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, 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 turbulence 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. Refiners 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 the extent of 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 Sometimes the pump becomes so full of sand that it becomes "sanded-up" or "sticks" and cannot be withdrawn from the tubing and in which case the tubing must be pulled too.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 operation. 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 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 tubule 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:

Figure 1 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 in the disk 25. A tube 33 is rigidly connected by external threads 34 within a threaded perforation in the disk 25 and extends up wardly through the chamber 26, parallel with the member 30, so that 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 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 chamber 26 goes downwardly, as shown by the lower curved arrow (Fig. 1), and is stopped by the upper surface siphon 40 rigidly connected at its lower end by external threads 41 within a threaded 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.

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 stops, to actuate the siphon tube 40. This action continues regardless of the ratio of oil and water the well produces.
gated 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 tubing 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