March 5, 1957 J. J. VARNER 2,783,716

SAND TRAP AND BOTTOM HOLE SEPARATOR

Filed May 17, 1954

FIG. 1

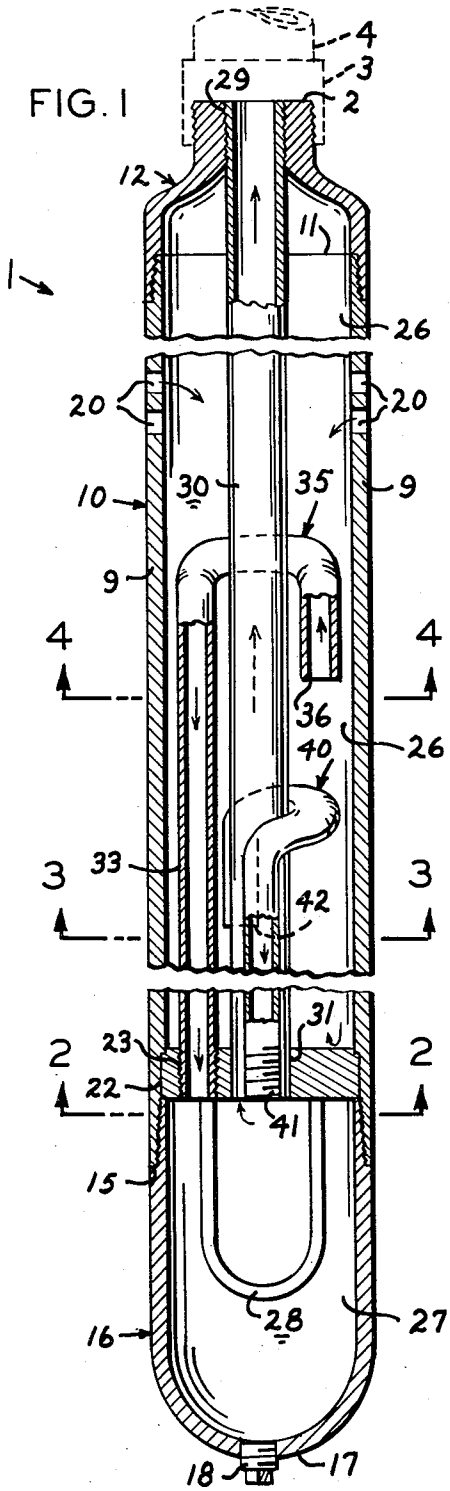


FIG. 4

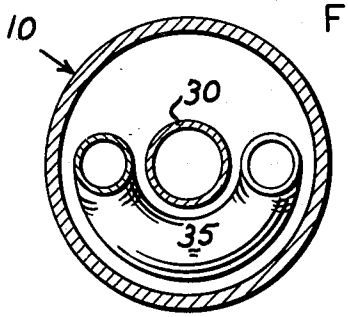


FIG. 3

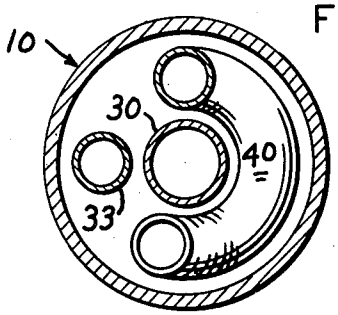
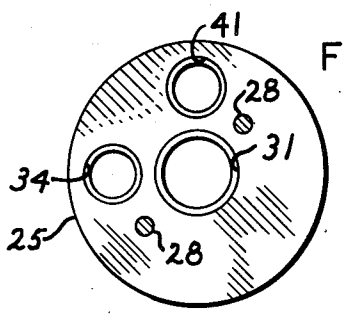


FIG. 2



John J. Varner

INVENTOR.

BY Joyce J. Miller

ATTORNEY

United States Patent Office 2,783,716
Patented Mar. 5, 1957

2,783,716

SAND TRAP AND BOTTOM HOLE SEPARATOR

John J. Varner, Lawton, Okla.

Application May 17, 1954, Serial No. 430,007

2 Claims. (Cl. 103—220)

The present invention relates to the oil well producing industry, and more particularly to a device designed to be run in a producing oil well on the bottom end of a production string of pumping tubing for separating the sand from the fluid and for separating the oil from the water before they are pumped from the well.

Many oil wells which have been completed as producers in a sand formation, produce gas, crude oil, and salt water and a certain amount of sand from the oil bearing formation. The amount of salt water produced varies from none to 90 percent or more from one well to another as well as does the amount of sand produced, which depends on the hardness of the producing formation and the amount of gas pressure which the formation contains. It is common practice to equip such oil wells for production by running a string of tubing into the well which has a "standing-valve" or a pump seat adjacent its lower end. A conventional oil well pump is run within the tubing on the lower end a string of rods, and is seated above the standing valve or pump seat. Operation of the pump by the rods alternately opens and closes valves and seats within the pump which draws the fluid from the bottom of the oil well upwardly into the pump and out the tubing at the top of the well. Gas pressure within the producing formation causes a turbulance of the fluid oil and water which buoyantly supports a certain amount of sand. In conventional pumping installations, such as just described, the sand, oil, water and gas are all drawn into the pump where the pressure under which the pump operates to lift the fluid to the top of the well causes the oil and water and gas to intermingle or emulsify into a tightly knit solution which settles-out into its component parts slowly, and in some instances will hardly settle-out of its own accord at all. Refineries will not purchase crude oil containing more than 1 percent water. Therefore it is desirable to use equipment such as applicant's device to keep the oil separated from the water.

The primary concern of the operators of such producing wells is the sand entering the oil well pump with the fluid. This sand causes very rapid wear of the working parts of the pump and results in lowered efficiency of the pump's operation and eventually in the necessity of pulling the rods and pumping out of the well to replace the worn out parts. Sometimes the pump becomes so full of sand that it becomes "sanded-up" or "sticks" and cannot be withdrawn from the tubing and in which case the tubing must be pulled too. The pulling of the rods and pumps and sometimes the tubing is a costly operation, for labor and materials used, as well as the loss and pump and sometimes the tubing is a costly operations are being made. Quite often the frequent necessity of "pulling" a well results in such a high "production cost" that no profit is realized from producing the well.

A number of devices have been made which are intended for use in separating the sand from the oil and water, such as slotted or perforated pipe, but they have

the common failure of not providing a "settling" chamber or space for trapping the sand and separating the gas from the fluid.

The principal object of this invention is to provide a device for use in a fluid, gas and sand producing oil well which will trap the sand within the device and allow the gas and water to gravitationally separate from the oil.

Another object of this invention is to provide a device of this class which will allow the pump to alternately produce gravitationally separated oil and water without the intermingling of the two.

Another object of this invention is to provide a device of this class that will materially reduce the production cost of a pumping well by keeping the pump free of sand, thus lengthening the service life of a pump.

Another object is to provide a device of this class which will serve as a mud-anchor for the lower end of the tubing.

A further object of this invention is to provide a device of this class which has no moving parts which may become worn by operation and which is easily disassembled for cleaning.

Yet another object is to provide a device of this class which is easily adapted to any size of tubing installation.

The present invention accomplishes these and other objects by providing a vertical hollow elongated horizontally divided body connected to the lower end of a tubing string having perforations adjacent its upper end for the entry of the well fluid. The sand carried by the fluid settles in the lower part of the upper chamber of the body and the fluid, gravitationally separated oil and water, is alternately conveyed into the lower chamber through the dividing partition by a pair of siphon tubes. A central tubate member conveys fluid from the lower chamber of the body upwardly upon actuation of the pump.

Other objects will be apparent from the following description when taken in conjunction with the accompanying single sheet of drawings, wherein:

Figure1 is a vertical cross-sectional view of the device;

Figure 2 is a horizontal cross-sectional view taken substantially along line 2—2 of Fig. 1;

Figure 3 is a horizontal cross-sectional view taken substantially along line 3—3 of Fig. 1; and

Figure 4 is a horizontal cross-sectional view taken substantially along line 4—4 of Fig. 1.

Like characters of reference designate like parts in those figures of the drawings in which they occur.

In the drawings:

Reference numeral **1** indicates, as a whole, the device having a reduced upper end **2** externally threaded to be received by an adapter **3** connected to the lower end **4** of a string of tubing. The tubing **4** houses a conventional oil well pump, not shown. The device **1** includes an elongate hollow cylindrical body **10** having a wall **9** rigidly connected at its upper end **11** by suitable mating threads to a reducing swage **12**. The lower end **15** of the body **10** is closed by a bull-plug **16** rigidly connected by suitable mating threads. The lower end **17** of the bull-plug **16** is provided with a removable drain plug **18**. The body **10** may be of any desired diameter that may be easily run within the casing, not shown, of the well to be produced. The body **10** may be made any desired length, but preferably at least 20 feet, other factors permitting. The body **10** is provided with a plurality of spaced-apart transverse perforations **20** through the wall **9** below the upper end **11**. Adjacent its lower end the bore of the body **10** is circumferentially slightly enlarged, as by boring, a selected distance indicated by the line **22**, and ending in an abrupt annular shoulder **23**. A flat metal disk **25**, having a diameter permitting a slip-fit within the bore **22**, is externally turned at one

end, as by a lathe, to fit within the bore of the body **10** and to form an abrupt circumferential shoulder for mating with the shoulder **23**. The disk **25** horizontally partitions the body **10** forming an upper chamber **26** and a lower chamber **27**, and is held in place within the bore **22** by the abutting upper end of the bull-plug **16**. A U-shaped rod **28** is rigidly connected to the lower surface of the disk **25**, as by welding, to facilitate the removal of the latter.

The reduced upper end **2** is threaded internally, as at **29**, for engagement with external threads of a vertical tubate member **30** which extends downwardly through the chamber **26** and through a slip-fit central bore **31** in the disk **25**. A tube **33** is rigidly connected by external threads **34** within a threaded through perforation in the disk **25** and extends upwardly through the chamber **26**, parallel with the member **30**, to a point below the perforations **20** where it is bent to form a substantially horizontal semi-circular circumferential bend around the tubate member **30** and adjacent the wall **9**, and then downwardly parallel with the member **30** a selected distance forming a siphon tube **35** having an open inlet end **36**. A similar tubate siphon **40** is rigidly connected at its lower end by external threads **41** within a threaded through perforation in the disk **25** spaced substantially 90° with relation to the tube **33** and extends parallel therewith upwardly through the chamber **26**, ending in a downwardly open end **42** a selected spaced distance below the end **36** of the siphon tube **35**.

Operation

The device is placed in a producing oil well on the bottom end of a string of tubing **4** adjacent the bottom or opposite an oil producing formation, as described hereinabove. Fluid, oil and water, enters the upper chamber **26** through the perforations **20** carrying sand with it. Gas within the oil and from the oil bearing formation tends to gravitationally separate from the oil and water and does not enter the chamber **26**, since to do so it would have to go downward and gas tends to rise, unless forced downwardly, but goes upwardly around the tubing **4** within the annulus of the casing, not shown, and is bled off into gas gathering lines, not shown. Oil, water and sand entering the elongate chamber **26** goes downwardly, as shown by the lower curved arrow (Fig. 1), and is stopped by the upper surface of the partition plate **25**. Within the chamber **26**, without gas to agitate the mixture, the sand, water and oil gravitationally separate, with the sand piling up on the surface of the disk **25** and the water above it, with the lighter oil on top. As soon as enough fluid has entered the chamber **26** to fill it to the level of the top of the siphon tube **40**, oil starts through the siphon **40** and goes downwardly and empties into and fills the lower chamber **27**. A pump, not shown, lifts the oil upwardly from the chamber **27** through the member **30**. This action continues, the siphon keeping the chamber **27** filled with oil as the pump lifts it out, and is supplemented by the siphon tube **35** siphoning oil from the chamber **26** to the chamber **27** as soon as the body **10** has been filled with fluid. The pump will pump only oil until such time as the water level within the chamber **26** has reached the top of the level of the siphon tube **40**. When the water has reached this level the siphon tube **40** conveys the water from the chamber **26** downwardly into the chamber **27**, and the water being heavier than the oil, displaces the oil, which is pumped out, and fills the chamber **27** and the pump stops pumping oil and pumps water until such time as the water level within the chamber **26** is lowered to the level of the end **42** of the siphon **40**. Then the pump stops pumping water and pumps oil, which is conveyed to the chamber **27** by the siphon tube **35**, until the water level again builds up within the chamber **27** to actuate the siphon tube **40**. This action continues regardless of the ratio of oil and water the well produces.

Thus it seems obvious that, with the pump lifting oil and water alternately, the oil being pumped into a receiving tank, not shown, allows the water, when the pump puts water into the tank, to gravitationally settle downwardly through the oil with little or no intermixing and be drawn off through manually operated valves with which the tank is usually equipped.

It only takes approximately a quart of sand to completely "sand-up" or stick a pump and since the device **1**, as designed, will hold approximately 20 gallons of sand, the service life of a pump is greatly extended. When the device has become full of sand, the pump stops producing oil and it is then necessary to remove the pump and tubing and clean the device. The device is cleaned by removing the bull-plug **16** and pulling the disk **25** with its attached siphon tubes **35** and **40** out of the body **10** by the aid of the rod **28**. The member **30** remains in the body **10** since it is not rigidly connected to the disk **25**. The device is washed out and reassembled and then again run in the well with the tubing.

Obviously the invention is susceptible to some change or alteration without defeating its practicability, and I therefore do not wish to be confined to the preferred embodiment shown in the drawings and described herein, further than I am limited by the scope of the appended claims.

I claim:

1. A sand trap and bottom hole separator connected to the lower end of a tubing string, including: a vertically disposed elongated tubular body having a reduced upper end threadedly engaged with the lower end of said tubing, the said body having a plurality of inlet ports adjacent its upper end, the lower end of said body having an enlarged smooth bore terminating upwardly in an annular shoulder; a partition disk closely received by the lower end of said body within said enlarged bore and disposed adjacent said shoulder; a bull-plug threadedly engaged with the lower end of said body for closing the latter, the uppermost end of said bull-plug rigidly impinging said disk against said shoulder, said plug forming a chamber below said disk; an elongated tubular member common to oil and water threadedly engaged adjacent its upper end by the bore of said reduced end, the lower end of said member axially carried by said disk and extending therethrough and opening into said chamber for fluid communication between said chamber and said tubing; a water siphon tube vertically disposed within said body adjacent said tubate member, said siphon tube having legs of unequal length, the lowermost end of said longer leg rigidly carried by and extending through said disk and opening into said chamber for fluid communication therewith, the lowermost end of said shorter leg spaced a substantial distance above said disk; and an oil siphon tube vertically disposed within said body adjacent said tubate member, said oil siphon tube having legs of unequal length, the lowermost end of said longer leg of said oil siphon tube rigidly carried by and extending through said disk and opening into said chamber for fluid communication therewith, the lowermost open end of the shorter leg of said oil siphon tube spaced a substantial distance above the uppermost portion of said water siphon tube.

2. A sand trap and bottom hole separator connected to the lower end of a tubing string, including: a vertically elongated tubular body having a reduced upper end threadedly engaged with the lower end of said tubing, said body having a plurality of inlet ports adjacent its upper end, the lower end of said body having an enlarged smooth bore terminating upwardly in an annular shoulder; a horizontally disposed partition disk closely received by said enlarged bore, the upper surface of said disk having a peripheral recess for co-operatingly receiving said shoulder therein; a U-shaped handle rigidly connected to and depending from said disk for removal of the latter from said body; a bull-plug threadedly en-

gaged with the lower end of said body for closing the latter, and forming a chamber below said disk, the uppermost end of said bull-plug rigidly impinging said disk against said shoulder; an elongated tubular member common to oil and water threadedly engaged adjacent its upper end by the bore of said reduced end, the lower end of said member slidably carried axially by said disk and extending therethrough and opening into said chamber for fluid communication between said chamber and said tubing; a water siphon tube vertically disposed within said body adjacent said tubate member, said siphon tube having legs of unequal length, the lowermost end of said longer leg rigidly carried by and extending through said disk and opening into said chamber for fluid communication therewith, the lowermost end of said shorter leg

spaced a substantial distance above said disk; and an oil siphon tube vertically disposed within said body adjacent said tubate member, said oil siphon tube having legs of unequal length, the lowermost end of said longer leg of said oil siphon tube rigidly carried by and extending through said disk and opening into said chamber for fluid communication therewith, the lowermost end of the shorter leg of said oil siphon tube spaced a substantial distance above the uppermost portion of said water siphon tube.

References Cited in the file of this patent

UNITED STATES PATENTS

1,603,874	Scott et al.	Oct. 19, 1926
1,673,663	Chancellor et al.	June 12, 1928