Sept. 2, 1930. I. L. DUNN 1,774,640

METHOD OF CLEANING WELLS

Filed May 17, 1926 3 Sheets-Sheet 1

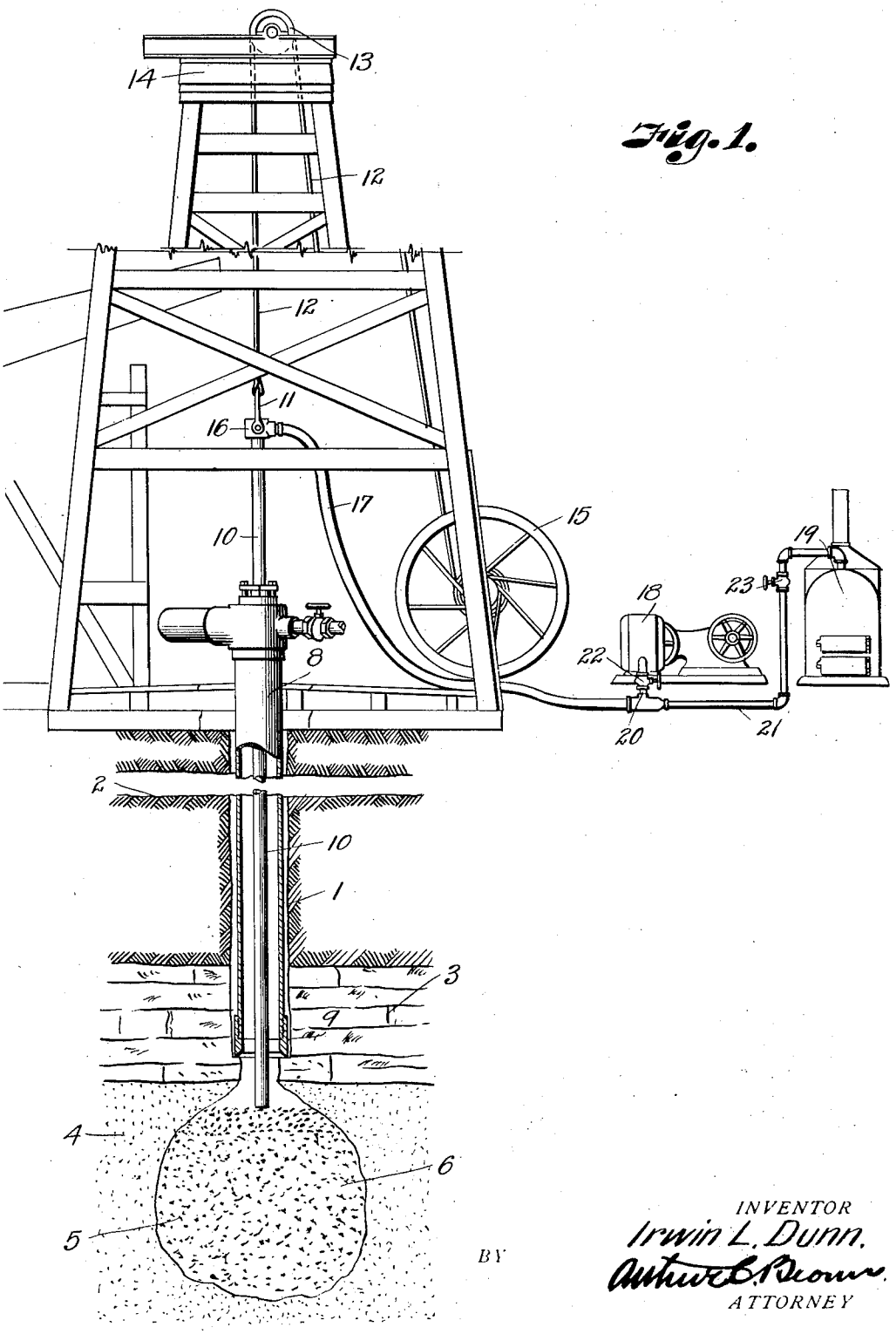


Fig. 1.

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Fig. 2.

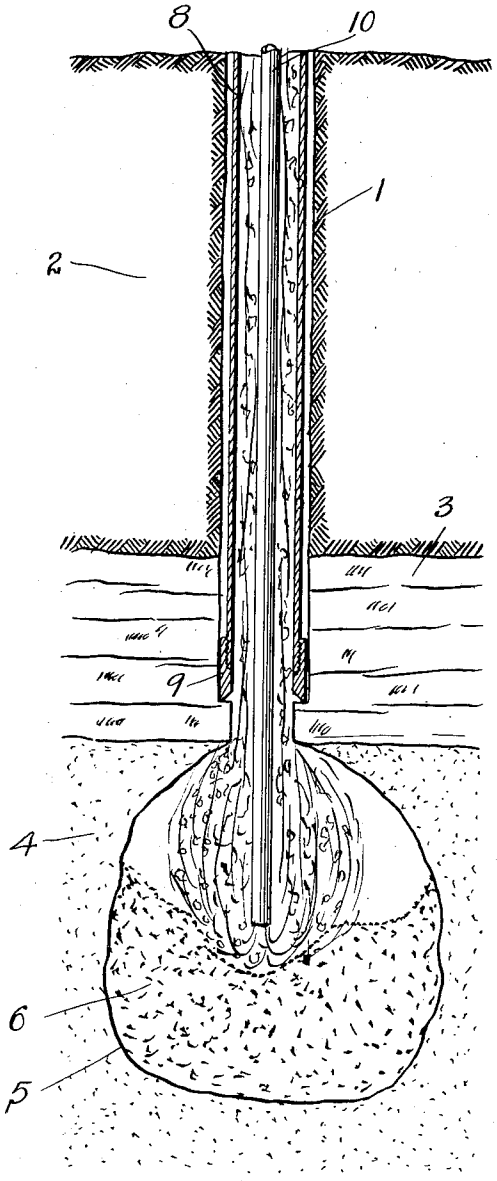
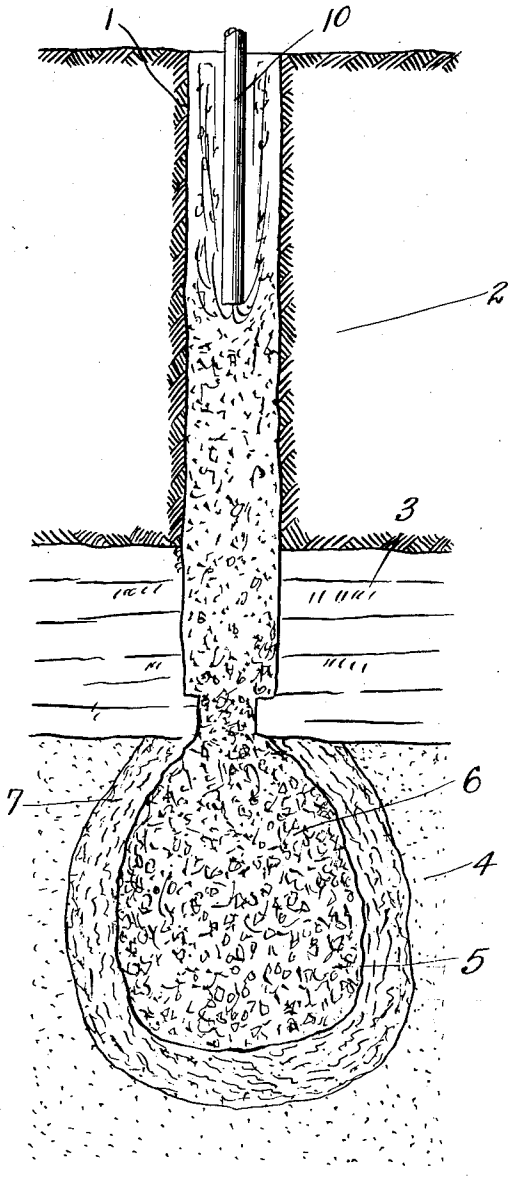


Fig. 3.



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Fig. 4.

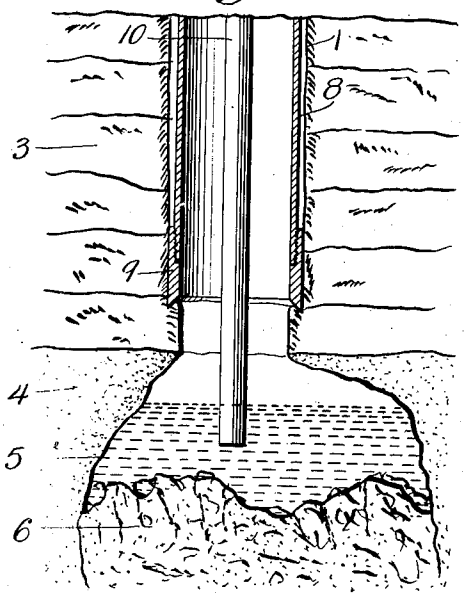


Fig. 5.

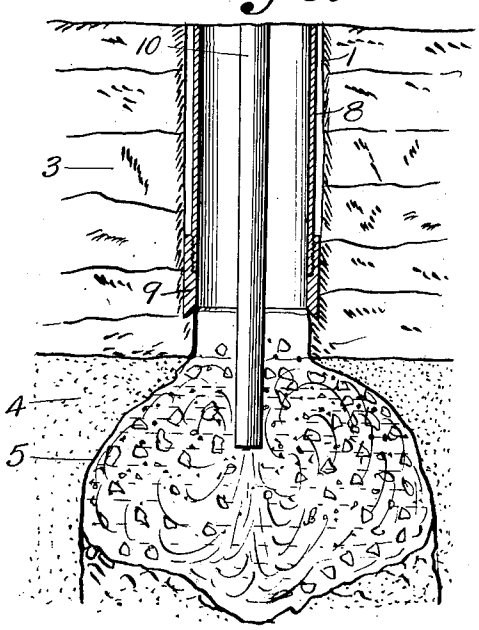


Fig. 6.

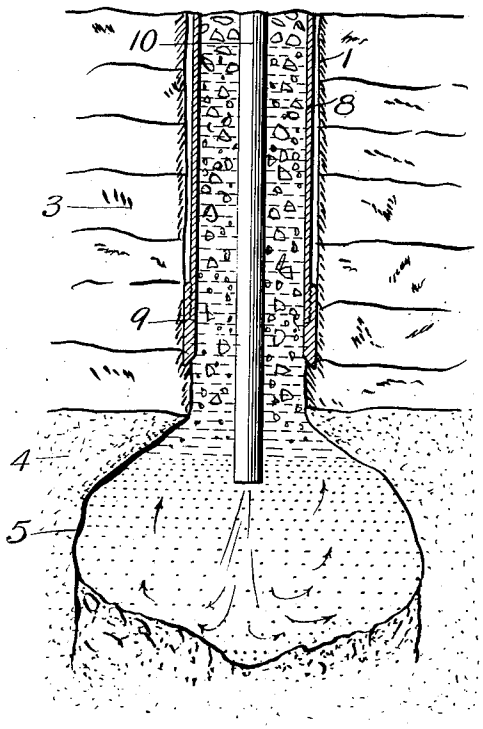
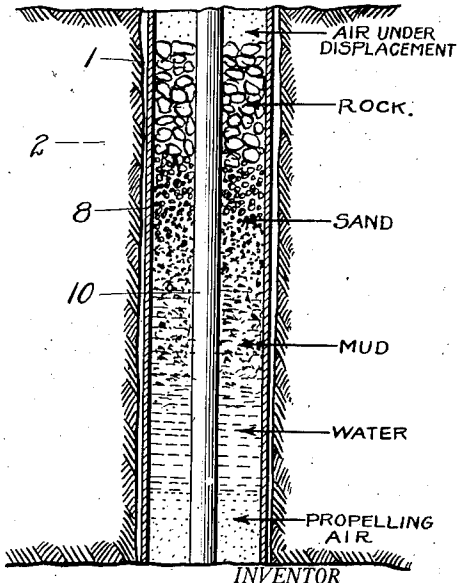


Fig. 7.



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Patented Sept. 2, 1930 1,774,640

UNITED STATES PATENT OFFICE

IRWIN L. DUNN, OF TULSA, OKLAHOMA, ASSIGNOR TO AIR CLEANING AND REAMING CORPORATION, OF TULSA, OKLAHOMA, A CORPORATION OF OKLAHOMA

METHOD OF CLEANING WELLS

Application filed May 17, 1926. Serial No. 109,702.

My invention relates to a method of cleaning oil wells and has for its principal object to increase or restore flow in wells clogged by an accumulation of detritus consisting of sand, small rocks or earthy matter resulting from displacement by flow from the sand, natural caving, artificial scouring, or other causes, the present application being a continuation of my application filed October 11, 1923, Serial No. 667,849.

When a well is drilled through an impervious capping stratum into oil-bearing sand, gas confined below the capping stratum induces flow of oil through the porous sand into the well, usually with sufficient pressure to carry the oil, together with sand displaced by the flow or loosened by the explosion of the charge if the well is shot, through the well to the surface. As the gas is exhausted from the sand more rapidly than the oil, the flow decreases until the fluid eventually becomes placid, or relatively so, and the displaced solids precipitate to the bottom of the well. This accumulation continues after pumps are put in operation and is frequently artificially induced by reaming to remove the crust which may form on the wall of the well, and by steaming or other methods employed for removing the paraffin that sometimes settles in the sand adjacent the well. Removal of the detritus is not only essential for preservation of the pumps, but has the further advantage of increasing flow from the sand. Should the well be abandoned and the casing removed, caving continues at the well hole and detritus accumulates until the hole is filled to a considerable depth, or the well is intentionally filled with sand pumpings or mud to prevent damage to the oil sand by inflow of water through the abandoned well.

When such an abandoned well is to be restored, these sand pumpings or mud must be removed to expose the oil sands, and the casings replaced to protect the well from cavings and water.

It is accordingly a purpose of my invention to provide a new and improved method of removing the accumulation of detritus or other clogging material from an oil well by means of gaseous or expansible pressure mediums, such as gas or air, by employing a liquid mixing or vehicle medium, such as water or oil, in conjunction with the pressure medium, and by the application of a heating medium, such as steam, to preliminarily melt the paraffin when such is present in the sands.

In effecting removal of the detritus in accordance with my method I employ mechanical structure, a preferred form of which is illustrated in the accompanying drawings, wherein

Fig. 1 is a vertical section of an oil well, showing in elevation apparatus set for cleaning the well in accordance with my improved method.

Fig. 2 is an enlarged view of part of the well, showing the apparatus in use and after part of the detritus has been removed.

Fig. 3 is a similar view of an abandoned well in process of restoration by my cleaning method.

Fig. 4 is a detail view of a well equipped for cleaning, illustrating levels of detritus and a water charge and setting of the tubing for an initial blow.

Fig. 5 is a view of the well immediately after the air has been turned on.

Fig. 6 is a view of the well illustrating formation of the water slug in the lower portion of the casing after breaking of the water seal at the mouth of the tubing.

Fig. 7 is a similar view, illustrating stratification of the plug as it reaches the upper portion of the casing.

Referring more in detail to the drawings:

1 designates an oil well, extending through earth 2 and a capping stratum 3 into oil-bearing sand 4, the well terminating in a shot hole or pocket 5 within the oil sand, the shot hole or pocket being partially filled with detritus 6 consisting of sand, small rocks or earthy matter displaced by the explosion in the hole, by flow from the sand or by natural caving.

7 designates bodies of paraffin formed within the sand adjacent the well. These bodies of paraffin are not always present but occasionally occur and, when present, interfere

with and sometimes entirely stop the flow of oil from the sand to the well.

8 designates a casing extending through the well to a point above the shot hole or pocket and here shown sealed in the hole by a shoe 9 of common construction, although this arrangement may be varied to meet requirements of local conditions. Extending through the casing is tubing 10 which, in accordance with my method, is suspended by a bail 11 from a flexible cable 12 running over a pulley 13 on a suitable support, indicated at 14, and connected with a reeling mechanism, indicated at 15, whereby the tubing may be raised and lowered within the casing and shot hole or pocket for the purpose presently described.

The bail 11 is attached to a coupling 16 at the upper end of the tubing, and connected with said coupling is a hose 17, having connection with a source of fluid pressure medium supply, here indicated as an air compressor 18 and with a steam boiler 19, through a coupling 20 and a branch conduit 21. The coupling 20 and branch conduit 21 are provided with valves 22 and 23 respectively, whereby flow from the compressor and the boiler may be controlled, so that either air or steam may be separately conducted to the tubing 10.

Assuming the mechanical elements to be assembled as described in connection with a well in the condition illustrated in Fig. 1 of the drawings, the cleaning of the well is effected as follows:

The tubing is let down to within a few inches of the surface of the detritus in the shot hole or pocket and a sufficient volume of water poured into the well to saturate the detritus and provide a surplus for covering the top thereof, from three to five barrels being preferably employed as this quantity is sufficient to form a pool over the bed of detritus, submerge the lower end of the tubing and when columned in the well bore with the detritus, to form a slug of sufficient density to prevent the air from breaking through, without such excessive hydrostatic pressure as to overcome the air pressure and be forced laterally into the oil sand prior to delivery of the material into the casing.

When the air is first turned on it is delivered as a jet through the water overlying the detritus into contact with the latter, displacing the loose sand, gravel and other matter in the bed so that the latter mixes with the water (Fig. 5) and is forced therewith into the annular space about the tubing in the well. The air, continuing to discharge into the pocket, forces the water and detritus through the annular space in the form of a slug, some air slipping through the water but not in sufficient quantity to lose the driving force, and whatever liquid that may drop back being picked up and returned by the oncoming air.

As the slug is driven upwardly through the well, the air which slips through the water effects stratification of the content according to size and density so that discharge from the well is first of the air displaced by the slug, then the rock and gravel-like particles, then the smaller sand and gravel-like particles, followed by the finer particles suspended in water and finally relatively clear water. When the slug has been delivered, flow from the compressor is cut off, the tubing lowered to position over the detritus at its lowered level, a new charge of water admitted to the well and the process described repeated, alternate charging and blowing being continued until the detritus has been removed.

In some cases water or oil already in the hole may serve as the vehicle, and in still other cases there is an excess of fluid in the hole, some of which must be preliminarily removed to reduce the head to that sufficient to constitute a vehicle for the detritus.

When the method is employed in abandoned wells which have become clogged to a considerable depth above the shot hole, the same method is employed, but in some cases, where the detritus reaches to near the surface, air alone is sufficient to discharge the finer particles, water being supplied when the lower depths are reached.

In wells wherein paraffin has settled in the sand, steam may be supplied to heat and soften the paraffin as a preliminary step, the steam penetrating the sand wall to melt the paraffin so that it may flow through the pores into the shot hole or pocket to be removed with the solid matter, as above described. In carrying out the heating step the compressor is shut off and the line opened to the boiler, the flow of steam being discontinued after the paraffin has melted, and the compressor then connected with the tubing to permit the blowing-out, as heretofore described.

While I have specifically described the supplying of air through the tubing and discharge of the detritus through the casing, it is apparent that this flow may be reversed, and that the air may be delivered through the casing and discharge effected through the tubing. In some cases it may be advisable to discharge through the casing initially and then discharge through the tubing after the mass of the detritus has been removed, and only finer particles remain in the well.

While I have specifically mentioned air as the expelling agent, natural gas may be employed if available, the term being intended to include any gaseous fluid which will exert an expansive force in addition to its mechanical lifting power.

What I claim and desire to secure by Letters Patent is:

1. The method of cleaning wells compris-

ing lowering casing in a well hole to adjacent the well pocket, lowering tubing through the casing into the pocket, delivering liquid onto detritus accumulated in the well pocket, and delivering air under pressure into the liquid to blow out the liquid and detritus, shutting off the air, supplying fresh liquid, lowering the tubing to near the new level in the pocket and renewing the air flow.

2. The method of cleaning wells comprising lowering casing in a well hole to adjacent the well pocket, lowering tubing through the casing into the pocket to provide separate channels in the well hole and casing, delivering liquid onto detritus in the pocket, and delivering air under pressure through the tubing into the liquid to agitate the liquid and detritus and blow the mixture through the casing.

3. The method of cleaning wells comprising lowering casing in a well hole to adjacent the well pocket, lowering tubing through the casing into the pocket to provide separate channels in the well hole and casing, delivering liquid onto detritus in the pocket, delivering air under pressure through the tubing into the liquid to agitate the liquid and detritus and blow the mixture through the casing, shutting off the air, lowering the tubing, supplying fresh liquid and resuming flow of air, the casing remaining in its originally set position.

4. The method of cleaning wells comprising delivering a charge of water onto detritus in the well, lowering tubing to a point above and near the surface of such detritus, and propelling the charge of water, with detritus mingled with it, from the well by means of air delivered through the tubing into the water and the detritus.

5. The method of cleaning wells comprising supplying a charge of water onto detritus in the well, loosening the detritus and commingling the detritus with the water by means of air delivered through the water into the detritus from above the detritus, and propelling the water and detritus from the well by means of a following volume of air under pressure.

6. The method of cleaning wells comprising delivering a charge of water onto detritus in the well to form a pool over the detritus, lowering tubing through the well and into the water to near the surface of the detritus, blowing air through the tubing to first loosen the detritus and then propel the water and loosened detritus through the well to outlet at the top of the well.

7. The method of cleaning wells wherein detritus has accumulated in a pocket at the bottom of the well hole comprising delivering a charge of water onto the detritus, lowering tubing through the well to near the surface of the detritus, delivering air through the tubing into the water and the detritus to loosen the detritus and force the water and loosened detritus from the pocket into the well hole, and propelling the body of water and detritus through the well by a following column of air supplied through the tubing.

In testimony whereof I affix my signature.

IRWIN L. DUNN.