US 20110162841A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2011/0162841 A1**

(43) **Pub. Date: Jul. 7, 2011**

Wilson

(54) **CONTINUOUS SLOW DISSOLVING CHEMICAL TREATMENT FOR OIL AND GAS WELLS**

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(21) Appl. No.: **12/900,218**

(22) Filed: **Oct. 7, 2010**

Related U.S. Application Data

(60) Provisional application No. 61/285,752, filed on Dec. 11, 2009.

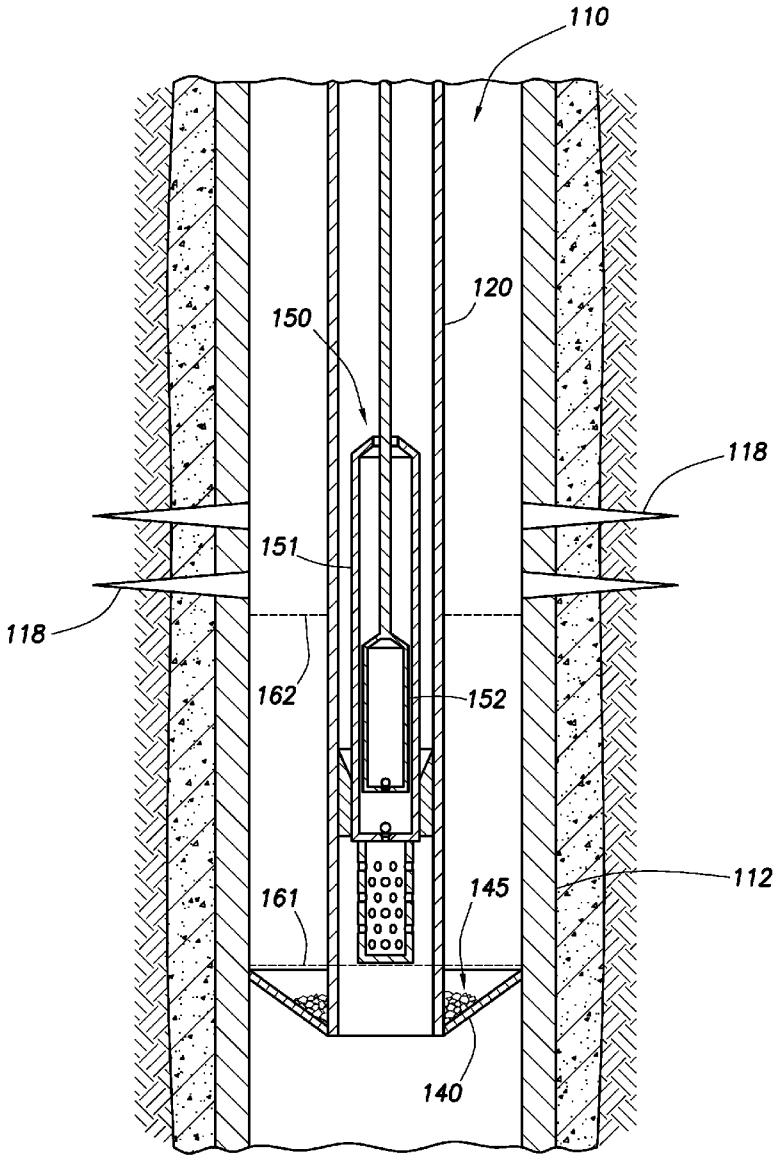
Publication Classification

(51) **Int. Cl.**
A47B 43/00 (2006.01)

(52) **U.S. Cl.** **166/279**

(57) **ABSTRACT**

The invention relates to dispensing slow release chemicals for inhibiting the formation of scale, corrosion or other precipitates in hydrocarbon wells. The chemical is provided into a dispenser positioned for at least nearly continuous exposure to liquid preferably in the active water phase. The active water phase is generally just below the inlet into production tubing.



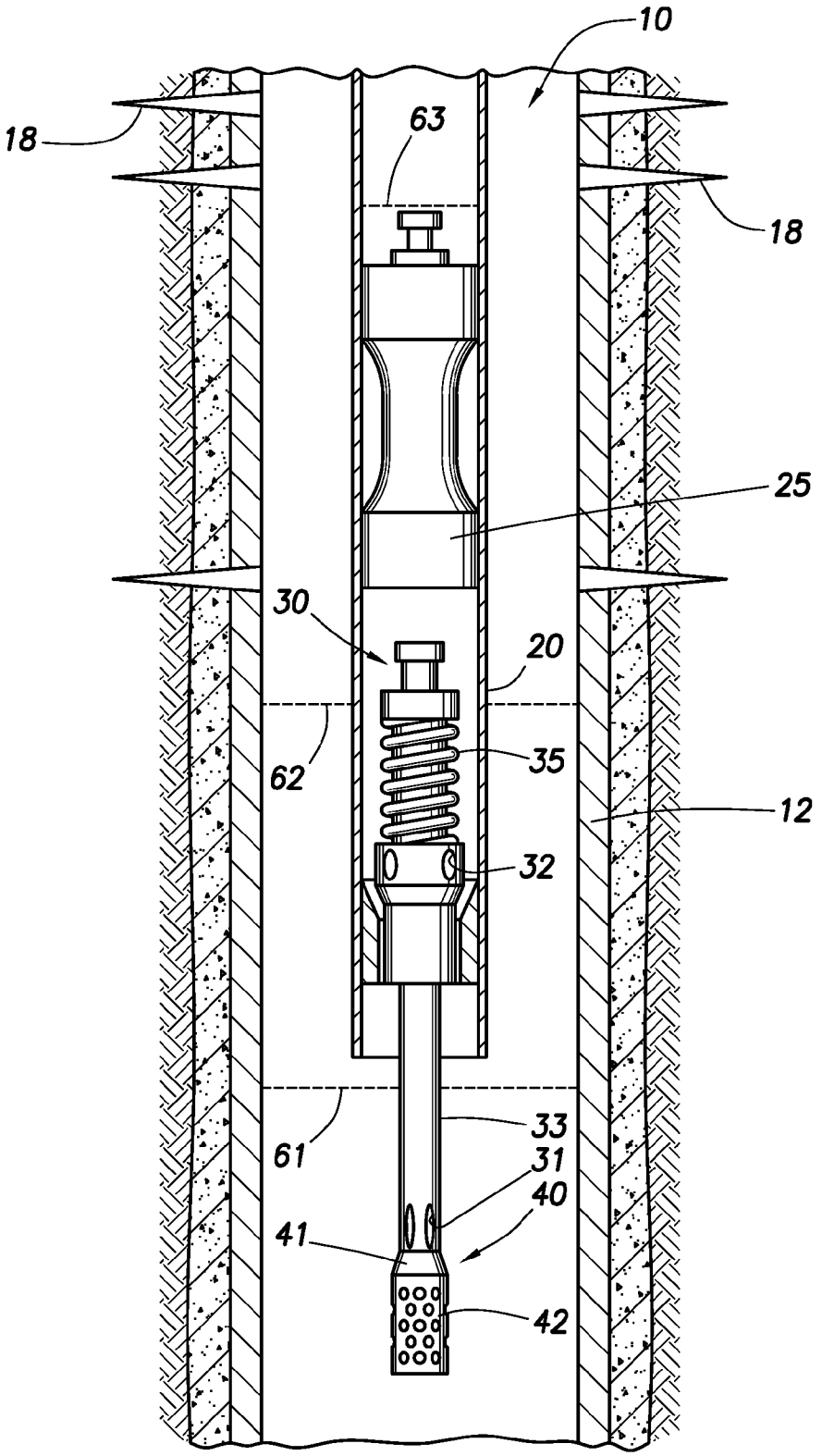


FIG. 1

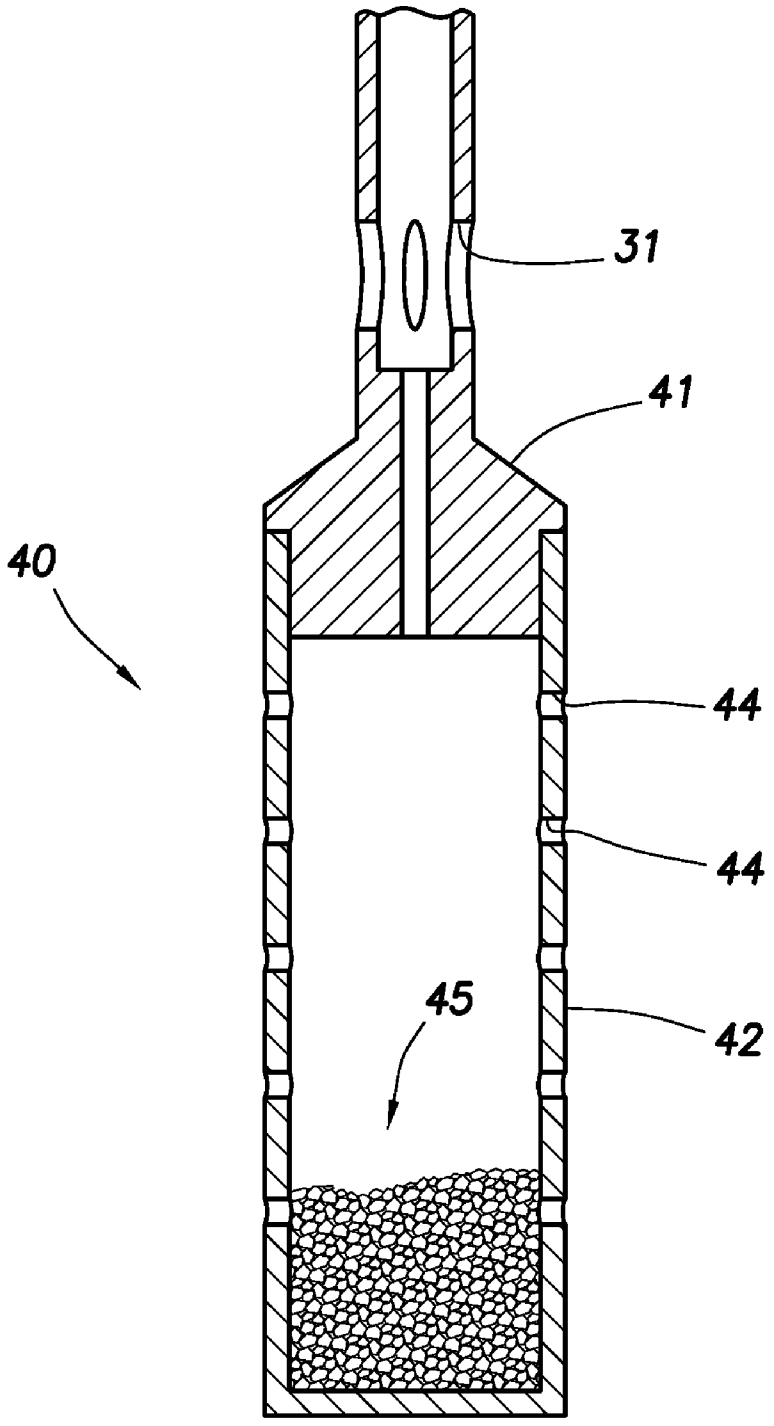


FIG.2

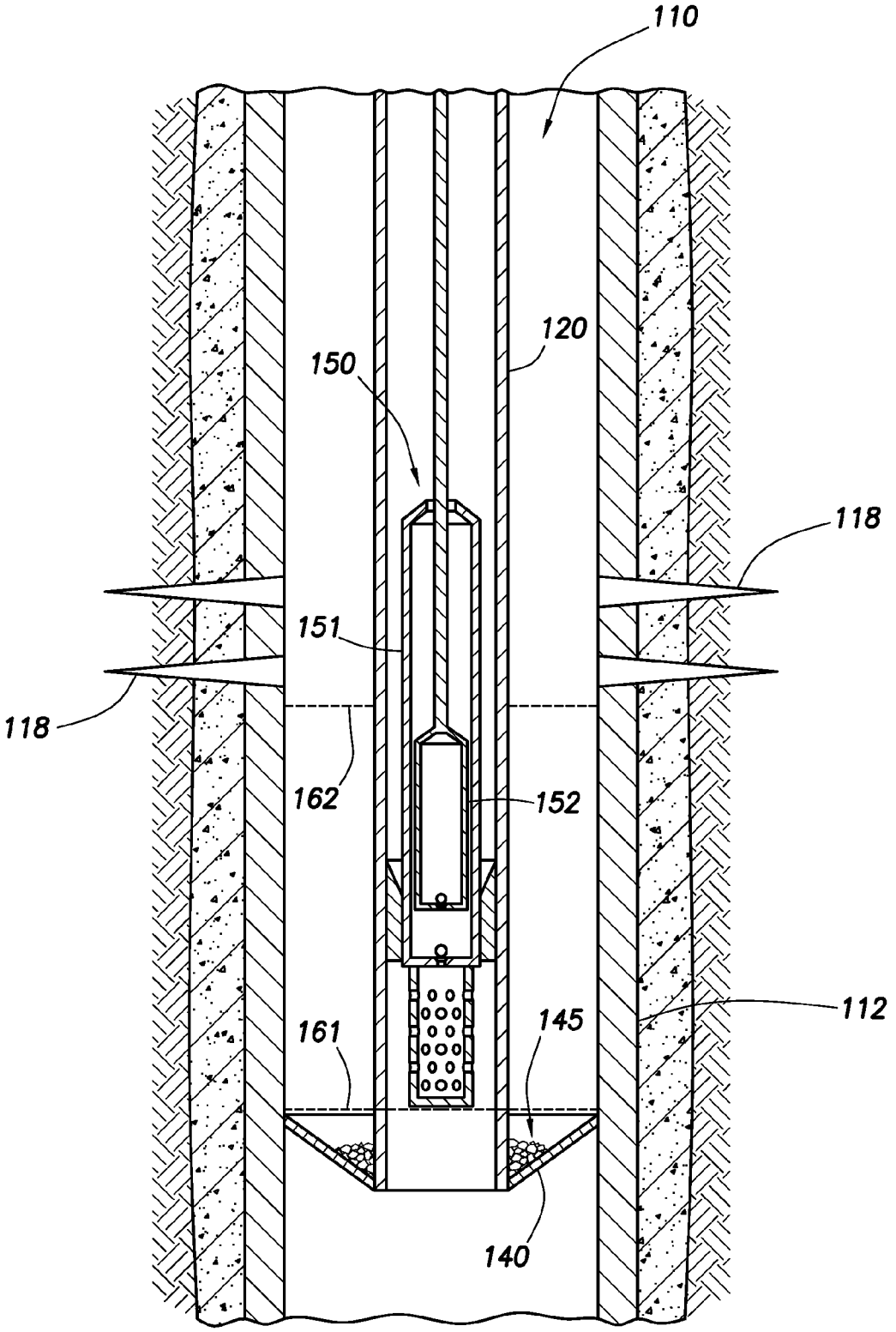


FIG.3

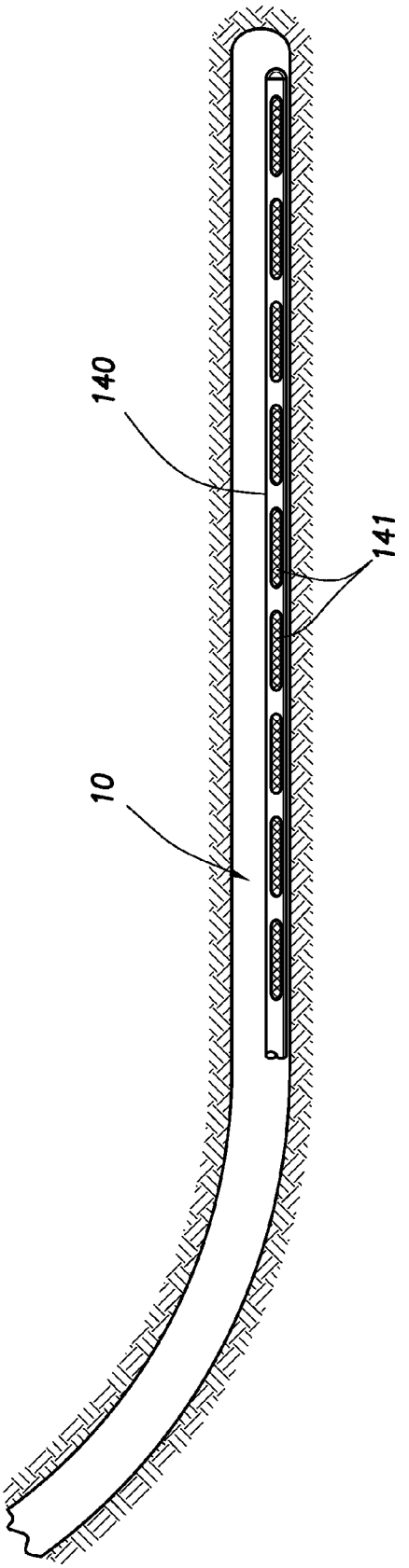


FIG.4

CONTINUOUS SLOW DISSOLVING CHEMICAL TREATMENT FOR OIL AND GAS WELLS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a non-provisional application which claims benefit under 35 USC §119(e) to U.S. Provisional Application Ser. No. 61/285,752 filed Dec. 11, 2009, entitled "Continuous Slow Dissolving Chemical Treatment for Oil and Gas Wells," which is incorporated herein in its entirety.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] None.

FIELD OF THE INVENTION

[0003] This invention relates to oil and gas wells that are prone to forming scale or corrosion.

BACKGROUND OF THE INVENTION

[0004] It is a common problem for either scale or corrosion to form inside gas and oil wells and sometimes both. Scale and corrosion interfere with operations of plunger lift and other moveable parts and is especially troubling when downhole equipment is to be pulled after months or years in the well. For example, production tubing may be installed in a well and sit motionless for years, but must be pulled out of the well for certain workover or recompletion efforts to extend the life of the well.

[0005] Chemical treatments for prevention, inhibition or control of scale and corrosion are known. Most are in a liquid form and are added to the well on a periodic basis. The chemical may mix in with other liquids at the bottom of the well and distribute itself around to all the surfaces that are likely to have scaling or corrosion problems. However, while the liquid chemicals are in the well, liquids are typically being produced out. As a result, the expensive chemicals that are added to the well remain in the effected area for a very limited time. For example, it is quite conceivable for a gas well to produce liquid water in volumes where the entire liquid production in one day is several times the volume of liquid in the well at any given time. After three or four days, the area at the bottom of the well where corrosion and scale are most likely to occur is flushed clean of the chemicals. If the chemical injection is on a monthly basis, the well spends far more time each month unprotected than protected.

[0006] There has been some effort to make such chemicals in a slower release formula that is solidified. Such chemicals are installed during hydraulic fracturing propping efforts where the well is overpressured to force open fractionation areas to create more open flow paths for oil and gas to get to the wellbore. Proppant or granules of sand are injected into the fractures in the formation to support the fractures in their more open orientation. Chemicals are baked into slow dissolving fused glass and some are blended to be slow released such as blended with clay can be injected with the proppant to provided extended protection against the problems of scale to the extent that the fluids are passing through the areas where the chemicals rest. Solids formed of slow dissolving chemicals that are currently added to a well with fracture proppant are being developed and expanded for use in paraffin formation, corrosion, scaling biocides and other precipitation problems and H_2S scavengers that are encapsulated in a slow dissolving matrix or crystallized form for slow release.

SUMMARY OF THE INVENTION

[0007] The invention relates to a method for slow release dispensing of a chemical within a producing hydrocarbon well to control a chemical process such as corrosion or hydrate formation or alter the physical properties of one or more chemicals such as dissolving paraffin waxes. The method more particularly includes the steps of selecting a chemical for obtaining a chemical result within the wellbore where the chemical is bound within a complex so that it slowly dissolves in wellbore fluids of the type existing in a producing hydrocarbon well and is slowly dispensed over time, installing a chemical dispenser into the hydrocarbon well such that the chemical dispenser is substantially continuously exposed to such liquids in the hydrocarbon well and wherein the dispenser includes an enclosure with a perforated portion for fluids to pass through and contact and dissolve the chemical; and continuously dispensing the chemical from the dispenser into the liquids in the hydrocarbon wellbore to maintain an effective dosage of the chemical in the liquid to obtain the desired chemical result.

[0008] The invention more particularly relates to a method for slow release dispensing of a chemical within a producing hydrocarbon wellbore to control a chemical process such as corrosion or hydrate formation or alter the physical properties of one or more chemicals such as dissolving paraffin waxes. The methods includes the steps of selecting a chemical for obtaining a chemical result within the wellbore where the chemical is bound within a complex so that it slowly dissolves in wellbore fluids of the type existing in a hydrocarbon wellbore and is slowly dispensed over time and attaching the chemical dispenser onto hydrocarbon production equipment. The hydrocarbon production equipment is installed into the hydrocarbon wellbore such that the chemical dispenser is substantially continuously exposed to such liquids in a hydrocarbon wellbore and the chemical is installed into the dispenser. It should be noted that in some embodiments, the chemical is installed before the dispenser is installed into the wellbore and in other embodiments the chemical may be installed into the dispenser after the dispenser is installed into the wellbore. The chemical is continuously dispensed from the dispenser into the liquids in the hydrocarbon wellbore to maintain an effective dosage of chemical in the liquid to obtain the desired chemical result.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The invention, together with further advantages thereof, may best be understood by reference to the following description taken in conjunction with the accompanying drawings in which:

[0010] FIG. **1** is a fragmentary partially cross sectional view of a plunger lift production system in a hydrocarbon well showing an embodiment of the present invention;

[0011] FIG. **2** is a fragmentary cross sectional view of the chemical dispenser of the present invention.

[0012] FIG. **3** is a fragmentary partially cross sectional view of a rod pump production system in a hydrocarbon well with an embodiment of the present invention; and

[0013] FIG. **4** is a fragmentary cross section of a wellbore with a further embodiment of the present invention installed therein.

DETAILED DESCRIPTION OF THE INVENTION

[0014] Turning now to the preferred arrangement for the present invention, reference is made to the drawings to enable a more clear understanding of the invention. However, it is to be understood that the inventive features and concept may be manifested in other arrangements and that the scope of the invention is not limited to the embodiments described or illustrated. The scope of the invention is intended only to be limited by the scope of the claims that follow.

[0015] A wellbore, generally indicated by the arrow **10**, is shown in FIG. **1**. The wellbore **10** has been cased with casing **12**. Perforations **18** have been created in the casing **12** near the hydrocarbon bearing formation to allow such hydrocarbons out of the higher pressure formation into the lower pressure wellbore **10**. Production tubing **20** is positioned within casing **12** to carry liquids to the surface. In the installation shown in FIG. **1**, a plunger **25** is installed within production tubing **20** and typically resting on plunger stop **30**.

[0016] While plunger lift technology is well known, a brief explanation will be provided here. As hydrocarbon production occurs from the hydrocarbon bearing formation through the perforations **18**, natural gas and liquids enter the wellbore **10**. Liquids that primarily includes water, but may include liquid hydrocarbons, descend to the bottom of wellbore **10** while natural gas advances up the annulus between the production tubing **20** and casing **12**. As the liquids collect in the bottom of the wellbore **10** below the bottom end of production tubing **20** in the area that is sometimes referred to as the "rat hole". Eventually, the liquid level rises around the outside of the production tubing **20** and up inside the production tubing through bottom holes **31** in bypass conduit **33** and out through top holes **32** which are part of the plunger stop **30**. Plunger **25**, while having a diameter that approximates the interior diameter of the production tubing **20**, does not seal against the inside of the production tubing **20** and only rests on the plunger stop **30**. A coiled spring **35** absorbs any shock of a rapidly descending plunger **25**. Liquids slowly move around the heavier plunger **25** until a volume of liquid is in the production tubing above the plunger **25**.

[0017] In operation, the well is shut in by closing the wellbore **10** from any production. Pressure within the wellbore increases until the pressure within the wellbore is approximately the same as in the formation. The wellbore **10** is opened for production through the production tubing **10**. Natural gas within the annulus out side the production tubing **20** decompresses by pushing liquid into the production tubing **20** and forcing the plunger **25** to the surface. When the plunger reaches the surface, it is carrying with it a slug of liquid ahead of it and sometimes more follows the plunger. Once the plunger reaches the surface, a plunger catcher catches and holds the plunger **25** out of the way of gas production into the meter and on to a natural gas gather system.

[0018] While some amount of liquid is conveyed out of the wellbore **10**, much of the liquid below the bottom of production tubing **20** remains in the wellbore. Eventually, the gas production slows and the plunger catcher is programmed to release the plunger **25** to descend down to plunger stop **30**. In some procedures, the well may be shut in at that point or gas production would continue by opening up natural gas production from the annulus. Eventually, more liquids are produced that fill the casing **12** and production tubing **20**. Such liquids, especially water with substantial amounts of dissolved solids cause scale to form on surfaces. Scale causes problems for downhole operations where parts remain stationary for extended times and then have to move in close proximity to other metals. Scale that may form within the production tubing above the location where the plunger rests on the plunger stop **30** until the well is opened up for lifting the plunger **25** could interfere with the plunger lifting to the surface and even catch the plunger at the bottom of the production tubing. In this event, the production tubing would have to be pulled out of the wellbore **10** and cleaned out or replaced.

[0019] The level of liquid in the wellbore **10** ranges from lower level **61** and is preferably maintained at or below level **62** so as not to block any of the perforations **18**. In a plunger lift arrangement such as shown, it is unlikely that liquid would exist much, if any, below the bottom end of the production string **20** and it is common for the gas pressure in the annulus to be higher than the gas pressure in the tubing so that while the liquid level may be at level **62** or below, the liquid level within the tubing may be at a level indicated at **63**. In the preferred embodiment, the dispenser **40** is disposed within the liquid, continuously.

[0020] In the present invention, plunger stop **30** includes a chemical dispenser **40** to liquids in the rat hole to continuously administer chemical treatment to the well. The chemical dispenser comprises a base **41**, a cover **42** connected to the bottom end of bypass conduit **33** to maintain the base **41** and cover **42** into the liquid. Preferably, the base **41** and cover **42** are entirely submerged in the liquid at all times once liquids have been produced from the formation. In continuous contact with the liquid, chemicals within the cover **42** are exposed to the liquid and allowed to disperse in the liquid. Slow release chemicals, such as chemicals bound up in slow dissolving materials may provide extended presence of the chemicals in the liquid. When the chemicals are anti-corrosion chemicals or scale inhibitor, the liquid is continuously dispensed as liquids continually enter the wellbore **10** and as liquids are periodically withdrawn from the wellbore. The liquids are stirred as the plunger is directed to the surface while the chemicals remain immersed in the liquid filled space in the rat hole.

[0021] As shown in FIG. **2**, the chemical dispenser **40** is fairly simple having a base **41** with a cover attached by screw threads or other connecting arrangement. Chemical **45** is provided in the cover **42** and liquid enters and escapes through holes **44**.

[0022] In FIG. **3**, a different embodiment of the chemical dispenser **140** having a porous or screen structure in the shape of an inverted umbrella is shown attached to the outside of production tubing **120** so that the liquid level is generally above the dispenser **140**. The chemical **145** may be added to the well through the annulus within the casing **112** and outside the production tubing **120**. In this particular embodiment, a rod pump **150** draws liquids through a strainer nipple **155**. Rod pump **150** operates in a conventional manner where liquids are drawn into and through the strainer nipple **155** by the plunger **152** moving up and down within barrel **151** and one way valves maintaining liquid flow up the production string **120**. With the chemical **145** in the dispenser **140** continuously dispensing chemicals into liquids at the base of the well, materials that might otherwise precipitate such as scale are inhibited. Additional chemical is periodically added from the surface through the annulus and caught in the dispenser

140. Similarly to the embodiment in FIG. **1**, the liquid level is generally going to range between level **161** and **162** so that the dispense is substantially immersed in the liquid in the rat hole.

[0023] In tests in operating wells, the solid, slow release chemicals provided active protection for months and are believed to be likely to provide years of protection. As compared to a system where liquid chemical is delivered on a monthly basis by a service technician, the solid, slow release chemical in a continuously liquid wet position in the rat hole is more effective and far less costly.

[0024] In another embodiment of the invention shown in FIG. **4**, a chemical dispenser **140** is installed in a generally horizontal section of a well where liquids are being produced that are chemically prone to form scale, or corrosion or other production limiting problems. The dispenser **140** is shown as a hollow tube with screen covered ports **145** through which liquids may pass and come in contact with the solid installed inside the hollow tube of the dispenser **140**. A liquid permeable container of most any sort will suffice. With the dispenser laying on the bottom of the horizontal section, if the liquids include both hydrocarbons and water which may form stratified layers, the chemical is most accessible to the water in which most of the problems may arise. It should be understood that slightly inclined or severely inclined portions of problematic wells may be provided with a dispenser **140** that is much smaller in diameter than the wellbore so as not to significantly interfere with liquid production while dispensing chemicals that may prolong high hydrocarbon recovery rates. The chemical is slowly dispensed into the fluids which are produced to the surface through equipment that is now less likely to suffer scale build-up or corrosion, etc. In some wells, several laterals may extend from a common vertical well and each lateral may be provided with a dispenser **140** conveyed by wireline or coiled tubing tool and recovered for reloading when the chemical has been fully spent some many months or years later.

[0025] As a final reflection of the invention, with the contribution of this invention, slow released chemicals may dramatically alter the lives of oil field personnel and reduce the costs of operating and maintaining wells. In the event that both water and liquid hydrocarbons are present, it is common for the hydrocarbons to rise to the surface and the water to sink to the bottom although the fluids are often stirred and turbulent so that settling is unlikely to be perfect. In the lower portions where the water is the continuous phase (droplets of oil in water rather than droplets of water in oil) the slow release chemical seems to be most available for dispensing. As such, having the chemical in a dispenser in the well is not the simple objective. It appears that the invention works best if the dispenser is located and substantially continuously immersed in the water continuous phase. At the same time, deep in the rat hole or well below the lower end of the production system such as the production tubing, the liquids are not as stirred as the liquids closer to the lower end of the production tubing. The active liquid interval where water is the continuous phase and where the water is likely to be regularly produced to the surface where the chemical dissolved in the water may be exposed to the surfaces vulnerable to the formation of precipitates such as scale or corrosion and reduce the buildup or actively reduce any buildup would be an optimal application of the present invention.

[0026] Finally, the scope of protection for this invention is not limited by the description set out above, but is only limited by the claims which follow. That scope of the invention is intended to include all equivalents of the subject matter of the claims. Each and every claim is incorporated into the specification as an embodiment of the present invention. Thus, the claims are part of the description and are a further description and are in addition to the preferred embodiments of the present invention. The discussion of any reference is not an admission that it is prior art to the present invention, especially any reference that may have a publication date after the priority date of this application.

1. A method for slow release dispensing of a chemical within a producing hydrocarbon well to control a chemical process such as corrosion or hydrate formation or alter the physical properties of one or more chemicals such as dissolving paraffin waxes, where the method comprises:

a) selecting a chemical for obtaining a chemical result within the wellbore where the chemical is bound within a complex so that it slowly dissolves in wellbore fluids of the type existing in a producing hydrocarbon well and is slowly dispensed over time;

b) installing a chemical dispenser into the hydrocarbon well such that the chemical dispenser is substantially continuously exposed to such liquids in the hydrocarbon well and wherein the dispenser includes an enclosure with a perforated portion for fluids to pass through and contact and dissolve the chemical; and

c) continuously dispensing the chemical from the dispenser into the liquids in the hydrocarbon wellbore to maintain an effective dosage of the chemical in the liquid to obtain the desired chemical result.

2. The method for slow release dispensing of a chemical within a producing hydrocarbon well according to claim **1** wherein the well includes a producing zone and the dispenser is attached to the periphery of production tubing prior to installing the production tubing into the hydrocarbon well such that when the production tubing is installed in the well, the chemical dispenser is positioned below the producing zone and wherein the dispenser includes an open upper portion and a porous bottom surface for fluids to pass through and further including a step of installing the chemical into the dispenser by depositing the chemical from the surface into the dispenser that is positioned below the producing zone.

3. The method for slow release dispensing of a chemical within a producing zone of a hydrocarbon wellbore according to claim **1** wherein the chemical is installed into the dispenser prior to the step of installing the dispenser into in the hydrocarbon well.

4. The method for slow release dispensing of a chemical within a producing zone of a hydrocarbon wellbore according to claim **3** wherein the dispenser comprises a tube with a sidewall and perforations in at least portions of the side wall and the chemical is installed into the tube prior to the step of installing the hydrocarbon production equipment in the hydrocarbon wellbore.

5. The method for slow release dispensing of a chemical within a producing hydrocarbon wellbore according to claim **1** where in the step of installing the dispenser into the hydrocarbon well further includes a step of attaching the dispenser to hydrocarbon production equipment wherein the hydrocarbon production equipment has a bottom end that when installed into the well is spaced from the bottom of the well to define a rathole between the bottom end of the hydrocarbon production equipment and the bottom of the well, and wherein the dispenser is attached near the bottom end of the

hydrocarbon production equipment to extend into the rathole and slowly dispense the chemical.

6. The method for slow release dispensing of a chemical within a producing hydrocarbon wellbore according to claim **5** wherein the method includes installing the chemical dispenser at the end of an extension so that the chemical dispenser is fully immersed in liquid in the wellbore.

7. The method for slow release dispensing of a chemical within a producing hydrocarbon wellbore according to claim **1** wherein the selected chemical causes inhibition of scale within the well.

8. The method for slow release dispensing of a chemical within a producing hydrocarbon wellbore according to claim **1** wherein the selected chemical causes inhibition of corrosion within the well.

9. A method for slow release dispensing of a chemical within a producing hydrocarbon wellbore to control a chemical process such as corrosion or hydrate formation or alter the physical properties of one or more chemicals such as dissolving paraffin waxes, where the method comprises:

a) selecting a chemical for obtaining a chemical result within the wellbore where the chemical is bound within a complex so that it slowly dissolves in wellbore fluids of the type existing in a hydrocarbon wellbore and is slowly dispensed over time;

b) attaching the chemical dispenser onto hydrocarbon production equipment;

c) installing the hydrocarbon production equipment into the hydrocarbon wellbore such that the chemical dispenser is substantially continuously exposed to such liquids in a hydrocarbon wellbore;

d) installing the chemical into the dispenser; and

e) continuously dispensing the chemical from the dispenser into the liquids in the hydrocarbon wellbore to maintain an effective dosage of chemical in the liquid to obtain the desired chemical result.

10. The method for slow release dispensing of a chemical according to claim **9** wherein the step of installing the chemical into the dispenser occurs after the hydrocarbon production equipment is installed into the wellbore.

11. The method for slow release dispensing of a chemical according to claim **9** wherein the step of installing the chemical into the dispenser occurs before the hydrocarbon production equipment is installed into the wellbore.

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