

Jan. 14, 1941.

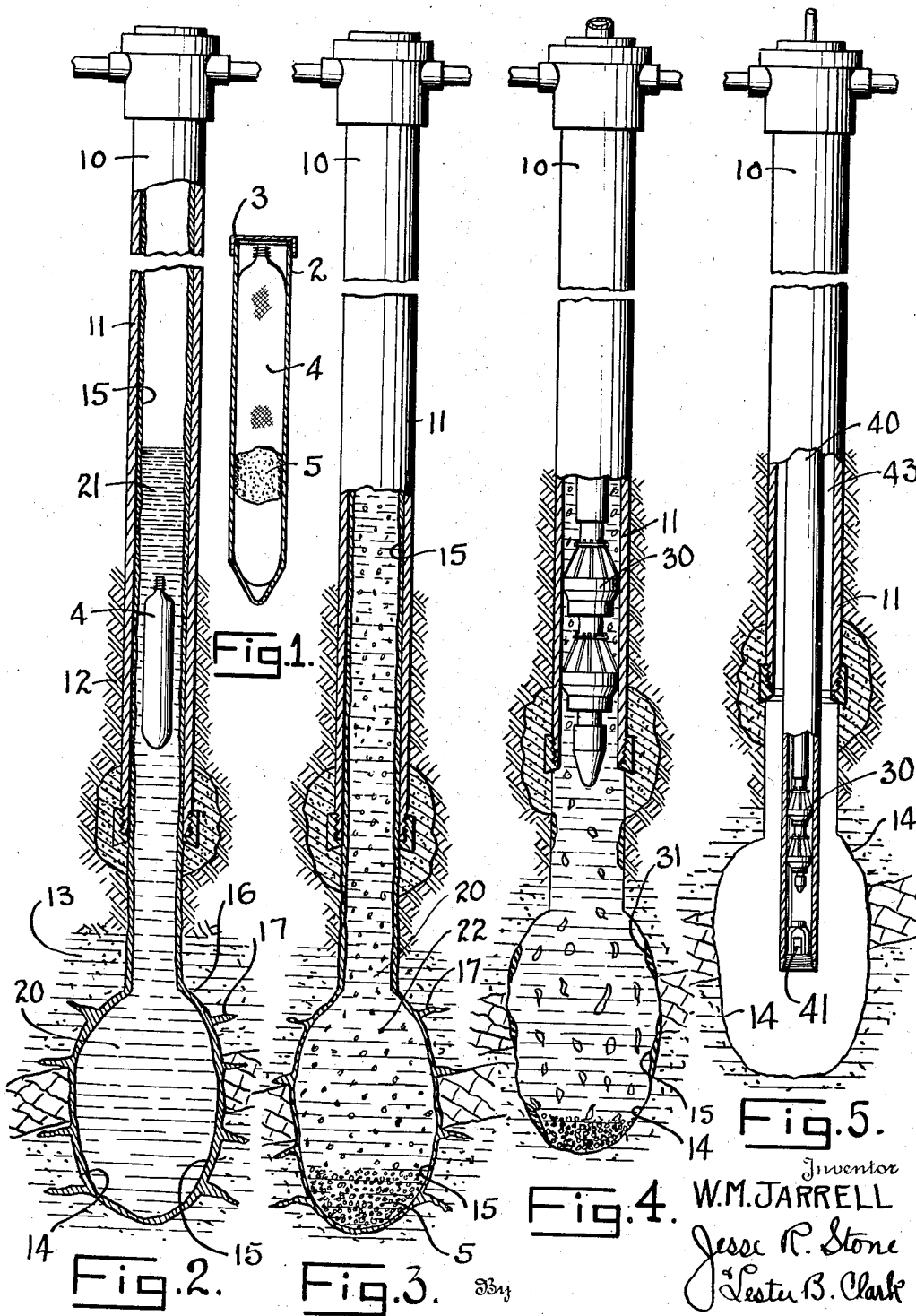
W. M. JARRELL

2,228,629

METHOD OF TREATING OIL AND GAS WELLS

Filed Dec. 20, 1938

2 Sheets-Sheet 1



Jan. 14, 1941.

W. M. JARRELL

2,228,629

METHOD OF TREATING OIL AND GAS WELLS

Filed Dec. 20, 1938

2 Sheets-Sheet 2

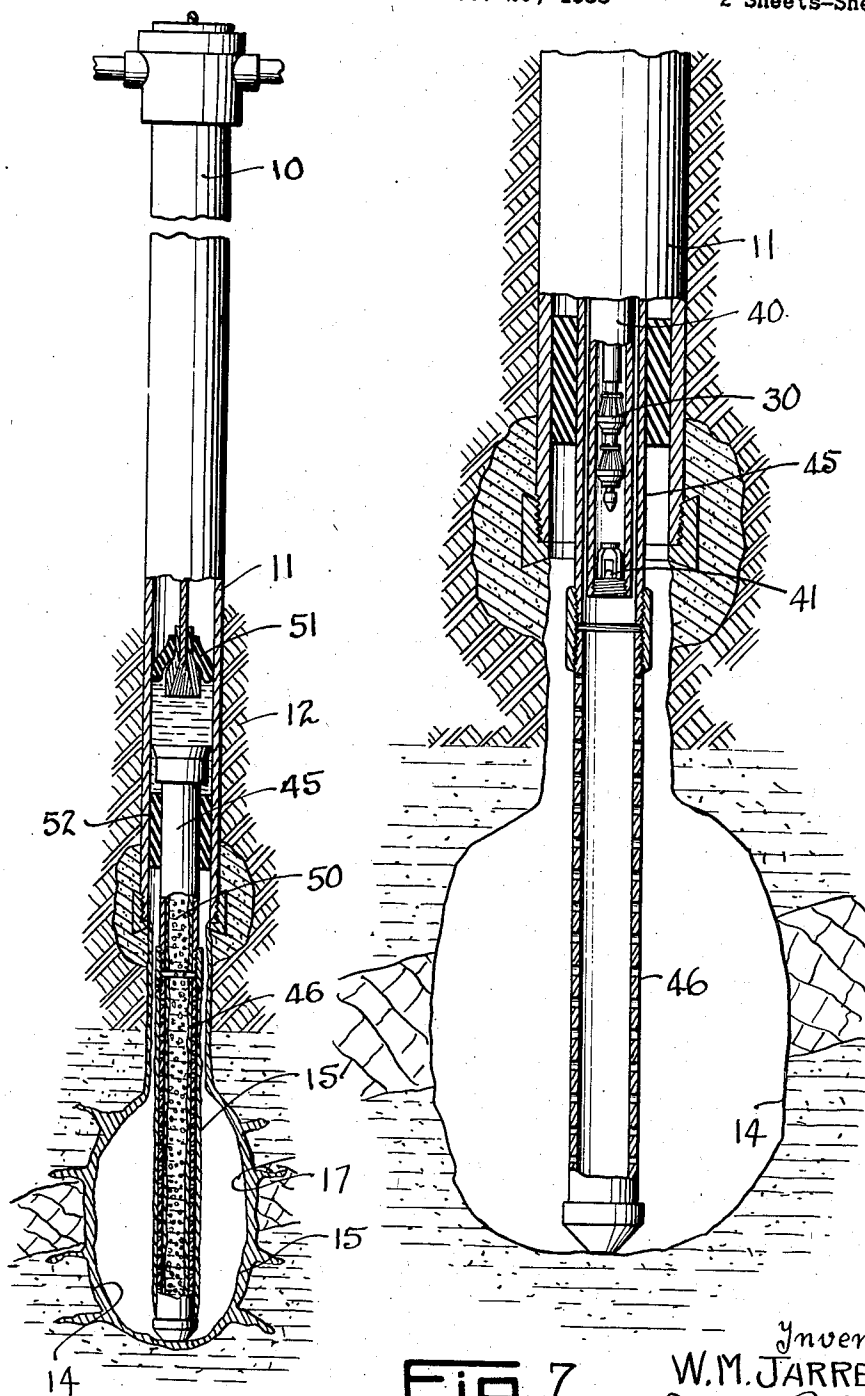


Fig. 6.

Fig. 7.

Inventor
W. M. JARRELL
Jesse R. Stone
Lester B. Clark
Attorneys

UNITED STATES PATENT OFFICE

2,228,629

METHOD OF TREATING OIL AND GAS WELLS

Walter M. Jarrell, Austin, Tex.

Application December 20, 1938, Serial No. 246,771

3 Claims. (Cl. 166—21)

The invention relates to a means and method of treating oil and gas wells to remove accumulations of paraffin or asphalt, or soft shale, or shale muck or rotary mud therein.

5 The present invention relates generally to that disclosed in my co-pending application, Serial No. 87,502, filed June 26, 1936, for a Means and method of treating wells, the present invention being more specific as to details of the method and to a somewhat different container for the chemical and caustic soda but is entitled to the benefit of the filing date thereof as to all common subject matter.

15 It will be understood that during the production of oil and gas from wells the release of the pressure on the formation causes an evaporation and a deposit of paraffin upon the face of the exposed formation and for distances back into the formation between the interstices of the sand particles of the formation and deposits of shale muck, if shale is present in or near the oil formation and where water contacts such shale, also deposits formed from surface water entering into the well, and rotary mud left from drilling. Such deposits also occur on the well tubing, casing and liner, so that it becomes necessary from time to time to remove this coating of paraffin, asphalt gum, shale muck and rotary mud.

30 It is an object of the invention to provide a means and method whereby the paraffin, asphalt, mud and muck accumulations in the well bore are dislodged and disintegrated and suspended by the agitation of a chemical reaction and are then forced upwardly in the well bore to become intermixed with water and oil so as to form an emulsion from which the paraffin, asphalt, mud and muck will not recondense. This is accomplished by the fact that small particles of the chemical travel upward into the oil and water and spend the force of their reaction in that body of oil and water in the well bore, maintaining a constant heat far above the congealing point of any of the substances dislodged.

45 Another object of the invention is to form an emulsion in a well bore by heating the paraffin and muck in the well by a heating reaction of chemical, caustic soda and water, so that the mixture of paraffin, asphalt, muck and mud, steam and gas generated by the chemical will provide a continuous reaction to agitate the smaller particles of the chemical within the well bore so as to develop the entire strength of the chemical and to form an emulsion with an oil and water deposit in the well bore.

55 Still another object of the invention is to pro-

vide a container for chemical and caustic soda to be dropped into a well bore which container is composed of fabric which will be consumed by the reaction.

Still another object of the invention is to provide a convection circulation in a well bore due to an exothermic heat reaction which will disintegrate the muck on the face of the formation and entrap, while maintaining a constant heat far above the congealing point, such disintegrated paraffin asphalt, mud or muck being moved up into the well bore by the liberation of gas from the chemical reaction, in a body of oil and water so that it can not recondense and may be removed from the well bore by swabbing or otherwise.

Other and further objects of the invention will be readily apparent when the following description is considered in connection with the accompanying drawings wherein:

Fig. 1 is a vertical section wherein the fabric container for the chemical and caustic soda is shown in elevation with certain parts broken away to illustrate the contents thereof.

Fig. 2 is a vertical sectional view showing diagrammatically a well bore where a cavity has been formed and upon the walls of which a deposit of paraffin, asphalt, muck or mud has accumulated and is to be removed and shows the deposited water and the fabric container or charge of chemical being dropped into the well bore.

Fig. 3 is a view similar to Fig. 1 but showing the reaction as having been initiated and the convection circulation established to melt and dislodge the muck and accumulation from the formation.

Fig. 4 shows the next step of the method wherein the accumulation formed is being removed by a swabbing action.

Fig. 5 shows the well after the emulsion and other materials have been removed therefrom and wherein a vacuum has been created in the well while the well is empty so as to draw into the well any water which might be remaining in the formation or near the surface of the formation, and such vacuum tends to initiate a flow of oil back into the well.

Fig. 6 shows a view wherein a well containing a liner and strainer is being treated while a pressure is being maintained thereon.

Fig. 7 shows another form wherein a tubing and strainer remain in the well and the suction is applied thru the tubing.

In Fig. 1 a tube 2 has been illustrated which is preferably of metal and is provided with a

cover 3. This tube 2 is arranged to receive a fabric container 4 which is in the nature of a fabric covering for a body of chemical and acid 5. This fabric container 4 can be made of any suitable fabric but in actual practice it has been found that either silk or wool is preferable because these fabrics will be consumed by the reaction of the chemical and caustic soda. The chemical is usually aluminum castings of aluminum sand, aluminum dross, oil and the caustic soda may be flaked caustic soda. These materials may be intimately mixed together and it has been found in actual practice that, by coating the particles of aluminum and chemical with a small quantity of heavy lubricating oil that the absorption of moisture will be prevented. The caustic is thus prevented from attacking the aluminum prior to the addition of water so that the complete charge may be readily mixed and stored for long periods of time without deterioration.

The tube will be transported to the well and when it is to be used the fabric container 4 will be removed and the fabric container and charge of material introduced into the well bore.

Fig. 2 shows a diagrammatic arrangement of a well 10 which is provided with a casing 11. This casing penetrates the earth formation 12 to the elevation of a producing formation 13. The well cavity is illustrated at 14 and an accumulation of material 15 is shown on the face 16 of the formation and penetrating into crevices 17 and into the interstices between the sand particles of the formation 13. This accumulation of paraffin 15 is also shown as inside of the casing 11.

In one manner of practicing the method a body of water 20 has been deposited in the well bore and any predetermined volume may be used, depending upon the amount of chemical which is to be used and, in actual practice, it has been found that our parts of water to one part of treating material is satisfactory. The water may or may not fill the cavity 14 depending on the conditions encountered.

Fig. 2 shows the fabric container of chemical and acid as having been dropped into the well bore and moving downwardly therein. A body of oil 21 in any desired volume may have been deposited upon the water 20 either before the fabric container 4 is introduced or directly thereafter. In either event this oil increased the static pressure on the face of the formation and tends to confine the water, and will be more specifically described in connection with the operation of the reaction.

In Fig. 3 the fabric container 4 has landed on the bottom of the well bore and has been ruptured. This breaking of the fabric container exposes the caustic soda and the chemical or if container is not ruptured in its fall, the fabric will absorb enough moisture to begin the chemical reaction, and in this event, the fabric container will be eaten away, so that an exothermic reaction is initiated. This reaction raises the temperature of the water 20 to such an extent that steam is formed and with the static pressure on the face of the formation this heat is caused to penetrate the paraffin, asphalt, muck, or mud to begin melting these deposits and disintegrating them as best seen in Fig. 3, where the particles of muck, or mud and other accumulations 22 are shown as having been dislodged from the cavity. Some of the chemical which has not yet reacted with the water is shown at the base of the cavity.

Naturally the reaction of the chemical caustic soda and water is violent and there is considerable

agitation set up which assists in dislodging the accumulation. The fact that heat is generated increases the temperature of the face of the formation and gas is liberated from the oil and the chemicals and from the accumulations on the face of the formation and liner. The expansion of this gas causes the breaking up of the cake on the face of the formation and assists in dislodgment.

The tremendous heat generated sets up a convection circulation so that the gas, water, steam and muck begin to rise in the well bore, as best seen in Fig. 3. The heat of the reaction is confined to a considerable extent by the body of oil 21 on the top of the water and because of the lighter specific gravity of the oil there is a tendency for it to remain on the top.

As the convection circulation is set up and the heated mixture rises in the well bore it becomes intermixed with the oil due to the presence of the gas and steam which will move upwardly through the oil.

In addition to the heat and agitation created by the reaction there is also a corrosive action which takes place. This corrosion of the shale, mud or muck disintegrates such material so that it is broken up into smaller particles which will be readily carried along by the movement of the fluid in the well. Thus there are two forces tending to dislodge the material.

This intermingling of the mixture and the oil forms an emulsion and it has been found in practice that where a sufficient volume of oil has been provided the emulsion thus formed entraps the muck, paraffin and mixture which rises in the well bore to form a composition from which the paraffin, asphalt, muck and mud will not recondense. It appears that portions of the gas formed are entrapped in the emulsion so that the solid portions thereof are more or less frothy and foamy.

While these reactions and intermixing of the fluids, liquids and solids is progressing naturally the heavier liquid will circulate toward the bottom of the well and cover the areas coated with the mud, muck, etc. Thus this hot caustic solution is in contact with the material to be removed and the reactions continue automatically.

Fig. 4 shows a swab 30 as being lowered into the well bore whereby the emulsion just described can be removed from the well bore by washing the formation or liner by alternately applying vacuum and pressure to the formation.

This suction tends to dislodge additional material from the face of the formation and as the reaction of the remaining chemical at the bottom of the cavity carries these disintegrated deposits up the well bore, due to the steam and gas given off by the second or continued reaction, there is still some of the cake as at 31 remaining on the face of the cavity in Fig. 4. The suction applied by the swab 30 or otherwise tends to draw this cake away from the formation.

Before the swabbing action additional water may be introduced into the well bore, this water having a greater specific gravity than the emulsion, or the oil that remains in the upper reaches of the well bore will settle down into the cavity 14. In some instances the emulsion formed may be quite compact and the added water might be held on top thereof instead of penetrating further into the well. To speed up the settling of the water introduced into the well through the emulsion existing in the well bore, a bailer may be run from the top of the well, through the water introduced and through the emulsion to the bottom of the well bore and then is pulled from the

well. The water will tend to follow the bailer thru the emulsion toward the bottom of the well. The chemical and caustic soda remaining in the bottom of the cavity will be caused to react upon the addition of water so as to initiate a second reaction in which an additional amount of heat and corrosion is applied to the formation. This second heating and corrosive reaction will penetrate into the crevices such as 17 because of the fact that the initial cake or emulsion 15 has been dislodged and also because of the fact that the face of the formation is now heated to a higher temperature. During this second reaction a swab may be lowered into the fluid of the well bore and a suction or reduction pressure created depending upon the structure of the oil formation. This vacuum is created to pull all disintegrated accumulations into the well bore so that they may be carried up the well bore by the second reaction of the chemical. Pressure and suction may be alternately applied so as to surge the hot chemical solution into and out of the formation.

In actual practice the heat and corrosive reaction lasts for a period of three or four hours. The swabbing action is carried on, during, or after this second reaction as circumstances may warrant.

Another manner of practicing the invention is to drop the fabric container 4 of chemical and caustic soda into the well bore when it is entirely empty so that as it strikes the bottom of the cavity the chemical and caustic soda will be widely dispersed and will adhere to the accumulation 15 on the face of the formation. Following this dispersion the water and oil may be added. This method may be practiced the same as previously described but the introduction of the chemical while the cavity or well is empty is sometimes of advantage, particularly when such well produces a quantity of water along with the oil.

A third body of water may be added to carry on a last reaction and to utilize every particle of chemical which has been introduced. It has been found that in practice satisfactory results can be obtained if the first chemical reaction initiates a temperature of approximately 320 F. and the second reaction at about 280 F., and the third reaction at about 200 F. under low pressures. The well may be washed with water to remove any deposits of sand or undissolved shale which may have been drawn into the cavity while swabbing, and then the tubing may be run back into the well and the well is now ready to be pumped after having been treated, unless swabbing the tubing to leave the well on a vacuum is thought necessary before placing the well on the pump.

It will be apparent that three reactions have transpired, the first tends to heat and remove the exposed foreign material, the second continues the heat and corrosion on the formation and tends to carry the disintegrated material upwardly in the well while the swabbing action creates alternate pressure and suction on the formation to surge the hot chemical solution into and out of the formation; the third reaction occurs after enough water has been added to cover the face of the formation so that a hot caustic solution will be caused to penetrate the formation and wash out any remaining mud, muck, etc. The heavier solution naturally floats out any emulsion remaining upwardly in the well so that it may be readily removed. It has been found in actual practice that if approximately one half of the total amount of water to be used is introduced to begin with and then one quarter for the second reaction and

the final one quarter for the third reaction that a satisfactory operation is obtained.

A composition for making up a charge to be used in treating wells may consist of: 100 pounds of caustic soda, 25 pounds of aluminum dross; 12½ pounds of aluminum castings or sand; 15 pounds of soap powder, and sufficient oil to cover all of the particles constituting the charge.

Fig. 5 shows an arrangement wherein the tubing 40 is shown as being positioned in the well after the accumulation of muck and other material has been removed, as by swabbing or otherwise.

A swab 30 of a suitable size is lowered thru the tubing and may be used in this manner to create a suction on the face 14 of the formation. A standing valve 41 is carried by the lower end of the tubing and in this manner by an upward pull upon the swab 30. A reduction in pressure can be created in the cavity 14 and the standing valve 41 will hold this pressure providing that the top of the well is sealed by the casinghead which is shown in the drawings. Annular chamber 43 between the tubing and the casing will also be subjected to this pressure in this form of the invention.

This reduction in pressure may be exerted on the formation so that there will be a tendency to draw any water or chemical fluid from crevices of the formation, and the formation, and will also encourage the movement of oil and gas back into the well.

Fig. 6 shows an arrangement similar to Fig. 2 but wherein the well contains a liner 45 which has an upper blank section and the lower perforated section 46. This liner carries an accumulation of muck 15 both inside and outside thereof and this same accumulation is as shown on the face 14 of the well bore. A body of chemical and water has been deposited inside of the liner 45 as indicated at 50 and a closure plug 51 is in the form of a packer has been positioned in the casing 11 above the liner. A lead seal or packer 52 forms a seal between the liner and the casing. At any time during the reaction a pull may be exerted on the plug 51 to expand it and set it firmly in the casing. The reaction generates pressure inside of the liner which pressure is thus confined by the plug 51 so that the formation and equipment in the well bore will all be subjected to such pressure.

The pressure increases the efficiency of the chemical and corrosive so as to force the solution thru the strainer or liner and reacts against the formation. The plug 51 may be removed after the desired period of time by an additional pull thereon so as to release the pressure and swabbing of the well will remove the accumulated emulsion and wash the liner of foreign material.

Fig. 7 shows a combination arrangement which is a combination of Figs. 5 and 6 wherein the assembly of Fig. 5 has been inserted in the liner of Fig. 6. The operation will be obvious for exerting a reduction in pressure upon the formation after the muck has been cleaned therefrom, and this vacuum may be applied for any length of time and the alternate pressure and vacuum utilized until the muck has been dislodged and production of oil and gas initiated.

What is claimed is:

1. A method of treating oil wells to remove accumulations of paraffin, shale muck, rotary mud, etc. therefrom comprising depositing a charge of aluminum and caustic in the well, adding a body of water in proportion to the amount of chemical

and caustic, adding a body of oil to float on the water which oil is in proportion to the bottom hole pressure of the well and intended to exert on the face of the formation a pressure slightly in excess of the formation pressure, heating the accumulation of material on the face of the formation by the heat generated from the reaction of the water, chemical and caustic, to dislodge the material by melting and disintegrating and the formation of gas and steam due to such heating, so that such material will rise in the well bore and become intimately mixed with the oil and water to form an emulsion of the material and oil and water, and removing the emulsion thus formed from the well.

2. The method of treating wells to remove an accumulation of paraffin or other materials from the face of the producing formation comprising the steps of depositing a batch of heat forming chemical into the well bore at the elevation of the formation, depositing a body of water on top of the chemical so as to initiate a chemical reaction, providing a body of oil on top of the water, allowing the chemical reaction of the water and chemical to proceed to form steam in the well bore so that the heat, agitation and corrosive action will combine to melt and dislodge the paraffin from the face of the formation so that the increase in volume due to such reaction and the formation of steam will institute a circulation of the melted paraffin which will move upwardly in the bore to intermix with the oil to form an emulsion, applying a suction on the formation face while removing the emulsion to break down

the face of the formation, again adding water to prolong the chemical reaction in order to continue the application of heat to the face of the formation to melt any paraffin remaining and subsequently applying suction and again withdrawing said additional emulsion which is formed.

3. A method of treating wells to remove accumulations of paraffin, asphalt, mud or muck material which comprises the steps of predetermining the quantity of water necessary to react with a predetermined amount of chemical and caustic soda to create at a heating and corrosive reaction of the necessary magnitude, introducing the chemical, caustic soda, and one half of the water into the well bore, introducing a body of oil on top thereof, allowing the reaction to proceed to soften, disintegrate and corrode the accumulation of material in the well bore so that such material will be moved in the bore and an emulsion of the caustic solution, material and oil will be formed, adding one quarter of the water, so as to initiate a second reaction with the chemical and acid remaining, removing the forming emulsion while alternately applying suction and pressure to the well bore, and finally adding the last quarter of water to complete the reaction and provide a body of hot caustic solution in contact with the formation while alternately applying suction and pressure so as to surge such solution into and out of the formation to wash the formation of accumulated material, and continuing such surging and washing until production occurs.

WALTER M. JARRELL.