

April 26, 1938.

H. C. WOLF

2,115,378

PROCESS FOR SECONDARY RECOVERY FROM OIL WELLS

Filed Feb. 2, 1937

2 Sheets-Sheet 1

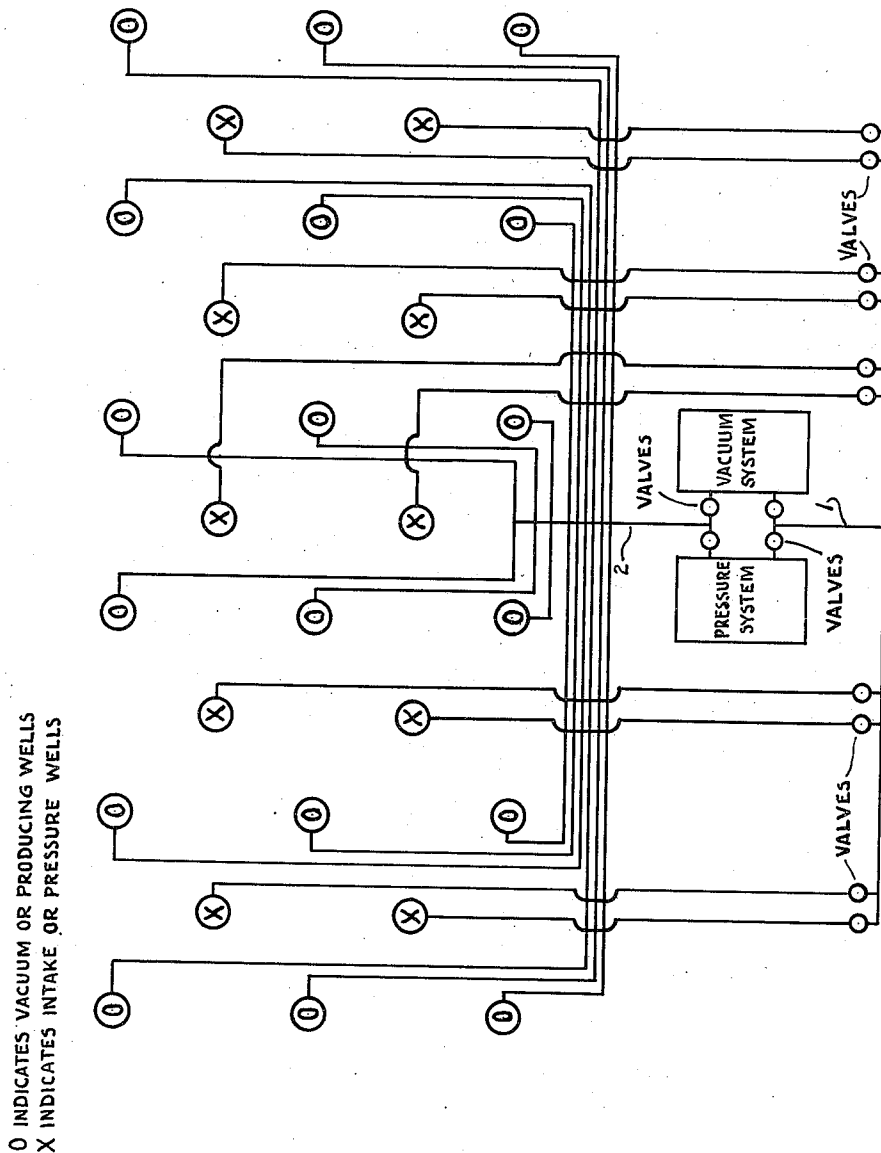


FIG. 1

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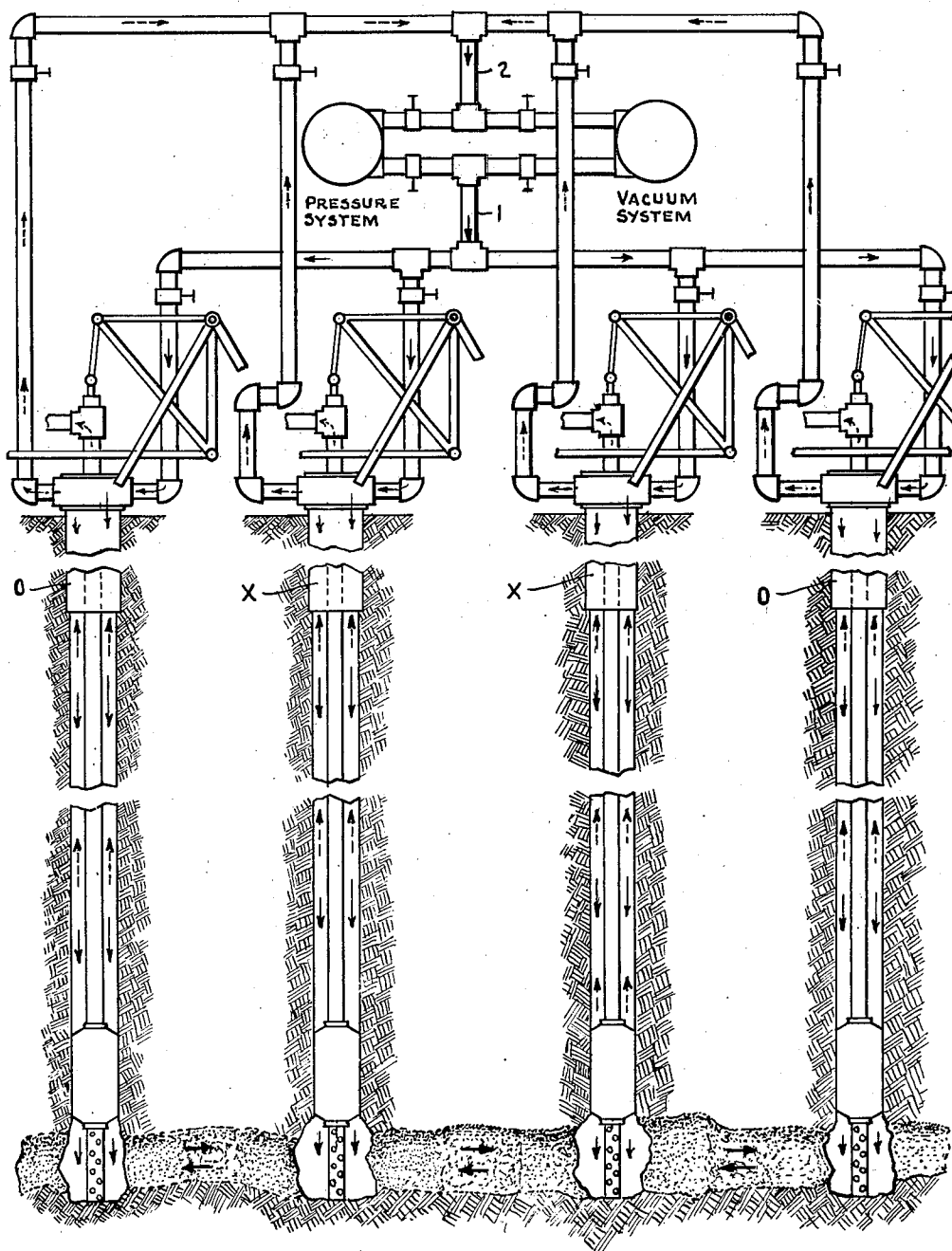


FIG. 2

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UNITED STATES PATENT OFFICE

2,115,378

PROCESS FOR SECONDARY RECOVERY
FROM OIL WELLSHarry Comer Wolf, Irvine, Ky., assignor to Arnold
R. Hanson and S. Willner Hanson, trustees

Application February 2, 1937, Serial No. 123,596

7 Claims. (Cl. 166—21)

My invention relates to the method, sometimes termed secondary method, for increasing the production of oil wells on a given lease.

This application relates more specifically to the one set forth in my application Serial No. 82,828, filed June 1, 1936, of which this is a continuation in part.

It is commonly known that by ordinary methods all oil cannot be recovered from a producing oil formation; after the normal production ceases from the natural flow caused by natural gas or water pressures exerted underground, various types of pumps or lifts are next conventionally utilized, until finally even these mechanical methods cease to produce enough oil to be profitable. At that time wells are usually abandoned.

For some years various methods of reduced pressures or elevated pressures have been utilized, to obtain further recovery from such wells, in so doing artificial pressures are supplied to replace the original substructure pressures. These pressure methods are commonly known as repressuring or secondary recovery.

As secondary recovery methods are put into use, it is found that ordinary methods used prior to this secondary period, have usually recovered variously from eight per centum to thirty per centum of the oil in the producing horizon, leaving available for recovery by secondary methods, variously from seventy per centum to ninety-two per centum of the oil originally in the structure.

My method comprises a combination of vacuum and fluid pressure developed by applicant's practical experience extending over a considerable period of years in the oil fields during which the method hereinafter described has been actually and successfully employed.

The principal object of my invention is to increase and maintain the permeability of the oil sands of each and every well on a lease for all of the area surrounding each individual well. I accomplish this by first determining the critical pressure which establishes the static balance between the permeability of the sands and the viscosity of the oil.

A further object is to permit the use simultaneously of every well as a producing unit rather than closing certain ones which are used to convey pressure to the sands in the former practice.

A further object is to provide a method which when employed will periodically produce from all oil wells on a lease utilizing reduced or elevated pressures alternately on each well, thereby increasing production of the lease as a whole by reason of the utilization of each and every well

thereon instead of necessitating part of the wells not being pumped because of being continually used as intake pressure wells.

A further object is to provide a method of increasing the profitable operation of an oil lease by reason of the use of my method to regulate and stabilize the production of oil from an oil producing property, and also by reason of the fact that this method will increase the ultimate total oil recovered from a given structure containing oil.

In the drawings which are hereunto annexed and made a part of this specification, I illustrate more or less graphically a typical oil lease and apparatus to employ my method. It should be understood that they are only for illustrative purposes, as many forms of apparatus can be used to carry out my method.

My means of accomplishing the foregoing objects may be more fully comprehended by having reference to the accompanying drawings, which are hereunto annexed and are a part of this specification, in which:

Fig. 1 is a graph of a typical oil lease equipped with apparatus to employ my improved process or method.

Fig. 2 is a view of a group of wells showing the pump jacks, and cylinders, casings with their connections to the compressor and vacuum pump and a diagrammatic section of the rock and sand. Similar reference numerals refer to similar parts throughout the entire specification.

In employing my method, if new wells are to be drilled to supplement wells already existing, I try to drill them on the commonly termed five-spot plan, as shown in Fig. 1; but if sufficient wells are already drilled, I connect them as nearly as possible in conformity with this plan.

As shown in the drawings, intake or pressure wells are indicated as X, and the vacuum, producing wells are indicated as O. I connect each well to a central manifold 1 as shown on the drawings, or each group of wells to a common line, common to each group of wells X and O. I connect a vacuum pump of standard type of suitable dimensions and suitably powered to the common line or manifold 1 to which the X wells are connected and I connect the discharge side of a suitable compressor or pump of any well known make to the common line or manifold 2 to which the O wells are connected.

In order to determine the critical pressure by which to establish the static balance between the permeability of the sands and the viscosity of the oil, I first take a gauge record of the pressure

on the well. In some instances, it requires tremendous volume before pressure begins to build up a well. In other instances, pressure will build up in a few minutes. After determining this time-volume factor by frequent gauge tests over a period of hours or days, as may be necessary, I find in practice that I can then set the regulators proportionately, or in general, I have observed that the greater amount of time taken to build up pressure in a well, the higher is the critical pressure for the establishment of the required static balance.

My reasons for this operation are purely economic, in that it permits me to pump wells while said wells are being subjected to pressure, whereas, the conventional method of repressuring oil structures takes the pressure well out of production while it is under pressure.

I find in practice that it is necessary, after the initial steps of taking gauge pressures first above mentioned, to check the reactions on each well by actual trial, as I am only able to determine within plus or minus 2 lbs. gauge pressure, the exact pressure underground that establishes the condition of static balance which I desire. For example, by the gauge tests above referred to, I might determine that a well will pump while being subjected to a pressure of five (5) lbs. per square inch gauge, which is, at the elevation where I am working, 19.3 lbs. per square inch absolute pressure; though my determination is five (5) lbs. per square inch, I find in practice that due to variation in underground well equipment, it might be four (4) lbs. or it might be six (6) lbs.

By following this procedure, I have achieved by this method in the field what might be termed revivification of depleted oil wells, as for example, wells that have not produced for several years more than three (3) to five (5) gallons of oil per day, have been brought into production ranging from thirty (30) to sixty (60) gallons per day by the use of this method, and they are pumped simultaneously with the other wells thus materially increasing the productiveness of the field or lease. For example, if there are fifty (50) wells on a lease and ten (10) are used for repressuring, under the old practice, these ten (10) are no longer producing, whereas by my process every well is a producing well and as a consequence, in the given case, there is a twenty (20%) per cent increase.

In operation I can suddenly change the X wells to the compressor and the O wells to the vacuum, by simply changing the valves at the centrally located control point, without going to each well to effect such change. By doing this, I find in practice that the sudden or instantaneous reversal of the direction of flow of the oil in the structure, due to the combination of reduced pressure in the producing O wells, and the pressure applied to the oil in the structure through the intake X wells, results in a cleaning out of the pores of the producing structure.

I also find in practice, that instead of producing only from the O wells, I can at periodic intervals produce from the X wells simultaneously, and the O wells. Such is not common practice; on the contrary, it is common practice to use

installations that result only in production from the O wells, thereby losing much production that I find in practice with my method, can be obtained from wells ordinarily restricted from production by reason of their use as pressure or intake wells.

Having described my invention, what I regard as new and desire to secure by Letters Patent is:

1. The process of producing oil which resides in forcing into a pressure well a repressuring medium in order to force the oil in the formation to adjacent wells and simultaneously therewith pumping oil from these adjacent wells and then changing the pressure well to a vacuum well and the adjacent wells to pressure wells whereby no idle well is left.

2. The process of producing oil which resides in forcing into a pressure well a repressuring medium in order to force the oil in the formation to adjacent wells and therewith pumping oil from these adjacent wells and then changing the pressure well to a vacuum well and the adjacent wells to pressure wells simultaneously at periodic intervals, whereby no idle well is left.

3. The process of producing oil which resides in forcing into a pressure well a repressuring gaseous medium in order to force the oil in the formation to adjacent wells and simultaneously therewith pumping oil from these adjacent wells and then changing the pressure well to a vacuum well and the adjacent wells to pressure wells, whereby no idle well is left.

4. The process of producing oil which resides in forcing into a pressure well a repressuring gaseous medium in order to force the oil in the formation to adjacent wells and therewith pumping oil from these adjacent wells and then changing the pressure well to a vacuum well and the adjacent wells to pressure wells simultaneously at periodic intervals, whereby no idle well is left.

5. The process of producing oil which resides in first determining the critical pressure which establishes the static balance between the permeability of the sand and the viscosity of the oil, then forcing into a pressure well a repressuring medium in order to force the oil in the formation to adjacent wells and simultaneously therewith pumping oil from these adjacent wells and then changing the pressure well to a vacuum well and the adjacent wells to pressure wells, whereby no idle well is left.

6. The process of producing oil which resides in forcing into a pressure well a repressuring medium in order to force the oil in the formation to adjacent wells and simultaneously therewith pumping oil from these adjacent wells and from the repressuring well, and instantly changing the pressure wells to vacuum and the vacuum to pressure wells whereby all wells may be used for production.

7. The process of producing oil which resides in forcing into a pressure well a repressuring medium in order to force the oil in the formation to adjacent wells and therewith pumping oil from these adjacent wells and from the repressuring well simultaneously at periodic intervals, and instantly changing the pressure wells to vacuum and the vacuum to pressure wells.

HARRY COMER WOLF.