

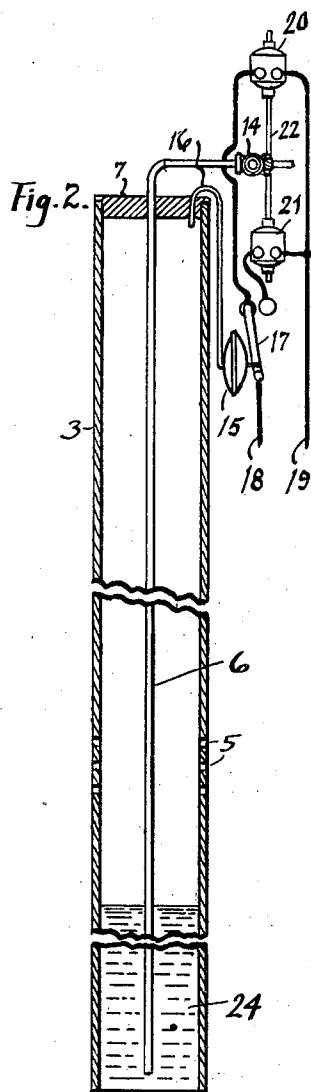
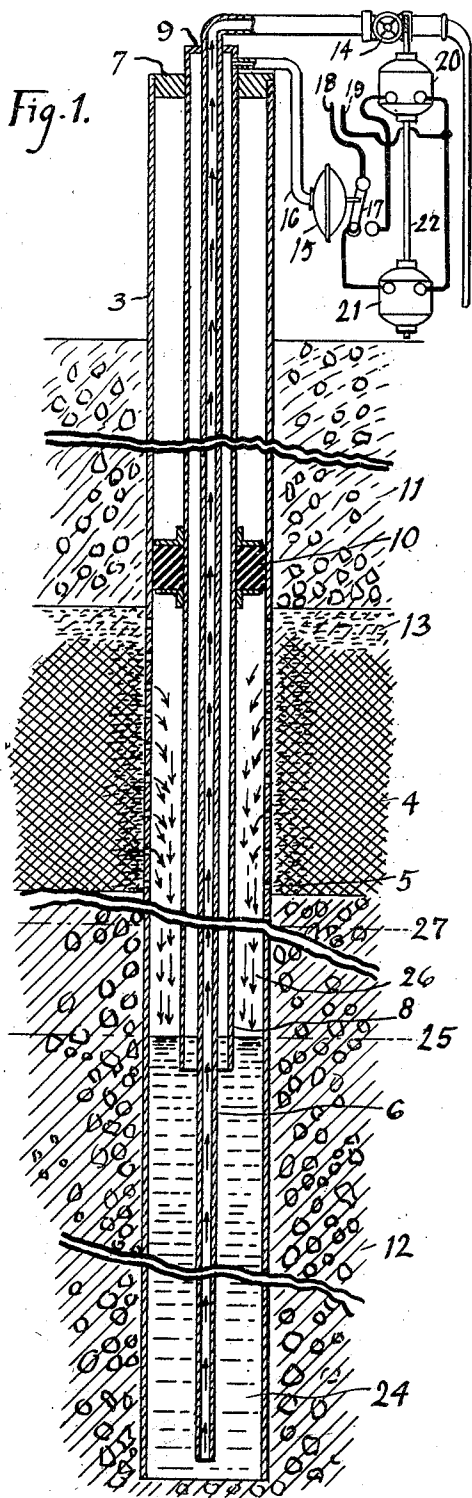
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SUBTERRANEAN AUTOMATIC OIL WELL CONTROL

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SUBTERRANEAN AUTOMATIC OIL WELL CONTROL

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This invention relates to an improved method and apparatus for recovering hydrocarbon oils from the earth without disturbing the gas or hydrostatic pressure, or equilibrium thereof in the earth structures.

The objects of the invention are to provide an improved method and simple and efficient apparatus for extracting the hydrocarbon oils without reducing or disturbing the gas or hydrostatic pressures in the earth structures, to recover a maximum percent of the hydrocarbon oils, to produce the hydrocarbon oils with a minimum of equipment, to control the flow of the hydrocarbon oils, and to produce hydrocarbon oils with bottom and edge-water troubles eliminated.

Hydrocarbon oils, water and various gases have accumulated in structural earth traps, through hydrostatic and gravitational forces and pressures. Laboratory experiments show that under several hundred pounds of pressure, oil travels easily through oil stratum, and that under suitable pressure and within the earth formations, the oils have a proportionately high temperature whereby hydrocarbon oils attain utmost freedom from viscosity, and test wells show temperature to be maintained uniformly throughout an oil bearing structure.

In all prior methods of producing oil, a hole has been drilled into the oil structure, and the gases, oil elements and pressures have been allowed to mingle and escape. Release of pressure causes immediate decrease in oil temperature, thereby causing viscosity throughout the oil structure from edge water to flow string. Under these prior conditions, it is estimated that but twenty per cent of the oil is recovered.

Given a virgin untouched structure, a well can be so constructed and regulated that the original conditions, pressures and temperatures may be maintained until practically all of the liquid hydrocarbon oils have been extracted from an oil bearing structure.

Under my method and with the use of my improved apparatus, the original temperatures and conditions are retained, the hydrocarbon oils then contract in original volume through the external conditions responsible

for the original accumulation of the oils, which retain their freedom from viscosity, and, whereby, through retention of original pressure and temperature, they will flow freely and much more rapidly through the oil structures than any laboratory experiment has shown.

To accomplish these objects, I employ a method and a certain form of well construction whereby the temperature is maintained in the oil structure of the earth, whereby the oil is separated and entrapped below the oil structure, and whereby an intermediate pressure controls the flow of the entrapped oil from the well.

The apparatus embodies a practically non-leaking well casing, a perforated section therein extending in the oil bearing structure of the earth, an entrapping section below the oil bearing structure, a discharge tube extending substantially from the bottom of the well to the top thereof, a seal within the well casing above the oil bearing structure of the earth, control means for the discharge tube at the top thereof, and a tube concentric with the discharge tube and containing the intermediate pressure to actuate the control means.

The accompanying drawing illustrates the apparatus and method of constructing a well which I have so far found to be the most practical in carrying out the present invention.

In the drawing: Figure 1 is a vertical section of a well provided with control apparatus in accordance with my invention. Fig. 2 is a modified form of well construction and apparatus.

Referring more particularly to the drawing, well casing 3 extends from the top to the bottom of a well, and, in that portion of the casing passing through the oil bearing structure 4, I provide a series of perforations 5, each of less diameter than the interior diameter of discharge pipe 6, which extends from the bottom of the well to the top thereof, and through well cap 7. A pressure tube 8 is concentric with discharge pipe 6, and extends to the top of the well, and terminates a distance below the oil bearing earth structure, and above the bottom of pipe 6. Pressure tube 8 has a cap 9 at the top through

which pipe 6 extends. A seal 10 is disposed in the well casing above the oil bearing structure 4, and tube 8 and pipe 6 extend there-through. The well casing consists of sealed pipe, preferably welded pipe, and the pipe 6 and tube 8 are of similar construction. Earth strata 11 and 12 are such as to form a trap for hydrocarbon oils, gas and pressures that may be found in oil strata 4. A gas bearing strata 13 is usually found above oil strata 4. A valve 14 controls the discharge pipe 6, and is actuated to open and closed position through intermediate pressure in pressure tube 8. As one example of means whereby pressure actuates the valve 14, I provide a pressure-actuated valve 15, connected through tube 16 with pressure tube 8, and actuating an electric switch 17, which controls electrical energizing conductors 18 and 19 to electric motors 20 and 21, adapted to turn shaft 22 in opposite rotary directions, as either motor is energized, and thereby to open or close control valve 15.

Without pipe 8 the well casing would have a chilling effect on delivery pipe 6, and thereby retard the expansion and flow of oil. By providing pipe 8, the outgoing oil in discharge pipe 6 is maintained at its original high temperature until it is at or near the top of the well, and whereby the oil will attain greater expansion and thereby flow more readily and at higher levels.

Many deep wells have the well casing more or less injured by the boring tools, and in some cases there are sections of the well casing that are separated from one another and allow pressure to leak therefrom. I avoid this leakage by providing the packer 10 which confines the pressure to the interior of the well at and below the oil-bearing earth structure.

There is no gas in the discharge tube except that which is in solution in the oil. The expansion occurs only when the release valve is opened. The pressure in pressure tube 8 may be the same as in the oil-bearing earth structure or it may be less. No pressure can escape from tube 8 but it varies by the rise and fall of the oil level therein and therefore will actuate control valve 14 as set forth.

In the modified form of well construction as shown in Fig. 2, the well casing 3 and discharge tube 6 are similar in arrangement as shown in Fig. 1, but the packer and pressure tube have been omitted. A well constructed as in Fig. 2 without the packer and pressure tube, might under perfect and ideal conditions, operate to recover oil in the manner that the well shown in Fig. 1 operates.

Separated oil 24 appears in the bottom of the well to the lower level indicated by line 25, and arrows 26 represent oil that is percolating from perforations 5 above the upper oil level 27.

My improved method of recovering oil without perceptibly disturbing the natural

temperature of the oil bearing earth strata consists in constructing a well as shown, having a perforated section extending through the oil bearing strata, in placing a seal 10 in the well casing at a point above the oil bearing strata, in forming an oil entrapping section below the oil bearing strata, in providing a discharge pipe extending from the bottom to the top of the well, a valve to control the discharge pipe, means for actuating the valve to open and closed positions, and in providing a pressure tube co-extending with the discharge tube at the top whereby to utilize the pressure for actuating the valve actuating means. As the pressure within the well as constructed will be the practical equivalent of the pressure within the earth structure of the oil bearing strata, the resultant temperature of the oil will remain the same, and, under the uniform conditions of pressure and temperature, the oil, will gravitate and settle into the settling portion of the well, and will accumulate in the discharge tube. As the settled oil approaches the level indicated by line 27, it has compressed the gas or entrapped air in compression tube 8 and in pressure-regulating valve 15 sufficiently to actuate electrical switch 17 and thereby energize electric motor 20, whereby to open control valve 14. A quantity of oil is then discharged from tube 6, and the settled oil will lower its level to the line 25, thereby reducing compression in tube 8 and valve 15, thereby to actuate switch 17 and energize motor 21, and thereby to close valve 14. The settled oil will then increase in the well and the cycle will be repeated. In the event the oil level falls below the bottom end of compression tube 8, gas will flow therein and restore the equilibrium of pressure. With this improved well construction and apparatus, the original temperature of the oil bearing strata, the settled oil, and the oil within the discharge tube, are practically maintained.

It may be noted that, while this apparatus operates to control the flow of oil intermittently from a well having a natural high pressure, it will operate as well to automatically control an oil well pumping apparatus, starting and stopping the same in accordance with the amount of oil within the well.

The compression pipe may be carried upwardly at the side of the discharge pipe, and will provide pressure whereby to control the flow of oil from the discharge pipe, but, in such a case, will not provide heat-insulating means for the upper portion of the discharge pipe, although the upper space within the well casing serves this purpose.

With the use of my improved apparatus, gases and oils are maintained in their respective conditions of gravity, temperature and pressure, both within the oil-bearing structure and within the apparatus, and no expansion or release of pressure, or reduc-

tion of temperature occurs until final release of the oil from the discharge tube.

What is claimed is:

1. An apparatus for recovering oil, comprising a non-leaking well casing, a seal within the casing and above the oil-bearing structure, a discharge tube within the casing and extending from the bottom to the top of the well and through the seal, a heat-insulating and compression casing surrounding the discharge tube, a valve at the top of the discharge tube, and means for actuating the valve to open and closed positions actuated by the pressure within the compression tube.
2. An apparatus for recovering oil, comprising a non-leaking well casing extending from the surface to the oil-bearing structure and serving as a compression chamber, a discharge tube within the casing having an open bottom terminal at the bottom of the well and extending to the top of the well, a cap to seal the top of the well, the discharge tube extending therefrom, a valve at the top end of the discharge tube, means for actuating the valve to open and closed positions, and pressure actuated means actuated by the pressure within the well casing for operating the valve actuating means.
3. An apparatus for recovering oil, comprising a non-leaking, heat-insulating, and compression well casing extending from the surface to the oil-bearing structure, a discharge tube within the well casing and extending from the bottom to the top of the well, a control valve at the top end of the discharge pipe, means for actuating the valve to open and closed positions, and operating means for the valve actuating means, actuated by pressure within the well casing.
4. An apparatus for recovering oil, consisting of a well casing, a discharge tube within the well casing extending from the bottom of the well below the oil-bearing structure to the top of the well, and open at its bottom terminal, a seal at the top of the well casing, a valve at the top of the discharge tube, and means for opening and closing the valve through pressure from the compression well casing.
5. Apparatus for recovering oil, consisting of a non-leaking well casing extending from the surface of the earth to a depth below the oil-bearing structure, and including a perforated section extending through the oil-bearing structure, a discharge tube within the casing and extending from the bottom to the top of the well, and having an open terminal end at the bottom, a seal within the casing and above the level of the oil-bearing structure, a heat-insulating and compression casing co-extending with the discharge tube, and to the top of the well, a valve at the top end of the discharge tube, and means for actuating the valve to open

and closed positions through the pressure within the compression casing.

6. Apparatus for recovering oil, consisting of a non-leaking well casing extending from the surface of the earth to a depth below the oil-bearing structure, and including a perforated section extending through the oil-bearing structure, a discharge tube within the casing and extending from the bottom to the top of the well and open at its bottom terminal, a seal within the casing and above the oil-bearing structure, a compression and heat-insulating casing surrounding the discharge tube, valve control means disposed at the top of the discharge tube, means for actuating the valve control means through pressure from the compression casing, and a valve controlling the discharge tube mounted at the top end thereof and actuated by the valve control means.

7. Apparatus for recovering oil, comprising a well casing, a discharge tube within the casing and extending from the bottom of the well below the oil-bearing structure to the top of the well and open at its bottom terminal, a seal at the top of the well casing, an inner casing terminating above the bottom terminal of the discharge tube and otherwise co-extending with the discharge tube, a valve at the top of the discharge tube, means for opening and closing the valve, and means for governing the opening and closing means actuated by pressure from the inner compression casing.

8. Apparatus for recovering oil, comprising a well casing, a discharge tube within the casing, open at the bottom and extending to the top of the well, a compression casing terminating above the bottom of the discharge tube and otherwise co-extending therewith, a release valve at the top of the discharge tube, and control and actuating means for the valve actuated by pressure from the compression casing.

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