(No Model.)

H. FRASCH.

INCREASING THE FLOW OF OIL WELLS.

No. 556,669. Patented Mar. 17, 1896.

Fig. I.

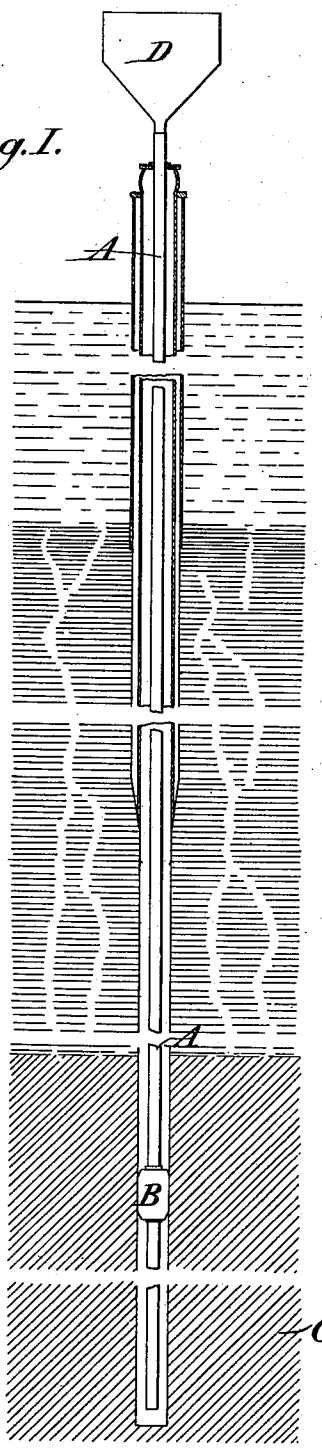
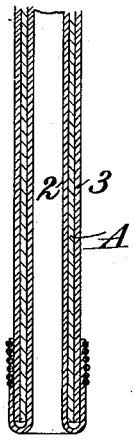


Fig. II.



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UNITED STATES PATENT OFFICE.

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INCREASING THE FLOW OF OIL-WELLS.

SPECIFICATION forming part of Letters Patent No. 556,669, dated March 17, 1896.

Application filed June 27, 1895. Serial No. 554,177. (No model.)

To all whom it may concern:

Be it known that I, HERMAN FRASCH, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Increasing the Flow of Oil-Wells; and I do declare the following to be a full, clear, and exact description of the invention.

This invention relates to a method of increasing the flow of oil-wells in limestone formations—such, for example, as the oil-wells of the Lima district in Ohio and of certain other parts of the United States and of Canada. Heretofore it has been customary to increase the flow in these, as in other wells, by exploding torpedoes therein. The effect of the explosion is to shatter the rock; but this is filled with liquid and the disintegration does not extend far.

The present invention consists in a new and superior method based upon chemical action.

In accordance with the new method a chemical reagent which attacks the limestone-rock, in which the well is, is introduced thereinto in sufficient quantity to exert a substantial effect upon the walls of the well. In order to secure an extended effect not only is the reagent introduced into the cavity of the well, but the reagent in the well is put under strong pressure, which may be that of a high column of liquid in the supply-pipe, so as to be pressed into the rock and made to act upon the same at a distance from the original well-hole. As these wells are ordinarily of great depth—say twelve hundred feet—an enormous pressure may thus be developed, and, if desired, other pressure-producing means may be employed. It is an advantage to confine the reagent outside the supply-pipe to the lower or oil-yielding portion of the well-hole. This can be done by a suitably-arranged packer which shuts off the lower from the upper portion of the hole and prevents the reagent from ascending above the packer. The reagent seems to act chiefly upon the films which bind together the more solid particles, and thus by disintegrating the rock into a more or less sand-like mass to increase its porosity. As a result of this action a larger territory may be drained, while the oil has a larger surface through which to filter and a more ready access to the well-hole. By using enough acid and pressing it back into the rock long channels can be formed and oil reached thereby which otherwise could not be had without drilling other wells, if at all. In order that the product of the chemical reaction may not remain in the rock to obstruct the passages and to diminish the well-cavity use is made of a reagent, such as hydrochloric or muriatic acid, which in attacking dissolves the rock, or, in other words, forms a soluble compound of calcium, such as the chloride, for example. The use of commercial muriatic or hydrochloric acid (which is of a specific gravity from 1.15 to 1.20 and contains from thirty to forty per cent. by weight of the acid gas HCl) is recommended, from about one thousand to two thousand gallons of such commercial acid being preferably employed for a dose.

The enlargement of the well-cavity is in itself of importance, particularly with small wells, for the wells cease to flow when they become full, and with small wells it is therefore necessary to pump out at short intervals, which is more expensive than to remove the same quantity of oil by less frequent pumpings.

After introducing a suitable quantity of the reagent it is advantageous to displace it and cause it to penetrate farther into the rock by forcing a neutral or cheap liquid, such as water, into the well, and it is also advantageous in case the acid is not wholly neutralized by the limestone (or generally as a measure of precaution) to introduce an alkaline liquid (preferably milk of lime) to neutralize any trace of acid which may exist.

The advantage of neutralization is to avoid the danger of corroding the subsequently used apparatus, either that for cleaning out the well or for pumping. The cleaning out consists in removing the solid subdivided particles of rock which are brought into the well-hole and may be done with the usual sand-pump, the usual drilling-tools being used (if necessary) to loosen any hard sediment which may form. More or less of the liquid which returns to the well-hole would be removed

with the said solid particles; but that which is free from the finely-divided solid matter or sand-like particles can be removed by the pumping apparatus (composed of tubing and sucker-rod) which is employed to pump the oil. By the use of a chemical reagent which forms a soluble salt of calcium the products of the chemical decomposition of the limestone are removed with the liquid in which the salt of calcium is dissolved, and which conveys the same from the remotest points. The channels which have been cut in the rock are thus left free, thereby securing the maximum increase of the flow of oil as well as of the oil-holding capacity of the well.

The following is a description of what is considered the best mode of carrying out the invention, reference being had to the accompanying drawings, which form part of this specification, and in which—

Figure I is a diagram of a well with the supply or reagent-introducing pipe in place, and Fig. II is a detail view illustrating a mode of protecting the said pipe.

The pipe A is provided with a rubber packer B in the rock above the Trenton limestone C, in which the well is. It may be enameled or lead-lined pipe, externally coated with enamel or lead below the packer B, or it may be otherwise made proof against corrosion. There is a box D provided with a funnel-shaped bottom to feed the acid to the pipe A. As shown in Fig. II the pipe A is lined with a tube 2 of soft rubber and covered exteriorly with another soft-rubber tube 3, the lower end of the inner tube being turned back over the pipe A, and also over the outer tube, and the whole wrapped to prevent ingress of liquid at the joint.

The reagent (muriatic or hydrochloric acid) is placed in the box D, which is kept full, so that the pressure of the whole column (of twelve hundred feet, if that be the depth of the well) is exerted upon the acid in the well, which acid is by the pressure and its own corrosive action forced into the rock, greatly increasing its porosity and extending the area drained by the well and also enlarging the well-cavity. When as much acid as desired, say one thousand gallons, has gone into the rock, a force-pump is connected with the pipe A and fresh water is forced down to displace the acid in the pipe and rock, and by forcing it still farther into the rock extend the area of its action. After a rest of, say, twelve hours milk of lime is pumped down to neutralize any trace of acid that might exist. The well is then cleaned out and the tubing replaced, and the work of pumping oil carried on as usual.

The usual sand-pump may be used in cleaning out, and it may, of course, be employed as often as necessary, after pumping is resumed, in order to remove solid particles which may be brought into the well-hole during the pumping, the tubing being temporarily removed in order to allow the use of the sand-pump.

Other reagents may be used instead of hydrochloric or muriatic acid, although this is preferred by reason of its efficiency and cheapness.

The rock might also be acted upon with the aid of a gaseous reagent, instead of simply by a liquid—as, for example, the rock might be decomposed by introducing hydrochloric-acid gas into the well and the resulting chloride of calcium be dissolved in water artificially introduced or naturally present in the well.

I claim as my invention or discovery—

1. The method of increasing the flow of oil-wells in limestone formations, by introducing into the well a large quantity of a chemical reagent which attacks the rock, and allowing said reagent to act upon the walls of the well; substantially as described.

2. The method of increasing the flow of oil-wells in limestone formations, by introducing into the well a large quantity of a chemical reagent which attacks the rock, and subjecting such reagent in the well to strong pressure; substantially as described.

3. The method of increasing the flow of oil-wells in limestone formations, by introducing into the well a large quantity of a chemical reagent which is a solvent of the rock (such as hydrochloric or muriatic acid), and allowing said reagent to act upon the walls of the well; substantially as described.

4. The method of increasing the flow of oil-wells in limestone formations, by introducing into the well a large quantity of a chemical reagent which is a solvent of the rock (such as hydrochloric or muriatic acid), and subjecting such reagent to strong pressure; substantially as described.

5. The method of increasing the flow of oil-wells in limestone formations, by introducing into the well a large quantity of a chemical reagent which attacks the rock, and allowing said reagent to act upon the walls of the well, and also introducing a neutral or cheap liquid such as water into the well to force the said chemical reagent farther into the rock; substantially as described.

6. The method of increasing the flow of oil-wells in limestone formations, by introducing into the well a large quantity of a chemical reagent which is a solvent of the rock (such as hydrochloric or muriatic acid), and allowing said reagent to act upon the walls of the well, and also introducing a neutral or cheap liquid such as water into the well to force the said chemical reagent farther into the rock; substantially as described.

7. The method of increasing the flow of oil-wells in limestone formations, by introducing into the well first a chemical reagent to attack the rock forming the walls, then a neutral or cheap liquid such as water to force the reagent into the rock and finally a neutralizing liquid; substantially as described.

8. The method of increasing the flow of oil-wells in limestone formations, by introducing into the well a large quantity of a chemical reagent which attacks the rock, confining said reagent to the lower or oil-yielding portion of the well-hole, and forcing it by pressure into the rock; substantially as described.

9. The method of increasing the flow of oil-wells in limestone formations, by introducing into the well a large quantity of a chemical reagent which attacks the rock, forcing it by pressure into the rock, removing the pressure, and cleaning out the solid particles which are brought into the well-hole; substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

HERMAN FRASCH.

Witnesses:
F. W. LOTHMAN,
N. J. WORLEY.