil with consequent detriment to the effective and prolonged production of the producing sand.

20 The invention has been illustrated with the outer space or column 12 as consisting mainly of oil, and the inner space or column 11 as consisting entirely of water. It will be understood, however, that these proportions are merely illustrative of one practical embodiment of the invention. By increasing the height of the outer casing member 7 and assuming the producing sand capable of sufficient pressure to raise the column of oil to a height greater than is necessary to balance the inner column of water in the manner illustrated in Fig. 1, the oil would drop down a distance sufficient to permit it to enter the apertures 9. In this event the oil being much lighter than the water would ascend to the surface more rapidly and be discharged over the rim 8 of the inner casing 5 into the bottom of the well through the aperture 4 in the packer 2. It will be further apparent that by increasing the length of the casing 7, column 12 of oil may be extended upwardly to any desired height above the sand or strata 10 to retard the escape from the sand of free gas.

25 In using the apparatus constituting the present invention it is intended to drill the well for a considerable depth below the producing sand, say 80 to 100 feet or more, in order to provide a reservoir for the fluid flowing over the inner and outer casing members. The fluid, consisting of water and oil, is designed to be pumped from the bottom of the well. Assuming the well to be drilled 100 feet below the producing sand, the well will accommodate about 4 barrels of fluid. In the event that the well produces

2 barrels a day it is only necessary to pump the same every two days in order to keep the well clear. The apparatus covered by the present invention performs the desired results continuously and without attention as long as the well is productive. The presence of the protective covering of oil against the surface of the sand provides the desired pressure to retard the escape of the free gas and insures that the latter shall bring forth its maximum amount of oil.

What I claim is:—

1. The method of preventing the access of water to the surface of oil producing strata within an oil well, which consists in trapping the oil and water within the well, maintaining a protective covering of oil adjacent the surface of the oil producing strata, and maintaining a column of water adjacent said column of oil, whereby the higher specific gravity of the water supports the oil column in contact with said oil producing surface, and the water is displaced therefrom.

2. The method of regulating the flow of oil from oil wells which consists in maintaining a column of oil within the well adjacent the surface of the oil producing strata, and supporting said oil column by means of a column of water, whereby said water is prevented from contacting with the surface of said oil producing strata.

3. The method of regulating the flow of oil from oil wells which consists in constantly maintaining a protective covering of oil on the circumferential surface of the oil producing strata within the well by means of hydrostatic pressure.

4. The method of preventing the access of water to the surface of the oil producing strata within an oil well, which consists in trapping the oil and water within the well, maintaining a protective covering of oil against the surface of the oil producing strata, and maintaining a laterally connected column of water adjacent said column of oil, whereby the hydrostatic pressure of the water column supports the oil column in contact with said oil producing surface, and the water is excluded therefrom.

5. An apparatus for regulating the flow of oil from oil wells, comprising in combination: a packer positioned within an oil well, an inner casing on said packer, an outer casing on said packer, and spaced from said inner casing, said outer casing having an opening for communication between the oil column space and the space between said casings, the space between said outer casing and the wall of the well being designed to receive a column of oil and the space between said inner and outer casings being designed to receive a column of water, said water reaching said space between said casings through said opening and maintaining

said oil column on the exterior of said outer casing by the higher specific gravity of said water column.

6. An apparatus for regulating the flow of oil from oil wells, comprising in combination: a packing member positioned within an oil well boring, a plurality of casing members supported by said packing member, the innermost of said casing members being disposed within the adjacent casing member and spaced therefrom, and the outermost of said casing members being spaced from the walls of the well boring and terminating at its upper end at a higher level than the top of the innermost casing member, said outermost casing member being arranged to afford communication between the spaces on each side thereof from below the tops of said casing members, whereby separate fluid columns are maintained in said oil well.

7. An apparatus for regulating the flow of oil from oil wells, comprising in combination: a packing member positioned within an oil well boring, a plurality of casing members supported by said packing member, the innermost of said casing members being disposed within the adjacent casing member and spaced therefrom, and the outermost of said casing members being spaced from the walls of the well boring adjacent the oil producing strata and communicating with the space between said casings, whereby fluid columns of fluids of different specific gravity are maintained in said oil well by the hydrostatic pressure of the inner fluid column so that the oil in the outer fluid column is maintained in contact with the oil producing strata.

8. An apparatus for preventing the access of water to the surface of oil producing strata in an oil well, comprising in combination: a packing member positioned within an oil well boring, a pair of casing members supported by said packing member adjacent the oil producing strata, one of said casing members being disposed within the other and spaced therefrom, and the other of said casing members being spaced from the walls of said well boring, and means affording communication between said casing members, whereby laterally connected fluid columns are maintained by hydrostatic pressure in said oil well above said packing member, and the outer fluid column is maintained in contact with the oil producing strata.

9. An apparatus for regulating the flow of oil from an oil well, comprising in combination: a packing member positioned within an oil well boring, a plurality of casing members supported by said packing member, the innermost of said casing members being disposed within the adjacent casing member and spaced therefrom, and the outermost of said casing members being

spaced from the walls of the well boring and apertured for communication between the spaces on each side of said outermost casing member, whereby fluid columns of different heights are maintained within said spaces by hydrostatic pressure.

10. An apparatus for regulating the flow of oil from an oil well, comprising in combination: a packing member disposed within an oil well boring, a plurality of casing members disposed above said packing member, the innermost of said casing members being contained within the adjacent casing member and spaced therefrom, and the outermost of said casing members being spaced from the walls of the well boring adjacent the oil producing sand thereof and apertured for communication between the spaces on each side of said outermost casing member, whereby laterally connected fluid columns of different density are maintained within said spaces, and the fluid column of lesser density is maintained within the outer of said spaces in contact with said oil producing sand by the hydrostatic pressure of the fluid column of greater density contained within the inner of said spaces.

11. The method of regulating the flow of oil from oil wells which consists in constantly maintaining a protective covering of oil within the well adjacent the surface of the oil producing strata, and supporting said oil column by means of a balancing column of water, whereby the escape of free gas from the producing strata is retarded and the life of the well prolonged.

12. The method of regulating the flow of oil from oil wells which consists in constantly maintaining an hydraulically balanced protective covering of oil on the surface of the oil producing strata whereby the pressure of said oil covering retards the escape of gas from said strata.

13. Apparatus for maintaining a protective oil column to the depth required to keep covered with oil the exposed surface of the oil-bearing stratum or strata in an oil well comprising, in combination: an inner casing to confine a balancing water column; a higher outer casing to confine an oil column, said outer casing being spaced from said inner casing and from the wall of the well; said outer casing being arranged to afford communication between the two spaces from below the depth of the required oil column; the difference in the height of the outer casing to confine the oil column and the inner casing to confine the balancing water column being substantially that fraction of the total depth of the required oil column which measures the difference between the specific gravities of the oil and water, whereby the oil column is maintained to a sufficient depth to keep covered with oil the exposed surface of the oil-bearing stratum or strata.

14. A method of maintaining a protective oil column to the depth required to keep covered with oil the exposed surface of the oil-bearing stratum or strata in an oil well which consists in maintaining a column of oil within the well adjacent the surface of the oil producing stratum or strata and supporting said column of oil by means of a shorter column of water, the difference in the height of the column of oil and the balancing column of water being substantially that fraction of the total depth of the required oil column which measures the difference between the specific gravities of the oil and the water, whereby the oil column is maintained to a sufficient depth to keep covered with oil the exposed surface of the oil-bearing stratum or strata.

In testimony whereof I have hereunto set my hand.

JOSEPH F. RYAN.