June 9, 1931. K. B. BOWMAN 1,809,546

METHOD OF CLEANING WELLS

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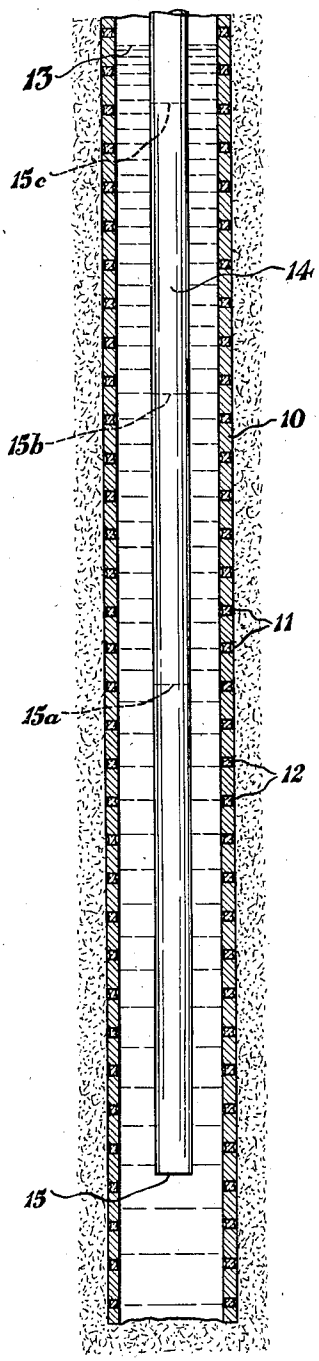


Fig. 1

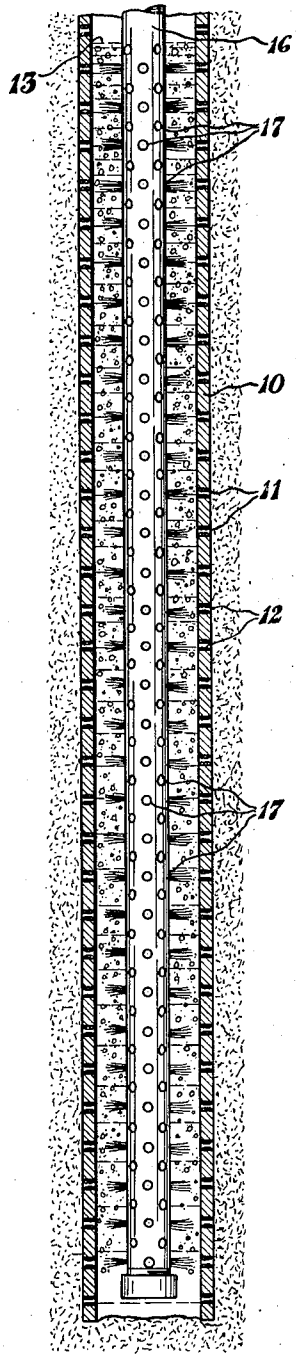


Fig. 2

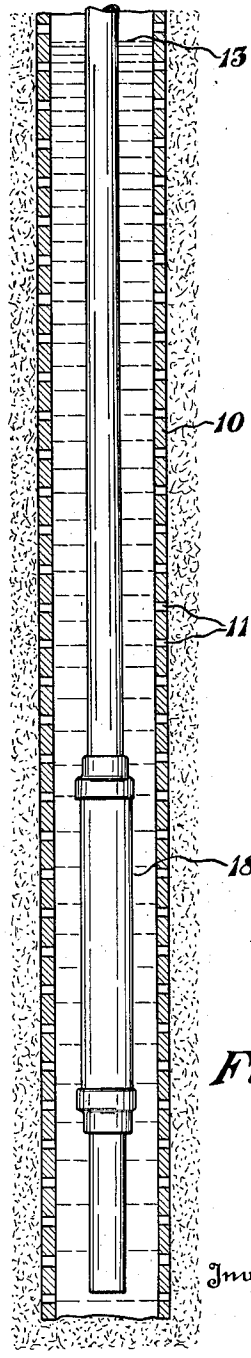


Fig. 3

Inventor

By K. B. Bowman

Harry Grease Attorney

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UNITED STATES PATENT OFFICE

KIEL B. BOWMAN, OF MASSILLON, OHIO, ASSIGNOR TO THE OHIO DRILLING COMPANY, OF MASSILLON, OHIO, A CORPORATION OF OHIO

METHOD OF CLEANING WELLS

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The invention relates to the cleaning of wells and more particularly to an acid treatment for removing incrusting solids from water wells.

In certain localities the water contains bicarbonates of calcium, iron and magnesium, which are normally soluble in water under pressure, but which are crystallized out upon the nearest surface if the pressure is released or the solution heated.

These incrusting solids forming upon the casings of water wells considerably decrease the amount of their production, and in a comparatively short time the flow may be entirely stopped, as the formation completely covers the perforations in the well casing.

When a well has reached this condition it is useless and unless these incrusting solids can be removed from the casing sufficiently to uncover the apertures therein, it is necessary to abandon the well and drill a new one.

The object of the present improvement is to provide a process for quickly and easily removing the entire incrustation of solid carbonates from the well casing, permitting the maximum flow of water therethrough.

The above and other objects may be attained by introducing into the well muriatic acid to an amount substantially fifty per cent of the total volume of water in the well. In order to evenly distribute the acid throughout the well, portions of the acid may be introduced at different levels.

An air line is then inserted into the well, provided with perforations throughout the depth of the water in the well and air is forced into the same. The solution is allowed to act for about twenty-four hours and then pumped out and the water is then continuously pumped from the well for a period of about twenty-four hours, at the end of which all traces of the muriatic acid will be gone.

It has been found that this method of cleaning wells dissolves and removes all of the incrusting solids from the casing of the well, entirely uncovering the apertures therethrough and permitting a maximum flow of water through the casing.

The invention may be carried out in the manner illustrated in the accompanying drawings, in which

Figure 1 is a longitudinal sectional view through a well, showing the manner of introducing the acid at different levels;

Fig. 2, a similar view showing the manner of introducing air into the solution; and

Fig. 3, a similar view showing the manner of pumping out the acid and water.

Similar numerals refer to similar parts throughout the drawings.

A well casing is represented at 10, provided with the usual apertures 11 for permitting a flow of water therethrough to the interior of the casing.

In Fig. 1 these apertures are shown as substantially entirely closed with incrusting solids indicated at 12. When a well gets into this condition, it is substantially useless as very little, if any, water can be obtained therefrom.

A typical analysis of these incrusting solids is as follows:

	Per cent
Calcium sulphate	15.78
Calcium carbonate	41.23
Iron carbonate	24.61
Iron chloride	12.50
Magnesium carbonate	6.37

These carbonates are soluble in a solution which gives hydrogen ions, such as the acids and acid salts. A reaction will take place at ordinary temperatures and atmospheric pressure, giving an evolution of carbonic acid gas and salts of the metals remaining either suspended or actually dissolved in the liquid. If pressure is increased, then the reaction takes place very slowly and reaches equilibrium very quickly. The carbonates will not dissolve and the reaction stops.

This is explained by the following typical reaction equation:

$$CaCO_3 \text{ plus } 2HCl = CaCl_2 \text{ plus } H_2CO_3$$

$$\frac{CaCO_3 \times 2HCl}{CaCl_2 \times H_2CO_3} = \frac{K_1}{K_2}$$

Where K_1 and K_2 are reaction constants, if K_1 equals K_2, then there will be no reaction. If K_1 is greater than K_2, then the carbonate

will dissolve to completion. We can make K_1 greater than K_2 by removing the H_2CO_3 as rapidly as it is formed in the reaction. This can be done by putting a gas into the solution and displacing the CO_2 as the following typical reaction:

$$H_2CO_3 \text{ plus air} = H_2O \text{ plus } CO_2$$

Then the total expression is thus:

$$\frac{CaCO_3 \times 2HCl}{CaCl_2 \times H_2O \times CO_2} = \frac{K_3}{K_4}$$

and K_3 will always be greater than K_4. By the use of air or other gases included in the claims the CO_2 is taken out of the system by blowing it up out of the well. The reaction will take place under a pressure which is never exceeded in ordinary water wells.

In carrying out the improved method to which the invention pertains, the first step consists in introducing muriatic acid (28% HCl) below the water level 13 of the well. Preferably an amount of muriatic acid estimated at fifty per cent of the total volume of water in the well is introduced at different levels below the water level.

This acid may be introduced into the well by means of a pipe 14 which is preferably first lowered to the position shown in full lines in Fig. 1, terminating about twenty feet from the bottom of the well as indicated at 15 and one-fourth of the total acid is poured into the well at this point.

The pipe 14 may then be raised to about one-half the depth of the water, as indicated in broken lines at 15*a* and another fourth of the acid is added. The pipe may then be raised to about one-fourth the depth of the water, as indicated in broken lines at 15*b*, and another fourth of the acid introduced, after which the pipe is raised to about ten feet below the water level, as indicated in broken lines at 15*c* and the remaining fourth of the acid is put into the water.

The next step in the method is illustrated in Fig. 2. The pipe 14 has been withdrawn and an air line 16, provided with spaced apertures 17, extending throughout the entire depth of the water, is inserted to the bottom of the well, as shown.

The apertures 17 are so spaced and cover such an area that air may be forced into the well solution at all depths. Air is turned into the air line 17 and the solution is allowed to act for twenty-four hours.

The air line is then removed and the solution is pumped out by any suitable apparatus indicated generally at 18 in Fig. 3. The water is pumped out for about twenty-four hours, at the end of which time no trace of the acid remains.

As indicated in Fig. 3, all of the incrusting solids have been dissolved and removed from the casing, leaving the apertures 11 entirely open and permitting a maximum flow of water through the casing.

The difference between the present process and one in which an acid is merely charged into the water in a well, is that for a period of some twenty-four hours the solution is acted upon by the air which is forced into it, so that the carbon dioxide which is formed by the dissolving of the carbonate incrustments is driven off.

It has been found by actual trial that by merely putting acid into a well the incrustments are not dissolved and that the acid solution does not continue to act beyond a very brief period, and soon becomes dormant.

It has also been found by trial that the mere mechanical agitation as by means of a plunger or a propeller mixer does not increase the activity of the acid, over a quiet solution; but that when a gas is forced into the liquid, so as to bubble up through the entire column of liquid in the well, for a substantial period of say twenty-four hours, the carbon dioxide gas formed by the reaction of the acid upon the incrustments is displaced and carried upward, out from the solution in the well.

As a result of the continual removal of the carbon dioxide gas, the action of the acid continues to be effective without being suppressed by the presence of the carbon dioxide gas.

I claim:

1. The process of removing incrusting solids from water wells which includes introducing an acid into the water, forcing gas under pressure into and through the solution for about twenty-four hours to drive off carbon dioxide formed by the action of the acid upon the incrusting solids, and then pumping the solution out of the well.

2. The process of removing incrusting solids from water wells which includes introducing muriatic acid into the water, forcing gas under pressure into and through the solution for about twenty-four hours to drive off carbon dioxide formed by the action of the acid upon the incrusting solids, and then pumping the solution out of the well.

3. The process of removing incrusting solids from water wells which includes introducing acid into the water to an amount of fifty per cent of the volume thereof, forcing gas under pressure into and through the solution for about twenty-four hours to drive off carbon dioxide formed by the action of the acid upon the incrusting solids, and then pumping the solution out of the well.

4. The process of removing incrusting solids from water wells which includes introducing muriatic acid into the water to an amount of fifty per cent of the volume thereof, forcing gas under pressure into and through the solution for about twenty-four hours to drive off carbon dioxide formed by

the action of the acid upon the incrusting solids, and then pumping the solution out of the well.

5. The process of removing incrusting solids from water wells which includes the introduction of acid at different levels under the water in the well, forcing gas under pressure into and through the solution for about twenty-four hours to drive off carbon dioxide formed by the action of the acid upon the incrusting solids, and then pumping the solution out of the well.

6. In a process of removing incrusting solids from water wells which includes introducing an acid reacting material into the water of the well, the step of bubbling a gas through the acid solution in the well.

7. In a process of removing incrusting solids from water wells which includes introducing an acid reacting material into the water of the well, the step of removing the carbon dioxide formed by passing a stream of a gas through the acid solution in the well.

8. In a process of removing incrusting solids from water wells, the steps of introducing an acid reacting material into the water of the well, disturbing the equilibrium reaction between the acid material and the incrusting material by passing a stream of a gas through the acid solution in the well until substantially complete reaction has taken place and removing the acid solution from the well.

9. In a process of removing incrusting solids from water wells which includes introducing an acid into the water of the well, the step of bubbling air through the acid solution in the well.

10. In a process of removing incrusting solids from water wells which includes introducing an acid into the water of the well, the step of removing the carbon dioxide formed by passing air through the acid solution in the well.

11. In a process of removing incrusting solids from water wells, the steps of introducing an acid into the water in the well, bubbling air through the acid solution in the well until substantially complete reaction between the acid and the incrusting material has taken place and removing the acid solution from the well.

12. In a process of removing incrusting solids from water wells, the steps of introducing hydrochloric acid into the water in the well, bubbling air through the acid solution until substantially complete reaction between the acid and the incrusting material has taken place and removing the acid from the well.

In testimony that I claim the above, I have hereunto subscribed my name.

KIEL B. BOWMAN.