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F. SQUIRES.

METHOD OF RECOVERING OIL AND GAS.

APPLICATION FILED MAR. 9, 1916.

**1,198,078.**

Patented Sept. 12, 1916.

2 SHEETS—SHEET 1.

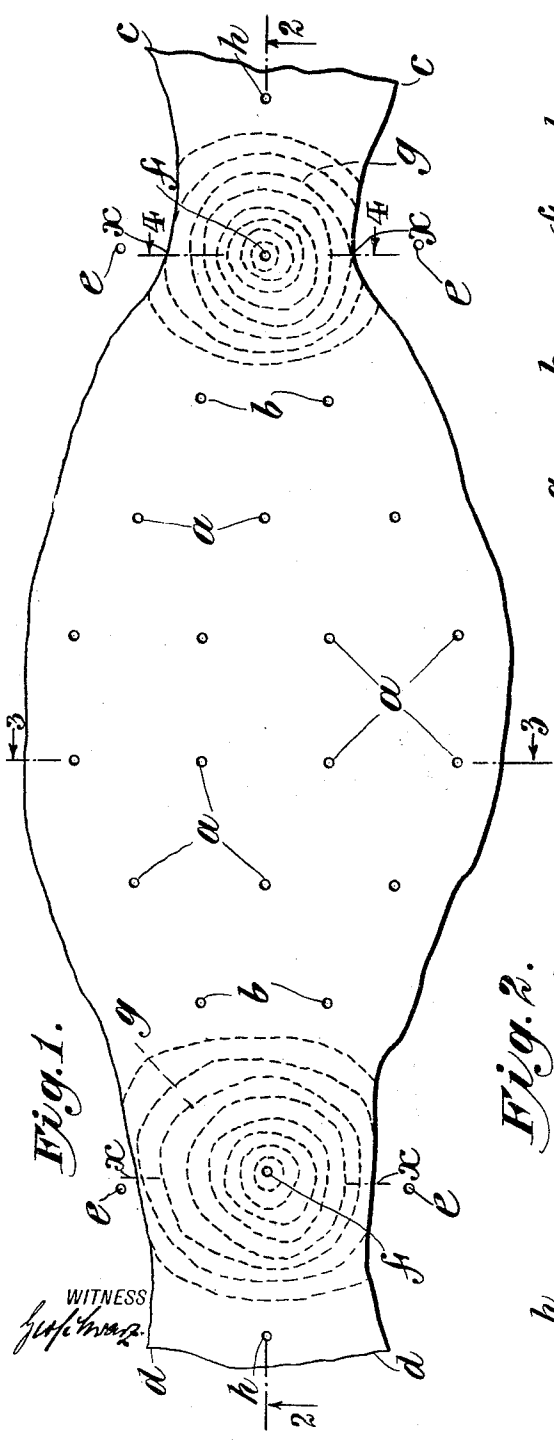



Fig. 1.

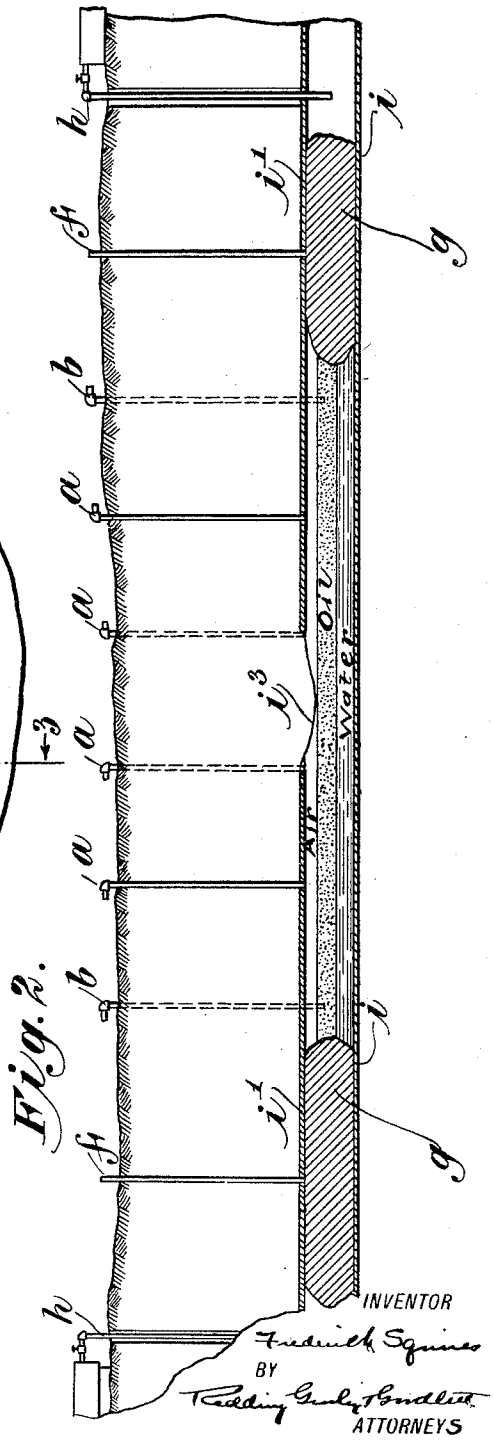



Fig. 2.

WITNESS

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2 SHEETS—SHEET 2.

Fig. 3

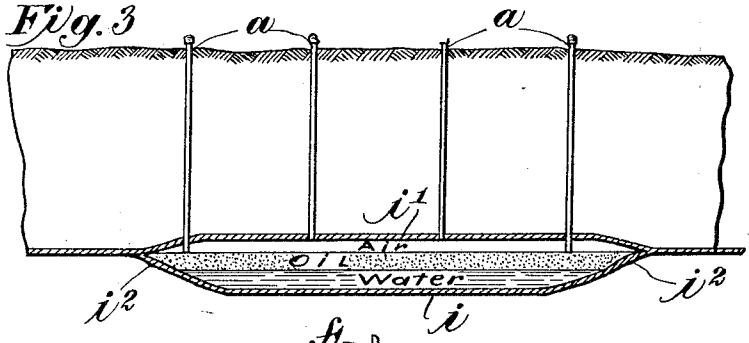



Fig. 4.

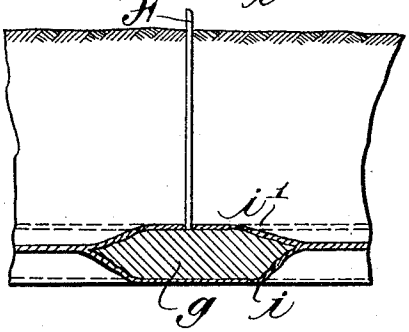



Fig. 5.

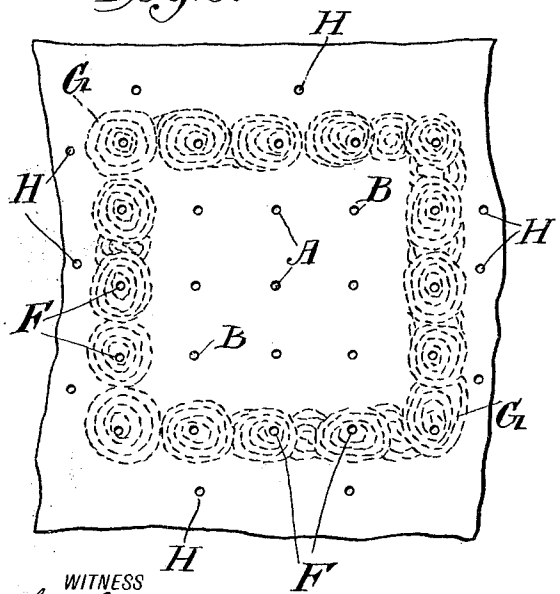
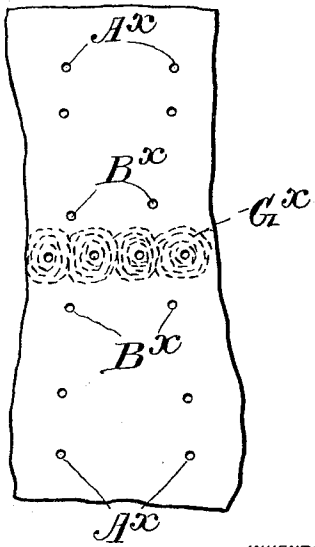



Fig. 6.




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# UNITED STATES PATENT OFFICE.

FREDERICK SQUIRES, OF MARIETTA, OHIO, ASSIGNOR TO WALTER SQUIRES, OF ZANESVILLE, OHIO.

## METHOD OF RECOVERING OIL AND GAS.

1,198,078. Specification of Letters Patent. Patented Sept. 12, 1916.

Application filed March 9, 1916. Serial No. 83,011.

*To all whom it may concern:*

Be it known that I, FREDERICK SQUIRES, a citizen of the United States, residing at Marietta, in the State of Ohio, have invented certain new and useful Improvements in Methods of Recovering Oil and Gas, of which the following is a specification, reference being had to the accompanying drawings, forming a part hereof.

It is now the general practice to recover oil and gas from non-flowing wells by applying pressure to one of several wells drilled to the oil sands and relying on the pressure to vent the oil and gas at certain other wells, which serve as venting wells, drilled to the same sands, or bring it to such wells for pumping to the surface. Usually compressed air is employed and oftentimes suction pumps are used on the venting wells in conjunction with the compressors on the other wells. In this method it is evident that the friction of the sands alone is relied on to maintain a sufficient pressure at the venting wells to lift the oil and gas to the surface or bring it to the bottom of the wells from whence it may be pumped to the surface. In large sand fields, especially those of a conglomerate composition, the area of pressure and degree of porosity are so great as to make it impossible to maintain a pressure adequate for the purpose. Again, it often happens that wells on neighboring leases, drilled to the same sands, are left open, either intentionally or after abandonment, so that the pressure applied to such sands finds a ready release at such open wells and is not effective for the purpose of forcing the oil and gas to the venting wells provided. Under such conditions, not only is the method wholly ineffective for the recovery of the oil and gas, but it is, in fact, most disadvantageous to the operator since it actually drives the oil and gas from his lease along the easier paths to the open wells on neighboring leases.

It is the primary object of the present invention to meet these objections to known methods involving the principle stated by providing means for presenting the dissipation of the fluid pressure applied to the sands and further to prevent the oil and gas in the sands being operated from flowing to neighboring leases. Incidental to the improved method is a highly advantageous way of forcing the oil and gas to the venting wells and maintaining it in the neighborhood of the venting wells until entirely withdrawn. This last condition is one which will be recognized as most advantageous, in as much as known methods, where effective in forcing the oil and gas to the venting well, have made no provision for checking the flow thereof past the venting well with the result that a large percentage of oil and gas under the pressure medium has been forced beyond the venting well on to neighboring leases.

In accordance with the present invention, it is proposed to form in the oil sands a dam of a relatively incompressible fluid, such as water, which dam shall serve, either wholly or in conjunction with the impervious mineral boundaries of the sands, to entrap the oil and gas over any desired area, so that such oil and gas under pressure from a relatively compressible fluid, such as air, may be forced to the pumps in or out through suitable venting wells located within the included area. This liquid dam may be created by forcing in water under pressure and may have its area controlled by applying air pressure to each side thereof through wells provided for that purpose and so may, through this pressure control, be caused to encroach more or less, as may be desirable, on the oil sands for the purpose of forcing the entrapped oil and gas out through the venting wells. This system which, for convenience, may be termed a flood pressure system, permits the liquid dam or flood to be used as desired in assisting the compressed air in venting the entrapped oil and gas. Where, as it is often the case, the oil sand is found in a comparatively narrow streak and disposed within an impervious mineral covering, the improved method will be especially useful in that it permits a dam of liquid to be thrown across this oil streak adjacent the boundaries of the particular lease which the streak traverses, so that all of the oil and gas between these boundaries may be held there and ultimately recovered as by applying air pressure thereto between the liquid dams or by causing the liquid dams to encroach on the oil and gas and so force it from the venting lease. The invention is not to be limited in its application to any such condition,

however, as it will also be found useful in large oil tracts in which the sands are of unknown extent and outline. In such a field, the advantage of an impervious mineral boundary on one or more sides of the oil bearing stratum would not be had, but the sands would, as usual, be capped at top and bottom by such an impervious layer of rock. The present method is used in such sands by creating a continuous dam of liquid in the oil sands, of any desired outline, usually depending upon the outline of the particular lease being operated. The dam in this instance is maintained by pressure applied to the two sides thereof and, being continuous, is controlled in the manner indicated with respect to the separate dams described above and as employed in narrow sand streaks. Still another condition under which the improved method is useful is one in which a liquid dam is formed near the center of an oil lease traversed by a narrow sand streak and air pressure is applied at opposite sides of the dam at points near the boundaries of the lease, so that oil and gas included in the sands between the dam and the pressure wells is vented through venting wells provided therefor. In this case different pressures may be maintained at opposite sides of the dam and the latter may be caused to encroach on the oil and gas in one direction or the other as desirable.

The invention will be described in greater detail in connection with a specific application of the improved method to fields wherein the three suggested conditions may arise, and as illustrated in the accompanying drawings, in which—

Figure 1 is a somewhat conventional illustration in plan of an oil bearing streak of sand drilled for the practice of the invention. Fig. 2 is a view in section through the earth and the field indicated in Fig. 1 and taken along the plane of the line 2—2 of said figure. Fig. 3 is a sectional view somewhat similar to Fig. 2, but taken transversely through the field of Fig. 1 along the plane indicated by the line 3—3. Fig. 4 is another transverse section through the field along the plane indicated by the line 4—4 of Fig. 1. Fig. 5 indicates somewhat conventionally a continuous dam in an oil field in which the improved flood pressure is to be employed. Fig. 6 is a conventional view of another condition under which the present method may be used successfully.

As this description proceeds, it will be made plain that the improved method is not to be limited in its application to oil bearing strata of any particular outlines, nor to oil sands having peculiar local conditions. It may be practised, in principle, under any circumstances where it is desired to create some means for limiting the free flow of oil and gas in any direction, through the sands, and for preventing the dissipation of the air pressure applied to such sands for the purpose of venting such oil and gas. For instance, by reference to Figs. 1 and 2, it may be supposed that the sand streak traversing the particular lease to be operated is of some such outline as is shown in Fig. 1 and that the impervious rock walls at the sides of the lease converge at certain portions, as will be later described. In accordance with the present methods, pressure wells *a* would be drilled to the oil bearing sands and pressure applied through such wells to vent the oil and gas through the venting wells *b* located at the most advantageous points. It is quite evident that whether these venting wells *b* be located between the pressure wells *a* or outside of them, or whether the sands be relatively dense or not, the waste of effective pressure is necessarily great since the pressure may find an outlet longitudinally of the narrow streak in directions away from the venting wells *b*, as well as through said wells. Where the sands are relatively porous, as is the case when they are of a conglomerate composition, it is often impossible to maintain a sufficient pressure on the wells *a* to carry the oil to the pumps in or to lift the oil and gas through the venting wells *b*, so that the lease remains unworked. Again, where the owners of neighboring leases drill wells to the same sands and leave them open, the pressure applied at the well *a* will find ready escape through such wells and bring about, often times, a liberal discharge of oil and gas on the neighbor's property. Again, the ready escape found by oil and gas in such sand strata always results in the carrying off from the operated lease of a certain percentage of the oil and gas of which the operator is the owner.

In accordance with the present invention, the highly inefficient, and often times ineffective, methods now employed are replaced by means which entrap the oil and gas on the lease operated and permit of its ready recovery. The improved method further eliminates the dissipation of the pressures applied to the sands and augments such pressures by relatively incompressible fluids, such as water, which may be controlled in such manner as to cause their encroachment upon the oil and gas and assist in their discharge.

For convenience in the description, a concrete case will first be considered. Let it be assumed that the lease to be operated, besides having its sands in the narrow and irregular streak shown in Fig. 1, has its boundaries along the lines *c*, *c*, *d*, *d*, at the ends of the streak. By drilling, it may be determined that the oil bearing sands are contracted at the points *x*, *x*, the non-productive wells *e* indicating, within limits, the

166. WELLS, 21



boundaries of the streak. The wells *f*, *f*, are drilled to the sands along the section of the contracted portions of the streak and through these wells is introduced, under pressure, a suitable relatively incompressible fluid, preferably water, which saturates the sands immediately in the neighborhood of the wells and forms a liquid dam across the contracted sections *x*, *x*. Air pressure is applied to the sands at either side of the dams *g*, as through the pressure wells *a* and the counter-pressure wells *h*, which latter are drilled outside of the dams. It will be evident that by equalizing the pressures on opposite sides of the dams *g*, the dams may be held against movement and caused to fill the sand stratum from the impervious floor *i* to the impervious roof *i'* between which the sand is disposed. By raising the pressure relatively, the oil and gas entrapped between the dams *d* and the impervious side walls $i^2$ of the oil belt, may be forced readily through the venting wells *b*. The dams and impervious side walls prevent dissipation of the air pressure applied through the wells *a* so that it may be said that the entire pressure is effective in accomplishing its intended purpose. No matter, how porous the sand in the streak, no difficulty will be experienced in raising the pressure in the included area sufficiently high to force the oil and gas to the pumps in or actually from the venting wells *b*.

As soon as the oil level within the included area drops, the liquid dams *g* may be caused to move inwardly toward the venting wells and so encroach upon the oil to be vented, by controlling the relative air pressures on the two sides of the dams or by forcing in more water through the hydraulic wells *f*. In either event, the oil is held in the neighborhood of the venting wells *b* until entirely removed. It has no outlet from the included area. No matter what the condition in the sands on the neighboring leases, the pressures applied through the wells *a* will be wholly effective in venting the oil and gas entrapped between the dams *g*, *g*. In bringing about this venting, it will be evident that the layers of water and oil disposed within the included area will not fill the impervious casing from the floor *i* to the roof *i'*, in which case the natural tendency will be for the air to flow under pressure along the surface of the oil between its level and its roof *i'* and escape through the vents. To obviate this condition, the casings of the venting walls *b* are extended downwardly into the oil and terminate well below the level thereof so that no gas or air can pass out through the casing without carrying with it a quantity of oil, owing to the liquid seal effected. Such liquid seals may also be found at other sections of the sand stratum, as indicated at $i^3$, where the root *i'* is somewhat irregular and projects downwardly into the layer of oil. This condition is helpful in bringing the air pressure to bear on the oil.

Under the conditions illustrated in Fig. 5, it may be supposed that the oil sands are of unknown area and outline and that the lessee of a portion of such sands desires to remove the oil and gas from his holdings without forcing them on to neighboring leases and without wasting the compressed air by relying only on the friction of the sands to maintain the pressures. In this case, hydraulic wells F are placed around the wells to form an included area of any desired outline (rectangular in the illustrated embodiment) and a continuous dam G is formed in the sands which is maintained, as described with reference to the preceding figures of the drawings, by applying pressure on both sides thereof, as through counter-pressure wells H and included pressure wells A. The pressure applied through the included wells A serves to vent the oil and gas through the venting wells B which may be disposed at suitable points. As the oil and gas are vented, it may be desirable to cause the dam G to contract relatively so as to encroach on the sands and assist the pressures thereon in venting the oil and gas. This encroachment may be effected in the manner heretofore described.

In Fig. 6 is illustrated another possible application of the method, in which a dam $G^x$ is formed transversely of the oil bearing sand streak and at about the mid-section thereof, in the manner before described, and pressure wells $A^x$ are drilled adjacent the outer ends of the streak and the oil and gas included between the pressure wells and the liquid dam $G^x$ vented as through venting wells $B^x$. The dam $G^x$ in this instance may be moved relatively through the sand streak to cause the encroachment before referred to for the purpose of augmenting the pressures and assisting in the venting of the oil and gas.

It is possible in this specification only to describe a few of the conditions under which the method will be especially useful, but it has been sought to emphasize throughout that there is involved an improved principle on which the steps of the method are based and that the invention is not to be limited to the concrete applications shown in the drawings.

Reference is to be had to the appended claims for a definition of the scope of the invention.

I claim as my invention:

1. The method of recovering oil and gas which consists in forming a liquid dam under pressure in the oil bearing sand to pre-

vent the escape of the entrapped oil and gas, and applying pressure independent of the liquid to said oil and gas to vent them.

2. The method of recovering oil and gas which consists in forming a liquid dam in the oil bearing sand to prevent the escape of the entrapped oil and gas, and creating a pressure differential on the dam by applying independent pressures at opposite sides thereof to cause it to encroach on the oil and gas under the control of the operator.

3. The method of recovering oil and gas which consists in forming a liquid dam in the oil bearing sand to prevent the escape of the entrapped oil and gas, applying pressure to the opposite sides of the dam to maintain it, and creating a pressure differential on the dam by applying independent pressures at opposite sides thereof to cause it to encroach on the oil and gas under the control of the operator.

4. The method of recovering oil and gas which consists in forming a liquid dam under pressure in the oil bearing sand to prevent the escape of the entrapped oil and gas, applying pressure to the opposite sides of the dam to maintain it, applying pressure to said entrapped oil and gas to vent them, and creating a pressure differential on the dam to cause it to encroach on the oil and gas under the control of the operator to assist in the venting.

5. The method of recovering oil and gas which consists in drilling pressure and venting wells to the oil bearing sands, sinking a casing in the venting wells with its end below the oil level to form a liquid seal and applying pressure to the surface of the oil through the pressure wells.

This specification signed this third day of March A. D., 1916.

FREDERICK SQUIRES.

**Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."**