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[54] **METHOD OF PLACING A WELL ON PRODUCTION**

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[52] **U.S. Cl.** **166/309,** 166/311, 166/314

[51] **Int. Cl.** **E21b 43/00**

[58] **Field of Search** 166/309, 311, 314

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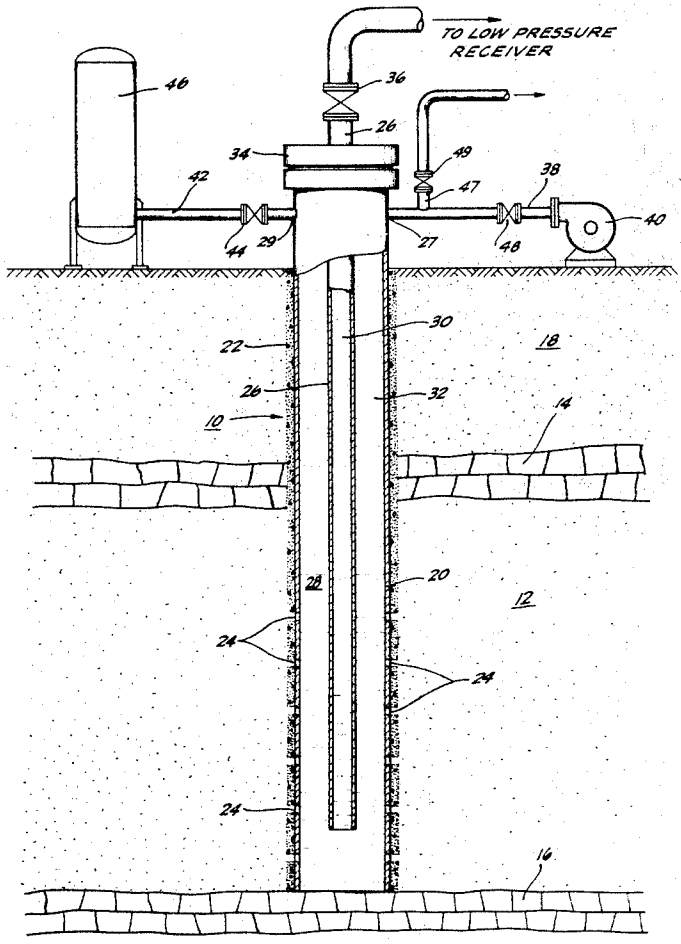
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[57] **ABSTRACT**

A method for removing liquid from a natural-flow well so as to reduce the hydrostatic pressure in the well below the formation pressure so that formation fluids will flow from the formation into the well and through the well to the surface. At least one slug of compressed gas is injected into the well annulus thereby displacing some of the liquid in the annulus into the tubing and forcing liquid in the tubing upward and out of the tubing. A volume of foaming agent solution is then injected into the annulus, displacing more liquid from the annulus into the tubing and forcing liquid in the tubing upward. Pressure on the annulus is then released, causing foam to form in the well. In this manner the hydrostatic pressure of liquid in the well is reduced below the formation pressure so that fluid can flow from the formation into the well.

10 Claims, 6 Drawing Figures



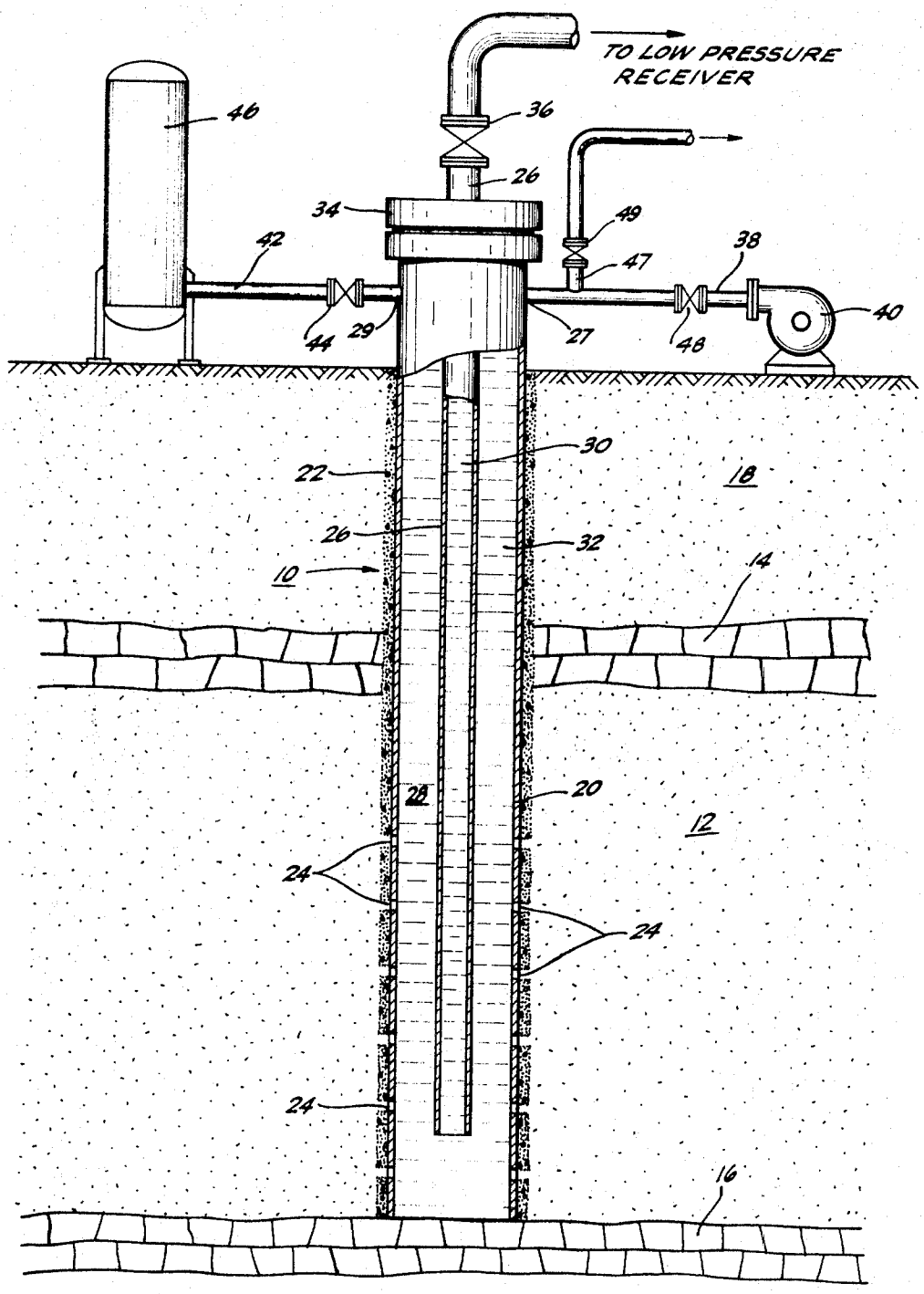

TO LOW PRESSURE RECEIVER
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Fig 1

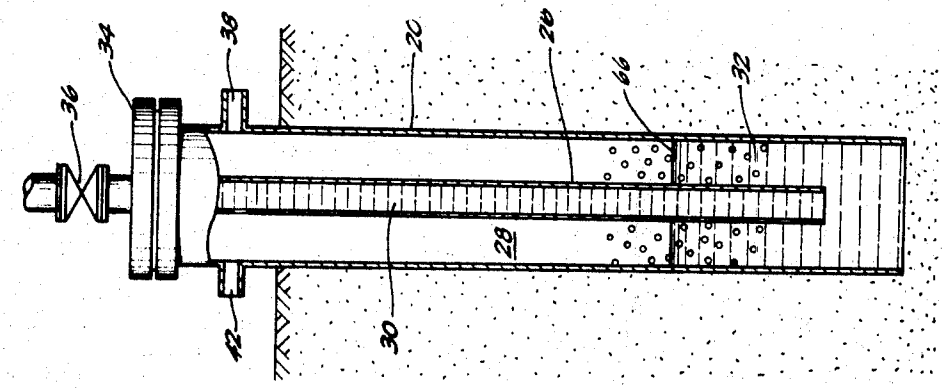


Fig 5

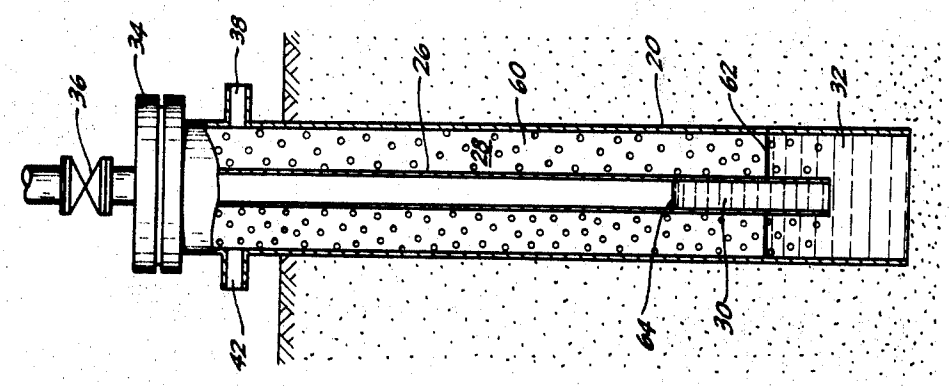


Fig 4

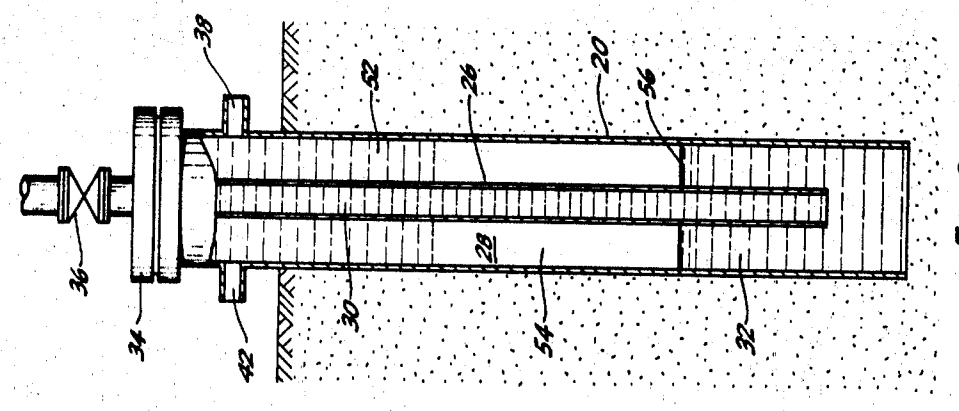


Fig 3

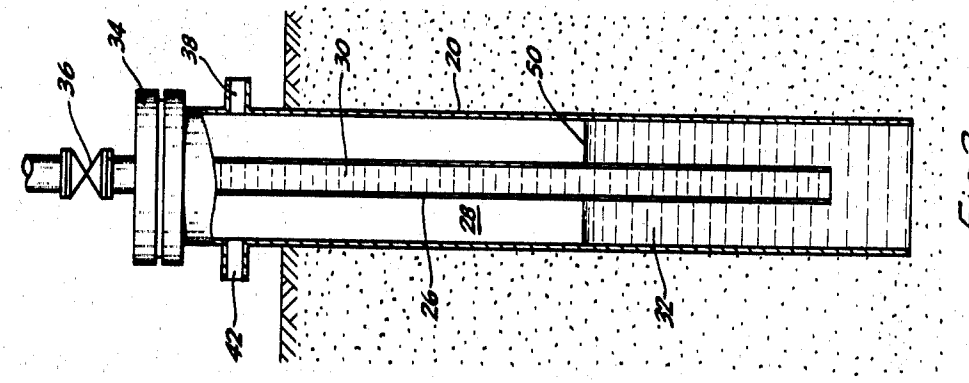


Fig 2

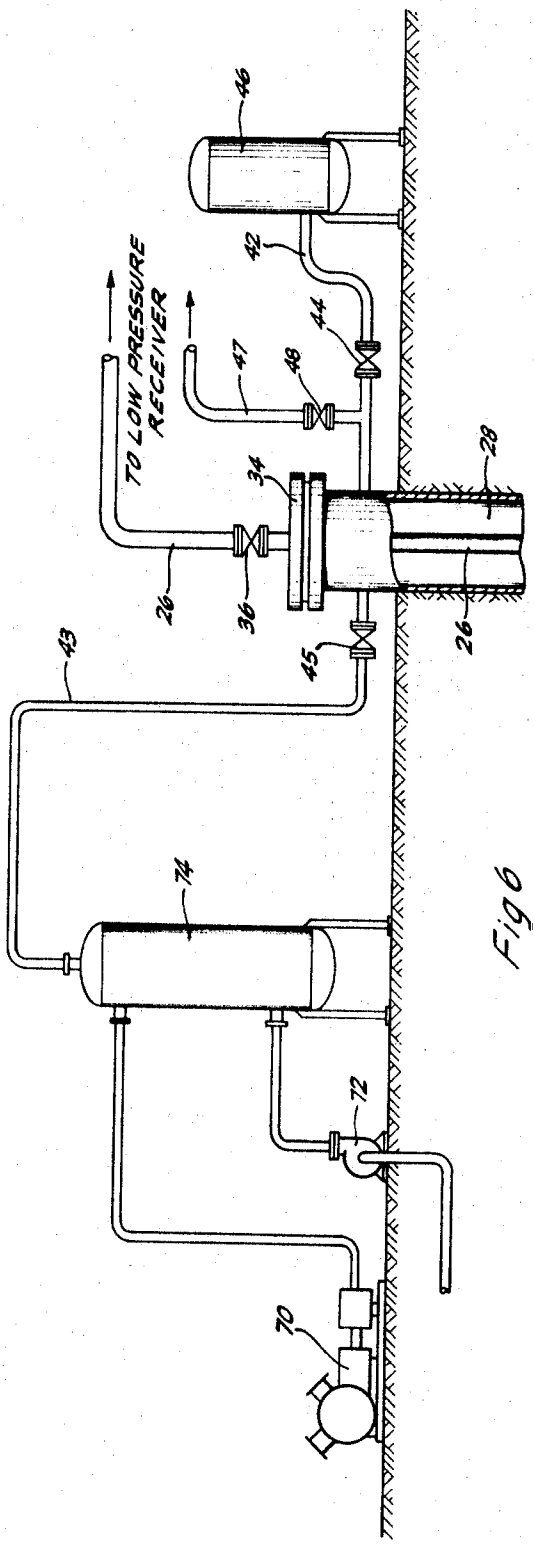

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Fig 6

METHOD OF PLACING A WELL ON PRODUCTION

This invention relates to the production of oil and/or gas from subterranean fluid-bearing formations, and more particularly concerns a method for initiating production of oil and/or gas through a well penetrating a fluid-bearing subterranean formation wherein the pressure in the formation is sufficient to cause the produced fluids to flow from the formation to the surface, but is insufficient to overcome the hydrostatic head of a column of liquid in the well.

It is conventional practice in the drilling of wells into subterranean fluid-bearing strata, and in the completion, workover and treatment of such wells to maintain a column of liquid in the well of sufficient density to overcome the fomration pressure, thereby preventing blowout of the well during the contemplated operation. In many oil and/or gas producing operations, the pressure in the formation is sufficient to cause the produced fluids to flow naturally from the formation to the surface without pumping or other externally induced lifting, but is insufficient to overcome the hydrostatic head of the column of drilling mud, completion fluid, or other liquid in the well. Thus, it becomes necessary to remove at least a portion of the liquid from the well so as to reduce the hydrostatic pressure in the well adjacent to the producing formation sufficiently to permit the flow of produced fluids into the well and through the well to the surface.

The removal of liquid from the well has conventionally been accomplished by swabbing the well, i.e., by running a special swabbing tool into the well on a wire line to mechanically lift liquid out of the well. The swabbing operation requires the expense of bringing special equipment to the well, and the swabbing action itself often requires several days to carry out. When the drilling is carried out at a remote, inaccessible location, for example, in the Arctic or in the tropics, where transportation is difficult, the expense of bringing in special equipment and of operating it can be prohibitive.

It has been proposed, for example in U.S. Pat. No. 3,019,839 to Bloom, to relieve the hydrostatic pressure of fluids in a well by application of gas pressure alternately to the liquid within the tubing and to that in the annulus in order to force this liquid to the surface and out of the well. By repeatedly applying gas pressure alternately to the liquid in the tubing and in the annulus, a pendulum-like or rocking action of liquid witin the annulus and the tubing is induced and liquid is discharged through both the tubing and annulus until the hydrostatic pressure is lowered sufficiently to allow recovery of the oil from the well by natural flow or by pumping. While theoretically attractive, this alternate application of gas to the annulus and the tubing requires a high pressure compressor to supply gas at a pressure sufficient to overcome a substantial hydrostatic head so as to displace liquid from the wells, e.g., nitrogen at pressure of 1,000 to 5,000 psi and higher, and also requires expensive, quickly responsive valves to switch the flow of this high pressure gas alternately to the tubing and to the annulus. Accordingly, use of this method is limited to the more accessible sites where such equipment is more readily available.

Recently, it has been suggested that production of gas from gas wells can be stimulated by dropping surfactants, preferably in stick form, into the tubing string to induce foaming in the well. These foam sticks depend for their activity upon gas produced by the well and are of use only where the well is producing gas. If the well does not produce a significant quantity of gas, the foam sticks are all but useless.

U.S. Pat. No. 2,168,116 to Crites et al. sets forth a method which involves the creation of a controlled foam lift condition in order to induce flow of oil wells. In accordance with this method, a foaming agent is added to the oil in the well with the producing column closed off. Next, the liquid and foaming agent in the well is agitated by the injection of gas under pressure; and the producing column is then opened to allow the well to flow under its own pressure. This method also requires the use of an expensive high pressure compressor to assure that gas is supplied to the bottom of the borehole in an amount sufficient ot provide the agitation necessary to form foam.

A need therefore exists for a simple, yet effective method for initiating production from a natural-flow well in which the hydrostatic pressure of liquid in the well prevents the flow of produced fluids from the formation to the well. This method should make use only of equipment normally present at oil field sites and require no specialized or expensive equipment.

Accordingly, a primary object of this invention is to provide a simple method for initiating the production of oil and/or gas from a fluid-bearing subterranean formation penetrated by a well.

Another object of this invention is to provide a simple, inexpensive method for removing liquid from a well.

Still another object of this invention is to provide a method for initiating the production of fluids from a fluid-bearing formation having sufficient pressure to cause the produced fluids to flow naturally from the formation to the surface without pumping or other externally induced lifting, but insufficient pressure to overcome the hydrostatic head of a column of liquid in the well.

Yet another object of this invention is to provide a simple, inexpensive method for initiating the production of oil and/or gas from a fluid-bearing subterranean formation which does not require specialized equipment.

These and other objects and advantages of the invention will be apparent from the following detailed description.

According to this invention, quiescent liquids are removed from a well to reduce the hydrostatic pressure in the well by injecting at least one slug of compressed gas into the annulus between the walls of the well and the production tubing, with the tubing open, thereby displacing some of the liquid in the annulus from the annulus into the tubing and forcing liquid in the tubing upward and into a low pressure receiver located at the surface. The tubing is kept open and pressure maintained in the annulus while a measured volume of a foaming agent solution is injected into the annulus, thereby compressing the previously injected gas and displacing still more fluid in the annulus from the annulus into the tubing and forcing liquid in the tubing into the low pressure receiver. The pressure on the annulus is then reduced. With the reduction in pressure, foam is produced in the annulus, thereby lowering the density of the fluid in the annulus whereby fluid in the annulus flows into a low pressure receiver at the surface and liquid flows from the tubing into the annulus. WIth

the removal of liquid from the tubing and annulus, the hydrostatic pressure in the well is lowered sufficiently that fluids will flow from the formation into the well.

In embodiments of this invention particularly preferred for use in difficulty accessible locations where only limited equipment is available, the compressed slug of gas can be provided from a low presusre compressor, i.e., one having an output of only about 60 to 150 psig. The gas output of such compressor is admitted into a closed gas storage vessel and water then introduced into, i.e., pumped into, the vessel to compress the gas therein to a higher pressure, i.e., to about 500 to 1,500 psig.

The invention is further defined by the accompanying drawings, wherein like numerals refer to like parts throughout, and in which:

FIG. 1 is a schematic cross sectional view of a well completed in a permeable subterranean reservoir illustrating the condition of the well at the time when the process of this invention is to be initiated and depicting means which can be employed in practicing the invention;

FIG. 2 is a schematic cross sectional view of the well illustrating the first step of this invention wherein a slug of gas under pressure is introduced into the annulus;

FIG. 3 is a schematic cross sectional view of the well illustrating the second step of the process of this invention in which foaming agent solution is injected into the annulus;

FIG. 4 is a schematic cross sectional view of the well illustrating the condition after the third step of the treatment in which the pressure in the annulus is reduced and foam formed therein;

FIG. 5 is a vertical cross sectional view of the well illustrating the level of fluids in the well after completion of the process of this invention and after the flow of fluids from the formation is established; and

FIG. 6 is a schematic illustration of the apparatus used to adapt a low pressure compressor for the practice of the method of this invention.

Referring now particularly to FIG. 1, a well **10** is shown traversing a permeable fluid-bearing formation **12**, which is shown bounded at its upper and lower extremities by essentially impermeable strata **14** and **16**, respectively, strata **14** being overlain by the formation **18**. The illustrated well is cased and cemented through formations **12**, **14** and **18** with casing **20** which is surrounded by an outer cement sheath **22**. Casing **20** and cement sheath **22** are perforated at a plurality of locations **24** thereby providing fluid communication between the interior of the casing and formation **12**. Tubing **26**, which can be a conventional production tubing or simply a length of tubing lowered into the well, extends from the surface downwardly into well **10**, preferably substantially coaxially within casing **20**. Although the well is shown in this embodiment as cased, it is to be understood that the method of this invention is amenable to practice in both cased and uncased wells and in wells completed with conventional slotted liners.

Annulus **28** is formed between tubing **26** and the inner wall of casing **20**. The bottom of tubing **26** is spaced from the bottom of the well so that there is fluid communication between annulus **28** and the interior of tubing **26**. A column of liquid **30**, which can be, for example, residual fluids from the drilling operation, has accumulated in tubing **26** and a corresponding column of liquid **32** in the annulus **28**. The hydrostatic pressure exerted by these fluids in the well adjacent to fluid-bearing formation **12** exceeds the formation pressure so that fluids are prevented from flowing from the formation into the well. It is the purpose of this invention to depress the level of these fluids in the well by removing at least a portion thereof in order to reduce the hydrostatic pressure in the well sufficiently to allow fluid to flow from the formation into the well.

Tubing **26** extends through gas tight cap **34** which closes the upper end of the casing, a gas-tight seal being provided at the juncture of tubing **26** and cap **34**. Valve **36** regulates the flow of fluid through tubing **26**. Conduit **38** extends between compressor **40** and casing **20**, and provides means by which gas under pressure can be conducted from compressor **40** to annulus **28**, and conduit **47** provides means for communicating annulus **28** with the low pressure receiver. Valve **48** regulates the flow of gas through conduit **38** and valve **49** regulates flow from the annulus **28** to the low pressure receiver. Conduit **42** communicates annulus **28** and a supply source **46**, which contains an aqueous solution of foaming agent. Flow of fluid through conduit **42** is regulated by valve **44**.

In accordance with this invention and as particularly illustrated in FIG. **2**, a slug of compressed gas is admitted into annulus **28** compressor **40** by opening valve **48**. The gas introduced into annulus **28** displaces liquid from the annulus into tubing **26** and thence upwardly through tubing **26** to a low pressure receiver such as a sump or tank, not shown, located at the surface. The level of the liquid in annulus **28** is depressed to a lower level **50**. Valve **36** which regulates flow in the tubing, is open so that liquid displaced from the well flows from tubing **26** to the low pressure receiver. This step can be repeated a plurality of times, setting up a rocking action within the well, with more liquid being expelled from tubing **26** as each slug of compressed gas is admitted into annulus **28**.

After the column of liquid in the annulus has been depressed to the lower level **50**, a metered volume of foaming agent is introduced into the annulus from supply source **46** by opening valve **44**. The foaming agent solution can be pressured or pumped into the annulus in conventional manner. As shown in FIG. **3**, a column **42** of foaming agent solution is formed above a cushion **54** of compressed gas which in turn is above column **32** of liquid in the annulus. The presence of this cushion may be momentary, with migration of foaming agent through the air cushion occurring in a relatively short time period. However, in some downhole situations, this air cushion can be present for a period of several minutes up to an hour or so with only a relatively small quantity of foaming agent solution passing through the cushion. Pressure is maintained on the annulus by maintaining valves **48** and **49** closed. Tubing **26** is at this stage substantially filled with liquid, some of this liquid overflowing the tubing and being displaced into the low pressure receiver which is at substantially atmospheric pressure, the only pressure upon the liquid in the tubing is that due to the hydraulic head of liquid in the tubing.

In FIG. **4**, the condition of the well is shown after pressure on the annulus is released by opening valve **47**. As illustrated in this FIGURE, a column of foam **60** is formed in annulus **28**. At least a portion of this foam is discharged from the annulus through conduit **47**, and the density of liquids remaining in the annulus is low-

ered as indicated by liquid interface **62.** Also, liquid flows from tubing **26** flow back into the annulus, so that tubing **26** is only partially filled with liquid **30,** as indicated by the level **64,** thereby lowering the hydrostatic pressure in the well adjacent to formation **12.**

In FIG. **5,** the well is shown with a lower level of liquid **32** in the annulus as illustrated by liquid interface **66.** Some foam remains in the annulus, however, a portion has broken down or been dispelled therefrom. Also, gas will accumulate in the annulus, tending to depress the liquid therein. With the hydrostatic pressure in the well lowered, normal flow of fluids from the formation to the well can occur. In the case of a naturally flowing well of the type illustrated, pressure within the formation will be sufficient to elevate oil and gas coming into the well to the surface as rapidly as it is supplied to the well by the formation.

An estimation of the drop in the level of liquid in the well in response to injection of gas at a given known pressure and subsequent injection of a given volume of foaming agent solution is given by the equations

$$H_2 = k\left[\, V_w/Aa + \sqrt{(V_w/Aa) + 4H_1P_1/P}\,\right] \tag{1}$$

H_1 is the distance between the surface and the top of the liquid level **50** in the well after injection of compressed gas;

H_2 is the distance between the surface and the top of the liuqid level **56** (bottom of air cushion) after injection of a volume (Vw) of foaming agent solution;

Vw is the volume of foaming agent solution injected into the annulus;

P_1 is the pressure of gas in the annulus above the liquid level after injection of the compressed gas (but before injection of the foaming agent solution);

P is the specific gravity of the aqueous solution of foaming agent, which usually is approximately that of water; and

k is a constant; and

$$H_3 = k'H_2\,(Aa/A_a + A_t) \tag{2}$$

H_3 is the distance between the surface and the top of the liquid level in the well immediately after the the depressurization step;

H_2 is as determined in equation (1),

Aa is the cross sectional area of the annulus;

A_t is the cross sectional area of the tubing; and

k' is a constant.

Knowing the pressure and volumes of gas and of foaming agent solutions available, the above equations can be used to determine the displacement of liquid in the well and, conversely, the requirements for achieving a certain amount of displacement can be calculated.

As indicated above, gas pressures used in the method of this invention are relatively low, usually within the range of about 50 psi to about 1,500 psi, and more particularly within the range from about 500 psi to about 1,200 psi. Since this pressure is exerted in slugs on fluid in the annulus, there is, advantageously, no need for a powerful, high pressure compressor. In field operations, especially at remote locations, pressures sufficient to initiate flow of fluids from the well can be generated using equipment normally present at a drilling site.

An alternative method of using a low pressure compressor in a high pressure operation is illustrated in FIG. **6.** This equipment comprises a low pressure compressor **70,** e.g., one having an output of about 70 to about 150 psig. This small compressor is employed in conjunction with a pump **72,** for example, a mud circulation pump, and an air storage vessel **74.** In use, air from low pressure compressor 70 at about 150 psig is admitted into the air storage vessel **74** and water pumped into the storage vessel from a water source, not shown, using pump **72** in order to compress the air in the vessel **74,** for example, to a pressure of about 500 to 1,500 psig. Air so compressed is then fed through conduit **43** into the annulus **28** of the well where it acts to force the liquid in the annulus downward, thereby displacing liquid from the annulus into the tubing and from the tubing into the low pressure receiver as shown in FIG. **2.**

In some instances, only one slug of gas, such as air, exerted on the liquid in the annulus **28** can suffice. However, in preferred embodiments of this invention, compressed gas is intermittently injected into the annulus a plurality of times, liquid being forced upward in the tubing each time. Usually, for wells of about 3,000 to 7,500 feet depth in which there is calculated to be a moderate formation pressure, e.g., 2,800 to 4,400 psig, a slug of compressed gas will be injected into the annulus about three to ten times before foaming agent solution is injected. Deeper wells with higher hydrostatic pressures of liquid therein and those in which the formation pressure is relatively low can require the injection of about 15 to 50 or more slugs of compressed gas. In cases where a plurality of slugs of compressed gas are required, each slug can be provided using the apparatus of FIG. **6.** Usually a total of about 100 to about 3,000 cubic feet of gas measured at injection temperature and pressure will be injected into the annulus.

Owing to economic considerations, the compressed gas employed will usually be air. However, the gas can be a hydrocarbon gas, e.g., natural gas comprising mixtures of methane and ethane; any of the chemically inert gases, e.g., helium, argon, or nitrogen; carbon dioxide; and other gases which do not condense under the conditions employed or react chemically to an appreciable extent with fluids in the annulus. It is desirable that the gas employed be insoluble or only very slightly soluble in the liquid, but relatively high solubility should not preclude the use of a particular gas. However, if a soluble gas is used, it is necessary to supply sufficient gas over and above that which dissolves to insure that both liquid and gas phases exist in the well.

As indicated by the formula set forth above, the amount of liquid displaced from the well varies in proportion to the volume of the foaming agent and gas injected into the well. Usually from about 250 cubic feet to about 3,000 cubic feet of foaming agent solution will suffice in most situations, this amount naturally varying inter alia with the depth of the well itself, the depth of liquid in the well, the pressure of the gas injected prior to injection of the foaming agent solution, and the dimensions of the tubing and casing.

When the foaming agent is injected into the annulus of the well above the cushion previously established by

the compressed gas, additional liquid is displaced from annulus **28** into tubing **26** and thence into the low pressure receiver. Releasing pressure in the annulus, e.g., by opening valve **49**, allows the compressed gas in the air cushion to expand and to rise in the annulus. Contact of the expanding gas with the foaming agent causes a foam to be formed, which lowers the density of fluid in the annulus. With this reduction of density of fluids in the annulus, liquid will flow from tubing **26** into annulus **28**. Also, the pressure in the formation normally will exceed the pressure in the well and fluids will flow from the formation into the well.

Any one of a number of water-soluble surfactants which have foam producing properties can be used as the foaming agent. Surface active agents which have the ability to produce foams include those of nonionic, anionic and cationic nature. Among the particularly suitable foaming agents for use in the method of this invention are fatty alkylol amide condensates, substituted polyamines, polyoxyethylene condesates of fatty alcohols, polyoxyethylene condensates of fatty acids, polyoxyethylene esters of long chain mixed acids, polyoxyethylene esters of long chain amides, polyoxyethylene condensates of halogenated tallow, polyoxyethylene alkyl phenols, polyoxyethylated polyoxyolefins, polyoxyethylated polyoxyolefin amines, polyoxyethylene aliphatic ethers, polyoxyethylene aliphatic thioethers, phosphoric acid esters of polyethylene glycol, condensation products of polyhydric alcohols with water soluble polybasic acids, alkali metal salts of alkylaryl polyester sulfonates, alkali metal organic sulfates, alkyl alkanoloamine sulfates, alcohol sulfates, alkali metal organic phosphates, fatty acid imidazolines, and the like. Further information concerning such foaming agents and an indication of their commercial availability is given in McCutcheon's Detergent and Emulsifiers Annual, issued yearly.

A particularly preferred foaming agent for use in the method of this invention is a commercially available foaming agent which comprises an admixture of lauryl polyethylene oxide ammonium sulfate and alkanolamide builders marketed by Procter and Gamble Company under the trademark O.K. Liquid. Another particularly preferred foaming agent is an alkyl polyethylene oxide sulfate having the formula

$$C_xH_{2x+1}(OCH_2CH_2)_yOSO_3M$$

where x is an integer having a value of 8 to 11, y is an integer having a value of 1 to 5, and M is sodium, potassium or ammonium. A particularly preferred alkyl polyethylene oxide sulfate is marketed by General Analine and Film Corporation under the trademark Alipal CD–128. Other particularly preferred foaming agents are sodium lauryl sulfate, sulfated potassium ricinoleate, sodium alkylnaphthalene sulfonate and ehtanolamide fatty acid condensates.

The foaming agent will normallly comprise about 0.01 to 2 percent by weight of the solution in which it is incorporated. Usually about 0.5 to 1.5 weight percent foaming agent will produce a satisfactory foam. The aqueous solution can be formed with fresh water or brine.

It has been found that by employing the method of invention, it is possible to remove a volume of liquid from a well in a matter of a few hours, wherein the removal of this volume of fluid by swabbing would require several days. Wells with exceedingly low formation pressures may require that the process of this invention be repeated to reduce the column of liquid sufficiently that natural flow will occur. However, since the method is inexpensive both in regard to the time and equipment required, this presents no difficulty and wells can be brought to production using this method where other methods would be impractical.

This invention is further described by the following example which is illustrative of a specific mode of practicing the invention and is not intended as limiting the scope of the invention as defined by the claims.

Example 1

This example illustrates the practice of this invention in removing drilling fluid from an oil well in order to reduce the hydrostatic pressure in the well. The well to be treated is completed in an Artic location at a depth of about 3,200 feet with 5-½ inch diameter casing cemented in place and gun-perforated at about the 3,150 foot level with two holes per foot throughout a 29 foot potential oil-producing interval. A 3,190 foot length of tubing having a 2.36 inch inside diameter and 2.76 inch outside diameter is inserted into the casing, the lower end of the tubing extending to just below the perforations in the casing. The well is equipped substantially as illustrated in FIG. **6**. The tubing and the annular space between the tubing and the sidewall of the casing are filled with drilling fluid having a specific gravity of about 1.0.

Only a small compressor of about **147** psig output is available as a source of compressed gas. A surplus length of casing string **11** inches in internal diameter and about 656 feet long is sealed at each end by metal end pieces thereby converting it to a gas storage vessel having a volume of about 430 cubic feet. Air from the compressor is admitted into this gas storage vessel, then water is pumped into the vessel, using a mud circulation pump of conventional design, to compress the air in the gas storage vessel to a pressure of about 852 psig. The air thus compressed is admitted into the annulus between the tubing and the casing. In response to the pressure exerted on the liquid in the annulus by injection of compressed air into the annulus, liquid is visually observed to flow from the tubing into a surface sump. The air compression and injection steps are repeated three times, the air being compressed to about 852 psig in each stage. Fluid is visually observed to be displaced from the tubing into the sump at each injection stage. Pressure is maintained on the annulus during the air injection steps.

Subsequently, about 353 cubic feet of a **1** percent aqueous solution of "O.K. Liquid" foaming agent is pumped into the annulus. Still more fluid is observed to be displaced from the tubing.

Pressure on the annulus is relieved, and foam is produced in the annulus reducing the density of the fluid remaining therein. The level of fluid in the well is calculated to be depressed by about 3,116 feet.

Upon completion of the above series of steps, the well is placed on production and naturally flows at a relatively high rate.

Various embodiments and modifications of this invention have been described in the foregoing description and draiwngs, and further modifications will be apparent to those skilled in the art. Such modifications are included within the scope of this invention as defined by the following claims.

Having now described our invention, I claim:

1. A process for initiating production from a well traversing an oil and/or gas bearing formation having insufficient pressure to overcome the hydrostatic pressure of liquid in the well, said well having a tubing extending from the surface downward into the well and having means located at the surface to control flow from the tubing, an annulus being formed between said tubing and the wall of the well, and the interior of the tubing being in fluid communication with the annulus, said process comprising:

injecting at least one slug of compressed gas into the annulus with the tubing open, said slug of gas being of sufficient quantity and at sufficient pressure to displace a portion of the liquid in the annulus from the annulus into the tubing and to displace liquid in the tubing upward and out of the well;

with the tubing open and while maintaining the pressure in the annulus, next injecting a solution of a foaming agent into the annulus;

thereafter releasing the pressure in the annulus, thereby generating foam in the annulus; and

allowing fluids to flow from the formation into the well and upwardly to the surface under formation pressure.

2. The process as defined in claim 1 wherein the compressed gas injected into the annulus is air.

3. The process as defined in claim 1 wherein the compressed gas injected into the annulus is at a pressure of from about 50 to 1,500 psig.

4. The process as defined in claim 1 wherein the volume of compressed gas injected into the annulus is from about 100 to 3000 cubic feet measured at injection temperature and pressure.

5. The process as defined in claim 1 wherein the concentration of foaming agent in said foaming agent solution injected into the annulus is from about 0.01 to about 2 percent by weight.

6. The process as defined in claim 1 wherein the volume of foaming agent solution injected into the annulus is from about 250 cubic feet to about 3,000 cubic feet.

7. The process as defined in claim 1 wherein a plurality of slugs of compressed gas are injected into the annulus prior to the injection of said solution of foaming agent.

8. A process for initiating production from a well traversing an oil and/or gas-bearing formation having insufficient pressure to overcome the hydrostatic pressure of liquid in the well, said well having a tubing extending from the surface downward into the well and having means located at the surface to control flow from the tubing, an annulus being formed between said tubing and the wall of the well, and the interior of the tubing being in fluid communication with the annulus, said process comprisng:

injecting about 250 to about 3,000 cubic feet of compressed gas measured at injection conditions of temperature and pressure of about 50 to 1,500 psi into the annulus with the tubing open, said injection of compressed gas displacing a portion of the liquid in the annulus from the annulus into the tubing and displacing liquid in the tubing upward and out of the well;

with the tubing open and while maintaining pressure in the annulus, next injecting into the annulus, from about 250 to about 3,000 cubic feet of an aqueous foaming agent solution having a foaming agent concentration of from about 0.01 to about 2 percent by weight;

thereafter releasing the pressure in the annulus thereby generating foam in the annulus; and

allowing fluids to flow from the formation into the well and upwardly to the surface under formation pressure.

9. A process for initiating production from a well traversing an oil and/or gas-bearing formation having insufficient pressure in the formation to overcome the hydrostatic pressure of liquid in the well, said well being provided with a tubing extending from the surface downward into the well and spaced from the wall of the well, an annulus being formed between said tubing and the wall of the well, said tubing having means located at the surface to control fow from the tubing, and the interior of the tubing being in fluid communication with said annulus, said process comprising:

admitting the output of a low pressure compressor into a gas storage vessel;

introducing water into said storage vessel at an elevated pressure, thereby compressing the gas therein;

injecting at least one slug of the gas so compressed into the annulus of the well with the tubing open, thereby displacing a portion of the liquid in the annulus into the tubing and liquid in the tubing upward and out of the well;

with the tubing open and while maintaining pressure in the annulus, next injecting an aqueous foaming agent solution into the annulus;

thereafter releasing pressure in the annulus, thereby generating foam in the annulus, and

allowing fluids to flow from the formation into the well and upwardly to the surface under formation pressure.

10. A process for initiating production from a well traversing and oil and/or gas-bearing formation having insufficient pressure to overcome the hydrostatic pressure of liquids in the well, said well being provided with a length of tubing extending from the surface downward into the well and spaced from the wall of the well, an annulus being formed between said tubing and the wall of the well, said tubing having means located at the surface to control flow from the tubing, and the interior of said tubing being in fluid communication with the said annulus, said process comprising:

admitting air at a pressure of about from 70 to 150 psig into a closed air-storage vessel,

introducing sufficient water into said storage vessel to compress the air in said vessel to a pressure of from about 500 psig to about 1,500 psig,

with the tubing open introducing at least one slug of the said air thus compressed to a pressure of from about 500 psi to about 1,500 psi into the annulus of the well, the total volume of said gas injected being from about 100 to 3,000 cubic feet measured at injection temperature and pressure, thereby displacing a portion of the liquid in the annulus from the annulus into the tubing and displacing liquid in the tubing upward and out of the well;

with the tubing open and pressure maintained in the annulus, next injecting into said annulus from about 250 to about 3,000 cubic feet of an aqueous foaming agent solution having a foaming agent concentration of about 0.01 to 2 percent by weight;

thereafter releasing pressure in the annulus, thereby generating foam in the well, and

allowing fluid to flow from the formation into the well and upwardly to the surface under formation pressure.

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