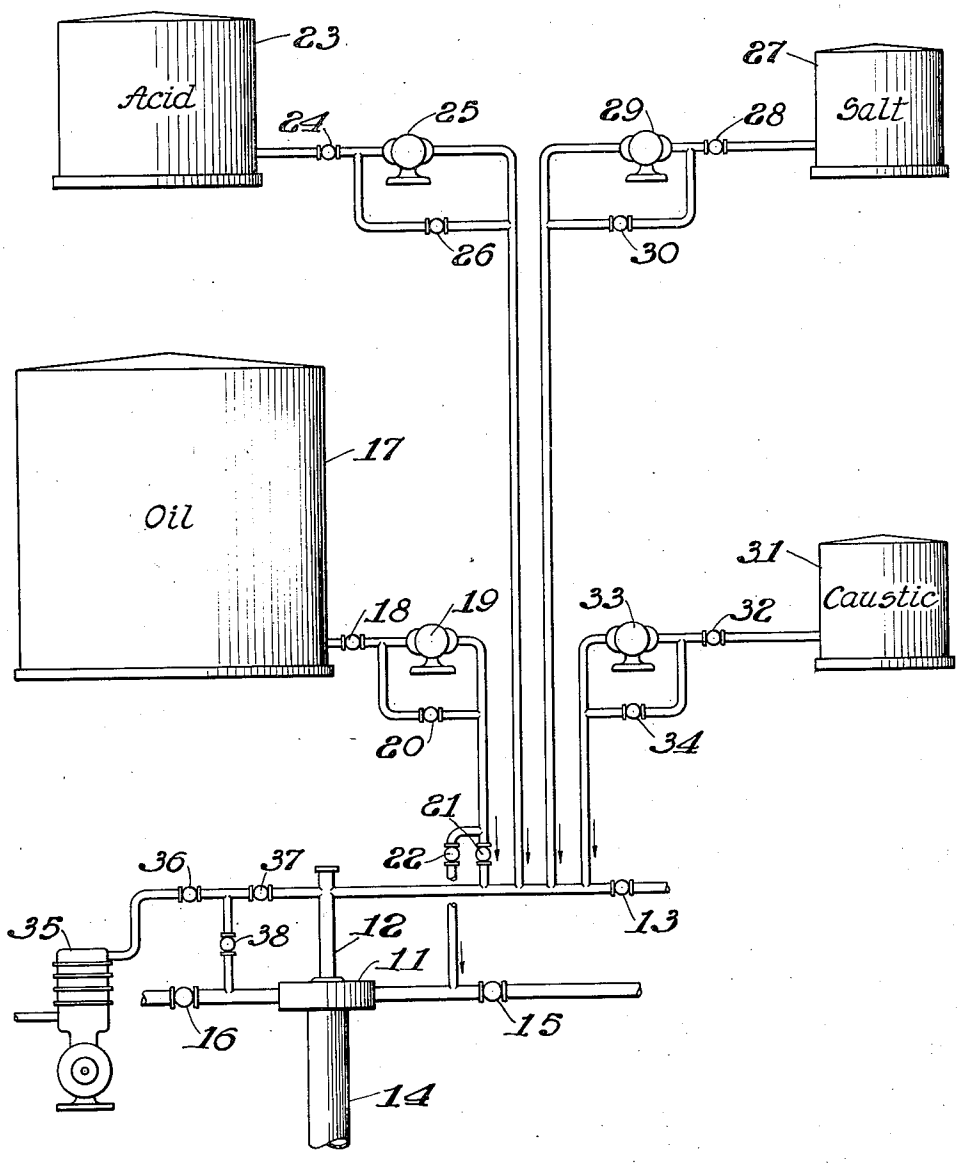
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WELL TREATING

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WELL TREATING

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9 Claims. (Cl. 166—1)

My invention relates to the treatment of wells to cause, restore or increase the production of such fluids as oil, gas, water, brine, etc. therefrom. More particularly it relates to the treatment of deep oil wells in order to cause, restore or increase oil production therefrom.

One of the most successful methods for the treatment of wells is the use of acid. However, corrosion problems seriously interfere with the beneficial use of this method. It is an object of my invention to provide improvements in the use of acid so that corrosion of the metal parts of the well can be prevented or at least very materially lessened. Further objects will become apparent as the description of my invention proceeds.

The particular acid chosen for use in my process will depend on the nature of the formation. When the formation is predominately limestone or contains a limestone "cement" it is best to use hydrochloric acid. Nitric acid is also suitable in such cases, but sulfuric acid should be avoided due to its propensity to form insoluble sulfates. The acid used may have a strength of from about 5% to about 35% HCl by weight and can be used in widely variable quantities, for instance, from about 250 gallons to about 2000 gallons. The acid is preferably pumped down through the tubing in the conventional manner.

In the case of formations other than limestone formations other acids can be used.

As above-mentioned, the use of acid is highly advantageous in many cases. One important disadvantage, however, is that the acid tends to attack the tubing and other metal parts of the well causing very serious corrosion with consequent loss of valuable equipment and danger to the well. It has been attempted or proposed to overcome this disadvantage of acid treating by the use of inhibitors in the acid, by treating the well in advance of the introduction of the acid with an inhibiting solution, by putting the acid down into the well as the internal phase of an oil-acid emulsion, etc., but none of these methods has been entirely satisfactory. They invariably permit some corrosion and are expensive and troublesome. I have overcome these disadvantages by the hereinafter described procedure which is at the same time simpler and more effective than those known to the prior art. The action of such acids as hydrochloric on tubing or other metal parts of the well is relatively slow, even if no inhibitor is used. On the other hand the rate of introduction of the acid into the well is normally rapid and can readily be speeded up by the use of pressure or otherwise so that it takes but a few minutes. The corrosion is due not so much to the actual contact of the body of acid with the metal parts of the well during the time the acid is being introduced as it is to the fact that a film or layer of acid adheres to the metal and remains in contact with it long after the the main body of the acid has passed into the geological formation at the base of the well. This film of acid concentrates its attack on certain susceptible portions of the metal and causes severe pits. The acid also accumulates at joints, etc. and remains there after the body of acid has passed into the formation.

The corrosion of the metal parts can be greatly reduced by removing this film or layer of acid. This can be done by introducing the acid into the well rapidly and then following it by the introduction of a relatively small amount of a solution of a substance which will react with the acid and destroy its acid properties. I prefer to use an aqueous solution of a caustic material such as sodium hydroxide, sodium carbonate, sodium bicarbonate, potassium hydroxide, potassium carbonate, potassium bicarbonate, calcium hydroxide, ammonia, etc.

The amount of caustic used should be small since only a small amount is required and since larger amounts may cause undesirable chemical reactions after reaching the geological formation at the base of the well. I prefer to use an amount of caustic chemically equivalent to from 1% to 10% of the acid previously used. Amounts as low as .1% and as high as 20% or even 30% can be used.

The caustic should preferably have a lower gravity than the acid previously introduced so as not to mix with the body of acid. Thus, for instance, when a 15° Bé. solution of hydrochloric acid is used a 10° Bé. solution of sodium hydroxide is suitable.

To still further prevent mixing of the acid and caustic an inert "spacer" of intermediate gravity may be introduced into the well after the acid but before the caustic. Any inert liquid or solution can be used as a spacer. Aqueous solutions of salts are particularly suitable.

An example of the acid treating step of my process will be described with reference to the accompanying drawing in which the numeral 11 represents the casing head of a well. Oil is normally produced from the well by means of tubing 12 and valve 13. Gas is normally produced by means of casing 14 and valve 15 and/or 16. When

the well is ready for treatment, oil from tank 17 is pumped into the well by means of valve 18 and pump 19 or flowed in by means of valves 18 and 20. The oil can be admitted into the tubing by means of valve 21 or into the casing by means of valve 22 but is preferably introduced into both tubing and casing to an extent at least sufficient to counter-balance the formation pressure. After the oil has been introduced, acid, for instance 15° Bé. hydrochloric acid, is introduced into tubing 12 from tank 23 by means of valve 24 and pump 25 or valves 24 and 26. After 500–1000 gallons of acid have been introduced valves 24 and 26 are closed and a spacer such as a 12.5° Bé. solution of sodium chloride is introduced from tank 27 by means of valve 28 and pump 29 or valves 28 and 30. After from 10 to 40 gallons of this spacer have been introduced, valves 28 and 30 are closed, and a caustic solution, such as a 10° Bé. solution of sodium hydroxide, is introduced from tank 31 by means of valve 32 and pump 33 or valves 32 and 34. The amount of caustic introduced may suitably be from 25 to 75 gallons. During the introduction of the chemicals, valves 13, 15, 16, 37 and 38 are, of course, closed. After the chemicals have all been introduced they can, if necessary be forced into the formation by pumping oil into the tubing from tank 17 by means of valve 18, pump 19 and valve 21 or by means of gas or air introduced through compressor 35 and valves 36 and 37. It is undesirable, however, to force the acid too far into the formation since it is of maximum benefit in reacting on that portion of the formation nearest the cavity and should be allowed to remain in contact with it. Gas or air can also be introduced into the casing by means of valves 36 and 38.

Instead of forcing the chemicals into the formation by the use of oil, gas, etc., this can be accomplished by the use of a large excess of the "spacer" either before or after the introduction of the caustic. The amount of caustic can also in some cases be greatly increased in order to force the acid into the well and to still further insure against corrosion. The "spacer" serves to prevent contact of acid and caustic. Alternatively, a large volume of water can be pumped in after the caustic to force the acid into the formation.

After the acid has had sufficient time to react with the formation or constituents thereof, for instance from 12 to 48 hours, the chemicals can be removed through tubing 12 and valve 13 by suitable pumping means not shown. If the acid removed from the well is not entirely spent an additional amount of caustic from tank 31 can be introduced into the tubing after the withdrawal of the acid in order to prevent corrosion. The well is then ready to be placed on production.

It will be understood that the drawing is merely diagrammatic. In practice the apparatus can be simplified by manifolding the lines from the various tanks into a common pump.

The acid used in my process need not contain corrosion inhibitors, but these may be used as an added safeguard, the neutralizing agent preventing the residual corrosive action which is present with even the best inhibitors.

I have described my invention in terms of certain specific embodiments thereof but I do not desire to be limited thereby but only to the scope of the appended claims in which I have set forth the novel features of my invention.

I claim:

1. In a method of treating a well to increase the rate of fluid production therefrom, the steps which comprise introducing into said well a material adapted to dissolve at least a part of the geological formation at the base of said well and also adapted to attack the structural materials of said well and then immediately introducing into said well a second material adapted to neutralize the action of said first material having a lesser specific gravity than said first-mentioned material and on said structural material.

2. In a method of treating a well to increase the rate of fluid production therefrom, the steps which comprise introducing into said well through a metal conduit an acid solvent for at least a portion of the geological formation at the base of said well and then immediately introducing into said well through said conduit a material adapted to neutralize a portion of said acid solvent.

3. Steps according to claim 2 in which said acid solvent and said neutralizing material are kept separate during their introduction into said well by the use of an inert spacer.

4. In a method of treating a well to increase the rate of fluid production therefrom, the steps which comprise introducing into said well through a metal conduit an aqueous solution of hydrochloric acid followed immediately by a relatively small amount of an aqueous salt solution having a specific gravity less than that of said hydrochloric acid solution followed immediately in turn by a relatively small amount of a solution of a caustic alkali having a specific gravity less than that of said salt solution.

5. In a method of treating a well to increase the rate of fluid production therefrom, the steps which comprise introducing into said well through a metal conduit an acid solvent for at least a portion of the geological formation at the base of said well and then immediately introducing into said well through said conduit a solution of lower specific gravity than that of said acid solvent and adapted to neutralize a portion of said acid solvent.

6. In a method of treating a well to increase the rate of fluid production therefrom, the steps which comprise introducing into said well through a metal conduit an acid solvent for at least a portion of the geological formation at the base of said well and then immediately introducing into said well through said conduit, in order to prevent further attack on said conduit by the film of said acid solvent remaining on the inner surface of said conduit, a material adapted to neutralize from about 1% to about 10% of said acid solvent.

7. Steps according to claim 6 in which said material has a specific gravity lower than that of said acid solvent.

8. In a method of treating a well to increase the rate of fluid production therefrom, the steps which comprise introducing into said well through a metal conduit an acid solvent for at least a portion of the geological formation at the base of said well and then immediately introducing into said well through said conduit, in order to prevent further attack on said conduit by the film of said acid solvent remaining on the inner surface of said conduit, a material adapted to neutralize from about .1% to about 30% of said acid solvent.

9. Steps according to claim 8 in which said material has a specific gravity lower than that of said acid solvent.

GEORGE L. PARKHURST.

CERTIFICATE OF CORRECTION.

Patent No. 2,038,956. April 28, 1936.

GEORGE L. PARKHURST.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, lines 9, 10 and 11, claim 1, strike out the words "having a lesser specific gravity than said first-mentioned material and" and insert the same after "material", line 8, same claim; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 26th day May, A. D. 1936.

Leslie Frazer

(Seal) Acting Commissioner of Patents.

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