137-13 CROSS REFERENCE SEARCH ROOM

April 19, 1960 E. I. SCRIVNER 2,933,042

ADDITIVE WELL PUMP

Filed June 10, 1957

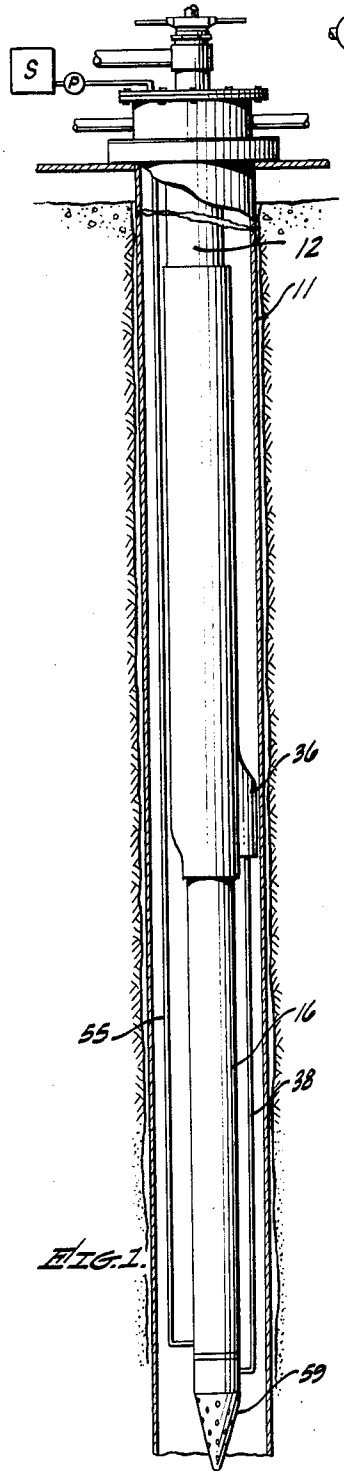


FIG. 1.

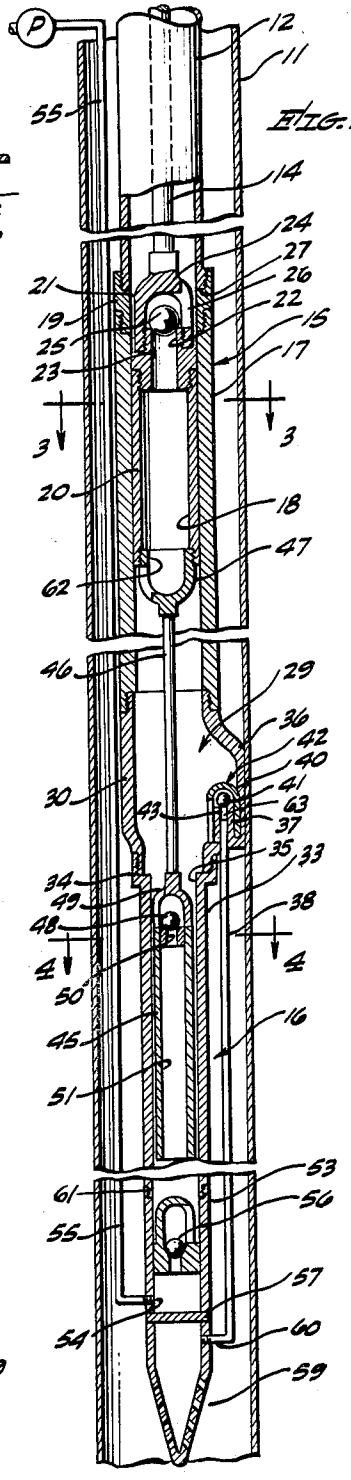


FIG. 2.

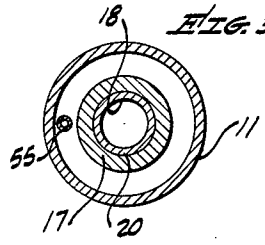


FIG. 3.

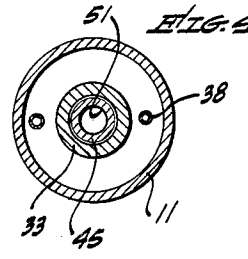


FIG. 4.

INVENTOR.
EDITH I. SCRIVNER
BY
William R. Hennelly
ATTORNEY.

United States Patent Office 2,933,042 Patented Apr. 19, 1960

2,933,042

ADDITIVE WELL PUMP

Edith I. Scrivner, Lakewood, Calif.

Application June 10, 1957, Serial No. 664,567

3 Claims. (Cl. 103—1)

This invention relates to well pumping equipment and more particularly to pumps used in producing oil wells.

In the use of well pumping equipment for the production of viscous crude oils, for example, the usual practice is to install means such as a reciprocating type of pump at a point below the fluid level in the well and operate the pump by an elongated member or sucker rod extending throughout the production tubing leading upwardly from the pump to the surface of the ground. At the upper end of the sucker rod a motor or engine is provided to impart a reciprocating motion to the sucker rod. The means for translating the motor rotation to the reciprocating rod is most generally a walking beam supported upon a suitable fulcrum and driven by a crank from the slow speed motor.

In such an arrangement where the heavy oil surrounds the sucker rod throughout its length, the rate of travel of the rod is limited since its descent due to gravity is retarded by the effect of the heavy fluid. Accordingly, the capacity of the pump is reduced.

In addition, crude oil and other fluids pumped from the earth contain foreign matter and chemicals which have a deleterious effect on the production tubing and sucker rod. For example, encrustations and deposits are formed on the rod and the interior of the tubing which reduce the area through which the oil may flow upward.

For these and other reasons it is desirable in many pumping operations to introduce chemical additives to the crude oil or other fluid to increase the efficiency of the pumping apparatus. That is, if heavy or viscous oil is being pumped it is advantageous to introduce a low viscosity fluid as a diluent which produces a condition which is more favorable to the efficient pumping of viscuous oil from wells. In other instances it is desirable to introduce a chemical additive which prevents the accumulation of encrustations or deposits in the fluid passage from the well and around the sucker rod.

Accordingly, it is an object of the present invention to provide an improved well pump by which additive fluid may be introduced into the fluid being pumped in predetermined amounts.

It is another object of the present invention to provide an improved reciprocating well pump in which additive fluids are introduced only into the fluid which has entered the pumping apparatus.

It is a further object of the present invention to provide an improved well pumping apparatus in which the composition of the fluid flowing through the apparatus is accurately controlled.

It is another object of the present invention to provide an improved mixing pump for wells in which the additive fluid and the mixed well fluid are contained within the pumping apparatus.

The present invention is an improved well pump for mixing an additive fluid to the fluid being pumped and comprises a lower working barrel having an additive fluid inlet thereto and an upper working barrel positioned above the lower barrel and separated therefrom by a

mixing chamber. A first hollow plunger is reciprocable in the lower working barrel, and a second hollow plunger is reciprocable in the upper working barrel with the plungers being operably connected in a sucker rod string. A standing valve at the lower end of the lower working barrel allows entrance of additive fluid to the lower barrel which is pumped through the lower barrel to the mixing chamber by means of appropriate traveling valving. A second standing valve allows entrance of fluid from the well bore to the mixing chamber at the lower end of the upper working barrel. Traveling valve means on the upper plunger permit the mixed fluid to be pumped from the mixing chamber to the tubing string. The upper and lower plungers are of predetermined diameters dependent upon the ratio of additive fluid to be mixed with the well fluid.

The novel features which are believed to be characteristic of the invention, both as to its organization and method of operation, together with further objects and advantages thereof, will be better understood from the following description considered in connection with the accompanying drawing in which a presently preferred embodiment is illustrated by way of example. It is to be expressly understood, however, that the drawing is for the purpose of illustration and description only, and is not intended as a definition of the limits of the invention.

Figure 1 is a partially sectional view in elevation of the presently preferred embodiment of this invention disposed within a well casing;

Figure 2 is a view in cross-section of the pump of the present invention;

Figure 3 is a view taken along line 3—3 of Figure 2; and

Figure 4 is a view taken along line 4—4 of Figure 2.

Referring now to the drawing, the well casing **11** is supported at its upper end by a pumping head of any preferred form. Branch pipes extending from the casing serve to convey any gas that the well may be producing while the oil or fluid being pumped flows upward through the production tubing **12** and is discharged through a discharge pipe. A polish rod passes through a stuffing box at the top of the pumping head and is connected to the sucker rod **14**. The pumping and discharge arrangement and apparatus are not shown or described in detail since they may be of any type known to the prior art and form no part of the present invention.

As shown in Figs. 1 and 2, the mixing pump of the present invention comprises an upper pump section **15** and a lower pump section **16** which are interconnected and adapted to be lowered into the well casing **11** containing a fluid, such as oil, which is to be pumped to the surface. The upper pump section **15** comprises a barrel **17** which is connected at its upper end which is the outlet end of the pump section to the lower open end **27** of the production tubing **12** through which the oil is pumped to the surface. The drawing is partially schematic and various unions and connections and standard pump parts of a type well known to the art may be used throughout the present invention. In the illustrative embodiment, the upper pump barrel **17** is connected to the inlet end **27** of the tubing **12** by means of a connecting collar **19** which is female threaded and mateable with the male threads of the tubing **12**, and male threaded at its lower end to be mateable with female threads at the upper end of the barrel. Thus, the barrel **17** is removably connected to the tubing. An upper pump plunger **20** is tubular in configuration and has an outside diameter substantially equal to but less than the inside diameter of the barrel **17** with a longitudinal opening **18** therethrough. The upper end of the plunger **20** is affixed to the sucker rod **14** through a traveling valve **21** of the type well known to the art which allows the passage

of fluid upward through the plunger **20** and valve **21**, but prevents the flow of fluid downward and into the plunger. In the embodiment shown the traveling valve **21** comprises a seat **22** having an opening **23** therethrough which is threadably mateable with the plunger **20**. The valve cage **24** is in turn threaded upon the seat and encloses a ball check **25** which is mateable with the seat **22** to close the opening **23** when fluid attempts to flow downward therethrough. The ball **25** is free within the cage **24** and openings **26** are provided in the cage to allow passage of fluid when the upward flow of fluid lifts the ball **25** from its seat **22**. The cage **24** is threadably connected to the lower end of the sucker rod **14**, thus affixing the upper plunger **20** to the sucker rod for vertical reciprocating movement therewith within the upper barrel. As is well known in the art the volume of fluid pumped by the upper plunger is substantially equal to the internal cross-sectional area of the barrel times the length of stroke as will be further described in connection with the operation of the apparatus in its presently preferred form.

At the lower end **62** of the upper barrel **17**, which forms the fluid inlet of the upper pump section **15**, a mixing chamber **29** is defined by the interior of a vertically disposed housing formed by a tubular section **30** of predetermined length. The chamber tubing **30** is threadably connected to the lower end of the upper barrel **17** and is decreased in diameter at its lower end. At the lower end of the chamber tubing **30** a lower pump barrel **33** is connected at the upper end **35** thereof by a connecting collar **34** which is mateable with male threads on the chamber tubing **30** and female threads on the lower barrel **33**, as previously described. A protrusion **36** is provided at one side of the chamber tubing **30** to define a slip joint **37**, of the type known to the art, into which a fluid conduit **38** may be slidably engaged. That is, the protrusion defines a cylinder having an inside diameter substantially equal to the outside diameter of the fluid conduit and forming a fluid inlet **43** through a standing valve **40** into the mixing chamber **29**. The standing valve is of the type well known to the art having a ball check **41** contained within a cage **42** and mateable with the fluid inlet **43** to allow the passage of fluid from the conduit **38** into the mixing chamber but to prevent flow of fluid outward from the chamber.

As described hereinbefore the lower barrel **33** is affixed at the lower end of the chamber tubing **30** such that the upper end **35**, which is the outlet end of the lower pump section **16**, is in fluid communication with the mixing chamber **19**. The lower barrel **33** is of substantially lesser inside diameter than the upper barrel **17**. A lower pump plunger **45** of the type well known to the art is provided for reciprocating movement within the lower barrel and is again tubular in configuration with an outside diameter substantially equal to the inside diameter of the barrel **33**. The upper plunger **20** and the lower plunger **45** are interconnected by a connecting rod **46** which is connected to the upper plunger **20** at the lower end thereof through a spider **47** or similar connecting means which allows the passage of fluid into the opening **18** of the plunger. The connecting rod is connected to the lower pump plunger **45** at the upper end thereof through a traveling valve of the type well known to the art and similar to that described at the upper end of the upper plunger. That is, a ball check **48** is contained within a cage **49** which is threadably connected to the connecting rod **46**. The ball **48** is above the seat **50** which is affixed to the plunger **45** and is mateable therewith to allow the upward passage of fluid through the lower plunger **45** but to prevent downward travel of fluid from the mixing chamber **29** into the plunger opening **51**.

Thus, the pump plungers **20** and **45** are connected to form a continuous plunger structure and are separated by

a mixing chamber from which fluid can flow only upward through the upper plunger. As discussed hereinbefore, the plungers and respective barrels are of different diameters and will pump proportionally different volumes of fluid as described in further detail following.

A length of tubing or sleeve **53** is connected at the lower, or inlet, end **61** of the lower barrel to form an extension thereof and has an additive fluid inlet **54** therein to which an additive fluid conduit **55** is connected by standard fittings or joints. Thus, as shown in Figs. 1 through 4, the additive fluid conduit is connected beneath the lower barrel and extends upward alongside the pump and tubing **12** within the casing to the surface where a source S (shown diagrammatically in Figure 1) of fluid to be added to the oil or well fluid is supplied. A slip joint of the conventional type may be inserted into the fluid conduit for ease of assembly or removal. An hydraulic pump P may be used at the surface in some applications to furnish sufficient pressure to the additive fluid for circulation although gravity pressure will be sufficient for most purposes. Interposed between the additive fluid inlet **54** and the lower barrel **33** is a standing valve **56** of the conventional type described hereinbefore to allow the passage of additive fluid upward into the lower barrel and plunger but to prevent flow of fluid from the lower barrel. A closure **57**, such as a pipe blank, is positioned in the sleeve **53** beneath the additive fluid inlet to prevent flow of fluid downward from the inlet **54**.

A length of perforated pipe **59** is affixed beneath the closure **57** having a connection **60** for the oil conduit **38** to permit oil or other fluid being pumped to flow from the well through a fluid inlet **43** and the standing valve **40** and into the mixing chamber. Accordingly, oil from the well is admitted to the mixing chamber **29** through the standing valve **40** while additive fluid is supplied from the surface and is admitted through the second standing valve **56** and pumped into the mixing chamber **29** by the lower pump in quantities determined by the diameter of the lower pump barrel.

Thus, in operation, referring to the figures the fluid to be added to the oil being pumped, is supplied from a tank or reservoir (not shown) and flows downward through the conduit **55** to the lower standing valve **56**. On the downward stroke of the plungers, additive fluid passes upward through the traveling valve **48** of the lower plunger. Simultaneously, oil is admitted through the open pipe **59** and passes through the conduit **38**, upward through the standing valve **40** and into the mixing chamber **29**. As the plungers move upward the traveling valve **48** on the lower plunger seats, and the additive fluid in the barrel **33** above the plunger is moved into the mixing chamber **29**. The volume of additive fluid pumped into the chamber is thus equal to the cross-sectional area of the lower plunger times the length of stroke. The additive fluid and oil admitted to the chamber through the standing valve are mixed in the chamber and then pumped upward by the upper plunger. Thus, on the downward stroke of the plungers the upper plunger traveling valve **21** opens and the mixed fluids within the chamber flow through the traveling valve **21** to the top of the plunger **20**. On the upward stroke, the valve **21** seats and a volume of mixed fluids substantially equal to the cross-sectional area of the upper plunger times the length of stroke is moved upward through the production tubing **12**. From the foregoing it may be seen that the proportion of additive fluid or diluent to be mixed with the oil being pumped through the tubing can be predetermined and closely controlled by selection of the correct diameter of the lower plunger and barrel. That is, for example, if a three to one ratio of oil to additive fluid is required such a ratio is obtained by utilizing a lower plunger and barrel having a cross-sectional area equal to one-third the cross-sectional area of the upper plunger and barrel.

Although the present invention has been described in

connection with a traveling plunger type of pump it is equally applicable to a pump of the traveling barrel type and various modifications in the standard pump parts and fitting can be made. Thus, the present invention provides an improved additive or mixing pump which allows a predetermined proportion of additive fluid to be mixed in a closed cycle with the oil or other fluid being pumped through the production tubing, but which does not allow contamination of the fluid in the well itself, nor the loss of additive fluid to surrounding areas.

What is claimed is:

1. An improved well pump for mixing an additive liquid to the well liquid being pumped through production tubing having a liquid inlet at the lower open end thereof substantially vertically disposed in a well comprising: an upper liquid pump vertically disposed below said tubing, said upper pump having a liquid outlet connected to and communicating with the liquid inlet to said production tubing; a tubular section defining a liquid mixing chamber vertically disposed below said upper liquid pump, said tubular section being connected to and in liquid communication with the liquid inlet to said upper pump; a lower liquid pump vertically disposed below said tubular section, said lower pump having a liquid outlet connected to and in liquid communication with said tubular section; an additive liquid inlet to said lower pump, closed conduit means between said liquid inlet to said lower pump and a source of additive liquid at the surface of the well; a well liquid inlet to said mixing chamber; means operatively interconnecting said upper liquid pump and said lower liquid pump such that the pumping capacity of said lower pump is substantially less than the pumping capacity of said upper pump, whereby said lower pump pumps additive liquid to said mixing chamber and said upper pump pumps additive liquid and well liquid to said production tubing and from said well.

2. An improved well pump for mixing an additive liquid to the well liquid being pumped through production tubing having a liquid inlet at the lower open end thereof substantially vertically disposed in a well comprising: an upper pump barrel having a first predetermined inside diameter, a lower pump barrel having a second inside diameter substantially less than said first diameter and a closed lower end, said upper and lower pump barrels being vertically disposed and spaced apart by a tubular section defining a mixing chamber, said tubular section being connected to the lower end of said upper barrel and the upper end of said lower barrel to define a liquid path from the liquid outlet of said lower barrel to the liquid inlet of said upper barrel, said upper barrel being connected at the upper end thereof to the open end of said production tubing; said tubular section defining a well liquid inlet to said mixing chamber; an additive liquid inlet to said lower barrel proximate the closed lower end thereof, closed conduit means from a source of additive liquid at the surface of said well to said additive liquid inlet; an upper pump plunger for pumping mixed well liquid and additive liquid reciprocable with respect to said upper barrel, a lower pump plunger for pumping additive liquid reciprocable with respect to said lower barrel, said upper and lower pump plungers having pumping diameters proportional to said first and second diameters respectively, said upper and lower plungers being operably interconnected by a connecting rod connected vertically therebetween, said upper pump plunger being connected to a sucker rod for reciprocation therewith; and valving means to allow the flow of additive liquid upward through said lower barrel to said mixing chamber and to allow the flow of additive liquid and well liquid through said upper barrel to said production tubing and from the well.

3. An improved well pump for mixing an additive liquid to the well liquid being pumped upward through production tubing in a well comprising: an upper and lower pump section substantially vertically disposed in said well, said upper pump section including an upper tubular barrel having a first inside diameter, said upper barrel connected at the upper end thereof to the lower open end of said production tubing; a vertically disposed tubular section, the interior surface of which defines a mixing chamber, said tubular section being connected at the upper end thereof to the lower end of said upper barrel in communication therewith; said lower pump section including a lower barrel having a second inside diameter substantially less than the inside diameter of said upper barrel, said lower barrel being connected at the upper end thereof to the lower end of said tubular section and communicating with said mixing chamber, said lower barrel having a closed lower end; a vertically disposed upper traveling plunger reciprocable within said upper barrel; a vertically disposed lower traveling plunger reciprocable within said lower barrel, said lower plunger being of substantially lesser diameter than said upper plunger; a connecting rod operatively interconnecting the lower end of said upper plunger and the upper end of said lower plunger; said upper plunger being connected at the upper end thereof to a sucker rod for reciprocation therewith; an upper traveling valve on said upper plunger to allow upward travel of liquid from said upper pump section to said production tubing; a lower traveling valve on said lower plunger to allow upward flow of liquid from said lower pump section to said mixing chamber; a first standing valve proximate the closed lower end of said lower barrel to allow upward flow of liquid to said lower barrel; an additive liquid inlet to said lower barrel between the closed lower end thereof and said first standing valve; closed conduit means connected between said additive liquid inlet and a source of additive liquid at the surface of said well; a well liquid inlet to said mixing chamber, and a second standing valve at said well liquid inlet whereby said lower pump pumps additive liquid to said mixing chamber and said upper pump pumps additive liquid and well liquid to said production tubing and from said well.

References Cited in the file of this patent

UNITED STATES PATENTS

955,580	Caverno	Apr. 19, 1910
966,772	Sattler	Aug. 9, 1910
1,104,962	Clark	July 28, 1914
1,322,236	Fish	Nov. 18, 1919
1,421,004	Hibbard	June 27, 1922
1,597,161	Kellogg et al.	Aug. 24, 1926
1,703,423	Herman	Feb. 26, 1929
1,703,428	Neilsen	Feb. 26, 1929
1,738,136	Bannon	Dec. 3, 1929
1,771,070	Bannon	July 22, 1930
2,029,473	Fox	Feb. 4, 1936
2,213,807	Starbuck	Sept. 3, 1940
2,330,781	Langmyhr et al.	Sept. 28, 1943
2,473,726	Payne	June 21, 1949
2,567,513	Haines	Sept. 11, 1951
2,764,940	Long	Oct. 2, 1956